

55-F-226C

Hwy #86

GRAND RIVER

BA ~~SECRET~~
440

RACEY, MACCALLUM AND ASSOCIATES

LIMITED

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**Consulting Engineers
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JACQUES POULIN,
QUEBEC LAND SURVEYOR

THE VIBRATION ENGINEERING COMPANY

MONTREAL: 4123 SHERBROOKE STREET WEST, FITZROY 5261
TORONTO: 33 BLOOR STREET EAST, WALNUT 2-9071

REPORT NO. S-500-501/55/1-122-1

310 Odeon Building,
20 Carlton Street,
Toronto, Ontario.

August 11th, 1955.

55-F-226C

Department of Highways for Ontario,
c/o Lazarides, Lount and Partners,
79 Scollard Street,
TORONTO, Ontario.

RE: FOUNDATION INVESTIGATION - PROPOSED
BRIDGE SITE - HIGHWAY NO. 86 CROSSING
THE GRAND RIVER

Dear Sirs:

In accordance with your instructions we have completed the drilling of four (4) boreholes at the above site. We now wish to report as follows:-

LOCATION OF THE SITE AND OF THE BOREHOLES

The site is located on Grand River, approximately one-half mile east of the Village of West Montrose where a westward continuation of the existing Highway No. 86 would cross the Grand River.

The four (4) boreholes were spotted in the field in accordance with the locations shown in a sketch supplied by the client. The elevations of the boreholes were determined by levelling referring to the contour lines on the western embankment of the river. These contour lines were shown on the client's sketch.

REPORT NO. S-500-501/55/T-122-1 Cont'dTHE DRILLING WORK

The drilling equipment was sent to the site on June 15th, 1955. Work commenced on Borehole No. 2 on June 16th and was completed on June 22nd. Interruptions to the normal progress of the work were caused by some damage to the three-inch extra heavy duty drive-pipe due to the stiff nature of the soil causing unusual wear. The presence of numerous boulders required removal by blasting several times. The drive-pipe was taken to a depth of 38 feet at which level there was refusal. Attempts were made to wash down by hand and by drilling with open rod but without success. Finally, by means of an AXT diamond bit wash-water samples were taken to the final depth of 50 feet. Borehole No. 1 was begun on June 23rd and completed on June 28th. Progress was slow due to conditions similar to those encountered in Borehole No. 2 with the added factor of a boulder being jammed in the drive pipe making it necessary to pull the pipe and redrive. Borehole No. 3 was started on June 29th and completed on June 30th. Borehole No. 4 was started on July 4th and completed on July 7th.

The drillers' equipment consisted of a standard diamond drill manufactured by LONGYEAR. Three-inch diameter extra heavy duty drive-pipe was driven by a 300 lb. drive-hammer dropped 24". Samples of the soil were taken with a standard two-inch split-spoon sampler at 2-1/2 ft. intervals where possible and the sampler was driven by 140 lb. hammer dropped 30". Where drilling was carried out with the AXT diamond bit the drill rods were carrying pressure at all times. Water supply was by means of a supply pump from the Grand River to a storage tank.

REPORT NO. S-500-501/55/T-122-1 Cont'd

DISCUSSION OF THE RESULTS

The soils body in the investigated area is of pleistocene origin with the exception of the uppermost five to ten feet on the lower embankment (Borehole Nos. 3 and 4).

The lower embankment of the river shows in Borehole No. 3 loose to medium dense sand which appears to be a recent river deposit to a depth of approximately 10 feet. In Borehole No. 4 loose sand of the same origin occurs to only approximately 5 ft. depth and is underlain by fine to coarse sand layers in a dense state of compaction to approximately 12 ft. depth.

The soil of pleistocene origin on both embankments of the river consists of layers of varying composition changing from silty gravelly to medium sand with occasional boulders to silty clay and silt clay of low plasticity. All these soils prove to be very dense or extremely stiff. The density of the soil increased to such an extent that the normal drilling procedure of driving pipe and sampling was abandoned at a depth of 38 and 39 feet in Boreholes Nos. 1 and 2 respectively and at a depth of 28 and 31 feet in Boreholes Nos. 3 and 4. Below these levels the soil was penetrated by drilling with the diamond bit. The drill was carrying a pressure all the time during this procedure, thereby confirming the density of the soil.

