56-F-217C

NAGAGAMI RIVER

B.A.514

RACEY, MacCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY
Consulting Engineers
AND ASSOCIATED STAFF

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

REPR 500-504/T-258 56-F-217C

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

18 April 1956.

Department [illegible]ghways of Ontario,
c/o Sir Alexander Gibb & Partners,
4 Wellington Street East,
TORONTO, Ontario.

Attention: Mr.C.C.Marshall.

RE: FOUNDATION INVESTIGATION FOR
PROPOSED HIGHWAY BRIDGE,
NAGAGAMI RIVER, ONTARIO.

Dear Sirs:

We have completed our investigation of the Nagagami River and submit the attached report, covering the drilling operations and the results and conclusions obtained. A summary of our comments is presented for your consideration:-

1. As far as bearing capacity is concerned, the soil conditions appear good, the safe bearing capacity being 3 tons/sq.ft.

2. The river is fast flowing and the spring flow is probably at least five times the fall and winter flow. During the spring breakup, the river is probably subject to ice scour.

3. The river banks appear stable.

4. Bedrock is of biotite gneiss with pegmatitic inclusions. This rock is water bearing below the east bank, and artesian wells were brought in at boreholes 2 and 3. An account of a method which has been used by us and proved both efficient and inexpensive, is given at the end of this report.

This report was prepared by Mr.P.E.M.Monk, who supervised the drilling work in the field. I have read the report and am in accord with it. If there are any further queries you may have in connection with the report, we will be pleased to discuss them with you, at your convenience.

Yours very truly,
RACEY,MacCALLUM AND ASSOCIATES LIMITED

W. A. Trow

WAT/MD

W.A.Trow,P.Eng.

FOUNDATION INVESTIGATION

FOR

PROPOSED HIGHWAY BRIDGE,

MAGAGAMI RIVER, ONTARIO.

Report No: S-500-504/T-258 Racey,MacCallum & Associates Limited

18 April 1956

C O N T E N T S

E N C L O S U R E S

18 April 1956.

FOUNDATION INVESTIGATION FOR PROPOSED HIGHWAY BRIDGE, NAGAGAMI RIVER, ONTARIO.

PURPOSE OF THE INVESTIGATION

This report covers the investigation for the determination of foundation conditions for the proposed highway bridge over the Nagagami River, on Highway 11, approximately 40 miles west of Hearst, Ontario.

DESCRIPTION OF THE SITE

The Nagagami River flows in a northerly direction at the bridge site, and is cutting a deep valley through material of glacial or interglacial origin. This glacial material overlies bedrock of biotite gneiss and pegmatitic granite. Downstream of the proposed bridge and near the site of the existing bridge, the bedrock appears to outcrop in the river bed. The river appears to be immature and fast flowing at all times of the year. The discharge varies greatly, being probably at least five times greater during spring flood than during the fall and winter low. The river bed is boulder strewn and the magnitude of some of the boulders indicates that the transporting powers of the river must be considerable.

DRILLING WORK AND SUBSOIL CONDITIONS

The drill was moved to the Nagagami River from the Shekak River on Wednesday 21 March. Hole no.4 was started the same day and completed on the next day. The depth of water in the river was two feet and the river bed was boulder strewn. An attempt was made to drive three inch pipe in preparation for sampling but, due to the boulders, this proved impossible. For this reason it was decided to run flush joint to bedrock and obtain a general qualitative estimate of the soil conditions, upon which the method of approach for the remaining holes could be determined. A depth of three feet of boulders was encountered, underlain by stiff silty clay to bedrock at 32 feet. Random boulders were struck at a depth of 11 feet and again at 28 feet. From the cores obtained, these boulders are probably not bigger than nine inches in diameter.

Borehole no.3 was started on 23 March and completed on 24 March. As a result of the information obtained from hole 4, it was estimated that the boulder cover on the river bed was not more than three feet in depth. This boulder layer was removed by hand as far as was possible, working through the ice; this operation enabled the drive pipe to be driven into the underlying silty clay. The silt stratum ran from 4 feet to bedrock at 24 feet, with a few boulders just above bedrock.

