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58-F-254C

Hwy [#] 401

UNDERPASS

BLAND FORD TWP.

BA 788

58-F-254C

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.

A. ERIC RANKINE, B.SC., M.E.I.C., A.M.I.ELEC.E., P.ENG.

TORONTO DIVISION
27 CARLTON STREET
Toronto 2.

Reference: S-500/T-1384.

12 September, 1958.

Department of Highways of Ontario,
280, Davenport Road,
TORONTO - Ontario.

Attention: Mr. J. McAllister.

RE: FOUNDATION INVESTIGATION FOR A
PROPOSED UNDERPASS OF HIGHWAY
NO 401, BLANDFORD TOWNSHIP NO 1,
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 do not hesitate to get in touch with
us.

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

Yours sincerely,
RACEY, MacCALLUM AND ASSOCIATES LIMITED,

Ronald F. Scott.

Ronald F. Scott, P.Eng.,
Divisional Soil Engineer.

RFS:YDP

Department of Highways of Ontario,
280, Davenport Road,
Toronto.

FOUNDATION INVESTIGATION FOR A PROPOSED
UNDERPASS OF HIGHWAY NO 101, BLANDFORD
TOWNSHIP NO 1, ONTARIO.

Reference: S-500/T-1384

Racey, MacCallum and Associates
Limited.

12 September, 1958.

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TORONTO DIVISION
27 CARLTON STREET

Toronto 2.

Reference: S-500/T-1384.

12 September, 1958.

FOUNDATION INVESTIGATION FOR A PROPOSED
UNDERPASS ON HIGHWAY NO. 401, BLANDFORD
TOWNSHIP NO.1, ONTARIO.

This investigation was carried out between 3 and 11 September, 1958, and consisted of four borings with adjacent cone penetration tests to a maximum depth of 58 feet. The report contains a summary of the test results and recommendations regarding the foundations of the proposed structure.

FIELD WORK :

The site is located on the gravel road which forms the road allowance between the Township of Blandford on the West side, and the Township of Blenheim on the East side, approximately 5 miles South of the village of Bright. The ground water table in this area is very close to the surface, and a large section of land surrounding the site for the proposed underpass is occupied by a swamp. The existing gravel road is built on logs. The proposed Highway No 401 will cross under this road at an approximately 45 degree angle with the level of its surface about 4 feet above the present grade of the gravel road. The gravel road will be led over the highway.

At the time of the borings no survey had been carried out by the Department of Highways of Ontario, and the location of the underpass was related to the junction of the gravel road and the road allowance between Concessions IV and V, see Enclosure No 1. Although it was originally planned to locate the borings at the extreme ends of the proposed abutments, approximately 25 feet off the centre of the gravel road, it was decided that drilling close to the edge of the timber road base would be less time-consuming and would still give a representative picture of the soil conditions.

Drilling was carried out using a lightweight type of diamond drill, equipped with EX-size casing, standard 2 inch outside diameter split spoon sampler, and thin-walled 2 inch inside diameter samplers.

Reference: S-500/T-1384
- Continued -

15 September, 1958.

Adjacent to each boring a 2-inch diameter 60 degree point angle cone was driven, using the same driving energy as employed for the split spoon (140 lb hammer at 30 inches drop). This gives a continuous record of the density changes with depth.

Some difficulties were encountered obtaining samples at greater depths. The coarse constituents of the till layer found at that depth tended to clog the casing, and one or two samples of this coarse wash had to be removed before the undisturbed soil could be reached.

BORING RESULTS :

The results of the borings are presented on the Engineering Data Sheets of Borings No's 1 to 4, Enclosures No's 2 to 5. A separate description of the soil conditions at each proposed abutment is given in the following paragraphs.

Under the South abutment, where Borings No's 1 and 4 are located, the soil consists of approximately 18 feet of extremely soft organic muck, underlain by about 15 feet of loose to medium dense layers of silty sand and sandy silt. The organic muck is highly compressible, and its natural moisture content was found to be of the order of 400 per cent. Below this layer, at about 33 feet below the surface, a medium stiff to stiff glacial till was found, consisting of a silty clay to clayey silt with some gravel and pockets of granular soil. The gravel and sand content of this till appears to increase with depth, until at about 50 feet the soil can be described as a coarse sand with fine to coarse gravel. The density of this till layer increases slowly with depth. The cone penetration resistance increases quite sharply, due to the friction on the rods, but the standard penetration resistance shows little increase until at about 53 feet, where coarse granular soil was found in both holes.

