

#62-F-235C

DEV. ROAD

#170

BEDFORD

MILLS

DIVERSION



Mr. A. M. Towe,  
Bridge Engineer.  
Materials & Research Division,  
(Foundation Section)

March 6, 1962.

FOUNDATION INVESTIGATION REPORT

By: E. M. Peto Associates, Ltd.

Attention: Mr. K. L. Kleinsteinber,  
Municipal Bridge Liaison Engr.

Re: Bedford Mills Diversion,  
Dev. Road 170, Bedford Mills,  
Ontario. (W.O. 51-70129)

Attached, we are forwarding to you, the above-mentioned report submitted by the Consultant, E. M. Peto & Associates.

We have reviewed the report and believe that it contains all the information necessary for your future design work. If there are any problems you would like to discuss in connection with the above report, please feel free to call on our Office.

AGS/MdeF

Attach.

cc: Messrs. A. M. Towe (2) ✓

J. V. Ludgate

G. E. French (Dist. Mun. Engr.)


A. Watt

J. E. Cruspier

E. B. Allison, Cty. Engr., Kingston (2)

Foundations Office

Gen. Files.

  
A.G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

**E. M. PETO ASSOCIATES LTD.**

**Job No. 6223**

**1287 Caledonia Road,  
Toronto 19, Ontario.  
RUssell 9-1126-7**

STRUCTURE SITE No. 7-75

**March 2nd, 1962.**

**The Department of Highways of Ontario,  
Materials and Research Section,  
Parliament Buildings,  
Toronto, Ontario.**

**Attention: Mr. A. Rutka, P. Eng.,  
Materials and Research Engineer.**

**Re: Site Investigation,  
Bedford Mills Diversion,  
Dev. Road 170,  
Bedford Mills, Ontario.**

**Gentlemen:**

We have pleasure in submitting two copies of our Report No. 6223 on the above site investigation. The remaining twelve copies will be presented within a few days.

By means of a mesh of probes we have established the approximate contours of surface of bedrock in the area of the water gap crossing, as plotted on the enclosed Drawing No. 2. A sketch of the topography of the site is included on Drawing No. 1.

In addition, longitudinal sections and cross sections of the bedrock surface are presented on Drawings 3 and 4.

As will be observed from the bedrock surface contours, a saddle in the granite bedrock exists at the water gap between the rock exposures on both sides of the channel. The centre of this saddle is located some 25 ft to 30 ft west of the presently proposed centre line of the highway. The rock surface drops steeply on both sides of this saddle.

In order to take advantage of the local higher elevation of bedrock, it appears advisable to relocate the centre line of the proposed highway in the vicinity of the channel crossing by moving it 20 ft, or, preferably, 25 ft to the west. In this way, construction problems for the bridge foundations will be greatly simplified, and a considerably lesser quantity of fill will be required on the east side of the bridge approach embankments. However, the volume of necessary excavation through the rock ridge west of the centre line south of the water gap will be greater.

The crossing of the water gap can take the form of large diameter culverts, surrounded by rock fill resting on the elevated surface of the granite bedrock. Alternatively, a bridge can be constructed, supported on concrete piers or timber trestles resting on the bedrock. In the vicinity of the bridge structure, the bedrock is covered by only a few feet of the soft organic muck, sawdust and timber.

The bridge approach embankments will have to be supported on the surface of the bedrock, since the overlying soft organic topsoil, or organic muck possesses negligible strength. These soft materials will have to be removed under the embankment fill and the quantity and extent of the required granular fill can be judged from the enclosed cross sections.

We consider the report to be comprehensive within your terms of reference; however, we would be most pleased to provide additional assistance should you wish to discuss further any of the points.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,

*C. J. Heuman*

*for*

E. M. Peto, P. Eng.

RK:sb

**THE DEPARTMENT OF HIGHWAYS OF ONTARIO**  
**MATERIALS AND RESEARCH SECTION**

**BEDFORD MILLS DIVERSION**

**DEV. ROAD 170, DIST. #3**

**W. O. 51 - 70129**

**E. M. PETO ASSOCIATES LTD.,**

**1287 Caledonia Road,  
Toronto 19, Ontario.**

## TABLE OF CONTENTS

### Page No.

Covering Letter

Report

A. AUTHORITY AND SCOPE OF WORK	1
B. GENERAL INFORMATION	2
1. Sequence of Events	2
2. Field Operations	7
3. Ground Elevations	9
4. Laboratory Testing	10
5. Presentation of Results	10
C. SITE DESCRIPTION	11
D. SOIL CONDITIONS	16
E. WATER CONDITIONS AND HYDROLOGY	22
F. CONCLUSIONS AND RECOMMENDATIONS	24
1. Water Gap Crossing	24
2. Section North of Water Gap	29
3. Section South of Water Gap	31

APPENDIX A - Standard Procedure

APPENDIX B - List of Probes

Borehole Logs.

Drg. No. 1: Site Plan and Sketch Plan of Topography

Drg. No. 2: Contour Map of Rock Surface

Drg. No. 3: Longitudinal Sections

Drg. No. 4: Cross-sections.



## A. AUTHORITY AND SCOPE OF WORK

The site investigation described in this report was authorized by Mr. A. Rutka, Materials and Research Engineer, Ontario Department of Highways, by letter dated February 2nd, 1962, W. O. 51-70129.

The site investigation was required in connection with the relocation of County Road 10, County of Frontenac, at Bedford Mills, County of Bedford, Ontario. The project is referred to as Dev. Road 170, at Bedford Mills, Dist. #8.

The new alignment of the road will pass partly over wooded areas with rock outcrops, partly through drowned land and swamp, and partly through a water gap, near the south-western extremity of Loch Lake. A bridge is to be provided at the water gap, and information was required with regard to the bridge foundation problems. Information pertaining to the bridge approaches was also sought, essentially concerning the determination of suitable foundation medium for the embankment fills, details of soils to be removed, drainage, stability, erosion, and construction problems.

The limits of the investigation to be carried out by this company were to be agreed with Mr. J. Gruspier, Regional Soils Engineer, Regional D. H. O. office, Kingston.

A. AUTHORITY AND SCOPE OF WORK (Cont'd)

On February 6th, 1962, our engineer Mr. R. Kulesza, visited the D. H. O. regional office at Kingston and has been informed by Mr. McMaster that the regional D. H. O. office at Kingston have investigated the water gap located between Chainages 251 and 253. We were required to carry out the site investigation at the water gap between the Chainages 247 and 249. Later, at a site meeting, authority was obtained from Mr. R. B. Allison, County Engineer, County of Frontenac, to extend the site investigation for the section of the realigned road between the Chainages 243 and 249.

B. GENERAL INFORMATION:

1. Sequence of Events

February 2nd, 1962: Authority was obtained from Mr. A. Rutka to proceed with the site investigation.

February 5th, 1962: Our engineer, Mr. R. Kulesza, contacted by telephone Mr. J. Gruspier, at the regional D. H. O. office Kingston, and informed him that the site investigation will be commenced the following day. As Mr. Gruspier was to be absent from Kingston on February 6th, arrangement was made for Mr. Kulesza to call at the D. H. O. office and speak with Mr. McMaster concerning the scope of the work.

B. GENERAL INFORMATION:

1. Sequence of Events (Cont'd)

February 6th, 1962: Mr. R. Kulesza and our drilling crew unit No. 4, arrived at the site. Enroute, Mr. R. Kulesza called at the regional D. H. O. office in Kingston and was informed by Mr. McMaster that the D. H. O. regional office had investigated the water gap between Chainages 251 and 253. We were required to investigate the main water gap between Chainages 247 and 249. The exact limits of our work were to be determined after consultation with the County Engineer, County of Frontenac. Mr. R. Kulesza was to call the following day to obtain information concerning the limits of the work to be performed by this company.

