No. 2

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 83

MACKENZIE RIVER DRAINAGE BASIN

DAM SITE INVESTIGATION

SITE NO. 16

ABERDEEN FALLS DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

OTTAWA

1964

FOR DEPARTMENTAL USE ONLY

NOT TO BE QUOTED AS A PUBLICATION

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 83

MACKENZIE RIVER DRAINAGE BASIN

DAM SITE INVESTIGATION

Site No. 16

ABERDEEN FALLS DAM SITE

(Map and Preliminary Report)

by

E.B. Owen

OTTAWA

1963

CONTENTS

Illustrations

CONTENTS

ABERDEEN FALLS DAM SITE

General Description

Aberdeen Falls dam site is located on Peel River about 12 miles upstream from the junction of the Peel and Wind Rivers. An alternate site, Wind River dam site, is located immediately downstream from the mouth of Wind River. Both sites are situated within the MacKenzie River drainage basin.

The proposed dam is part of a plan to develop hydroelectric power on Rat River which flows east through McDougall Pass some 126 miles to the north.

The purpose of the dam is to divert Peel River water north through Eagle Plain to Bell River and hence northeast to McDougall Pass. In doing so Peel water must twice cross the divide between the drainage basins of Yukon and Mackenzie Rivers. One divide which separates Peel and Eagle Rivers is situated near the south end of Palmer Lake at approximate latitude 66°8' and longitude 136°22'. The other is at the west end of McDougall Pass at latitude 67°13' and longitude 136°28'. The latter divide separates Bell and Rat Rivers.

To prevent the diverted Peel water from escaping westward via Bell and Porcupine Rivers a second dam will be constructed on Porcupine River either at Bell site eleven and a half miles downstream from the mouth of the Bell or at Porcupine Canyon site a few miles east of the Alaska-Yukon Territory boundary. The geology at these 2 sites will be described in subsequent reports.

The elevation of Peel River at Aberdeen Falls site is about 740 feet whereas the divide immediately south of Palmer Lake over which Peel River water will be diverted is 1,279 feet above sea level. Consequently the height of the dam will be in the order of 550 feet. The height could be decreased by lowering the floor of the outlet at Palmer Lake. This would be a difficult task. This area was one of the main discharge routes of glacial meltwaters flowing in a northerly direction from wasting ice masses to the south and southeast. The steep rock walls along the sides of the valley in which Palmer Lake is located indicate these waters cut down many feet into bedrock. The thickness of overburden beneath Palmer Lake is unknown but it is believed to be relatively thin and consequently any excavation here would be chiefly in bedrock. The greater part of overburden probably consists of coarse-grained, bouldery gravel which could be excavated with a large dipper dredge. A suction dredge, unless it were equipped with a crushing plant, would have difficulty moving the larger boulders. It is doubtful if there is any till present beneath the gravel. Bedrock in the area consists of thin-bedded shale and siltstone with a gentle westerly dip up to 15 degrees.

At Aberdeen Falls site Peel River is flowing in an easterly direction between steep bedrock bluffs which rise abruptly from the edges of the river to heights greater than 150 feet. A gently sloping terrace, ranging in width from 900 to 1,500 feet, extends north from the left side of the canyon to the toe of a steep rock bluff in which it is proposed to locate the left abutment of the dam. It is believed this is a bedrock terrace and the overburden covering it is thin. Two similar terraces occur along the right side of the canyon. The lower terrace which is located in the upper part of the main wall of the canyon has an average width of about 100 feet. It occurs only at irregular intervals in the upstream part of the area mapped. The upper terrace occurs at the same elevation as the terrace north of the canyon. However it is not as wide and is broken in the centre by a rock ridge capped with limestone which extends from the river back to the bluff forming the right abutment.

Bedrock exposed in the area consists of flat-lying, Palaeozoic sedimentary rocks of which shale is the most common. Considerable limestone and limestone breccia with narrow shale interbeds is exposed in the walls of the canyon in the upstream part of the site area while in the downstream part bedrock consists chiefly of shale and argillaceous limestone with some argillite and dark chert.

Overburden on the terraces consists of thin deposits of silt, sand and gravel overlying bedrock. Talus covers much of the abutment slopes. Many huge limestone boulders occur along the base of the canyon walls in the upstream part of the area. During the investigation one such boulder weighing about 20 tons was seen to drop into the river.

Unconsolidated Deposits

Four types of unconsolidated deposits exist at Aberdeen Falls dam site. These are as follows:

1. Recent alluvium: The steep, rock bluffs rising abruptly from the sides of Peel River have prevented the formation of extensive deposits of Recent alluvium. The largest area covered with this material occurs along the right side of the river near stations G-1 and G-2. The alluvium consists chiefly of silt and sand with minor quantities of gravel containing boulders up to 10 inches in diameter. The material is relatively fine-grained. The presence of numerous elongated, bedrock outcrops projecting through the alluvium indicate the deposit is thin. Sandstone is the most common rock present in the gravel. Boulders of quartzite, limestone and granite are also present but in minor quantities. The absence of large boulders in the alluvium in the downstream part of the site area suggests steel sheet piling could be driven through it with little difficulty. This is not true in the upstream part where the canyon is much narrower. Here large boulders, generally limestone and limestone breccia, are believed to occur

beneath the river. Such boulders would prevent piling from reaching bedrock surface. The quantity of Recent alluvium along Peel River not only in the site area but also for several miles up and downstream from the site is small. It is doubtful if the alluvium has any use as a construction material.

2. Talus: Talus is material resulting from the mechanical disintegration of adjacent bedrock. It seldom can be used as a construction material but the size and shape of the rock fragments in the talus is a good indication of how the source rock will break when blasted. Talus derived from the thick beds of limestone and limestone breccia which are exposed in the canyon walls in the upstream part of the site area and to a lesser extent on both abutments contains rock fragments several feet in diameter. In the centre and downstream parts of the site area where bedrock consists chiefly of thin-bedded shale and argillite the talus consists of small, platy rock fragments. This talus frequently contains numerous grey, rounded, sandstone boulders derived from coarse-grained, glacio-fluvial gravel which overlies bedrock in some places along the tops of the canyon walls.

3. Glacio-lacustrine (silt): This material consists of dark grey silt with some clay which covers large parts of the bedrock terraces along both sides of the canyon. In places the material is sandy. The silt directly overlies bedrock or glacio-fluvial material. The thickness of the deposit is unknown but is believed to be thin. The material might be used in the impervious core of an earth dam. An extensive test pitting program should be conducted in the areas where the silt is known to occur to determine the quantity available. A grain size analysis curve produced from a representative sample (No. 15) of the material is included at the end of this report.

4. Glacio-fluvial (sand, gravel): This material consists of fine- to coarse-grained sand interbedded with coarse-grained gravel. In places the sand contains considerable silt. Thin deposits of the material occur along

the bottom parts of both abutment slopes where they are concealed by a thick layer of vegetation. It is exposed in thicknesses up to 15 feet along the top of the left wall of the canyon in the downstream half of the site area. The greatest thicknesses of sand and gravel occur in this locality. In the vicinity of station Z-12b ground surface is pitted with kettles - small basins created by the melting of buried or partly buried blocks of ice after sedimentation has ceased. It is believed the bedrock terraces on both sides of the canyon were formed for the most part by erosion by the same streams which deposited the glacio-fluvial material. Consequently the material should directly overlie bedrock. A test pit put down near station Z-2 encountered bedrock beneath 20 inches of gravel. Representative samples (Nos. 13 and 14) of the finer sandy material and of the gravel were forwarded to the soils laboratory of the Water Resources Branch in Vancouver for grain size analyses. The resultant curves are included at the end of this report.

Bedrock

General Description

The most common rocks at Aberdeen Falls dam site consist of thin-bedded shale and argillaceous limestone with minor quantities of argillite and black chert. Overlying these rocks is about 60 feet of thick-bedded limestone and limestone breccia. These in turn are overlaid with soft, black, thin-bedded shale.

