cc: Foundations Files (Rm. 110)

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

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

Watt's (Hook's) Creek Bridge,
W.P. 42?-64, Site No. 3-36,
Highway 17, District No. 9 (Ottawa).

We have reviewed the Preliminary Bridge Plan Drawing D-6211-P for the above mentioned structure.

We have no comments.

K. G. Selby

KGS/MdeP

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. S. McCombie
G. Scott

Foundations Files
Gen. Files

File this with H. G. Golder and Associates Report of 1967.

M. Devata
23/Nov/70.

19TH NOV 20 PM 4:34

08323

MX KINR NOV 20/70 4 PM

OTTA 3 TO J E CALLAGHAN DIST ENGR

DOWN 3 M STOYANOFF BRIDGE OFFICE

G STERMAC FOUNDATION SECTION

KINR COPY TO J E GR[illegible]ER M AND T

H B MCKAY ENG AUDIT

M R ERNESAKS FUNCTIONAL PLANNING

P BILLINGS REG DIRECTOR

R FORREST SCHEDULING CO-ORDINATOR

T C KINGSLAND BRIDGE OFFICE

RE WP 425-54-00 - HIGHWAY NO. 17 - WATT'S (ROCK) CREEK BRIDGE

4.4 MILES WEST OF HIGHWAY NO. 15 - DISTRICT NO. 9 OTTAWA

REGIONAL PRE-CONTRACT REVIEW MEETING FOR THE ABOVE NOTED PROJECT TO BE HELD ON FRIDAY DECEMBER 4TH, 1970 AT 10:30 A.M. IN BOARD ROOM NO. 1 AT THE KINGSTON REGIONAL OFFICE.

R T MOLARO ROAD DESIGN

JM

Advised Mr Markavitch that there are no special problems in foundations design and consequently we will not attend the meeting.

Department of Highways Ontario

Copy for the information of
Mr. A. Stermac,
Principal Foundation Engineer

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

Bridge Division,
Downsview, Ontario

July 13, 1967

Watt's (Rocks) Creek Bridge
W.P. 425-64, Site No. 3-36
Highway 17, District No. 9

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-6211-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.

G.S. Grebski,
Bridge Design Engineer

CSG:rd

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

No comments
17/8/67 A.K.R.

# 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


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 WATT'S CREEK CROSSING,
OTTAWA, ONTARIO.
W.P.425-64.

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
67750

cc: Foundations Office (Rm. 110)

Mr. B. A. Davis,
Bridge Engineer,
Bridge Division,
Main. Bldg.

Attention: Mr. S. McCombie

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

March 20, 1967

MAR 20 1967

FOUNDATION INVESTIGATION REPORT FOR D.N.D.
BY: E. G. GOLDER AND ASSOCIATES LIMITED -
Proposed Watt's Creek Crossing, Highway 17,
Ottawa, Ontario -- District No. 9 (Ottawa).
W.P. 425-64

Attached, please find the above mentioned report prepared and submitted by the consultant, E. G. Golder and Associates Ltd.

We have reviewed the report and believe that it contains all the information necessary for your further design work.

Regarding the recommendations, we would like to mention that it is our experience that serious difficulties can be encountered when augering in sensitive clays, and we would therefore suggest that this procedure not be used.

Should you have any further queries, please feel free to contact this Office.

A. G. Sterman
PRINCIPAL FOUNDATION ENGINEER

AGS/mdef
Attach.
cc: Messrs. B. A. Davis (2)
E. A. Tregunno
D. W. Farren
S. J. Markiewicz
C. A. Robertson
G. Scott
J. E. Gruspier
B. A. Singh
Foundations Office Files
Gen. Files

cc; Mr. H. Szymanski (1 of 2)

Hwy. 401 & Keele St.,
Downsview, Ontario.
Tel. No. 248-3282

Materials and Testing Division

February 16, 1967

M. R. Gelder and Associates Ltd.,
2466 Bloor Street west,
Toronto, Ontario.

Attention: Mr. J. A. Gerang

Re: Foundation Investigation -- Letter of Authority
W.P. 425-64; Site No. 3-36,
Watts Creek -- Hwy. No. 17,
District No. 9 (Ottawa).

Dear Sir:

Please consider this your authority to carry out the necessary foundation investigation at the above mentioned site.

The necessary drawings were handed to your representative on February 13, 1967, at which time, all the foreseeable problems were discussed.

You are requested to commence the investigation as soon as possible, and submit eleven (11) copies of the final report to the Department by not later than March 20, 1967.

For any problems regarding location or alignment, please consult Mr. G. Scott, Regional Bridge Location Engineer, Kingston - Tel. No. 544-2220 - (Area Code 613). Problems pertaining to the subsoil or foundations should be discussed with our Foundation Section.

We understand that this work will be carried out from your Ottawa office.

cont'd. /2 ...

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 drawing accompanying the foundation report, showing the location of borings, the inferred subsoil conditions, etc., is to become a contract drawing, you are requested to prepare it in accordance with the D.H.O. Standards. To enable you to do this, we are supplying you with a sample drawing with all the necessary explanations, together with linen sheet for your drawing. You are also requested to provide us with a Cronaflex copy of the drawing.

