

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

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

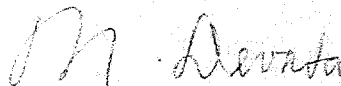
July 21, 1967

--- North Raisin River ---
North Bridge, 6.0 Miles North of St. Andrews
W.P. 39-66-03 -- Site No. 31-107
Hwy. 138 -- District No. 9 (Ottawa)

We have reviewed your Preliminary Bridge Plan Drawing
D-6208-P for the above-named structure.

We have no comments.

AD/MdeF



M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Sternac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. S. McCombie
G. Scott

Foundations Files
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Department of Highways Ontario

Copy for the information of

Mr. A. Stermac, Principal Foundation Engineer,
Room 107, Lab. Building

Mr. G. Scott,
Reg. Bridge Location Engineer,
Kingston Regional Office

Bridge Division,
Downsview, Ontario

July 12, 1967

North Raisin River
North Bridge 6.0 Miles North of St. Andrews
W.P. 39-66-03, Site No. 31-107
Highway 138, District No. 9

Attached herewith are prints of the Preliminary Bridge
Plan Drawing D-6208-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$36,000.
This cost includes tender, materials, engineering and sundry
construction.

Any comments or revisions you may have should be submitted
within three weeks.

CSG:rd

C.S. Grebski,
Bridge Design Engineer

Attach.

c.c. S. McCombie
A. Stermac
R. Forrest
E. Cross

Mr. B. H. Davis,
Bridge Engineer,
Bridge Division,
Admin. Bldg.

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

Attention: Mr. B. McCombie

March 21, 1967

MAR 21 1967

FOUNDATION INVESTIGATION REPORT FOR D.B.O.
BY: H. W. Golder and Associates Limited --
Proposed North Raisin River Bridge - North
Crossing of North Branch, Proposed Hwy. 136,
Rockland, Ontario. District No. 9 (Ottawa).
-- S.P. 39-66-3 --

Attached, please find the foundation investigation report for the above mentioned site, prepared and submitted by the consultant, H. W. Golder and Associates Ltd.

We have reviewed the report and believe that the factual information is adequate and well presented. The recommendations pertaining to the foundations of the proposed structure have been discussed with the consultant, and it was agreed that:

(a) the bridge should be founded on spread footings at a depth of at least 3 ft. below river bottom (subject to hydrological requirements), or on bedrock at approx. elevation 288; and

(b) the choice between the two alternatives should depend on the findings - i.e., the type of foundations of the existing bridge which will be demolished and replaced.

The present bridge does not show any signs of distress, and we feel that if the same type of footing is used for the new structure no problems should be encountered.

In both cases, we would suggest that the excavation be carried out under water to the required elevation. The formwork should then be lowered and a tremie seal poured. After pumping out the water, further work can proceed in the dry. It is felt that the proposed construction procedure is appropriate for this particular project, and that least problems should be encountered. This, however, does not preclude the use of any other method or procedure that would provide a satisfactory end result.

cont'd. /2 ...

Mr. E. R. Davis,
Bridge Engineer - Bridge Div.,
Attn: Mr. R. McCombie.

March 21, 1967

Should you wish to discuss any aspects of the foregoing problems, please feel free to contact this Office.

AGS/EdsF
Attach.

Afternoon
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. E. R. Davis (2)
H. A. Trogaskes
C. W. Ferron
S. J. Markiewicz
C. H. Robertson
C. Scott
J. E. Grusnier
S. A. Singh

Foundations Files ✓
Gen. Files

Box. 401 & Leslie St.,
Downsview, Ontario.

Tel. No. 343-3882

Materials and Testing Division

February 16, 1967

**H. C. Golder and Associates Ltd.,
2444 Bloor Street West,
Toronto, Ontario.**

Attention: Mr. J. L. Gendron

Re: Foundation Investigations -- Letter of Authority

**(1) W.P. 39-66-2 - North Branch of H. Haisin River,
South Crossing.**

**(2) W.P. 39-66-) - North Branch of H. Haisin River,
North Crossing.**

Proposed Hwy. #138, District No. 3 (Ottawa).

Dear Sir:

Please consider this your authority to carry out the necessary foundation investigations at the above mentioned sites.

The necessary plans were given to your representative on February 13, 1967, at which time, all the problems were also discussed.

You are to commence the investigations as soon as possible and submit eleven (11) copies of each of the final reports to the Department by not later than March 26, 1967.

Should you encounter any problems regarding locations and/or alignments, please contact Mr. C. Scott, Regional Bridge Location Engineer, Kingston - Tel. No. 344-2220 - (Area Code 513). Problems regarding subsoil conditions should be taken up, if necessary, with our Foundation Section.

We understand that this investigation will be undertaken out of your Ottawa office.

February 16, 1967


The field work should, at all times, be supervised by a qualified soils Engineer. Any deviation from this agreement has to meet our prior approval.

Previous requirements as to preliminary borehole information and laboratory testing program, should be followed.

Since the drawings accompanying the foundation reports, showing the location of borings, the inferred subsoil conditions, etc., are to become contract drawings, you are requested to prepare them in accordance with the B.M.C. Standards. To enable you to do this, we are supplying you with a sample drawing with all the necessary explanations, together with linen sheets for your drawings. You are also requested to provide us with Crenaflex copies of the drawings.