There are several structures, i.e., folds and faults, scattered throughout the rock exposed at the site which undoubtedly effect the competency of the rock mass. On the basis of these structures and on the lithology of bedrock the site area can be divided into 3 parts. In the upstream part where the canyon is the most narrow and the greatest drop in the river occurs bedrock exposed in the canyon walls consists chiefly of three massive, flat-lying beds of limestone. These beds vary from 15 to 30 feet in thickness. An interbed of soft, black shale about 3 feet thick occurs between the middle and lower beds. The upper part of each bed consists of fine-grained, grey limestone which grades downward into a coarse-grained, firmly cemented breccia containing many large, angular fragments of shale and limestone up to 8 feet in length. Small, subrounded to rounded fragments of banded chert, granite and quartzite also occur throughout the breccia. About two-thirds of each limestone bed consists of breccia. The calcareous cement binding the fragments is similar to the limestone in the upper part of the bed.

A narrow, bedrock terrace situated along the top of the uppermost limestone bed occurs in the right wall of the canyon. This terrace which is 75 to 100 feet wide extends south from the main wall of the canyon to a steep, 75-foot bluff in which the soft, black shale overlying the limestone is exposed.

In the upper part of the canyon Peel River is flowing over the thin-bedded shale and black, argillaceous limestone which underlies the massive limestone beds and which is exposed further downstream in both walls of the canyon. At low water these rocks are visible in the exposed parts of the canyon floor.

An asymmetrical, synclinal fold which intersects the river at about 75 degrees occurs in the centre part of the site area. Here the massive limestone beds which upstream were essentially flat-lying dip sharply downstream and disappear beneath the river. As a result the canyon walls here consist of the soft, easily eroded shale which overlies the limestone. The location of the fold axis is marked by a valley, 200 feet in width, which has been cut into the right wall of the canyon for a distance of about 500 feet. The valley is the probable result of erosion by the river of disturbed shaly bedrock along the axis of the fold.

The limestone reappears in the floor of the canyon about 300 feet downstream from the valley. At this point the canyon becomes very narrow, averaging less than 200 feet in width. This is due to the presence of the more resistant limestone. There is a drop of about 3 feet in the level of the river where it flows over the limestone strata. The strike of the bedding is almost at right angles to the river and the dip is relatively shallow ranging from 12 to 14 degrees upstream.

The limestone is exposed in both walls of the canyon for a distance of about 400 feet downstream from where it reappears in the canyon floor. In this area the shale beds overlying the limestone are frequently contorted and close folded. They are not believed competent. Numerous small faults parallel to the folding are also present.

Bedrock in the downstream part of the site area consists of thin-bedded shale and argillaceous limestone with some argillite and black chert. The limestone is a fine-grained, dark grey to black, massive rock which occurs in beds up to 12 inches in thickness. It constitutes about 60 per cent of the rock exposed in the canyon walls. The shale is soft and black. It occurs in beds seldom greater than 4 inches in thickness which are interbedded with the more competent limestone. The argillite and black chert are interbedded as small lenses in the shale. The argillite occurs throughout the area whereas the chert was observed only in the downstream part along the base of the right (south) wall of the canyon. The chert may also exist in other places in the downstream part of the canyon which were inaccessible at the time of the investigation.

A massive bed of limestone breccia similar to that exposed further upstream is exposed in the floor of the canyon about 1,000 feet upstream from the edge of the map area (about 300 feet upstream from stations P-1 and P-2). The bed is about 10 feet in thickness and has a shallow upstream dip of 10 degrees. The downstream end of the limestone is cut by a normal fault which dips downstream at about 65 degrees. The limestone reappears in the canyon about 2,000 feet further downstream well beyond the limit of the area included in the accompanying geological map.

Bedrock Structures

Bedding upstream from the folded area is horizontal or dips at low angles into the right (south) wall of the canyon. The strike of the jointing is variable intersecting the river at many angles. The dips vary from 80 degrees to vertical. In the massive limestone the jointing is frequently continuous throughout the individual beds but seldom passes from one bed to another. The spacing varies from 6 to 24 inches. They are frequently open (1- to 3-inch wide fractures) in the upper 6 to 8 feet of the bed but below these depths are tight.

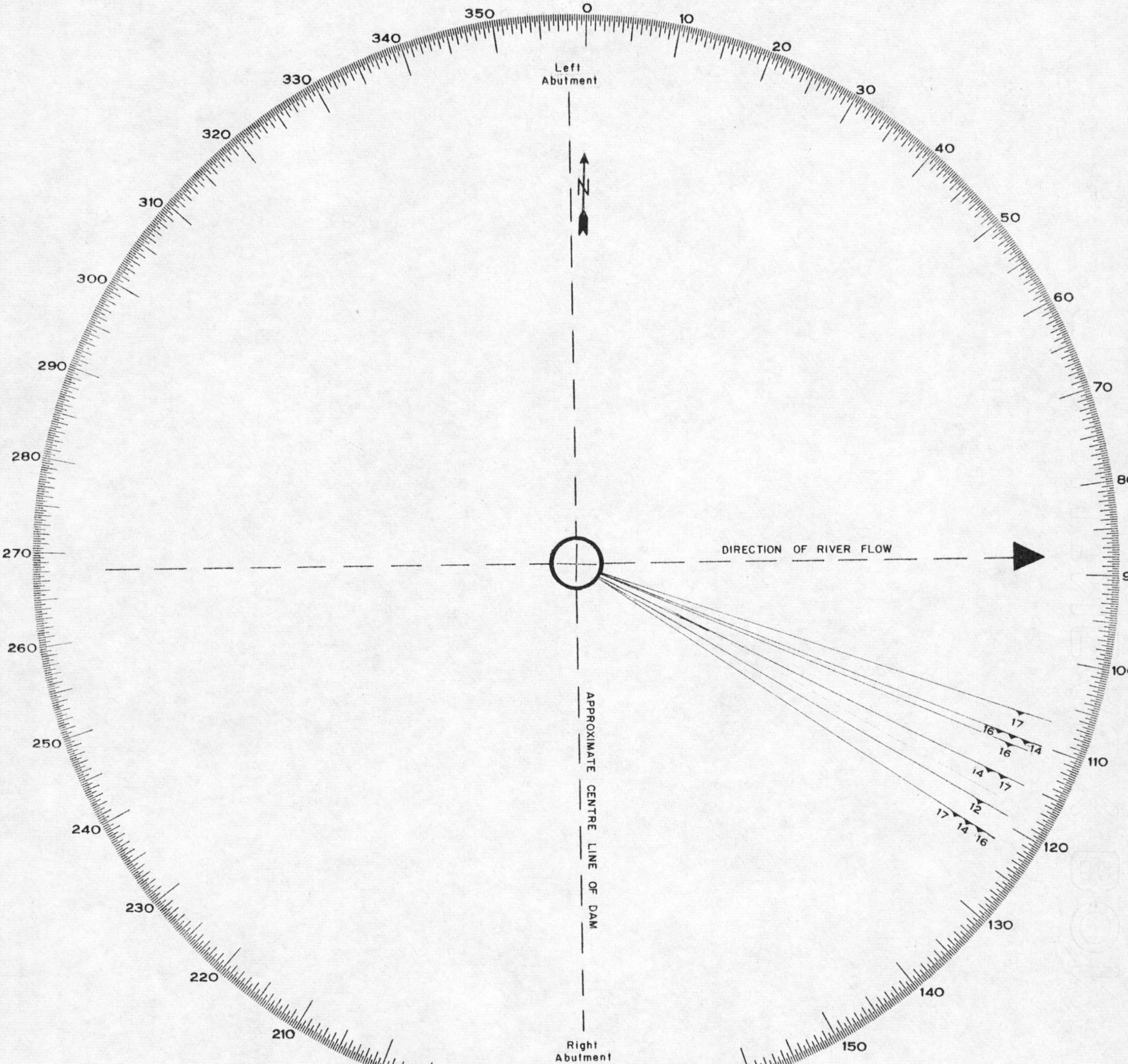
Numerous small thrust faults are visible in both walls in the upper part of the canyon. The faults usually intersect the river at angles greater than 45 degrees and dip upstream at low angles. One such fault occurs at station G-8. This structure intersects the river at 58 degrees and has a shallow upstream dip of about 27 degrees. The movement along the fault is about 12 inches. Little broken rock is associated with the fault and gouge does not occur. Most of the faults are continuous across the canyon. Slickensiding in the shale separating the massive limestone beds suggests some lateral movement has taken place along these strata but the amount of displacement is unknown.

