

23-65 180

WILLIAM A. TROW AND ASSOCIATES LTD.

SITE INVESTIGATIONS
LABORATORY TESTING
SOIL MECHANICS CONSULTATION

W. A. TROW, M.A.S.C., M.E.I.C., ENG.

WP 94-61

1850 JANE ST.,
WESTON, ONT.
CH. 1-4644

Project: J755

October 31, 1961

Mr. A. Rutka,
Acting Materials and Research Engineer,
Department of Highways of Ontario,
Parliament Buildings,
Toronto, Ontario

Attention: Mr. N.D. Stermac, P.Eng.,
Principal Soils & Foundation Engineer

Re: Foundation Investigation
Bridge Replacement
Hwy. 2, Over Wood Creek

Henry

Dear Sirs:

The enclosed report describes the foundation conditions existing at this bridge site.

The site is underlain by approximately 33 feet of medium stiff to stiff marine clay. According to the results of vane shear tests, the safe net bearing capacity of the clay, below anticipated footing level, is about 2000 psf. In view of this low design pressure, together with the difficulties of construction about 8 feet below water level, the proposal of spread footings is considered impractical.

We have therefore recommended that the proposed structure be founded on timber piles, end bearing about 34 to 39 feet below creek surface in a stratum of sandy silt gravel till. This medium dense to very dense stratum, which contains numerous boulders, was encountered below the marine clay and extends for a further depth of at least 40 feet. A conservative design capacity of 15 tons is recommended for these piles.

We shall be pleased to discuss any points that may arise after your review of this report.

Yours very truly,

W. Trow

WAT/gc
Enc.

William A. Trow, P.Eng.

WILLIAM A. TROW AND ASSOCIATES LTD.

DEPARTMENT OF HIGHWAYS OF ONTARIO
MATERIALS AND RESEARCH DIVISION
PARLIAMENT BUILDINGS, TORONTO, ONT.

FOUNDATION INVESTIGATION
BRIDGE REPLACEMENT
HWY. 2, OVER WOOD CREEK

Project: J755

William A. Trow & Associates Ltd.

October, 1961

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FOUNDATION INVESTIGATION
BRIDGE REPLACEMENT
HWY. 2, OVER WOOD CREEK

Project

Realignment of and improvements to Highway 2 in this general area incorporate the replacement of the existing bridge over Wood Creek.

The proposed 30 foot span structure will be located approximately 40 feet upstream of the existing bridge. Additional embankment fill to a height of about 7 feet above water level will be required on the north side of the west approach in order to bring the road to the level of existing Hwy. No. 2.

This report presents the results of the recently completed field investigation and discusses the foundation requirements.

Site Description

At this site Wood Creek is a sluggish stream between 90 and 130 feet wide. Considerable swamp growth of reeds and rushes extends for some distance from each bank.

At the bridge site, however, the west approaches have been extended into the stream bed towards the bridge for a distance of about 80 feet. According to D.H.O. probings immediately upstream and downstream of this embankment fill, stiff clay is located about 4 feet below water level.

The ground on both banks is in pasture with isolated groups of trees. The very flat surface topography is indicative of a lake bed or marine deposit.

Water level in the creek remained relatively constant during the investigation at El 151.7 feet.

The existing bridge is reported to be about 40 years old.

Soil Types Encountered

Two borings were put down at this site on diagonal corners of the proposed bridge in the positions shown in drawing 1. Dynamic cones were driven beside each boring, and on a third corner of the proposed structure. The results of these borings are shown in the borehole logs and presented as drawings 2 to 4 of this report. The relevant data from the logs is summarized in the estimated stratigraphical profile on drawing 1.

Reference to these drawings shows that the site is underlain by about 33 feet of stiff to medium stiff fissured marine clay. Above a depth of about 13 feet or El 139 feet, the clay becomes progressively stiffer and more desiccated. Below this level, vane tests showed the clay to possess a strength between 900 and 1000 psf. In boring 2 on the west approach, clay was encountered at El 147.6 feet under about 10 feet of embankment fill. Stiff clay in the bottom of the creek bed is indicated on D.H.O. Plan E-4002-1 at slightly higher levels immediately adjacent to the embankment.

An inconsistency with the results of these borings is revealed by cone 3, which high resistance indicates the clay to be much stiffer than quoted above. Since refusal on wood was encountered on an adjacent test, this high resistance may be the result of some wood being carried down with the cone point.

Below the clay, a medium dense to very dense sandy silt gravel till was encountered at El 120 feet. After about 4 to 7 feet penetration into this stratum, a high concentration of cobbles and boulders was encountered. A slight artesian pressure was encountered in this stratum in borehole 1.

Borehole 1 was continued through this stratum in an effort to determine bedrock level. However, in view of the slow drilling progress through the boulders and the improbability that piles would penetrate far into this stratum, the boring was terminated at El 80 feet in this material. The maximum size of boulder cored was 6 feet, below El 112.1.

Laboratory testing of these foundation soils was not considered necessary. In particular, tests on the marine clay would have served no useful purpose, since vane tests had indicated that it was too weak to economically support the weight of the proposed structure.

Discussion of Foundation Requirements

The choice of the most suitable type of bridge support, represents the only foundation problem at this site. Embankment stability is more than adequate for the present proposals.

If spread footings were adopted for this project, they would be located about 4 feet below creek bed level or about El 144 feet. According to the vane test results, the safe net bearing value of the medium stiff marine clay at and below this level is about 2000 psf. Since this pressure is too low for design purposes, and since excavation difficulties will be experienced in digging 8 feet below the water level, this foundation proposal is not considered to be practical.

The alternative of end-bearing untreated Class B timber piles driven to refusal in the underlying gravel till is recommended. Timber piles should encounter refusal at depths between El 113 feet and El 117 feet. Refusal

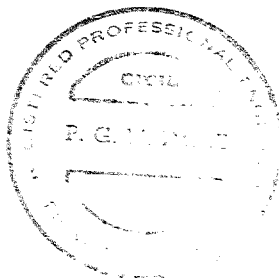
should be designated as 8 blows per inch penetration under a driving energy of 8750 ft.lbs. per blow. A design capacity of 15 tons per pile is recommended. This conservative figure is chosen in case individual piles should partially bear on the side of a boulder. Steel H piles are not recommended since refusal depths in the gravel till are most difficult to predict, and the piles may be damaged and distorted by the boulders.

