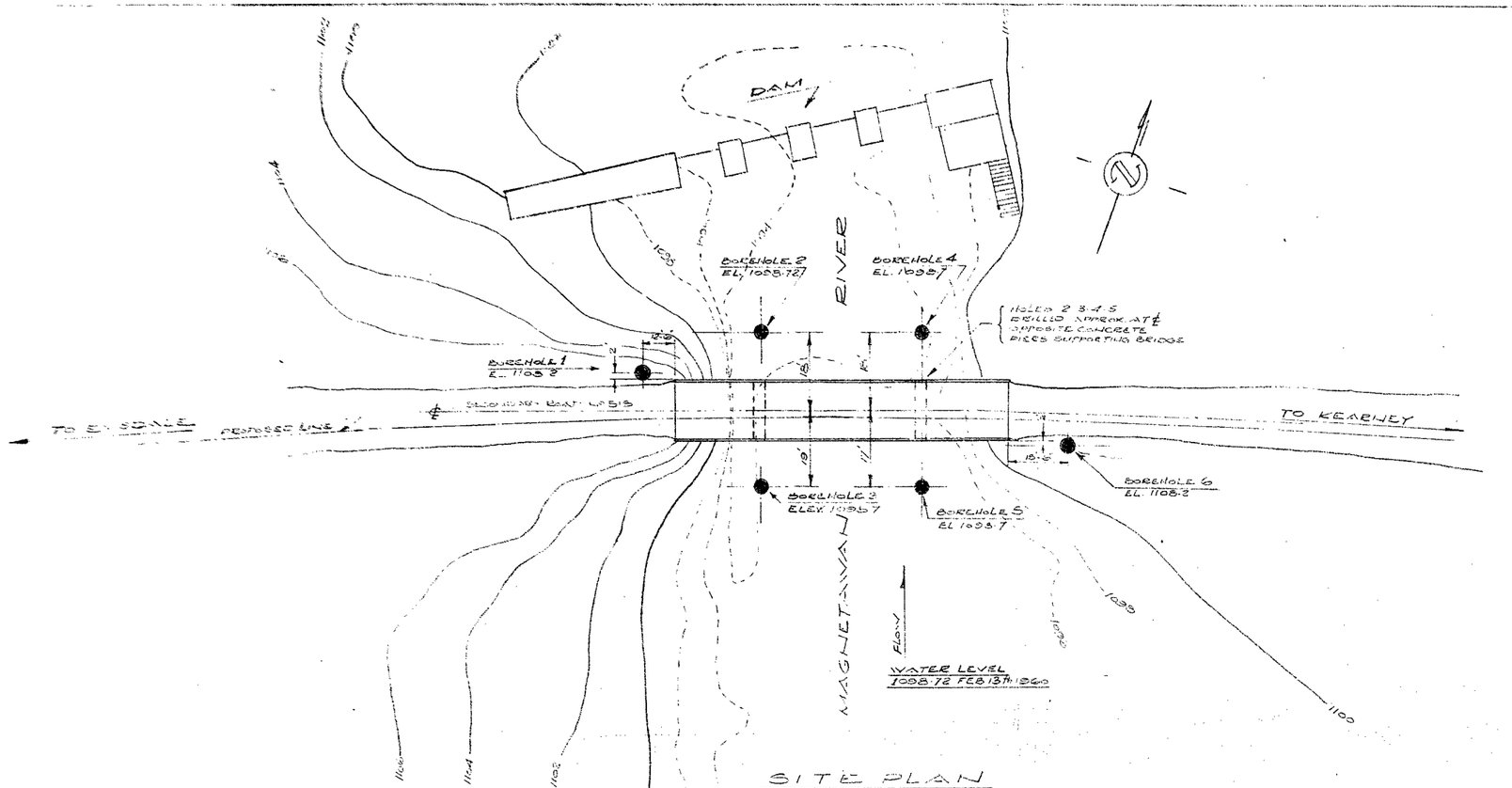
60-F-309C
W.P. 223-59
Hwy. #518

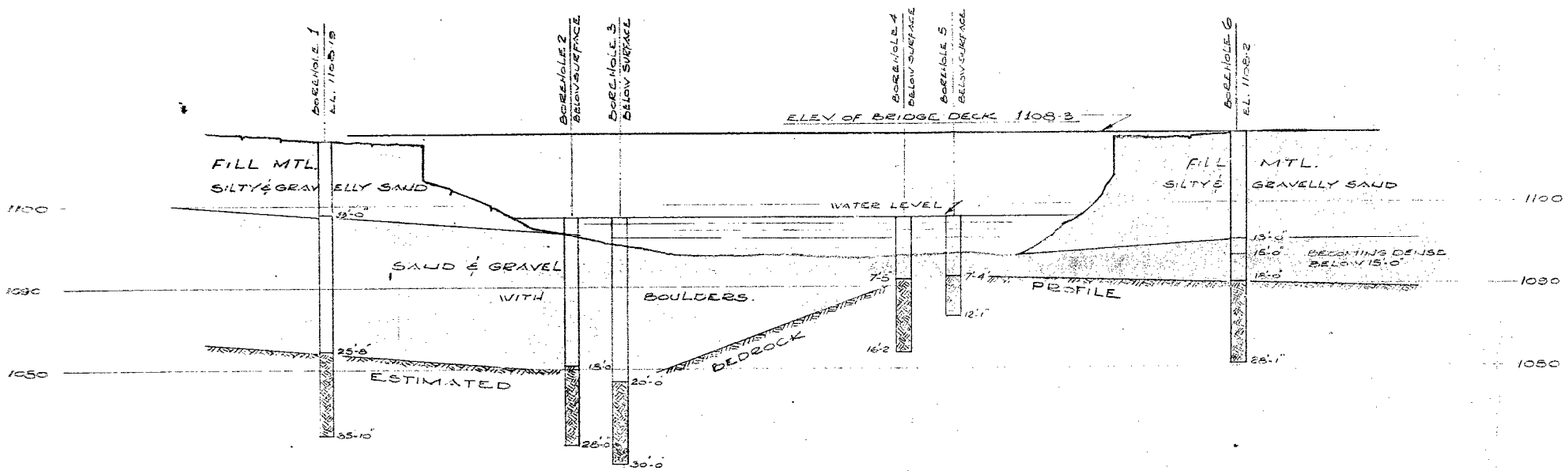
MAGNETAWAN RIVER



SITE PLAN

SCALE 20' 1"

TEMPORARY BENCHMARK
IN SOUTH WEST ROOT
OF TWIN BIRCH 1116.09



SECTION ON HOLES 1 & 6 WITH HOLES 2-3-4-5 PROJECTED INTO LINE

HORIZONTAL & VERTICAL SCALE 10' = 1"

NOTE: SEE ATTACHED BOREHOLE LOGS FOR COMPLETE SOIL DATA.

