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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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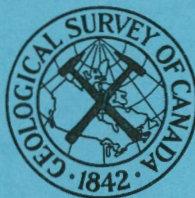
GEOLOGICAL SURVEY OF CANADA  
TOPICAL REPORT NO. 102

YUKON RIVER DRAINAGE BASIN  
DAM SITE INVESTIGATION

SITE No. 22

**FIVE MILE RAPIDS DAM SITE**  
(MAP AND PRELIMINARY REPORT)

BY  
E. B. OWEN



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OTTAWA  
1965

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## FIVE MILE RAPIDS DAM SITE

### General Description

Five Mile Rapids dam site is located on Stewart River, Yukon Territory about 40 miles upstream from the community of Mayo Landing. Fraser Falls dam site, described in Topical Report No. 98, is located about 5 miles downstream. The two sites are part of a scheme to develop the entire hydro-electric power potential of the Yukon River drainage basin.

It is unlikely dams would be constructed at both sites. The dam proposed for the Fraser Falls site would be much larger and consequently would provide more power and storage than a dam at Five Mile Rapids. Its construction would obliterate the need of a dam at Five Mile Rapids as the proposed full supply level of its reservoir is about 1,900 feet which is about 100 feet higher than the highest point in the Five Mile Rapids dam site area. The chief purpose of any dam built at Five Mile Rapids would be to provide storage for dams constructed at Independence and Porcupine sites more than 120 miles downstream.

Five Mile Rapids site can best be reached from Mayo Landing by ascending Stewart River using shallow draft boats. At Fraser Falls there is an excellent one-half mile portage along the left side of the river. Further upstream at Three Mile Rapids boats will have to be lined, preferably along the right side, for about 100 feet. Light aircraft can be landed safely on the river about a mile upstream from the site.

### Geology of the Site Area

The general geology of the region has been described by Bostock.<sup>1</sup> The Pleistocene geology is described in a report by the Geological Survey of Canada which is presently under preparation.<sup>2</sup>

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<sup>1</sup>Bostock, H.S.: Mayo, Yukon Territory, Map 890A, Geol. Surv. Can., 1946.

<sup>2</sup>O.L. Hughes: personal communication.



The geology of the Five Mile Rapids dam site area is similar to that at Fraser Falls. Bedrock at both sites consists of interbedded quartz and sericite schist which have resulted from the metamorphism of sedimentary rocks. The quartz schist is a competent rock and should provide suitable foundation material. The sericitic type is a softer, more easily weathered rock which should be avoided if possible. About 20 per cent of bedrock at Fraser Falls site consists of sericite schist whereas at Five Mile Rapids site it occurs only as narrow interbeds in the more massive quartz variety.

The two sites are situated in a narrow, north-trending valley along which Stewart River is rapidly flowing with a gradient of about 5 feet per mile. Bedrock is exposed in many places along the sides of the river and as islands at the sites and at Three Mile Rapids located about 3 miles upstream from Fraser Falls.

About a mile upstream from Five Mile Rapids site Stewart River which has been flowing in a westerly direction along a wide, drift-floored valley turns sharply to the north. Between the bend and Fraser Falls, some 6 miles downstream, the river consists of a series of rapids interspersed with broad, smooth stretches; its banks are, in general, steep and rocky and its course relatively straight. A short distance below Fraser Falls the Stewart commences to turn back to the west. At Gordon Landing, 10 miles downstream from Fraser Falls, it has resumed in westerly course.

The narrow valley in which the sites are located is probably relatively recent in the history of Stewart River although there is evidence it existed as a distinct topographic feature during the last glaciation. According to Bostock the last ice-sheet moved in a westerly direction across the area. That part in Stewart River valley terminated a short distance downstream (west) from Mayo Landing. However, striae on the left abutment at the Fraser Falls site indicate a northerly movement parallel to the valley. This may have resulted from base flow of the ice as its bottom part was directed

along the valley. An important product of the ice is the dense till deposited along the left side of the valley near Fraser Falls. This could be used in construction of an earth-fill dam. The absence of glacio-fluvial deposits on the terraces at the sites suggests the valley did not act as a drainage channel for meltwaters from the ice and as a consequence little natural aggregate will occur at the sites.