CONCLUSIONS

We understand that the foundations for the bridge abutments are proposed to be based at a depth of 20 ft. below ground level on the lower embankment (at Boreholes Nos. 3 and 4) and at a depth of 35 ft. below ground level on the steep and high embankment (Boreholes Nos. 1 and 2).

REPORT NO. S-500-501/55/T-122-1 Cont'dCONCLUSIONS Cont'd

We feel that the soil at the anticipated depths for the foundation will carry a load not exceeding 3.5 tons per square foot without the danger of differential settlement. The cohesive strength and the internal friction of the soils provide ample resistance against lateral thrust.

The superficial sandy soils on the lower embankment down to a depth of approximately 12 feet appear to be in a different state of compaction as revealed by the penetration of the two-inch split-barrel sampler. The allowable bearing values for sand are based on a settlement of approximately one inch. One-tenth of the number of blows on the standard 2" split-barrel sampler, expressed in tons per square foot, is conservatively given for dry sand. The respective value for saturated sand is based on theoretical considerations and assumed to be about 50% of the former value. In the present case this would mean that the allowable bearing value would be approximately one ton per square foot for the conditions encountered in Borehole No. 3. However, due to the drilling procedure with the necessary washing of the drive-pipe, before the penetration test is carried out, some loosening of sand soils is liable to occur and, in many cases, the penetration values obtained are too low. On the other side, 80% to 90% of the settlement of sand coincides with the application of the load and the rest is negligible. Therefore, if a load of two (2) tons per square foot for the foundation of the wing walls at 5 ft. depth has been chosen, we believe that the amount of settlement to be expected will not exceed 1.5 inches and the differential settlement be less than 50% of this value. The conditions

REPORT NO. S-500-501/55/T-122-1 Cont'd

CONCLUSIONS Cont'd

in Borehole No. 4 permit a load of 2 tons/sq. ft. to be applied safely. As already mentioned in a previous conversation, special attention should be paid to the possibility of scour as the soils to a depth of about 12 feet apparently are recent river deposits and, during flood conditions, may be exposed to erosion.

COMMENTS ON ARTESIAN CONDITION ENCOUNTERED IN BOREHOLE NO. 3

At a depth of approximately 44 ft. fine gray sand was observed in the wash-water returning from the drilling operations. At 45' it was ascertained that the drill had encountered artesian conditions and drilling was stopped. The water flowed slowly and rapidly became clear indicating that little, if any, caving was taking place at depth. After completion of operations, the hole was blocked by cement injection.

It must be noted that this aquifer was encountered in only one borehole because of the shallower penetration of the above holes. It is surmised, therefore, that it results from a porous formation extending possibly throughout the area but at sufficient depth to remain unaffected by excavation to the desired level. We should point out, however, that heavy blasting operations or deep piling at or close to the site may reopen the sealing strata and should be executed with great caution.

We trust that the foregoing information will be satisfactory and shall be pleased to discuss the matter further with you if you deem it advisable.

Yours very truly,

RACEY, MACCALLUM AND ASSOCIATES LTD.

K. Tumbasing, P. Eng.

KT/PW

Original and two copies - Messrs. Lazarides, Lount and Partners, Toronto, Ont.

c.c.'s: 2 - Racey, MacCallum and Associates Limited, Montreal, P. Q.
1 - Soils Engineer

