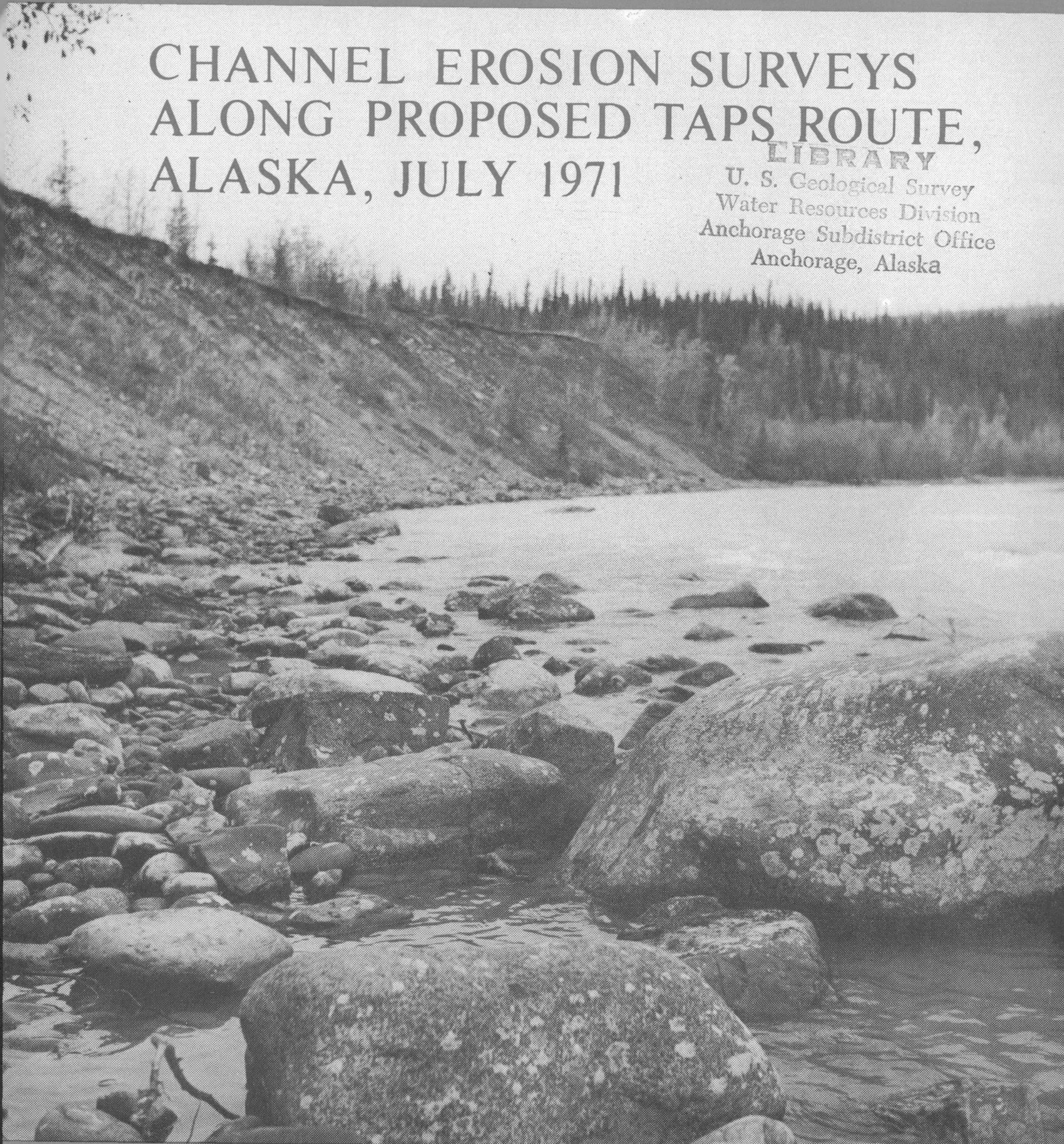
CHANNEL EROSION SURVEYS ALONG PROPOSED TAPS ROUTE, ALASKA, JULY 1971



UNITED STATES DEPARTMENT OF THE INTERIOR
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By
Joseph M. Childers

BASIC-DATA REPORT

Anchorage, Alaska
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CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS--Continued

TABLES

CHANNEL EROSION SURVEYS ALONG PROPOSED TAPS ROUTE, ALASKA, JULY 1971

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INTRODUCTION

The U.S. Geological Survey has the threefold responsibility along the proposed route of the Trans-Alaska Pipeline System (TAPS): to investigate possible hydrologic hazards to the pipeline, to investigate possible impacts of the pipeline on water resources, and to develop a better understanding of Arctic hydrology. Because the proposed pipeline route lies within many stream channels, one of the obvious hydrologic hazards is channel erosion. It was considered a major hazard in a report by Hadley (1969) after a short reconnaissance of the proposed pipeline route and also in a national assessment of water resources by the Water Resources Council (1968). The U.S. Department of Interior has also recognized the channel erosion problems in considering the environmental impacts of TAPS and has stipulated conditions for their control (U.S. Dept. of Interior, 1972a, b). The Alyeska Pipeline Service Company (APSC), who would build and operate TAPS, has described methods for complying with the Department of Interior stipulations for channel and erosion control (APSC, 1971).

Two basic channel erosion problems are: (1) Erosion that could be severe enough to cause pipeline rupture and oil spillage, and (2) erosion that could cause water quality degradation through siltation of streams. Erosion that could endanger the pipeline would probably result from major floods, from the cumulative movement of channels over a period of years (Brice, 1971), from scour in large alluvial flood plains (the total flood channel) and perhaps also from flow around or under ice or frozen streambeds. Erosion that would cause water-quality degradation through siltation would probably be most likely in small streams with watersheds containing fine-grained erodable soils.

This report provides descriptions of preconstruction conditions at selected channel sites along the northern segment of the TAPS from Prudhoe Bay to the Salcha River (fig. 1). The information presented could be used in studies of severe channel erosion, streambed scour, bank erosion, or rechannelization. The report also presents a plan for detecting and measuring significant erosion and the important factors causing the erosion, such as flood discharge, icing development, and construction activities. A companion report (Childers, 1972) presented the results of flood surveys at the channel erosion sites.