THE STRATIGRAPHY SHOWN BETWEEN BOREHOLES IS INFERRED AND MAY DIFFER FROM THAT EXISTING.

DHO PROJECT No WP 223-59

REGISTERED PROFESSIONAL ENGINEER E. M. PETO PROVINCE OF ONTARIO

e.m. peto & associates ltd.

SOIL SITE INVESTIGATION
AT
MAGNETAWAN RIVER/HWY 518
KEARNEY
FOR
DEPT. OF HIGHWAYS OF ONTARIO

CUR JOB No. 59361	DATE 24 FEB/60
CLIENTS PLAN No. E 36001	PER. G. J. M.

cc: Mr. D. C. Ramsay

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Section.

March 9, 1960.
FOUNDATION REPORT - by
E.M. Peto Associates, Ltd.

Attention: Mr. S. McCombie.

Re: Magnetawan River Bridge,
Kearney, Ont. - Hwy. 518,
W.P. 223-59 - District 11.

The detailed foundation report completed by E.M. Peto & Associates, has been reviewed by this Section. Comments arising from the review of this report are stated below:-

1. Both the existing approach fill material and the overburden material are essentially granular. Some boulders were encountered in the overburden.

2. Possible types of foundations include a combination of spread footings on rock and steel 'H' piles, drilled-in caissons, or a rock-filled timber crib.

   (a) Combination of spread footing and piled foundation:- As proposed by the Consultant, the East pier and abutment may be founded on bedrock at approx. elevation 1090.0'. These footings would be approx. 9 feet below water level. Dewatering of this excavation will be difficult and a tremie concrete may best be specified. If sheet piling is called for, heavy sections should be used since difficult driving is anticipated. Large boulders should be removed from the surface before attempting to drive the sheet piling. The depth of penetration of sheet piling, as seen from boreholes 4 and 5, will be small. If a braced sheet pile cofferdam is attempted, and dewatering of this cofferdam is suggested, a tremie concrete seal at the bottom, will be required to prevent a large influx of water from the irregular bedrock surface.

cont'd. /2 ...

Types of foundations: (cont'd.) ...

2. (a) cont'd. ....

At the West abutment and pier, steel 'H' piles, driven to bedrock at approx. elevation 1082', may be used. If it is desired to use spread footings for the West pier and abutment, these footings may be designed for a bearing pressure of 3 T/ft.^{2} at elevation 1090' in the vicinity of Boreholes 2 and 3, and elevation 1099' in the vicinity of Borehole 1. Steel sheet piles will probably meet refusal to driving at from 4 to 5 feet from the bedrock surface, while steel 'H' piles should penetrate to the surface of the bedrock. A 14" steel 'H' pile at 73#/ft. may be designed to carry a load of 50 tons.

(b) Drilled-in caissons will provide excellent support for the proposed structure. No dewatering problems would be associated with this type of design.

(c) A rock-filled crib may possibly be the simplest and cheapest type of foundation for the proposed structure. The crib may be placed directly on the surface of the overburden, if sufficient scour protection is provided. The height of crib required for this location may be beyond that considered feasible, and thus rule out this alternative.

3. No problems associated with the stability of the approach embankments are anticipated at this site.

If we can be of further assistance in connection with the design of the foundations for this structure, please contact the Foundation Section.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.
per:

K. Peaker

(K. Peaker,
FOUNDATION SUPERVISING FIELD ENGR.

KP/MdeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. C. Ramsay
G. K. Hunter
H. C. Dernier
P. Arkema
A. Watt
Foundations Office
Gen. Files.

e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:- 66281

1287 caledonia road,
TORONTO 19, ONTARIO.
RUssell 9-1126
March 4, 1960.

60- F- 309c

Soil and Foundation Engineering Branch,
Department of Highways of Ontario,
Downsview, Ontario.

Attention: Mr. K. Peaker, P. Eng.

Re: Magnetawan River Bridge
Kearney, Ontario. Highway 518
District 11, Huntsville
H.P. 223-50

Dear Sirs:

We have pleasure in enclosing herewith ten (10) copies of our report covering the sub-soil conditions, the condition of the existing bridge, temporary diversion routes, etc., for the above mentioned project. Preliminary borehole logs of the field results from test holes 1 and 6 were forwarded February 15th and 17th during progress of the work.

For your convenience, we summarize here very briefly the information set out in some detail in the body of the report:

1. The foundations of the existing bridge appear to be quite sound, considering the age of the bridge, although some deterioration of the upstream and of the East pier has developed. The outer bridge beams are spalling rather badly in several places. The bridge parapet walls are holed in numerous places and are in a serious state of disrepair. The bottom of the deck is sound.

2. Both a North and South diversion route is available during bridge construction. We recommend the South route since it is much shorter and therefore will require less maintenance, less widening and less brush clearance at the numerous blind corners.

2. Cont'd. In view of the rather frequent usage of the highways by logging trucks, the existing road width over much of the alternative routes is sub-marginal; we therefore recommend consideration of the use of a Bailey Bridge by-pass either, to the North, or South of the existing bridge.

3. Both of the existing bridge approaches are constructed of rather loose gravelly sands; the West approach fill is 9 ft. thick, the East approach fill is 13 to 15 ft. thick.

The original overburden soil is basically sand of various grain sizes, with considerable gravel content, and liberally supplied with boulders. The original overburden is about 12 to 16 feet thick at the West abutment and pier, and 3 to 4 feet thick at the East abutment and pier. This non-cohesive soil ranges in density from compact to extremely dense.

The bedrock is banded biotite gneiss. The bedrock elevation ranges from 1078 to 1082 feet at the West abutment and pier, to about 1090 to 1091 feet at the East abutment and pier.

4. Since bedrock appears to be only 7 to 8 feet below water level at the East abutment and pier, it seems practical to consider founding any new pier and abutment on the bedrock, using a suggested bearing value of 20 to 30 tons per sq. ft.