Charges for the work performed will be in accordance with your Schedule of Rates, dated October 1, 1965, and invoices to be addressed to the attention of the undersigned.

Yours very truly,



A. Hutter

MATERIALS & TESTING ENGINEER

AGA/74ef
Attach.

cc: Messrs. S. McCombie
S. J. Markiewicz
C. E. Robertson
G. Scott
J. L. Graspler
H. Koenigs
Mrs. I. Steinberg
A. Crowley
M. Szymanski (2)✓
Foundations Office
Gen. Files (2)

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS
HEAD OFFICE - TORONTO, ONTARIO

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

196 BRONSON AVENUE
OTTAWA 4, ONTARIO
235-9698

F. J. HEFFERNAN (OTTAWA)

March 17, 1967.

Department of Highways, Ontario,
Materials and Testing Division,
Hwy. 401 & Keele Street,
DOWNSVIEW, Ontario.

Attention: Mr. A.G. Stermac, P.Eng.,
Principal Foundation Engineer.

RE: SOIL INVESTIGATION,
PROPOSED NORTH CROSSING OF
NORTH BRANCH OF NORTH RAISIN RIVER,
MONKLAND, ONTARIO.
W.P.39-66-3.

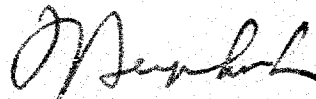
Dear Sirs:

We have delivered to you today, by messenger, eleven (11) copies of our report presenting the soil conditions and foundation recommendations at the above site. A Cronaflex copy of Figure 1 from the report was also included with the shipment.

We trust that this report contains sufficient information for your requirements. If you have any questions, or if we can be of any further service to you on this project, please call us.

Yours very truly,

H. Q. GOLDER & ASSOCIATES LTD.,



J. L. Seychuk, P.Eng.

DEW:hdg
67751

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS
HEAD OFFICE - TORONTO, ONTARIO

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

F. J. HEFFERNAN (OTTAWA)

196 BRONSON AVENUE
OTTAWA 4, ONTARIO
235-9698

W.P.39-66-3

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED NORTH RAISIN RIVER BRIDGE

NORTH CROSSING OF NORTH BRANCH

PROPOSED HIGHWAY 138

MONKLAND

ONTARIO

Distribution:

- 11 copies - Department of Highways, Ontario,
Toronto, Ontario.
- 2 copies - H. Q. Golder & Associates Ltd.,
Ottawa, Ontario.

March, 1967

67751

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ABSTRACT

The results of an investigation to determine the subsoil conditions at the proposed north crossing of the north branch of the North Raisin River by Highway 138 near Monkland, Ontario, are reported and recommendations are made for the foundation design and construction of the proposed bridge structure and roadway embankments.

It was found that below a surficial cover of silty topsoil, the site is underlain by a coarse glacial drift deposit consisting of compact sand, gravel and boulders with some silt. This glacial deposit is underlain directly by sound flat lying limestone bedrock at a depth of about 10 feet below river bed level. The groundwater level in the boreholes was observed to be at or slightly above river level.

It is recommended that the bridge abutments be founded on spread footings in the compact sand, gravel and boulder stratum at an allowable bearing pressure of 2 tons/sq.ft. The settlements of these footings should be less than 1 inch. In excavating for these footings, the groundwater should be controlled by the use of a steel sheet cofferdam to avoid loosening of the subsoil at and below foundation grade. Alternatively, but not necessarily for reasons of economy, the abutments may be founded on short displacement piles driven to practical refusal in the till or to the surface of the limestone bedrock.

The roadway approach embankments with 2 horizontal to 1 vertical side slopes founded on this granular subsoil, should be stable provided that competent fill, properly compacted in place, is used.

INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by the Department of Highways, Ontario, to carry out a subsurface investigation at the site of the north crossing of the north branch of the North Raisin River by the proposed Highway 138 (Line A) near McMillan Corners in Stormont County, Ontario. The purpose of this investigation was to determine the subsurface conditions across the site and to provide information for the foundation design and construction of the proposed structure and associated roadway approach embankments.

PROCEDURE

The field work for this investigation was carried out between February 21 and 23, 1967. During this period 2 boreholes with adjacent dynamic penetration tests were put down with a machine drillrig supplied and operated by the F.E. Johnston Drilling Co. Ltd. of Ottawa, Ontario. Standard penetration tests were carried out during the sampling operations. The underlying bedrock was cored in AXT size for a depth of 10 feet in each borehole. A piezometer was installed in each boring for groundwater level observations. The field work was supervised throughout by an engineer from our staff.

The location of the borings, together with a stratigraphic section across the site, are shown on Figure 1 located in a pocket at the rear of the report. A detailed log of each boring is shown on the Record of Borehole sheets following the text of this report.

All soil samples and rock core obtained during the investigation were brought to our laboratory for detailed examination and testing. The results of the testing are shown on the Record of Borehole sheets and on Figure 2.