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

Yours very truly,

A. Rutka

A. Rutka
MATERIALS & TESTING ENGINEER

AR/dcf
Attach.

cc: Messrs. A. McCombie
S. J. Markiewicz
C. S. Robertson
G. Scott
J. E. Gruspier
H. Konings
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

F. J. HEFFERNAN (OTTAWA)

196 BRONSON AVENUE
OTTAWA 4, ONTARIO
235-9698

W.P.-425-64

# REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED WATT'S CREEK CROSSING

HIGHWAY 17

OTTAWA ONTARIO

Distribution:

11 copies - Department of Highways, Ontario, Toronto, Ontario.

2 copies - H Q. Golder & Associates Ltd., O tawa, Ontario.

March, 1967

67750

TABLE OF CONTENTS

## ABSTRACT

The results of an investigation to determine the subsoil conditions at the proposed new Watt's Creek crossing near Ottawa, Ontario, are reported and recommendations are made for foundation design and construction of the proposed bridge structure and roadway embankments.

It was found that below some 5 to 8 feet of clayey fill, the site is underlain by firm to stiff silty clay, which at the abutment locations is about 12 feet thick. The sensitivity of the clay as measured by the ratio of undisturbed to the remoulded vane in situ shear strength is of the order of 10. This sensitive silty clay is underlain by a few feet of relatively soft glacial till then by sandstone bedrock at a depth of about 10 to 13 feet below creek bottom. The groundwater table as measured in the boreholes was at a depth of 4 to 7 feet below existing roadway grade or some 2 to 5 feet above creek level.

It is recommended that the abutments for this rigid frame structure be founded on piles end bearing on the sandstone bedrock. Either steel H piles or large diameter pre-augered concrete filled pipe piles would be suitable at this site.

Based on the shear strength profile obtained for the silty clay stratum, the raised roadway approach embankments, with 2 horizontal to 1 vertical side slopes and a vertical end slope, should be stable. The settlement resulting from the raising of the profile grade should be minor and will mainly take place prior to final paving of the roadway.

## 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 proposed new bridge on Highway 17, crossing Watt's Creek near the western limits of Ottawa, in Carleton County. 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 the investigation was carried out between February 18 and 20, 1967. During this period 2 boreholes with adjacent dynamic penetration tests and 2 additional dynamic penetration tests were put down with a machine drillrig supplied and operated by the F.E. Johnston Drilling Co. Ltd., of Ottawa, Ontario. The underlying bedrock was cored in AXT size in each of the boreholes for a depth of about 10 feet. 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. A detailed

log of each boring and additional dynamic penetration tests is shown on the Record of Borehole sheets following the text of this report.

All soil samples and rock core 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 ground surface elevations at the boreholes were obtained by the Department of Highways, Ontario. The elevations are understood to be referred to Geodetic datum.

## SITE AND GEOLOGY

The site is located in Nepean Township of Carleton County on Highway 17 about 4.4 miles west of the junction of Highways 15 and 17. The road running north towards Shirleys Bay leaves Highway 17 about 100 yards east of the site. Watt's Creek (also called Rock's Creek) is about 10 feet wide at normal water level and flows in a northerly direction. The area immediately west of Ottawa is in the physiographic region known as the Ottawa clay plain and is generally flat lying farmland with occasional wooded areas.

From existing geological information it is known that the site is over or near the contact between the March formation and the underlying Nepean formation. The March formation is interbedded sandstone and dolomite while the underlying Nepean formation is sandstone. Both are of the Ordovician system laid down in the Palaeozoic era. From the results of this present investigation it has been concluded that the site is over the Nepean formation which is known to vary in thickness from several feet to many hundred feet. Underlying the Nepean formation, and in some places the March formation, is older Precambrian rock.

## SOIL CONDITIONS

### General

At this site there is an existing embankment crossing the creek. Underlying the embankment is up to 13 feet of firm sensitive silty clay overlying friable but quite sound sandstone bedrock. 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

Overlying the site is between 5 and 8 feet of fill from

the existing roadway embankment. The upper 1.5 feet of this fill is brown sand and gravel roadway base course. Below this the general embankment fill is firm brown clayey silt, with some sand and a trace of gravel. Standard penetration resistances ("N" values) range between 5 and 8 blows/ft. A typical grain size distribution curve for the material is on Figure 2.

Sensitive Silty Clay

Underlying the embankment fill below about elevation 214 is between 11 and 13 feet of firm becoming stiff sensitive silty clay. The clay is fissured and brownish grey near the top of the stratum becoming grey and less fissured with depth. A typical grain size distribution curve is on Figure 3. The liquid limit obtained on one sample is 47 with a corresponding plastic limit of 17. The natural moisture content of the clay ranges between 44 and 51 percent.

Five in situ vane shear tests in the stratum gave undrained shear strengths for the material between 640 and 1,440 lb/sq.ft. with a general strength increase with depth. Corresponding remoulded in situ vane shear tests gave remoulded undrained shear strengths between 40 and 280 lb/sq.ft. Based on the vane test results the sensitivity of the clay, which is the ratio of in

situ to the remoulded undrained shear strengths, is between 5 and 16. Two undrained triaxial compression tests were carried out on relatively undisturbed samples. These gave undrained shear strengths of 800 and 950 lb/sq.ft. Failure strains for these tests were about 3 percent. The triaxial tests gave lower strengths than the corresponding in situ vane tests. This is probably due to loss of strength because of some unavoidable sample disturbance.