Since the marine clay must have endured consolidating pressures of at least 3000 psf to 4000 psf in order to develop an undrained shear strength of 1000 psf approximately, the imposition of a maximum height of fill of 11 feet should merely cause a slight recompression of this material. Accordingly, no stability problem exists and the deep seated settlement movements should be well within tolerable limits. It will be necessary, however, to remove the rushes and organic material covering the creek bed floor in the path of this embankment.

Conclusions and Recommendations

- 1) A deposit of medium stiff marine clay, up to 33 feet in depth, underlies the site. Vane shear tests show the average strength to be about 1000 psf. A stratum of medium dense to dense sandy silt gravel till, below the clay at El 120 feet, extends for the full depth of the borings. The till contains a high concentration of cobbles and boulders up to 6 feet in size. Bedrock was not encountered.
- 2) The clay is too weak for the economic support of the bridge on spread footings.
- 3) The use of timber piles, driven to refusal in the lower stratum of gravel till, is recommended. A safe capacity of 15 tons per pile should be available.
- 4) There is no embankment stability problem. However, minor settlements can be anticipated under the west approaches.

PGMI/gc
J755
Oct., 1961



P.G.M. Imrie
Peter G.M. Imrie, P.Eng.

APPENDIX A

The two borings at this site were put down utilizing two conventional diamond drills equipped for soil sampling. Progress through the gravel till was very slow, and was achieved by alternately drilling ahead with AX core barrel, and AX or BX casing as necessary. Dynamic cones were driven as indicated in the report.

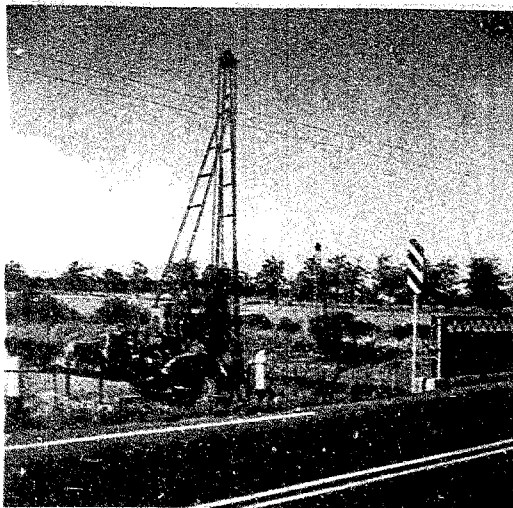
Disturbed samples of the various soil strata were obtained by driving a standard 2 inch outside diameter split spoon sampler into the soil ahead of the boring. The number of 350 ft.lb. hammer blows required to extend the penetration of the split spoon from 6 inches to 18 inches was recorded as the penetration resistance of the soil. Upon recovery, the samples were inspected, and retained in moisture proof plastic bags.

Undisturbed samples of the clay deposit were obtained by pressing a 2-inch inside diameter shelly tube sampler into the soil ahead of the boring. Upon recovery, the tubes were sealed with low melting point wax for transportation to the laboratory.

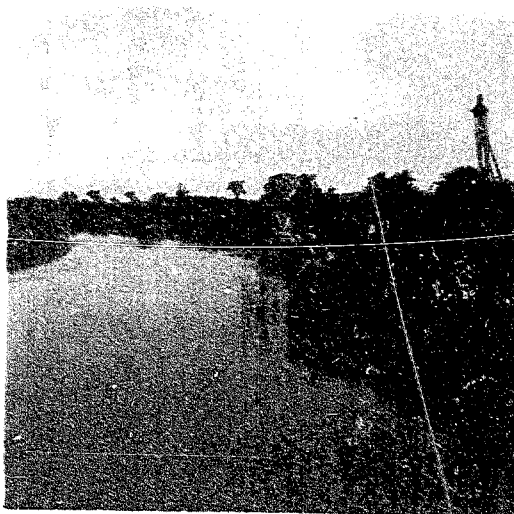
In-situ shear strength measurements were made using a 2-1/8 inch diameter vane. The vane was carefully inserted 15 inches into the soil ahead of the boring, and a test performed. On completion of this test, the vane was rotated six complete turns, and the remoulded strengths of the soil measured.

In view of the relatively straightforward soil conditions encountered, laboratory testing of the recovered samples was considered unnecessary.

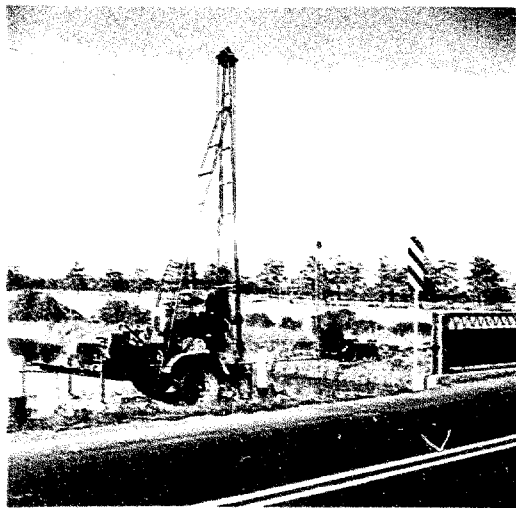
The elevation of the borings was referred to a bench mark of El 154.79 feet, about 190 feet northeast of the bridge.



View looking Northeast
Foreground drill on BH 2
Background drill on BH 1



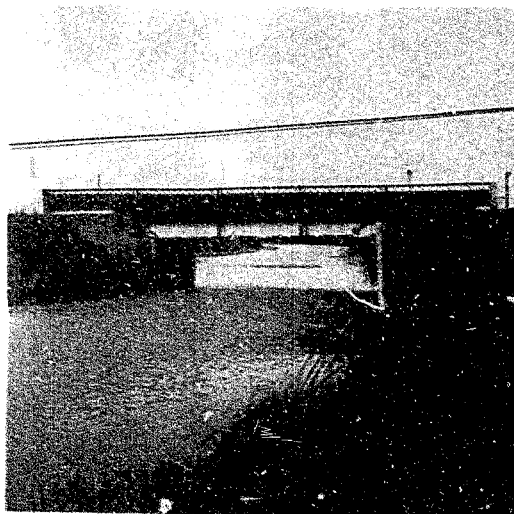
View looking North - (Upstream)
Drill on BH 1