The borehole locations and the ground surface elevations at the boreholes were obtained by a Department of Highways, Ontario survey crew. It is understood that these elevations are referred to Geodetic datum.

SITE AND GEOLOGY

The site is located in Roxborough Township of Stormont County about 1 mile north of McMillan Corners along the existing county road running from Cornwall to Monkland Station. The structure under investigation on the proposed Highway 138 (Line A) is to replace the existing county bridge at the north crossing of the north branch of the North Raisin River. At this site the river is some 10 feet wide at normal water level and runs in a south west-

erly direction through boulder strewn fields.

The site is in the physiographic region known as the Glengarry till plain. It has an undulating surface consisting of well formed drumlins together with intervening clay flats and swamps. The till is known to be very bouldery and has a high proportion of limestone. Over much of the area the bedrock is within 25 feet of ground surface.

The bedrock underlying the site is known, from existing geological information, to be the Ottawa formation of the Trenton and Black River groups. It is grey, flat lying limestone with occasional shaly partings and is of Ordovician age.

SOIL CONDITIONS

General

At this site a generally compact granular boulder till overlies sound bedrock to a depth of about 14 feet below the normal water level in the stream. The detailed stratigraphy encountered in each boring is on the Record of Borehole sheets and a section of the inferred stratigraphy across the site is on Figure 1.

Surficial Deposits

At the boreholes, which were put down along the stream

banks, there is 1 to 1.5 feet of silty topsoil. It may be partly alluvium deposited by the stream. Boulders are present on the surface around the site and within the existing approach embankments for the present bridge as an attempt to drive a penetration cone met refusal at about 2 feet on a boulder.

Boulder Till

The significant soil stratum across the site is a generally compact grey sand, gravel and boulders with some silt and a trace of clay some 14 feet thick. The deposit becomes more granular and bouldery with depth. The lower 6 feet of borehole 2 is almost all boulders. The hole had to be advanced through them by diamond drilling methods. Two typical grading curves can be found on Figure 2. The material is essentially non-plastic. Standard penetration resistances ("N" values) range between 10 to greater than 100 blows per foot. These values are considered to be high as they are affected by the large content of gravel and boulders. Based on the lower values obtained together with the dynamic penetration test results, the relative density is considered to be generally compact.

Bedrock

The bedrock surface underlying the boulder till is

level, at a depth of about 14 feet below the normal stream level, or about elevation 289. It is sound grey, generally horizontally bedded, limestone with occasional fine shaly partings.

GROUNDWATER CONDITIONS

Piezometers were installed in both boreholes following completion of the borings to determine the groundwater level. Details of these installations are given on the Record of Borehole sheets. The groundwater level across the site is at or slightly above river level, at elevations ranging between 301 and 303.

PROPOSED BRIDGE STRUCTURE

General

It is understood that the north crossing of the North Raisin River by the proposed Highway 138 is to be by a single span rigid frame structure some 30 feet long and about 42 feet wide as shown on Figure 1. A one span concrete bridge presently exists at this site on County Road No. 16. The grade line along the proposed Highway 138 which generally will follow the alignment of County Road No. 16 in this area is to be raised some 4 feet above the grade of the county road.

Foundations

The significant foundation stratum at this site, for the

support of the proposed bridge structure, is the compact sand, gravel and boulder stratum which exists at and below the river bed. To provide frost protection, the footings should be taken down at least 5 feet below the low river level. This depth, in this coarse granular subsoil, would also provide scour protection for the footings.

The "N" values obtained within the bouldery stratum at and below proposed foundation level range from about 15 blows/ft. to greater than 100 blows/ft. The higher "N" values are probably affected by the coarse granular nature of portions of the stratum. The dynamic penetration test in borehole 1, suggests that the soil at this location is in the compact range. Based on these results, an allowable bearing pressure of 2 tons/sq.ft. may be used in design of footings founded in the compact sand, gravel, and boulder stratum. With this bearing pressure, the resulting settlement of the footings should be less than 1 inch, a significant portion of which should occur during construction. Precautions should be taken during construction to prevent loosening of the granular soil at and below foundation grade as discussed below.

Alternatively, the bridge abutments may be founded on short displacement piles driven to practical refusal in the till or to the surface of the bedrock. Because of the presence of boulders, over-driving of piles could cause marked structural damage. Conse-

quently, pile driving resistance must be carefully controlled to avoid over-driving. For example, pipe piles fitted with a conical point and driven at the base on a concrete plug, or precast concrete piles fitted with a rock point could be used. For an allowable load of 60 to 70 tons a final penetration of 1 inch under 10 blows using a hammer energy of at least 20,000 ft.lb. per blow can be used as a criterion for design. However, the use of piles at this site for such a small structure may be quite uneconomical.

Closed end abutments should be backfilled for a distance of at least 5 feet horizontally with a well compacted, free-draining and non-frost-susceptible granular material. Provisions should also be made for drainage from the backfill to prevent hydrostatic or ice pressure build up behind the walls. With full effective drainage of the backfill, a coefficient of lateral earth pressure at rest, $K_0 = 0.4$ and a total unit weight of $\gamma = 135$ lb/cu.ft. should be used for the compacted granular backfill in design of the abutment walls.