Borehole no.1 was commenced on 24 March and completed on 26 March. From 0-5 feet a medium, slightly organic silty clay of medium stiffness was encountered, underlain from 6 to 26 feet by boulders and gravel with sand and silty clay. An attempt was made upon first encountering the boulders, to blast a way down, but when it became apparent that the boulder layer was extensive, flush joint was run. Limited core samples were taken by means of an AXT diamond bit. This gave qualitative information only, since the soil recovered was in a highly disturbed state and had been saturated by the drill water.

Borehole no.6 was commenced on 27 March and completed on 29 March. Due to the steepness of the bank at this point, approximately five hours were spent digging a ledge to support the drill and tripod. From 0-5 feet, a medium, soft, slightly organic silty clay containing some sand was encountered, and this was underlain by a dense silt to bedrock at 59 feet.

Borehole no.5 was commenced on 29 March and completed on 31 March. By removing the upper boulder layer by hand, it was possible to drive the three inch pipe. The soil beneath this boulder layer was stiff silt and clayey silt to bedrock at 37 feet. At around 20 feet, the clayey silt contained fine gravel.

Borehole no.2 was commenced on 2 April and completed the same day. Bedrock was at 27.5 feet and was overlain by dense silt.

Bedrock in all locations was biotite gneiss, with pegmatitic granite inclusions.

In boreholes 2 and 3 artesian conditions were encountered, with a head about ten feet higher than river level. Ten feet of three inch pipe was left in each hole, to enable speedy location during construction and to provide means for sealing the flow.

DISCUSSION OF THE RESULTS

The bearing capacity of the soil appears good. The lowest value of penetration resistance at a depth greater than five feet, using a standard two inch O.D.split spoon, was 29 blows per foot.

The soil at the locations of the four piers and the west abutment is fairly uniform and in these regions should have a safe bearing value of 3 tons/sq.ft.

Laboratory tests indicate that the natural water content of the soil is at or about its plastic limit and is, therefore, in a relatively incompressible state.

The east abutment is founded on boulders, gravel and sand and, while no quantitative tests were possible, the soil appears to be quite dense. The general condition of the soil in the area indicates that the silt and clay was deposited during the pleistocine period. Since the river is immature, there seems little doubt that the material underlying the east abutment is in a dense condition.

CONCLUSIONS

1. The foundation conditions are good. Laboratory tests indicate the soil to be stable and it should be relatively incompressible.

2. The safe bearing value for a simply supported structure of the nature suggested, is 3 tons/sq.ft.

3. No observations were possible on the rate of scour, and the effect of pier placement is uncertain. Terzaghi recommends that, where no direct observations of the effect of scour have been made, in view of the inevitable uncertainty involved in forecasts, a large margin of safety is required.*

4. The river level just prior to the spring thaw is low, and it is therefore almost certain that there will be ice scour, together with scour resulting from the movement of the boulders which cover the river bed. It seems probable that these boulders are moved and replaced each year.

5. There will almost certainly be considerable lateral thrust from the ice jams.

6. The depth at which the pier foundations are to be placed must be sufficient to ensure safety from scour, due to soil disturbance resulting from the placement of the piers, and to accomodate the lateral and longitudinal thrusts resulting from ice jams.

7. It was noticed that many of the bridges in the locality, which are of stone filled wood crib construction, subside and require lifting from time to time. This may be due to a settling of the rock fill, due to erosion of the underlying river bed.

8. The abutments should be placed at a depth of at least six feet below the present ground surface. According to the plans submitted to us, the abutments should be above high water level, but ice conditions may be such that scour could occur well above the water level, due to packed ice cakes. It may, therefore, be advisable to protect the abutment slopes in some way.

9. If drilled caisson type piers are used, there should not be undue difficulties caused by boulders beyond a depth of four feet, though an occasional boulder up to one foot in diameter may be expected, and which will require removal by hand.