February 7th, 1962: The field crew unloaded equipment and constructed a drilling raft to be put on water. Mr. R. Kulesza called at the regional D. H. O. office at Kingston and through Mr. McMaster it was arranged that the County Engineer, Mr. R. B. Alison would visit the site the following day.

## B. GENERAL INFORMATION:

### 1. Sequence of Events (Cont'd)

February 8th, 1962: Eighteen probes were carried out by hand to investigate the depth of bedrock north of the main water gap. The probes were driven on offsets at the Chainages 248 + 50 and 249 + 00. Mr. R. B. Allison, Mr. J. Gruspier and party visited the site, and were informed by Mr. Kulesza of the results of probes on the north side of the water gap. Mr. R. B. Allison authorized investigation of the section up to 200 ft south of the water gap.

February 9th and 10th, 1962: Probes on water along the centre line were performed; also, a part of the probes south of the water gap was carried out by hand.

February 12th, 1962: Two lines of probes on water, on both sides of the water gap and perpendicular to the centre line, were carried out.

Mr. R. B. Allison visited the site, and was informed by Mr. R. Kulesza of the progress of the work.

B. GENERAL INFORMATION:

1. Sequence of Events

February 12th, 1962 ; (Cont'd)

From the results obtained so far, it became apparent that a shoulder in the bedrock exists at the water gap and that the surface of the rock is within the depth of roughly 6 to 15 ft below water surface over an area extending from the centre line up to roughly 40 ft west of the centre line. The rock surface falls sharply on both sides of this shoulder. In view of this information, Mr. R. B. Allison decided provisionally that the centre line of the road at the gap will be moved 20 ft west, in order to take advantage of the rock shoulder.

February 13th, 1962: Water probes were completed and the drilling rig was moved to the south side of the water gap. The elevations on the north side of the gap were taken and the remaining probes were set out.

**B. GENERAL INFORMATION:**

**1. Sequence of Events (Cont'd)**

February 14th and 15th, 1962: The remaining land probes and test holes south of the water gap were completed. Levels of these probes were taken, and the topography of the site was surveyed.

February 16th, 1962: The site survey was completed. The drilling crew dismantled the raft, loaded the equipment and left the site.

## B. GENERAL INFORMATION: (Cont'd)

### 2. Field Operations

Because of the very irregular surface of the bedrock, characteristic of the Precambrian granite, a large number of probes was required to determine the depth to solid stratum at the location of the bridge and under the approaches. In order to save time, as many as possible of the probes were done by hand, by pushing or hammering a standard cone, attached to drilling rods. The probes were driven until refusal was reached, which was identified by the drilling foreman and the engineer as the surface of bedrock by the sound and feel of bounce of rods.

In a few cases, standard split spoon was attached to the drilling rods instead of the cone in order to recover samples of soil overburden over the bedrock.

All probes on the north side of the water gap, i. e. probes 57 to 74 were carried out by hand.

All the probes done on water were carried out from a raft, mostly with the drilling rig.

## B. GENERAL INFORMATION:

### 2. Field Operations (Cont'd)

The majority of the probes and all the test holes on the south side of the water gap were carried out with the drilling rig.

All probes marked by the letter P were standard cone probes, while the boreholes are marked B. H. Soil samples were recovered in the boreholes, and taken to our laboratory.

The granite bedrock encountered under the channel bed in borehole 31 was proved by 3 ft 2 in. of diamond drilling. In no other case was the bedrock drilled, as, due to its very irregular surface, drilling was not considered worthwhile and informative, since only a few feet away the bedrock surface may be at quite a different elevation. Instead, it was considered more practicable and reliable to establish the rock surface by a large number of cone probes driven to refusal on the rock. The large number of probes and the uniform pattern of results, as indicated by the contours included on Drawing No. 2, ensure that the surface of the bedrock within the limitations of its irregular nature has been reliably established. The very steep slopes of the bedrock away from the shoulder in the rock on both sides of the centre line suggest it unlikely that refusal was obtained on boulders rather than on bedrock; large boulders could obtain no support on the steep sides of the rock, covered only by very soft organic muck and sawdust.

Where open boreholes were performed our standard drilling and sampling procedures were followed, as outlined in the enclosed Appendix A.



## B. GENERAL INFORMATION:

### 2. Field Operations (Cont'd)

A total of 74 probes and 4 test holes were carried out at the site. The positions of the test holes and probes are shown on Drawing No. 2, on which the ground elevations and the elevations of surface of bedrock (where established) are also given.

In addition, all the probes are listed, together with elevations and depth to rock, in Appendix B. The nature of overburden over the bedrock and the depth of free water are also given, where established.

Borehole logs were prepared for the test holes in which soil samples were recovered.

### 3. Ground Elevations

The elevations of the existing grade at the test holes and probes were measured by our engineer and referred to a temporary bench mark, which was taken as the ground level at the wooden stake marking Chainage 249 + 00. From the Client's profile of the centre line of the realigned road, the elevation at this chainage was taken as 111.5, County of Frontenac datum. The elevations at the test holes and probes are marked on the site plan on Drawing No. 2 and are also tabulated in Appendix B. The elevation of free water in the gap on February 13th, 1962 was 108.5.

The ground elevations supplied by the D. H. O. regional office at Kingston were not used.

B. GENERAL INFORMATION: (Cont'd)

4. Laboratory Testing

No laboratory testing of soil samples was considered necessary, and no tests were carried out.

5. Presentation of Results

A sketch plan, showing the topography of the area, is presented on Drawing No. 1.

The positions of all test holes and probes are shown on Drawing No. 2, on which the elevations of the existing grade and of top of bedrock are also marked. This drawing also contains tentative contours of the bedrock surface, obtained by interpolation between the probes. It must be pointed out that, due to the very variable surface of the Precambrian granite, the actual contours may be more irregular than represented on the drawing.

Details of soil conditions found in the test holes from which soil samples were recovered are presented on the borehole logs.

The following sections are plotted on Drawing No. 3,

1. Section along centre line from Ch. 243 + 00 to 249 + 00.
2. Section 20 ft east of the centre line between Ch 247 + 00 and 249 + 00.
3. Section 20 ft west of the centre line between Ch. 247 + 00 and 249 + 00.
4. Section 50 ft west of the centre line between Ch 247 + 00 to 249 + 00.

## B. GENERAL INFORMATION:

### 5. Presentation of Results (Cont'd)

The following cross sections are plotted on Drawing No. 4.

Ch. 245 + 00	Ch. 247 + 50
Ch. 245 + 50	Ch. 247 + 75
Ch. 246 + 00	Ch. 248 + 00
Ch. 246 + 50	Ch. 248 + 50
Ch. 247 + 00	Ch. 249 + 00
Ch. 247 + 25	

The subsoil conditions are described in Chapter D, and the engineering considerations and conclusions are discussed in Chapter E.

## C. SITE DESCRIPTION:

The area lies within the Precambrian Shield, and is characterized by a rugged, rocky topography. The site is situated near the south-western corner of Loon Lake, which has an irregular shoreline, with numerous bays and inlets, partly covered by swamps.

A key plan of the site is included on Drawing No. 1, on which a sketch showing approximately the topographical features of the site, has also been plotted.

The site along the sections investigated can be briefly described as follows. It should be noted that, for the purpose of describing locations, the centre line of the proposed road was assumed to run from south to north. Direction marked as "east" is therefore to the right of centre line, and "west" is to the left of centre line.