Clayey Silt Till

Underlying the sensitive clay in borehole 2 is a 5 foot thick stratum of firm grey clayey silt till with some sand and gravel. The stratum did not appear in borehole 1.

Bedrock

The bedrock underlying the site, at elevation 197 to 200, is a sound but slightly friable sandstone with occasional fine shaly zones and fractures. In borehole 1, granitic rock underlies some 9 feet of sandstone.

## 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 in the clay overburden is at about elevation 214 which is roughly creek level. This was determined in borehole 2 where the piezometer was sealed into the clay stratum. In borehole 1 the bedrock was not sealed off and the water level is some 3 feet higher.

## PROPOSED BRIDGE STRUCTURE

### General

It is understood that the existing concrete bridge carrying Highway 17 over Watt's Creek is to be replaced by a single span rigid frame structure some 36 feet long and about 38 feet wide as shown on Figure 1. During reconstruction of Highway 17, the grade will be raised some 5 feet at the bridge crossing.

### Foundations

Due to the low shear strength of the silty clay subsoil, together with the relatively shallow depth to bedrock, it is recommended that the abutments be founded on piles taken down to the surface of the bedrock. In order to minimize remoulding of the sensitive silty clay during pile driving, it is recommended that a small displacement pile such as a steel H section be driven to refusal on the surface of the bedrock. An allowable loading of 70 tons per

pile may be used for 12 inch X 53 lb. steel piles driven to a set of 10 blows per inch with a hammer developing in excess of 20,000 foot pounds per blow.

Alternatively, excavation to bedrock could be made using a large diameter auger (greater than 30 in.) and a steel lining to prevent caving of the sensitive clay. Provided that the bedrock surface is clean (and this should be checked by inspection) a bearing pressure of 20 tons/sq.ft. may be used for the sandstone in the design of concrete-filled steel-lined piles. No belling out at the base of the pile is recommended in this case because of possible sloughing of the overburden.

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 abutment walls. With full effective drainage of the backfill, a coefficient of lateral earth pressure at rest, Ko, = 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.

Approach Embankments

It is understood that the proposed grade is to be raised

5 feet above the existing grade at the creek crossing location. Stability computations have been carried out for the proposed embankment. Based on the undrained shear strengths measured in the silty clay stratum at the site, the factor of safety of the vertical frontal part of the proposed embankment at the abutment, would be in excess of 1.5 which is considered adequate.

From the shear strength profile obtained from tests on the silty clay stratum, and from available local geological information (Crawford, Eden, 1965), it is considered that the clay has been preconsolidated by about 1 ton/sq.ft. in excess of the present overburden pressure. The addition of 5 feet of fill, or a load of about 0.3 tons/sq.ft., should result in only some minor recompression of the clay. The settlement resulting from this increase in embankment loading should be of the order of 2 to 3 inches, the majority of this settlement taking place within several months after placing of the embankment fill. This fill, adjacent to the pile supported bridge structure, should be placed and compacted well in advance of final paving operations.

CRAWFORD, C.B. and EDEN, N.J. (1965). "A comparison of laboratory results with in situ properties of Leda clay". Proc. Sixth Int. Conf. Soil Mech. Fdn. Eng. I.31-5.

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

Donald E. Welch

D. E. Welch, P.Eng.

REGISTERED PROFESSIONAL ENGINEER D. E. WELCH PROVINCE OF ONTARIO

for F. J. Heffernan, P.Eng.

DEW:hdg
67750
March 16, 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

*AS* auger sample
*CS* chunk sample
*DO* drive open
*DS* Denison type sample
*FS* foil sample
*RC* rock core
*ST* slotted tube
*TO* thin-walled, open
*TP* thin-walled, piston
*WS* 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.

*WH* sampler advanced by static weight—weight, hammer

*PH* sampler advanced by pressure—pressure, hydraulic

*PM* sampler advanced by pressure—pressure, manual

### III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

| *Relative Density* | *N, blows/ft.* |
|---|---|
| Very loose | 0 to 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very dense | over 50 |

(b) *Cohesive Soils*

| *Consistency* | $c_u$, *lb./sq. ft.* |
|---|---|
| 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

*C* consolidation test
*H* hydrometer analysis
*M* sieve analysis
*MH* combined analysis, sieve and hydrometer[1]
*Q* undrained triaxial[2]
*R* consolidated undrained triaxial[2]
*S* drained triaxial
*U* unconfined compression
*V* field vane test

NOTES:

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

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

# LIST OF SYMBOLS

## I. 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 |

## II. STRESS AND STRAIN

| | |
|---|---|
| $u$ | pore pressure |
| $\sigma$ | normal stress |
| $\sigma'$ | normal effective stress ($\bar{\sigma}$ is also used) |
| $\tau$ | shear stress |
| $\epsilon$ | linear strain |
| $\epsilon_{xy}$ | 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 |

## III. SOIL PROPERTIES

### (a) *Unit weight*

| | |
|---|---|
| $\gamma$ | 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 |
| $G_s$ | 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 $= -\Delta e/\Delta \log_{10} \sigma'$ |
| $c_v$ | coefficient of consolidation |
| $T_v$ | time factor $= c_v t/d^2$ ($d$, drainage path) |
| $U$ | degree of consolidation |