Under the North abutment, where Borings No's 2 and 3 were carried out, corresponding soil layers were encountered, but the depths differed somewhat from those met at Boring No 1 and No 4. The soft organic muck only extends to about 10 feet below the surface, under which is found the silty sand and sandy silt deposit and the till layer begins at about 23 feet. At both borings a sharp drop in density was observed in the till layer at 40 - 45 feet. This could be explained by the presence of water under a slight artesian pressure in the granular till at about 45 feet. This became evident in Boring No 2, after it had been left open for one night. It might have caused some softening of the overlying clayey till. The very low standard penetration resistance recorded at Boring No 2 at 31 feet is thought to be caused by washing out the casing to too great a depth before sampling.

RECOMMENDATIONS : /Over -

Reference: S-500/T-1384

15 September, 1958.

- Continued -

RECOMMENDATIONS :

The proposed level of Highway No 401 at the location of the site is 5 - 6 feet above the present level of the swamp on both sides of the gravel road. If the required fill is placed in a systematic manner, it will be possible to displace most of the organic muck and thus eliminate time-consuming consolidation settlements of great extent. The underlying till is not expected to settle appreciably under this fill load.

The approaches of the gravel road to the underpass will be up to 27 feet above the swamp level, which would certainly be sufficient to displace the underlying muck. The till layer may be expected to settle somewhat under this relatively high load, but in view of the high content of granular soil the bulk of these settlements is expected to take place within about 4 months' time. It is not possible to determine the extent of these settlements with any accuracy, but they should not be more than 1 to 6 inches.

For the foundations of the abutments and wing walls the only solution would seem to be piles. They could be driven without difficulty through the organic muck and underlying silty sand into the till layer; from that depth on, penetration would be increasingly difficult because of the pockets of hard silt and coarse granular soil. It is felt, therefore, that piles with a relatively low bearing capacity driven into the till for no more than 5 feet, would be preferable over larger, heavier piles driven to refusal at an undetermined depth that might vary as much as 20 feet under the same abutment.

The properties and constituents of the till layer vary without any regular pattern, and an accurate determination of the pile bearing capacity from strength tests on individual samples would be unrealistic. Therefore, the standard penetration resistance may be considered as accurate a guide as can be obtained at present. An evaluation of the pile bearing capacity can be obtained from the formula :

$$Q = \frac{4 N A}{F S}, \text{ where :}$$

N = Average standard penetration resistance in blows/ft. below the point of the pile.

A = Cross-sectional area of pile end, in square feet.

FS = Factor of safety, taken as 3.0.

Q = Safe bearing capacity of pile in tons.

If the piles are driven into the till to a depth where the standard penetration resistance is 20 blows/ft, the available safe

Reference: S-500/7-1384.

15 September, 1958.

- Continued -

bearing capacity would be 27 tons per square foot of pile tip. This would be a very suitable value for timber piles, which could easily be driven below the ground-water table. Precast concrete piles could also be used.

Steel piles would only be economical if higher loads were involved, i.e. if each pile were driven to refusal at depths probably varying from 40 feet to 60 feet for each abutment.

For the South abutment and wing walls, timber or concrete piles should be driven to a depth of about 45 feet, or Elevation 902 feet, in order to obtain the 27 tsf bearing capacity. For the North part a depth of 25 - 30 feet or Elevation 920 feet would probably be sufficient. It is felt that the decrease in density at about 40 feet under the North section will not affect the bearing properties of the pile group. These same depths may be adhered to for batter piles.

The high approaches of the gravel road to the underpass will cause a large horizontal thrust against the abutments and wing walls. These earth pressures are closely linked with the type of fill embankment to be used for the highway and with the programming of the project. At this stage it can only be mentioned that it is apparent that a considerable number of batter piles will be required.

