#56-F-205C

HWY #10

CULVERT AT

CREDIT RIVER

B.A.549

RACEY, MACCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

MONTREAL VANCOUVER

TORONTO

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TORONTO DIVISION
20 CARLTON STREET

Reference: S-500/T-487

5 November 1956.

Mr. A. M. Toye,
Bridge Engineer,
Department of Highways of Ontario,
280 Davenport Avenue,
TORONTO, Ontario.

Attention: Mr. S. McCombie

RE: FOUNDATION INVESTIGATION FOR
A CULVERT, AT THE CREDIT RIVER,
HIGHWAY 10 CROSSING, APPROXIMATELY
FOUR MILES NORTH OF CALEDON, ONTARIO.

Dear Sirs:

We have completed our investigation of subsoil conditions at the above noted site, and our report on the subject is attached hereto.

For your convenience, the conclusions of this report are as follows:-

1. Neglecting the organic materials above El.1311.5 feet, the subsoil at the site consists of uniform coarse grey silt, which is separated between El.1299.5 and 1292.5 feet by a layer of coarse gravel and boulders. The silt appears to be in a much denser condition below El.1292 feet, although there is evidence to suggest that the relative density of the upper silt is greater than standard penetration tests indicate.

2. The permissible bearing value and recommended footing depth, depends upon the type of culvert under consideration. A reinforced concrete box culvert would appear to require support on the dense gravel and boulder stratum encountered below El.1299 feet. The bearing capacity of this stratum and of the underlying silt, is quite high for either a rectangular footing or for short piles. Excavation difficulties in the silt below the river level, should be anticipated.

5 November 1956.

3. A corrugated steel culvert, founded on the upper silt, should be possible, provided a bed of well-graded sand and gravel is placed in the river before the water level is lowered. Filter and rip-rap protection at the entrance and exist of the culvert is also recommended. This protection should be carried above maximum anticipated flood level.

We shall be pleased to discuss any aspect of the foundation conditions at this site, in greater detail, if you so require, or if culvert designs other than assumed here are given consideration. We thank you for this opportunity to be of service to you.

Yours very truly,
RACEY,MacCALLUM AND ASSOCIATES LIMITED

W. Trow

W.A.Trow,P.Eng.,
Division Soils Engineer.

WAT/MD

FOUNDATION INVESTIGATION FOR A CULVERT,

AT THE CREDIT RIVER, HIGHWAY 10 CROSSING,

APPROXIMATELY FOUR MILES NORTH OF

CALEDON, ONTARIO.

Report No: S-500/T-487 Racey, MacCallum and Associates Limited

5 November 1956.

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ENCLOSURES

5 November 1956.

FOUNDATION INVESTIGATION FOR A
CULVERT, AT THE CREDIT RIVER,
HIGHWAY 10 CROSSING, APPROXIMATELY
FOUR MILES NORTH OF CALEDON, ONTARIO.

This report describes the results of a foundation investigation, consisting of two borings taken to a depth of forty two feet below the present ground surface, to determine the subsoil competence at the above noted culvert site. This work was carried out during the period from 10 October to 16 October, 1956, and was restricted to two borings because uniform subsoil conditions appeared to prevail. The locations of these borings, designated H2 and H3, are indicated on the attached sketch, enclosure no.1.

DESCRIPTION OF THE SITE AND OF THE SUBSOIL

The Credit River at this site, flows in a westerly direction along the northern base of a high hill, which rises toward the south and which appears to consist of densely-packed glacial till deposits, with erratic limestone boulders resting on its surface. A local well-driller reported that limestone bedrock lies about fifty feet below the surface of the top of this hill and, therefore, exists at a considerably higher elevation than present river level. In flood periods the river is reported to rise to each bank of its flood plain to the west, and to cover an adjacent access bridge, which is thirty two inches above present river level. The flood rise is, therefore, probably of the order of four feet.

