

CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
TOPICAL REPORT NO. 38

PACIFIC COASTAL DRAINAGE
DAM SITE INVESTIGATION

SITE NO. 30

KATHLEEN CANYON DAM SITE
(MAP AND PRELIMINARY REPORT)

BY
E. B. OWEN



OTTAWA
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KATHLEEN CANYON DAM SITE

General Description

Kathleen Canyon dam site is located on a sharp bend on Kathleen River about 5 miles upstream from its junction with Dezadeash River. The site of a proposed control dam, known as Kathleen Lake dam, is located about 13 miles upstream from the Canyon site between Haines Road bridge and Kathleen Lake. The purpose of this dam is to regulate the flow of water from Kathleen Lake to the proposed power dam at the canyon. The Kathleen Lake dam site is described in Topical Report No. 37, site no. 31. The elevation of the water surface at the Canyon site is about 336 feet lower than at the Lake site.

At Kathleen Canyon site the river is flowing generally west between 2 steep, rock bluffs some 50 feet in height. Bedrock exposed in the bluffs consists of medium-grained, grey granodiorite. Talus is negligible. On the right side of the river a low terrace, covered with Recent alluvium and glacio-lacustrine silt, extends north to the toe of a steep, 90-foot, till bluff. The elevation of the terrace varies between 2,070 and 2,100 feet above sea-level and its width varies from 50 feet adjacent to the canyon to 400 feet upstream and downstream from that place. Above the till bluff a second terrace with an elevation of about 2,260 feet extends northward beyond the limits of the area mapped. Terraces with similar elevations exist along the south side of the river. On the south side the lower terrace is covered with silt whereas glacio-fluvial sandy gravel covers the upper.

The general geology of the area has been described by Kindle¹.

¹Kindle, E.D.: "Dezadeash Map-Area, Yukon Territory"; Geol. Surv., Canada; Memoir 268, 1953.

Materials suitable for construction purposes are abundant in the area about the proposed site. The till contains few cobbles or boulders greater than 15 inches in diameter and should, if properly compacted, provide impervious material suitable for dyke construction. Representative samples of potential natural aggregate and impervious material were taken and forwarded to the Soils Laboratory of the Water Resources Branch in Vancouver for grain size analyses.

Unconsolidated Deposits

Four types of unconsolidated materials were identified in the area about Kathleen Canyon dam site. These are as follows:

1. Recent alluvium (silt, sand, gravel): This material has been deposited by the present Kathleen River. It consists of stratified silt, sand and gravel with few boulders over 8 inches in diameter. In the area mapped it occurs as a shallow, flood-plain deposit covering a low terrace which occurs along both sides of the river. The alluvium is believed to be unimportant as a construction material.

2. Glacio-lacustrine (clayey silt): This material at one time probably covered most of the area about Kathleen Canyon site. At present it exists on the terrace above the till bluff north of the river and on parts of the lower terrace on both sides of the river.

It consists of a yellowish, stratified, clayey silt with a medium dry strength. According to Kindle the silt was deposited by glacial Lake Champagne which formerly extended over a large part of Shakwak Trench and the surrounding area. Well defined beaches of Lake Champagne have been identified up to elevation 2,565 feet above sea-level. The thickness of the deposit varies from a few inches to several feet. The silt constitutes a potential source of impervious material but is not believed to be as suitable as till for dyke-building material. The till is as easily

accessible as the silt and occurs in greater quantities.

3. Glacio-fluvial (sandy gravel): This material consists of a roughly sorted, sandy gravel with few boulders over 8 inches in diameter. In the area mapped it underlies the thin deposit of clayey silt which covers the upper terrace north of the river and outcrops as a long, narrow exposure along the top of the bluff. It also covers the upper terrace south of the river. The material closely resembles the glacio-fluvial gravels sampled as potential aggregate along Alaska Highway and Haines Road. The cobbles are rounded to subrounded and commonly the under sides of those close to ground surface are coated with white carbonate. The quantity of gravel available in the site area is unknown. The most accessible material exists on the upper terrace south of the river. It is suggested that test pits be put down in this area to determine the thickness of the deposit and to obtain samples from which the quality of the material can be determined.

4. Till: At the site till constitutes most of the material exposed on the steep bluffs along both sides of Kathleen River. Till also occurs along the river for at least one mile upstream from the site and for one-half mile downstream. The presence of relatively impervious till around the perimeter of the reservoir area should decrease leakage of the impounded water.

The till is a dense, silty material containing minor amounts of clay and fine sand. Lenses of sand and gravel varying in thickness from 6 inches to 6 feet and in length up to 50 feet are distributed irregularly throughout the material. Boulders up to 10 inches in diameter are present. The till constitutes a potential source of material for the impervious core of an earth-fill dam or for any dykes which may have to be constructed. It should also form satisfactory abutment material. In the latter case,

however, test borings should be put down to determine the extent and permeability of any pervious sand and gravel lenses which might occur in the abutment area.