Following glaciation small temporary lakes were formed in the area in which silt and clay such as occurs along the sides of Watson Creek valley were deposited. The thermo-karst topography which exists on the floors of the valleys of Nogold and Watson Creeks and in the area east of the right abutment of Five Mile Rapids site was formed by the melting of isolated ice masses buried by glacio-lacustrine sediments. The large slide area along the right side of the river about one-half mile downstream from Five Mile Rapids site is the result of movement of these fine-grained materials toward the river.

#### Engineering Geology of the Dam Site

Bedrock at Five Mile Rapids dam site consists chiefly of massive, fine-grained, grey quartz schist. Scattered throughout this rock are narrow, continuous zones of soft, easily weathered, sericite schist, none of which are greater than 20 inches in thickness. These rocks are similar to those at Fraser Falls dam site except that at Five Mile Rapids site there is a higher percentage of quartz schist present. It is believed bedrock at Five Mile Rapids site is sufficiently competent to provide suitable foundation and abutment material for a dam.

As at Fraser Falls site the schistosity which is the chief structural feature present strikes generally across the river. However at Five Mile Rapids site the dip of the schistosity is downstream which is the reverse to that at Fraser Falls. This is less favourable for construction of a dam. The

bedding is more apparent at Five Mile Rapids site. It is almost parallel to the ~~schistosity~~ and has a similar downstream dip.

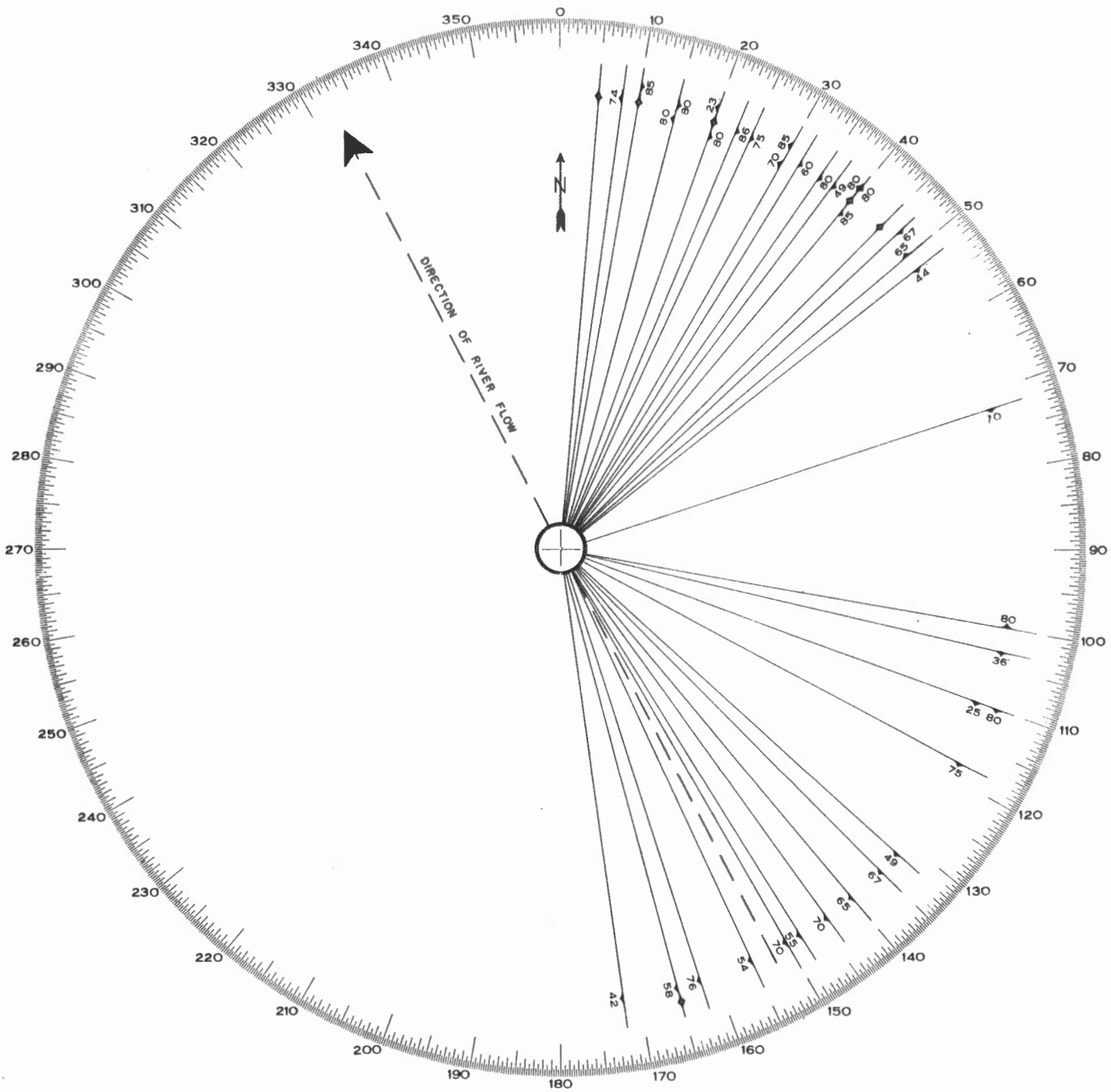
There are 2 prominent joint sets at Five Mile Rapids site. One of these which closely parallels a prominent set at Fraser Falls site strikes from 5 to 50 degrees east and, in general, dips steeply toward the right abutment. The other intersects the first at about 60 degrees and dips at more shallow angles into the left abutment. The spacing varies from a few inches to more than 4 feet. Open fractures up to 3 inches in width frequently occur along the jointing. These fractures probably do not extend far into bedrock but their presence helps to increase the amount of weathering in the surface rock.