5. Assuming provision of adequate frost cover with rip-rap protection against scour, the foundation of the West abutment could be placed as high as elevation 1097, i.e. about 2 feet below water level, using an allowable bearing value of approximately 3.5 tons per sq. ft.

The foundation for the West pier should be placed about 6 ft. below water level, i.e. at about elevation 1089, using an allowable bearing value of 4.0 tons per sq. ft.

6. If it is considered undesirable to carry the East foundations on unyielding rock and the West foundations on overburden which may consolidate, however small, under new load, it may be desirable to carry the West abutment and piers on piles driven to bedrock. We would recommend steel H piles in this case, although considerable difficulty may be anticipated with boulder and gravel interference.

7. We understand that the maximum flood level rise at this river site is only some 2 feet. During the period of the soil investigation, the water level variation was less than 0.25 inches from the recorded elevation of 1098.72 feet. Generally the soil conditions and our observations do not suggest that scour is a major problem at this site.

We trust that we have supplied the required information. However, if there are any points which you would like to discuss with us or about which any further information is desired, we would be pleased to be of assistance.

Yours very truly,

E. M. PETO ASSOCIATES LTD.

E. M. Peto, P. Eng.

EMP/vs

DEPARTMENT OF HIGHWAYS OF ONTARIO

SOILS REPORT

for

MAGNETAWAN RIVER BRIDGE - HIGHWAY 518

KEARNEY, ONTARIO.

March, 1960.

e. m. peto associates ltd.

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2. Appendix A

Description of Alternate Routes

Sketch showing Alternate Routes

Topographical print of general area of site

3. Appendix B

Table of Cone Penetration Test Results

4. Appendix C

Method of Operation

e. m. peto associates ltd., 1287 caledonia road, Toronto 19, Ontario

Job No. 59261 Client's Ref. No. Date March 2, 1960.

Report on

SOIL SITE INVESTIGATION

MAGNETAWAN RIVER BRIDGE - HIGHWAY 518

KEARNEY, ONTARIO

for

DEPARTMENT OF HIGHWAYS OF ONTARIO

INTRODUCTION:

We were authorized by letter dated December 18, 1959, from Mr. A. Rutka, acting Materials and Research Engineer, to carry out a foundation investigation at the existing bridge on Highway 518 over the Magnetawan River near Kearney. This work is under D.H.O. project number W.P.223-58, District 11, Huntsville.

The investigation was to be carried out in accordance with a marked site plan and verbal instructions given to our Mr. D. E. Hitchins on December 15, 1959, by Mr. K. Peaker. The programme initially called for the following work:

a) Test holes 1 and 6, at the Northwest and Southwest corners of the existing bridge, driven to prove bedrock, if possible, or at least 15 to 20 feet or very good bearing medium.

b) Test holes 3 and 4 at diagonally opposite ends of the piers to locate bedrock or adequate bearing.

c) Test holes 2 and 5 to be limited to cone penetration tests if soil conditions appear uniform and excellent.

d) Mr. Peaker requested that all 6 test holes prove bedrock by drilling 10 feet if rock is encountered near the stream bed.

e) Cone tests to precede the BX holes in each case.

INTRODUCTION: Cont'd.

f) Hole 4 to be driven with 4" casing for large diameter samples if soft cohesive soils are encountered to depth.

PROGRAMME OF WORK:

The field work was carried out in accordance with our standard procedure as described in Appendix C.

The field crew with drill rig unit no. 4 arrived on site simultaneously with the Field Engineer at 8:00 a.m. on February 9, 1960. The raft for the pier test holes was unloaded and assembled in the water. The drill rig equipment was unloaded and the rig set up on a platform built up at test hole 1.

Work proceeded rather slowly the first week, hindered initially by the snow on the site, then by two days of intermittent rain and sleet, followed by severe cold weather which slowed the start of work each morning. The casing broke as bedrock was reached at test hole 1 and the hole had to be re-driven when attempts to "fish" the casing failed. The casing also broke at test hole 1A, but was removed and the bedrock refusal was cored.

Test hole 6 was then driven at the diagonally opposite end of the bridge without trouble.

The equipment was set up on raft and test holes 2 and 4 on the downstream side of the bridge were completed. The casing refusal on a boulder at hole 4 and the core barrel sanded in below the boulder on the second run; 50% of the core in the tube was lost in extricating the core barrel. At test hole 3, the BX casing shattered on a boulder at the 12 to 14 ft. depth. 4" pipe driven over the BX casing was also damaged. AX casing was drilled through the boulder after coring both the BX casing pieces and the boulder with the AXT core bit.

The equipment was then moved over to the upstream side of the bridge (the bridge clearance was too low for the raft and the machine) and test holes 8 and 5 were complete. Progress at hole 5 was hindered by boulders which were alternately cored through with AXT bit and then reamed through with AX casing.

Test hole 5 was completed on February 22, 1960; the equipment was dismantled and loaded, and the crew returned to Toronto the same evening.

REPORT OF EXISTING BRIDGE:

The existing bridge serves Highway 518 crossing the Magnetawan River at a point approximately two miles West of the village of Kearney, in the Township of Perry.

The structure is a 3 span reinforced concrete bridge with thin concrete parapet walls. These walls have been rather badly damaged; the 2" thick panels contain numerous holes, some of the posts at 10' centers have been damaged, the northwest end post has been ripped out, and the concrete curb forming the base of the wall has been knocked away in several places, even to the extent of severe deterioration of the edge of the bridge deck at these points.

The bridge abutments originally consisted of open bents; the west abutment has been closed with heavy logs, but one log has fallen out and the sand fill is spilling through, undoubtedly causing a depression in the road surface each Spring. The East abutment has been back filled with rock fill which has spilled through the abutment.

The two piers of concrete appear to rest on rock-filled timber cribs. The East pier has been damaged at the upstream side and a steel "prow" has been fitted to protect the concrete pier.

The underside of the bridge deck appears completely sound; however, we are advised that the upper surface has been badly damaged by road salts, and a heavy wearing surface of asphalt was applied several years ago after surface treatment of the concrete deck.

The road deck is supported by four re-inforced concrete beams. The center two beams appear to be in excellent condition; so also are the two outer beams under the longer center span, except for minor spalling of the North side beam. However, the two outer beams under both the East and West short approach spans have spalled very badly in one or two places, particularly under the West span. The bottom reinforcement (4 straight bars and 2 bent up at the 1/3 points) is completely bare on the South side of the West span.