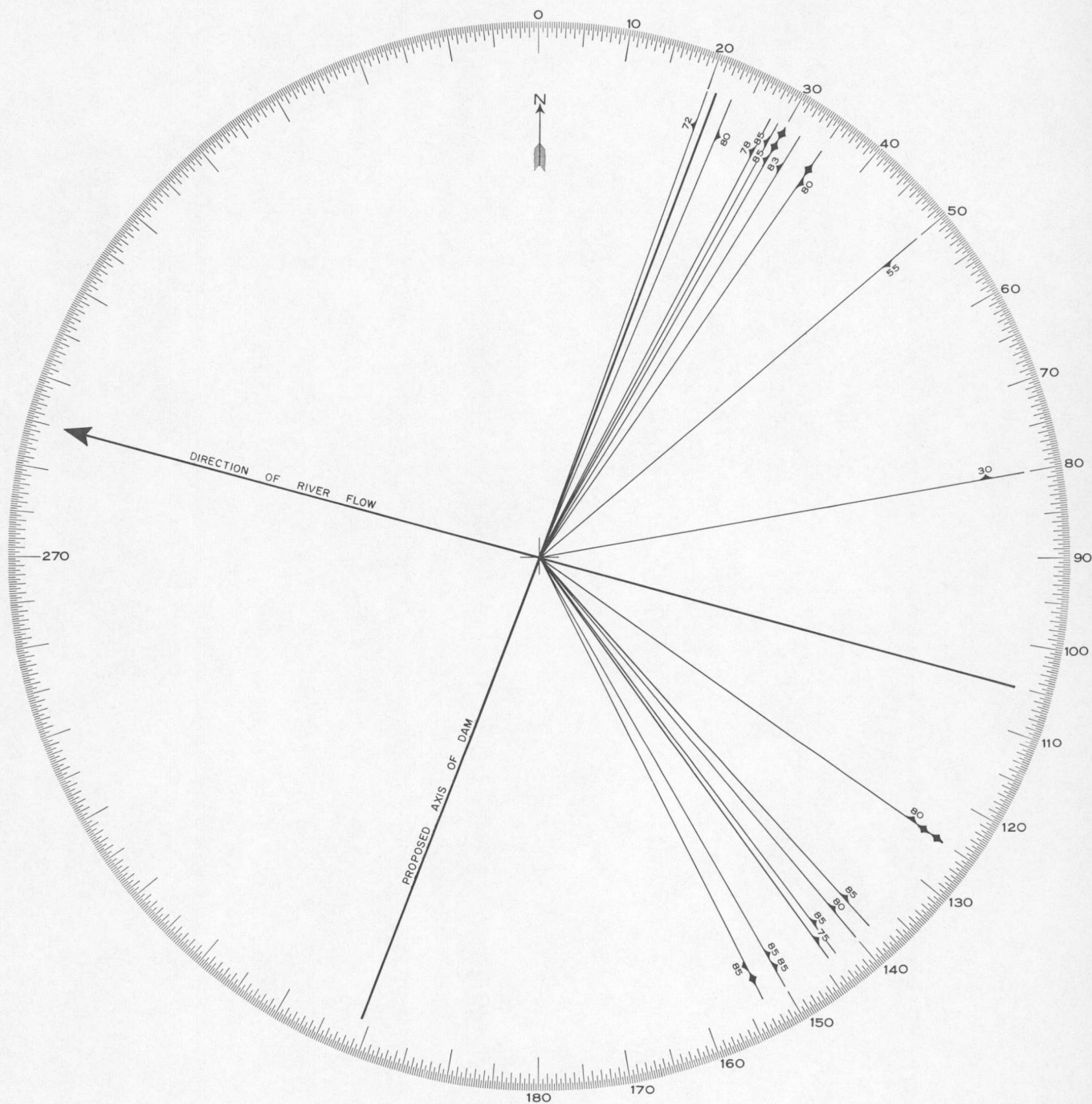
Bedrock

General Description

Bedrock consists of a fairly massive, medium-grained, grey granodiorite through which Kathleen River has cut a gorge some 40 feet in depth. Irregular fragments, up to 6 inches in diameter, of a dark grey, micaceous rock are scattered throughout the granodiorite. Jointing is common with the result that many large rock fragments which have broken off along the joint planes occur along the base of the vertical rock walls lining the canyon. Weathering is negligible.

Bedrock Structures

Jointing is the most prominent structure in bedrock exposed at Kathleen Canyon. It appears to have some control over the course of the river. In the upstream part of the map-area the river changes in direction as much as 148 degrees and flows parallel to the jointing for a distance of about 300 feet. The most suitable location for the dam is believed to be in the downstream part of the canyon. Here the jointing intersects Kathleen River at right angles and dips steeply downstream. Horizontal jointing is common especially along the left side of the river in the downstream part of the canyon. The spacing between the vertical jointing varies from 6 inches to 5 feet whereas it varies from 6 inches to 2 feet in the horizontal. As a consequence bedrock tends to break off in slabs. There is no visible evidence of faulting in bedrock exposed at the site.



JOINT ROSETTE

The above illustration presents diagrammatically the direction and dip of the jointing in bedrock exposed at Kathleen Canyon dam site.

Quality of Bedrock

The granodiorite exposed at the site is a relatively dense, massive rock which should provide suitable foundation and abutment material. It should also yield satisfactory riprap.

Engineering Considerations

Depth of Overburden

Overburden in the area consists chiefly of glacio-fluvial sand and gravel overlying till with minor quantities of glacio-lacustrine silt and recent alluvium. Its thickness is believed to be considerable. The highest elevation at which bedrock is exposed is 2,125 feet above sea-level whereas the elevation of the highest terrace is about 2,260. The surface of bedrock underlying Shakwak Trench is believed to be undulating with the areas of greatest relief trending in a northwest direction parallel to the movement of the last ice-sheet which passed through the Trench. Bedrock surface at Kathleen Canyon site is believed to be relatively level with a gradual increase in elevation toward bedrock exposures about 2 miles east and southwest of the site. It is doubtful if there is more than 25 feet of overburden beneath Kathleen River at the site.