C. SITE DESCRIPTION: (Cont'd)

Chainage 243 + 00 to 244 + 50

In this section, the centre line of the proposed realigned road passes along the eastern slope of a high rock ridge, which continues to rise to the west. The ground elevations in this section range from 132 to 115 ft. The slope is very irregular, and generally steep. It is partly covered by drift and topsoil, while some rock outcrops are visible.

Ground rises by about 20 ft within 50 ft west of the centre line. To the east of the centre line, the ground surface falls steeply, and near Ch 243 + 50, a small inlet in the lake commences 38 ft east of the centre line and is 27 ft wide. The elevation of surface of ice in this inlet was 109.5. Another bedrock ridge, 8 ft wide, is located to the east of this inlet, while the open lake begins 73 ft from the centre line.

At Ch 244 + 00 the slope to the east of the centre line is more gradual, and the lakeshore is at a distance of 47 ft.

At the Ch. 244 + 50 the ridge rises by approximately 10 ft in a distance of 30 ft west of the centre line and drops to a more level ground 10 ft east of the centre line. The lakeshore at this section is some 35 ft east.

C. SITE DESCRIPTION (Cont'd)

Chainage 244 + 50 to 246 + 00

Near Ch. 244 + 70 the centre line descends from the rock ridge onto a terrain possessing a more gentle slope, and where the surface of the bedrock is covered by a greater thickness of drift and topsoil. The area is also densely wooded.

To the west of the centre line, the bedrock outcrops at a distance of approximately 20 ft at Ch. 245 + 00, 30 ft at Ch. 245 + 50, and 25 ft at Ch. 246 + 00.

The wooded terrain continues to a distance of 25 ft east of the centre line at Ch. 245 + 00, where a swamp begins and extends to the lakeshore at a distance of 80 ft east of the centre line.

At the Ch. 245 + 50, the fairly level terrain, overgrown by trees and with rock buried by drift, continues, while a rock ridge again commences some 120 ft east of the centre line.

Chainages 246 + 00 to 247 + 25

In this section, the centre line passes over a swamp, which commences near Ch. 245 + 90. At Ch. 246 + 00, the swamp extends to a distance of 23 ft east of the centre line; at Ch. 246 + 50, the swamp extends 95 ft east, where a rock outcrop is observable.

C. SITE DESCRIPTION:

Chainages 246 + 00 to 247 + 25 (Cont'd)

At Ch. 247 + 00, the swamp continues far to the east and merges into the lake.

West of the centre line, rock outcrop occurs 25 ft from the centre line at Ch. 246 + 00.

Chainages 247 + 25 to 248 + 20

The water gap exists in this section, and at the time of the site investigation the water was open between the Ch. 247 + 25 and 248 + 20. A slow flow through the gap in an easterly direction was observed.

Chainages 248 + 20 to 249 + 00

In this section the centre line passed over the frozen surface of the lake, and the frozen swamp, on the north side of the channel. Because of the ice and snow cover, it was difficult to establish definitely the exact position of the boundary of the swamp, but it appeared to be near the Ch. 248 + 30.

The area to the east of the centre line was open ice and swamp, extending far out into the lake.

West of the centre line, a ridge with rock exposures commenced near Ch. 248 + 40, and the south-east tip of this ridge was located some 25 ft west of the centre line, while the south-west tip was at a distance of 42 ft from the centre line.

C. SITE DESCRIPTION:

Chainages 248 + 20 to 249 + 00 (Cont'd)

At the Ch. 248 + 50, the eastern side of the ridge was 15 ft from the centre line, while the western side was at a distance of 37 ft.

At the Ch. 249 + 00, the ground surface was already on the eastern slope of the ridge, which commenced some 5 ft to the east of the centre line. The western edge of the ridge was 20 ft west of the centre line.

The area to the west of the rock outcrop ridge was fairly level, and densely wooded.

The northern limit of the site investigation was Ch. 249 + 00. North of this chainage, the centre line passes partly over rock outcrops and partly over wooded drift areas, until the water gap located between Ch. 250 + 50 and 253 + 10 is reached.

#### D. SOIL CONDITIONS:

The area is located on the Precambrian Shield, and is characterized by rugged, rocky topography. The Loon Lake, the south west corner of which is crossed by the realigned road, has numerous inlets and bays which are partly sunken land and swamp.

The land areas partly consist of rock outcrops, bare or covered by a thin layer of drift and organic topsoil, while in other parts the bedrock is covered by a variable thickness of sandy and clayey drift and organic topsoil. The terrain is densely wooded.

Considerable thickness of coarse sawdust was present under water, particularly in the swamp areas. The sawdust originated at the abandoned timber mill located a quarter of a mile south-west of the water gap.

For detailed description of the soil conditions in the area investigated, it is convenient to sub-divide the proposed realigned road into the following sections:

1. Section north of water gap (Ch. 248 + 40 to 249 + 00).
2. Water gap (Ch. 247 + 15 to 248 + 40).
3. Section south of water gap (Ch. 243 + 00 to 247 + 15).

The soil conditions in each of the three above sections will now be briefly described.



D. SOIL CONDITIONS: (Cont'd)

1. Section north of water gap (Ch. 248 + 40 to 249 + 00)

The soil conditions in this section are illustrated on Drawing No. 4 on which cross sections at the Ch. 248 + 50 and 249 + 00 have been plotted.

The granite bedrock outcrop in this section is in the form of a small ridge 20 to 25 ft wide, which runs at an angle of about 30° to the centre line of the proposed road.

The outcrop commences approximately at the chainage 248 + 40, and its south-eastern tip is at a distance of 25 ft west of the centre line, while, the south-western tip is at a distance of 42 ft from the centre line. The ridge rises to an elevation of about 115 opposite chainage 249.

The centre line north of Ch. 248 + 90 passes over the eastern slope of the ridge.

At Ch. 249 + 00, the eastern edge of the ridge, which marks the boundary of the swamp situated to the east of the centre line, is about 5 ft east of the centre line. The western edge of the ridge at this chainage is approximately 20 ft west of the centre line.

D. SOIL CONDITIONS: (Cont'd)

1. Section north of water gap (Ch. 248 + 40 to 249 + 00)

The surface of the bedrock drops both to the east and to the west of the outcrop ridge, as illustrated by the contours on Drawing No. 2 and by the cross-sections on Drawing No. 4. However, the slope is gentle up to approximately 20 ft east of the centre line and 60 to 80 ft west of the centre line. Further away from the centre line, the slope in the rock surface becomes sharp and, on the eastern side, amounts to 30 ft in a horizontal distance of approximately 35 ft. At a distance of 70 ft east of the centre line, the surface of the bedrock drops to the elevation 65, as compared with the elevation 108.8 of the frozen surface of the swamp.

East of the rock outcrop ridge, the surface of the granite bedrock is covered by very soft organic muck, mainly in the form of coarse sawdust, apparently brought by the water flow from the neighbouring, abandoned timber mill. Some wood logs are also present.

Where the bedrock surface is at a depth greater than 13 ft, the soft organic muck rests on layers of brown clayey silt, of very soft consistency. Below the depth of 43 ft, layers of dense sand with pebbles rest on top of the bedrock, and support in turn the soft silty clay and the organic muck layers.

West of the bedrock outcrop ridge, the bedrock is covered by soft organic topsoil, and where the bedrock surface falls to a depth greater than 5 ft below the existing grade, the rock is covered by denser sandy and silty layers.

D. SOIL CONDITIONS: (Cont'd)

2. Chainages 247 + 25 to 248 + 40 (Water gap)

The water gap extends between the rock outcrops located on both sides of the channel which are approximately 120 ft apart. Between the exposures, the bedrock surface forms a submerged saddle, the centre of which is situated roughly 25 ft to 30 ft west of the centre line of the proposed road. The centre strip of this saddle is fairly horizontal, with the bedrock surface between the elevations 100 and 103.5, i. e. 5 to 8.5 ft below the surface of water in the channel.

