

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31G5-130

W.P. No. \_\_\_\_\_

CONT. No. \_\_\_\_\_

W. O. No. \_\_\_\_\_

STR. SITE No. \_\_\_\_\_

HWY. No. 16

LOCATION JOCK RIV.,  
NEPEAN TWP.

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

NONE

REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



ONTARIO  
DEPARTMENT OF HIGHWAYS

BA 899

3165-130
GOCRES No.

**Memo to** Mr. S. McCombie, **Date** May 28, 1959.  
Bridge Planning Engineer. **Subject** \_\_\_\_\_  
**From** Materials & Research Section.

Re: Racey, MacCallum and Associates'  
Soil Investigation for Proposed  
New Bridge over Jock River, Hwy.16,  
Twp. of Nepean, District of Carleton,  
Ontario.

Enclosed herewith are two copies of a report submitted recently by Racey, Macallum on the above noted structure site.

Your attention is drawn to the fact that the subsoil consists of loose to medium dense sand with gravel and boulders. Bedrock was proven at Elevations 221.0 and 230.0 feet. In view of the loose condition of the upper stratum of sand and gravel, spread footings are not recommended. A pile foundation should be used. The pile type will depend upon economics. Large capacity Franki caissons founded at a depth of 20 to 25 feet below the existing ground surface should be given consideration. If "H" piles are to be used, they will have to be driven to the underlying bedrock stratum.

*L. G. Soderman*

LGS/MdeF  
Encls. (2)

L. G. Soderman,  
PRINCIPAL SOILS & FOUNDATION ENGINEER.

RACEY, MacCALLUM AND ASSOCIATES  
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers  
AND ASSOCIATED STAFF

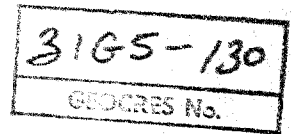
MONTREAL  VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.ENG., M.E.I.C., P.ENG.

H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

GEORGE L. HOUGHTON, A.M.I.MECH.E., M.E.I.C., P.ENG.



TORONTO DIVISION  
27 CARLTON STREET  
Toronto 2.

Reference: S-500/T-1683.

8 May, 1959.

The Department of Highways of Ontario,  
Foundation Section,  
Downsview Avenue,  
DOWNSVIEW - Ontario.

Attention: Mr. L. Soderman.

RE: SOIL INVESTIGATION FOR PROPOSED NEW  
BRIDGE OVER JOCK RIVER, HIGHWAY #16,  
TWP. OF WEPAN, DISTRICT OF CARLETON,  
ONTARIO.


Dear Sir,

The enclosed report presents the results of our soil  
investigation at the above location.

We hope the report is satisfactory to you; if you  
have any questions about it please do not hesitate to get in touch  
with us.

Thank you for this opportunity of being of service to  
you.

Yours very truly,  
RACEY, MacCALLUM AND ASSOCIATES LIMITED,

  
J. J. Schoustra, P.Eng.,  
Divisional Soil Engineer.

JJS:YDP

The Department of Highways of Ontario,  
Foundation Section,  
Downsview Avenue,  
Downsview, Ont.

SOIL INVESTIGATION FOR PROPOSED NEW  
BRIDGE OVER JOCK RIVER, HIGHWAY #16,  
TWP. OF NEPEAN, DISTRICT OF CARLTON,  
ONTARIO.

Reference: S-500/T-1683.

Racey, MacCallum and Associates  
Limited,

8 May, 1959.

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TORONTO DIVISION  
27 CARLTON STREET

Toronto 2.

Reference: S-500/T-1683  
- Report -

8 May, 1959.

## SOIL INVESTIGATION FOR PROPOSED NEW BRIDGE OVER JOCK RIVER, HIGHWAY #16, TWP. OF NEPEAN, DISTRICT OF CARLETON, ONTARIO

### INTRODUCTION:

The field investigation to determine the subsoil conditions at the site was carried out from 20 to 29 April, 1959.

This report presents a description of the field investigation and subsequent results, together with recommendations regarding a suitable type of foundation for the proposed bridge.

### SITE GEOLOGY:

A preliminary geological study indicates the area, i.e. the Ottawa - St. Lawrence Lowland, was subjected to quite a variation of geological events.

The features of the Ottawa - St. Lawrence Lowland record a sequence of Precambrian events followed by a very long period of erosion; a series of Palaeozoic deposits later subjected to faulting; a second, long period of erosion; glaciation; a last invasion and withdrawal of the sea; and subsequent erosion to present time.