Abutments and Foundations

The granodiorite exposed at the site is a competent, durable rock and should provide satisfactory abutment and foundation material. Seepage of reservoir water might possibly occur along the horizontal joint planes. The shallow, downstream dip of some of the jointing would increase the danger of slippage due to thrust of the dam on the rock foundations. It is believed the jointing can be easily grouted. The continuity of the horizontal and vertical joint sets would enable the grout solutions to readily penetrate the rock. It is possible that the till

which directly overlies bedrock on both sides of the river could be used as abutment material providing there were no permeable sand and gravel lenses present.

Construction Materials

Aggregate

Limited quantities of natural aggregate occur within the area mapped. The glacio-fluvial sandy gravel exposed along the top of the bluff north of the canyon would probably provide excellent aggregate. The quantity available, however, is small and it is not considered an important deposit. Larger quantities of similar gravel occur on the upper terrace south of the river. A program of test pitting would be required here to determine the quantity and quality available.

Several representative samples of natural aggregate were taken from various gravel deposits in the area about the site. Descriptions of the material and grain size analyses curves prepared in the Soils Laboratory of the Water Resources Branch in Vancouver are included at the end of this report.

Impervious Material

It is believed the till, if properly compacted, would provide satisfactory material for an earth-fill dam. Some of the oversize boulders would have to be removed. The deposit of clayey silt, which covers much of the ground surface about the site, is probably too thin to be of value. The thickness of this material can best be determined by a program of test pitting. The clayey silt at Kathleen Canyon site is similar to that at Kathleen Lake site. Permeabilities for the latter computed in the field are contained in the report on Kathleen Lake site (Topical Report No. 37, Site No. 31).

Pervious Material

Material suitable for the pervious shells of an earth-fill dam can be obtained from the sandy gravel deposits described under the aggregate heading. The gravel would have to be washed, screened and reblended to obtain the coarse, granular material required.

Riprap and Rock Fill

The granodiorite exposed in the canyon at the site should provide suitable riprap or rock fill. It is a fairly massive, durable rock with a relatively high specific gravity. The spacing of the numerous joints indicate the rock fragments might be slab-like, that is, narrow in one plane. Except for one outcrop the granodiorite is exposed only in the canyon walls. Consequently the extent of this rock type is unknown. Test borings put down to determine elevations of bedrock surface at the site could also be used to determine the extent of the granodiorite and the thickness of the overburden overlying it.

Ground Water

The ground-water table in the dam site area is believed to be low. Seepages were not observed in the rock walls of the Canyon and there are no ponds or swamps in the area examined. Ground water was not encountered in any test pit put down in the area. Accurate information regarding the ground-water table can only be obtained by installing ground-water observation holes and measuring them periodically.

Frozen Ground

Frozen till and glacio-lacustrine silt was encountered south of the river in several, shallow test pits put down in the lower terrace and on the slope below the upper terrace. The frozen material occurred directly beneath 10 to 18 inches of moss and decayed organic material (September 9, 1961). Localities where frozen ground was encountered in the site area are

indicated on the accompanying geological map.

Proposed Location of the Dam

It is suggested the axis of the proposed power dam be located in the downstream part of the canyon. Here the walls of the canyon ascend almost vertically from the river's edge to a height greater than 50 feet above the water. They are composed entirely of granodiorite.

Further Investigations — Conclusions

The results of this preliminary examination indicate that, geologically, Kathleen Canyon site is satisfactory. The rock is competent and construction materials readily available. If it is desired to utilize local materials in construction of the dam the unlimited quantities of till available should be considered. This material should prove satisfactory in construction of an earth-fill dam.

It is suggested test borings be put down in the site area to determine the following:

1. Elevations of bedrock surface beneath Kathleen River and north and south of the abutments.
2. The quantity, quality and permeability of the till overlying bedrock on both sides of the river.
3. The quality and permeability of bedrock.
4. Fluctuations in the elevation of the ground-water table.

Chemical Analyses of Kathleen River Water

Two samples of Kathleen River water were taken during the 1961 field season. One was taken at Haines Road bridge and the other immediately downstream from Kathleen River Canyon. The samples were analysed for their mineral content by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa. The results

of the analyses are included in the report on Kathleen Lake site (Topical Report No. 37, Site No. 31).

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:

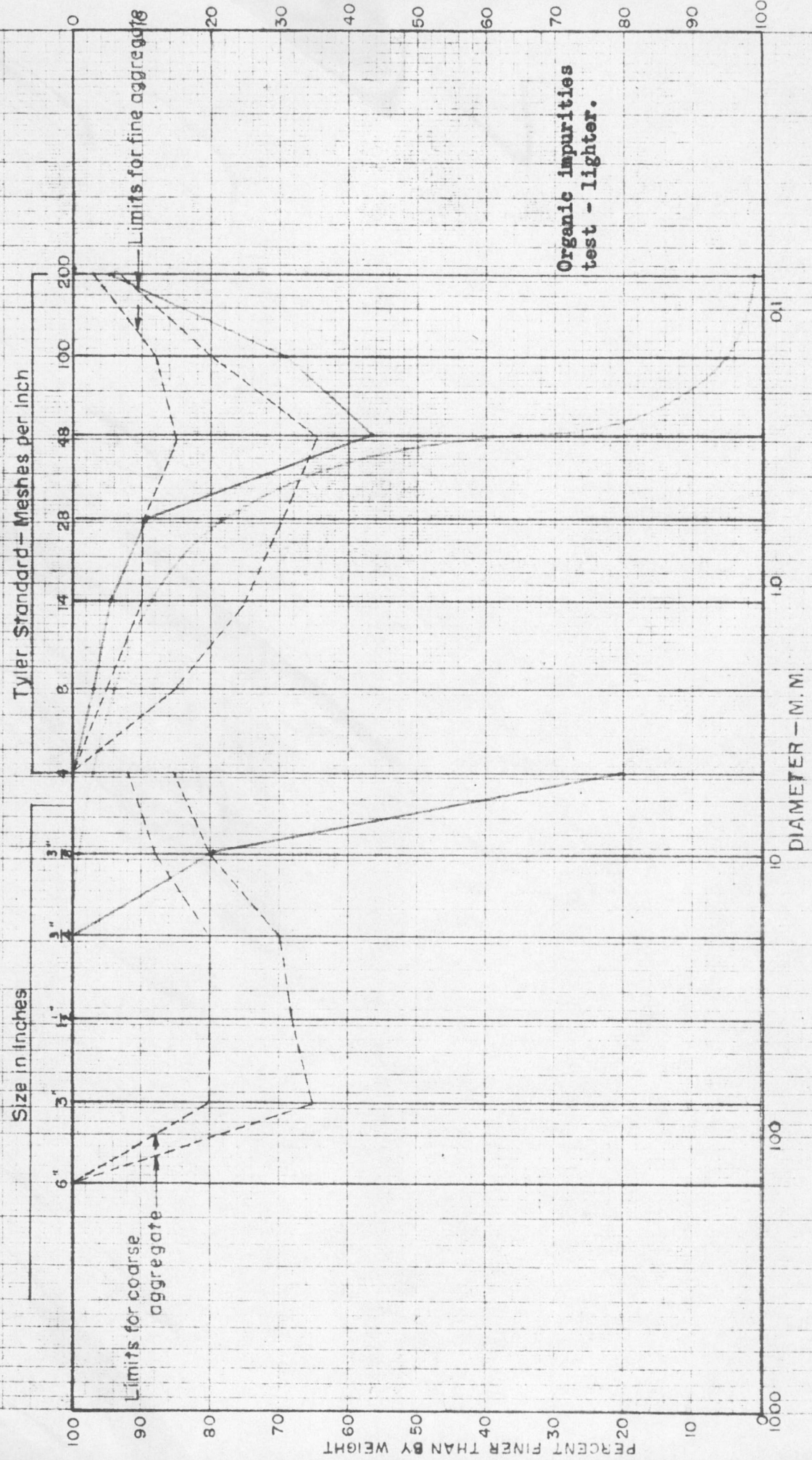
- (a) Limits of fine and coarse aggregate based upon a 6-inch, maximum size.
- (b) A cumulative grain size curve for each sample.
- (c) Curves showing the individual percentages of the coarse and fine fraction retained on each screen or sieve size.

One sample (No. 14) was analysed as potential impervious material; the remainder as potential aggregate.

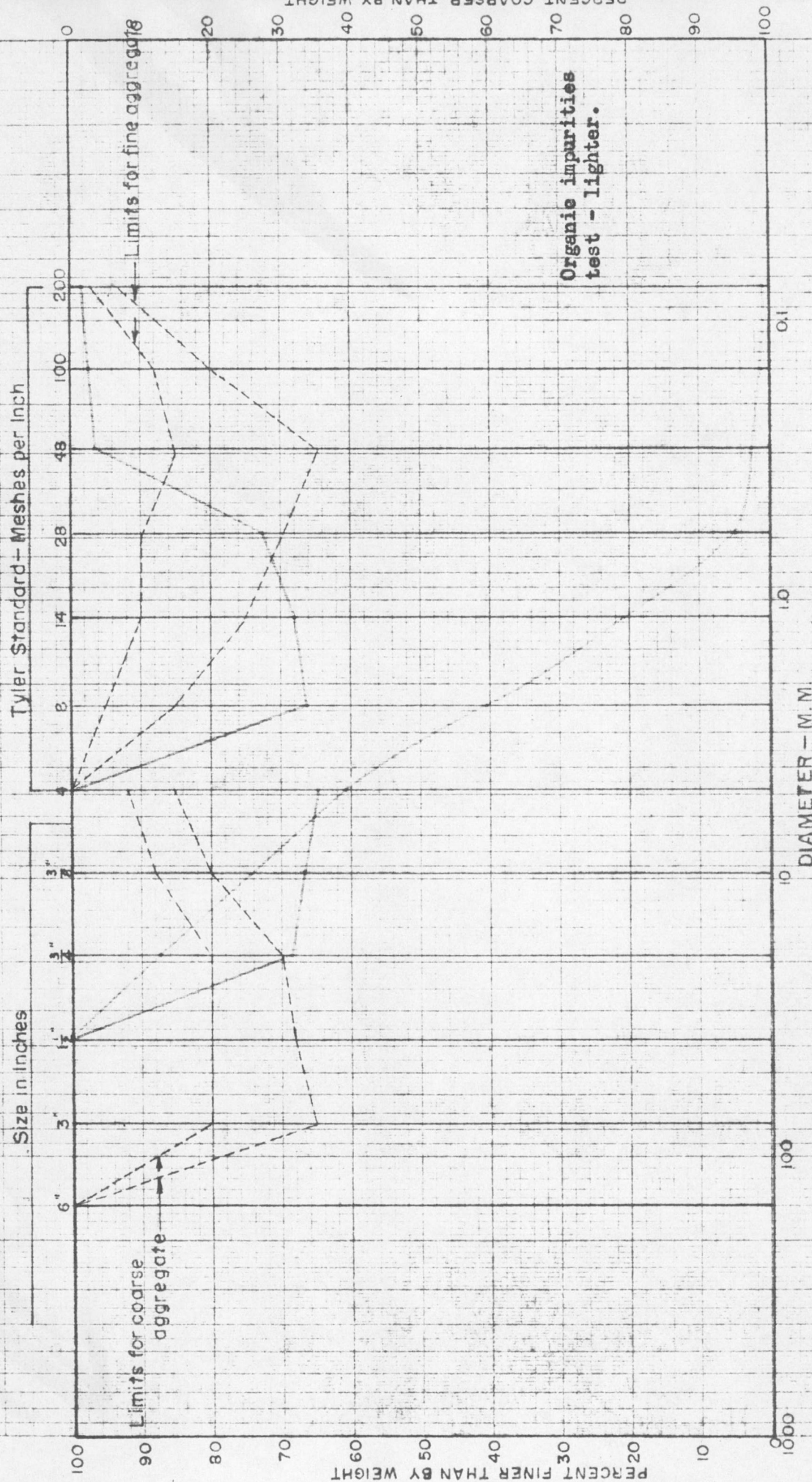
Description of Potential Aggregate for the following Grain Size Analyses Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
9	Cut on Pipe Line Road; 5 miles east of Haines Junction; 10 feet below ground surface; 15 feet above road	Fairly well graded, coarse-grained sand; minor gravel; no silt; very little weathering	None	25+ feet	Unlimited	Easily accessible glacio-fluvial material
11	Pit 1/2 mile north of Alaska Highway at mile 1012.6; 20 feet below ground surface	Well graded, fine-grained, sandy gravel; very little silt; a few rounded cobbles up to 6 inches in diameter; stratified with alternating beds of coarse-grained sand and fine-grained gravel up to 6 inches in thickness	None	25+ feet	Unlimited	Probably a Recent Lake Alsek shore line deposit; used for highway maintenance and for concrete foundations at C.N.T. relay station