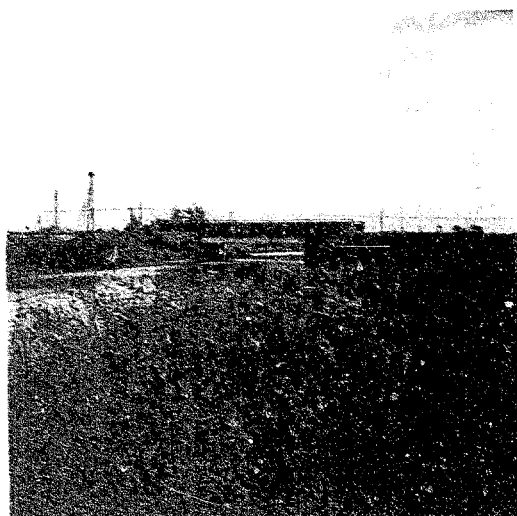
View looking Northeast
Foreground drill on BH 1
Background drill on BH 2



View looking North (Upstream)
Drill on BH 1



View looking North (Upstream)



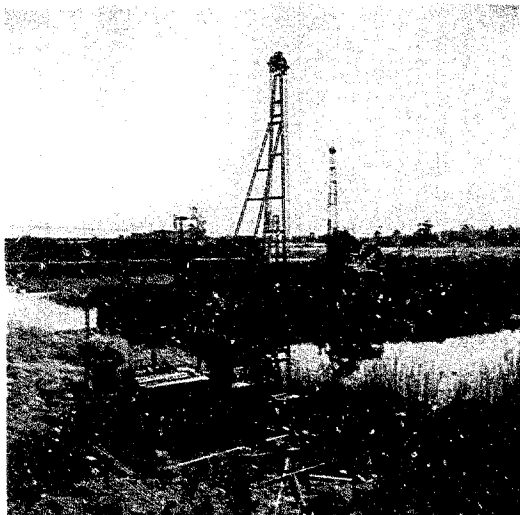
View looking South (Downstream)



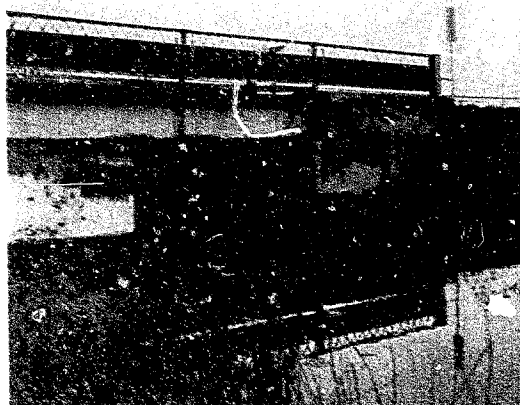
View looking North (Upstream)



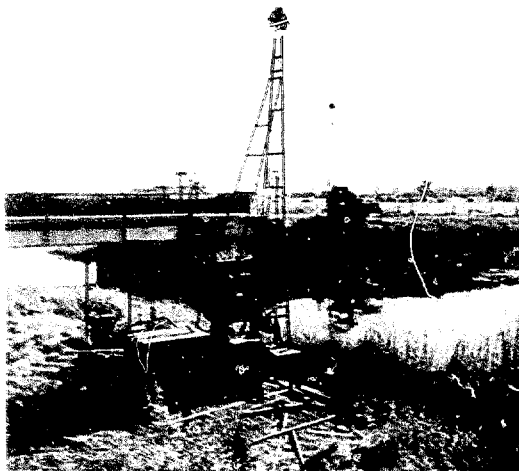
View looking South (Downstream)



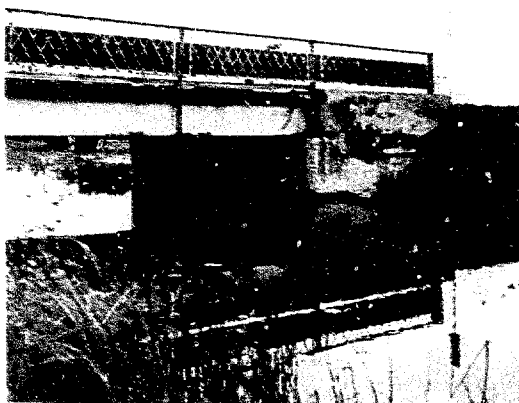
View looking Southwest
Foreground drill on BH 1
Background drill on BH 2



View looking Southwest



View looking Southwest
Foreground drill on BH 1
Background drill on BH 2



View looking Southwest

REL. PLAN
Scale 1" = 1 mile

Proposed Structure

Flow

WOOD CREEK

BH1

BH2

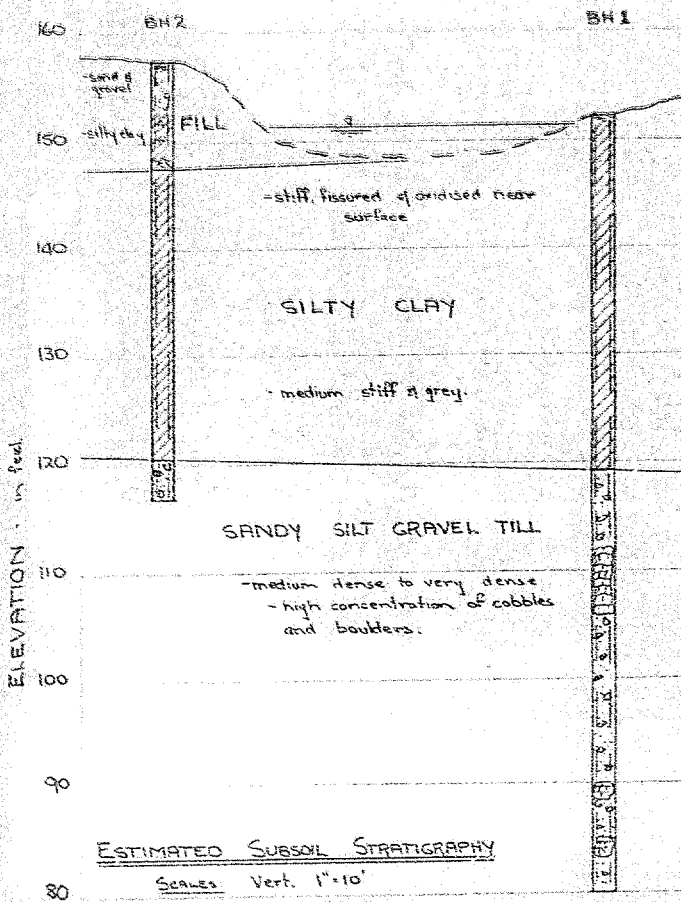
Proposed Revision, Lane C

BOREHOLE LOCATION PLAN.

