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G.I.-30 SEPT. 1976

GEOCRES No. 31G-119

W.P. No. _____

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W. O. No. _____

STR. SITE No. 3-124

HWY. No. _____

LOCATION BR. OVER JOCK RIV.
AT 5TH CONC. LINE RD.,
NEPEAN TWP.

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS: _____

DA 1973

31G-119
GEOCRES No.

REPORT
ON
FOUNDATION INVESTIGATION
BRIDGE OVER JOCK RIVER
AT 5TH CONCESSION LINE ROAD
TOWNSHIP OF NEPEAN

STRUCTURE SITE No. <u>3-124</u>

Submitted by
T. O. Lazarides and Associates Limited,
Foundation Division
Federated Consultants Building,
209 Davenport Road, Toronto 5, Ontario.

July 15, 1959.

Copy No. 2

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
2.0 SUMMARY AND CONCLUSIONS	1
3.0 DESCRIPTION OF SITE	1
4.0 DRILLING PROGRAMME	2
5.0 SOIL PROFILE DESCRIPTION	3
6.0 FOUNDATION CONDITIONS	4
6.1 Spread Footing Foundation	4
6.2 Pile Foundation	4

APPENDIX

Location of Boreholes	Figure 1
Profile on Road Centerline	Figure 2
Borehole Logs	Figures 3 and 4

1.0 INTRODUCTION

The purpose of the investigation described in this report is to establish foundation design factors for the proposed Jock River Bridge structure and the embankment approaches to the bridge. Authorization for the above investigation is contained in a letter dated June 18, 1959, enclosing copy of a resolution by the Township of Nepean Council.

2.0 SUMMARY AND CONCLUSIONS

The site investigation was completed on June 25, 1959. Two boreholes were put down as part of the site investigation.

The upper layers of the subsoil consist of medium dense to loose silty deposits containing some sand at the location of Borehole No. 1. Underlying these deposits there is a thin layer of glacial till followed by a strata of undetermined thickness of boulders closely packed with gravel, sand and silt. Boreholes were terminated in this strata.

The foundation conditions at the site indicate that a piled foundation will provide the most satisfactory and economical solution for both the north and south abutments. Piles may be driven to a pile tip elevation between +73 and +60 in the boulder packed strata. The presence of boulders at any particular pile location will determine the final driven depth. Artesian pressure occurs in the permeable deposits below elevation +80 at Borehole No. 2 and precautions will be required by the foundation contractor in this connection as discussed in Section 6.0 FOUNDATION CONDITIONS.

3.0 DESCRIPTION OF SITE

The proposed bridge is intended to replace an existing steel through truss bridge at the 5th Concession Line Road crossing of the Jock River in the Township of Nepean. The road is aligned approximately north northwest and the Jock River flows in a direction almost perpendicular to the road at the bridge site. Approximately 800 feet upstream a single track railroad bridge crosses the river.

The river at the site is from 140 feet to 170 feet wide. The surrounding land through which the river runs is hilly. Immediately

north of the river, these hills are small but south of the river they rise to a height of approximately 70 to 90 feet above the river.

Datum for the elevation of strata and topographical features was established at a Topographical Survey Bench Mark on the west side of the south abutment of the existing bridge at elevation +100.0. The exact elevation of this B.M. (B.M. No. 21 Nr C 59) is not yet available as the surveying in which it is to be incorporated is not completed.

During the period of the site investigation, the water surface was at an elevation of +85.0 and the maximum depth of the river underneath the existing bridge was only 1.3 feet. Upstream and downstream of the existing bridge the river depth is 4 to 5 feet. The shallow water underneath the bridge is due to the fact that in replacing the bridge deck, approximately five years ago, the old bridge deck was dropped onto the bottom of the river. At the south bank the ground surface rises at a moderate slope, approximately 1:20. On the west side of the existing road this slope is steeper than on the east side. The ground surface at the north bank rises at an almost vertical slope to elevation +91.5. From this point the slopes are less than 1:50. The hills to the south side of the bridge are very gravelly and sand rich. A number of gravel pits are located on top of the hills, some of them more than 50 feet deep. The profile in the pits indicated glacial-fluvial deposits with layers of from fine sand to coarse sand to gravel and stones.