### (e) *Shear strength*

| | | |
|---|---|---|
| $\tau_f$ | shear strength | |
| $c'$ | effective cohesion intercept | in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$ |
| $\phi'$ | effective angle of shearing resistance, or friction | |
| $c_u$ | apparent cohesion* | in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$ |
| $\phi_u$ | apparent angle of shearing resistance, or friction | |
| $\mu$ | coefficient of friction | |
| $S_t$ | sensitivity | |

*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. 17, 1967 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

| ELEVN. / DEPTH | DESCRIPTION | NUMBER | TYPE | BLOWS/FT. |
|---|---|---|---|---|
| 220.8 | GROUND LEVEL. | | | |
| 0.0 / 219.3 | BROWN SAND AND GRAVEL (FILL) | 1 | CS. | — |
| 1.5 | FIRM BROWN CLAYEY SILT, SOME SAND AND A TRACE OF GRAVEL WITH OCCASIONAL PIECES OF CONCRETE AND WIRE (FILL) | 2 | 2" O.D. | 5 |
| | | 3 | 2" O.D. | 7 |
| 213.2 | | 4 | 2" O.D. | 5 |
| 7.6 | FIRM BECOMING STIFF FISSURED SENSITIVE BROWNISH GREY SILTY CLAY WITH A TRACE OF SAND BECOMING GREY AND LESS FISSURED WITH DEPTH AND A TRACE OF GRAVEL BELOW 19' | 5 | 2" T.O. | Pm |
| | | 6 | 2" T.O. | Pm |
| | | 7 | 2" T.O. | Pm |
| 200.2 | | | | |
| 20.6 | SOUND GREY SLIGHTLY FRIABLE SANDSTONE BEDROCK WITH OCCASIONAL FRACTURES | 8 | AXT RC | — |
| | | 9 | AXT RC | — |
| 191.1 | | | | |
| 190.3 | | | | |
| 30.5 | END OF HOLE | | | |
| | SOUND PINK GRANITIC BEDROCK | | | |

ELEVATION SCALE: 225, 220, 215, 210, 205, 200, 195, 190, 185

DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (10, 20, 30, 40, 50)

SHEAR STRENGTH $C_u$, LB./SQ.FT. (VANE - + NAT., ⊕ REM., ● - φ) (500, 1,000, 1,500, 2000, 2500)

FROZEN

END OF PEN. TEST @ EL. 200.2
7 BLOWS FOR LAST INCH

PERCENT CORE RECOVERY: 100, 73

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT (Wp, W, WL) (10, 20, 30, 40)

ADDITIONAL LAB. TESTING: MH; Y=112 H; Y=114

PIEZOMETER OR STANDPIPE INSTALLATION: GROUND LEVEL, SURFACE SEAL, PLASTIC TUBING, BENTONITE SEAL, SAND FILL, PIEZOMETER

W.L. IN PIEZOMETER @ EL. 217.3 ON MARCH 7, 1967

15 / 10 ⊖ 5 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN J.A.

CHECKED D.W.

PROJECT No. [illegible]

# RECORD OF BOREHOLE 2

LOCATION See Figure 1 BORING DATE FEB. 20, 1967 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

| ELEVN. / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: BLOWS/FT. |
|---|---|---|---|---|---|
| 219.5 | GROUND LEVEL | | | | |
| 0.0 | FIRM BROWN CLAYEY SILT, SOME SAND AND A TRACE OF GRAVEL (FILL) | | 1 | 2" O.D. | 8 |
| | | | 2 | 2" O.D. | 9 |
| 214.0 | | | 3 | 2" O.D. | 8 |
| 5.5 | FIRM BECOMING STIFF FISSURED SENSITIVE BROWNISH-GREY SILTY CLAY WITH A TRACE OF SAND BECOMING GREY AND LESS FISSURED WITH DEPTH | | 4 | 2" O.D. | 2 |
| 202.5 | | | | | |
| 17.0 | FIRM GREY CLAYEY SILT WITH SOME SAND AND GRAVEL (TILL) | | 5 | 2" O.D. | 7 |
| 197.3 | | | | | |
| 22.2 | GREY SLIGHTLY FRIABLE BUT BECOMING SOUNDER WITH DEPTH SANDSTONE BEDROCK WITH AN OCCASIONAL FINE SHALY ZONES AND FRACTURES. | | 6 | AXT RC | — |
| | | | 7 | AXT RC | — |
| 186.0 | | | | | |
| 33.5 | END OF HOLE | | | | |

ELEVATION SCALE: 220, 215, 210, 205, 200, 195, 190, 185

DYNAMIC PENETRATION RESISTANCE BLOWS/FT. — 10 20 30 40 50

SHEAR STRENGTH $C_u$, LB./SQ. FT. VANE - + NAT., ⊕ REM. — 500 1,000 1,500 2,000 2,500

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT — $W_P$ W $W_L$

ADDITIONAL LAB. TESTING

PERCENT CORE RECOVERY: C7, 95

END OF PEN. TEST @EL. 192.3 50 BLOWS FOR LAST 2 INCHES

15 10 5 Percent axial strain at failure

PIEZOMETER OR STANDPIPE INSTALLATION

GROUND LEVEL
SURFACE SEAL
PLASTIC TUBING
BENTONITE SEAL
PIEZOMETER
BENTONITE SEAL
SAND FILL

W.L. IN PIEZOMETER @EL. 214.0 ON MARCH 7, 1967

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN J.A

CHECKED [illegible]