The existing bridge shows no evidence of fatigue due to poor foundation conditions, and the present deterioration of the concrete in the structure is due to other causes. Residents in the area during construction of this bridge, believe that it was founded in the dense gravel which was encountered at El.1299 feet in this investigation.

The subsoil profiles, as determined by the two borings, are indicated in enclosures 2 and 3, and are relatively self-explanatory. Hole 2 showed a surface layer of six and one half feet of very spongy topsoil, which remained dry until the underlying sand and gravel stratum was encountered. The ground water then rose immediately to a level coinciding with river level. This coarse granular stratum had a thickness of approximately four and one half feet and was underlain by uniform grey silt, which extended to El.1299.3 feet. According to the empirical standard penetration test, which determines relative density on the basis of the driving resistance per foot required to drive a standard two inch O.D.split-spoon, under 350 foot pounds energy, this silt may be classed as loose to medium dense. However, measurements of its density, as determined on undisturbed shelby tube samples, indicates that it has a relative density of the order of 77 percent of the maximum possible obtainable. This was also noted for the silt deposits in the bridge investigation made approximately half a mile north of this site.

Below the silt between El.1299.3 and 1292.3 feet, was a seven foot stratum of dense gravel and boulders which, in turn, was underlain by uniform dense grey silt. This latter material continued at least to El.1278 feet, the maximum depth of the boring. The subsoil profile observed in hole 2 was closely duplicated in hole 3, near the north east corner of the bridge. The only difference between the two borings was the absence of the four foot sand and gravel stratum at El.1314 feet, and the less spongy nature of the topsoil in hole 3.

DISCUSSION OF THE RESULTS

Any recommendations regarding the most desirable depth for the support of the proposed culvert and the safe bearing value at this depth, will be determined by the type of culvert under consideration. The foundation problems associated with the support of a reinforced-concrete box culvert for example, will conform in large part, to those requiring attention in the design of a regular bridge structure. In that instance, the most suitable depth for transmitting the footing load is at El.1299 feet, the top of the gravel and boulder stratum. The bearing capacity at this depth will be quite high and of the order of 8000 p.s.f. for a rectangular footing. For short piles it is probable that refusal will be encountered in this coarse granular soil, although some piles may penetrate into the underlying silt. The safe bearing capacity, in tons, of such piles will be approximately equal to thirty times the area in square feet of each pile point. A load test would be required for greater precision.

The silt overlying the gravel and boulder stratum is not recommended as a medium of support, despite earlier opinions regarding its probable in-situ relative density, because of the danger of obtaining a looser or quick condition during excavation below the water table. Control of a quick-sand condition at this site would only be obtainable by a combination of a cofferdam to hold back the river, and a vacuum well-point system to stabilise the silt. Because of the low permeability of the silt, this system would have to be in operation for a few days before excavation could proceed.

Because of its flexible nature, a corrugated steel culvert is more tolerant of the foundation conditions it requires and, therefore, support on the upper stratum of silt would appear to be quite permissible. Installation of this type of culvert in the dry state, must also anticipate a quick sand condition in the silt, unless control measures are taken. One method of control is to place a layer of well-graded sand and gravel in the river bed before the water is diverted. Some dredging may be required to clean the river bed prior to installation of this material, and about two feet of this mixture would be necessary to overcome any segregation of particles and to ensure that a good filter is obtained. This filter should help to control the movement of the silt after the river has been diverted for construction purposes. The use of a well-graded filter and rip-rap at the entrance and exit of the culvert, will also be necessary to avoid the undermining effects of stream flow after the culvert is in operation.

CONCLUSIONS

The comments presented in the foregoing section can be summarised as follows:-

1. Neglecting the organic materials above El.1311.5 feet, the subsoil at the site consists of uniform coarse grey silt, which is separated between El.1299.5 and 1292.5 feet by a layer of coarse gravel and boulders. The silt appears to be in a much denser condition below El.1292 feet, although there is evidence to suggest that the relative density of the upper silt is greater than standard penetration tests indicate.