CONCLUSIONS :

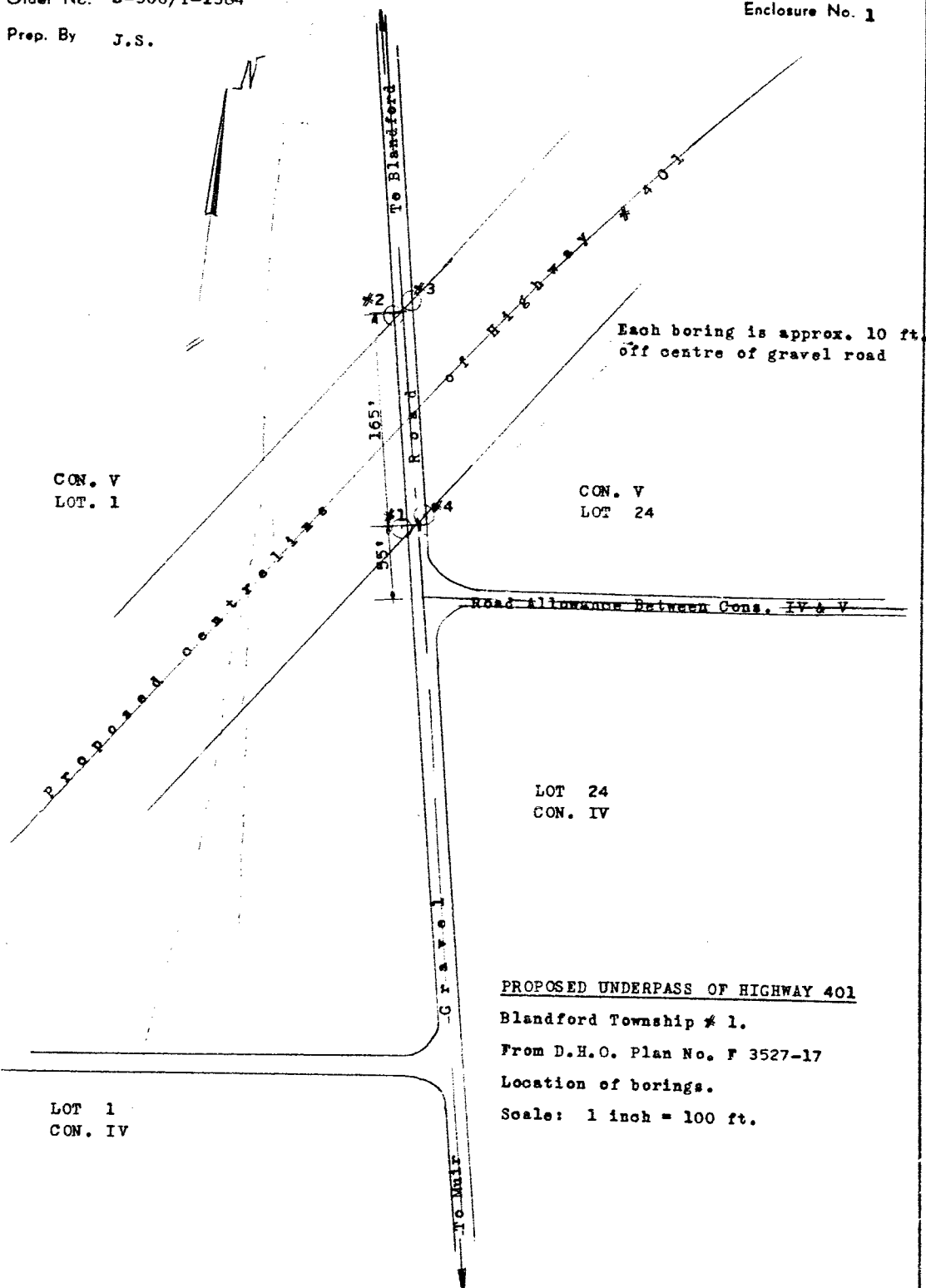
Summarising the results of this investigation, the following conclusions may be drawn :

1. The soil strata encountered at the site are, in succession :
10 - 18 feet of soft organic muck,
12 - 15 feet of silty sand, and
a thick layer of glacial till varying from clayey to sandy.
2. A pile foundation will be required for the proposed structure. Timber or precast concrete piles would be recommended.
3. At the South abutment the recommended pile length will be 45 feet, at the North abutment 27 feet. The safe bearing capacity of piles at these depths will be 27 tons per square foot of cross-sectional area.


J. J. Schoustra, P.Eng.,

JJS:YDP

Prep. By J.S.



RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1

Project: HIGHWAY # 401 UNDERPASS,
 Location: BLANDFORD TOWNSHIP # 1.
 Hole Location: See Enclosure No.1
 Hole Elevation and Datum: 947 Feet. M.S.L.
 Field Supervisor: H.G. Prep.: J.S.
 Driller: F.B. Checked: J.S. Date: 10.9.58

LEGEND

Shear Strength (C)

Unconfined compression

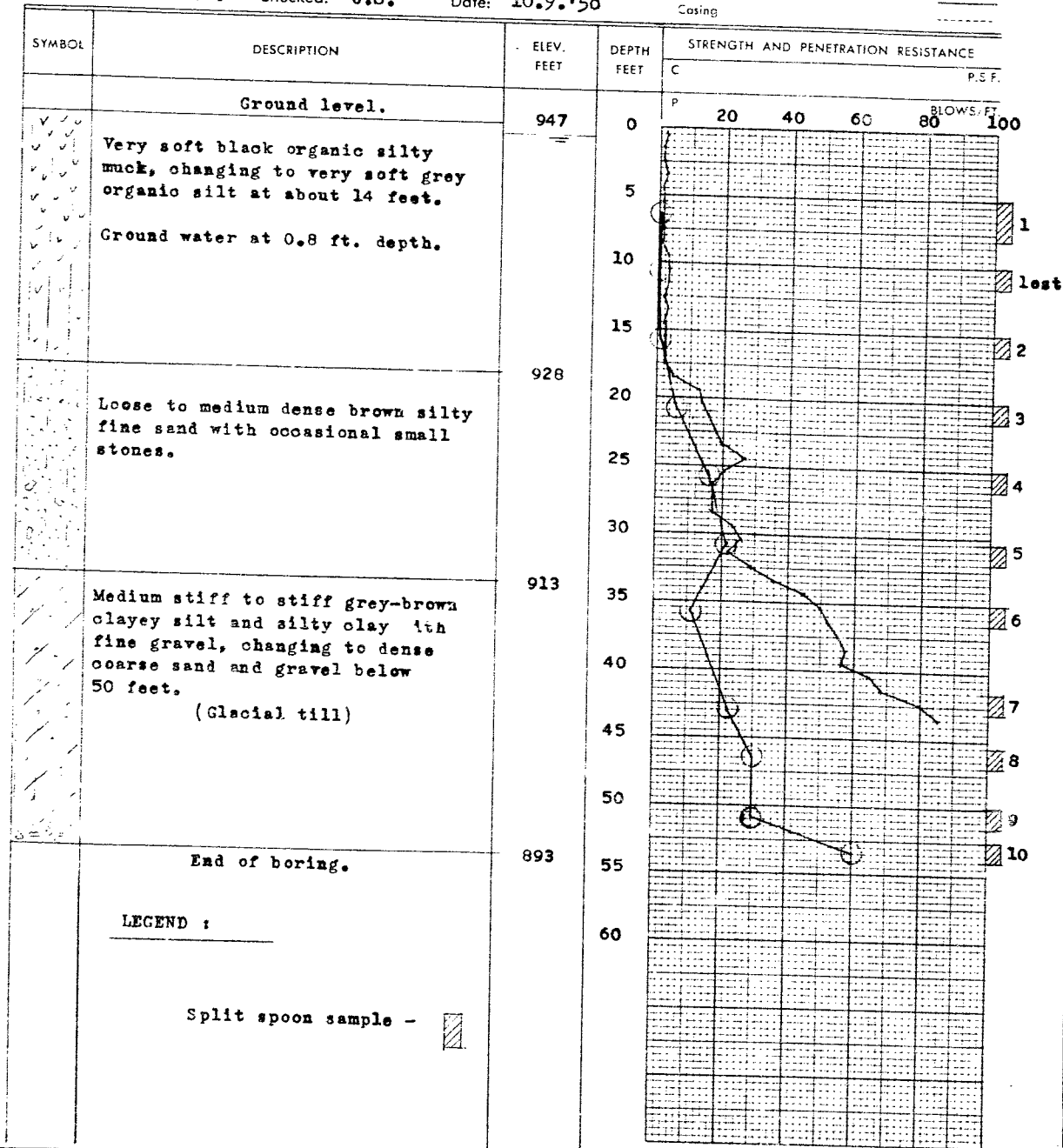
Vane test and sensitivity 'S'

Penetration Resistance 'P'

2" Split tube

2" Dia. Cone

Casing

⊕
45

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

Project: HIGHWAY # 401 UNDERPASS,
 Location: BLANDFORD TOWNSHIP # 1.
 Hole Location: See Enclosure No.1
 Hole Elevation and Datum: 947 Feet. M.S.L.
 Field Supervisor: H.G. Prep.: J.S.
 Driller: F.B. Checked: J.S. Date: 10.9.58

LEGEND

Shear Strength .C

Unconfined compression
Vane test and sensitivity S.