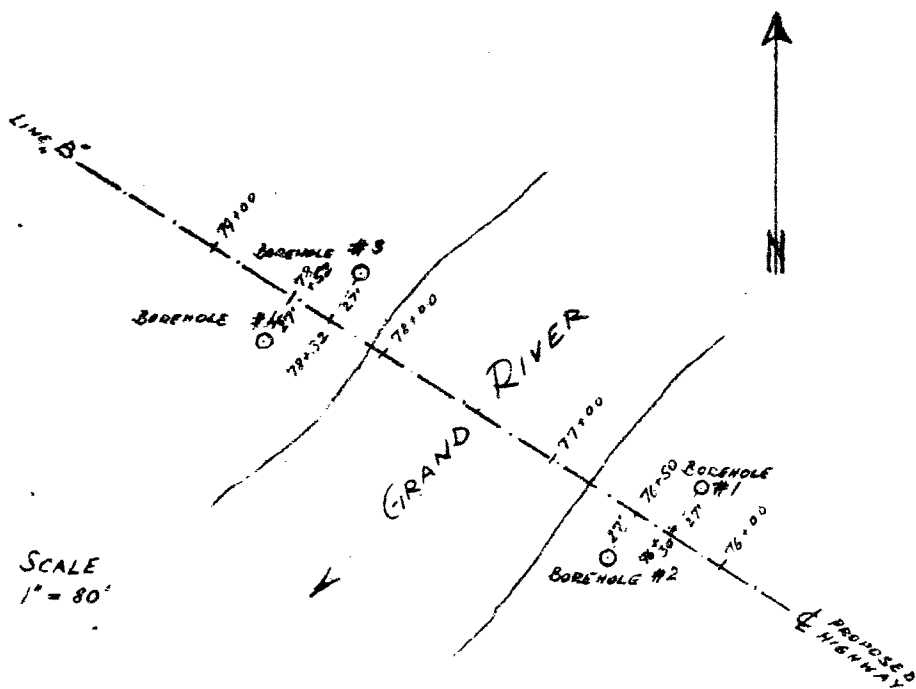
SCALE 1:50,000

ONE MILE

AFTER
TOP. MAP, SHEET GUELPH, WEST



TOPOGRAPHIC SKETCH SHOWING THE LOCATION OF THE PROPOSED BRIDGE
HWY. NO. 86 CROSSING THE GRAND RIVER.



BRIDGE SITE
HWY. NO. 86 CROSSING GRAND RIVER.
AT WEST MONTROSE, ONT.

SKETCH SHOWING THE LOCATION OF THE BOREHOLES

RACEY, MACCALLUM & ASSOCIATES, LTD.

M. CHEVNER
Priller

Foundation Engineering, Division

Engineering Data Sheet for Borehole:

Helper

D.M. & K.T.