The axes of the folding in the centre part of the site area intersects the river at about 75 degrees. A few small, irregular faults parallel to the folding occur in this area. There are two prominent joint sets. One intersects the river at angles between 18 and 30 degrees and, in general, dips steeply into the right wall of the canyon. The other set intersects the river at 65 to 75 degrees and dips steeply upstream. There are also a few minor, steeply dipping, discontinuous joints whose strikes are irregular.

In the downstream part of the site area the strike of the beds varies from south 53 degrees east to approximately east. The bedding intersects the river at angles between 17 and 44 degrees and dips at a shallow angle upstream or into the right (south) wall of the canyon. The intersection of the bedding with the course of the river can readily be observed. The more resistant beds project into the river from both sides of the canyon creating parallel lines of "white water" where the fast-moving river flows over them. This same situation exists in Peel River for several miles upstream from the site area. The presence of these elongated rock outcrops some of which extend nearly all the way across the river has made it almost completely unnavigatable in this area.

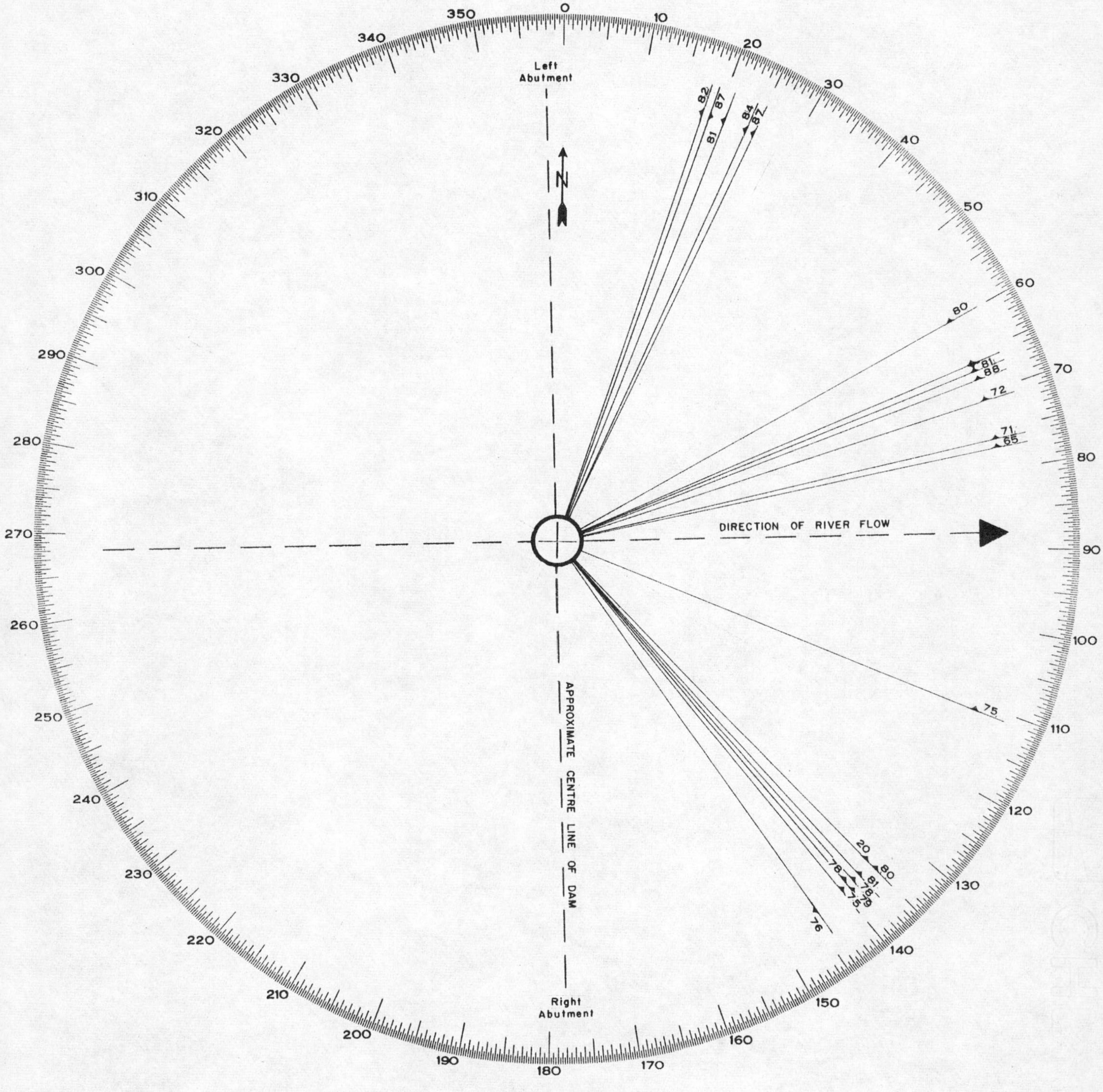
There are two prominent joint sets in the downstream part of the canyon. One set which closely parallels the river intersects it at angles between 6 and 20 degrees. This set is vertical or dips steeply into the left wall of the canyon. The other set intersects the first at about 75 degrees. It cuts the river at angles between 52 and 60 degrees and dips downstream at angles between 75 and 80 degrees. The spacing between the joints is extremely variable ranging from a few inches to several feet. Only a few of the fractures are open and then for only a few feet below ground surface. Most are tight.

A normal fault which cuts across the river at about 54 degrees occurs about 1,000 feet upstream from the east edge of the site area. The dip is 65 degrees downstream. A massive bed of limestone breccia which outcrops here in the floor of the canyon has been displaced downward by the fault. A similar bed outcrops in the canyon about 2,000 feet downstream. Assuming it is the same bed in the two outcrops the vertical displacement on the fault is about 340 feet. It is doubtful if this is the same limestone that occurs further