METHODS OF BLOCKING ARTESIAN WELLS

Drilling operations on boreholes 2 and 3 brought two artesian wells. Ten feet of three inch pipe was left in each of these holes and they should be easy to find during construction.

The normal method of blocking wells of this type is by grouting under pressure. Our experience has shown that this method can be excessively expensive. For cases where the rate of flow is low, the wells may be blocked by the use of Bentonite. Bentonite has the property of swelling to five times its volume when water is added and costs about $5.00 per hundred pounds. The Bentonite is moistened and rolled into small balls, into which some fine gravel or coarse sand is mixed for weight. These balls are dropped down the well and tamped by E rods with a small flat hammer on the end. The consistency of the Bentonite balls should be above the plastic limit and below the sticky limit.

Peter E. Morton Monk

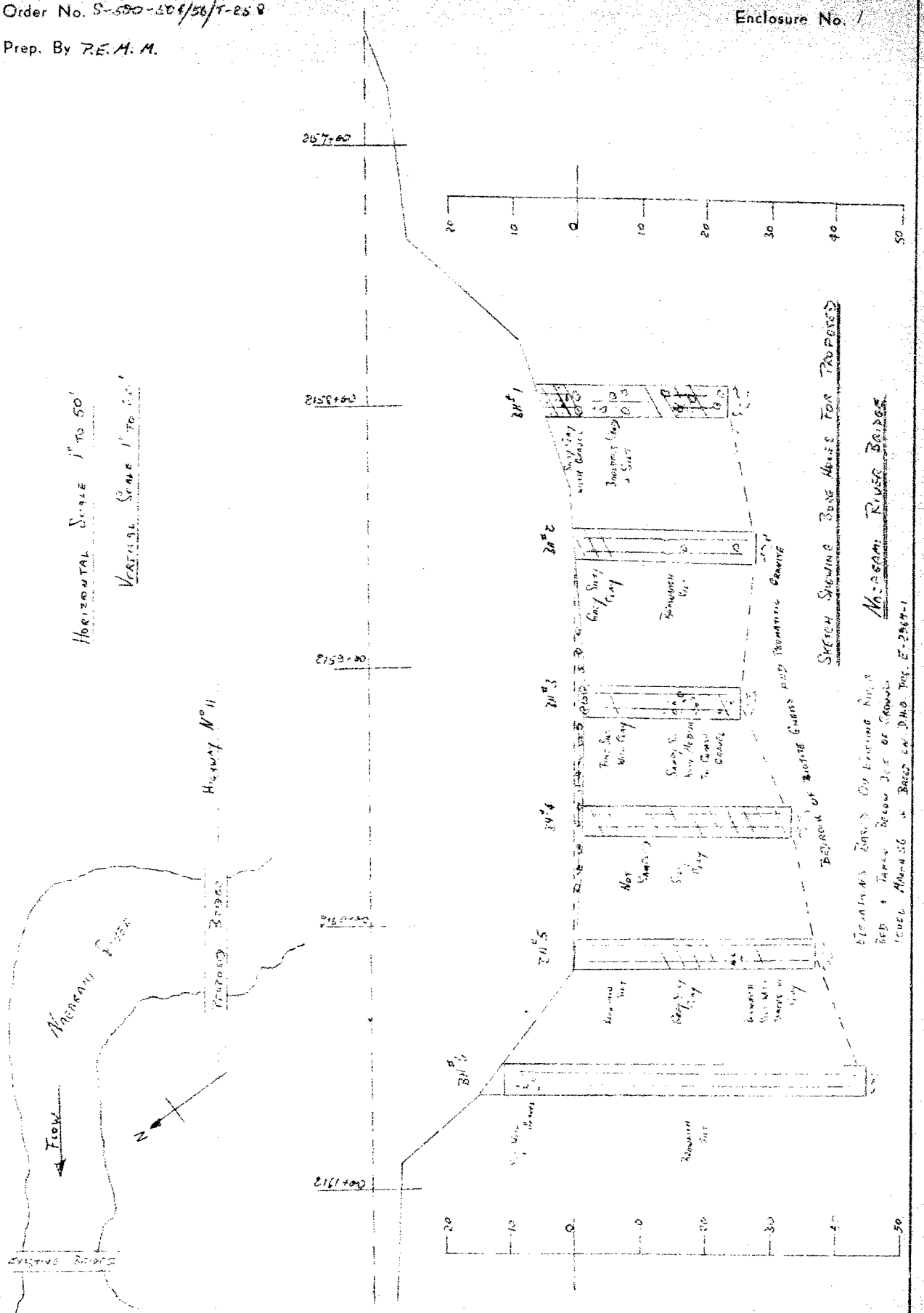
P.E.M.Monk, P.Eng.