According to Bostock a northeast-trending fault may intersect Stewart River at Five Mile Rapids dam site. There is, however, no indication of faulting in bedrock exposed at the site. A small fold indicated by a reversal in dip of both the bedding and schistosity occurs in the downstream end of the left abutment. The fold strikes in a northeast direction and intersects the river at 90 degrees.

Three different types of unconsolidated material occur at Five Mile Rapids dam site. Recent Alluvium consisting of silt, sand and gravel cover the narrow flood plains along both sides of the river. The highest elevation at which it occurs is 1,715. The material beneath the river is probably similar but contains a higher percentage of gravel.

Alluvium consisting of silt and sand covers a sloping terrace which extends from the river to the base of the rock outcrop forming the left abutment. The maximum elevation at which this material occurs is 1,735. The deposit is probably thin. The material has no value as a construction material but would have to be removed if the dam were extended across the terrace.

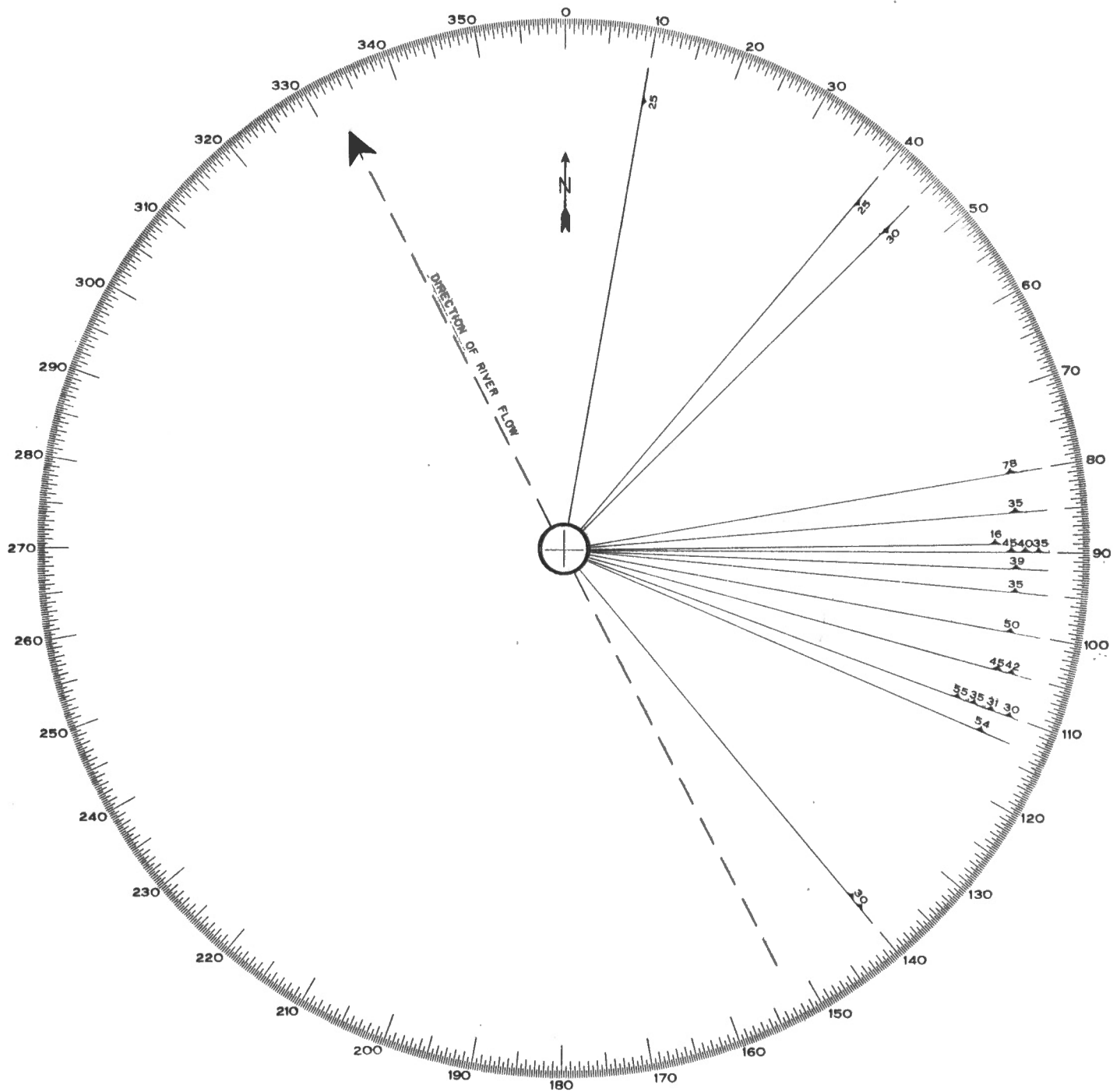
Glacio-lacustrine material consisting of a thin deposit of coarse-grained sand overlying silty clay covers the right abutment slope. These