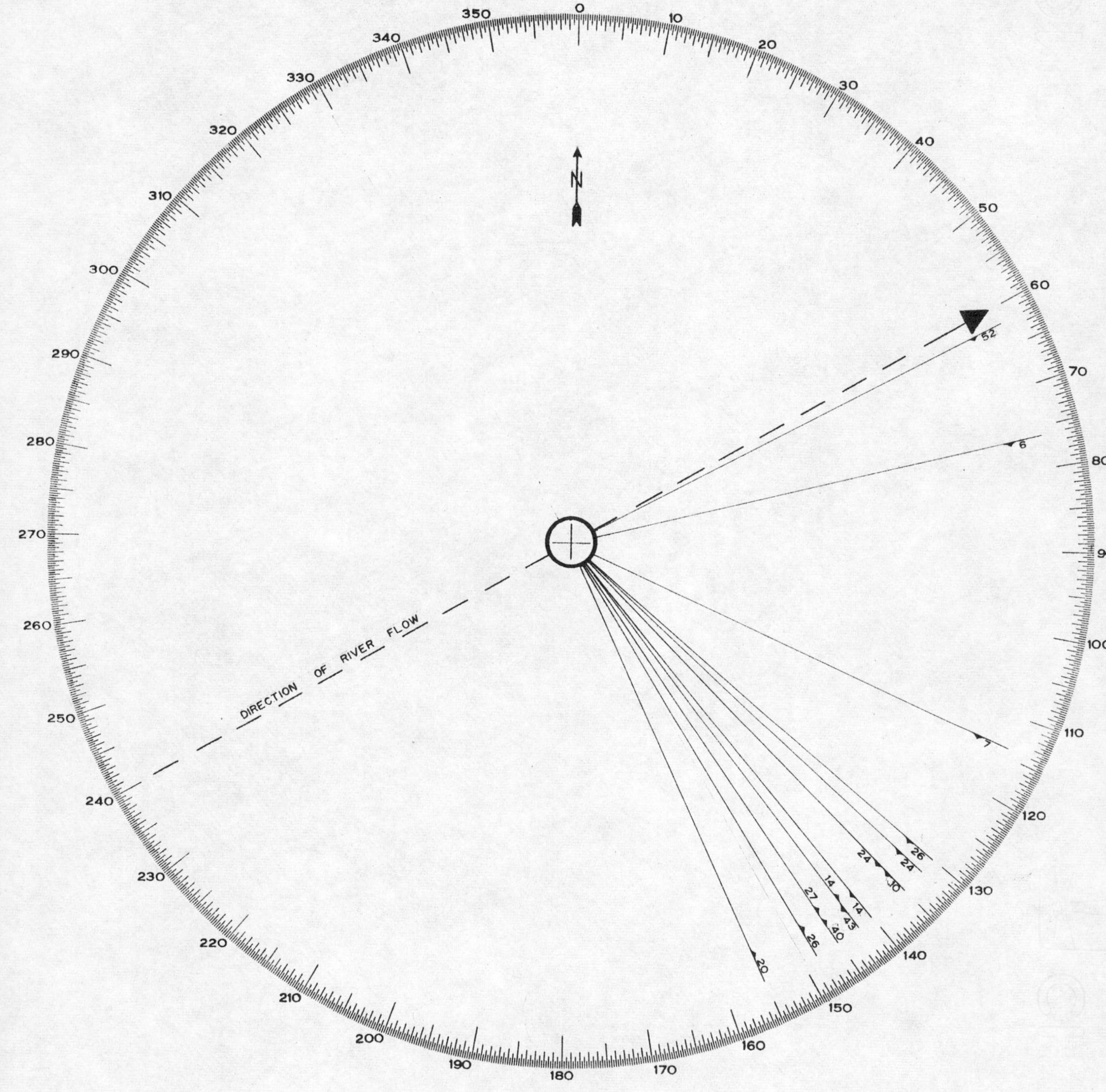
BEDDING ROSETTE

The above illustration presents diagrammatically the direction and dip of bedding in bedrock exposed in the downstream part of Aberdeen Falls dam site



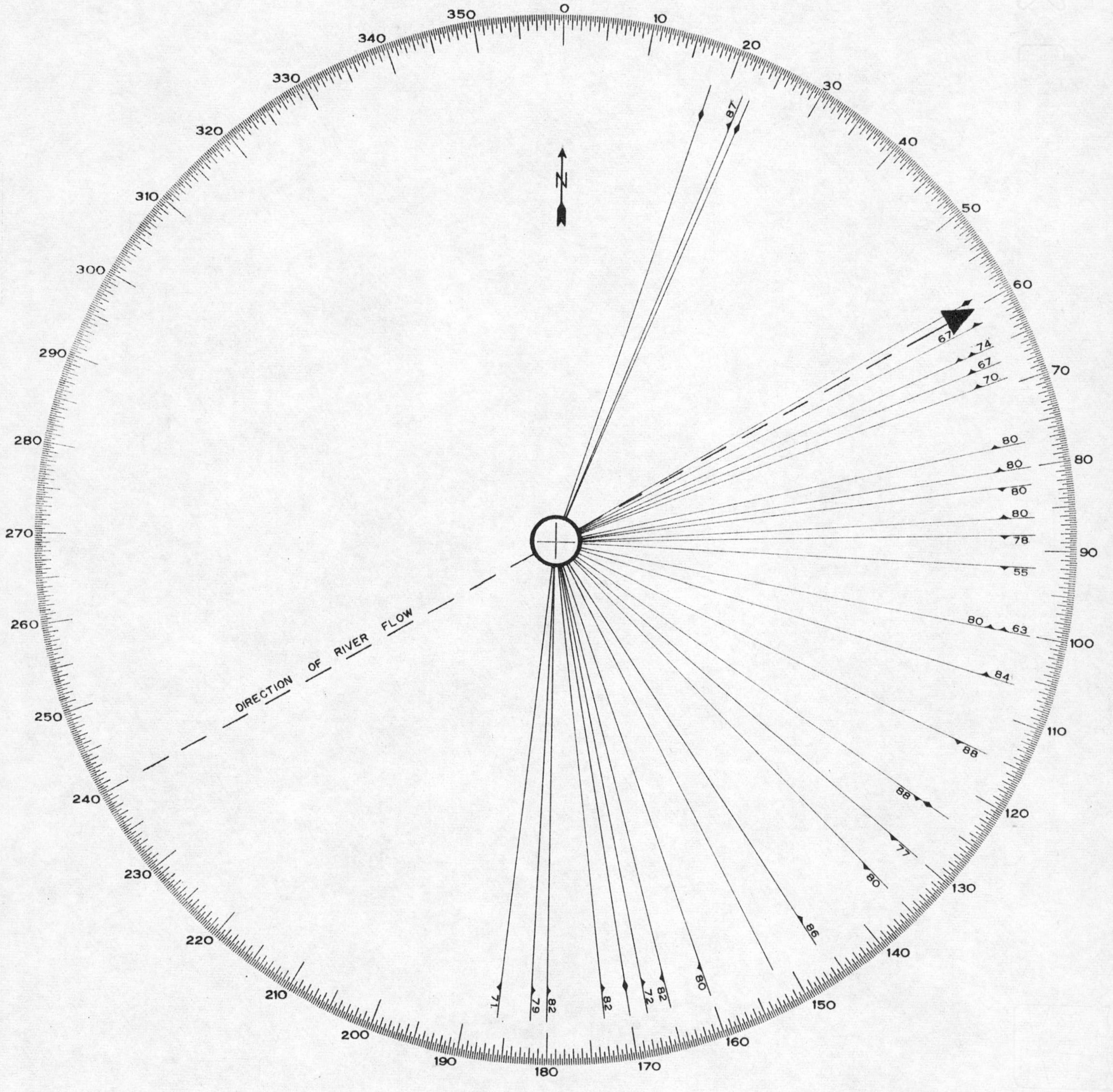
JOINT ROSETTE

The above illustration presents diagrammatically the direction and dip of jointing in bedrock exposed in the downstream part of Aberdeen Falls dam site



BEDDING ROSETTE

The above illustration presents diagrammatically the direction and dip of bedding in bedrock exposed in the centre part of Aberdeen Falls dam site



JOINT ROSETTE

The above illustration presents diagrammatically the direction and dip of jointing in bedrock exposed in the centre part of Aberdeen Falls dam site upstream in the centre part of the site area. The dip of the bedding is fairly constant between these two exposures and there is no fault present along which the limestone could have moved down to river level. The fault is exposed in a small valley in the right wall of the canyon about 300 feet upstream from station P-1. The valley is the result of erosion of the gouge and fractured rock associated with the fault. In the wall on the opposite side of the canyon there are several small, parallel faults spaced from 10 to 15 feet apart. A small valley has formed at each fault. It is apparent the larger fault on the right wall has split into several smaller faults all of which have approximately the same attitude.

Quality of Bedrock

The massive limestone and limestone breccia beds exposed in the canyon walls in the upstream part of the site area constitute the most competent rock in the area. These beds are horizontal and have a total thickness of about 60 feet. Interbeds of soft, black shale, 3 feet thick, occur about 20 feet from the bottom of the limestone. There is no evidence of solution cavities in these rocks. The numerous pot holes present in the limestone on the floor of the canyon are the result of erosion by the river.

The least competent rocks are the contorted shales which are exposed in the walls of the canyon in the centre of the site area immediately downstream from the fold. These rocks overlie the massive limestone. They are also exposed in a fairly continuous 25- to 75-foot bluff about 50 feet south of the right wall of the canyon near stations G-3 and G-4. Here they are flat-lying and are not deformed. The thin-bedded shale and argillaceous limestone occurring in the downstream part of the site area are believed competent. These rocks underlie the massive limestone beds. They are exposed in a few places on the floor of the canyon where the river has cut down through the limestone.

Engineering Considerations

Depth of Overburden

The thickness of overburden in the site area is seldom greater than 10 feet. The talus on the abutment slopes as well as the soils covering the terraces between the canyon and the abutments are thin. The sand and gravel deposits north of the river in the downstream part of the site area are the only exception. Here the kettle topography indicates glacio-fluvial deposition. In this area bedrock is exposed in the bottom of a narrow valley along a small creek. Here the thickness of the overburden which consists chiefly of gravel is at least 25 feet.