Apart from the rather appalling condition of the parapet walls, the concrete spalling of the outer bridge beams and the decay of the upstream face of the East pier, the bridge appears to be in remarkably good condition considering its age (51 years, we were advised by a local resident). The deterioration of the bridge walls is probably largely due to calcium chloride in the snow, slush and water, liberally splashed up by the lumber trucks during the milder weather.

SITE DESCRIPTION:

This region is very hilly; many of the valleys appear to contain ponded water, thus the area is dotted with numerous small lakes.

The site is located at the bottom of a small valley with high ground to both the East and West. The Magnetawan River flows to the North through the bottom of the valley.

SITE DESCRIPTION:

An H. E. P. C. water level control dam is situated about 30 yards below the North side of the bridge. The dam contains four sluices built between rock filled timber cribs; these cribs were encased in ice and snow, but one crib was cleared off and appeared to be in excellent condition. The water was approximately 12" deep over the sluices. The water remained shallow, between 12" and 24" deep, for a distance of about 15 feet back from the timber crib, then the bottom slopes down rapidly and the water is some 3 to 5 feet deep from there to the bridge.

Below the dam, the water is shallow and rapid; many of the rocks were snow and ice covered above water level. The river upstream of the bridge is ice covered. Shore edge ice also exists between the dam and the bridge. The ice and snow bridges over the lip of the dam above the sluices were broken out to avoid danger of damming due to ice floes in mild weather.

The valley and river more than double in width immediately upstream from the bridge; we understand that the East half of the widened river is actually marsh land under the present ice cover.

We were advised by local residents that the ridge of high ground to the West of the site consists of bedrock with a mantle of about 8 feet of soil. The heavy snow and ice cover at the time of the field work, besides hindering the speed of operation to some extent, prevented more detailed examination of the local topography.

SOIL CONDITIONS:

No attempt has been made to delineate on the borehole logs and soil profiles any stratification apart from a) fill, b) sand and gravel overburden, and c) bedrock surface.

a) Fill soils

The approach road to each abutment has been built up some 10 feet above the present water level. Thus, the surficial soils to varying depths at holes 1 and 6 are loose fills. The fill material is basically sand and gravel, generally brown in colour, and varying from silty fine sand with pebbles to a fine to medium to coarse sand with stones. Some organic matter, pieces of decaying wood, etc., was noted in various samples.

Most of the fill above the river water level was classified visually as moist or slightly moist; the excessively high natural moisture contents indicated in the upper 6 feet at hole 6 are probably due to silt or organic content, rather than the excessive moisture. Below the water level, of course, samples were wet or saturated.

SOIL CONDITIONS:

a) Fill soils - Cont'd.

The fill is generally very loose to loose, with N values ranging from less than 4 to a depth of 13. The depth of fill at test holes 1 and 6 appeared to be as follows:

Hole No.	Ground Elevation	Depth of Fill	Elevation
1	1108.2	9'0"	1099.2
6	1108.2	15'0"	1093.2

The original ground elevation at hole 6 may actually be nearer 1095.0 where the last evidence of decaying timber was noted, but the soil was not dense at this test hole until the 15 ft. depth.

b) Natural overburden

The natural overburden was encountered between various depths and elevations at each hole as given below. In the case of test holes 2, 3, 4 and 5, the top surface of the overburden constitutes the river bottom.

Hole No.	Upper Surface Depth - Elevation		Lower Surface Depth - Elevation		Thickness
1	9'0"	1099.2	25'8"	1082.5	16'8"
2	5'8"	1093.1	18'0"	1080.7	12'8"
3	4'0"	1064.2	20'0"	1078.7	15'9"
4	3'0"	1096.7	7'5"	1091.3	4'5"
5	4'4"	1054.4	7'4"	1051.4	3'0"
6	15'0"	1093.2	18'1"	1090.1	3'1"

The overburden consists of generally brown fine to medium sand with numerous stones and boulders. Layers and seams of gravel were noted, as for instance from about 8 feet to 10 feet at hole 3, and seams of grey silty very fine sand were noted at about the 11 ft. depth also at hole 3.

Generally the natural overburden is dense to very dense, with the following exceptions;

SOIL CONDITIONS:

b) Natural overburden - Cont'd.

Hole 1 from about 17' (elevation 1091.0) to near refusal at about 25' - compact only

Hole 2 from river bottom, 4'6" (elevation 1094.2) to about 8' below water surface - compact only

Hole 4 from river bottom 3'0" (elevation 1095.7) to about 5' below water surface - compact only

The river bottom in the area of test hole 5 was virtually a continuous mat of boulders up to 2 ft. or more in diameter.

c) Bedrock

Bedrock was encountered at various depths at all six test holes, as follows:-

Hole No.	Depth	Elevation
1	23'8"	1082.5
2	12' 0"	1089.7
3	30'0"	1078.7
4	7'5"	1091.3
5	7'4"	1091.4
6	15'1"	1090.1

Despite considerable variation in the colour of the rock core obtained from the various test holes, the bedrock appears to be basically all a banded gneiss. Most of the rock core is a biotite gneiss, in some places spotted with garnet. The colours range from buff to pinkish-grey to medium grey banded with light and dark grey. The rock is, of course, very hard. No open or water-bearing seams were noted.

The core recovery was generally excellent; some difficulty ensued in breaking off the core at the end of the run, since the rock did not "mud" well and did not break off readily.

SOIL CONDITIONS:

c) Bedrock (Cont'd.)

The results at hole 4 were poor due to sanding in of the core barrel at this hole below the boulder on which the casing refused; for this reason, and since refusal depth was very shallow, hole 5 was also cored for 5 feet to provide better confirmation of bedrock.

The rods with cone were driven to 20 feet below surface at hole 2 before driving this test hole, which ultimately refused at only 18' below surface. The badly damaged condition of the driving rods carrying the 60° cone suggests that the bedrock surface may be inclined at this test hole location.

At test hole 1, the casing broke off at refusal at approximately 27'8" below grade. At hole 1A some 18' to the West, the casing refused (and broke again) at only 25'8" below surface; this suggests again that the bedrock surface is inclined at this test hole location.

WATER CONDITIONS:

As might be expected, the water level in the casing at the four pier location test holes corresponded with the river water level, elevation 1098.7 ft.