PRECONSTRUCTION SURVEYS

Parts of streambeds may scour and fill rapidly at a site during a flood. The maximum streambed scour during such a period of scouring could be measured reliably by continuous monitoring. This is not practical in these studies, which are limited to measuring the net erosion that occurs during the time between surveys at the sites; thus only net streambed scour, bank erosion, and rechannelization will be measured. Bank erosion is a cumulative process, and the maximum erosion during periods of study can be measured at the sites.

All the sites selected were located in the permafrost region on large alluvial floodways and included meandering and braided streams and a stream on an alluvial fan. The sites selected represent regions with differing hydrologic

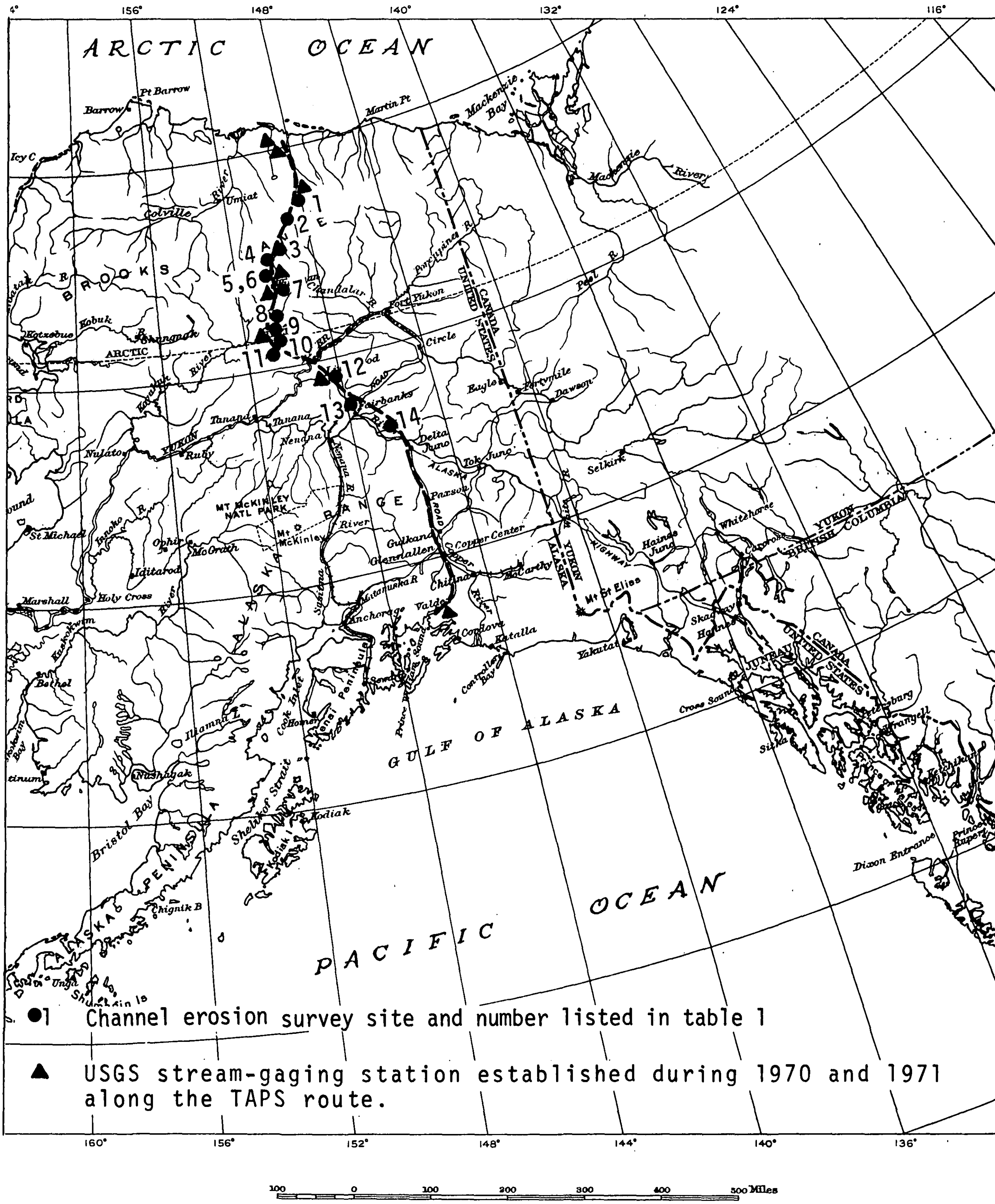

Figure 1.--Channel erosion survey sites along the trans-Alaska pipeline route.

conditions and thus the probability of determining the effect from erosion during a major flood at more than one site is increased.

To determine the net erosion that occurs between surveys the following background data was obtained. Cross sections defining the topography in the vicinity of the proposed pipeline were surveyed (1) along the pipeline centerline and (2) at locations upstream and downstream outside the probable construction zones. The upstream and downstream profiles or cross sections were marked for future surveys by steel rods driven into the ground at or near the ends of the cross sections. At some sites an identifiable lone tree or large stone marks the end of the cross section. The cross-section markers were made conspicuous for easy location and may be used for photogrammetric control in working with aerial photographs of the sites. If destroyed, they may be relocated from reference points established in the vicinity. A transit-stadia survey, using elevations from TAPS bench marks and locations based on centerline stationing, was made to establish vertical and horizontal location of the cross sections, photograph control points, and reference points.

The streambed was examined within the sites, and a sample location representative of the streambed surface was selected for analysis of particle-size distribution. Particle sizes were analyzed using optical methods (Ritter and Helley, 1969). A hand auger was used to collect samples of soil above ice or gravel for particle-size distribution analysis within the limits of downward penetration at selected locations on the vegetated flood plains.

Vertical aerial photography at most sites was obtained during low-flow, open-water conditions to provide a basis for evaluating changes that may be caused by construction and erosion. This photography should allow the preparation of site topographic maps with 1-foot vertical and horizontal resolution.

SURVEILLANCE PLAN

Observations will be made periodically at the selected sites. Low altitude aerial observations will be made at least once a year during the spring to estimate the extent of icing development. If exceptionally large, the icings will be surveyed on the ground. During the summer, on-the-ground observations will be made. After major floods, the peak discharge will be determined by slope-area methods. Current construction work will be described; the dates and details of past operations will be determined and recorded. If significant erosion is found, the cross sections will be resurveyed and new low-altitude vertical aerial photography will be obtained.