Scale: 1" = 20'

(Overlay Plan E-4552-1)

BENCHMARK - Top of
S.C.M. No. 99. 43 ft. left
of Sta. 412 + 19.
EL. 154.79



ESTIMATED SUBSOIL STRATIGRAPHY

Scales Vert. 1" = 10'
Horr. 1" = 20'

FOUNDATION INVESTIGATION

BRIDGE REPLACEMENT

HWY. 2 OVER WOOD CREEK


WILLIAM A. TROW & ASSOCIATES
INC.


J755


DWG. 1

LEGEND


PENETRATION RESISTANCE


2 OD SPLIT TUBE 


2 ID SHELBY TUBE 

2 DIA CONE 

SHEAR STRENGTH

UNDRAINED TRIAXIAL, AT OVERBURDEN PRESSURE 

UNCONFINED COMPRESSION 

VANE TEST AND SENSITIVITY (S_i) 

NATURAL MOISTURE CONTENT
AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT


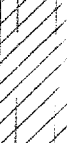
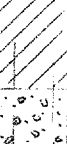

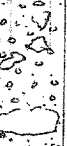
PLASTIC LIMIT

SAMPLE TYPE

2 O.D. SPLIT TUBE

1 I.D. SHELBY TUBE

3 O.D. SHELBY TUBE

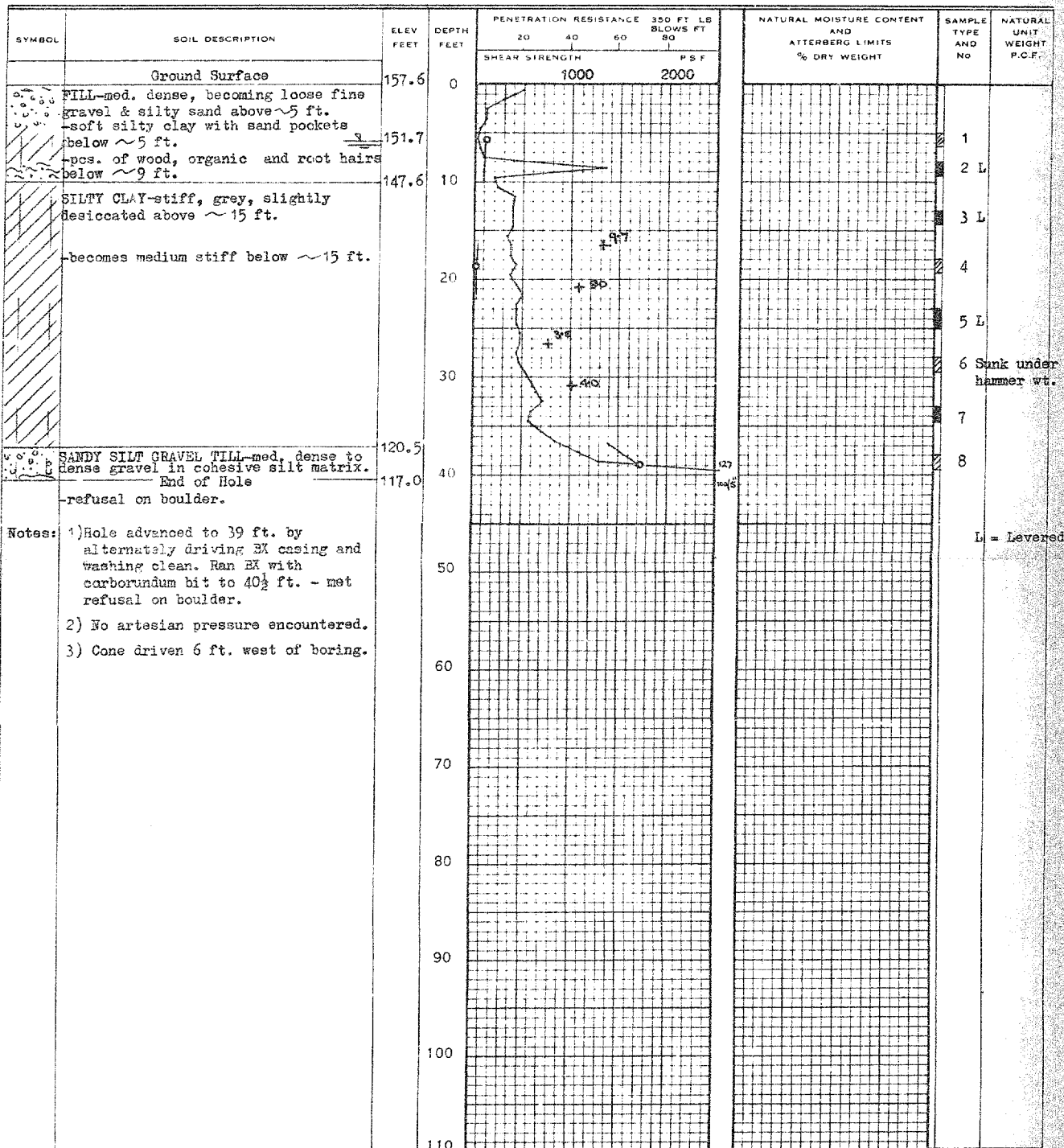
SYMBOL	SOIL DESCRIPTION	ELEV FEET	DEPTH FEET	PENETRATION RESISTANCE		350 FT. LB BLOWS FT 80	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND NO	NATURAL UNIT WEIGHT P.C.F.
				20	40				
	Ground Surface	152.1	0	1000		2000			
	SILTY CLAY	151.7	0					1 D	
	-very stiff to stiff, desiccated above ~13 ft.							2 L=10"	
	-root hairs above ~4 ft.							D= 8"	
	-oxidized brownish grey to ~8 ft., grey below 8 ft.		10					3 L	
		139						4 L	
	-medium stiff grey silty clay		20					5 Sank under wt. hammer.	
								6	
	-very occasional fine gravel sizes noted at ~28 ft.		30					7	
	SANDY SILT GRAVEL TILL-medium dense to very dense fine to coarse gravel in slightly plastic sandy silt matrix.	119.1						8	
	6 ft. boulder, limestone shale, about 60% recovery.	112.1	40					9	
		106.7						10	
	-fine to coarse angular gravel and numerous boulders in sandy silt matrix		50					11 To	
	-more sandy at ~56 ft.							12 recovery	
	-16 in. boulder below 62 ft.		60					13	
	-20 in. boulder below 67 ft.		70						
	End of Hole	80.0						D= Driven L= Levered	
Notes:	1) Hole advanced to 40 ft. by alternately driving EX casing and washing clean. Hole continued to 58 ft. by running EX casing or AX core barrel as necessary to progress through boulder. Hole continued to 72 ft. by running AX casing or AX core barrel as necessary.		80						
	2) Slight artesian flow at 39 ft., about 1 g.p.m. Rose to El. 153.4 in casing.		90						
	3) Cone put down 8 ft. East of boring.		100						
			110						