Proposed Location of the Dam

The result of the investigation indicates the thin-bedded shale and argillaceous limestone occurring in the downstream part of the canyon would provide the most satisfactory foundation and abutment material for a dam. It is suggested the centre line be located close to a line joining stations G-2 and G-6. Bedrock in this area has a favourable upstream dip, faulting and folding do not occur and the jointing is tighter and not as prominent as in bedrock further upstream. The rock is also relatively impermeable compared to other rocks in the site area.

The limestone exposed in the walls of the canyon in the upstream part of the site area is a competent rock. These beds, however, have a total thickness of only about 60 feet. Bedrock underlying the limestone consists of thin-bedded shale and argillaceous limestone. These are the same rocks as those in the area recommended and are believed to be competent. They are exposed in places along the bottom part of the canyon walls and would doubtless form part of the foundation for any proposed structure. There are at least 2 unsatisfactory features concerning this site. One is the soft, incompetent shale overlying the limestone which would undoubtedly form part of the abutment material. The other is the fact the dam would intersect the fold with its associated distorted and faulted rock with the result these incompetent rocks would form part of the foundation material.

Abutments and Foundations

Bedrock in the area suggested above as the best location for the dam should provide satisfactory abutment and foundation material. It is believed bedrock in both abutments up to a height of 550 feet above the river consists of limestone and limestone breccia overlying thin-bedded shale and argillaceous limestone. The dam will be founded on the latter rocks which underlie the valley floor between the abutments. The individual limestone and limestone breccia beds are competent. The contacts between the beds, however, as exposed in the canyon walls are not tight and may represent zones of weakness. These rocks should be investigated further as their presence in the abutments may result in leakage. The incompetent shale overlying the massive limestone beds will probably not occur in the abutments if the dam is constructed in the downstream part of the site area. The axis of the main fold intersects the bluff in which the right abutment is located about 1,700 feet upstream from the centre line. Its presence is indicated on the accompanying map by a wide, sloping valley which is continuous with the valley in the right wall of the canyon through which the axis passes.

In the design of the spillway structure consideration should be given to the erodibility of bedrock in the channel immediately downstream from the chute and stilling basin. Bedrock at Aberdeen Falls site is believed to be relatively soft. In this regard it is similar to the rock exposed at Palmer Lake. The steep rock walls which occur in both areas indicate these rocks can be more readily cut into by stream action.

Construction Materials

Aggregate

It is doubtful if there is a sufficient quantity of natural aggregate within the site area to satisfy the requirements of the project. The sand and gravel deposits covering the terraces bordering the canyon are thin. In most places they are believed to be less than 10 feet in thickness. Frequently they are covered with a thin layer of silt. The thickest deposits of gravel occur in the downstream part of the site area on the terrace north of Peel River.

Extensive deposits of gravel covered with a thin layer of silt occur in the area between Wind and Bonnet Plume Rivers. The northern limit of this deposit is about 16 miles southeast of the site. This area was part of a former drainage channel for north-flowing meltwater from an ice sheet to the south. The cost of transporting the material to the site would be high as Wind River as well as several smaller streams, some of which are located in deep, narrow valleys, would have to be crossed. The deposit, however, would be readily accessible from the alternate Wind River site.

The massive limestone exposed in the upper part of the canyon and in the abutment areas is the only rock in the area which might provide satisfactory aggregate. The interbedded shale would probably disappear in the crushing processes but the chert present in the breccia part of these beds might prove deleterious in the aggregate. Laboratory tests will be necessary to determine the effect of the chert in the concrete.

Impervious Material

The clayey silt on the terraces might prove suitable as impervious material for the core of an earth dam. A grain size analysis curve for the material is included at the end of this report. The thickness and extent of the deposit is unknown. Information obtained from a few test pits put down on the terraces indicates the deposit is thin and that the material invariably is frozen. It overlies either gravel or bedrock. An extensive test pitting program will be necessary to determine if sufficient material is available to satisfy the requirements of a large dam.

Pervious Material

Material suitable for the pervious shells, filters or drains of an earth dam could be obtained from the gravel deposits described under the aggregate heading. The gravel would probably have to be screened, washed and reblended to produce the types of granular material required.

Riprap and Rock Fill

The rock fragments in the talus derived from the massive limestone beds exposed in the upper part of the canyon are frequently very large and roughly squared. This is an indication this rock would provide satisfactory riprap. The thickness of the beds is only about 60 feet. Consequently to obtain a large volume of rock any quarry opened in it would be extensive. If it is not thought practical to develop a quarry in the canyon walls upstream from the dam similar rock occurs in the abutments from where it could be obtained during construction and stock-piled for future use. It is doubtful if the beds of argillaceous limestone at the suggested location of the dam are sufficiently thick to provide suitable rock fill. The soundness of this rock is also questionable. Bedrock for many miles on all sides of the site area consists of shales, argillites and argillaceous limestone similar to those exposed in the canyon. These rocks will have to be thoroughly tested to determine if they will provide satisfactory material.

Groundwater

There is little information concerning groundwater conditions in the site area. There is no evidence of circulating groundwater along any of the numerous joints or faults in the area. At the time of the investigation there were no springs or seeps issuing from the canyon walls nor was there any indication they had occurred in the past. In the lower part of the area the more calcareous beds weather white. This gives a vertical banded effect to the canyon walls as the products of weathering are carried down by surface water.

Frozen Ground

Frozen ground was encountered in every part of the site area except directly beneath Peel River where it was impossible to examine the material. Test pits put down on the terraces bordering the river and on the abutment slopes usually encountered frozen ground within 18 inches of ground surface (August 15, 1962). In general the frozen material underlies 8 to 12 inches of moss and decayed organic material.

Further Investigations - Conclusions

It should be remembered this report is based upon a preliminary geological investigation designed to furnish the engineer with general geological information regarding the proposed dam site. The report is based upon a rapid, field examination of bedrock and soils exposed at the site. The proximity of the frost line to ground surface prevented, in many places on the terraces, positive identification of the material. Consequently the contacts between the various deposits as drawn on the accompanying map are only approximate. The information contained in this report, however, is believed to be sufficiently precise to permit office studies and obtain general cost estimates.

The result of the investigation indicates the most suitable location for the dam is in the downstream part of the area included in the accompanying geological map. The exact location will depend upon the height of the bluffs in which the abutments will be located. These must extend at least 550 feet above the river. From the viewpoint of cost the horizontal distance between the abutments will also have to be considered.

There is an apparent shortage of materials for both an earth or rock-fill dam. There is also a shortage of natural aggregate in and near the site area. Large quantities of suitable gravel occur about 16 miles southeast of the site but the cost of transporting this material to the site would be high. The massive limestone exposed in the upstream part of the canyon and in the abutments should provide satisfactory riprap. It is not certain, however, this rock will yield suitable aggregate.

The thickness of overburden on the terraces and beneath the river is not great and consequently there should be no difficulty in founding the dam structures on bedrock. Shallow deposits such as these can be normally sampled using a back hoe or bulldozer. However, the frozen condition of the material may preclude this method of sampling.

The permeability of the rock mass is believed to be low. Excessive leakage through the abutments and foundations should not occur although pressure grouting will probably be necessary to seal the numerous joints.

Chemical Analysis of Peel River Water

On August 8, 1962 a sample of Peel River water was taken from the centre of the river at a point about 6 miles upstream from the site. The temperature of the water was 10.0°C. The sample was analyzed for its mineral content by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa. The results of the analysis are included on the following page.

The reported value of the turbidity should be considered only as indicative. Flash floods may cause a rapid increase in the sediment load. A proper sediment study requires regular sampling, often in the case of flash flooding, at hourly intervals. The quantity of dissolved salts in Peel River water is low, a condition which is common in many streams in Northern Canada. This is doubtless due to a large extent to the frozen condition of the adjacent ground and the resultant small quantities of groundwater entering the stream. Groundwater ordinarily contains a higher proportion of dissolved constituents than surface water. Bicarbonate salts of calcium and magnesium constitute the chief mineralization in Peel River. There are no salts present in sufficient quantity to be harmful to the concrete or other parts of the dam structures which would be exposed to the water.

Grain Size Analyses Curves

The grain size analyses curves included in this report were prepared in the Soils Laboratory of the Water Resources Branch in Vancouver. Each grain size sheet for potential aggregate shows the following information:

(a) Limits of fine and coarse aggregate based upon a 6-inch maximum size.