GRAIN SIZE ANALYSIS FOR CONCRETE AGGREGATE RECONNAISSANCE



Site Kathleen River Hole No. 9 Sample No. 9 Depth Plotted Date

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WATER RESOURCES BRANCH

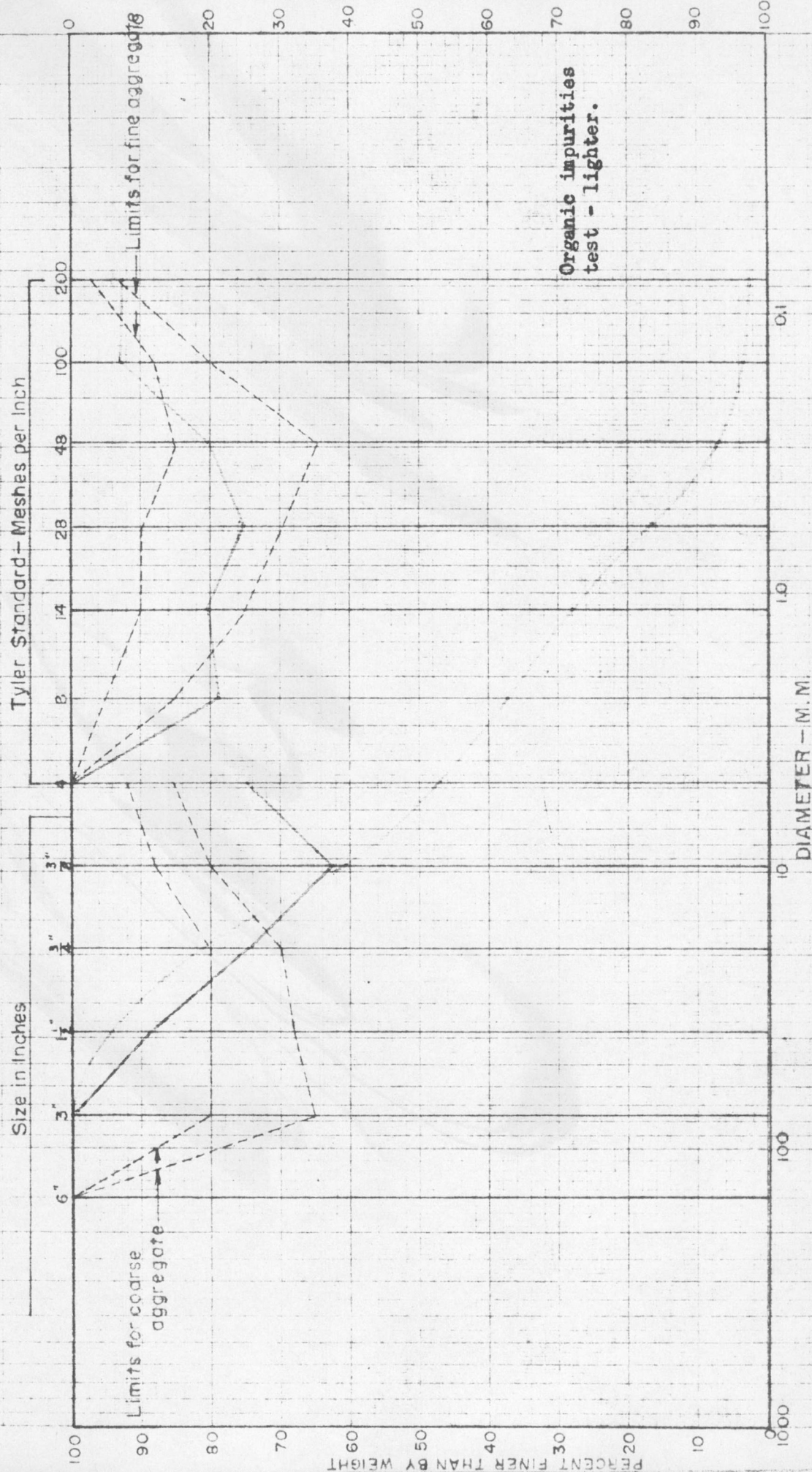
Organic impurities
test - lighter.