LEGEND

BOREHOLE NO. 2
 PROJECT Bridge Replacement,
Woods Creek, Lancaster, Ont.
 LOCATION See Dwg. 1.
 HOLE LOCATION See Dwg. 1.
 HOLE ELEVATION 157.6 ft.
 DATUM See Dwg. 1.


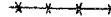

PENETRATION RESISTANCE
 2" O.D. SPLIT TUBE
 2" I.D. SHELBY TUBE
 2" DIA. CONE
 SHEAR STRENGTH
 UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE
 UNCONFINED COMPRESSION
 VANE TEST AND SENSITIVITY ϕ, ψ

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX X, LI
 ATTERBERG LIMITS
 LIQUID LIMIT
 PLASTIC LIMIT
 SAMPLE TYPE
 2" O.D. SPLIT TUBE
 2" I.D. SHELBY TUBE
 3" O.D. SHELBY TUBE







BOREHOLE No. 3 (Cone)
 PROJECT Bridge Replacement, Hwy. 2.
 LOCATION Wood Creek, Lancaster, Ont.
 HOLE LOCATION See Dwg. 1.
 HOLE ELEVATION 157.4 ft.
 CATUM See Dwg. 1.

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE 
 2" I.D. SHELBY TUBE 
 2" DIA. CONE 

SHEAR STRENGTH




UNDRAINED TRIAXIAL
 AT OVERBURDEN PRESSURE 
 UNCONFINED COMPRESSION 
 VANE TEST AND SENSITIVITY (S)  ^s

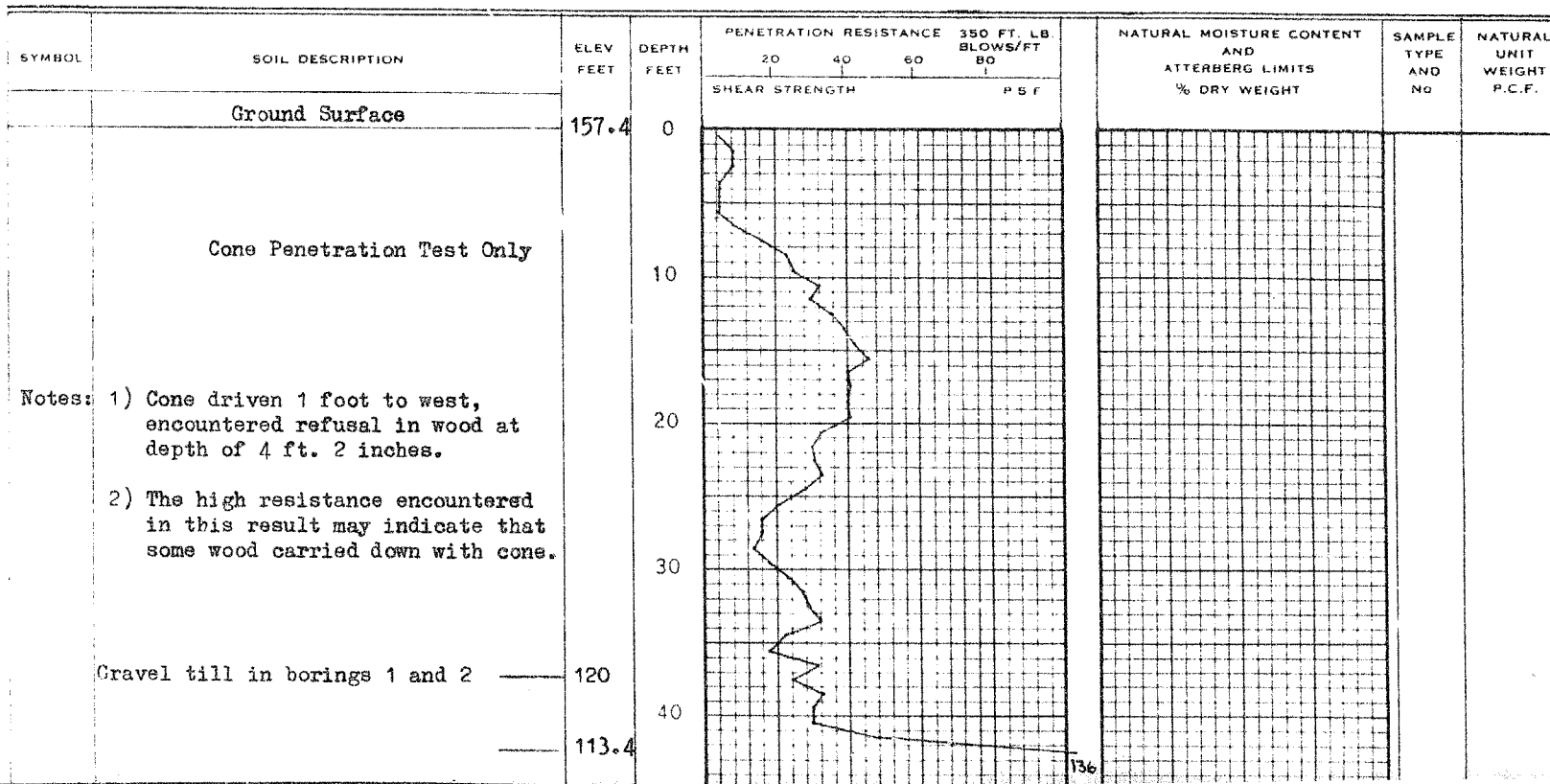
NATURAL MOISTURE CONTENT
 AND LIQUIDITY INDEX 

ATTERBERG LIMITS

LIQUID LIMIT 
 PLASTIC LIMIT 

SAMPLE TYPE

2" O.D. SPLIT TUBE 
 2" I.D. SHELBY TUBE 
 3" O.D. SHELBY TUBE 



Mr. A. M. Teye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)

Attention: Mr. S. McCombie.