PRECONSTRUCTION DATA

Data from the channel surveys are presented in the following summary (table 1) of site locations, bankfull main channel data, flood-plain soil particle-size distribution, icing data, and photographic flight information.

A compilation of selected information collected in the field is presented in the rest of the report. PC identifies a photograph control point.

Table 1.--*Channel erosion survey results.*

Site no.	Stream name	Location		Bankfull main channel				Flood-plain soil particle-size distribution						Location		Aerial photography	
		Latitude	Longitude	Width	Mean depth	Maximum depth	Median bed material	Depth	Underlying material	Gravel percent	Sand percent	Silt percent	Clay percent	Ice scars	Icings	Date	Scale
1	Sagavanirktok R near Sagwon	69°02'00"	148°49'00"	400	8	12	Small boulders	3.0	Frost	.0	56	35	9	-	-	-	-
2	Atigun R near Galbraith Lake	68°16'25"	149°24'30"	400	5	15	Fine gravel	2.7	Gravelly sand	44	52	3	1	-	-	-	-
3	Snowden C near Dietrich Camp	67°44'20"	149°45'10"	360	1	4	Large cobbles	3.0	Gravel	11	49	36	4	-	-	9-28-71	1:2,400
4	Dietrich R at Bettles R	67°38'40"	149°42'50"	370	4	8	Small cobbles	1.0	Gravel	33	33	33	1	-	-	9-28-71	1:2,400
5	Middle Fk Koyukuk R at Hammond R	67°27'45"	150°01'38"	320	5	10	Small cobbles	-	-	32	44	23	1	-	-	9-28-71	1:4,800
6	Hammond R near Wiseman	67°27'45"	150°01'38"	565	2	5	Large cobbles	1.5	Gravel, cobbles	0	20	66	14	-	-	9-28-71	1:4,800
7	Middle Fk Koyukuk R near Wiseman	67°26'05"	150°04'45"	500	6	8	Small cobbles	2.0	Gravel, cobbles	0	47	50	3	Both banks	-	9-28-71	1:4,800
8	South Fk Koyukuk R near Wiseman	67°01'10"	150°16'40"	600	4	7	Coarse gravel	1.6	Frost	0	65	32	3	Right bank	Channel	9-28-71	1:4,800
9	Jim R near Prospect C Camp	66°53'00"	150°31'00"	150	5	8	Coarse gravel	3.5	Frost	5	92	3	0	-	-	9-28-71	1:2,400
10	Prospect C near Prospect C Camp	66°46'50"	150°40'30"	70	5	7	Coarse gravel	1.0	Frost	1	48	45	7	-	-	9-28-71	1:2,400
11	Kanuti R near Bettles	66°26'30"	150°37'30"	85	5	9	Small cobbles	2.2	Frost	20	61	16	3	Right bank	-	9-28-71	1:2,400
12	Hess C near Livengood	65°40'30"	149°04'20"	190	6	12	Coarse gravel	2.8	Gravelly sand	0	48	47	5	-	-	9-28-71	1:2,400
13	Chatanika R near Olnes	65°03'41"	147°48'39"	117	7	12	Coarse gravel	2.8	Water table	0	83	16	1	-	-	-	-
14	Salcha R near Salchaket	64°29'00"	146°39'30"	600	10	18	Small cobbles	1.5	Gravel	11	74	14	1	-	-	-	-

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Figures 2-5.--Sagavanirktok River near Sagwon.

Location.--Lat 69°02'00", long 148°49'00", 4.5 miles upstream from Lupine River and about 26 miles south of Sagwon, Alaska.
(Sagavanirktok 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three channel sections (fig. 2) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 3) for locations). The upstream cross section shows the maximum evident flood channel to be about 1,400 feet wide, with the main channel about 400 feet wide and 10 feet deep, and the overflow about 3-4 feet deep or less. The floodflow would impinge on the high left bank at the pipeline crossing. The left bank is quite steep at the pipeline (slope = $20/70 \approx 0.30$). The channel downstream narrows to a width of about 700 feet and the mean depth is 11 feet.

Bed material in the channel varies from silt to boulders on the willow-covered flood plains and in the main channel. Figure 4 shows the bed material in the main channel at the pipeline crossing, and is probably characteristic of floodflow bed material in main channels. A size distribution for terrace soil below 3 feet of silt and peat and overlying frozen silt is shown in figure 5 and is considered characteristic of the terrace bordering the river on the east bank. A hole was augered through 3.2 feet of silt to frozen silt at PC 4 on the narrow flood plain.