**JOINT ROSETTE**

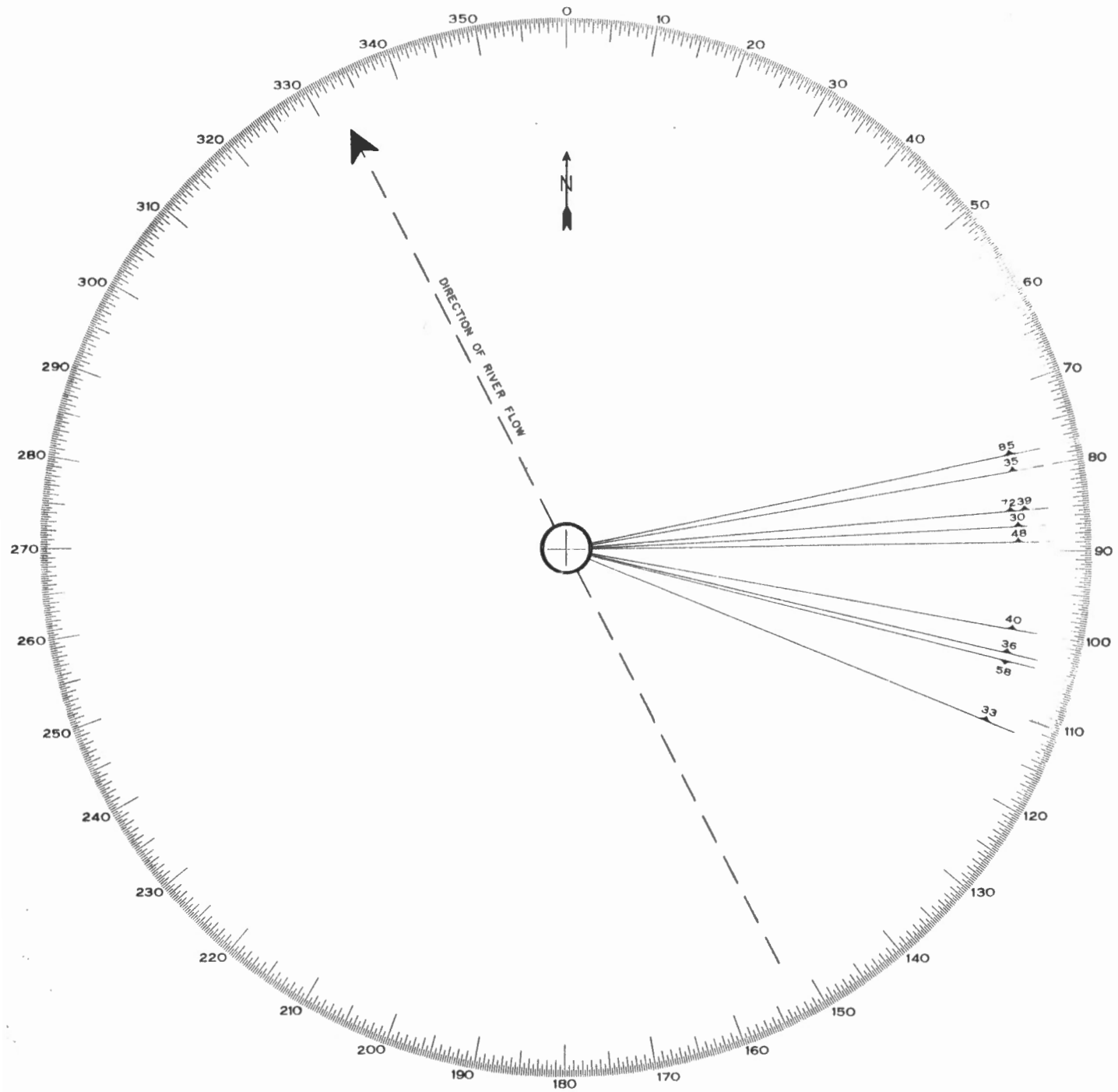
The above illustration presents diagrammatically the direction and dip of the jointing in bedrock exposed at Five Mile Rapids site.





**BEDDING ROSETTE**

The above illustration presents diagrammatically the direction and dip of the bedding in bedrock exposed at Five Mile Rapids site.



FOLIATION ROSETTE

The above illustration presents diagrammatically the direction and dip of the schistosity in bedrock exposed at Five Mile Rapids site.

materials extend east from the right abutment into an area of extensive thermo-karst topography. Their presence may limit the height to which the dam can be built. They are not stable and could not be used as foundation material. Numerous slides have taken place in this material along the right side of Stewart River downstream from the site. The wide, shallow valley floored with silty clay in the centre of the right abutment is probably an old slide scar.

The thickness of the alluvium at Five Mile Rapids dam site is not great. It is probably less than 20 feet on the bedrock terrace along the left side of the river. The presence of islands of bedrock in the river indicate the alluvium beneath the river is also shallow. Test borings will be necessary to determine the thickness of the glacio-lacustrine materials on the right abutment as there is no indication of bedrock on the abutment slope above the rock outcrops located along the lower part of the abutment.

#### Construction Materials

There is a shortage of construction materials in the dam site area. The glacio-fluvial silty clay is the most common unconsolidated material present. Tests will be necessary to determine if this could be used as impervious material for an earth dam. The sides of the wide, west-trending valley of Stewart River upstream from the site should be investigated for deposits of till and gravel. The gravel will probably occur on level terraces at various elevations above the valley floor and will overlie the till. Riprap and aggregate could probably be obtained by quarrying and crushing the quartz schist at the site.

#### Conclusions

The following conclusions have been made as a result of this preliminary geological investigation of Five Mile Rapids dam site:

1. Bedrock at the dam site consists chiefly of massive, fine-grained, grey quartz schist which should provide suitable abutment and foundation material.

2. Interbedded with the quartz schist are narrow bands of soft, sericite schist which are continuous over considerable distances. The presence of these physically weak rocks would tend to lower the competency of the rock mass and reduce its resistance to sliding. This may be important because of the downstream dip of the schistosity. Test borings will be necessary to determine the extent of these weak zones. If possible they should be avoided.