# RECORD OF ~~BOREHOLE~~ PEN. TEST 3

LOCATION See Figure 1 BORING DATE FEB. 18, 1967 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

| SOIL PROFILE | | | SAMPLES | | | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS/FT. 10 20 30 40 50 / SHEAR STRENGTH $C_u$, LB./SQ.FT. | COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT $W_P$ $W$ $W_L$ | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|
| ELEVN. / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | BLOWS/FT. | | | | | |
| 220.1 | GROUND LEVEL | | | | | 225 | | | | |
| 0.0 | PROBABLY FIRM CLAYEY SILT WITH SOME SAND AND A TRACE OF GRAVEL (FILL) | | | | | 220 | FROZEN | | | |
| 214.6 / 5.5 | | | | | | 215 | | | | |
| | PROBABLY FIRM BECOMING SOFTER SENSITIVE SILTY CLAY | | | | | 210 | | | | |
| | | | | | | 205 | | | | |
| 199.2 | | | | | | 200 | | | | |
| 20.9 | END OF PEN. TEST REFUSAL PROBABLY BEDROCK | | | | | | 100 BLOWS FOR LAST 11 INCHES | | | |
| | | | | | | 195 | | | | |

15 ○ 5 Percent axial strain at failure
10

VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN JA
CHECKED DW

# RECORD OF ~~BOREHOLE~~ PEN. TEST 4

LOCATION See Figure 1 BORING DATE FEB. 18, 1967 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

| ELEVN / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: BLOWS/FT. |
|---|---|---|---|---|---|
| 219.9 | GROUND LEVEL | | | | |
| 0.0 | PROBABLY FIRM CLAYEY SILT WITH SOME SAND AND A TRACE OF GRAVEL (FILL) | | | | |
| 213.9 | | | | | |
| 6.0 | PROBABLY FIRM BECOMING SOFTER SENSITIVE SILTY CLAY | | | | |
| 199.8 | | | | | |
| 20.1 | END OF PEN. TEST REFUSAL PROBABLY BEDROCK | | | | |

ELEVATION SCALE: 220, 215, 210, 205, 200, 195

DYNAMIC PENETRATION RESISTANCE BLOWS/FT. 10 20 30 40 50

SHEAR STRENGTH $C_u$, LB./SQ.FT

FROZEN

25 BLOWS FOR LAST INCH

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT $W_P$ W $W_L$

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

15 5 Percent axial strain at failure 10

VERTICAL SCALE 1 INCH TO 5'-0"