In the computation of sliding resistance between a rough concrete footing base and the undisturbed sand and gravel subsoil, a coefficient of friction of 0.45, which is a limiting value, may be used in design.

Construction Procedures

Depending on the water level in the creek at the time of construction, excavation of about 5 to 8 feet below river water level will be required for the bridge foundations. Control of groundwater will therefore be required for footing excavations in this granular subsoil to prevent a reduction in the in situ density of the subsoil at and below foundation level. This control could be obtained by excavation within a steel sheet piled cofferdam, the sheeting being driven to a penetration below final excavation equal to the depth of the excavation below the water level or to bedrock, whichever is less. However, sheeting could be damaged in driving to this penetration in the bouldery subsoil and provision should be made for pulling and re-driving sheeting or patching during construction.

Because of the composition and gradation of the bouldery till, dewatering by means of a vacuum wellpoint system is not considered to be practicable.

Approach Embankments

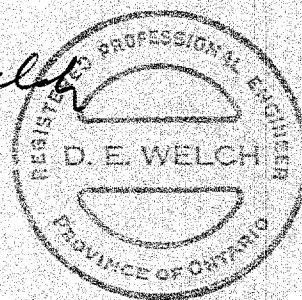
It is understood that the grade will be raised some 4 feet above present roadway level and some 10 feet above the river floodplain level. Due to the granular and competent nature of the

subsoil, there should be no overall stability problem with roadway approach embankments, if raised to the height proposed, using 2 horizontal to 1 vertical side slopes, provided they are constructed of suitable fill material, properly compacted in place.

All surficial topsoil and organic matter should be removed beneath the full base width of the embankments prior to their construction.

Donald E. Welch

D. E. Welch, P.Eng.



F. J. Heffernan

F. J. Heffernan, P.Eng.

DEW:hdg
67751

March 15, 1967.

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

<i>AS</i>	auger sample
<i>CS</i>	chunk sample
<i>DO</i>	drive open
<i>DS</i>	Denison type sample
<i>FS</i>	foil sample
<i>RC</i>	rock core
<i>ST</i>	slotted tube
<i>TO</i>	thin-walled, open
<i>TP</i>	thin-walled, piston
<i>WS</i>	wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

<i>WH</i>	sampler advanced by static weight—weight, hammer
<i>PH</i>	sampler advanced by pressure—pressure, hydraulic
<i>PM</i>	sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

<i>Relative Density</i>	<i>N, blows/ft.</i>
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

<i>Consistency</i>	<i>c_u, lb./sq. ft.</i>
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

<i>C</i>	consolidation test
<i>H</i>	hydrometer analysis
<i>M</i>	sieve analysis
<i>MH</i>	combined analysis, sieve and hydrometer ¹
<i>Q</i>	undrained triaxial ²
<i>R</i>	consolidated undrained triaxial ²
<i>S</i>	drained triaxial
<i>U</i>	unconfined compression
<i>V</i>	field vane test

NOTES:

¹Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

²Undrained triaxial tests in which pore pressures are measured are shown as \bar{Q} or \bar{R} .

LIST OF SYMBOLS

I. GENERAL

π	= 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

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	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

III. SOIL PROPERTIES

(a) Unit weight

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_s	specific gravity of solid particles $G_s = \gamma_s / \gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) Consistency

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density = $(e_{max} - e) / (e_{max} - e_{min})$

(c) Permeability

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

(d) Consolidation (one-dimensional)

m_v	coefficient of volume change = $-\Delta e / (1+e) \Delta \sigma'$
C_c	compression index = $-\Delta e / \Delta \log_{10} \sigma'$
c_c	coefficient of consolidation
T_v	time factor = $c_v t / d^2$ (d , drainage path)
U	degree of consolidation