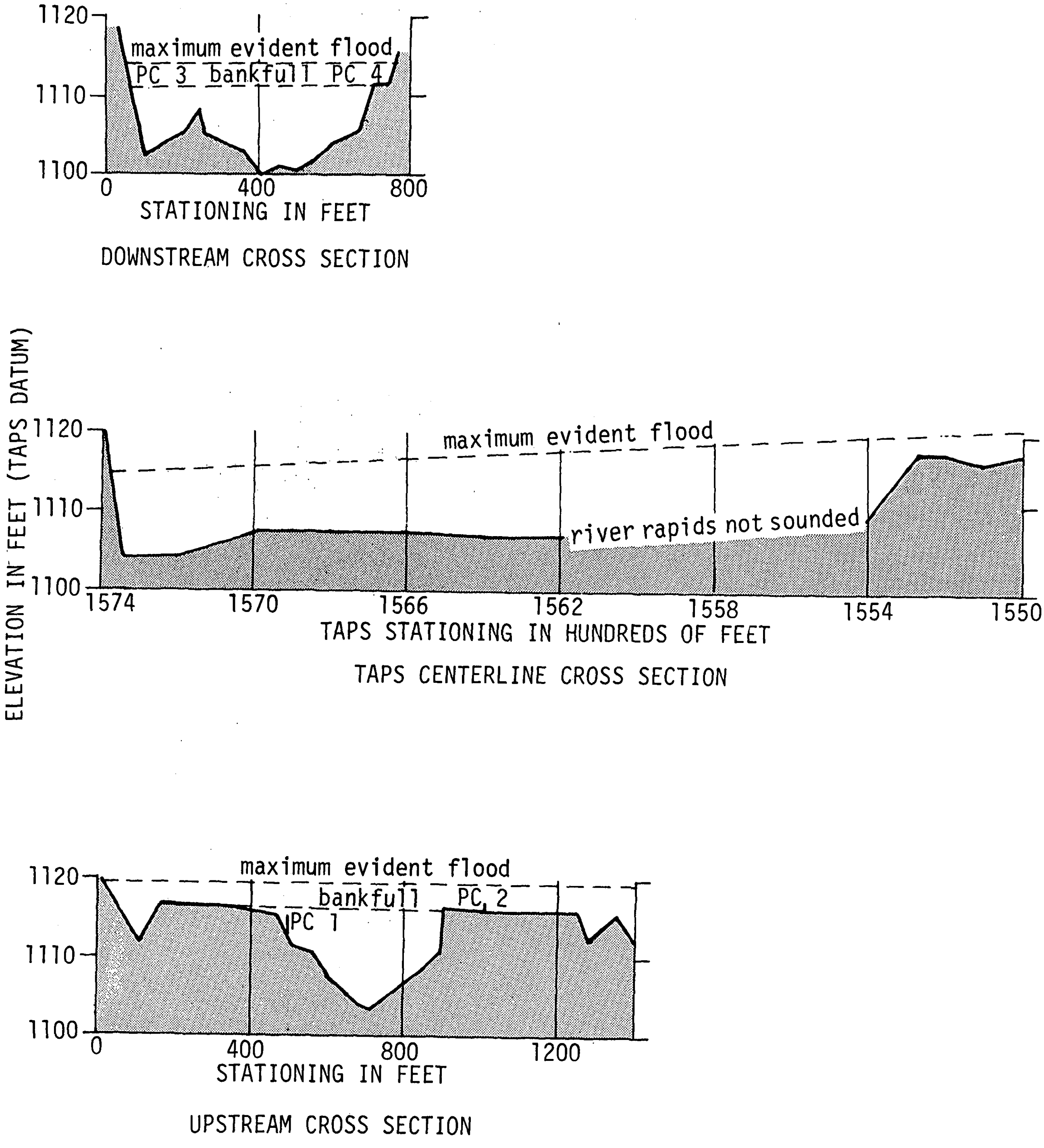


Figure 2.--Cross sections - Sagavanirktok River near Sagwon.

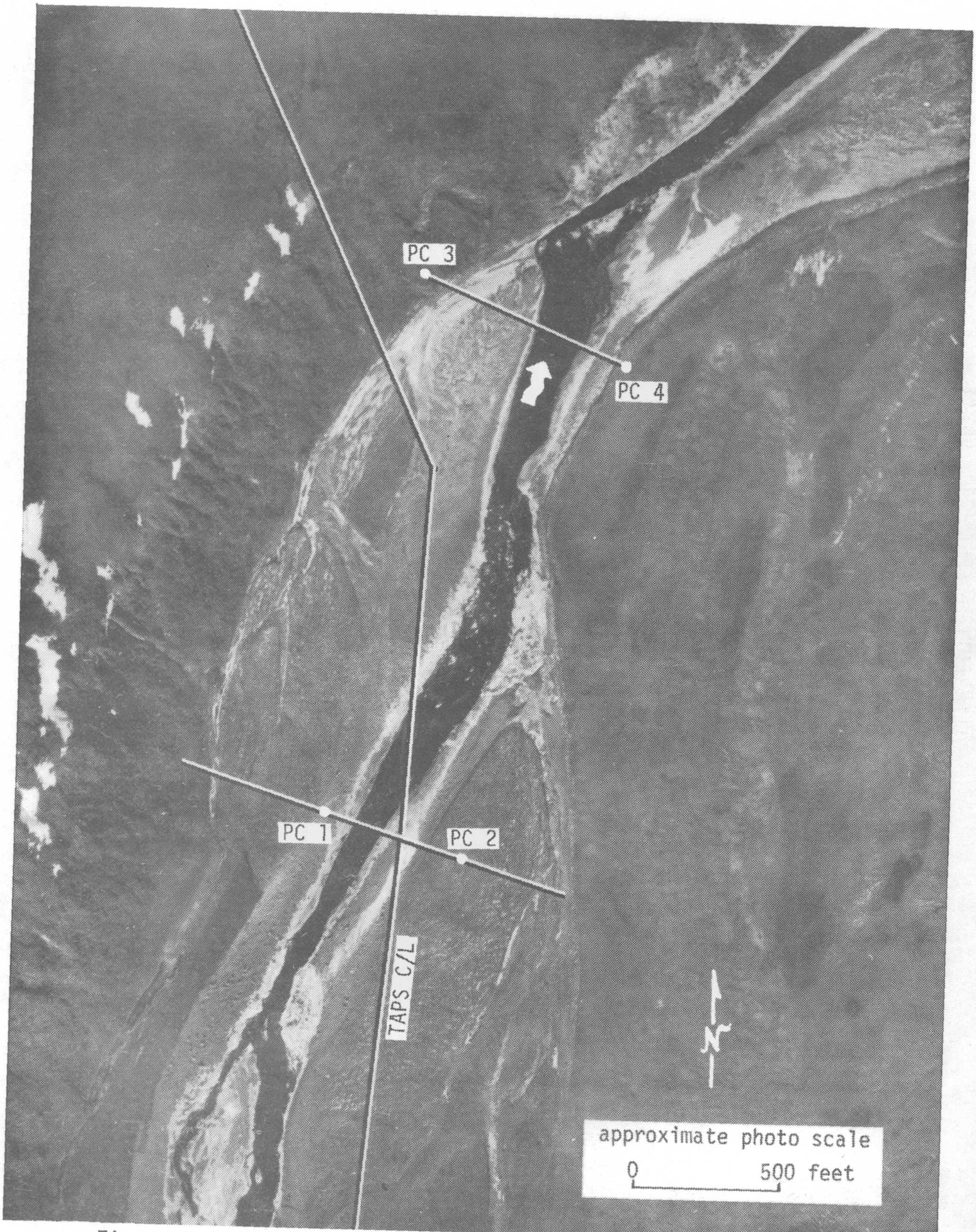


Figure 3.--Aerial photograph - Sagavanirktok River near Sagwon.

Figure 4.--Streambed material - Sagavanirktok River near Sagwon.