The surface of the rock falls both to the east and to the west of this saddle, but the drop becomes steep only 10 to 20 ft east and about 40 ft west of the proposed centre line.

Where the surface of the bedrock was at a depth not exceeding 8 to 12 ft, it was covered only by soft, organic muck and debris, and some logs. Where the bedrock was deeper, it was covered also by some denser materials, mainly in the form of clayey sand and gravel. Thus, the dense subsoil began at a depth of 10 ft 2 in. in probe 34, 12 ft 3 in. in probe 38, and 14 ft in probe 37. In these denser layers, a penetration resistance of 21 to 58 blows per foot was encountered when the standard cone probes were driven, as compared with only one or two blows in the soft organic debris.

The surface of the bedrock was found to rise again at the south-eastern part of the water gap, in the direction of a bedrock outcrop ridge which was observed some 75 ft east of Ch. 246 + 50. This rise in surface of the bedrock is illustrated by the bedrock contours on Drawing No. 2.

D. SOIL CONDITIONS: (Cont'd)

3. Chainage 243 + 00 to 247 + 25 (Section South of Water Gap)

Between Ch. 243 + 00 and 244 + 50, the centre line of the proposed road passes over the eastern slope of a high rock ridge, which is partly covered by organic topsoil and drift.

A bay in the lake and the swamp commence some 35 ft to 40 ft east of the centre line, and, at a distance of 50 ft from the centreline the surface of the bedrock drops to the elevation 103. In borehole 2, located 58 ft east of the centre line at Ch. 244 + 50, the bedrock was at the elevation 96.0 and was covered by 10 ft of loose to compact layers of silty sand with gravel, and by some clay layers. The top 4 ft of material consisted either of ice or water, or of partly decomposed wood and organic muck.

The ridge rises steeply to the west of the centre line in this section, and no materials other than organic topsoil or some drift are expected over the bedrock surface.

Between the Ch. 244 + 50 and 245 + 90, the centre line passes over a saddle in the surface of the granite bedrock, which runs roughly from east to west. The surface of the bedrock in a zone commencing some 10 ft west of the centre line and extending to 40 ft east of the centre line is fairly uniform and between the elevations 102 and 105. It is covered only by organic topsoil and some silty sand with stones.

A steep face of bedrock rises at a distance ranging from 20 to 30 ft west of the centre line in this section.

D. SOIL CONDITIONS:

3. Chainage 243 + 00 to 247 + 25 (Cont'd)

Between the Ch. 245 + 90 and the water gap, commencing at Ch. 247 + 25, the centre line passes over a swamp, and the elevation of the frozen surface ranged from 108.4 to 109.6.

The rock elevation at the centre line ranged between 97.1 near the water gap and 102.4 at Ch. 246 + 75.

To the west of the centre line, a steep face of outcrop was observable at a distance ranging from 15 to 25 ft.

To the east of the centre line, the surface of the bedrock dropped in a north-easterly direction, as indicated by contours on Drawing No. 2. The bedrock was covered mainly by very soft organic debris and sawdust, apart from the area east of Ch. 247 + 25, where hard obstructions, probably caused by sunken barges and timber, were encountered in probes P 19, P 20, and P 21. The elevation of bedrock could not be determined in these three probes, so that the contours in the corresponding area are only approximate.

At Ch. 247 + 15, the steep face of the rock outcrop west of the centre line turns sharply to the west and runs roughly parallel to the water gap.

E. WATER CONDITIONS AND HYDROLOGY:

At the time of the site investigation, an open channel approximately 100 ft wide extended between Ch. 247 + 25 and 248 + 20. The water was flowing towards the east. The elevation of the water surface was 108.5.

The sides of the channel were covered with ice which merged with the swamp on either side of the channel.

In the area of the proposed crossing of the gap, the water was 3 ft 3 in. to 5 ft 6 in. deep.

The bay of the lake located to the east of the centre line between Ch. 243 + 50 and 245, was completely frozen.

According to the National Topographic Survey map, the water elevation in Loon Lake, which is part of the Newboro Lake System, is 400 Geodetic. The elevation of Devil Lake located to the west of Bedford Mills is 430. The two lakes are separated by a narrow strip of land, in the position of the old mill, which was powered by water descending from the Devil Lake to Loon Lake. A small dam, located opposite the Bedford Mills at the Devil Lake, controls flow of water into the Loon Lake. The greatest flow can be expected after spring thaws, and water is reported to overflow the existing bridge, which normally has a six foot clearance and is 10 ft wide.

E. WATER CONDITIONS AND HYDROLOGY: (Cont'd)

However, it would appear that the flooding may be local, and be caused by insufficient flow capacity under the bridge, perhaps smaller than the rate of overflow from Devil Lake. It is most unlikely that the water in Loon Lake would vary by more than one to two feet due to the very large area of the Newboro Lake system. From the water marks on the boat house and on rock outcrops at the gap, the maximum level of water could be estimated as the elevation 111.

Thus, it would not appear that the variation of water level of more than two feet takes place at the proposed water crossing, and probably is less than this figure.

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 1. Water Gap Crossing

At the proposed centre line, the water gap is approximately 150 ft wide and its mid-point is near Ch. 247 + 75. It was difficult to define exactly the boundary between the open water channel and the swamp on either side of the gap because of the ice and snow cover.

Rock outcrops occur, in the form of ridges, some 15 ft west of the centre line south of the water gap at Ch. 247 + 15, and 25 ft west of the centre line north of the water gap at Ch. 248 + 40.

The site investigation has disclosed that the surface of the bedrock under the water gap forms a saddle, running between the rock outcrops on either side of the channel. As indicated by the bedrock contours, plotted on Drawing No. 2, the centre of this saddle is located some 25 to 30 ft west of the proposed centre line of the road. The surface of the rock is fairly level and lies between the elevations 100 and 103.5 in a strip of minimum width of approximately 20 ft, and between the elevations 95 and 103.5 in a strip of minimum width of 35 ft. The width of this fairly flat strip of the bedrock surface is larger on the north side of the gap and smaller on the south side.

The bedrock contours drop sharply both to the east and to the west of this saddle.



## F. CONCLUSIONS AND RECOMMENDATIONS:

### 1. Water Gap Crossing (Cont'd)

In its present alignment, the centre line of the new road is located near the eastern edge of the submerged rock saddle, and the surface of the bedrock drops by 5 to 10 ft within a horizontal distance of 20 ft east of the centre line. Further east, the drop becomes even sharper.

In view of the existence of the submerged rock saddle, with a fairly level surface of bedrock, under the water gap, it would appear very advantageous to relocate the centre line some 20 to 25 ft to the west of the present alignment. In this way, advantage would be taken of the relatively high and fairly level surface of the bedrock in the middle of the gap, facilitating design and construction of the structure carrying the road over the channel.

If the centre line is moved 25 ft to the west, and assuming a 30 ft width of structure foundations, the foundation level would be between the approximate elevations 97 and 103.5, i.e. 11.5 to 5 ft below the water surface. The differences in the elevation of the foundation base would be even smaller if the width was made less than the assumed 30 ft.

The structure, placed along the relocated alignment, could be supported either on concrete piers and abutments resting on surface of the bedrock or on timber trestles which we understand are being considered. Alternatively, it could take the form of circular, reinforced concrete culverts, supported on rock fill placed on the shoulder of the bedrock. The culverts could be surrounded by compacted rock fill and the fill could be built up to the required grade of the highway above the crown of the culverts.