*Terzaghi & Peck - Soil Mechanics in Engineering Practice, page 411.

Order No. S-600-201/56/T-258

Prep. By R.E.M.M.

Enclosure No. 1



Racey, MacCallum & Associates Ltd.

Order No. 5-580-50A/56/T-358 Enclosure No. 2

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: #1

Project: NAGAGAMI RIVER BRIDGE
Location: NAGAGAMI RIVER HIGHWAY 11 40 MILES WEST OF HEARST
Hole Location See Enclosure 1
Hole Elevation and Datum: 165 [illegible] Ice Level + [illegible] Profile D.H.O. Dwg E-2947-1
Field Work Begun 24/3/56 Ended 27/3/56

Field Supervision: P.E.M.M.
Driller: R. Constantineau
Prep.: P.E.M.M.
Checked:
Date: 12/4/56

LEGEND

Sampling Method
- 2" Dia. split tube
- 2" Shelby tube

Penetration Resistance
- 2" Split tube
- 2" Dia. Cone
- Casing

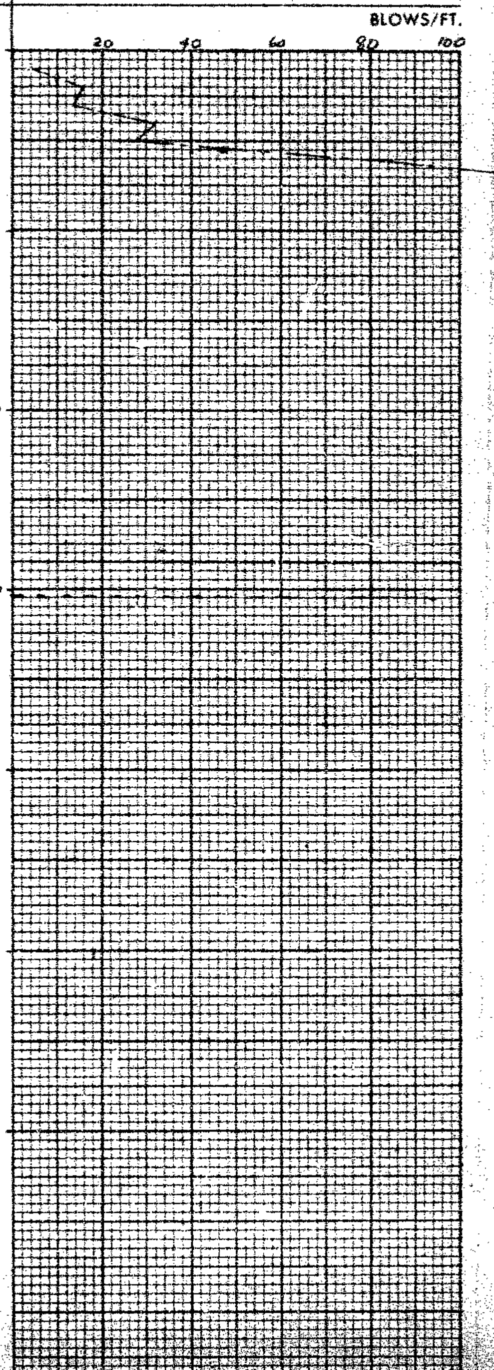
Strength
- Unconfined compression
- Vane test and sensitivity