The samples at test hole 1 were wet at 10 to 11 feet depth, i.e. at approximately elevation 1098.0. The water level on completion before pulling casing was 11'2" (elevation 1097.9).

At test hole 6, the water level in the hole was 10'1" (elevation 1098.1) after sampling to 13 ft., again corresponding with the river water level.

The level of the water in the river was checked daily from February 13, 1960, and remained at elevation 1098.7 feet with a maximum variation of only 0.25 inches. The surface velocity varies from approximately 0.8 feet per second under the center of the bridge to approximately 3 to 4 feet per second over the sluices.

OBSERVATIONS AND CONCLUSIONS:

1. The existing structure is supported on open abutments and on piers apparently carried on rock-filled timber cribs.

OBSERVATIONS AND CONCLUSIONS: Cont'd.

1. Apart from rather severe deterioration of the concrete walls, and to a lesser extent of the bottoms of the outer bridge beams, the bridge shows no signs of failure. There are no indications of any settlements. The East pier prow has been damaged, probably by a combination of weathering, ice and water scour, and has been repaired with steel plates. The underside of the bridge deck is sound.

2. We understand that consideration is being given to a new structure constructed to a grade line some 12 to 14 feet above the present bridge (elevation 1108.8) in order to minimize the present gradient on both approaches, but using approximately the same spans.

3. The abutments for a new structure may be founded as follows:

a) For the West abutment, on footings placed at elevation 1097.0 +, providing sufficient fill protected by rip-rap can be placed on the water side of the abutment to provide adequate protection against frost. We would suggest limiting the allowable bearing value to 3.5 tons per sq. ft. in view of the less dense condition some 6 feet below this elevation in order to avoid any danger of undue construction settlement of this abutment.

b) For the East abutment, on footings placed below elevation 1092.0 +, using an allowable bearing value of 4 to 5 tons per sq. ft. If there is a considerable horizontal thrust component to the abutment design, then it may be expedient to place the footings keyed into the bedrock at approximately elevation 1090.0.

The allowable bearing value for this rock is at least of the magnitude of 20 to 30 tons per sq. ft.

4. The piers for the new structure may be founded as follows:

a) For the West pier, on footings placed approximately 6 ft. below water level, i.e. at elevation 1089.0 +, using an allowable bearing value of 4 tons per sq. ft. The soil is so dense below this elevation that this figure is undoubtedly conservative.

OBSERVATIONS AND CONCLUSIONS: Cont'd.

4. b) For the East pier, the footings may be carried on the bedrock some 7 to 8 feet below water surface, i.e. at approximately elevation 1091.0 ± .

5. As an alternative, both the abutment and the pier on the West side may be carried on steel H piles driven to bedrock, particularly if the East pier and abutment are supported directly on rock and little or no differential settlement can be tolerated. Considerable difficulty will be encountered, both with boulders and dense sand and gravel layers, whether H piles are driven, or steel sheeting for cofferdam is considered.

6. We understand that the maximum rise and fall at the bridge site is limited to about 2 feet by the H. E. P. C. control dam just to the North of the bridge. Scour at the bridge piers is therefore not considered a major problem, although some protection must be supplied; we have the impression that the boulders upstream of the East pier were placed there as scour protection in the past.

7. During construction, we favour the use of a temporary Bailey bridge diversion at the construction site. If this suggestion is considered uneconomic, then we would recommend the use of alternative route A to the South; this would entail some widening and bush clearance of the numerous sharp corners in order to avoid danger of head-on collision with the surprisingly heavy traffic, including numerous logging trucks using this route.

8. There was no indication of any artesian water condition at any of the test holes, nor was there evidence of any "quicking" condition in the sand and gravel overburden.

E. M. PETO ASSOCIATES LTD.

C. F. Freeman, P. Eng.
Chief Engineer.

EMPiVs

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name (Kearney) Magnetawan River-Hwy.518 | Job No. 59261 | Borehole No. 1

Client Dept. of Highways, Ontario. | Casing BX | Boring Date Feb. 9th. 1960

Datum D.H.O. (Geodetic) | Compiled By E.M.P. | Checked By G.T.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- C. SOIL SHEAR STRENGTH LBS/SQ.FT.
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
									Used wash water below 13'
Snow packed surface			0'0"						
snow, approx. 8"			1108.2						
Gravelly fine to med. sand	Lt. brown		2'4"						
Fine sand	Lt.yellow brown	compact			1	s.s.	13	8.7	Almost dry
" "	Lt.red brown								
Pieces of wood			5'0"						
Fine sand, some silt	Brown	Loose			2	s.s.	6	9.6	Slightly moist
As above	As above				3	s.s.	6	11.5	Slightly moist
		Loose	9'0"						(Fill To 9')
Coarse sand & gravel to 2" dia.			1099.2						
Fine to coarse sand, some stones, (2" seam of fine gravel, black)	As above	Ex. dense			4	s.s.	86	11.8	V. moist to wet becoming wet at 11'6"
Fine to coarse sand with gravel	Brown	As above			5	s.s.	200/10"	20.0	Wet
			15'0"						
		As above			-	s.s.	233/3"		
Fine gravel & coarse sand	Multi.coloured gravel				6	w.s.	-	-	(casing blows dropped below 17')
			20'0"						
As above (stones to 1½" dia.)	grey Br.	Compact to dense			7	s.s.	28	-	saturated
			25'0"						
					-	s.s.	47	-	
Refusal at 27'3"			27'3"						
					Casing broke off at 22'				
		MOVED 18" west and washed casing to 25'							Hole 1A
			HOLE 1 A						
									Lost wash water at bottom of casing while drilling
Hole 1 A refused at 25'8"									
Diamond drilled with AXT	core barrel.		25'8"						
			1082.5						
Banded Gneiss	medium to dark grey with Lt. grey bands					R.C.	-	-	100% recovery AXT core (16 fractures, longest piece 10")
			30'9"						
Banded Gneiss	As above					R.C.	-	-	No core ground, 5" piece dropped out of bit, otherwise 100% recovery
			35'10"						
			1072.4						
		TEST HOLE TERMINATED AT 35'10"							

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name (Kearney) Magnetewan River Hwy. 518 | Job No. 59261 | Borehole No. 2

Client Dept. of Highways, Ontario. | Casing 4" Pipe - BX-AX | Boring Date Feb. 17th. & 19th. 1960