Within the lowland region for the most part all of the Palaeozoic bedrock is covered by recent sediments of glacial till, late marine deposits and lacustrine and fluvial muds and sands, mainly in a loose, unconsolidated state.

The bedrock in the immediate vicinity of the site is a dolomite and limestone (Oxford formation).

Reference: S-500/T-1683

6 May, 1959

FIELD INVESTIGATION:

The borings were carried out using a standard diamond-drilling rig equipped for sampling with a 2" O.D. Split Spoon. Adjacent to each borehole a 60° point angle cone was driven into the ground using the standard 140 lb. hammer at a 30" drop. This dynamic penetration test was carried out for the purpose of obtaining a continuous record of the state of density of the soil.

In addition, a few cone tests were attempted at locations Nos. 3 and 4 but proved unsuccessful. At No. 3, the maximum depth reached was 15', whereas at No. 4 the maximum was 11'. It might be noted here in all the cone tests gravel and/or boulders were encountered throughout, as indicated by the hammer bouncing during the driving. Further attempts at these two locations would entail the construction of drilling platforms further down the embankment slopes where in all probability a greater amount of boulders are present. As sufficient information was already obtained from B.H. #1 and 2, any further attempts in such a subsoil were decided against.

Once bedrock was reached, coring was continued for 5 ft. in B.H. No. 1 and 8½ ft. in B.H. No. 2. Core was also obtained of various types and sizes of boulders encountered throughout.

The locations of the boreholes and cone tests are shown on Enclosure No. 1 and the results on Enclosures Nos. 2, 3 and 4.

SUBSOIL CONDITIONS:

Numerous sampling in both boreholes gave the following data:

Underlying the loose embankment fill of gravel-sand-silt-clay, there is a deposit of loose to dense, light gray, fine to medium sand with fine to coarse angular to sub-angular gravel and boulders. The maximum size of boulder encountered was approximately 1½ ft. There is an appreciable amount of limestone rock-flour present throughout the deposit. The soil constituents found in this layer indicate it to be of glacial origin.

Underlying this deposit at approximate Elevation 236 at B.H. No. 2 and 232 at B.H. No. 1, there is a thin stratum 5' to 10' thick of a darker gray fine to medium dense sand. At Borehole No. 2 this stratum overlies the bedrock which is found at approximate Elevation 230, whereas at B.H. No. 1 there is an interrupting pocket and/or lens of fine to coarse, very dense angular gravel overlying the bedrock found at approximate Elevation 221.

The bedrock is a dolomitic limestone interbedded with some very thin seams of white sandstone. In the vicinity of B.H. No. 1 this bedrock is reasonably sound, whereas around B.H. No. 2 it is well-fissured with hairline cracks.

8 May, 1959

Reference: S-500/T-1683SUBSOIL CONDITIONS - Continued

The soil profile as described above appears to conform with the preliminary geological study in all main respects.

WATER CONDITIONS

The river water level as measured on April 21 was 258.3, but was dropping every day to a value of approximately 257.0 by April 28.

A Water Table reading taken in B.H. No. 2 at completion revealed it to be at Elevation 263.5. It might be noted here that while coring through the bedrock the wash water failed to return on reaching an approximate elevation of 223, indicating the presence of seepage cracks or channels in the rock itself. Based on this fact, together with the presence of a pond at a higher elevation on the adjoining property, it would seem reasonable to assume the Water Table in this particular location as following the contours of the land, i.e.: sloping down towards the river level of 257.0. The Water Table elevation, therefore, in the vicinity of the proposed foundations at some distance from the river edge should be in the neighborhood of 260.

FOUNDATIONS

The underlying sand deposit at depths at which a footing type of foundation would be feasible is in a relatively loose state. As a result of the very low bearing capacity of this stratum, such a foundation may be disregarded.

The recommended alternative would be a pile foundation driven to refusal either into the very dense sand layer occurring at approximate elevation 232 at B.H. No. 1 and 236 at B.H. No. 2 or to actual bedrock. Whether it is to be taken down to rock or not depends primarily on the bridge loadings and the economies of the various types and number of piles to be used.

The bearing capacity of foundation piles driven into the sand may be determined from the following empirical equation established by Meyerhof<sup>1</sup>:

$$Q = 4 N A_p + \frac{\bar{N} A_s}{50}$$

where Q is the ultimate bearing capacity of pile in tons  
 N is the standard penetration resistance at pile tip  
 A<sub>p</sub> is the cross-sectional area of pile tip  
 $\bar{N}$  is the standard penetration resistance of layer penetrated by pile  
 A<sub>s</sub> is the area of pile shaft

1 - "Penetration Tests and Bearing Capacity of Soils" - by G. G. Meyerhof, Proceedings of the A.S.C.E., January 1956.