Checked by

Hole Elevation: ~ 1069.6 Datum: M 56

Hole Elevation: ~ 1069.6 Datum: M 54

4/7/55

Day Month Year



NUMBER OF BLOWS/FT. ON 2" SPLIT -
BARREL SAMPLER

--- -- DITTO, ON 3" DRIVE PIPE

--X-- WATER CONTENTS

1-0 PL. PLASTIC LIMIT

PL 44 44 • 418V12

FOR LEGEND SEE ENCL. #2

WILLIAMS, M. CARLSON AND ASSOCIATES

LIMITED

Foundation Engineering Division

M. CHEVIER

Driller

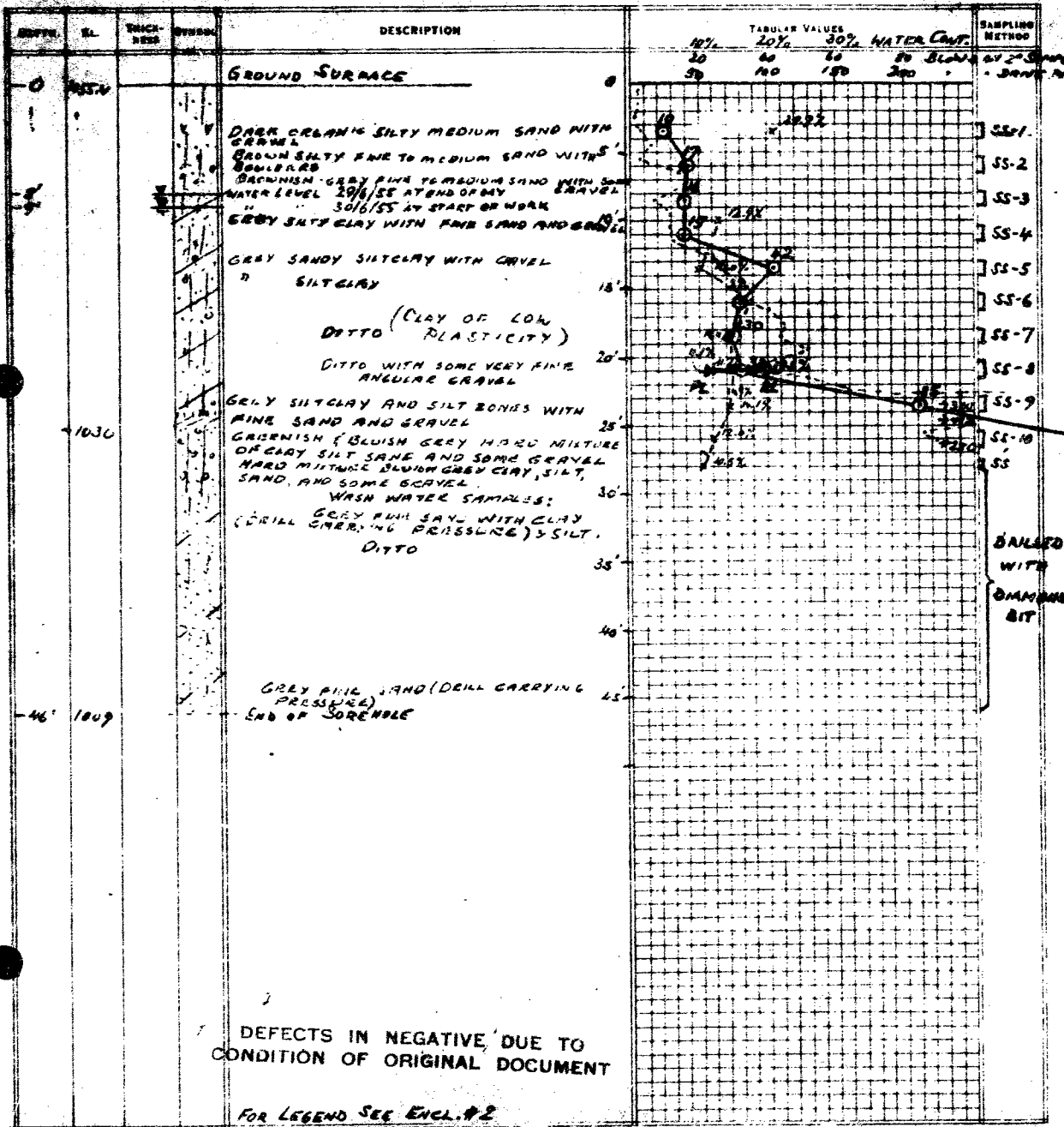
Helper

P.M. & K.T.

Checked by

4/7/55

Day Month Year



Job No. 77/55 Engineering Data Sheet for Borehole: 4

Helper

Job Name: PAW BRIDGE STA 4+1.16 CROSSING GRAND RIVER

P.M. & K.T.

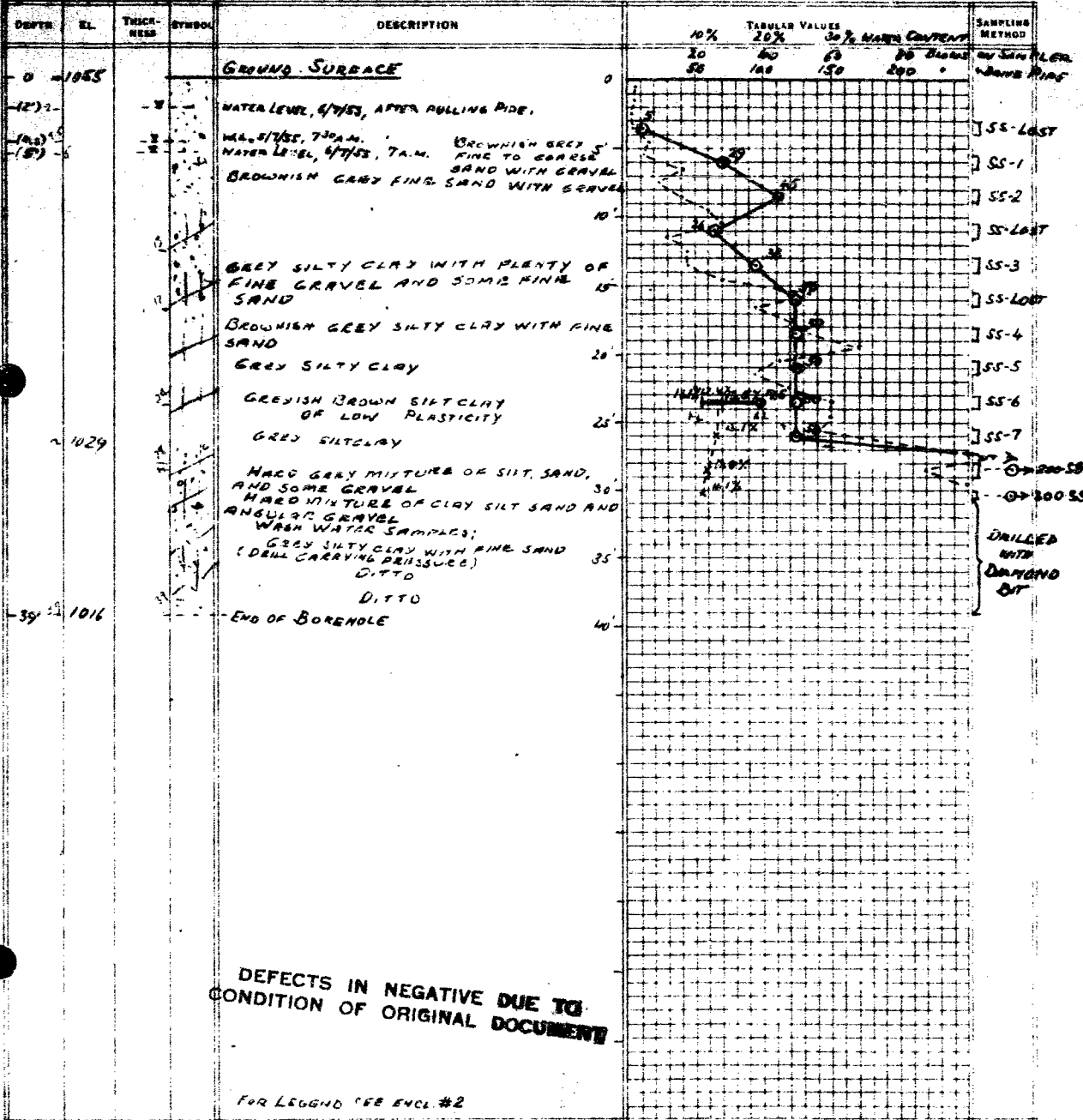
Job Located: WEST MONTAGUE, ONT.