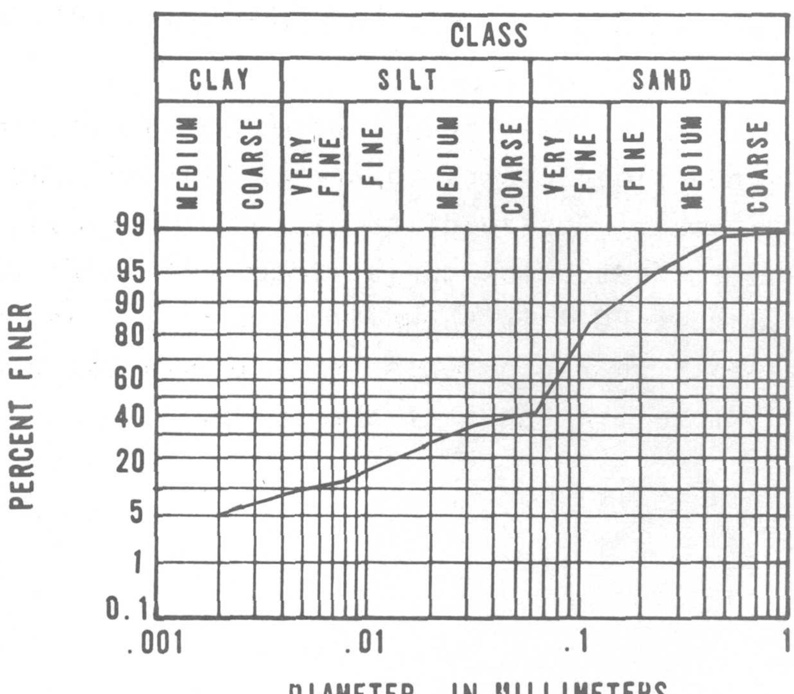


Figure 5.--Terrace soil sizes - Sagavanirktok River near Sagwon.

Figures 6-9.--Atigun River near Galbraith Lake.

Location.--Lat 68°16'25", long 149°24'30", about 5 miles upstream from the mouth of Galbraith Lake outlet. (Phillip Smith Mountains 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 6) were surveyed to define the ground elevations in the proposed crossing reach (see aerial photograph (fig. 7) for locations). The cross sections show the maximum evident flood channel, which has a maximum measured depth of about 15 feet at the toe of the right bank near the proposed pipeline. The right bank is on the outside of a bend at the pipeline and is a steep cutbank (slope = 12/20 = 0.60). The cutbank appeared to be silt and large blocks have slumped into the stream (fig. 8), which shows the right bank just upstream from the proposed pipeline crossing.

Bed material in the channel varies from silt on the willow-covered flood plains to bars of gravel and sand in the main channel. A size distribution for flood-plain soil taken 2.7 feet below the surface and overlying gravelly sand at PC 4 is shown in figure 9, and is considered reasonably characteristic for the vegetated flood plains that form the banks at the crossing.

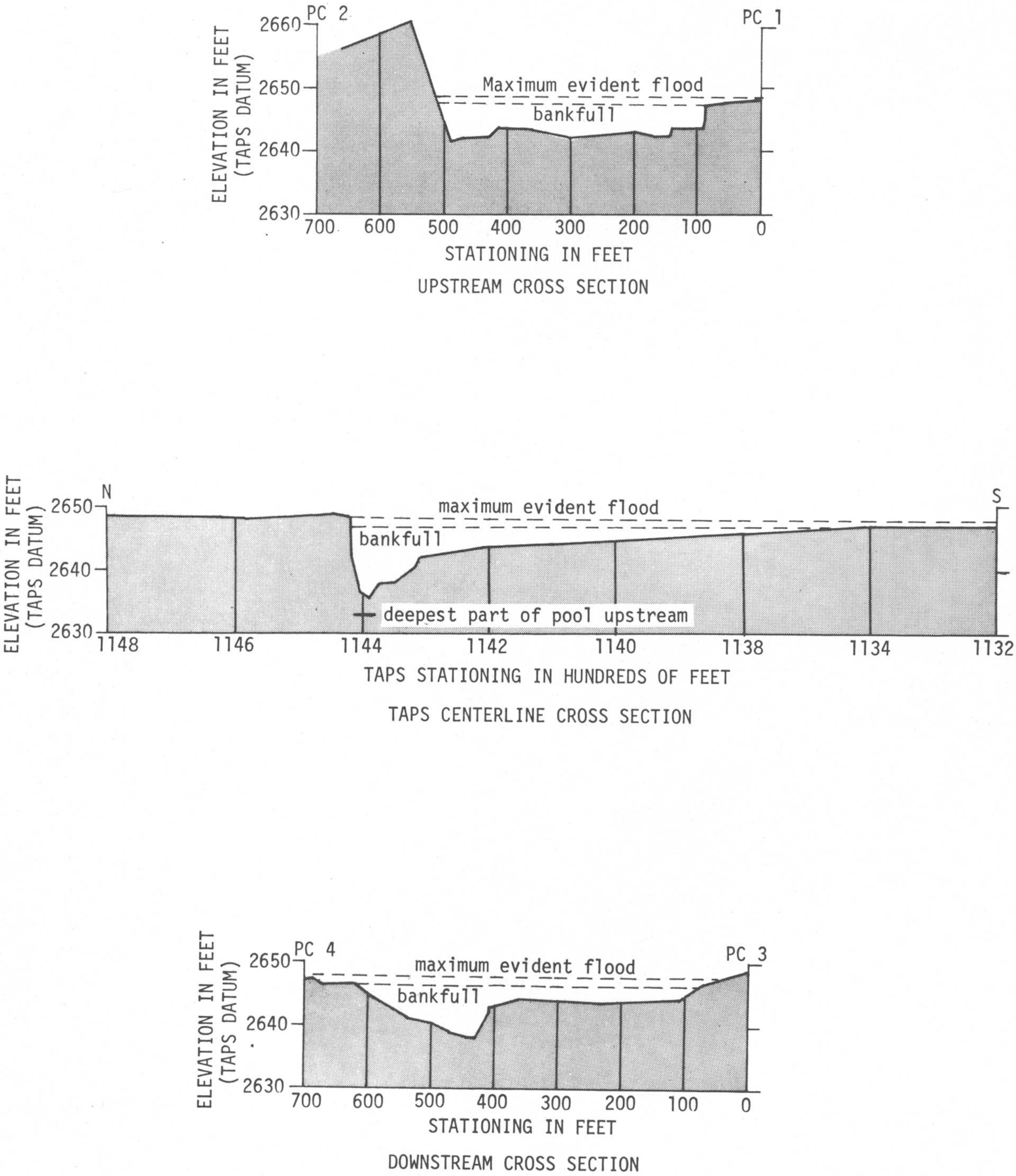


Figure 6.--Cross sections - Atigun River near Galbraith Lake.