Reference: S-500/T-1683

8 May, 1959.

FOUNDATIONS - Continued

Under the prevailing soil conditions at the site, a complicating factor in the choice of a suitable pile type is the presence of boulders of all sizes. As a result, it is recommended that a type other than thin-walled steel pipe piles or timber piles be used. A possible choice would be a "Franki Displacement Caisson" type of pile. It has the advantage that any boulders encountered that cannot be easily pushed aside may be smashed by the heavy ram acting on the pile tip concrete plug or, in extreme cases, by first smashing the concrete plug and then applying all the impact force directly onto the boulder itself. It is doubtful, however, if concrete end-bearing piles into the dense sand will be more economical to use than steel end-bearing piles seated in bedrock.

Due to the presence of gravel and boulders in the sand deposit, the recorded standard penetration resistance readings are greater than actual. As a result, the lowest values should be used in determining the pile bearing capacity. In the top sand-gravel deposit the average standard penetration value may be taken as 10, whereas in the underlying dense sand stratum a value of 35 to 40 may be used.

It might be mentioned here that, in using the above expression to determine the pile bearing capacity, the second term which allows for the skin-friction portion be modified according to the possible depth of scour. A brief inspection of the river current and river bottom made at the time of the field investigation, however, seems to indicate that the possibility of any detrimental scour occurring under normal conditions would seem to be negligible.

Lateral earth pressures against separate abutment type of structure may be computed as the "active" state for granular backfills. If a rigid frame construction is considered, the "at rest" state should be used.

CONCLUSIONS AND RECOMMENDATIONS

Summarizing the foregoing results and considerations, the following conclusions and recommendations seem warranted:

1. Underlying the loose gravel-sand-silt-clay embankment fill, there is a deposit of approximately 30 ft. thickness of loose to dense sand with fine to coarse angular gravel and boulders throughout. Occurring immediately underneath this deposit at elevation varying from 232 to 236 there is a 5' to 10' thick stratum of slightly darker grey, dense fine sand. The underlying bedrock found at elevation 221 at B.H. No. 1 and 230 at B.H. No. 2 is a grey dolomitic limestone.

2. As the Water Table seems to slope down towards the river, an elevation of approximately 260 may be expected at the location of the proposed foundation, i.e. at a short distance from the river.



Reference: S-500/T-1683

8 May, 1959.

CONCLUSIONS AND RECOMMENDATIONS - Continued

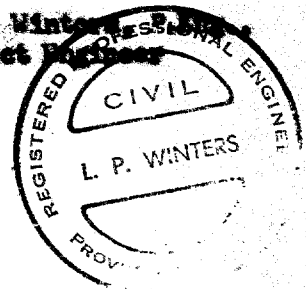
3. The recommended foundation for the proposed bridge is a pile foundation down to the lower dense sand strata or to bedrock depending on the load requirements and economic factors. The recommended type of pile is the "Franki Displacement Caisson."

The bearing capacity of a pile foundation may be determined from Meyerhof's empirical equation quoted above, using an "N" value of 10 for the top sand-gravel deposit, and an "N" value of 35 to 40 for the underlying dense sand stratum. It remains to be seen whether steel end-bearing piles will not be more economical.

4. It is doubtful whether any detrimental scour will occur; however, should previously recorded flow records show to the contrary, allowance for any future scour should be taken into consideration when applying Meyerhof's expression to determine the pile friction load.

LPW:EA

L. P. Winters  
Project Engineer



Prep. By L.P.W.

PLAN - SHOWING LOCATIONS  
OF BOREHOLES FOR PROPOSED

JOCK RIVER BRIDGE.

CONE #3

- SCALE : 1 INCH = 20 FEET
- B.M. TOP OF SOUTH-EAST CORNER  
HEADWALL 280.61

B.H.#1  
CONE#1

JOCK  
RIVER

HWY. # 16  
TO OTTAWA

Flow

B.H.#2

CONE #2

CONE #4

**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1.

Project: **Jock River Bridge,**  
 Location: **Highway #16, Ottawa.**  
 Hole Location: **See Enclosure No.1.**  
 Hole Elevation and Datum: **279.2 ft.**  
 Field Supervisor: **L.P.W.** Prep.: **L.P.W.**  
 Driller: **R.C.** Checked: \_\_\_\_\_ Date: **May 6/59**