(b) A cumulative grain size curve for each sample.

(c) Curves showing individual percentages for the coarse and fine fraction retained on each screen or sieve size. For these purposes the sample is divided at the No. 4 sieve into coarse and fine fractions.

One sample (No. 13) was analyzed as potential aggregate and two samples (Nos. 14 and 15) as potential impervious material.

In the site area the deposits of these materials are thin. A test pitting program will be necessary to determine the quantity available. This will be a difficult task because of the frozen condition of the ground. The gravel in sample No. 13 is similar to the material in the extensive deposits between Wind and Bonnet Plume Rivers.

Chemical Analysis of Peel River Water

(parts per million)

Location	Date	River Discharge	pH	SiO_2	Ca	Mg	Na	K	Fe	CO_3	HCO_3	SO_4	Cl	F	NO_3	Turbidity	Hardness as $CaCO_3$
Centre of Peel River; 6 miles upstream from Aberdeen Falls site	Aug. 8, 1962	Medium	7.8	3.7	38.4	10.8	2.1	0.3	0.58	0.0	127.0	36.8	1.2	0.2	0.1	7	140.0

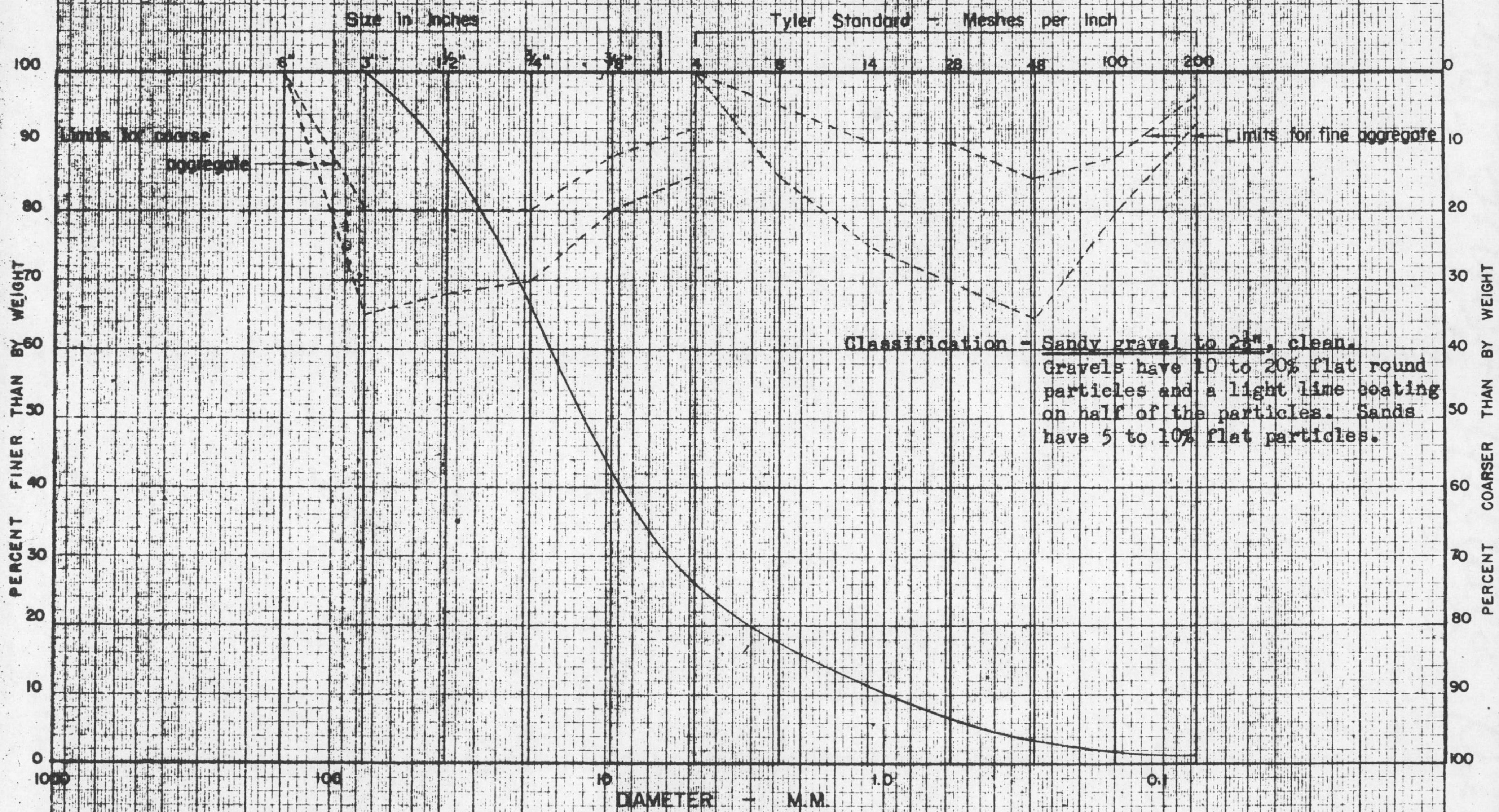
Description of Potential Aggregate for the following Grain Size Analyses Curve

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
13	North side of Peel River; 400 feet upstream from station P-2; 10 feet below top of bluff; 3 feet beneath ground surface.	Sandy gravel; very little silt or clay; a few rounded to sub-rounded boulders up to 10 inches; well sorted; no distinct stratification in visible material. <u>Cobble and Boulder Lithology</u> Granite - 5% Sandstone, quartzite, minor limestone - 90% Shale - 5%	10 feet of silty sand	12 inches to 15 feet	Length: $\frac{1}{2}$ mile Width: $\frac{1}{4}$ mile	

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES

WATER RESOURCES BRANCH

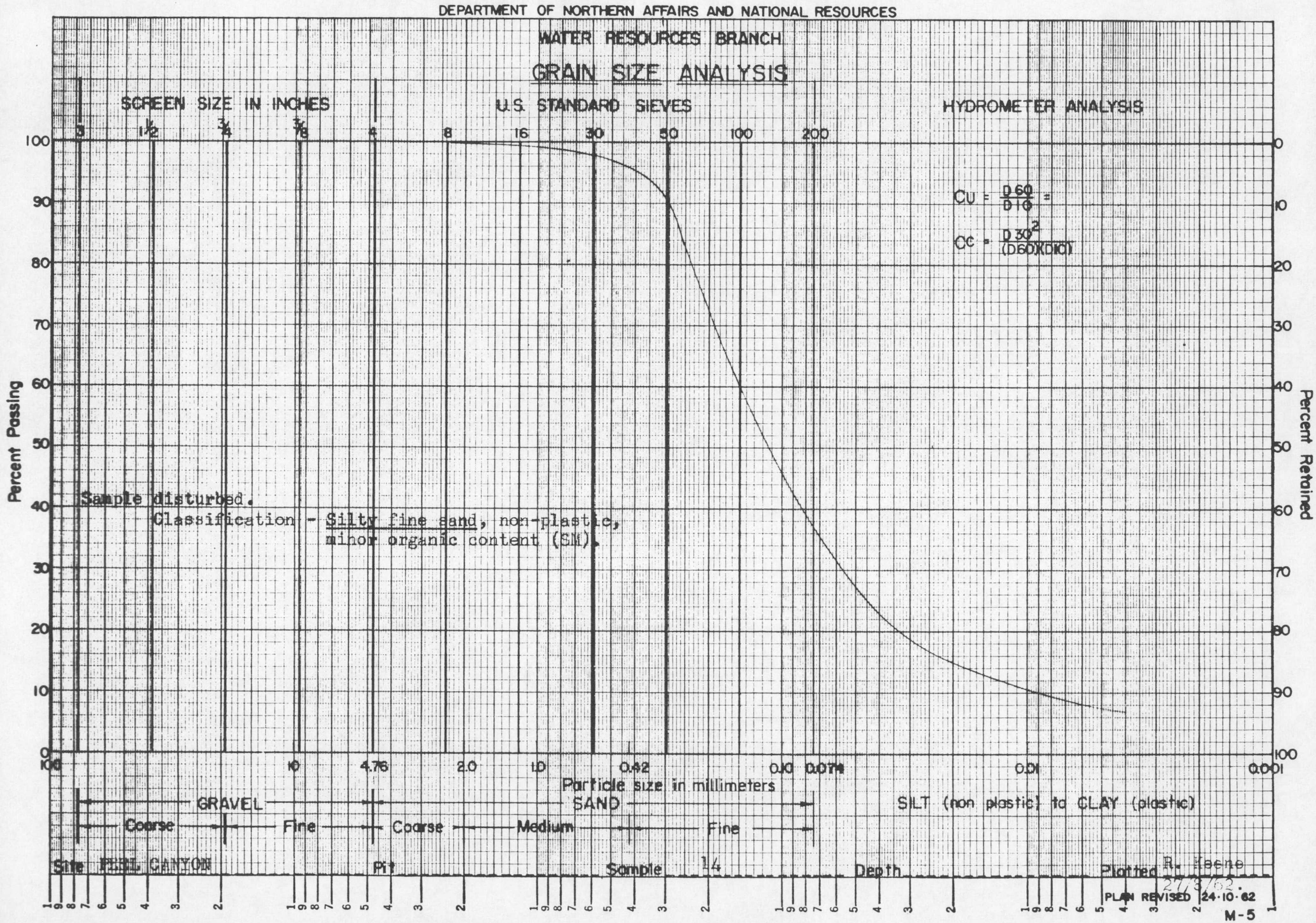
GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Size Peel Canyon Hole No. ____ Sample No. 13 Depth ____ Plotted R. Keene Date 27/8/62.