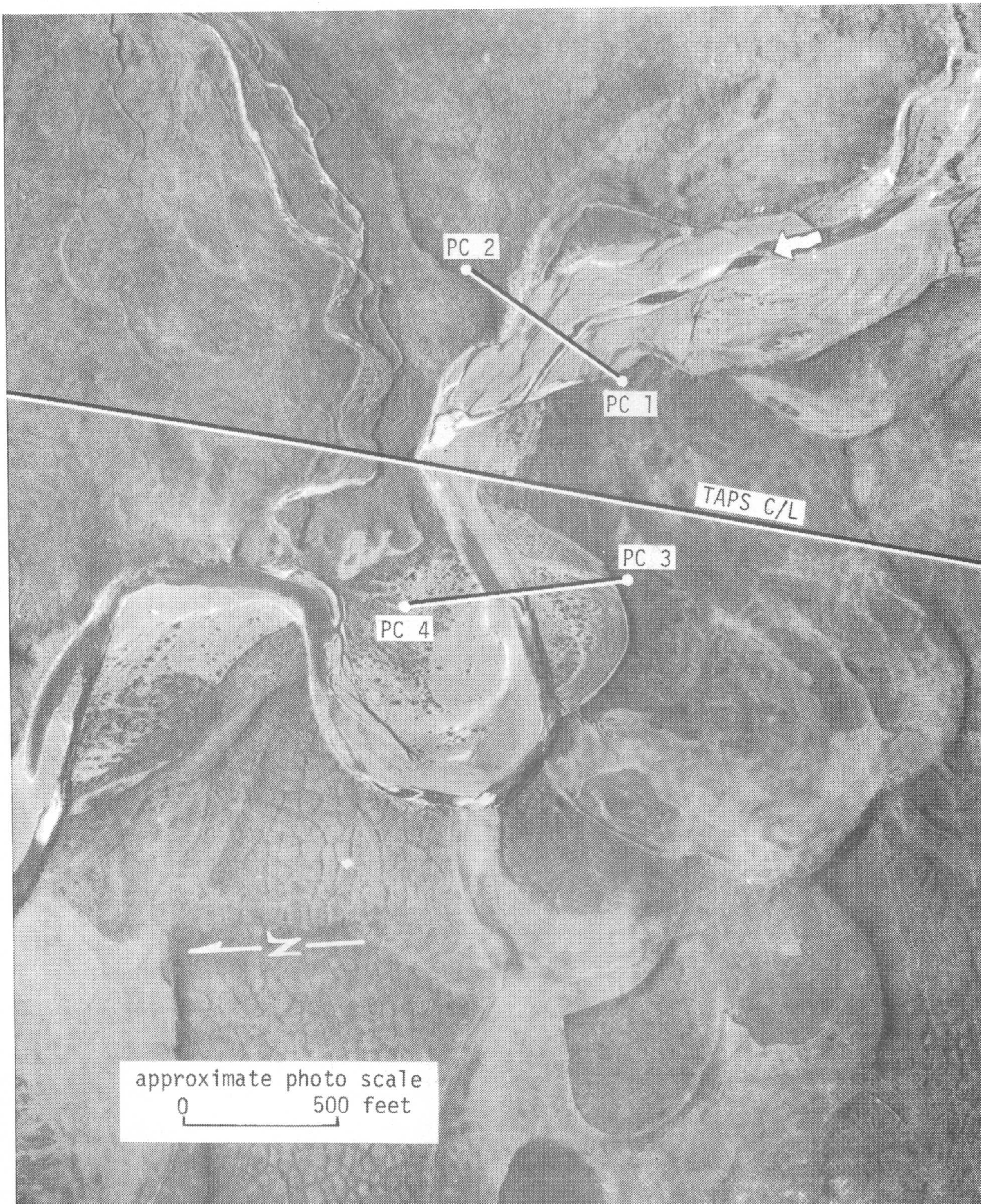


Figure 7.--Aerial photograph - Atigun River near Galbraith Lake.

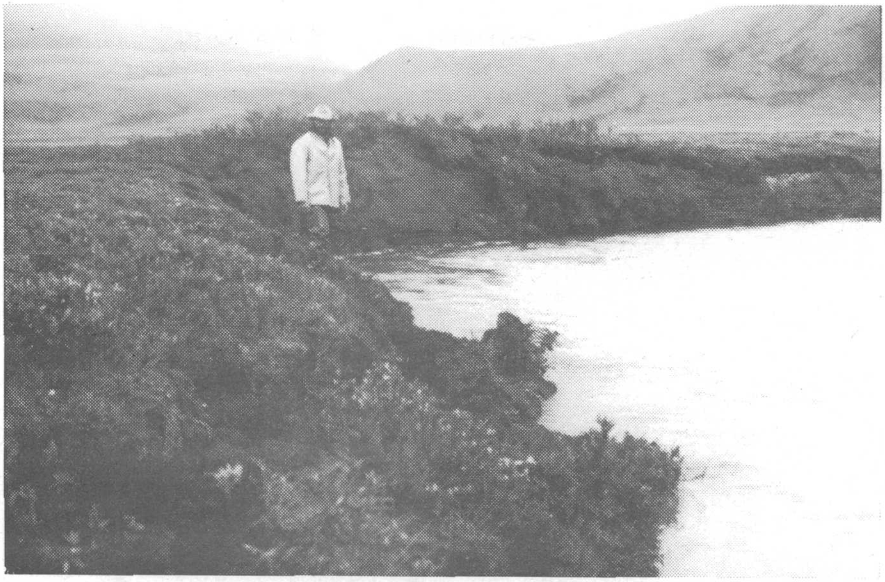


Figure 8.--Right bank - Atigun River near Galbraith Lake.