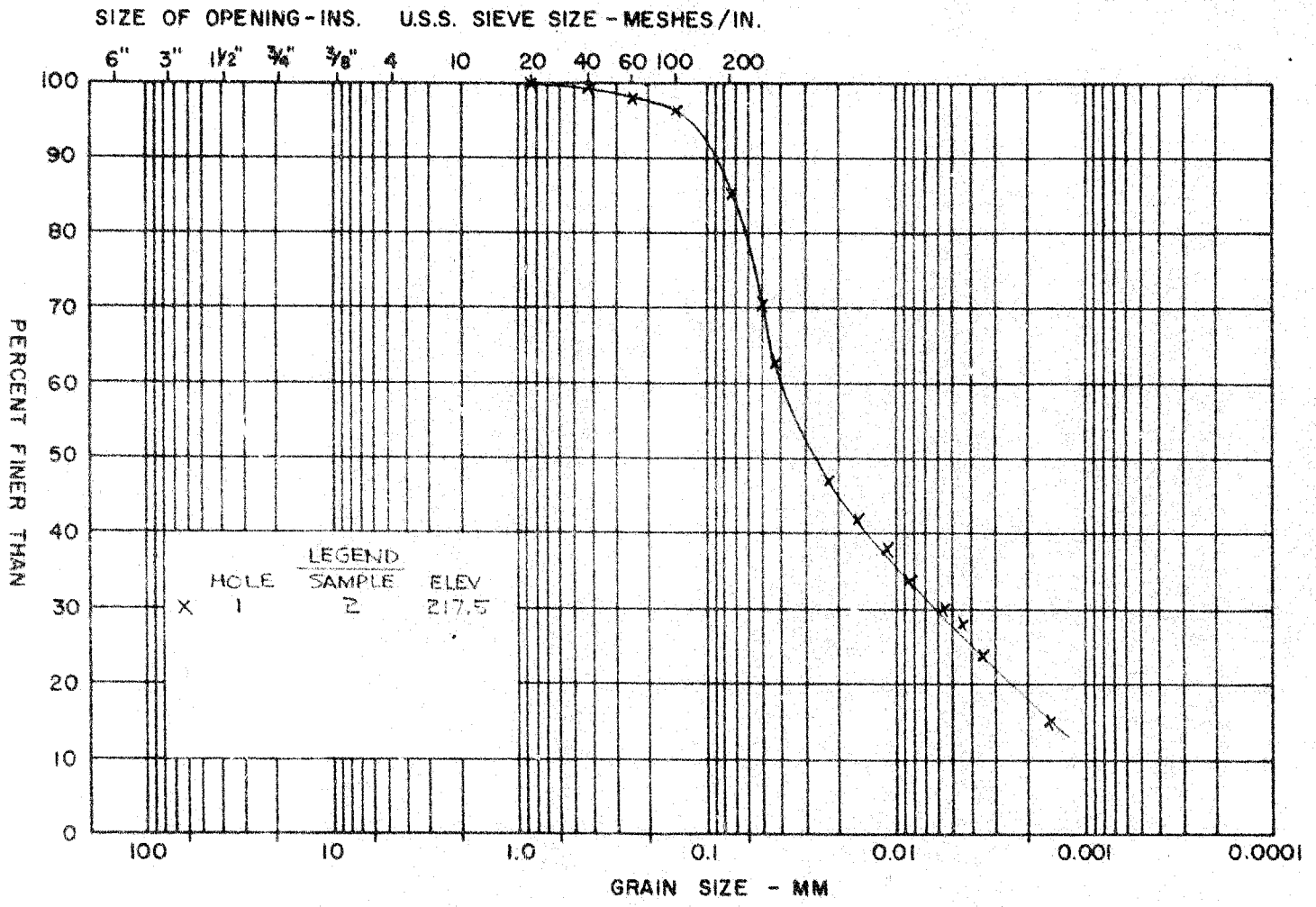
GOLDER & ASSOCIATES

DRAWN J.A.

CHECKED J.W.