(e) Shear strength

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_r	sensitivity

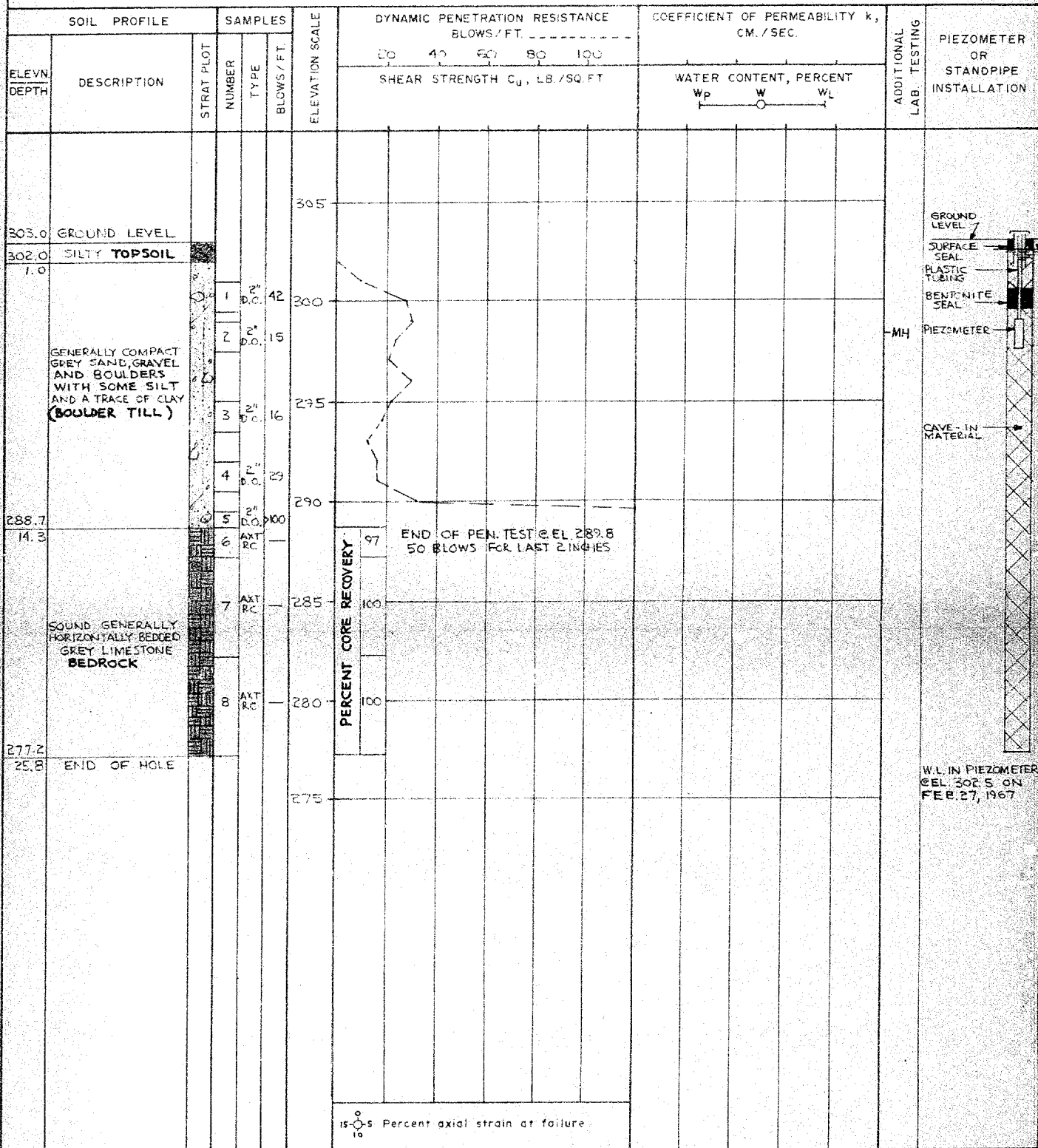
in terms of effective stress
 $\tau_f = c' + \sigma' \tan \phi'$

in terms of total stress
 $\tau_f = c_u + \sigma \tan \phi_u$

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

RECORD OF BOREHOLE 1

LOCATION See Figure 1 BORING DATE FEB. 21-22, 1967 DATUM GEODETIC
 BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER 6X CASING
 SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB DROP 30 INCHES



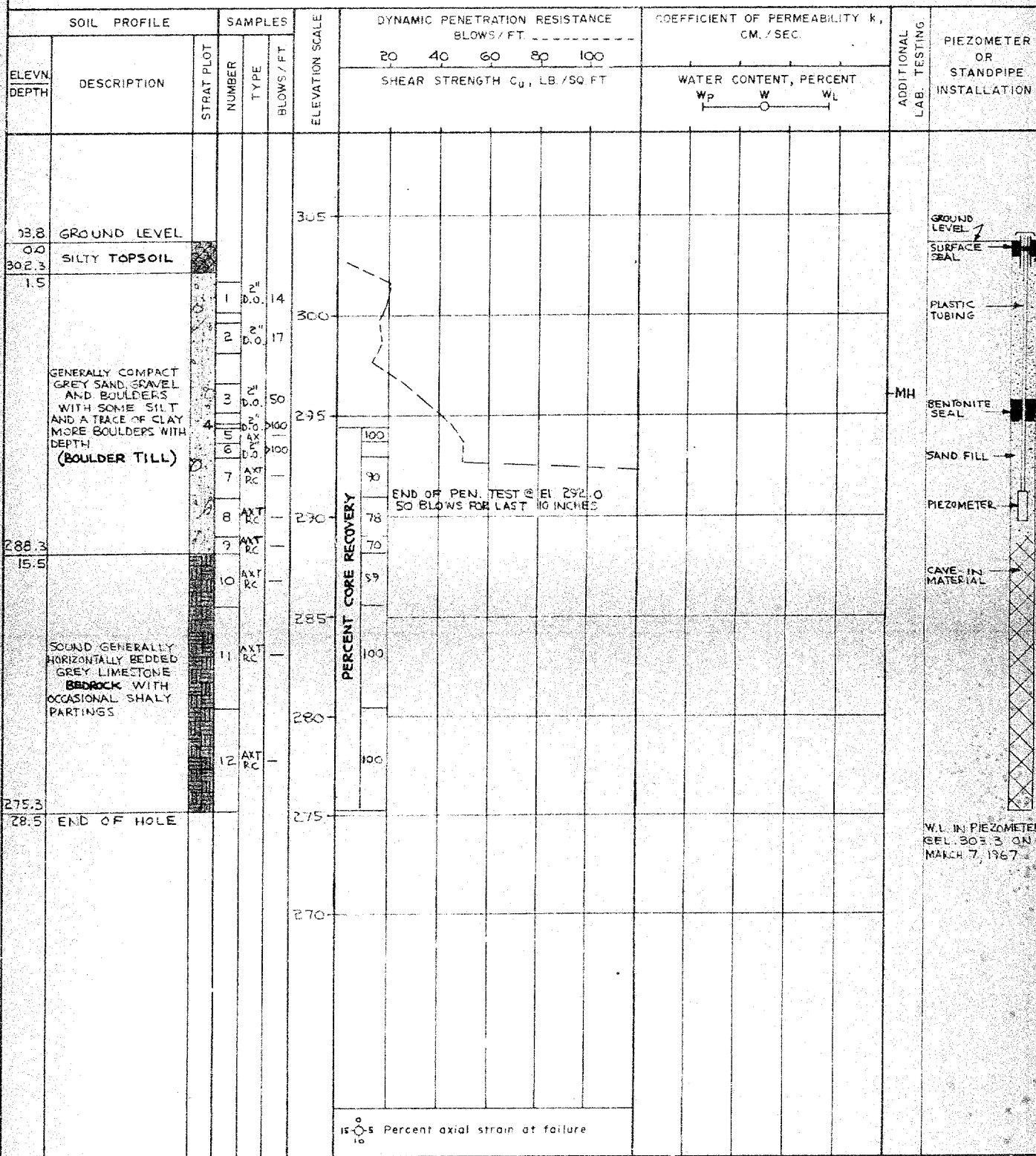
VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN J.A.
CHECKED J.W.