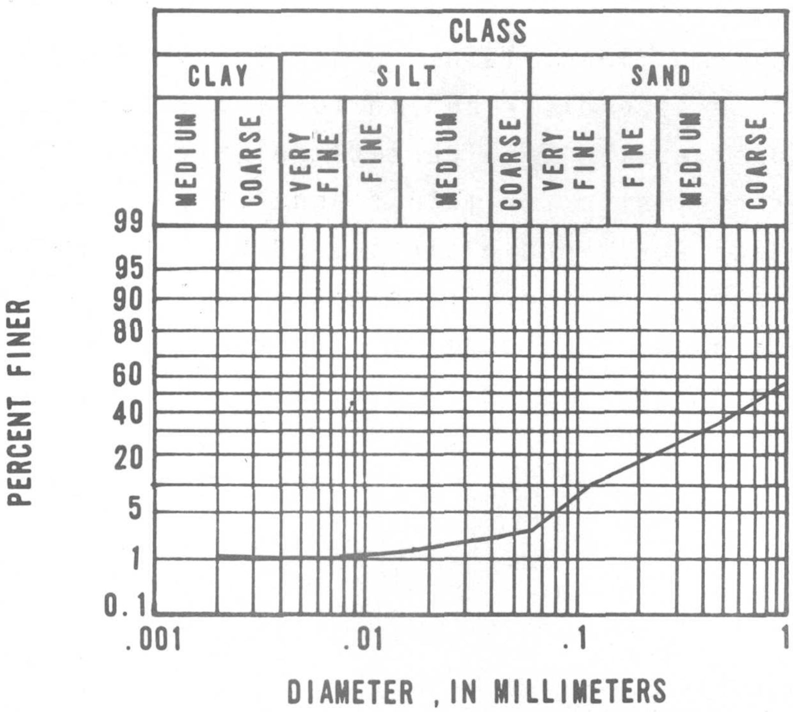


Figure 9.--Flood-plain soil sizes - Atigun River near Galbraith Lake.

Figures 10-13.--Snowden Creek near Dietrich Camp.

Location.--Lat 67°44'20", long 149°45'10", 0.5 mile upstream from mouth at Dietrich River, and about 25 miles north-northeast of Wiseman.
(Chandalar 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 10) for cross-section locations). The cross sections (fig. 11) and the aerial photograph show the maximum evident floodflow channel to vary greatly through the reach increasing in total width from about 220 feet at the upstream section to about 370 feet at TAPS centerline and 550 feet at the downstream section. Maximum channel depths are about 4 feet.

Bed material in the channel varies from silt on the willow-covered flood plains to small boulders in the main channels. A size distribution for bed material in the main channel at the TAPS centerline (fig. 12) is considered characteristic for main channel floodflow. A size distribution for flood-plain soil 3.0 feet beneath the surface halfway to the streambank from PC 4 (overlying gravel) is shown in figure 13. At PC 4 gravel and cobbles were found under moss at the surface.

Figure 10.--Aerial photograph - Snowden Creek near Dietrich Camp.

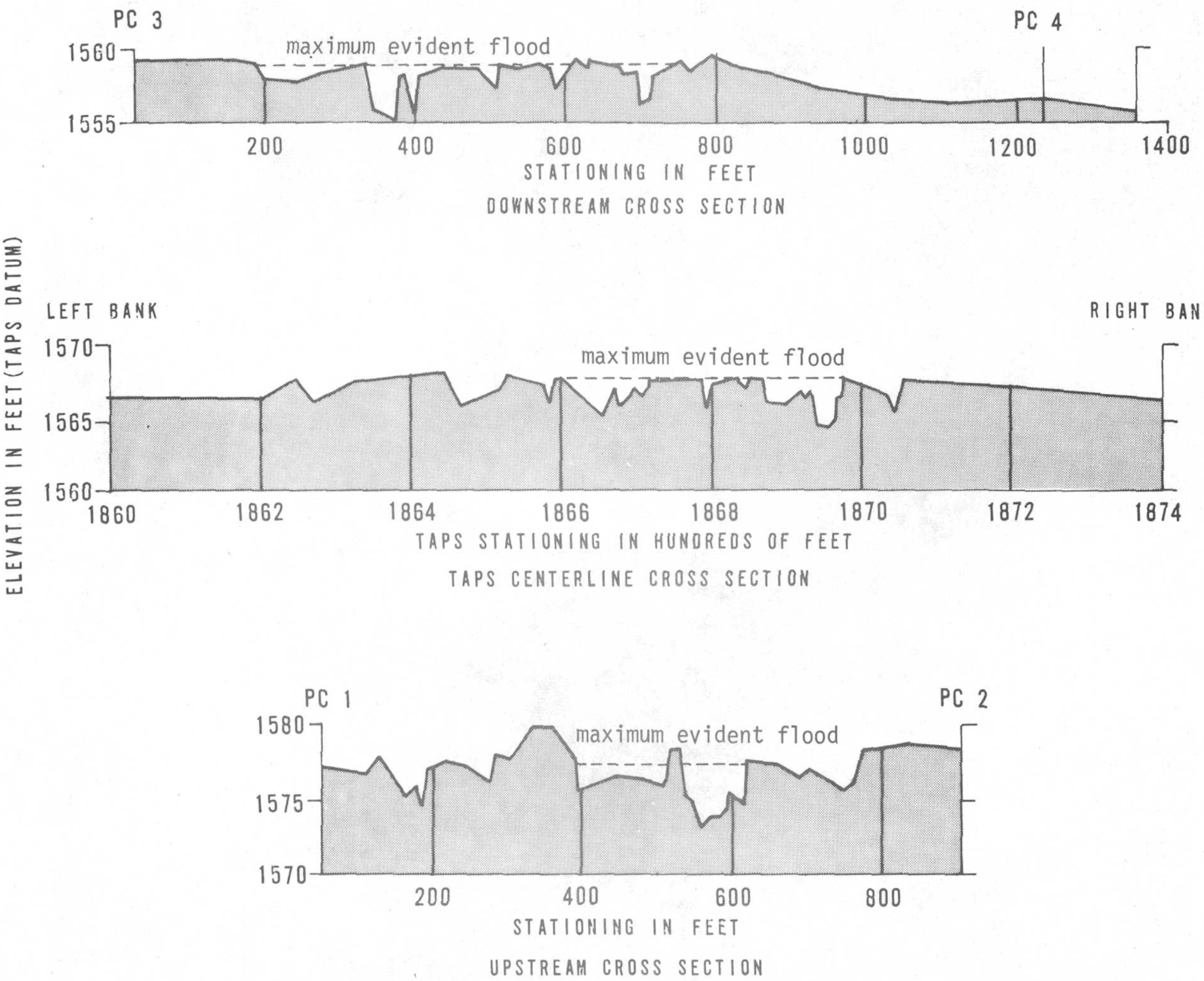
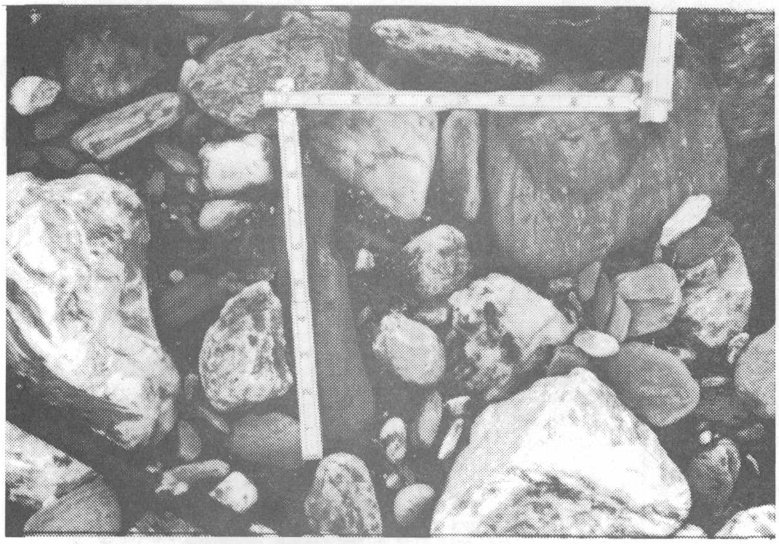