PROJECT No. 97759

M.I.T. GRAIN SIZE SCALE




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

GOLDER & ASSOCIATES

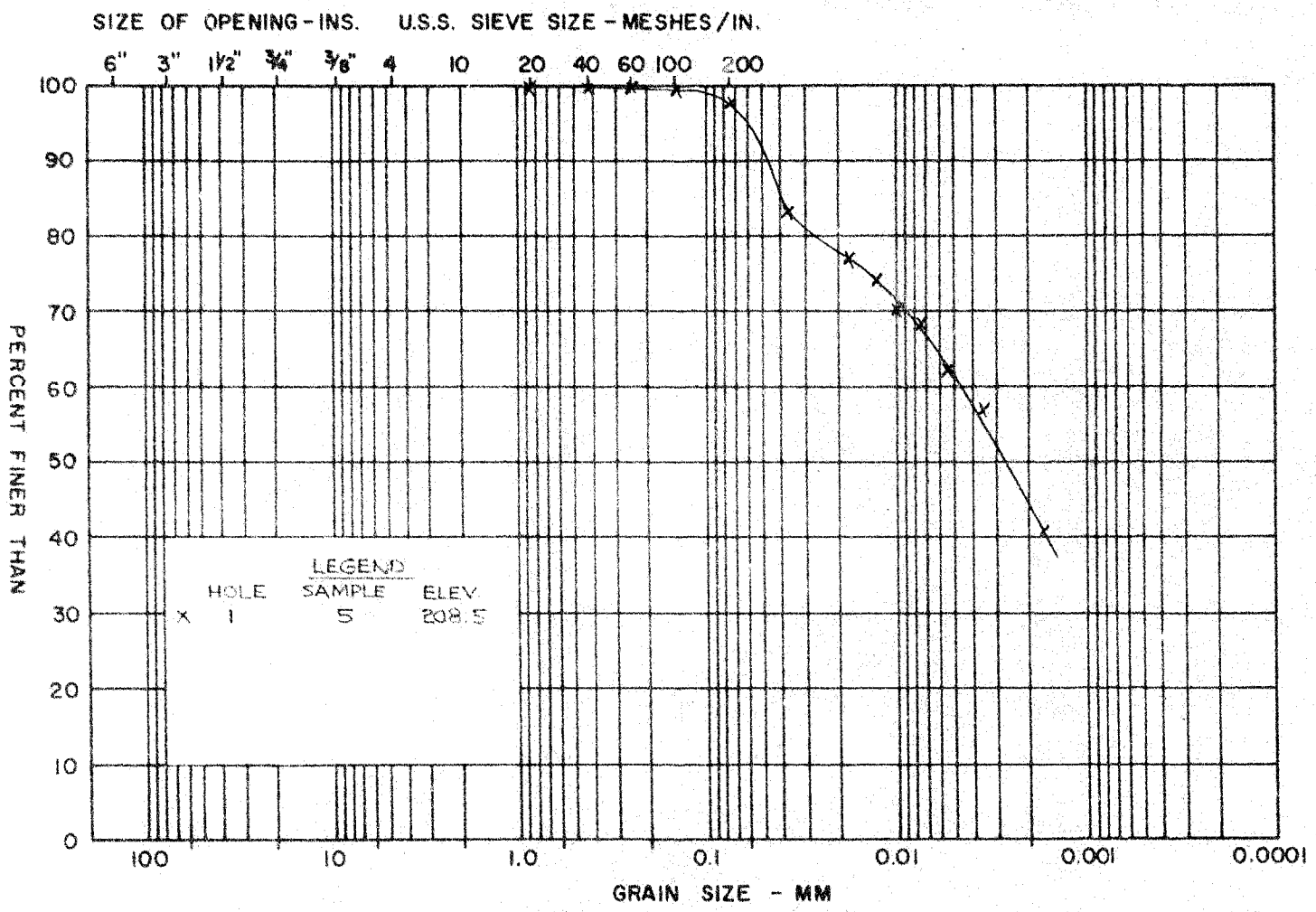
GRAIN SIZE DISTRIBUTION

SANDY SILT FILL

FIGURE 2

PROJECT No. 67750

M.I.T. GRAIN SIZE SCALE




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

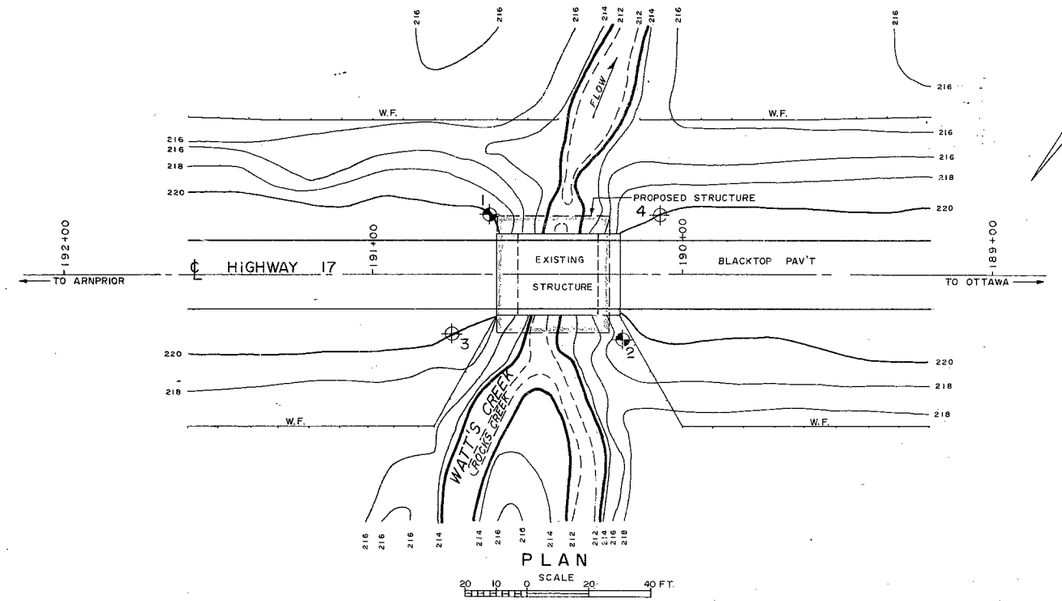
GOLDER & ASSOCIATES

# GRAIN SIZE DISTRIBUTION

SENSITIVE SILTY CLAY

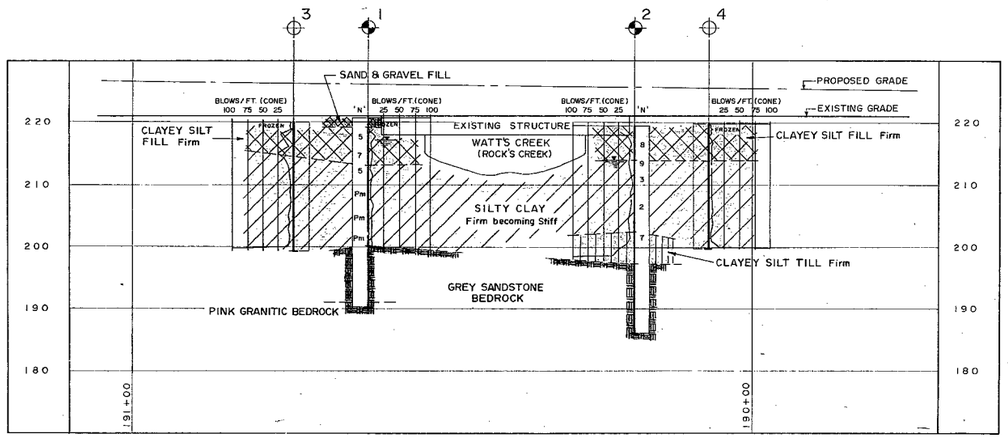
FIGURE 3

#67-F-205
W.P. #425-64
Hwy #17
WATT'S
(ROCK'S) CREEK
BRIDGE



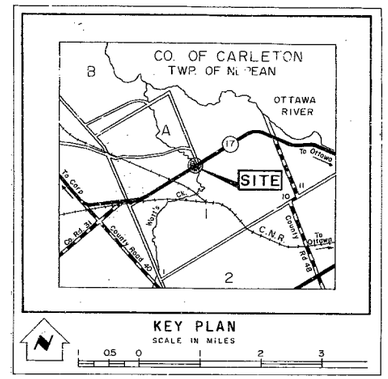

PLAN

SCALE 20 10 0 20 40 FT.




SCHEMATIC SECTION ALONG ℄ OF HIGHWAY 17

SCALE 10 5 0 10 20 FT.