Consistency
- Natural moisture
- Liquid limit
- Plastic limit

Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	SAMPLE NO.
			0	
	Silty Clay with Gravel + Sand Slightly Organic			S.S.1
	BLAST			
	Boulders + Sand with Some Clay			
			10	
	Core Sample Boulders Gravel Sand + Clay			
			20	
	Boulders Gravel + Silty Clay			
			30	
	Bedrock Pink Pegmatitic Granite. Core [illegible] To Prevent [illegible] [illegible] 55% Recovery			
			40	
			50	

STRENGTH AND PENETRATION RESISTANCE P.S.F.



CONSISTENCY AND UNIT WEIGHT P.C.F.

% DRY WEIGHT

Order No. S-500-504/56/T-258 Enclosure No. 3

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: # 2

Project: Nagagami River Bridge
Location: Nagagami River Highway 11 40 Miles West of Nearst
Hole Location See Enclosure 1
Hole Elevation and Datum: 0 Datum T.L. & S.L. Based on D.N.D. Dog E-2967-1
Field Work Begun 2/4/56 Ended 2/4/56

Field Supervision: P.E.M.M
Driller: R. Constantineau
Prep.: P.E.M.M
Checked:
Date: 12/4/56

LEGEND

Sampling Method
- 2" Dia. split tube
- 2" Shelby tube

Penetration Resistance
- 2" Split tube
- 2" Dia. Cone
- Casing

Strength
- Unconfined compression +
- Vane test and sensitivity ⊕S

Consistency
- Natural moisture ×
- Liquid limit —o
- Plastic limit —|

Natural Unit Weight *

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Brownish Grey Calcareous Silty Clay		0
	Brownish Calcareous Silt Dense		10
	Bedrock of Biotite Gneiss + Pegmatitic Granite Borehole Started in Mode of Preventing Artesian Conditions — Unsuccessful 25% Recovery Artesian Head 10ft		20
			30
			40

STRENGTH AND PENETRATION RESISTANCE
P.S.F.
BLOWS/FT.
20 40 60 80 100

CONSISTENCY AND UNIT WEIGHT
P.C.F.
% DRY WEIGHT
10 20 30

SAMPLE NO.
S.S.1
S.S.2

Order No. S-580-504/56/T-258 Enclosure No. 4

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: #3

Project: NAGAGAMI RIVER BRIDGES
Location: NAGAGAMI RIVER HIGHWAY 11 40 MILES WEST OF HEARST
Hole Location SEE ENCLOSURE 1.
Hole Elevation and Datum: o DATUM IS C.G.D. BASED ON D.H.O DWG E-2969-1
Field Work Begun 22/3/56 Ended 24/3/56

Field Supervision: R.E.M.M
Driller: R. GUSTAFSSON
Prep.: R.E.M.M
Checked:
Date: 12/4/56

LEGEND
Sampling Method
2" Dia. split tube
2" Shelby tube
Penetration Resistance
2" Split tube
2" Dia. Cone
Casing
Strength
Unconfined compression
Vane test and sensitivity
Consistency
Natural moisture
Liquid limit
Plastic limit
Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
			0
	BROWNISH GREY CALCAREOUS FINE SILT WITH TRACE OF CLAY		
	GRAY CALCAREOUS SANDY SILT WITH MEDIUM TO COARSE GRAVEL. DENSE		10
	VERY DENSE MIXTURE OF FINE SILT, FINE SAND & FINE GRAVEL WITH TRACE OF CLAY		20
	BEDROCK BIOTITE GNEISS AND PEGMATITIC GRANITE 85% RECOVERY		30
			40