Checked by

Hole Located: AS SHOWN ON SKETCH PLAN

Hole Elevation: ~1055 Datum: M.S.L.

14/7/55
Day Month Year



BA 440-A

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LIMITED

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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.E.C.E., P.ENG.

TORONTO DIVISION
27 CARLTON STREET

REFERENCE: S-500/T-297

18 November 1957.

55-F-226C

A.M. Toye, Esq.,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Road,
TORONTO, Ontario.

Attention: Mr. S. McCoshie

RE: ADDITIONAL SITE INVESTIGATION FOR
A PROPOSED BRIDGE OVER THE GRAND
RIVER, HIGHWAY 86 NEAR WEST MONTROSE,
ONTARIO, YOUR REFERENCE NO WP-11-56

Dear Sirs:

Enclosed herewith are the results of two borings performed at the above site, in accordance with your request of 7 October 1957. These are in addition to our investigation of July 1955, described in our report No S-500-501/55/T-122. A description of the field work and a summary of our conclusions are presented in the following paragraphs.

The field work was carried out between 10 and 25 October 1957. A conventional type of diamond drill was used, with flush joint BX casing and AI core barrel, in order to penetrate through the numerous boulders. Both borings were located in the river and the drilling was carried out in one to two feet of water. The results of the borings are presented on the Engineering Data Sheets, Enclosures Nos 2 and 3. Their location is shown on a sketch, Enclosure No 1.

Generally, the boring results are in agreement with the previous results. The top ten feet of the river bed consists of boulders, coarse gravel and sand. Because of the dams upstream there appears to be little sedimentation during the periods of low stream velocities, whereas erosion will take place when the dams are open at periods of high water. Therefore, the fine material from the river bed has probably been gradually washed out. Below

18 November 1957

this relatively recent river deposit, the soil appears to be of glacial origin, containing silt, sand, clay and gravel in a rather dense state. Below about twenty five feet it is so dense that sampling became extremely difficult. The presence of numerous boulders makes the standard penetration results rather dubious, but the fact that the drill was carrying pressure continuously when drilling with an AI core bit is indicative of the hardness of this layer.

The artesian conditions, recorded during our previous investigation, were again encountered at both borings. It would seem however that this time the water bearing layer was found at a considerably higher elevation than before. At Boring No 5 the water in the casing came up slowly to fifteen inches above river level when the hole was down to El 1032 feet. When the casing was down to El 1028 feet, the water came up very quickly to eight feet nine inches above river level, and along the outside of the casing water could be seen running up, boiling up silt and fine sand. The next morning the excess head in the casing was down to four feet above river level and no more vertical water movements were observed outside the casing. This four foot head remained the same generally throughout the boring.