**LEGEND**

Shear Strength C

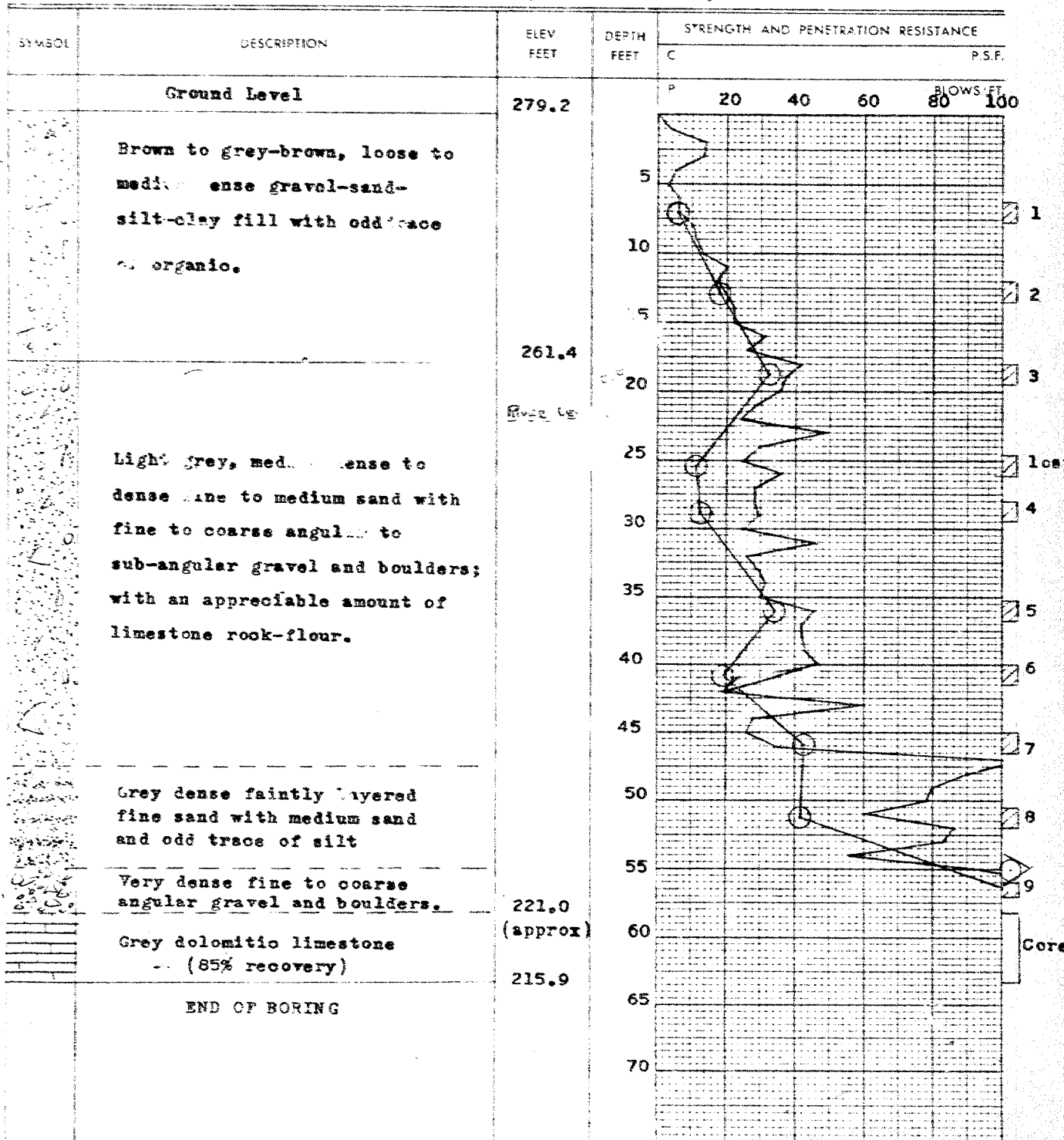
 Unconfined compression  $\Phi$   
 Vane test and sensitivity  $\Phi^s$ 

Penetration Resistance P

2" Split tube

2" Dia. Cone

Casing

 $\Phi$   
+<sup>s</sup>

**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2.

Project: **Jock River Bridge,**  
 Location: **Highway #16, Ottawa.**  
 Hole Location: **See Enclosure No.1.**  
 Hole Elevation and Datum: **271.2 ft.**  
 Field Supervisor: **L.P.W. Prep.: L.P.W.**  
 Driller: **R.C.** Checked: \_\_\_\_\_ Date: \_\_\_\_\_

**LEGEND**

Shear Strength (C)