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 1. Water Gap Crossing (Cont'd)

The above solution would be probably cheapest and easiest to execute. It would be entirely satisfactory, provided that the culverts have sufficient capacity to allow the flow after spring floods without the build-up of water level upstream (to the west) of the structure. The variation of water level in the present water gap is within one or two feet at the most. The level upstream of the crossing could, however, build up if the capacity of the culverts was insufficient for the flow requirements. The flow would be coming mostly from Devil Lake, the surface of which is about 30 ft higher than Loon Lake. The overflow from Devil Lake is controlled by a dam located a short distance to the west of the abandoned mill buildings. The flow of water passing through the culverts could probably be adjusted by controlling the flow over the dam, by alterations to the height of the weir. The required capacity of the culverts could be estimated from observations of quantity of flow over the dam after spring thaws. The appropriate time for making measurements would be when the water level in Devil Lake is at its maximum elevation. However, an allowance should also be made for flow originating from sources other than the overflow from Devil Lake. Loon Lake to the west of the crossing may also be fed by some springs, but no major sources of inflow were observed at the time of the site investigation.

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 1. Water Gap Crossing (Cont'd)

If the above solution is adopted, the rock fill could be placed under water directly on the surface of the granite bedrock, but the soft organic muck layer covering the surface of the bedrock should be removed. The greatest thickness of the muck in the area of the water crossing was 5 ft 2 in. in P 34, but was very variable, depending on the depth to the bedrock. Generally, it can be taken as extending to the surface of the bedrock from a depth of 3 ft 6 in. to 5 ft 6 in. below the water surface.

The soft muck could probably be removed with a drag line, though a pumping method could be considered. If a causeway crossed by culverts is constructed, it may be possible to remove the organic material by displacement with rock fill.

If it is decided to provide the crossing in the form of a bridge rather than a causeway with culverts, the problem of flow restriction through the gap will be eliminated. The maximum water level can be taken as the elevation 111, and the bridge should provide additional clearance only sufficient to allow through the likely craft.

We understand that the Client contemplates providing a bridge supported on timber trestles. The trestles could be founded on the surface of the granite bedrock, and embedded in concrete footings. Where the surface of the granite is irregular in the position of a column, it should be shaped and filled with concrete to provide a level support for the footing.

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 1. Water Gap Crossing (Cont'd)

Normally, the granite could be considered to possess a bearing capacity as high as 50 tons/sq. ft. However, examination of the rock exposures on land has shown that the granite is fissured and weathered. Also the 3 ft 2 in. rock core recovered after diamond drilling in B.H. 31 at Ch. 247 + 53 on the centre line, showed some fissures. It may therefore be advisable to restrict the foundation contact pressure to 25 tons/sq. ft. Where the surface of bedrock is exposed under the footings to visual examination, the bearing capacity could be improved where required, by grouting the fissures with cement.

If concrete piers are provided instead of timber trestles to support the bridge deck, the footings could be placed on the surface of the bedrock, and special shaping of the surface would probably be unnecessary. For this reason, and because of a greater safety against possible damage due to ice movements, concrete piers may be preferable to timber trestles.

The work on the bridge foundations could be conducted either under water, or the provision of a cofferdam drained of water could be considered. Construction of a cofferdam may present some problems, since in the area of the crossing the bedrock surface is covered by only a few feet of very soft organic muck and no stratum is available to support sheeting. Besides, due to the irregular surface of the bedrock, some seepage would continue under the bottom of the sheeting. However, an adequate cofferdam may possibly be constructed by driving sheeting through the organic muck to the surface of the bedrock and by providing additional support to the sheeting by placing granular

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 1. Water Gap Crossing (Cont'd)

fill, bags of sand, or other type of ballast on top of the muck around the bottom of the sheeting. Water, which may still percolate into the cofferdam, would then be pumped out as the work progresses.

Alternatively, an attempt could be made to construct a cofferdam from rock fill, but this may not be practicable because of the restricted width of the rock saddle and of its steep slopes to the east and west. Sufficient support for the rock walls may not be available without using very large quantities of material.

### 2. Section North of Water Gap

We were required to investigate only the section north of the water gap as far as Ch. 249 + 00. In this section, an approximately 25 ft wide ridge of bedrock outcrop rises above the swamp a few feet to the west of the centre line. To the west of this ridge, bedrock was found to be within a depth of 4 to 8 ft below the existing grade up to a distance of 60 to 80 ft from the centre line. However, east of the centre line the bedrock drops by 5 to 7 ft within a horizontal distance of 25 ft; further to the east, there is an even sharper slope, averaging approximately 40 degrees to the horizontal.

F. CONCLUSIONS AND RECOMMENDATIONS:

2. Section North of Water Gap (Cont'd)

As a raise in grade up to the elevation 118 is proposed in this section, a considerable quantity of fill may be required on the east side of the embankment if the present centre line is maintained, to make up for the drop in the surface of the bedrock. The fill would have to be placed on the bedrock, as the organic muck and sawdust which covers the granite, is extremely soft and could not support the embankment fill.

Because of the slope of the bedrock surface east of the centre line, it appears very advantageous to relocate the centre line 20 to 25 ft west of the present position. If this is done, then the centre line in this section will be located over the rock outcrop ridge, and construction problems for the placement of the fill would not be serious. Within 30 ft west of this relocated centre line, the bedrock surface is within a depth of 4 to 8 ft below the existing grade. It is covered mainly by organic topsoil and loose drift materials, which are soft and should be removed. The top two feet could probably be removed by scraping, but the water table, which commences below this depth, may necessitate excavation under water, unless seepage from the lake could be cut off. Alternatively, the soft material could be possibly removed by displacement with the rock fill. The fill should be thoroughly compacted and allowed to settle before construction of the pavement.

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 2. Section North of Water Gap (Cont'd)

Where the thickness of soft organic soil is considerable, displacement by a blasting technique could be considered.

The depth of soft material to be removed at any point and the quantity of the required fill can be estimated from the enclosed cross sections.

No special drainage measures over the portion of the highway north of the water gap appear necessary. Also, if rock fill is used for the embankment, there would not appear to be any serious danger of erosion.

### 3. Section South of Water Gap

If the original alignment of the highway is maintained, the most difficult part of this section would be in the immediate vicinity of the water gap. Between Ch. 246 + 50 and 247 + 25, surface of the bedrock drops towards the north-east and is covered only by very soft organic muck and sawdust. This material would have to be removed by drag line, by displacement with rock fill, or by a blasting technique. The compacted fill would have to be supported on the bedrock surface and the depth at any individual point and the quantity of fill can be estimated from the enclosed cross sections. Levelling of the bedrock surface to support the fill would probably prove too costly.

The compact sand and clay, found below the soft organic muck, could probably support embankment toes though some settlement may occur. However, the surface of the denser material under the soft muck would have to be proved by further probes, when the lateral extent of the embankment is known.

## F. CONCLUSIONS AND RECOMMENDATIONS:

### 3. Section South of Water Gap (Cont'd)

Between Ch. 245 + 75 and 246 + 50 the centre line passes over a shoulder in the bedrock running from east to west, which is covered by 6 to 7 ft of organic topsoil and loose drift. This material has to be removed before compacted fill is placed, but the construction in this section would not afford any particular difficulties.

South of the Ch. 244 + 50, the centre line passes over the eastern slope of a high rock ridge, and the bedrock extends to some 40 ft east of the centre line. The ground rises steeply to the west, and considerable excavation will be required. However, there appears to be no difficulty with stability of the eastern slope of the fill, which will be required to build up the necessary grade east of the centre line. The toe of the fill will be supported on the bedrock outcrops.