RECORD OF BOREHOLE 2

LOCATION See Figure 1 BORING DATE FEB. 22-23, 1967 DATUM GEODETIC
 BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING
 SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

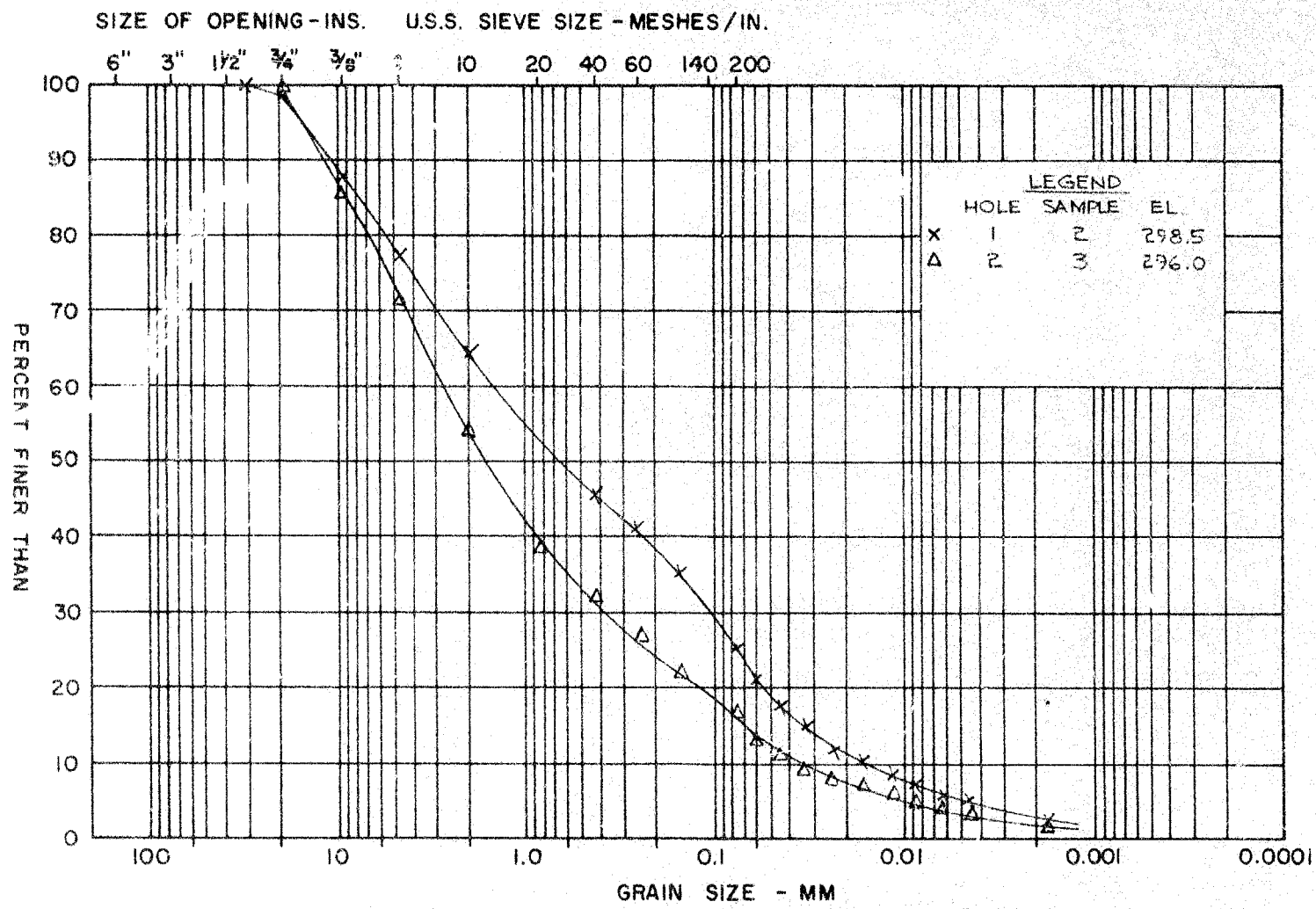


VERTICAL SCALE
 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN J.A.
 CHECKED S.W.