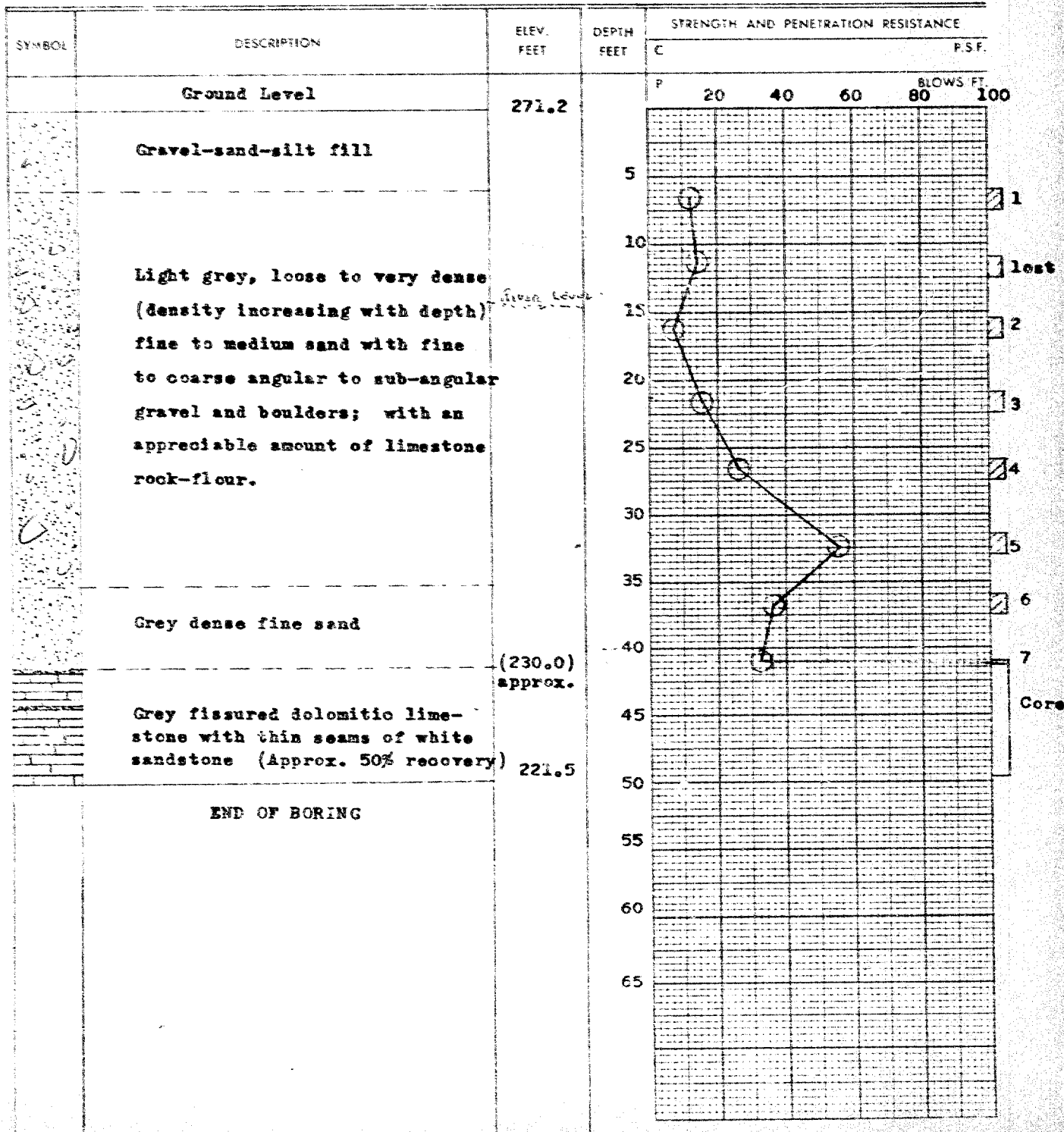
 Unconfined compression  
 Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

⊕  
45⊕  
⊕

**RACEY MacCALLUM AND ASSOCIATES LTD.**

Foundation Engineering Division

Engineering Data Sheet for ~~Project~~ **Cone #2.**

Project: **Jock River Bridge,**  
Location: **Highway #16, Ottawa.**  
Hole Location: **See Enclosure #1.**  
Hole Elevation and Datum: **278.5 ft.**  
Field Supervisor: **L.P.W.** Prep.: **L.P.W.**  
Driller: **R.C.** Checked: \_\_\_\_\_ Date: \_\_\_\_\_

## LEGEND

Shear Strength (C)

Unconfined compression  
Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

⊕  
+\*

⊕ ⊕ ⊕

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