Datum D.H.O. (Geodetic) | Compiled By E.M.P. | Checked By Sam

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- C. SOIL SHEAR STRENGTH LBS/SQ.FT.
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Water surface			0'0" / 1098.7						
River Bottom at 5'6"			5'6" / 1093.2						
Fine to coarse sand with gravel	Brown	Compact			1	S.S.	22	–	Saturated
			10'0"						Dense below 10'
Coarse sand & fine gravel boulder at 12'5"	brown	V. dense	12'5"		2	S.S.	152/10"	–	Saturated Bottom of B casing shattered betwee 12'5" & 14'6" 4" pipe damaged at 12'5
Fine sand with gravel & small boulders	brown	dense							AX casing drilled from 11'6" drilled through broken casing AX casin ~~drilled to 18'3"~~
Bedrock at 18'0" +			17'4" / 18'0" / 1080.7						AXT core barrel run fro 17'4" to 23'0" i.e. 5'8
Gneiss, some banding	buff, grading to pinkish grey and then to Lt. grey				–	R.C.			& recovery 4'10"
Banded gneiss			23'0"						
Banded gneiss (Garnet biotite gneiss)	Pinkish grey banded with dark grey		25'0"		–	R.C.			Drilled 5'0" (core barre full, but bottom 8" fe out of bit)
			28'0"						
		HOLE TERMINATED AT 28'0"							

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

(Kearney)

Job Name Magnetewan River-Hwy. 518 Job No. 59261 Borehole No. 3

Client Dept. of Highways, Ontario. Casing 4" Pipe - BX Boring Date Feb. 19th. & 20th. 1960

Datum D.H.O. (Geodetic) Compiled By Sam Checked By E.M.P.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
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ABBREVIATIONS

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- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
									Water level in casing
Water surface			0'0"						equal to river surface
			1098.7						(no Artesian condition)
River Bottom			4'6" 1094.2						
									Drove 4" Pipe to 9'10"
Sand with gravel and small boulders	Brown								
									V. dense gravel from 8' to approx. 10'
			9'10"						
Fine to coarse sand & gravel changing at 10'10" to silty very fine sand (stones)	Brown Grey	V. dense			1	S.S.	105	-	Wet Drilled BX casing from 10' to 16'2"
Medium sand changing to silty fine to medium sand with gravel	Brownish grey Brown	V. dense	15'4"		2	S.S.	62	-	Wet Cored through boulder 16' - 16'4" drilled AX casing to 20'
Fine sand with numerous boulders	Brownish grey "								Cored through boulder at 18'
Gravel, 19'9" to 20'0"			20'0"						
			1078.7						AXT core from 20' to 25'
Banded gneiss	Pinkish grey bands of Lt. to med. grey	Very hard rock			-	R.C.	-	-	100% recovery
			25'0"						
									AXT cores from 25' to 30'
Banded gneiss	Pink, lt.grey bands, grading to pink-grey	Very hard rock			-	R.C.	-	-	100% recovery
			30'0"						
		TEST HOLE TERMINATED AT 30'0"							

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

(Kearney)

Job Name Magnetewan River - Hwy. 518 Job No. 59261 Borehole No. 4

Client Dept. of Highways, Ontario. Casing BX Boring Date Feb. 16th. 1960

Datum D.H.O. (Geodetic) Compiled By E.M.P. Checked By Sam

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
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- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Water surface			0'0"						
			1098.7						
River bottom			3'0"						
(Boulder strewn)			1095.7						
Fine sand and gravel	Brown								2" S.S. refused at 5'8"
			5'8"		-	S.S.	100/1"	-	BX casing refused at 5'7
									Dutch cone refused at 7'5
Bedrock believed at 7'5"	+		7'5"						AXT core barrel drilled
	Lt. grey to		1091.3			R.C.			from 5'8" to 11'0", i.e.
Garnet biotite gneiss	pinkish grey								5'4" & recovered 3'7" of
			11'0"						core.
									AXT core barrel drilled
As above	As above					R.C.			from 11' to 16'2"; core
									barrel sanded in from 6'
									level. Some core lost in
1 ft. seam, Highly	Dk. greenish		16'2"						running back core barrel
crystalline rock	grey								Recovery 2'9"
		TEST HOLE TERMINATED AT 16'2"							

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name (Kearney) Magnetewan River-Hwy. 518 Job No. 59261 Borehole No. 5

Client Dept. of Highways, Ontario. Casing 4" Pipe - BX Boring Date Feb. 21st. & 22nd. 1960

Datum D.H.O. (Geodetic) Compiled By E.M.P. Checked By Sam

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- C. SOIL SHEAR STRENGTH LBS/SQ.FT.
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Water surface			0'0" / 1098.7						W.L. in casing at River Level
Water									
River Bottom, (Boulders)			4'4" / 1094.4						Drove 4" pipe to 5'6" pipe deflected off boulder & was removed.
Fine sand with gravel & boulders	brown		7'4" / 1091.4						Drilled BX casing to 7'7"
Banded gneiss (Biotite gneiss with odd garnet)	Lt. grey with Dk. grey bands		12'1"		-	R.C.	-	-	Drilled with AXT core bit from 7'4" to 12'1" 100% core recovery
			TEST HOLE TERMINATED AT 12'1"						

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

(Kearney)

Job Name Magnetewan River - Hwy. 518 Job No. 59261 Borehole No. 6

Client Dept. of Highways, Ontario. Casing BX Boring Date Feb. 15th. 1960

Datum D.H.O. (Geodetic) Compiled By E.M.P. Checked By Sam

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- C. SOIL SHEAR STRENGTH LBS/SQ.FT.
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth / Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface			0'0"						
Fine sand with stones, some organic content	Lt. grey-brown		1108.2						Frozen
Fine sand with stones (fill) silty fine sand	Lt. brown red-brown brown	Loose	5'0"		⊠	S.S.	8	13.9	Almost dry
Fine sand, grits & pebbles	brown	V. loose			⊠	S.S.	4/14"	26.9	Moist
Silty fine sand, pebbles (fill material)	brown	loose to compact			⊠	S.S.	11		(driving stone ahead o casing 7' to 10')
		▼	10'1"			▼			
Silty fine to medium sand, pebbles (some decayed wood)	Brown		1098.1 (11' to 11'9")		⊠	S.S.	4	28.1	V. moist to wet W.L. 10'1" after sampling t
Silty fine to coarse sand with gravel	Brown	Loose to compact			⊠	S.S.	10		13'. Some decayed wood Sa
			1580"						Dense below 15'
Fine sand & coarse sand in layers, with gravel			1093.2		⊠	S.S.	72	10.2	Wet
Complete refusal to chopping bit @ 18'1". Diamond drilled with AXT core barrel			18'1" 1090.1						Casing refusal 18'0" Drilled with AXT core barrel 18'1" to 23'1". Recovery 4'11".
Banded gneiss	Medium to Bk. grey with Lt. grey bands		23'1"		-	R.C.			Thin sand seam @ about 19'0"
									Drilled 23'1" to 28'1"
As above	As above				-	R.C.	-		Recovered 5'0"
			28'1" 1080.1						
		TEST HOLE TERMINATED AT 28'1"							