At Boring No 6 the first indication of artesian pressure was at El 1036 feet, with a head of two feet. This increased to a maximum of seven feet six inches at El 1015 feet. On completion of the drilling work both boreholes were thoroughly plugged with bentonite.

From the above results it would seem almost impossible to avoid disturbing the water bearing layer when excavating for the bridge piers. Because of the danger of scour the pier footings would have to be taken down to at least El 1030 feet. At that depth the safe bearing capacity would be of the order of four tons per square foot.

Any upward movement of water in the footing excavations should be prevented, as it would loosen the soil and reduce its bearing properties. Sheet piling would seem a necessity, in spite of the difficulties which are bound to be encountered in driving through boulders. Excavation and construction for the pier footings within a caisson under an excess head of water equal to the artesian pressure, would seem a practical solution.

We realize that the conditions reported require particular care and may affect the design considerably. We will be happy to discuss any problems with you in the course of your preparations for the work. We thank you for this opportunity of having been of service to you.

Yours very truly,
RACEY, MACCALLUM AND ASSOCIATES LIMITED


J.J. Schoustra, P. Eng.

JJS/MD

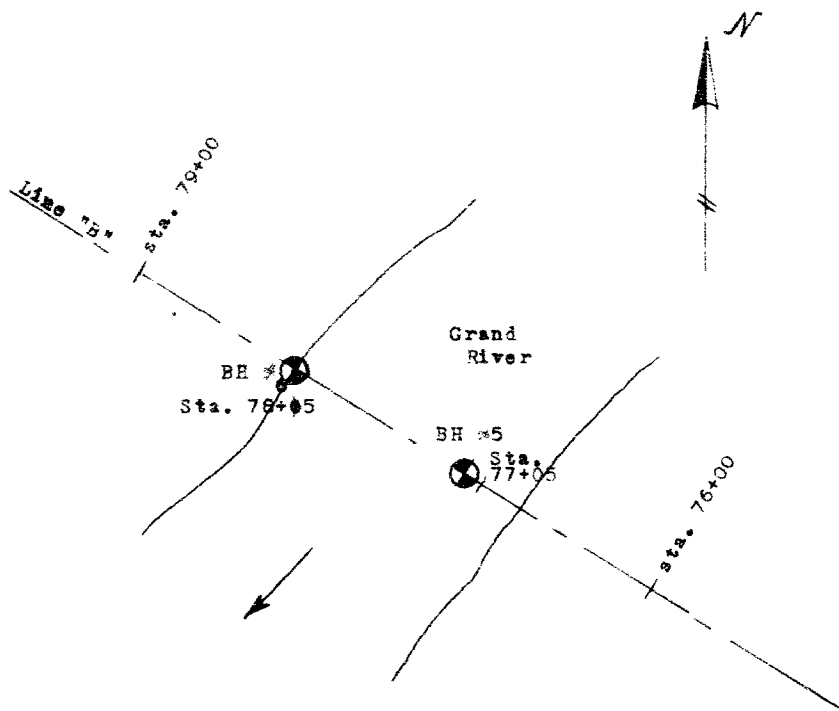
Order No. S-500/T-907

Prep By J.S.

Enclosure No. 1



LOCATION OF PROPOSED BRIDGE SITE



SKETCH, SHOWING LOCATION OF BORINGS
Scale: 1 inch to 80 ft.