3. There is a lack of construction materials at the site. The silty clay on the upper part of the right abutment is an extensive deposit and may have some use as impervious material. The nearest and most likely place to prospect for construction materials would be along the sides of Stewart River valley upstream from the site.

4. The best location for the dam would be in the upstream part of the site area immediately downstream from a small rocky island. The concrete structures would be located at the river with an earth section extending across the bedrock terrace west of the river to the left abutment. This dam would be similar to that proposed for Independence site but on a smaller scale. Another location could be along the fold axis in the downstream part of the site area which is indicated on the accompanying geological map.

5. There is no information regarding groundwater conditions at the dam site. Springs were not observed in either abutment nor is there any indication they have occurred in the past.

6. The frost line was encountered within 18 inches of ground surface in several places on the alluvium-covered terrace west of the river. Here the moss cover is as much as 24 inches thick whereas on the opposite side of the river where no frozen ground was observed it seldom exceeds 6 inches.

7. Test borings will be required to determine elevations of bedrock surface beneath the terrace west of the river, beneath the river and in the right abutment area. Soil samples should be taken and permeability tests conducted. The presence of soft, sericite schist in bedrock should be noted.

8. Bicarbonate salts of calcium and magnesium constitute the chief mineralization of Stewart River water. The results of chemical analyses of several samples of the water are included in the report on Fraser Falls dam site (Topical Report No. 98).

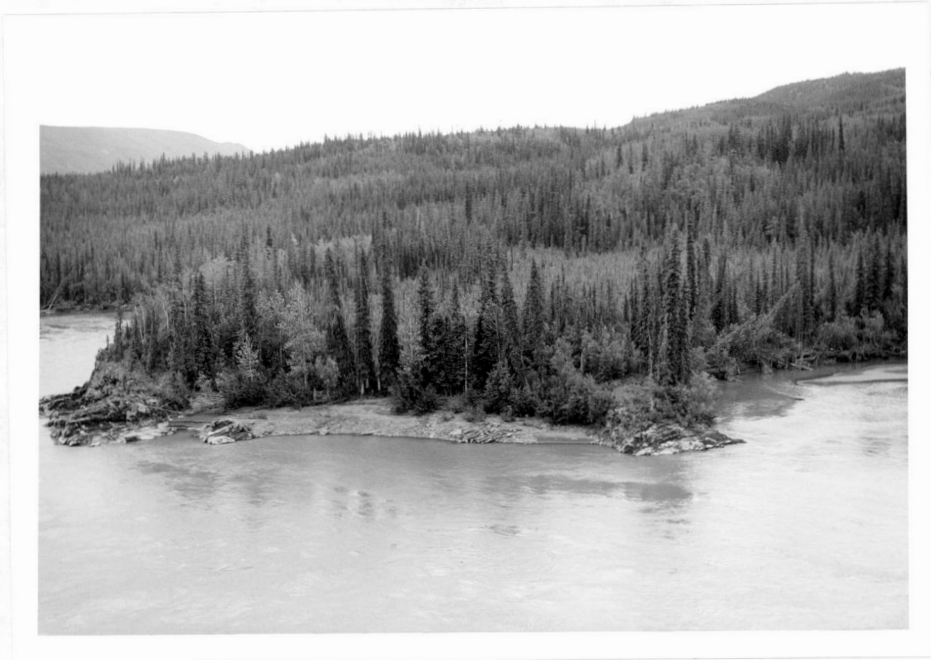


Plate 1

Left abutment area, Five Mile Rapids dam site;  
view from the right abutment.