Penetration Resistance IP

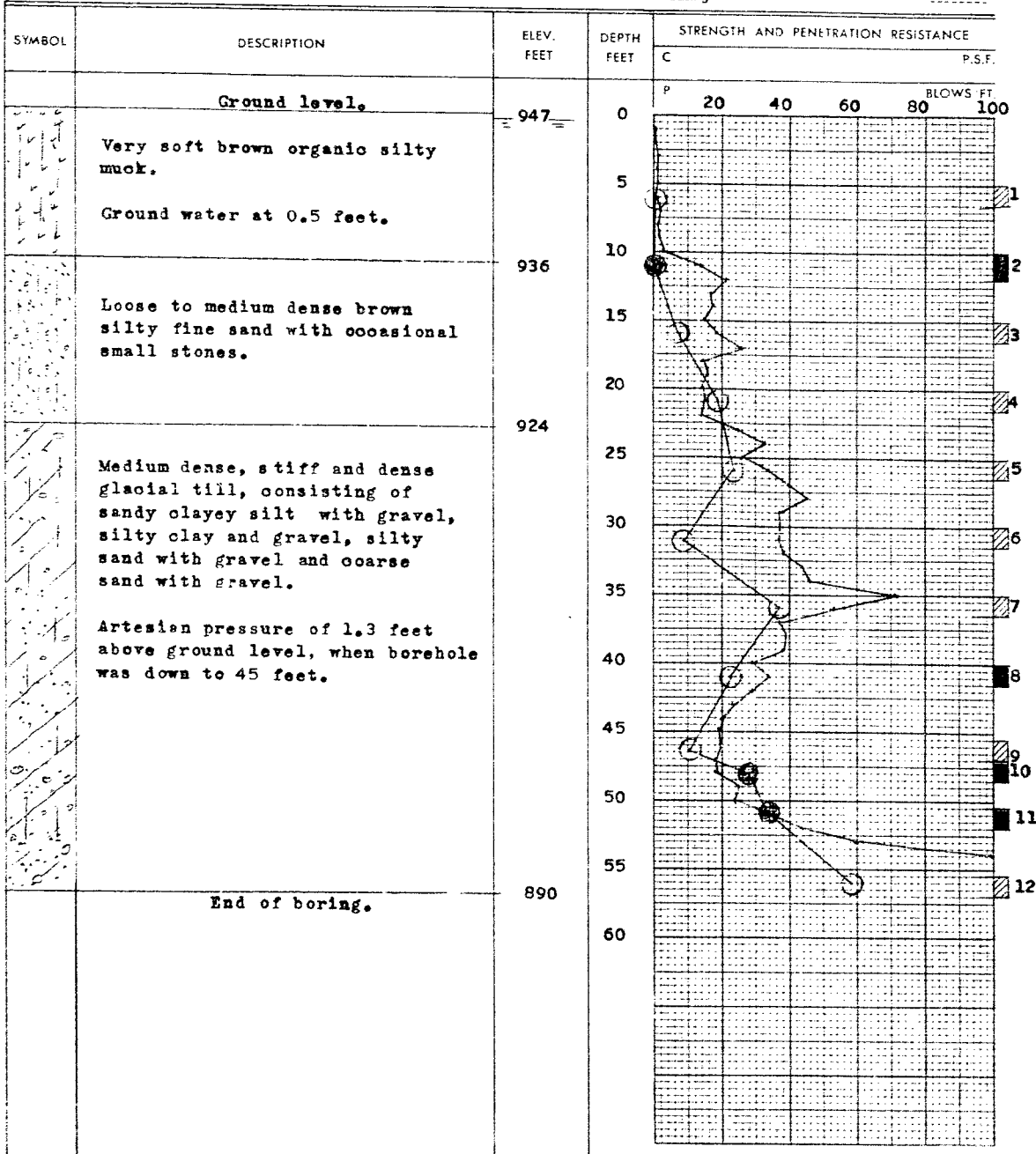
2" Split tube

2" Dia. Cone

Casing

⊕
+*

⊕ ⊕ ⊕



RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 3

Project: HIGHWAY # 401 UNDERPASS,
 Location: BLANDFORD TOWNSHIP # 1.
 Hole Location: See Enclosure No.1
 Hole Elevation and Datum: 947 Feet. M.S.L.
 Field Supervisor: H.G. Prep.: J.S.
 Driller: F.B. Checked: J.S. Date: 10.9.50