On Figure 2, Appendix I, is shown the location of the railroad in relation to the river and the elevations of top of bridge deck, top of rail and the maximum dip of road centerline on each side of bridge and track.

Information obtained locally seems to indicate a high water level around elevation + 94.5 \pm 1.0 feet. This has not been checked with the local Conservation Authority.

4.0 DRILLING PROGRAMME

Two (2) boreholes were drilled at the site between June 23 and June 25, 1959, under the continuous supervision of a soils engineer. The location of the boreholes is shown on Figure 1, Appendix I. The boreholes were drilled with a wash boring drilling rig and were 3" in diameter. Borehole No. 1 was drilled to a depth

of 24.0 feet (elevation +67.9), while Borehole No. 2 was taken down to a depth of 25.0 feet (elevation +61.6). The last 9 feet in Borehole No. 1 and 8 feet in Borehole No. 2 had to be drilled by rotating a diamond bit inside a core barrel. This procedure was necessary due to extremely closely packed large boulders. Further penetration was made impossible due to blocking of the core barrel.

A classification of the different strata, as well as the elevation of the strata limits and samples is shown on the borehole logs, Figures 2 and 4 in Appendix I.

Sixteen (16) samples were taken, all of which were disturbed. The water contents were determined on the silt rich samples. The majority of the disturbed samples were taken in connection with the standard penetration test.

The results of laboratory tests and standard penetration tests are shown on the borehole logs.

5.0 SOIL PROFILE DESCRIPTION

Both boreholes were terminated in a layer of fairly large boulders closely packed and surrounded with gravel, sand and silt. It was reported that boreholes drilled three miles further downstream at Jockville indicated a layer more than 60 feet thick of a similar nature.

In Borehole No. 1 the layer of boulders was encountered at elevation +76.9 and there is a sedimented layer about 4 feet thick of medium dense to dense grey glacial till having a high lime content. Above this layer, from elevation +80.9 to elevation +84.9 there is a 4 feet thick layer of loose dark grey silty sand with shells and organic matter. Overlaying this silty sand there is a 6 feet strata of medium to coarse silt with some fine sand, the bottom of which is grey and loose while the top stratum is weathered and medium dense. The surficial 1 foot layer is medium stiff topsoil.

Borehole No. 2 shows that the surface of the layers of boulders is at elevation +69.3 which is 7.5 feet below the same surface found in Borehole No. 1. Overlaying the strata of boulders there is approximately 1 foot of loose glacial till followed by a 7.5 feet thick layer of sedimented medium to fine sand, the density of which appears to be loose to medium dense. Above this sand layer,

from elevation +77.6 to 80.1, there is a 2.5 feet thick layer of loose grey glacial till. From elevation +80.1 to elevation +82.1 occurs a layer of reworked grey glacial till. The top 4.5 feet is soft topsoil and loose silt with organic matter. Although the sampling indicated that all layers above the boulders were loose, the layers in their natural undisturbed stage may have been dense. The disturbance was due to the following. After sample No. 3 was taken the water rose inside the casing and overflowed out at the top. This was due to artesian pressure in the granular layers caused by the proximity of the gravelly hills south of the bridge. The water flow out of the casing brought the material below the casing shoe to a "boiling" stage, thereby loosening the material and reducing its density. By extending the casing upward the water was found to stand at a height of 5.0 feet above the ground surface, at which height the water started running outside the casing where there was less headloss. An artesian pressure of more than 5.0 feet waterhead is therefore present in the permeable soil layers at depths below elevation +80.0 approximately.

6.0 FOUNDATION CONDITIONS

6.1 Spread Footing Foundation

The subsurface strata provide good foundation conditions but due to the fact that artesian pressure occurs in the permeable layers below elevation +80, a spread footing foundation will not be a safe solution. Although the soils in these strata may be kept undisturbed, at their original density during construction, by means of a groundwater lowering system, the artesian pressure would cause the soil layers to "boil" around the footing after construction is complete and pumping stopped. This would wash out some of the soil particles underneath the footing which may lead to failure of the whole structure or undesirable settlements. Unless spread footings are carried down to the interface elevation at the surface of the layer of boulders, a spread footing foundation is not recommended.