Description of Potential Impervious Material for the following Grain Size Analysis Curve

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
14	At station Z-12 on terrace north of river; 4 feet beneath ground surface	Fine-grained, silty sand; a few rounded pebbles up to $\frac{1}{2}$ inch	2 feet of clayey silt	2+ feet	Not large	Kettle topography in this area
15	At station Z-9 on terrace north of river; 3 feet beneath ground surface	Grey, clayey silt	None	Thin	Test pitting required	Material usually frozen

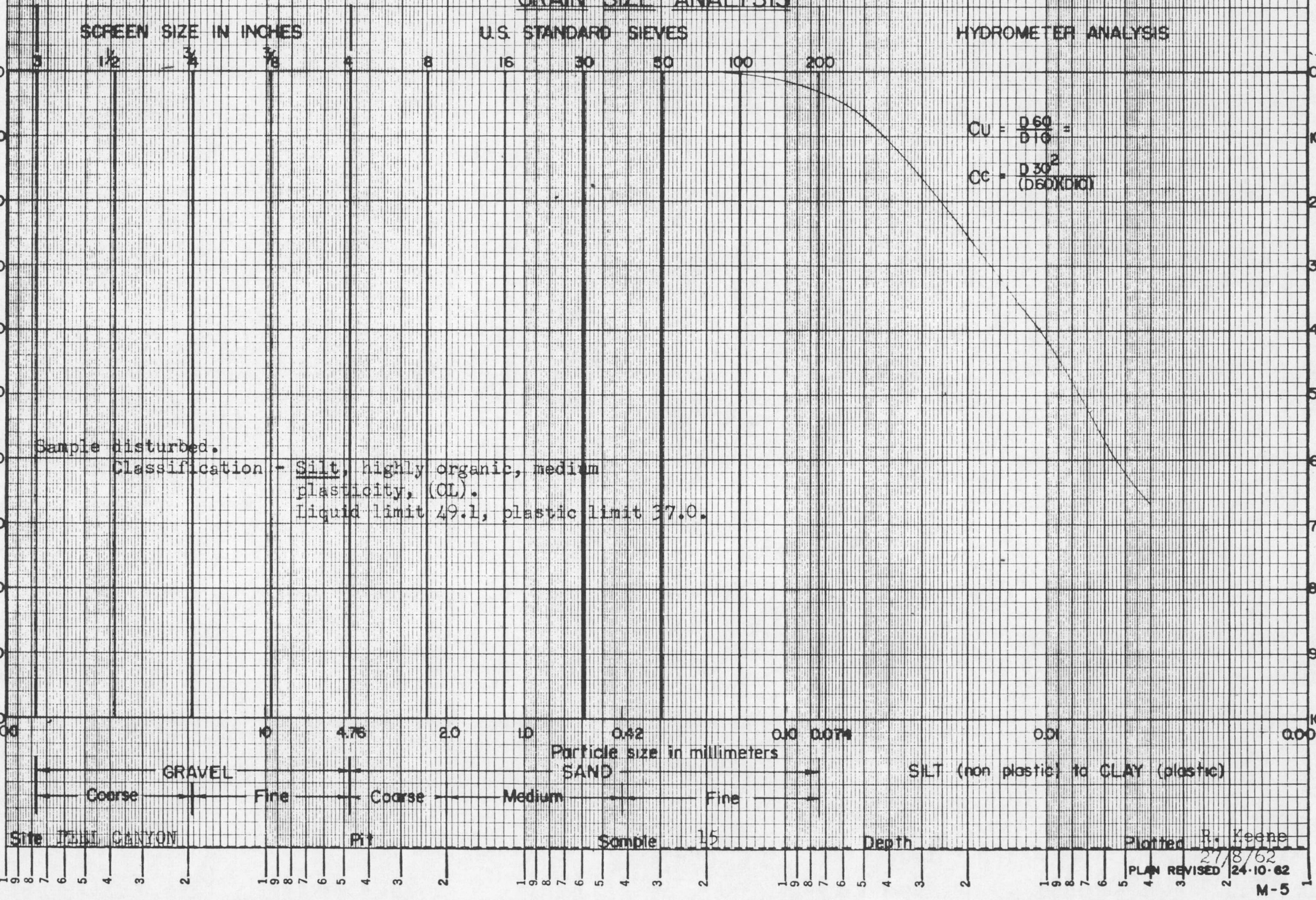


DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS
SCREEN SIZE IN INCHES
U.S. STANDARD SIEVES
HYDROMETER ANALYSIS
3 1½ ¾ ⅜ 4 8 16 30 50 100 200
CU = D60 / D10 =
Cc = D30² / (D60)(D10)
Percent Passing
Percent Retained
Sample disturbed.
Classification - Silty fine sand, non-plastic, minor organic content (SM).
100 10 4.76 2.0 1.0 0.42 0.10 0.074 0.01 0.001
Particle size in millimeters
GRAVEL
SAND
SILT (non plastic) to CLAY (plastic)
Coarse
Fine
Coarse
Medium
Fine
Site PEEL CANYON
Pit
Sample 14
Depth
Plotted R. Keene 27/8/62.
PLAN REVISED 24·10·62
M-5

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



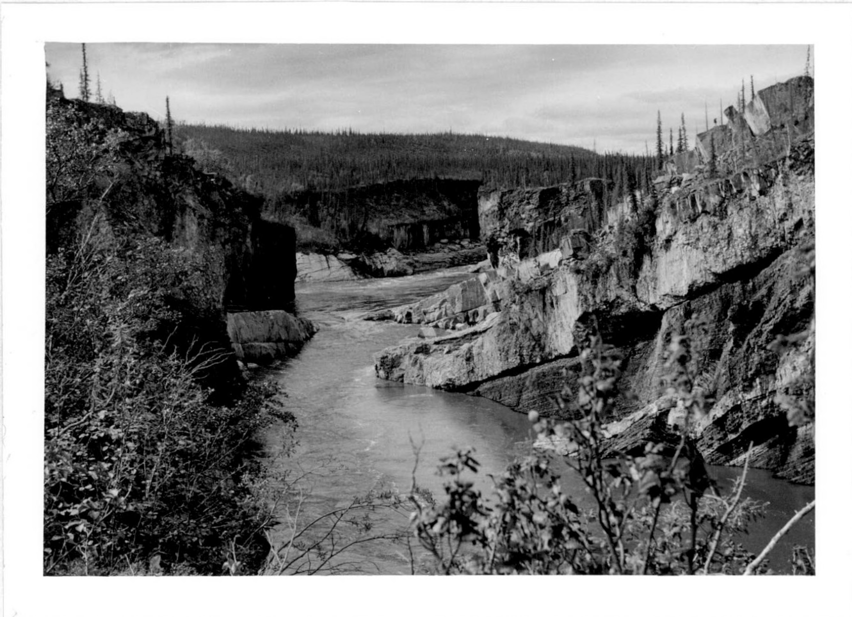


Plate 1

View looking upstream toward folded area in centre part of site; upstream dipping limestone and limestone breccia beds in right foreground are a continuation of horizontal beds in centre background.