If the centre line of the highway is relocated 20 to 25 ft to the west of the present position, as is recommended with particular view to the bridge construction problems, this alteration will also be advantageous for the construction of the highway south of the water gap, and in particular north of Ch. 245 + 00. The centre line will then be further away from the slope in the rock surface, which occurs north of Ch. 246 + 50 and between Ch. 245 + 00 and 245 + 75, so that a lesser quantity of fill will be required. However, the excavation will have to be more extensive because of the sharp rise in the slope of the ridge located to the west of the centre line.



F. CONCLUSIONS AND RECOMMENDATIONS:

3. Section South of Water Gap (Cont'd)

A suitable drainage ditch must be provided on the west side of the highway in this section, to collect surface water from the slope of the ridge located to the west of the highway. The water can be led down to the lake west of the bridge.

No special drainage measures on the east side of the highway appear necessary in this section.

Erosion of embankment toes is unlikely if the embankments, particularly in the vicinity of the water gaps, are constructed of compacted rock fill.

E. M. PETO ASSOCIATES LTD.,

*C. F. Freeman*

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

RK:sb

Job No. 6223

March, 1962.

## APPENDIX "A"

### STANDARD PROCEDURE

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 augers, 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 inch dia. x 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 (or pumped out) during the work as necessary, 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.

Borehole logs are prepared giving details of the soil description and condition as recorded in the field. These logs form the basis of the soil profile, which indicates the general stratigraphy assumed to exist between the boreholes as represented by the borehole logs.

The boreholes are normally set out by the Field Engineer, who also records the ground elevations referred to a temporary bench mark or known reference point. If the client has been responsible for setting out the boreholes and recording their ground elevations this is stated in the preamble to the report.

A plan is drawn up from drawings supplied by the Client or his representatives, showing the locations of the boreholes and the T. B. M. where applicable.

Normally, the standard penetration blows and the natural moisture contents are plotted against elevation as a graph, and these graphs form part of the appendices, together with laboratory test result details, ground water readings and other soil characteristics which can be best illustrated in graphical form.

APPENDIX "B"

LIST OF PROBES

# LIST OF PROBES

## 1. Probes South of Water Gap

<u>Probe No.</u>	<u>Chainage</u>	<u>Offset</u>	<u>Grade Level</u>	<u>Depth of Probe</u>	<u>Rock Level</u>	<u>Remarks</u>
P 1	243 + 50	50'E	109.5	8'5"	103.1	
P 2	244 + 50	60'E	108.6	7'9"	100.8	Possible obstruction.
P 3	245 + 00	--	117.5	4'0"	<113.5	Obstruction
P 4	245 + 00	25'E	111.8	8'9"	103.0	
P 5	245 + 00	50'E	109.9	4'6"		Obstruction
P 6	245 + 00	75'E	109.6	11'10"	<97.7	Hand probe terminated. Very hard going.
P 7	245 + 50	--	112.7	0'9"	111.9	
P 8	245 + 50	25'E	112.2	21'0"	91.2	
P 9	245 + 50	50'E	112.6	10'0"	102.6	
P10	246 + 00	--	109.6	5'9"	103.8	
P11	246 + 00	40'E	111.7	1'6"	110.2	
P12	246 + 50	--	109.2	10'0"	99.2	
P13	246 + 50	20'E	109.2	7'1"	102.1	
P14	246 + 50	40'E	109.9	3'3"	106.6	
P15	246 + 75	--	109.2	5'10"	102.4	
P16	247 + 00	--	108.9	7'1"	101.8	
P16A	247 + 00	20'E	109.0	22'7"	86.4	
P17	246 + 75	30'E	109.0	6'10"	102.2	
P18	247 + 25	--	108.4	11'3"	97.1	
P19	247 + 25	20'E	108.7	3'0"		Obstruction
P20	247 + 25	40'E	108.2	4'0"		Obstruction
P21	247 + 25	60'E	108.3	5'4"		Obstruction
P22	247 + 25	80'E	108.6	5'4"	103.3	
P23	247 + 25	20'W	109.0	9'11"	99.1	
P24	247 + 25	40'W	108.5	4'6"	104.0	
P25	247 + 25	70'E	108.6	7'3"	101.2	

## 2. Probes on Water

Elevation of Water Surface : 108.5

Measurements are from water surface.

<u>Probe No.</u>	<u>Chainage</u>	<u>Offset</u>	<u>Depth of Water</u>	<u>Depth of Probe</u>	<u>Rock Level</u>	<u>Remarks</u>
P26	247 + 53	80'E	3'0"	10'3"	98.2	
P27	247 + 60	80'E	3'	9'3"	99.2	
P28	247 + 48	60'E	2'7"	22'1"	86.4	Stiff at 15'6" (Sample of silty sand and gravel).
P29	247 + 58	40'E	4'7"	38'0"	70.5	
P30	247 + 55	80'E	4'10"	23'0"	85.5	Soft to firm clay at 20 ft.
P32	247 + 61	20'W	4'1"	6'3"	102.2	
P33	247 + 60	30'W	3'6"	8'9"	101.7	
P34	247 + 54	40'W	3'3"	8'5"	100.1	
P35	247 + 60	40'W	3'3"	10'6"		Hand probe. Rock not reached.
P36	247 + 47	60'W	4'5"	30'2"	78.3	Firm from 10'2"
P37	247 + 61	—	5'	17'0"	91.5	Dense from 14'
P38	247 + 69	—	5'4"	15'3"	93.2	Dense from 12'3"
P39	247 + 80	—	4'1"	11'11"	96.6	Dense from 8'2"
P40	247 + 90	—	5'1"	10'1"	98.4	
P41	248 + 02	—	5'	9'0"	99.5	
P42	248 + 08	5'6"E	5'	9'6"	99.0	
P43	248 + 08	—	5'	8'0"	100.5	
P44	248 + 08	10'6"W	5'	5'7"	102.9	
P45	247 + 69	50'W	4'10"	17'11"	90.6	
P46	247 + 85	50'W	4'8"	15'1"	93.4	
P47	248 + 00	50'W	4'7"	11'10"	96.7	
P48	248 + 10	80'E	6'4"	41'7"	66.9	
P49	248 + 10	60'E	6'	38'8"	69.8	Firm from 28'
P50	248 + 10	42'E	5'6"	31'9"	76.7	Dense from 30'3"
P51	248 + 10	20'E	5'0"	13'6"	95.0	V. soft all way
P52	248 + 14	20'W	4'2"	5'0"	103.4	
P53	248 + 12	40'W	4'3"	6'0"	102.5	
P54	248 + 14	50'W	4'	10'0"	97.6	
P55	248 + 20	60'W	3'2"	20'7"	87.9	
P56	248 + 26	80'W	4'3"	30'2"	78.3	Soft to firm clay from 12'7 - 10 blows/foot 23'-28'