Order No. S-500/T-907 RACEY, MACCALLUM AND ASSOCIATES
LIMITED

Linton

Hole B. No. 22/10/57

Foundation Engineering Division

Hole Date 24/10/57

Engineering Data Sheet for Borehole: 5

Job Name Bridge over Grand River

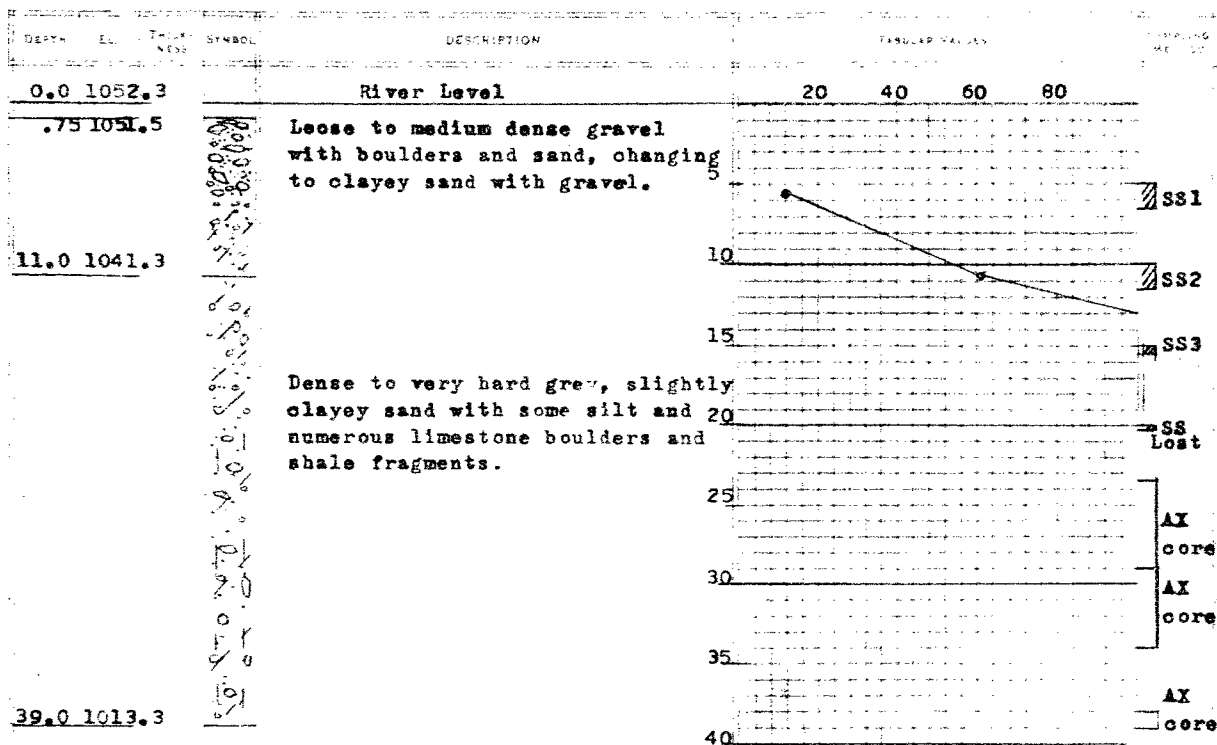
J.S.

Job Located West Montrose, Ont.

Hole Located See enclosure No. 1

Hole Elevation 1052.3 Datum M.S.L.

25 Oct. 57



Maximum artesian head of 8 ft.
9 in. above river level, when
casing down to 29 ft.

LEGEND

Split spoon sample



Standard penetration
resistance, blows/ft.



Order No. S-500/T-907

RACEY, MACCALLUM AND ASSOCIATES
LIMITED

Enclosure No. 3

Linton

Hole Began 10/10/57

Foundation Engineering Division

Hole Ended 22/10/57

Engineering Data Sheet for Borehole: 6

Hole No.

Job Name Bridge over Grand River

J.S.

Job Located: West Montrose, Ontario

Checked by

Hole Located: See enclosure No. 1

Hole Elevation: 1052.3 Datum: M.S.L.

25

Oct.

57

Date

Month

Year

DEPTH	EL.	THICK	SYMBOL	DESCRIPTION	TUBULAR VALVES	REMARKS
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0.0 1052.3

River Level

20 40 60 80

.6

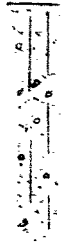


Loose to dense gravel with boulders and sand.

5

SS1

10.0 1042.3



Medium dense sandy silt and silty sand with some gravel.

10

SS2

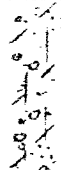
15

SS3

20

SS4

25.0 1027.3



Very dense slightly clayey sand with some silt and gravel and boulders.

25

SS5 > 1

30

SS6 > 1

36.0 1016.3



Probed with chopping bit. Extremely hard.

35

SS7

39.5 1012.8

40

Maximum artesian head of 7'6" above river level, when casing down to 37 ft.

LEGEND

Split spoon sample



Standard penetration resistance, blows/ft.