G.S.C. 8-8-63



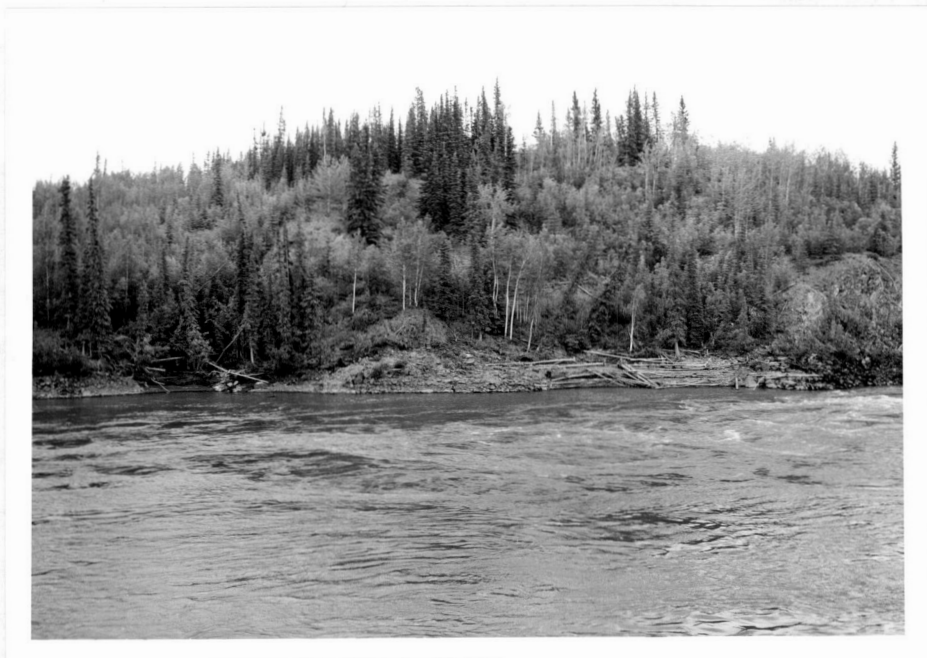


Plate 2

Right abutment, Five Mile Rapids dam site; view from left side of Stewart River; a large, old slide area exists immediately downstream.