STRENGTH AND PENETRATION RESISTANCE
P.S.F.
BLOWS/FT.
20 40 60 80 100

CONSISTENCY AND UNIT WEIGHT
P.C.F.
% DRY WEIGHT
10 20 30

SAMPLE NO.
SS-1
SS-2
SS-3
SS-4
SS-5

Order No. S-500-504/56/T-258 Enclosure No. 5

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: #4

Project: NAGAGAMI RIVER BRIDGE
Location: NAGAGAMI RIVER HIGHWAY 11 40 MILES WEST OF HEARST
Hole Location SEE ENCLOSURE 1
Hole Elevation and Datum: 0 DATUM TBE LEVEL. BASED ON D.H.O. DWG E-2014-
Field Work Begun 21/3/56 Ended 22/3/56

Field Supervision: P.E.M.M.
Driller: R. CONSTANTINEAU
Prep.: P.E.M.M.
Checked:
Date: 12/4/56

LEGEND
Sampling Method
2" Dia. split tube
2" Shelby tube
Penetration Resistance
2" Split tube
2" Dia. Cone
Casing
Strength
Unconfined compression +
Vane test and sensitivity ⊕S
Consistency
Natural moisture ×
Liquid limit —o
Plastic limit —|
Natural Unit Weight ✱

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE P.S.F. BLOWS/FT. 20 40 60 80 100	CONSISTENCY AND UNIT WEIGHT P.C.F. % DRY WEIGHT	SAMPLE NO.
	RIVER LEVEL 22/3/56		0			
	RIVER BED					
	SILTY CLAY NOT SAMPLED		10			
	APPARENTLY VERY DENSE		20			
			30			
	BEDROCK BIOTITE GNEISS & PEGMATITE & GRANITE 66% RECOVERY					
	FURTHER CORE RECOVERED 3/ CASE IN WORK HOLE		40			

Order No. S-500-504/56/I-258 Enclosure No. 4

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: #5

Project: NAGAGAMI RIVER BRIDGE
Location: NAGAGAMI RIVER HIGHWAY 11 40 MILES WEST OF HEARST
Hole Location SEE ENCLOSURE 1
Hole Elevation and Datum: 0 DATUM ICE LEVEL MEAN BASED ON D.N.D. DWG E-20471
Field Work Begun 29/3/56 Ended 31/3/56

Field Supervision: P.E.M.M
Driller: R. CONSTANTINEAU
Prep.: P.E.M.M
Checked:
Date: 12/4/56

LEGEND
Sampling Method
2" Dia. split tube
2" Shelby tube
Penetration Resistance
2" Split tube
2" Dia. Cone
Casing
Strength
Unconfined compression
Vane test and sensitivity
Consistency
Natural moisture
Liquid limit
Plastic limit
Natural Unit Weight

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	BROWNISH CALCAREOUS SILT VERY DENSE		0
	GREY SILTY CLAY		10
	CALCAREOUS SLIGHTLY LAYERED BROWNISH GREY SILT WITH LENSES OF CLAY DENSE		20
	BROWNISH CALCAREOUS SILT		30
	BEDROCK BIOTITE GNEISS & PEGMATITIC GRANITE 100% RECOVERY		40

STRENGTH AND PENETRATION RESISTANCE
P.S.F.
BLOWS/FT.
20 40 60 80 100

CONSISTENCY AND UNIT WEIGHT
P.C.F.
% DRY WEIGHT
10 20 30

SAMPLE NO
S.S. 1
S.S. 2
S.S. 3
S.S. 4
S.S. 5
S.S. 6

Order No. S-580-SD4/56/T-258 Enclosure No. 4

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: #6

Project: NAGAGAMI RIVER BRIDGE
Location: NAGAGAMI RIVER HIGHWAY 11 40 MILES WEST OF HEARST
Hole Location SEE ENCLOSURE 1
Hole Elevation and Datum: 410.5 DATUM FOR LEVEL MARCH 56 + 3½' ABOVE RIVER BED
Field Work Begun 27/3/56 Ended 27/3/56