APPENDIX A

Alternative Routes

We have included a sketch of the routes in the general area, Kearney - Emsdale. We were advised that the South alternate route was used several years ago when this bridge was temporarily closed for resurfacing of the deck. This route is passable, although rather narrow at present due to the snow banks; logging trucks might have some difficulty in passing unless the banks are plowed back, and two steep hills may cause difficulty in winter unless very well sanded. The road was not sanded at the time of inspection despite the severe icing conditions.

The alternative route to the North is much longer since it does not cut back into highway 518, leading directly into Highway 11 north of Emsdale. This route has at least two major hills and two small bridges; for the most part, this route is wider than the South route, but the East end contains some very narrow sections and several sharp blind corners, as does also the South alternate route.

In our opinion, neither route is practical without some widening for two way truck traffic; some bush clearance will be necessary at the numerous blind corners. The condition of the road surface was concealed by the hard packed snow and ice cover.

Under certain circumstances, consideration may be given to the installation of a temporary Bailey Bridge alongside the present structure.

The North or downstream side is favourable for the following reasons:

a) The water is shallow, hence timber crib piers could be constructed very easily on the sand and gravel bottom.

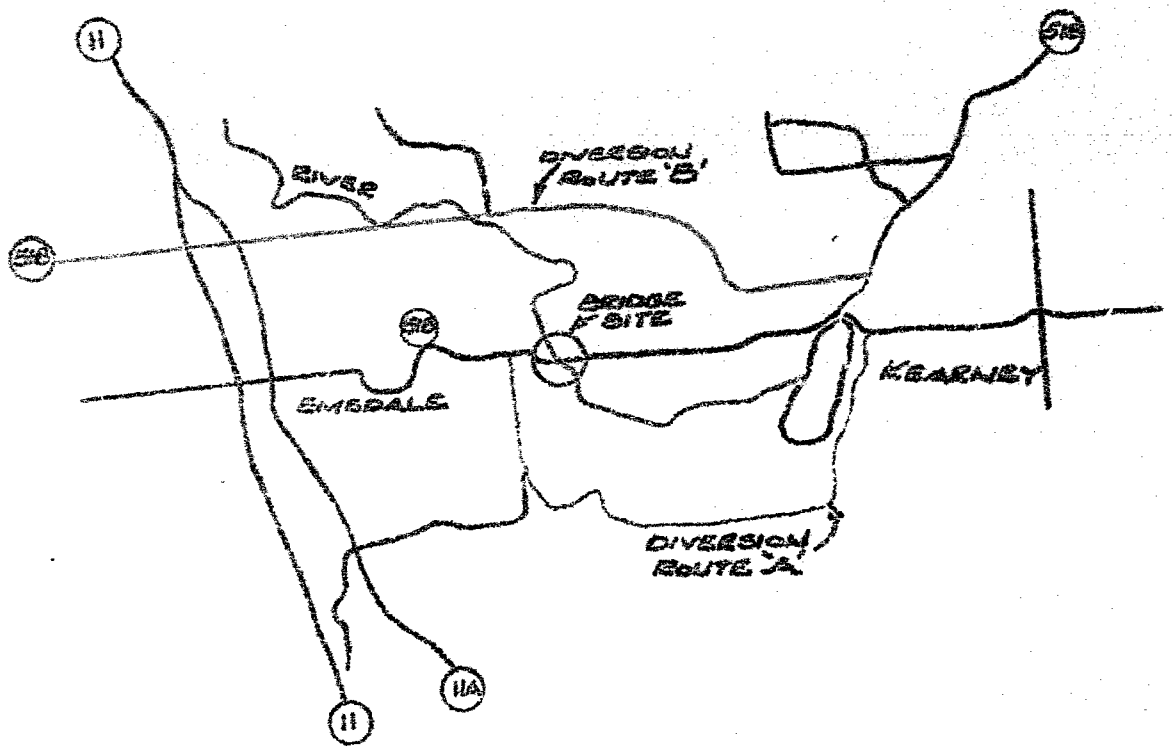
b) Three 40 foot "single-single" Bailey bridge spans would provide sufficient load limit for this route, at minimum expense.

c) The river does not flood to any extent at this point; despite two days of intermittent rain during the second week of February, the water level did not appear to rise more than two two or three inches. Maximum flood rise is believed to be only 2 or 3 feet.

d) Some approach road fill would have to be placed, particularly at the West side. This fill would be required in part, in any case, if the level of the bridge is to be raised by some 12 to 14 feet, in order to widen the base of the West approach embankment.

The use of the North side for a temporary by-pass has the major disadvantage that its use will interrupt the placing of part of the approach embankment on the West side; the by-pass would have to be closed during "closing" of the embankment.

The South or upstream side could be used for a Bailey bridge by-pass, but the water is deeper and private property would have to be used, at least on the West side.