6.2 Pile Foundation

A pile foundation is, however, feasible and economical. By using point bearing piles to carry the load down to the layer of boulders below elevation +74 on the north side and +69 on the south side, a satisfactory foundation may be obtained. It would be an advantage to use steel piles which could be cut to the

required length or welded with an extension, as an exact prediction of pile length at any particular location is not possible. Piles will be driven to a depth varying between elevation +73 and +60 at the tip. It is possible that piles may be driven to penetrate to a greater depth where the artesian water flow is large and the size of boulders comparatively small.

In order to be able to cast the pile cap in dry, if the base of the cap is located below elevation +85, a local groundwater lowering is recommended. Sump pumping in the excavation for the pile cap will be satisfactory and will not lead to appreciable "boiling" if the excavation is not deeper than elevation +84. For excavations to greater depth for the pile cap construction in the dry, well-pointing for local groundwater lowering will be essential. The possibility of an increase in the water elevation of the river after a heavy rainfall should be taken into consideration in the design of the cofferdam if the pile cap is to be cast in the "dry".

If an open abutment treatment is contemplated, precautions should be taken against the occurrence of boulders in the embankment approach fill in order to ensure the successful driving of piles.

Hydrological data obtained locally seems to indicate that any appreciable decrease of the flow opening under the bridge would not be advisable. Severe flooding already occurs upstream at the present time and the backwater curve resulting from any additional restriction of the channel may aggravate these conditions.