G.S.C. 35-5-62

Plate 2

View looking upstream through the canyon from a point on the fold axis; horizontal limestone and limestone breccia beds are visible along right wall of the canyon.

G.S.C. 36-7-62

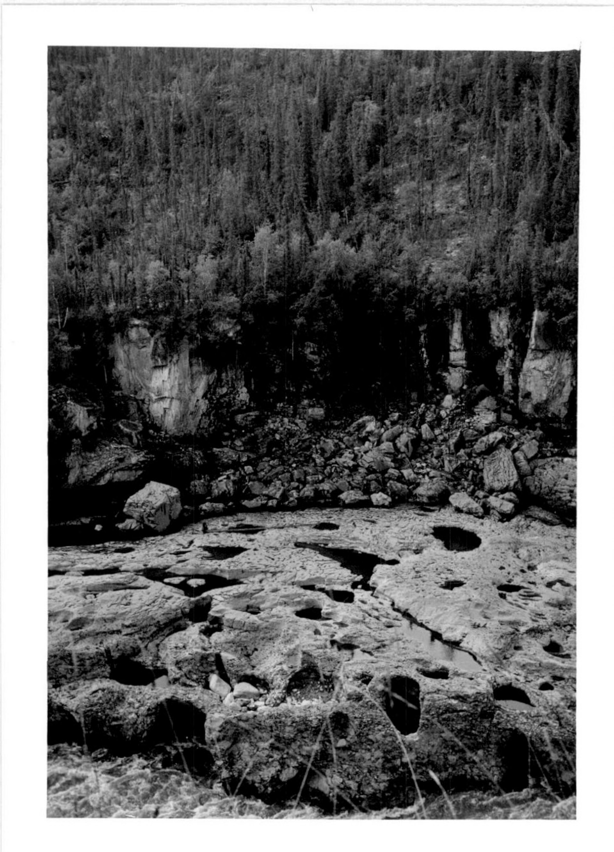


Plate 3

Potholes in limestone breccia in upstream part of the canyon.

G.S.C. 40-3-62

Plate 4

Folded, thin-bedded shale and argillaceous limestone exposed on the right wall of the canyon downstream from the fold axis.

G.S.C. 42-4-62

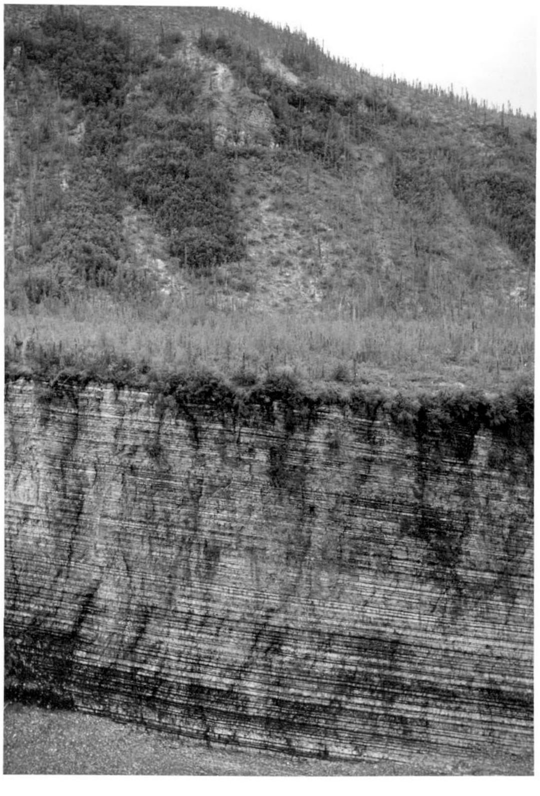
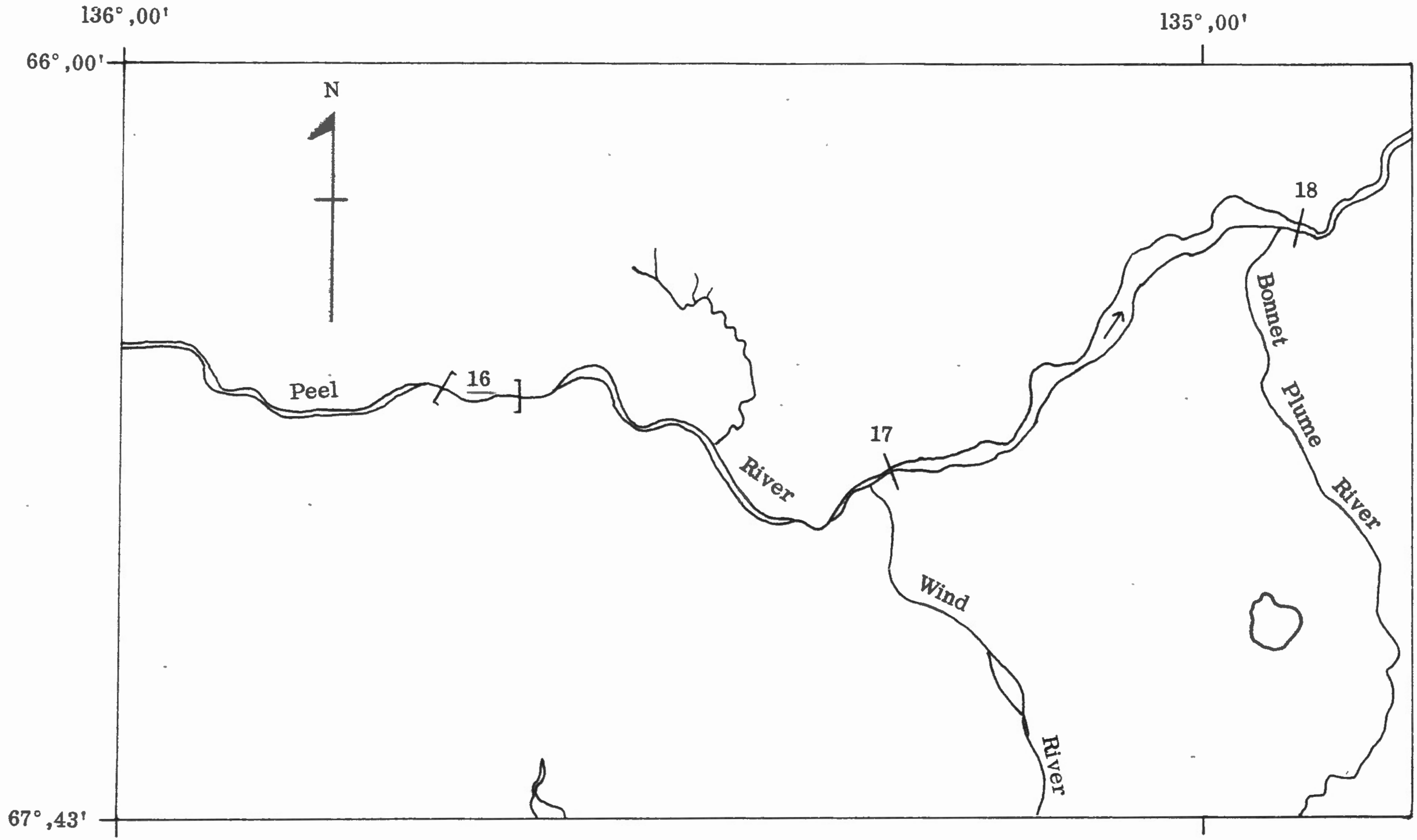


Plate 5

Thin-bedded shale and argillaceous limestone exposed in right wall of downstream part of canyon; dip is gently upstream; proposed right abutment is in background.

G.S.C. 43-1-62



LOCATION OF PROPOSED DAM SITES
MACKENZIE RIVER DRAINAGE BASIN
Scale: 1 inch to 4 miles (approx.)

Site No.	Name
16 -	Aberdeen Falls
17 -	Wind River
18 -	Bonnet Plume