Field Supervision: R.E.M.M
Driller: R. GOUCHEMINEAU
Prep.: R.E.M.M
Checked:
Date: 17/4/56

LEGEND

Sampling Method
- 2" Dia. split tube
- 2" Shelby tube

Penetration Resistance
- 2" Split tube
- 2" Dia. Cone
- Casing

Strength
- Unconfined compression +
- Vane test and sensitivity ⊕

Consistency
- Natural moisture ×
- Liquid limit —o
- Plastic limit ⊢

Natural Unit Weight ✱

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE P.S.F. BLOWS/FT.	CONSISTENCY AND UNIT WEIGHT P.C.F. % DRY WEIGHT	SAMPLE NO.
	CALCAREOUS BROWNISH SILT WITH FINE GRAVEL		0	20 40 60 80 100	10 20 30	S.S.1
	CALCAREOUS BROWNISH SILT VERY DENSE		10			S.S.2
			20			S.S.3
			30			S.S.4
	CALCAREOUS BROWNISH SILT VERY DENSE		40			S.S.5
			50			
	BEDROCK BIOTITE GNEISS & PEGMATITIC GRANITE 65% RECOVERY		60			

BA 514

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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., C., A.M.I.ELEC.E., P.ENG.

TORONTO DIVISION
20 CARLTON STREET

Reference: S-500/T-833. 2 August 1957.

Department of Highways of Ontario,
Bridge Office,
280 Davenport Road,
TORONTO, Ontario.

Attention: Mr.F.I.Hewson

RE: SOIL CONDITIONS AT THE
NAGAGAMI RIVER BRIDGE,
HEARST, ONTARIO.

Dear Sirs:

In response to your verbal request we accompanied you on a visit to the above mentioned site on 18 July 1957, in order to inspect the subsoil conditions.

At the time of our visit the excavation for piers at the east side of the river was stopped, because of suspected poor foundation conditions. The excavation was almost down to six feet below the river level and the soil at the bottom had a glossy gelatine-like appearance.

At the location of this excavation two borings, Nos.1 and 2, had been carried out in March 1956, showing the presence of a dense silt at the elevation of the proposed footings. Furthermore, at that location there appeared to be a perched water table below the impermeable soil layers, with a head of about four feet above river level. The casing of the borings was left in the ground and water was still running from the casing at Boring No.2 at the time of our visit.(See also our report S-500-501/T-258).

The excavation was drained by means of a sump pump and the bottom was inspected. Water only ran back in the hole at a very slow rate, most of it coming off the ground surface out of the above mentioned boring casing. The soil at the bottom appeared to be a dense silt in a saturated condition. No boiling was observed, not withstanding the fact that six feet of water had just been removed. Some pockets of medium to coarse grey sand were encountered in the silt.

2 August 1957.

In our opinion, as stated at the site, the silt is in a sufficiently dense condition to support the foundation loads recommended in our original report. Only if some coarse and granular lenses prove to be more extensive than foreseen, some boiling up in the excavation bottom might occur. In that case, drainage outside the excavation to a depth below the proposed footing depth, by means of well points, would be needed. If no water comes up through the excavation bottom, sump drainage would seem to be sufficient. The nearby borehole casing should be blocked with clay or concrete however, to stop the flow of water from the surface into the excavation.

Briefly, the conclusions after our visit can be described as follows:-

1. The silt at the bottom of the excavation is in a dense state and could safely be subjected to foundation loads as recommended in our report S-500-501/T-258.

2. The excavation can very likely be drained by means of a sump drain, provided the inflow from surface water is stopped by capping the adjacent borehole.

3. If unforeseen circumstances cause boiling up of the silt at the bottom of the excavation after sump drainage, a well point drainage system would be needed.

We trust that this will give you sufficient information and we thank you for this opportunity of having been of service to you. If there are further questions, please do not hesitate to let us know.

Yours very truly,
RACEY, MacCALLUM AND ASSOCIATES LIMITED

J.J.Schoustra.

JJS/MD
In duplicate