Site	Hole No.	Sample No.	Depth	Plotted	Date
Kathleen River		11			

Description of Potential Aggregate for the following Grain Size Analyses Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
12	Large pit on north side of Alaska Highway 1/2 mile east of Bear Creek; 15 feet below ground surface	Coarse-grained, sandy gravel; 6 inches of weathered material; a few rounded boulders up to 16 inches in diameter; stratified with alternating beds of coarse-grained sand and coarse-grained gravel up to 12 inches in thickness. <u>Pebble and Cobble Lithology</u> Igneous (granite, diorite) - 70% Sedimentary (arkose, greywacke) - 24% Shale - 1% Metamorphic (schist, gneiss) - 5%	None	80+ feet	Unlimited	Same type of deposit as sample No. 11; used for highway maintenance

GRAIN SIZE ANALYSIS For CONCRETE AGGREGATE RECONNAISSANCE



Organic impurities
test - lighter.

Site Kathleen River Hole No.

Sample No. 12

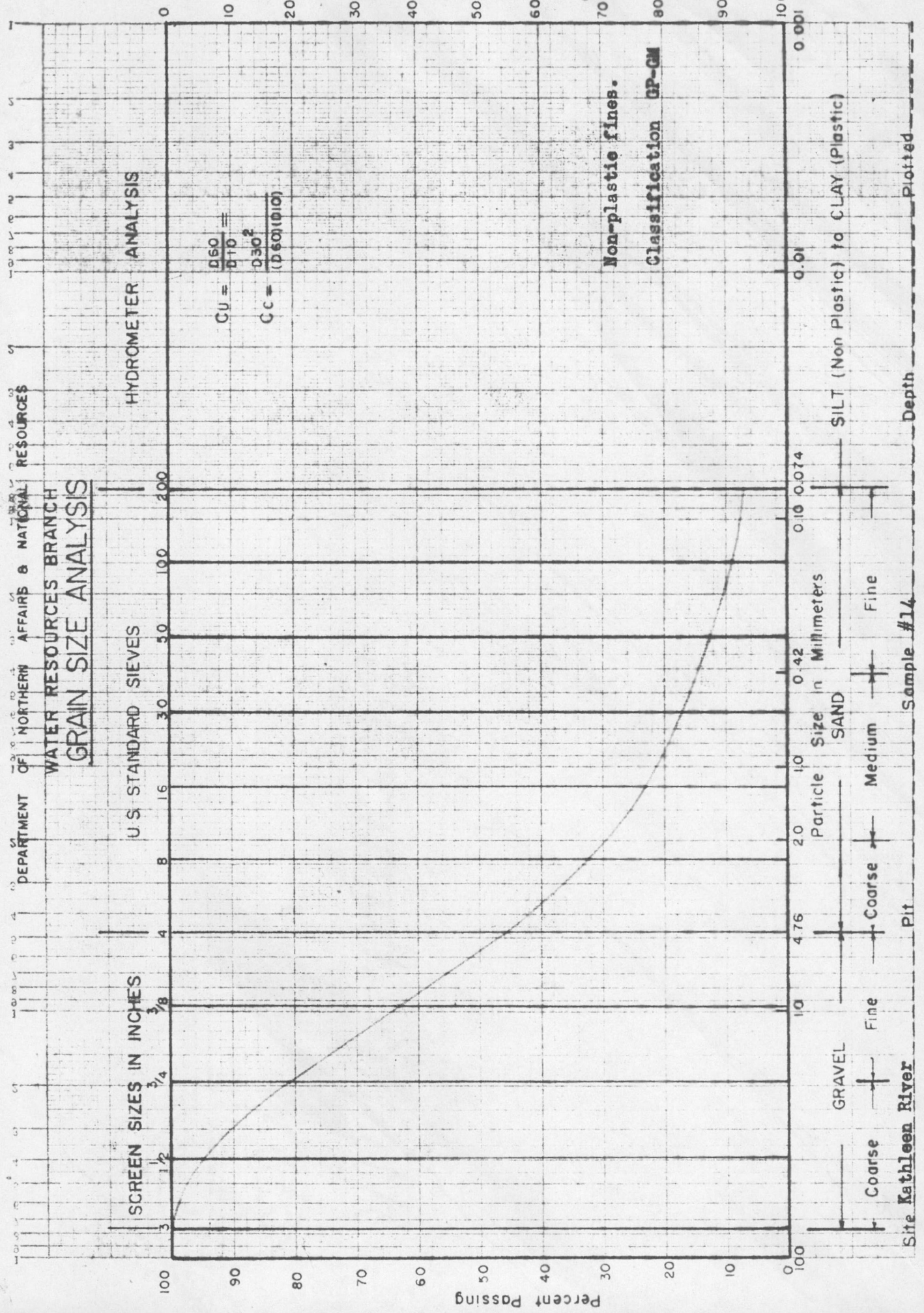
Depth

Plotted.

Date _____

Description of Potential Impervious Material for the following Grain Size Analyses Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
14	Bluff on east side of Kathleen River 1,500 feet upstream from dam site; 10 feet below top of bluff; 24 inches below ground surface	Silty, sandy gravel (Till); well graded from silt to 8-inch cobbles; dense; minor weathering in upper 12 inches <u>Pebble and Cobble Lithology</u> Igneous (granite, etc.) - 45% Sedimentary (sandstone) - 55%	6 inches to several feet of clayey silt	100+ feet	Unlimited; extends upstream from site along both sides of river for several miles	Easily accessible from dam site; forms steep bluffs along both sides of river.