2. The permissible bearing value and recommended footing depth,depends upon the type of culvert under consideration. A reinforced concrete box culvert would appear to require support on the dense gravel and boulder stratum encountered below El.1299 feet. The bearing capacity of this stratum and of the underlying silt, is quite high for either a rectangular footing or for short piles. Excavation difficulties in the silt below the river level, should be anticipated.

3. A corrugated steel culvert, founded on the upper silt, should be possible, provided a bed of well-graded sand and gra el is placed in the river before the water level is lowered. Filter and rip-rap protection at the entrance and exit of the culvert is also recommended. This protection should be carried above maximum anticipated flood level.

W. Trow

W.A.Trow,P.Eng.

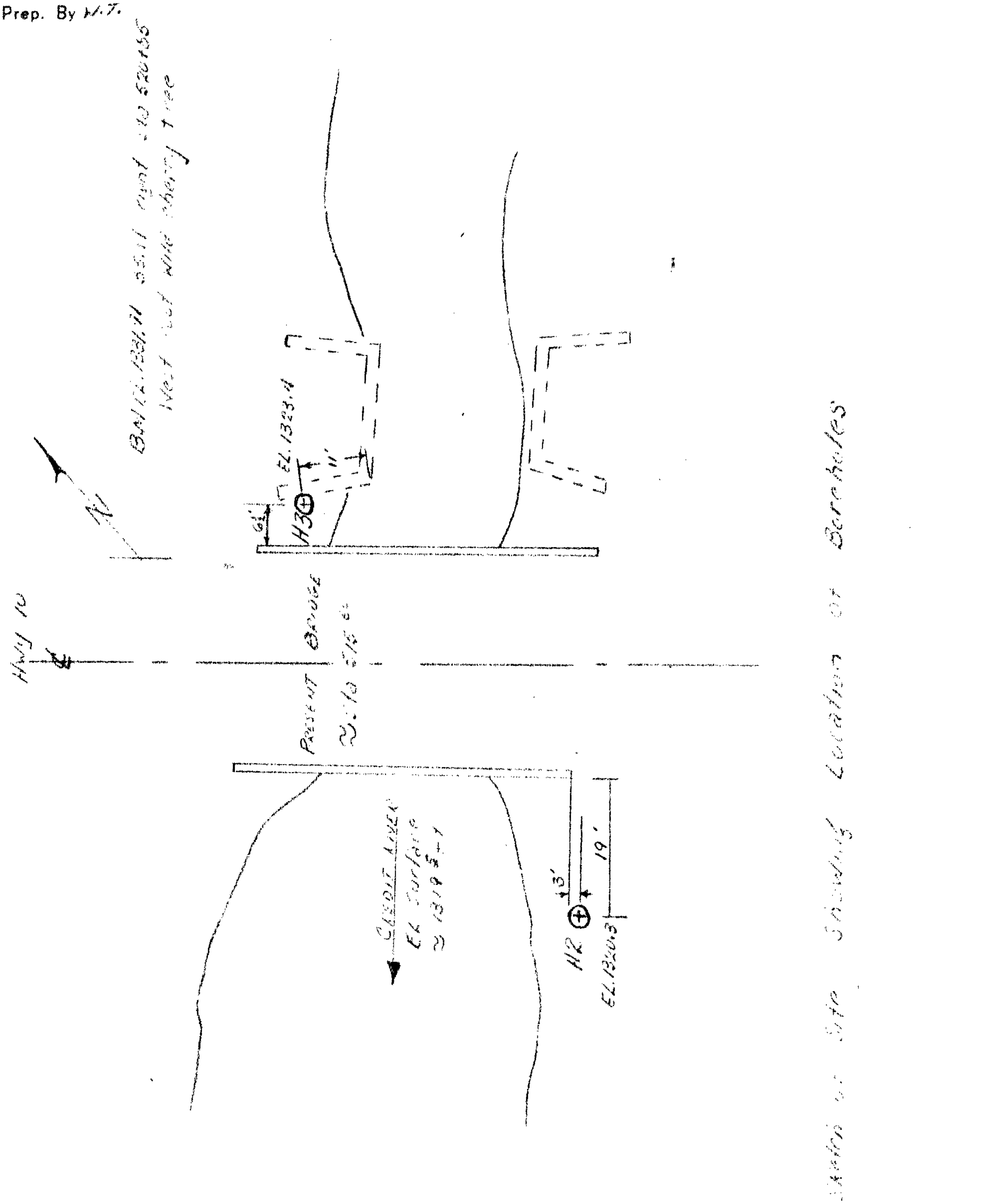
REGISTERED PROFESSIONAL ENGINEER
CIVIL
W. A. TROW
PROVINCE OF ONTARIO

WAT/MD
In quadruplicate

Order No. 5500/T 457