November 8, 1961.

FOUNDATION INVESTIGATION REPORT

By: W.A. Troy & Associates, Ltd.

Re: W.P. 94-61,
Wood Creek Crossing,
Hwy. #2, near Quebec Bay.
District #9.

We have reviewed the Consultants' report for the above structure, and are of the opinion that sufficient information is contained for your future design work in connection with this project.

If further information is required, please feel free to contact our Office.

X03/XdeP

Attach.

cc: Messrs. A. M. Teye (2)
H. A. Freganekes
H. D. McMillan
J. Ford
L. E. Walker
J. E. Graspier
T. A. Kovich
J. Roy
E. E. Saint
F. Norman
A. Watt
Foundations Office ✓
Gen. Files.

A. G. Sternac,
PRINCIPAL FOUNDATION ENGR.
Per:

K. G. Selby

(K. G. Selby,
SR. PROJECT FOUNDATION ENGR.)

Bridge Division,
February 5, 1962.

MEMORANDUM TO:

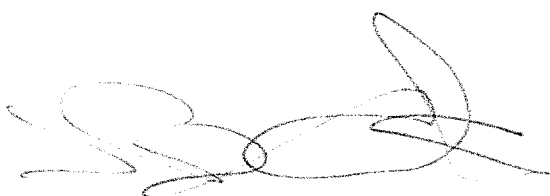
Mr. A. G. Stermac,
Principal Foundation Engineer,
Department of Highways,
Room 107,
Downsview, Ontario.

Ken
Feb 6. 1962
MB

RE: W.P. 94-61
Hwy. 2 at Wood Creek
1.3 Miles west of Quebec Bdry.
District 9

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

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



JBC/et

J. B. Curtis,
Bridge Location Engineer.

cc. D. Smith

61-F-213-C

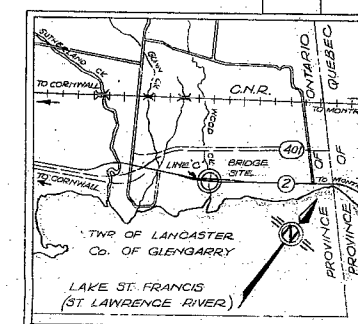
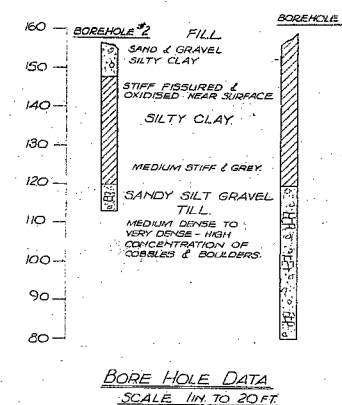
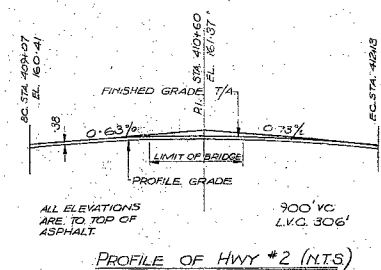
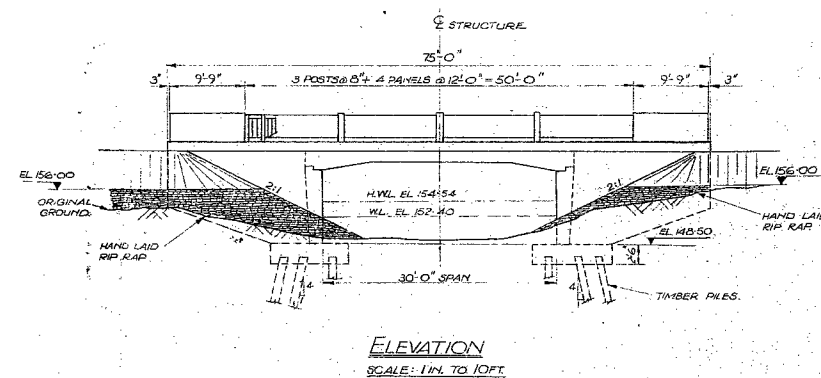
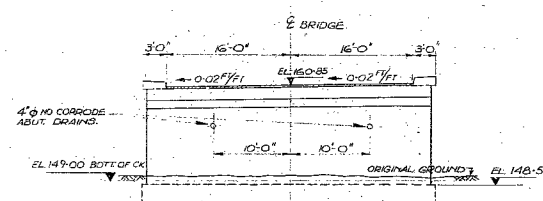
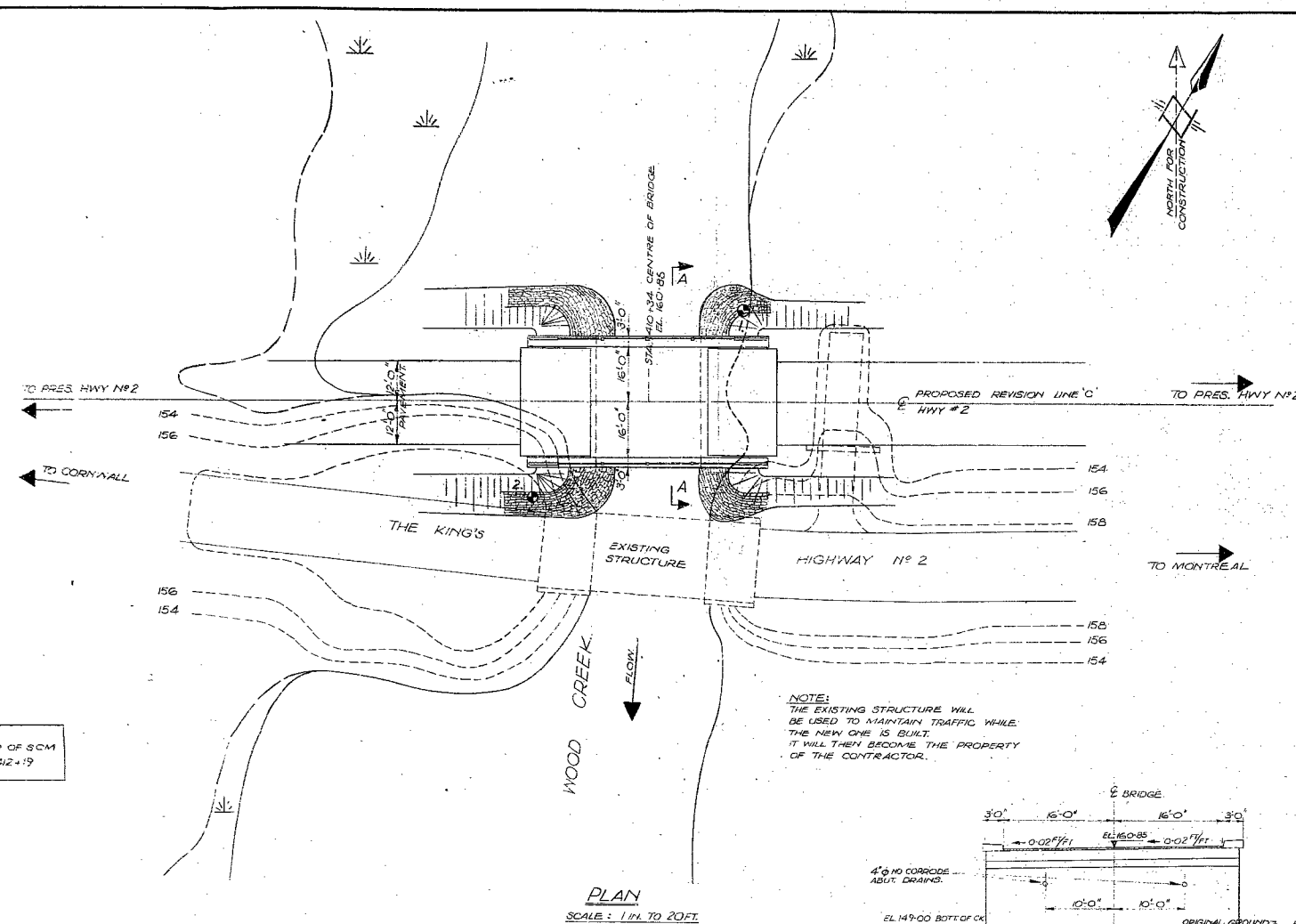
W.P. # 94-61