T. O. LAZARIDES AND ASSOCIATES LIMITED



R. W. Smith
Associate

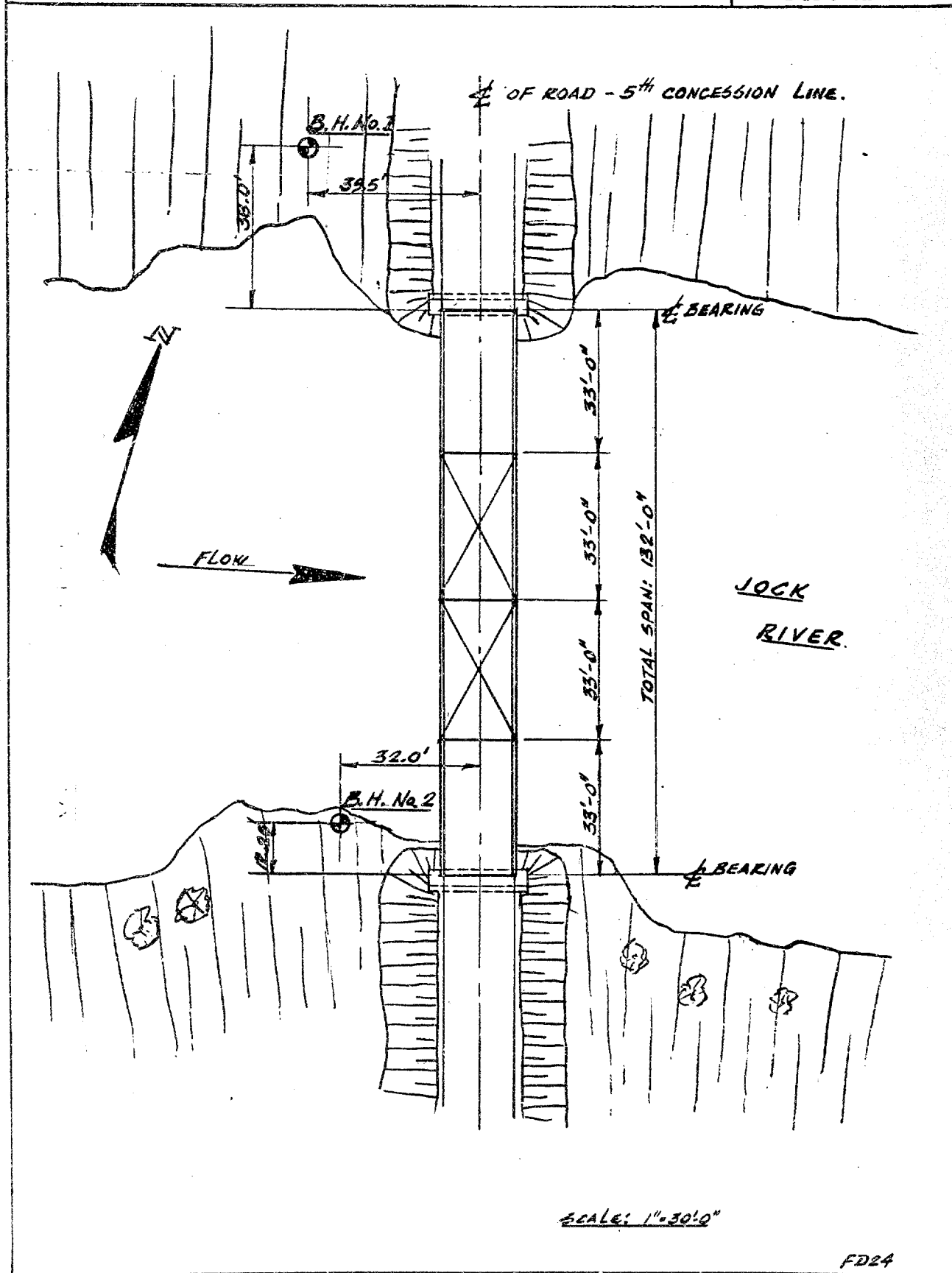


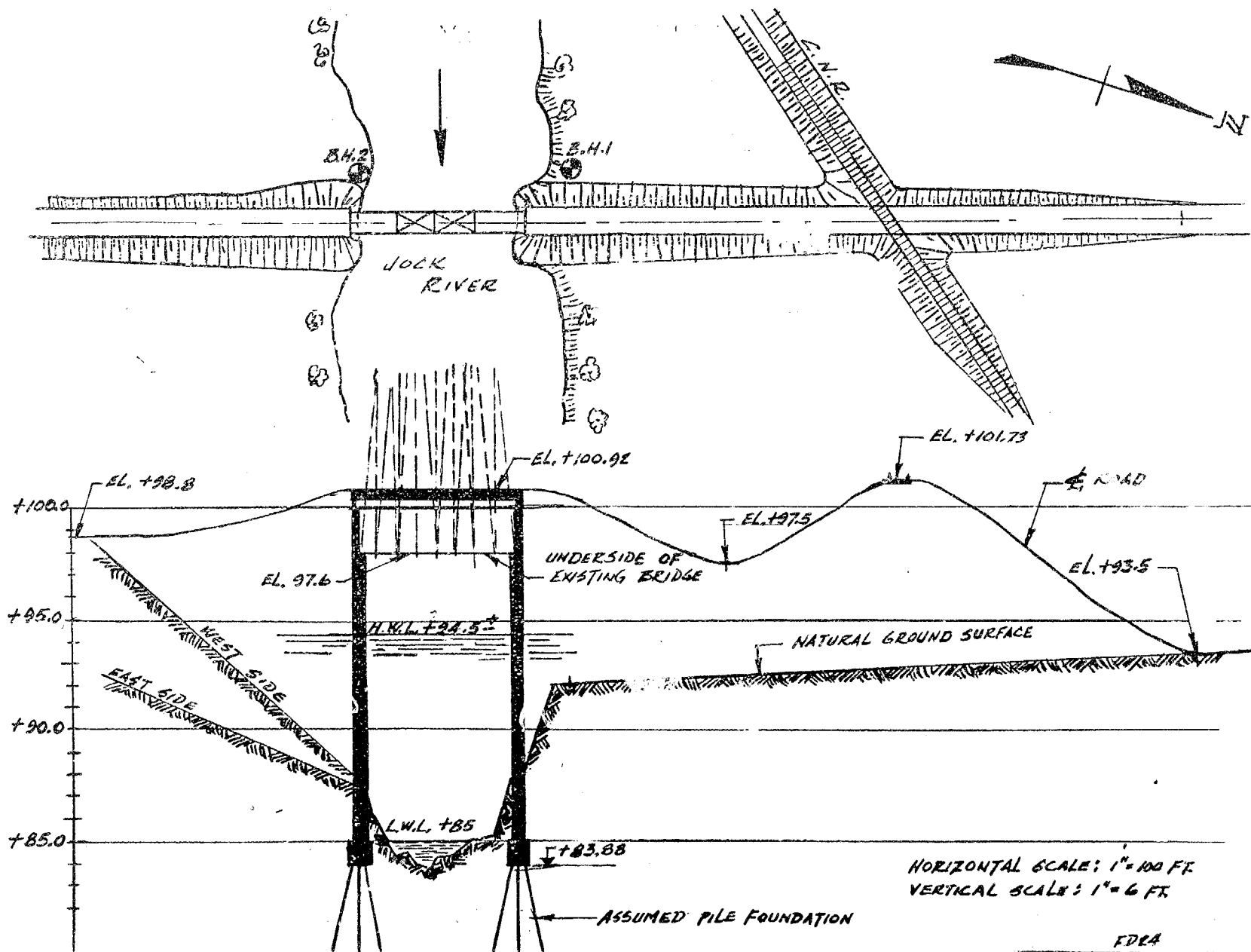
APPENDIX I

LOCATION OF BOREHOLES

APPENDIX I

FIGURE 1





T.O. LAZARIDES AND ASSOCIATES LIMITED

FOUNDATION DIVISION

FEDERATED CONSULTANTS BUILDING - 209 DAVENPORT ROAD, TORONTO 5, ONTARIO.

CLIENT: TOWNSHIP OF NEPEAN, ONTARIO.