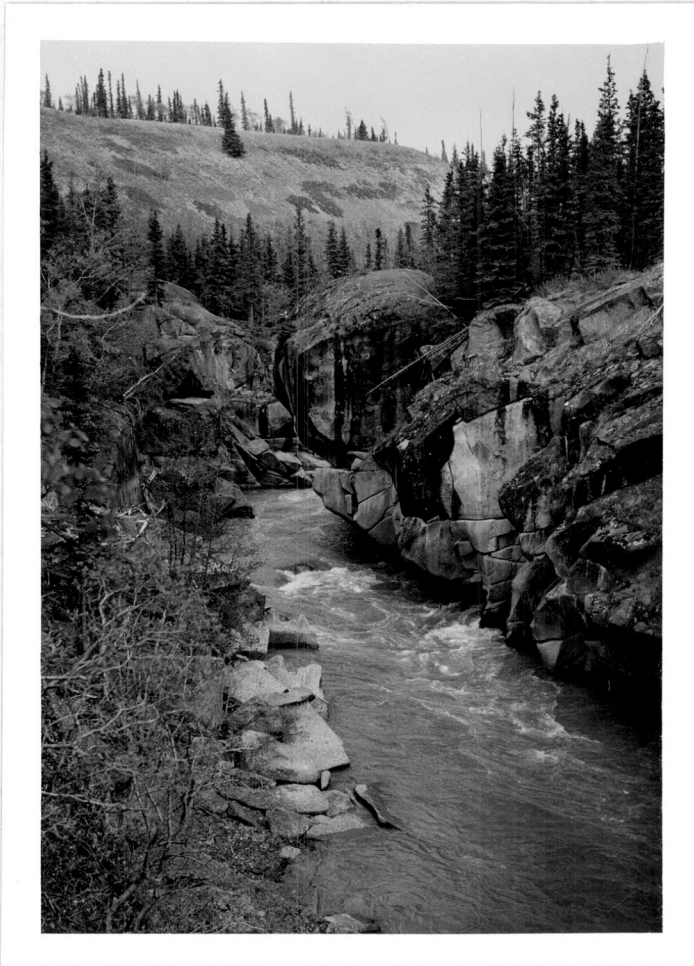


Plate 1

Kathleen Canyon looking upstream from the centre of the canyon.

G.S.C. 1-2-61

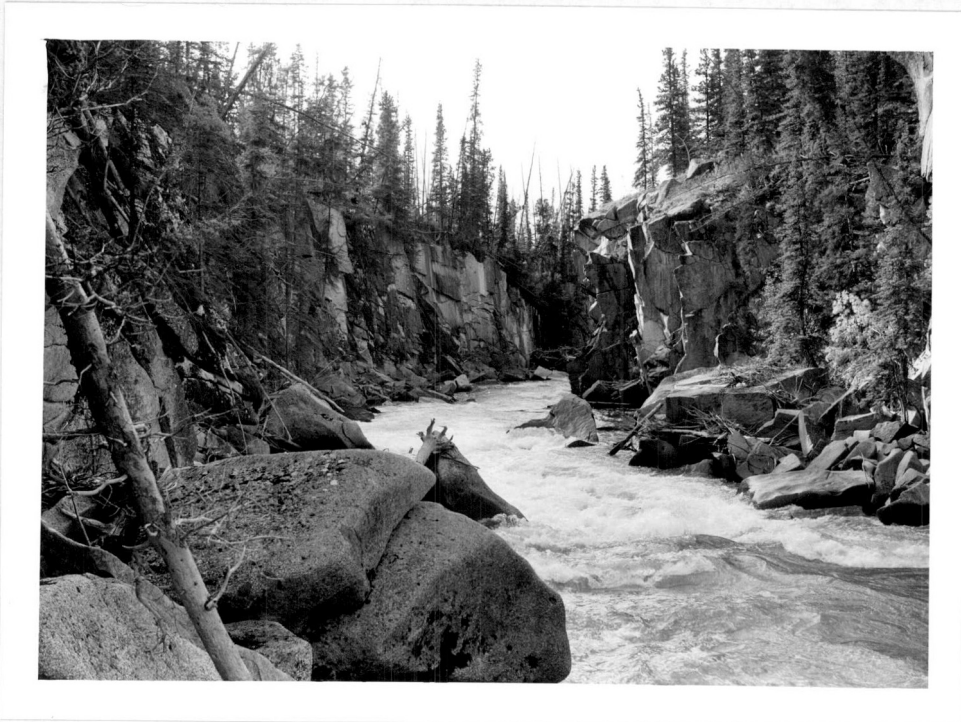


Plate 2

Kathleen Canyon looking downstream from the centre of the canyon. The proposed axis of the dam is in the centre of the photograph at the bend in the river.