HWY. # 2

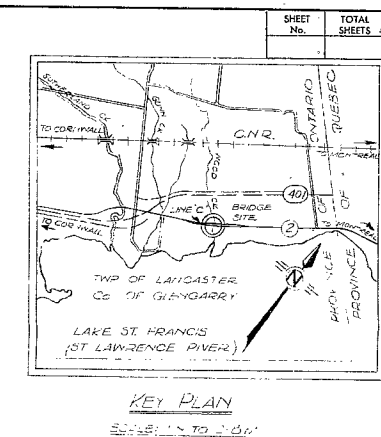
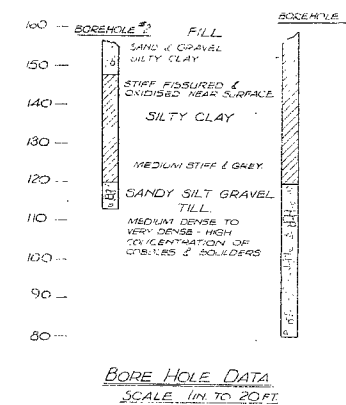
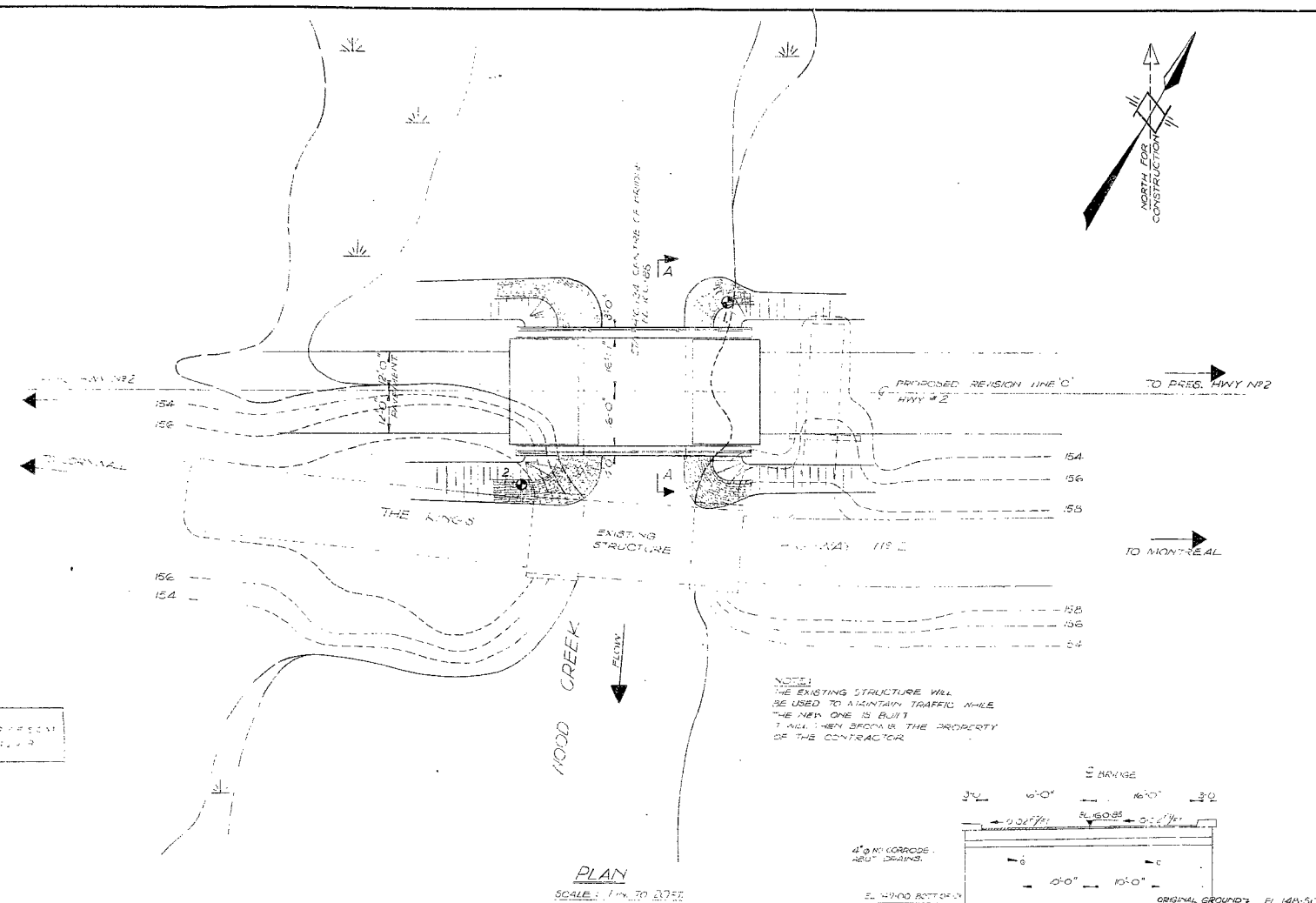
WOOD CREEK

CROSSING, NEAR

QUEBEC BDY.