Enclosure No. /

Prep. By M.T.



Racey, MacCallum & Associates Ltd.

Encl. No. 2

Order No.: 5500/T 437

RACEY, MacCALLUM AND ASSOCIATES LIMITED

Foundation Engineering Division

Driller: L. B.

Hole Begun

Helper

Hole Ended

Engineering Data Sheet for Borehole: 2

Checked by

Job Name: Credit River Bridge @ Sta 515+50 Hwy 10

Job Located: Approx 4 miles north Caledon Ont

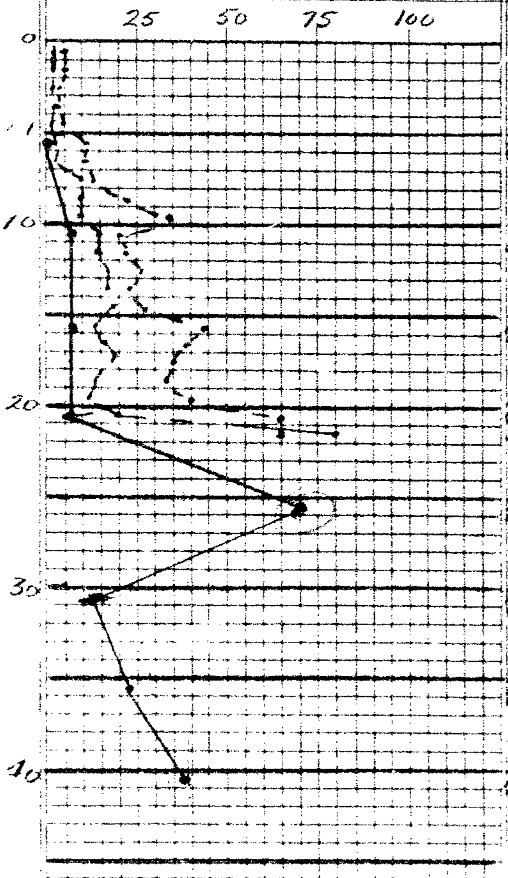
Hole Located: See encl. [illegible]

Hole Elevation: 1320^3 Datum: Geodetic El 1331.^{91}

Day Month Year

DEPTH	EL.	THICKNESS	SYMBOL	DESCRIPTION	SAMPLING METHOD
	1320^3			Ground Surface	
				Black spongy peat	
				ground water rose to [illegible] [illegible] to [illegible] sand	
6.5	1313^8			Med. sand and medium to large rounded limestone gravel	SS 1
11	1309^3				SS 2
				Uniform grey silt	SS 3
					SS 4
21'	1299^3			Dense gravel and boulders	255 150 300 210 SS 5
23'	1292^3			Uniform dense grey silt	SS 6
					SS 7
				End of Bore	SS 8
42'					

TABULAR VALUES Blows/Ft.