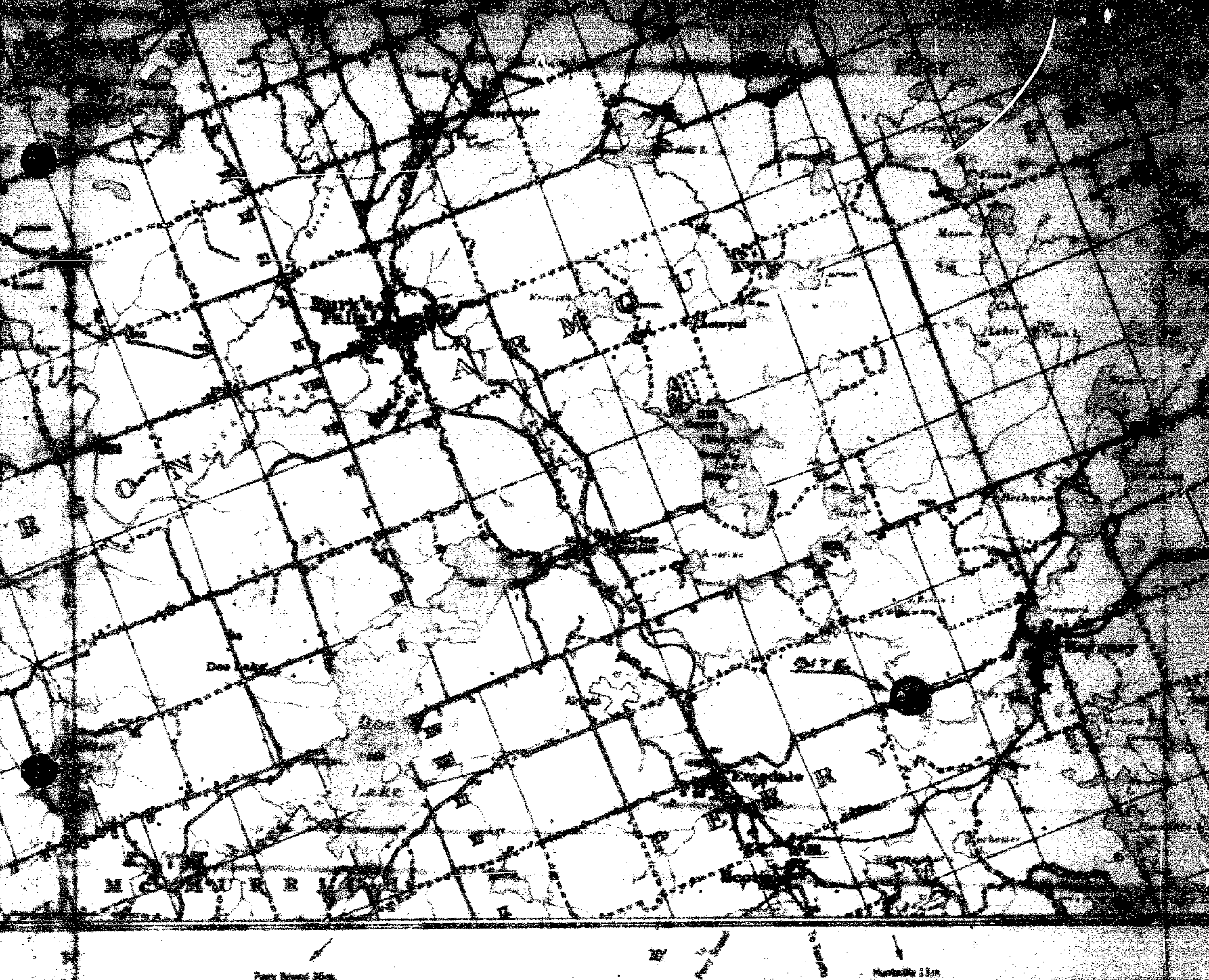
SKETCH SHEWING ALTERNATIVE ROUTES

NO SCALE

Job 69291

E.M. & T. Assoc. Ltd.

S.J.W.



Copies may be obtained from the Map Distribution Office, Department of Mines and ...

DRIDGE

ONTARIO

...6,720 or 1 inch - 2 miles

0 2 4 6 8 10 Miles

0 2 4 6 8 10 12 14 16 Kilometres

REFERENCE

Marsh, bog or open muskeg
Woods
Rapids or falls, with drop in feet
Gravel or sand
Building
Post office
Telegraph office
School
Saw mill
Grist or flour mill
Church with spire
Church without spire
Forestry tower
Cemetery
Lighthouse
Rocks or reefs
Geodetic bench marks
Height in feet

MAP SHEWING BRIDGE SITE LOCATION

Job No. 5281

... ASSOC. LTD.

APPENDIX B

TABLE OF PROBE TEST RESULTS

Depth	Hole No. / Elevation	#1 1108.2	#2 1098.7	#4 1098.7	#5 1098.7	#6 1108.2
0' - 1'		0		Water	Water	Frozen To
1 - 2		36	Water	To	To	2'
2 - 3		22	To	5'	4'3"	15
3 - 4		6	5'6"	8		3
4 - 5		6		14	29/9"	2
5 - 6		9	30	108	38	2
6 - 7		5	5	78	90	3
7 - 8		6	12	200/5"	90/4"	6
8 - 9		14	23	(1091.9)	(1091.4)	3
9 - 10		10/6", 85/3"	30			3
10 - 11		(1098.4) (X)	53			2
11 - 12			48			3
12 - 13			440			16
13 - 14			90			65
14 - 15			57			233
15 - 16			102			172
16 - 17			305			82
17 - 18			375 (*)	(1080.7)		350
18 - 19			444			(1090.2)
19 - 20			440/6"			

(*) Rods very badly bent and cone apparently sliding on inclined face of bedrock from 17' or 18' depth

(X) Refusal on boulder

APPENDIX C

METHOD OF OPERATION

The field investigation work is carried out by means of a skid-mounted diamond drill rig.

Standard sampling procedures are followed. Casing is driven and cleaned, either by tubes or by wash water.

Samples are recovered ahead of the casing at frequent intervals, with either a 2 inch or 3 inch O.D. split barrel sampling tube, Shelby tube, or split barrel sampling tube fitted with brass liners and special sharp cutting nose.

The standard penetration test results are recorded when sampling with the regular 2 inch O.D. split barrel sampler, these being the number of blows of a 140 pound hammer falling 30 inches, required to drive the sampling tube a distance of one foot into undisturbed soil.

The Dutch cone probe test is made by driving the drill rods into the ground with a 2"~~1/4~~" - 60° cone tip. The number of 4200 inch pound blows per foot of penetration are recorded, as in the standard penetration test.

Where required, "in situ" shear strength tests are made ahead of the casing, using modified Acker vane test equipment.

Disturbed samples are visually classified in the field, sealed in sample jars, and are re-examined, and tested as necessary, in the soils laboratory. Undisturbed samples are returned to the laboratory for later examination and testing, as required.

The test holes are bailed at the end of the day and on completion. Subsequent water level readings are taken for the duration of the field work. Water pressure readings are recorded when Artesian water conditions are encountered. Moisture content samples are recovered at frequent intervals to assist in the soil classification and the interpretation of water table results.