M.I.T. GRAIN SIZE SCALE



GOLDER & ASSOCIATES

COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE		CLAY SIZE	
	GRAVEL SIZE			SAND SIZE			FINE GRAINED			

GRAIN SIZE DISTRIBUTION
BOULDER TILL

FIGURE 2

Bill

W.P. 39-66-3

North Pissini River Bridge

Bouldery strata

Pile does not go to bedrock

Piles 4-8 ft long - hit boulders
20 blows/inch

W=4000 lb

height of drop

Hinged

294.0

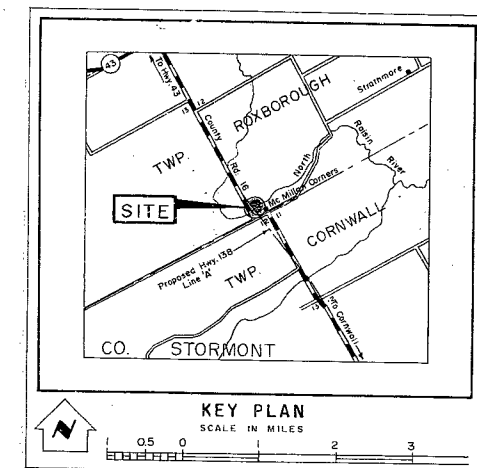
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W.P. #39-66-3


HWY #138

NORTH RAISIN


RIVER




LEGEND




Bore Hole



Cone Penetration Hole



Bore & Cone Penetration Hole

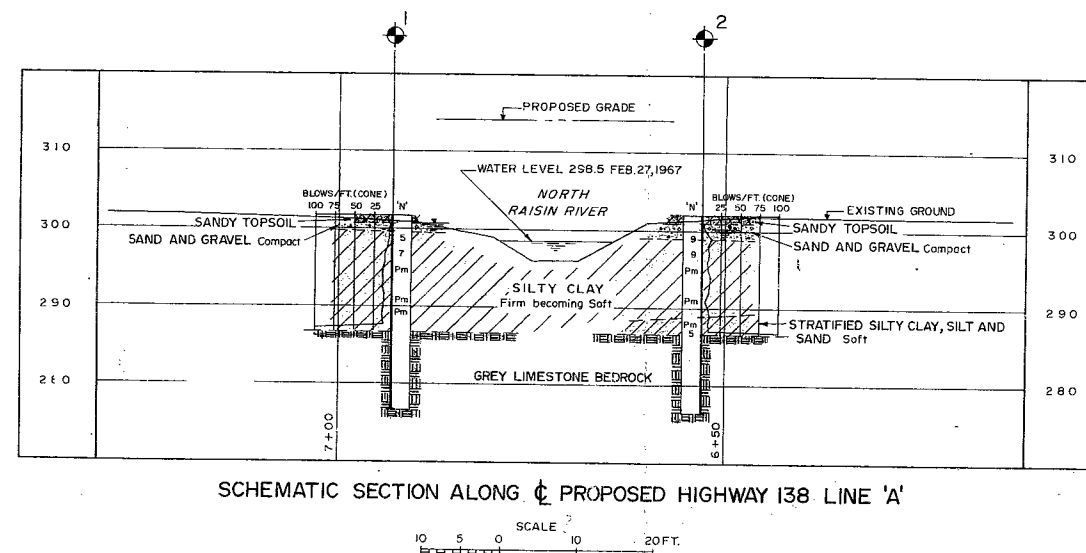


Water Levels established at time of field investigation.(MARCH,1967)

NO.	ELEVATION	STATION	OFFSET
1	301.8	6+93	23' LT.
2	302.0	6+53	21' RT.
3	301.7	6+91	21' RT.
4	301.5	6+58	20' LT.

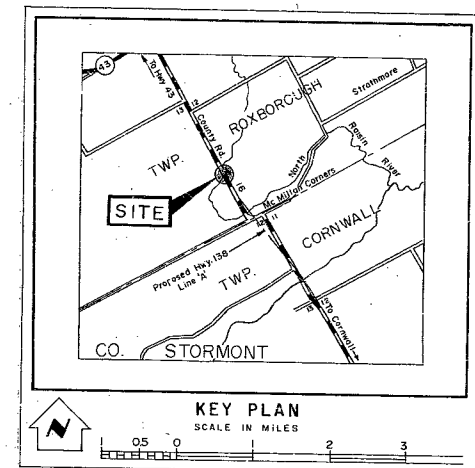
- NOTE -





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.