3. Probes north of water gap (land or ice)

<u>Probe No.</u>	<u>Chainage</u>	<u>Offset</u>	<u>Grade Level</u>	<u>Depth of Probe</u>	<u>Rock Level</u>	<u>Remarks</u>
P57	248 + 50	80'E	108.6	45'0"	83.6	Organic muck to 41'. V. soft clay from 41'. Compad sand and fine gravel from 44'4".
P58	248 + 47	60'E	108.7	40'5"	68.3	Organic muck and sawdust all way.
P59	248 + 50	40'E	108.7	21'9"	86.9	
P60	248 + 50	20'E	108.8	9'4"	99.5	
P 61	248 + 50		109.0	5'4"	103.7	
P62	248 + 50	25'W	113.7	0'3"	113.4	
P63	248 + 50	50'W	110.4	7'9"	102.6	
P64	248 + 50	75'W	110.6	23'0"	< 87.6	Dense at 5' Rock not reached Logs and slit at 22 ft. Dense at 43 ft.
P 65	249 + 00	70'E	108.8	44'0"	64.8	
P66	249 + 00	60'E	109.2	39'9"	69.4	
P67	249 + 00	50'E	109.4	30'5"	79.0	V. soft silt from 18'
P68	249 + 00	40'E	109.3	21'3"	88.3	V. soft organic muck allway
P69	249 + 00	30'E	109.5	17'8"	91.8	As above, logs from 15'
P70	249 + 00	30'E	109.2	10'0"	99.2	V. soft muck all way
P71	249 + 00	4'10"E	110.0	4'10"	105.2	Organic topsoil
P72	249 + 00	25'W	110.9	1'8"	109.2	Organic topsoil
P73	249 + 00	50'W	110.9	4'5"	106.5	As above & drift
P74	249 + 00	75'W	110.3	7'2"	103.1	As above

### LIST OF TEST HOLES

<u>B. H. No.</u>	<u>Chainage</u>	<u>Offset</u>	<u>Grade Level</u>	<u>Depth</u>	<u>Rock Level</u>
B. H. 2	244 + 50	58'E	108.6	12'7"	96.0
B. H. 9	245 + 40	50'E	112	11'4"	101
B. H. 13	246 + 50	15'E	109.2	7'1"	102.1
B. H. 31	247 + 53	Ø	108.5 (W.L.)	16'7"	95.1

Note: See borehole logs for details of soils in the boreholes.





## e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

## BOREHOLE LOG

Job Name Bedford Mills Diversion Job No. 6223 Borehole No. 31  
 Client D. H. O. Casing BX Boring Date February 9th, 1962  
 Elevation County of Frontenac Datum Compiled By R. K. Checked By S. B.

## 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  
ConsistencyDepth  
Elevation

## Legend

Sample No.  
and  
ConditionSample  
TypeNo. of  
Blows  
per FtMoisture  
Content

## WATER LEVELS &amp; REMARKS

B.M. 31 W.L. 108.5  
0'0"

Water

4'5"

Organic Muck and sawdust

Black &  
BrownExtremely  
soft

10'0"

Silty sand and stones

Brown &amp; Grey

Compact

12'0"

13'5"

Granite Bedrock

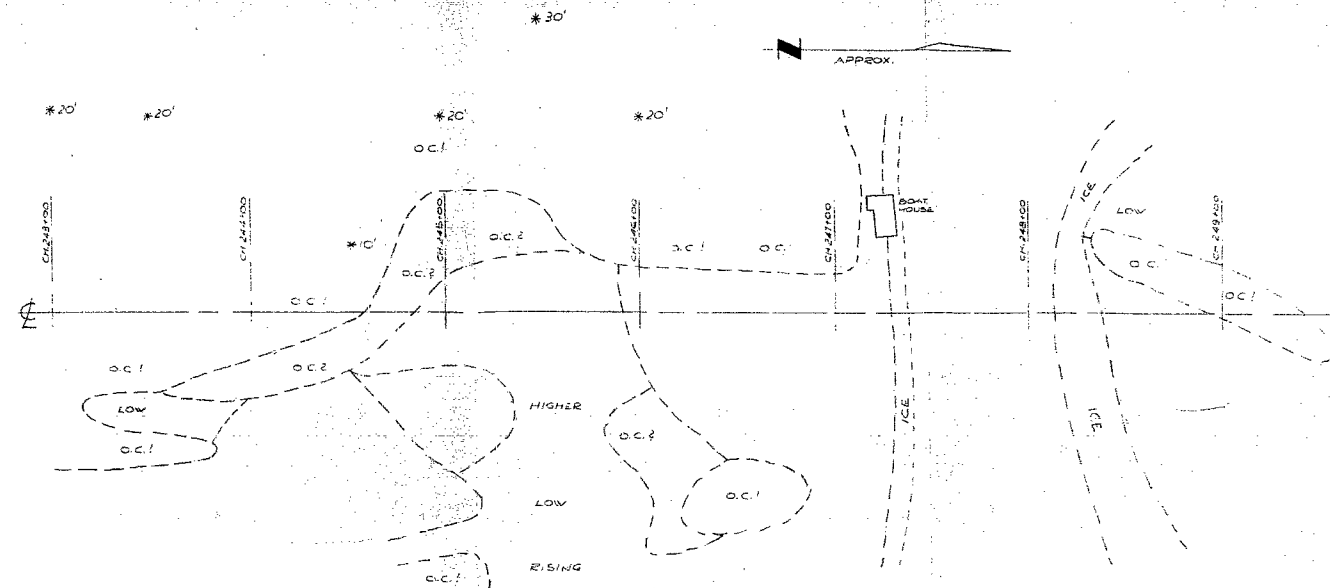
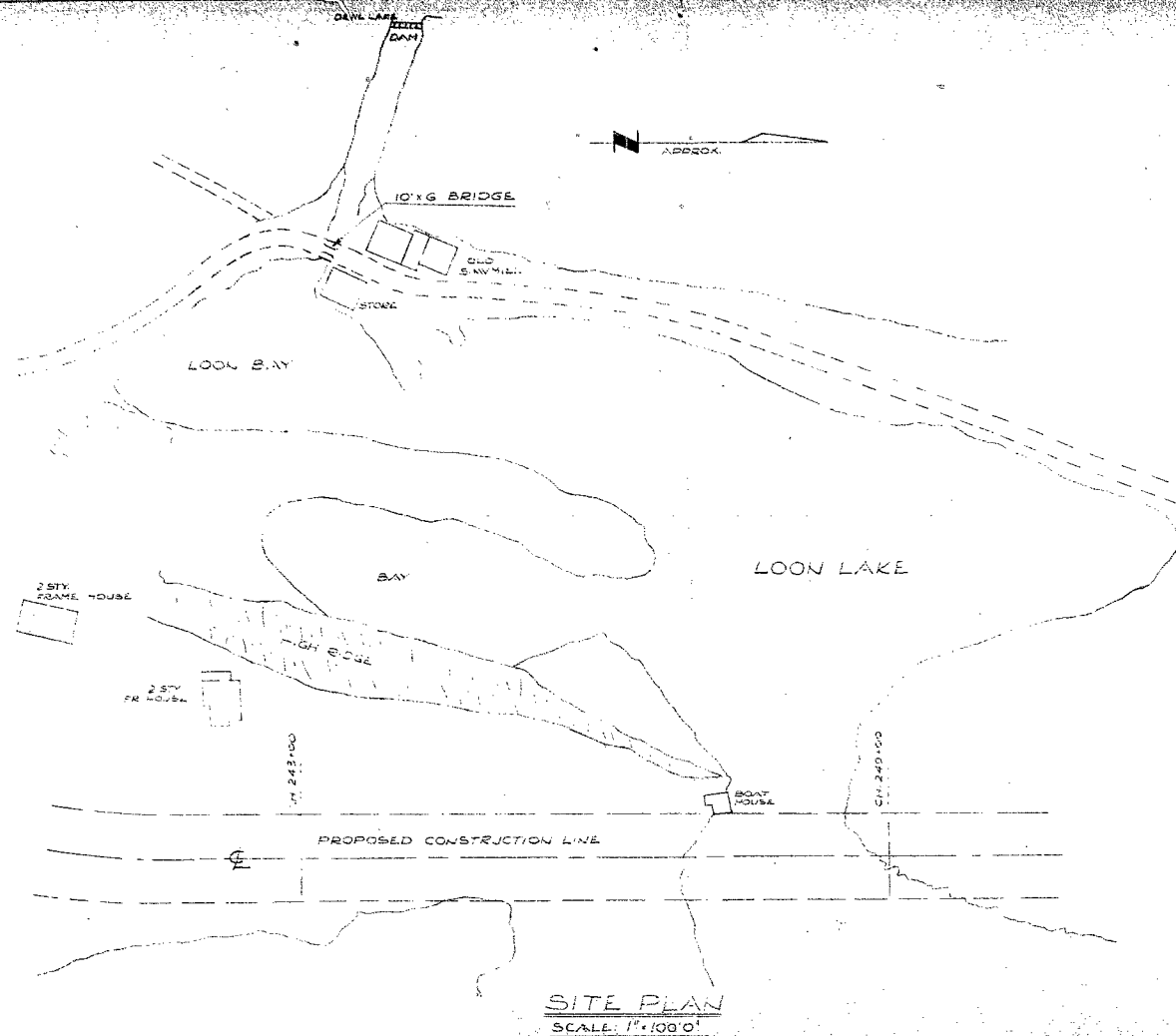
Red &amp; grey