Legend

SS = 2" O.D. split spoon

—•—•— Blows/ft 2" SS. 350 ft lbs energy

— — — Blows/ft 2" cone 350 ft lbs energy

- - - - Blows/ft 3" casing

Encl No. 3

Order No.: S500/T487

RACEY, MacCALLUM AND ASSOCIATES LIMITED

Foundation Engineering Division

Hole Begun ____________

Hole Ended ____________

Engineering Data Sheet for Borehole: 3

Driller ____________

Helper ____________

Checked by ____________

Job Name: Credit River Bridge ≈ Sta 515+50 Hwy. 10

Job Located: Approx 4 mi North Caledon, Ont

Hole Located: See encl. No. 1

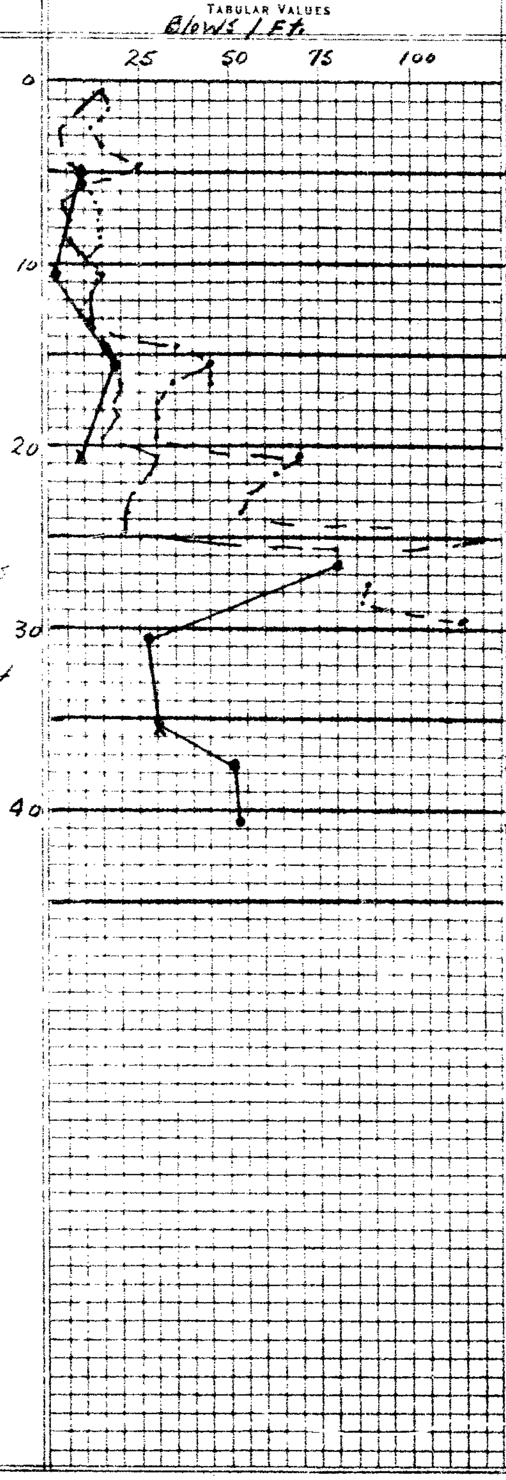
Hole Elevation: 1323.4 Datum: Geodetic El 1331.91

Day Month Year

DEPTH	EL.	THICKNESS	SYMBOL	DESCRIPTION
	1323.4			Ground Surface
				Black sandy top soil
				ground water level at river level
12	1311.4			Med. dense coarse grey silt
24	1299.4			Rounded gravel & boulders
31	1292.4			Uniform dense grey silt boulder at 35 ft
				End of bore

Legend See encl. No. 2

TABULAR VALUES



SAMPLING METHOD

SS1
SS2
SS3
T.W.4
SS5
T.W. lost
SS6
SS7