KEY PLAN

SCALE IN MILES 1 0.5 0 1 2 3

## LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation.(MAR. 1967)

| NO. | ELEVATION | STATION | OFFSET |
|---|---|---|---|
| 1 | 220.8 | 190+62 | 19.5'RT. |
| 2 | 219.5 | 190+19 | 21.0'LT. |
| 3 | 220.1 | 190+74 | 19.0'LT. |
| 4 | 219.9 | 190+07 | 19.0'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.

| PRINT RECORD | | |
|---|---|---|
| NO. | FOR | DATE |
| | | |

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |

H. Q. GOLDER & ASSOCIATES LTD.

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & TESTING DIVISION FOUNDATION SECTION

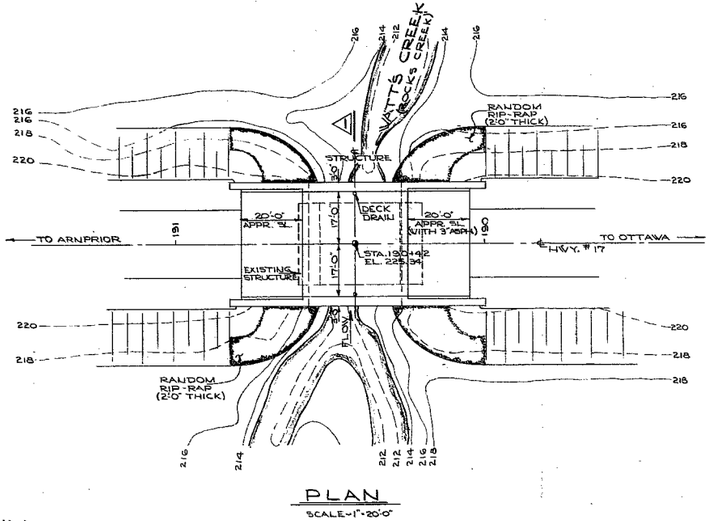
# WATT'S CREEK (ROCK'S CREEK)

KING'S HIGHWAY NO. 17 DIST. NO. 9
CO. CARLETON
TWP. NEPEAN LOT 5 CON. A & I

## BORING PLAN AND SOIL STRATIGRAPHY

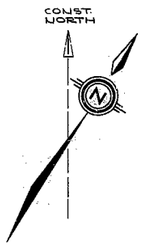
| | | | |
|---|---|---|---|
| SUBM'D. D.E.W. | CHECKED F.J.H. | W.P. NO. 425-64 | DRAWING NO. 1 |
| DRAWN J.A. | CHECKED D.E.W. | JOB NO. 67750 | |
| DATE FEB. 23, 1967 | | SITE NO. | BRIDGE DRAWING NO. |
| APPROVED PRINCIPAL FOUNDATION ENGINEER | | CONT. NO. | |

REF. NO. E-4633-1




PLAN

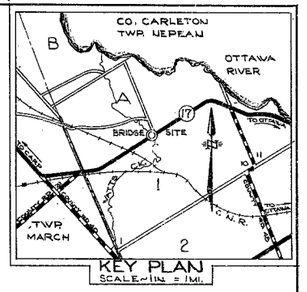
SCALE-1"-20'-0"





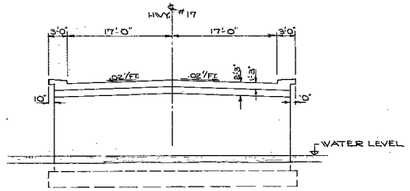
PROFILE HWY. 17

M.T.S




KEY PLAN

SCALE-1IN. = 1MI.




1 SCALE-1"=10'-0"

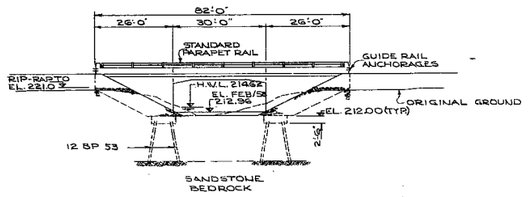
## GENERAL NOTES

CLASS OF CONCRETE
DECK, CURBS AND PARAPET WALLS -4000 P.S.I.
REMAINDER -3000 P.S.I.

CLEAR COVER ON REINFORCING STEEL.
FOOTINGS, ABUTMENTS AND PIERS -3"
CURBS -2"
DECK TOP -2" BOTT. 1½"

## GEODETIC DATUM

B.M. 226.42
U.E.W. IN S. ROOT OF 3.5 ELM
66'0 LT. OF STA. 196+37




ELEVATION

SCALE-1"=20'-0"

| PRINT RECORD | | |
|---|---|---|
| No. | FOR | DATE |
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| REVISIONS | | | |
|---|---|---|---|
| | DATE | BY | DESCRIPTION |
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DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

# WATT'S (ROCKS) CREEK BRIDGE

44 MILES WEST OF HWY. 15

KING'S HIGHWAY No. 17 DIST. No. 9
CO. CARLETON
TWP. NEPEAN LOT 5 CON. A-OTTAWA FR.

PRELIMINARY

APPROVED _____ BRIDGE ENGINEER

| | | | |
|---|---|---|---|
| DESIGN | | CHECK | |
| DRAWING | D.H.B. | CHECK | |
| DATE | JULY/67 | LOADING | HS20-44 |

SITE No. 3-36
W.P. No. 425-64
CONTRACT Nos.
DRAWING No. D-6211-P