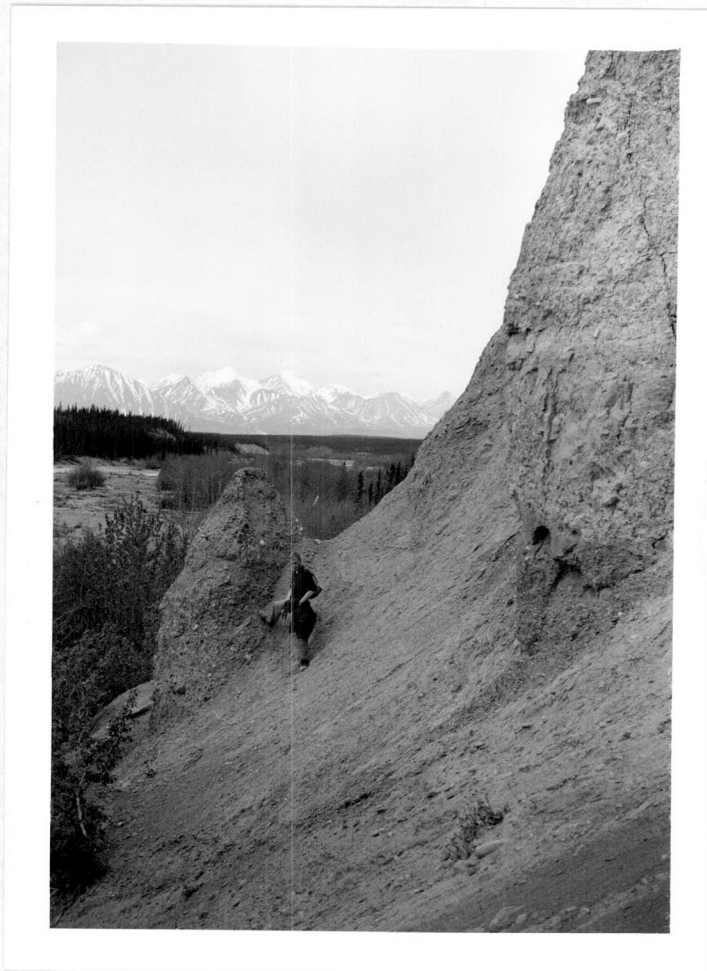
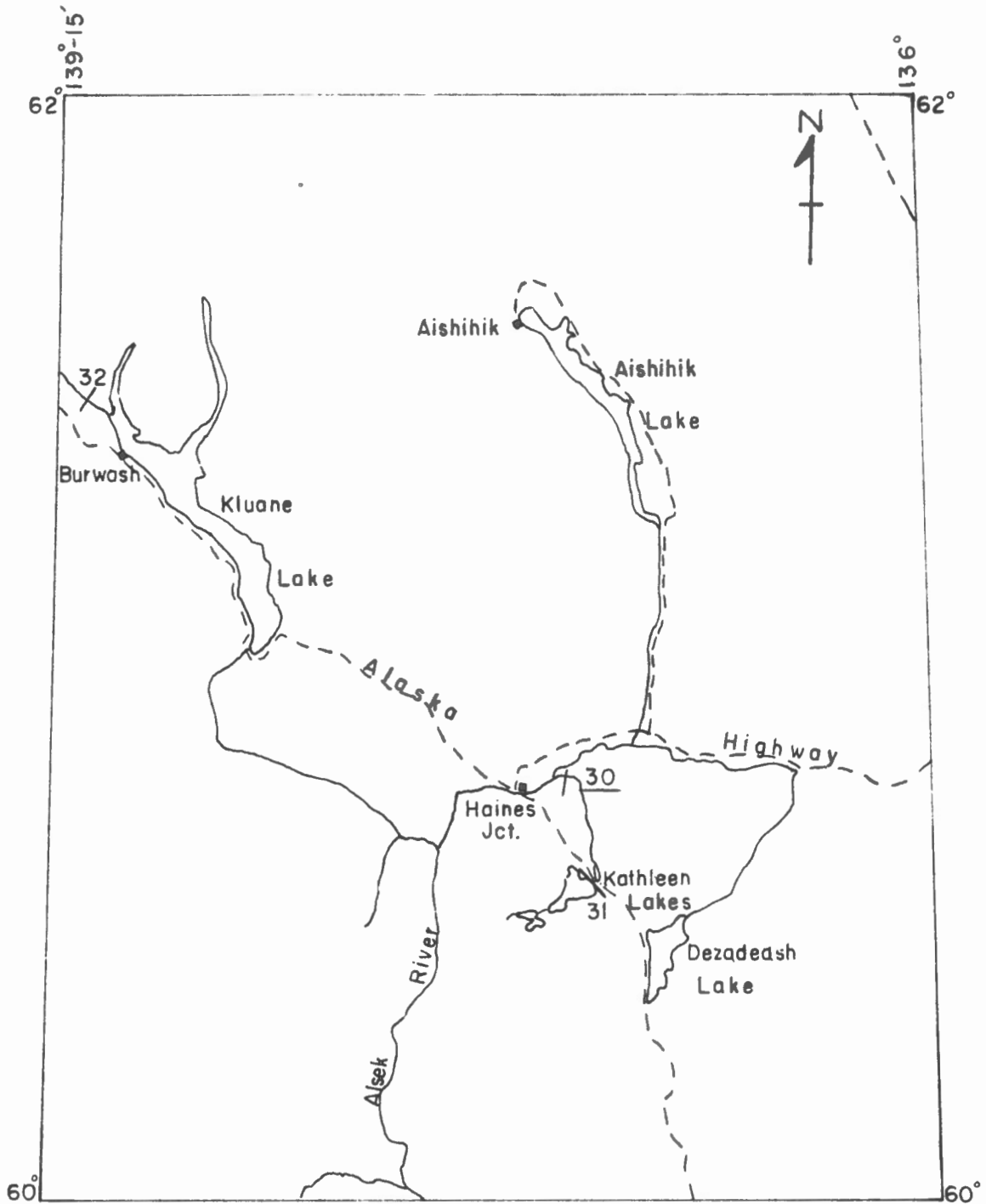


Plate 3

Till exposed in a bluff on the north side of Kathleen River 1,000 feet downstream from the lower end of the canyon. This is potential impervious material.

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LOCATION OF PROPOSED DAM SITES
YUKON RIVER DRAINAGE BASIN
AND PACIFIC COAST DRAINAGE

Scale: 1 inch = 20 miles

<u>Site No.</u>	<u>Name</u>
30 —	<u>Kathleen Canyon</u>
31 —	Kathleen Lake
32 —	Kluane Canyon