BOREHOLE LOCATION: SEE FIGURE 1

PROJECT: JOCK RIVER BRIDGE

SURFACE ELEV: +91.9 BORING DATE: 23/6/59

FIELD SUPERVISION: N.S. COMPILED: N.S.

LOCATION: 5th CONCESSION LINE

JOB NO: FD24

DATE: JULY 3, 1959.

BOREHOLE NO. 1

LEGEND:

WN - NATURAL WATER CONTENT. WL - W

WPL - PLASTIC LIMIT. - S

WLL - LIQUID LIMIT. - L

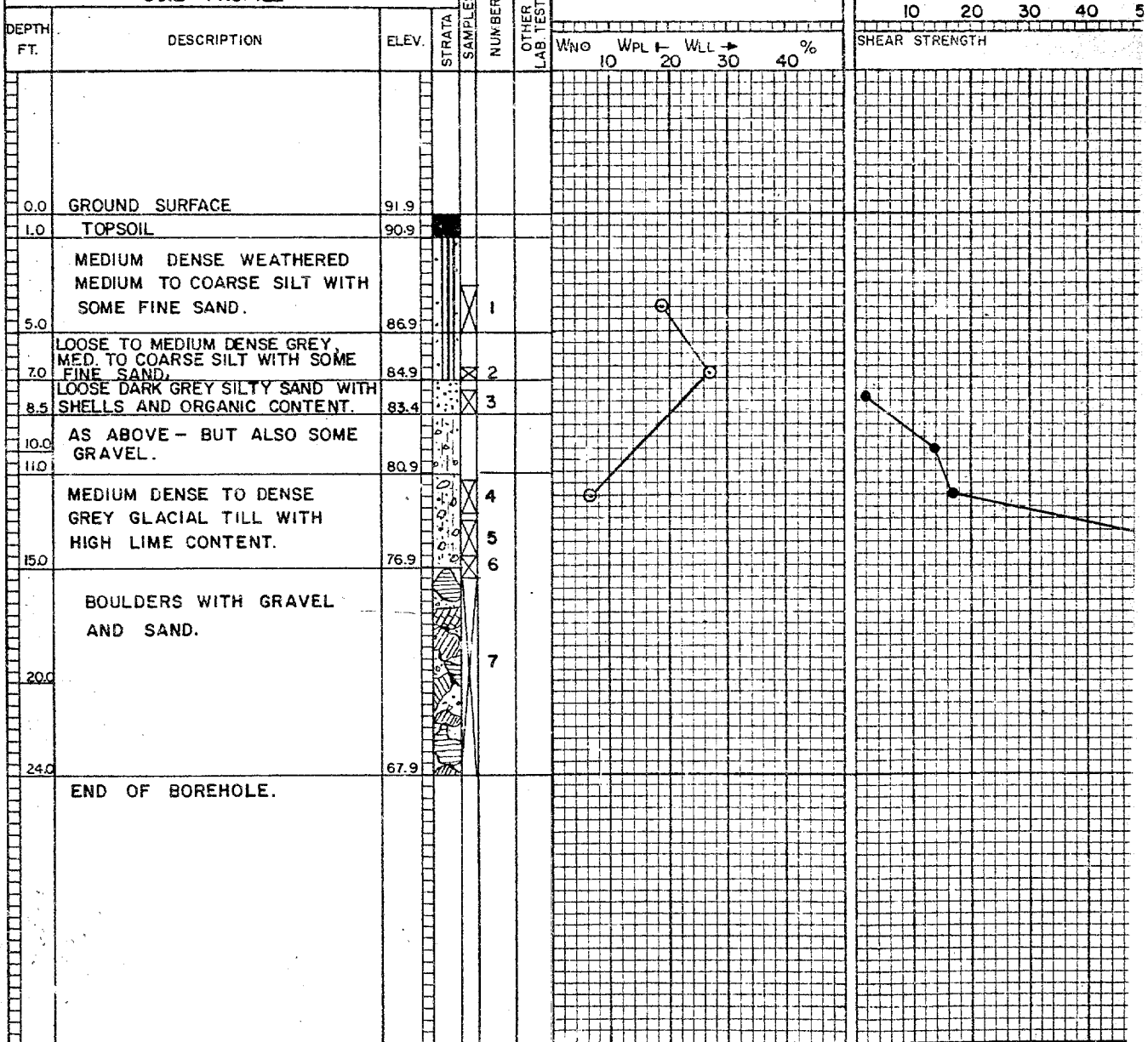
⊕ - INSITU VANE SHEAR STRENGTH AND SENSITIVITY. - C