[illegible]

REVISIONS _____ _____ _____ _____ _____	DATE	BY	DESCRIPTION																		
H. Q. GOLDBER & ASSOCIATES LTD. DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & TESTING DIVISION - FOUNDATION SECTION NORTH BRANCH NORTH RAISIN RIVER (SOUTH CROSSING) KING'S HIGHWAY NO. <u>138 LINE 'A'</u> DIST. NO. <u>9</u> CO. <u>STORMONT</u> TWP. <u>ROXBOROUGH</u> LOT <u>12</u> CON. <u>1</u>																					
BORING PLAN AND SOIL STRATIGRAPHY <table border="1"> <tr> <td>SUBM'D. D.E.W.</td> <td>CHECKED F.H.H.</td> <td>W.P. NO. 39-66-23</td> <td rowspan="2">DRAWING NO. 1</td> </tr> <tr> <td>DRAWN J.A.</td> <td>CHECKED D.E.W.</td> <td>JOB NO. 67752</td> </tr> <tr> <td colspan="3">DATE <u>MARCH 1, 1967</u> SITE NO.</td> <td rowspan="2">BRIDGE DRAWING NO.</td> </tr> <tr> <td colspan="3">APPROVED _____ <small>PROVINCIAL FOUNDATION DIVISION</small></td> </tr> <tr> <td colspan="3">CONT. NO.</td> <td></td> </tr> </table>				SUBM'D. D.E.W.	CHECKED F.H.H.	W.P. NO. 39-66-23	DRAWING NO. 1	DRAWN J.A.	CHECKED D.E.W.	JOB NO. 67752	DATE <u>MARCH 1, 1967</u> SITE NO.			BRIDGE DRAWING NO.	APPROVED _____ <small>PROVINCIAL FOUNDATION DIVISION</small>			CONT. NO.			
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CONT. NO.																					

REF. NO. E-4634-1

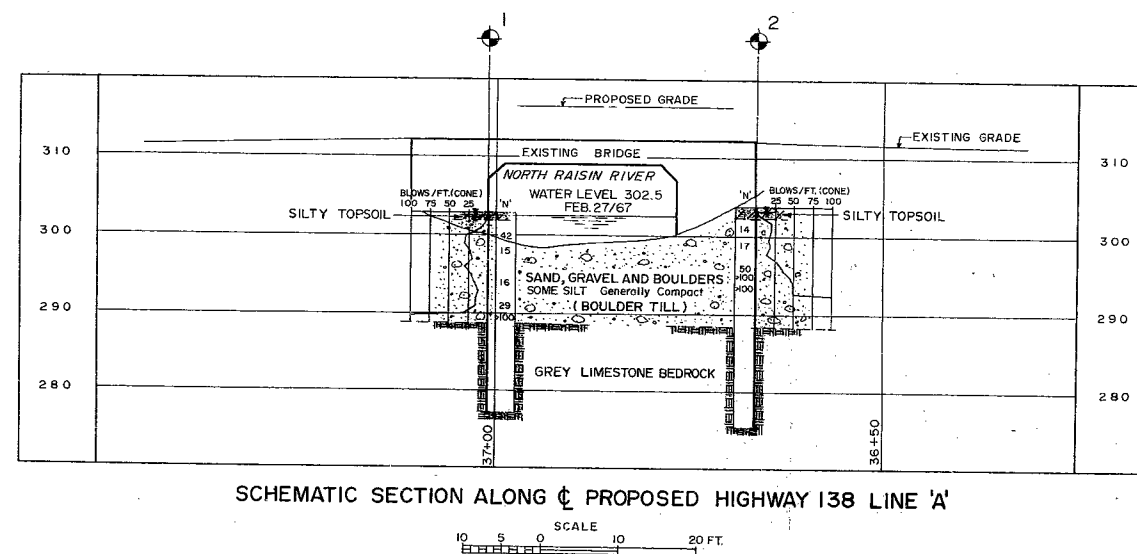


LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation. (MARCH, 1967)		

N.O.	ELEVATION	STATION	OFFSET
1	303.0	37+01	33.5' RT.
2	303.8	36+67	23.0' 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.

[illegible]

REVISIONS									
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H. Q. GOLDER & ASSOCIATES LTD.									
DEPARTMENT OF HIGHWAYS - ONTARIO									
MATERIALS & TESTING DIVISION - FOUNDATION SECTION									
NORTH BRANCH NORTH RAISIN RIVER (NORTH CROSSING)									
KING'S HIGHWAY NO. 138 LINE 'A' DIST. NO. 9									
CO. STORMONT									
TWP. ROXBOROUGH LOT 12 & 13 CON. 1									
BORING PLAN AND SOIL STRATIGRAPHY									
SUBM'D. D.E.W.		CHECKED F.J.H.		W.P. NO. 39-66-3		DRAWING NO. 1			
DRAWN J.A.		CHECKED D.E.W.		JOB NO. 67751					
DATE MARCH 2, 1967		SITE NO.		BRIDGE DRAWING NO.					
APPROVED		CONT. NO.		445-39-66-1					
PRINCIPAL FOUNDATION ENGINEER									

REF. NO. E-4635-1