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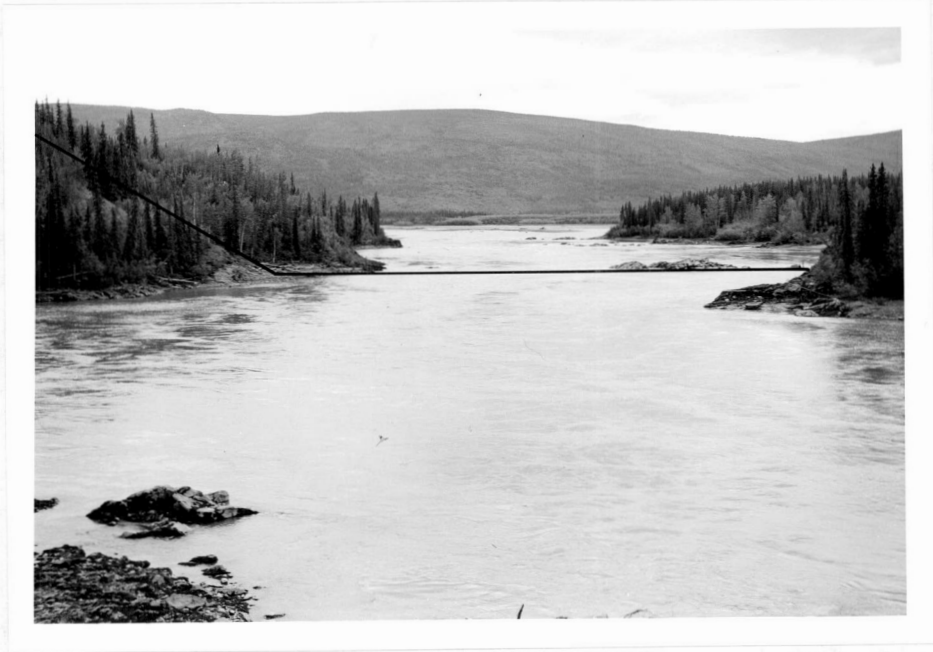
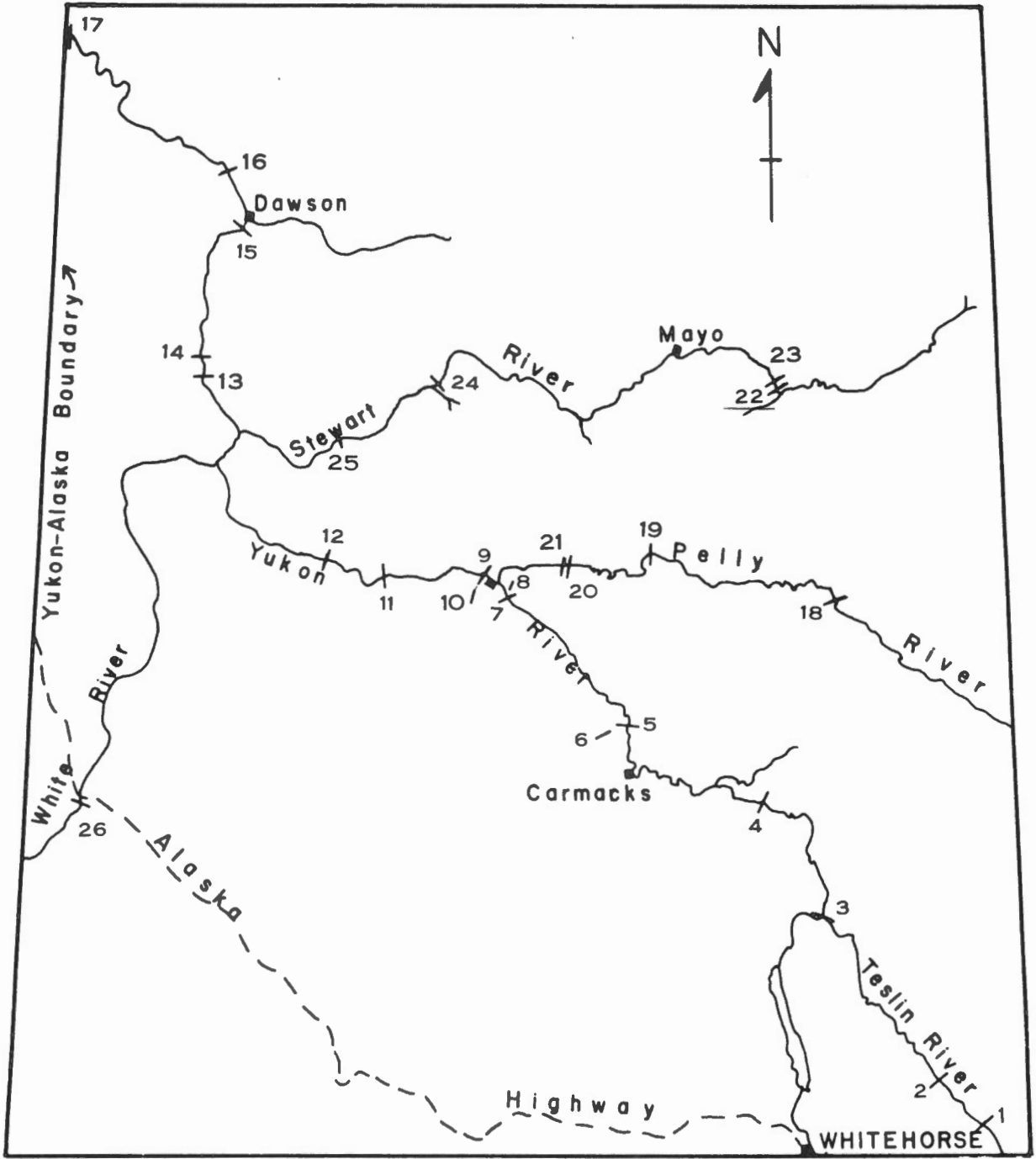


Plate 3

View looking upstream through Five Mile Rapids  
dam site; suggested location of dam indicated  
by the black line.

G.S.C. 8-7-63



LOCATION OF PROPOSED DAM SITES  
YUKON RIVER DRAINAGE BASIN  
Scale: 1 inch = 40 miles

Site No.	Name	Site No.	Name	Site No.	Name
1	Swift River	10	Fort Selkirk Draw	19	Granite Canyon
2	Northwest Power	11	Selwyn	20	Gerc
3	Hootalinqua	12	Britannia	21	Bradens Canyon
4	Big Salmon	13	Ogilvie no.1	22	Five Mile Rapids
5	Five Finger Rapids	14	Ogilvie no.2	23	Fraser Falls
6	Five Finger Draw	15	Upper Dawson	24	Independence
7	Wolverine	16	Lower Dawson	25	Porcupine
8	Wolverine Draw	17	Boundary	26	Lower Canyon
9	Fort Selkirk	18	Detour		