○ - 1/2 UNCONFINED COMPRESSION.

SOIL PROFILE

FIELD UNIT WEIGHT & P.C.F

STD. PENETRATION: BLOWS / FT.



T.O. LAZARIDES AND ASSOCIATES LIMITED

FOUNDATION DIVISION

ED CONSULTANTS BUILDING - 209 DAVENPORT ROAD, TORONTO 5, ONTARIO.

SHIP OF NEPEAN, ONTARIO.

CK RIVER BRIDGE.

CONCESSION LINE

BOREHOLE LOCATION: SEE FIGURE 1

SURFACE ELEV: +91.9 BORING DATE: 23/6/59

FIELD SUPERVISION: N.S. COMPILED: N.S.

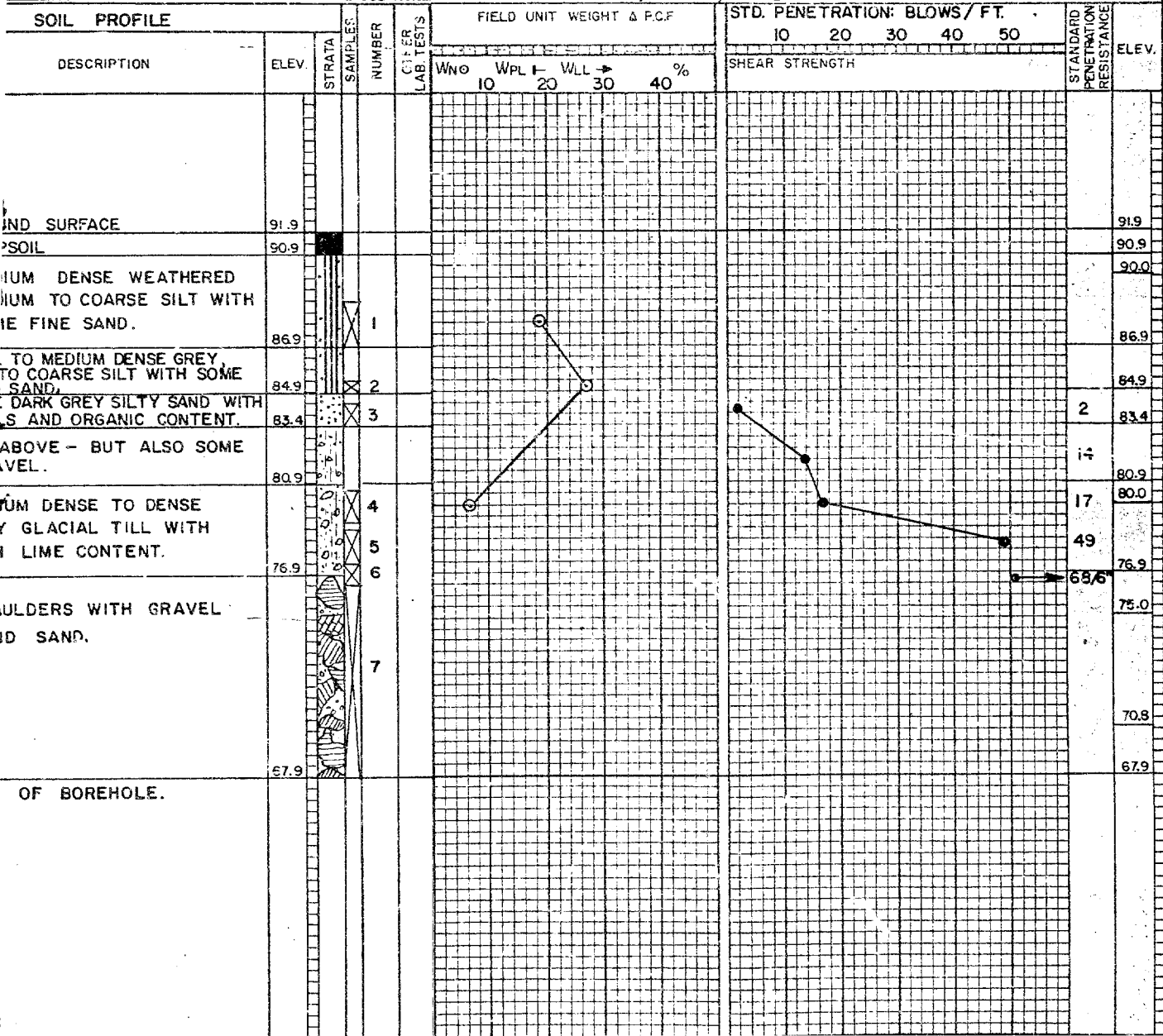
JOB NO: FD24 DATE: JULY 3, 1959.