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

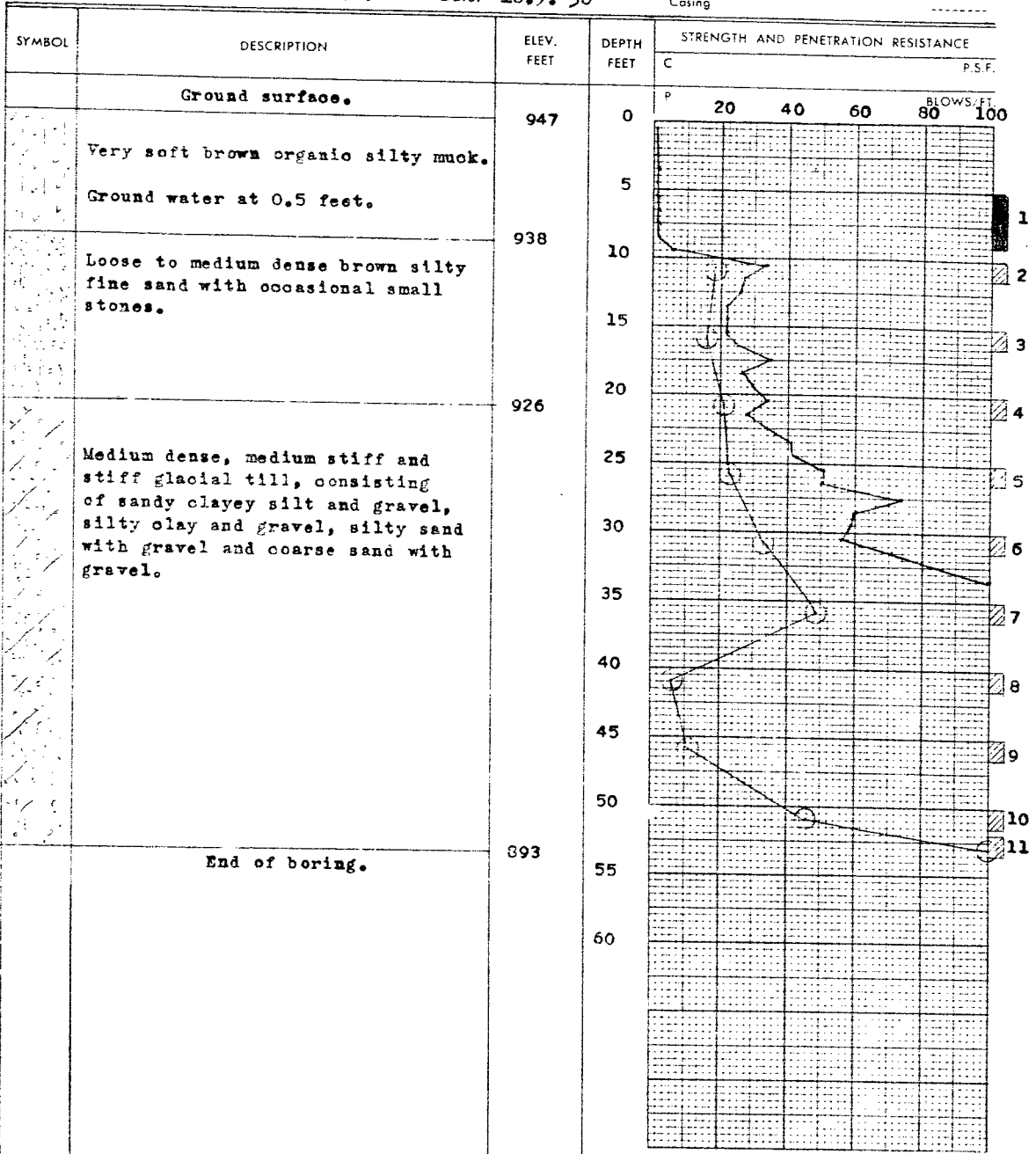
2" Split tube

2" Dia. Cone

Casing

⊕
+5

⊕ ⊕



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Foundation Engineering Division

Engineering Data Sheet for Borehole: 4

Project: HIGHWAY # 401 UNDERPASS

Location: BLANDFORD TOWNSHIP # 1.

Hole Location: See Enclosure No.1

Hole Elevation and Datum: 947 Feet. M.S.L.

Field Supervisor: H.G. Prep.: J.S.

Driller: F.B. Checked: J.S.

Date: 10.9.58

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance P

2" Split tube

2" Dia. Cone

Casing

⊕
+5

⊕ ⊕