[illegible][illegible]

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
<u>WOOD CREEK BRIDGE</u> (13M. WEST OF QUEBEC BDRY.)			
KING'S HIGHWAY No. 2 _____		DIST. No. 9 _____	
CO. GLENGARRY _____			
TWP. LANCASTER _____		LOT 6 _____ CON. I _____	
<u>PRELIMINARY PLAN.</u>			



NOTES:
1. TO DISTRICT ENGINEER
CONCRETE WORK ON THIS STRUCTURE MUST NOT BE COMMENCED UNTIL MONUMENTS
TO FIX CONTROL POINTS HAVE BEEN ERECTED AND CHECKED BY THE DISTRICT ENGINEER
2. TO CONTRACTOR
STRUCTURE IS TO BE BUILT IN ACCORDANCE WITH FORMS AND THE SPECIAL
PROVISIONS IN THE COPIES OF WHICH MAY BE OBTAINED FROM THE DISTRICT ENGINEER
CONCRETE MIX

APPROVED ADMIXTURES SUPPLIED BY THE CONTRACTOR WILL BE ADDED TO ALL CONCRETE AS SPECIFIED BY THE ENGINEER.

BORING DATA
THE COMPLETE SOIL INVESTIGATION REPORT (BATH) MAY BE EXAMINED AT THE
BRIDGE OFFICE, DOWNVIEW. THE DEPARTMENT DOES NOT GUARANTEE THE ACCURACY
OF THIS REPORT OR THE ABBRIDGED VERSION SHOWN ON THESE PLANS.

CLEAR OVER/ON REINFORCING STEEL
ROOTINGS ABUTMENTS DECK HANDRAILS

CONSTRUCTION NOTES

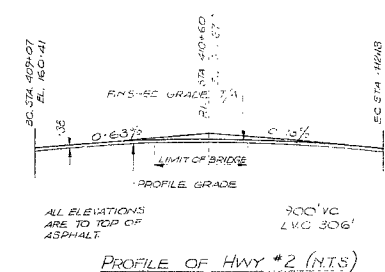
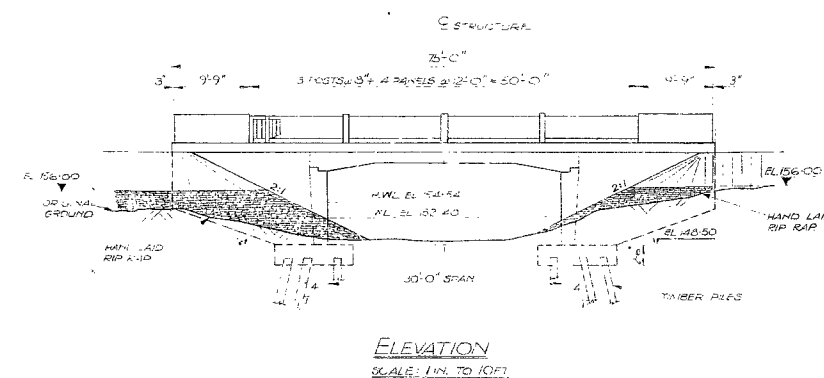
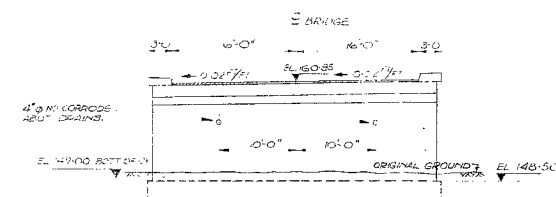
ALL EXPOSED EDGES TO BE CHAMFERED 1"1" EXCEPT AS NOTED.

ALL CONNECTION JOINTS MUST BE APPROVED BY THE BRIDGE ENGINEER.

THE GENERAL CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BRIDGE SEALS DEAD-LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF PLUS OR MINUS 1/8 INCH. IF THEY ARE CAST TOO HIGH THEY SHALL BE BROUGHT DOWN BY THE GENERAL CONTRACTOR. IF THEY ARE CAST TOO LOW THE GENERAL CONTRACTOR SHALL PROVIDE FULL BEARING SHIMS TO BRING THEM UP TO THE CORRECT ELEVATION. THE USE OF GROUT IS PROHIBITED.

THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT THE FINAL DECK ELEVATIONS CONFORM WITH THE ELEVATIONS SHOWN.

NO CONCRETE SHALL BE PLACED ABOVE BRIDGE SEAL UNTIL CONCRETE IN DECK HAS BEEN PLACED.

[illegible]

<div style="text-align: center;"> <u>DEPARTMENT OF HIGHWAYS ONTARIO</u> <u>BRIDGE DIVISION</u> </div>									
<u>WOOD CREEK BRIDGE</u> (341' WEST OF QUEBEC BCK.)									
KING'S HIGHWAY No. <u>2</u>					DIST. No. <u>9</u>				
CO. <u>SURVEYOR</u>									
TWP. <u>ANASTAS</u>					LOT <u>6</u>		CON. <u>E</u>		
<u>PRELIMINARY PLAN.</u>									
APPROVED _____ BRIDGE ENGINEER					SITE No. _____		W.P. No. <u>22-61</u>		
DESIGN	<u>D.G.</u>	CHECK			CONTRACT				
DRAWING	<u>J.R.</u>	CHECK			No.				
DATE	<u>APR 1961</u>	LOADING	<u>H.C. S/G</u>		DRAWING	<u>DC 996</u>	<u>-P</u>		