BOREHOLE NO. 1

APPENDIX
FIGURE 3

LEGEND:

- WN - NATURAL WATER CONTENT. WL - WATER LEVEL.
- WPL - PLASTIC LIMIT. ● - STD. PENETRATION RESISTANCE.
- WLL - LIQUID LIMIT. ○ - INSITU VANE SHEAR STRENGTH AND SENSITIVITY.
- ⊗ - UNDISTURBED SAMPLE. ⊠ - DISTURBED SAMPLE.
- - 1/2 UNCONFINED COMPRESSION



T.O. LAZARIDES AND ASSOCIATES LIMITED

FOUNDATION DIVISION

ED CONSULTANTS BUILDING - 209 DAVENPORT ROAD, TORONTO 5, ONTARIO.

SHIP OF NEPEAN, ONTARIO.

BOREHOLE LOCATION: SEE FIGURE 1

CK RIVER BRIDGE

SURFACE ELEV: 86.6 BORING DATE: 24/6/59.

FIELD SUPERVISION: N.S. COMPILED: N.S.

CONCESSION LINE

JOB NO. FD24 DATE JULY 3, 1959.

BOREHOLE NO. 2

APPENDIX
FIGURE 4

LEGEND:

- WN - NATURAL WATER CONTENT. WL - WATER LEVEL.
 WPL - ELASTIC LIMIT. * - STD. PENETRATION
 WLL - LIQUID LIMIT. RESISTANCE.
 ⊕ - INSITU VANE SHEAR. ⊗ - UNDISTURBED SAMPLE.
 STRENGTH AND SENSITIVITY. ⊗ - DISTURBED SAMPLE.
 ○ - UNCONFINED COMPRESSION.

SOIL PROFILE

FIELD UNIT WEIGHT & PCF

STD. PENETRATION BLOWS / FT.

10 20 30 40 50

SHEAR STRENGTH

STANDARD
PENETRATION
RESISTANCE

ELEV.

DESCRIPTION

ELEV.

STRATA

SAMPLES

NUMBER

OTHER
LAB TESTS

WNO

WPL

WLL

W

30

40

%

ND SURFACE

86.6

TOPSOIL AND MUD

82.1

GREY SILT WITH SAND
GRAVEL (REWORKED TILL)

80.1

GREY GLACIAL TILL.
PENED BY ARTESIAN PRESSURE.

77.6

SE TO MEDIUM DENSE
M TO FINE SAND
PENED BY ARTESIAN
SSURE.

70.1

GLACIAL TILL.

69.3

LDERS GRAVEL
SAND.

61.6

OF BOREHOLE.

86.6

85.0

82.1

80.1

77.6

4

22

26

70.1

60/3"

65.0

61.6