Very hard  
some fissures

18'7"

Diamond drilled from  
13'5" to 18'7"  
Core recovery 2 ft.

Test hole terminated at 18' 7"

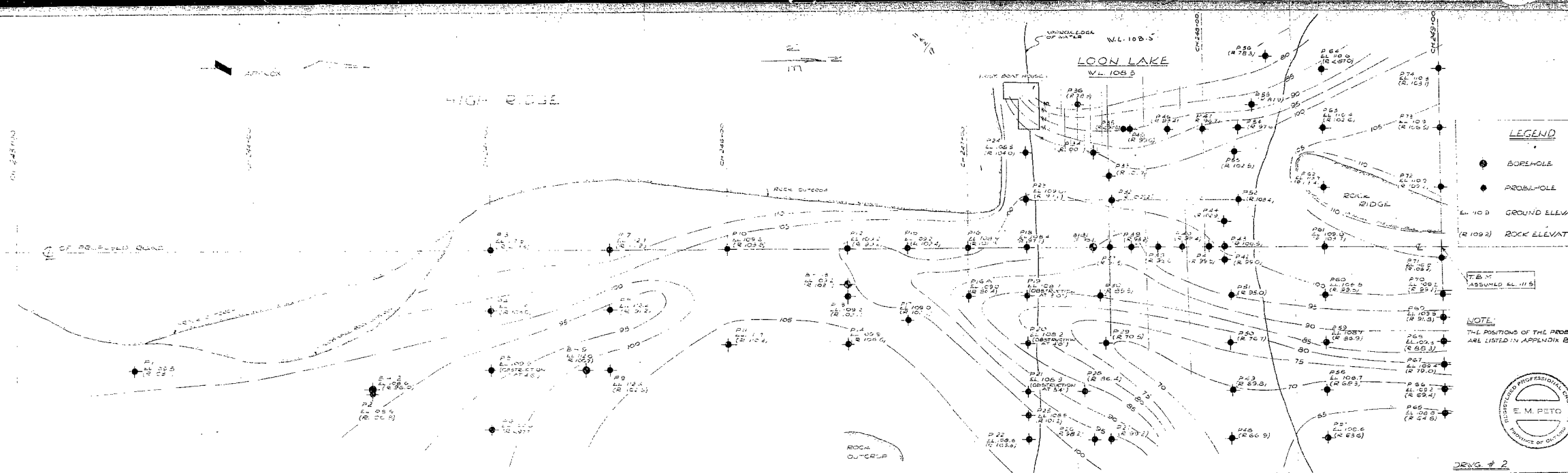


- LEGEND**
- INTERMEDIATE TOPG. (VARIABLE ORGANIC AND DRIFT COVER)
  - POSSIBLE BEDROCK OUTCROP
  - QUESTIONABLE BEDROCK OUTCROP (SHALLOW DRIFT COVER)
  - SWAMP
  - WATER
  - OC.1 DEFINITE BEDROCK OUTCROP
  - OC.2 POSSIBLE
  - \*20' 20' HIGHER THAN 1

**NOTE:**  
POSITIONS OF TOPOGRAPHICAL FEATURES ON THIS SKETCH ARE ONLY APPROXIMATE.

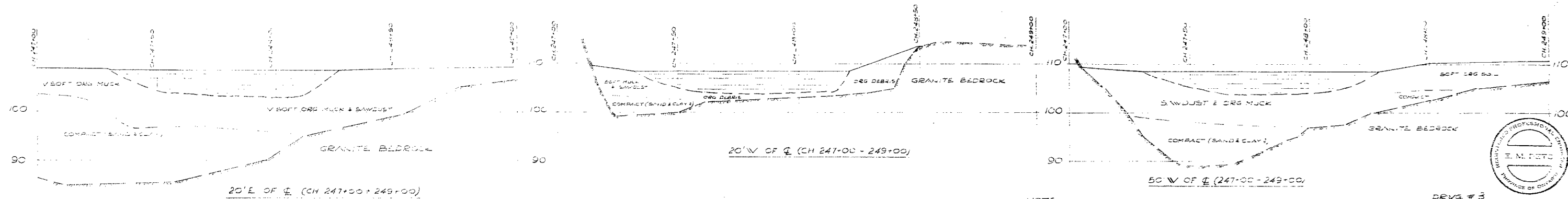
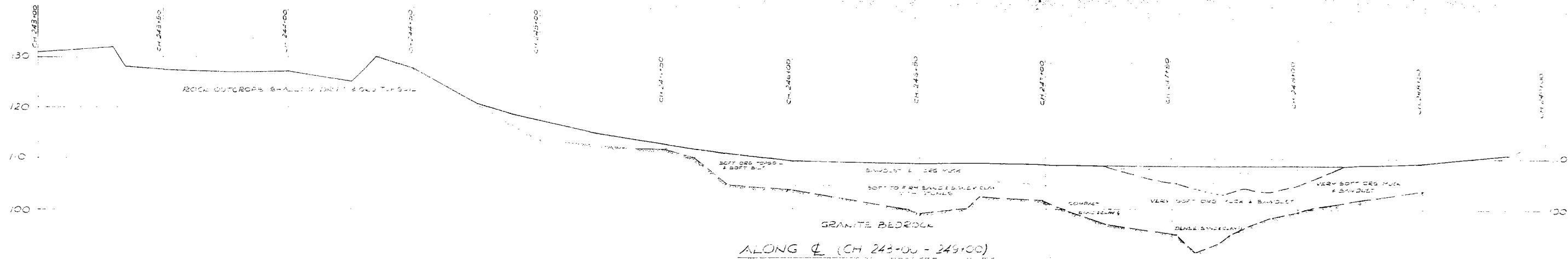


DWG. # 1  
JOB # 6223  
em peto associates ltd.  
FEB. 1962 K.K.



CONTOUR MAP OF ROCK SURFACE  
SCALE: 1" = 20'0"

DRWG. # 2  
JOB # 6223  
e.m. peto associates Ltd.  
FEB. 1962  
K.K.



**LONGITUDINAL SECTIONS**  
 SCALES: HOR. 1" = 20' 0", VERT. 1" = 10' 0"

**NOTE:**  
 ROCK PROFILE WAS OBTAINED FROM  
 PROBE RESULTS AND FROM CONTOURS  
 ON DRWG. # 2 AND IS ONLY APPROXIMATE.

DRWG. # 3

108 # 6223

**em peto associates ltd**

FEB. 1962 K.K.

REGISTERED PROFESSIONAL ENGINEER  
 E. M. PETO  
 PROVINCE OF ONTARIO