Figure 11.--Cross sections - Snowden Creek near Dietrich Camp.



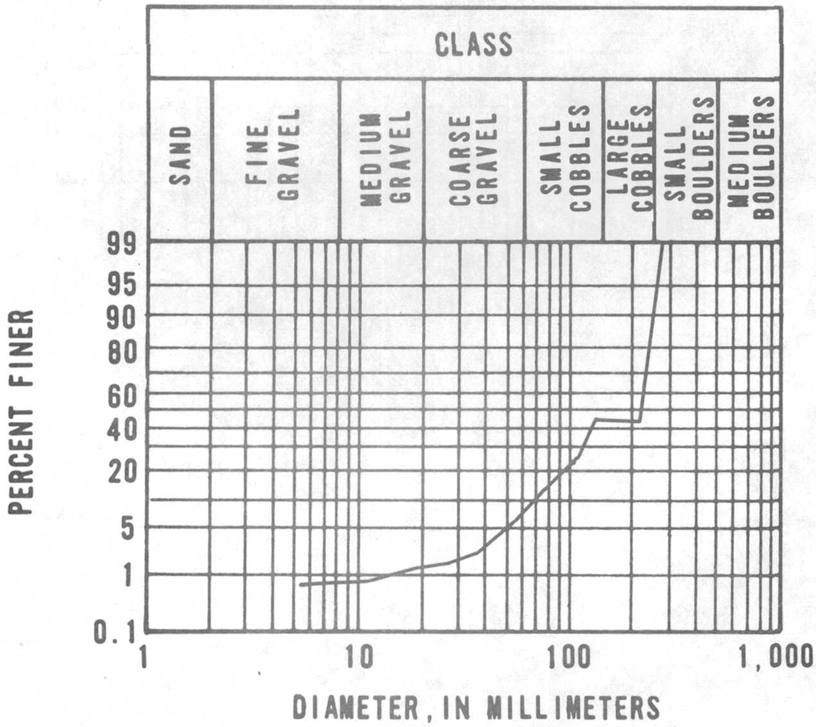


Figure 12.--Streambed material - Snowden Creek near Dietrich Camp.

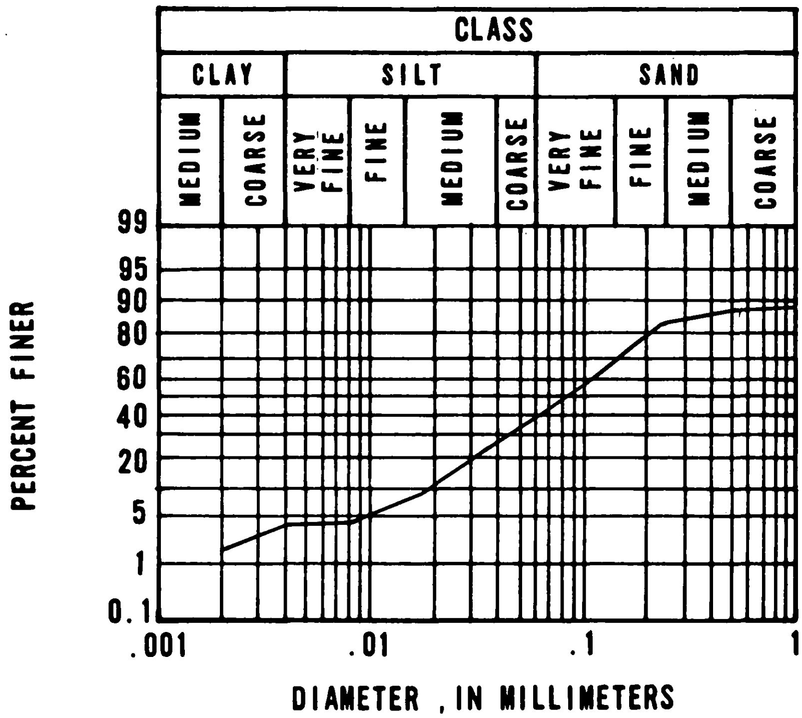


Figure 13.--Flood-plain soil sizes - Snowden Creek near Dietrich Camp.

Figures 14-17.--Dietrich River at Bettles River.

Location.--Lat 67°38'40", long 149°42'50", at TAPS pipeline crossing, 1 mile upstream from Bettles River and about 15 miles northeast of Wiseman.
(Chandalar 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 14) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 15) for locations). The cross sections show the maximum evident floodflow channel to be about 750-800 feet wide with the main channel increasing in width from about 270 feet at the upstream cross section to about 450 feet at the downstream section and maximum depths about 8 or 9 feet.

Bed material in the channel varies from silt on the willow-covered flood plains to large cobbles on riffles and upstream sides of point bars. A size distribution for bed material at TAPS centerline and considered reasonably characteristic for floodflow in the main channel is shown in figure 16. A size distribution for flood-plain soil about 1 foot below the surface overlying gravel at the upstream cross section on the willow-covered flood plain is shown in figure 17 and is considered reasonably characteristic of the soil on the flood plains.

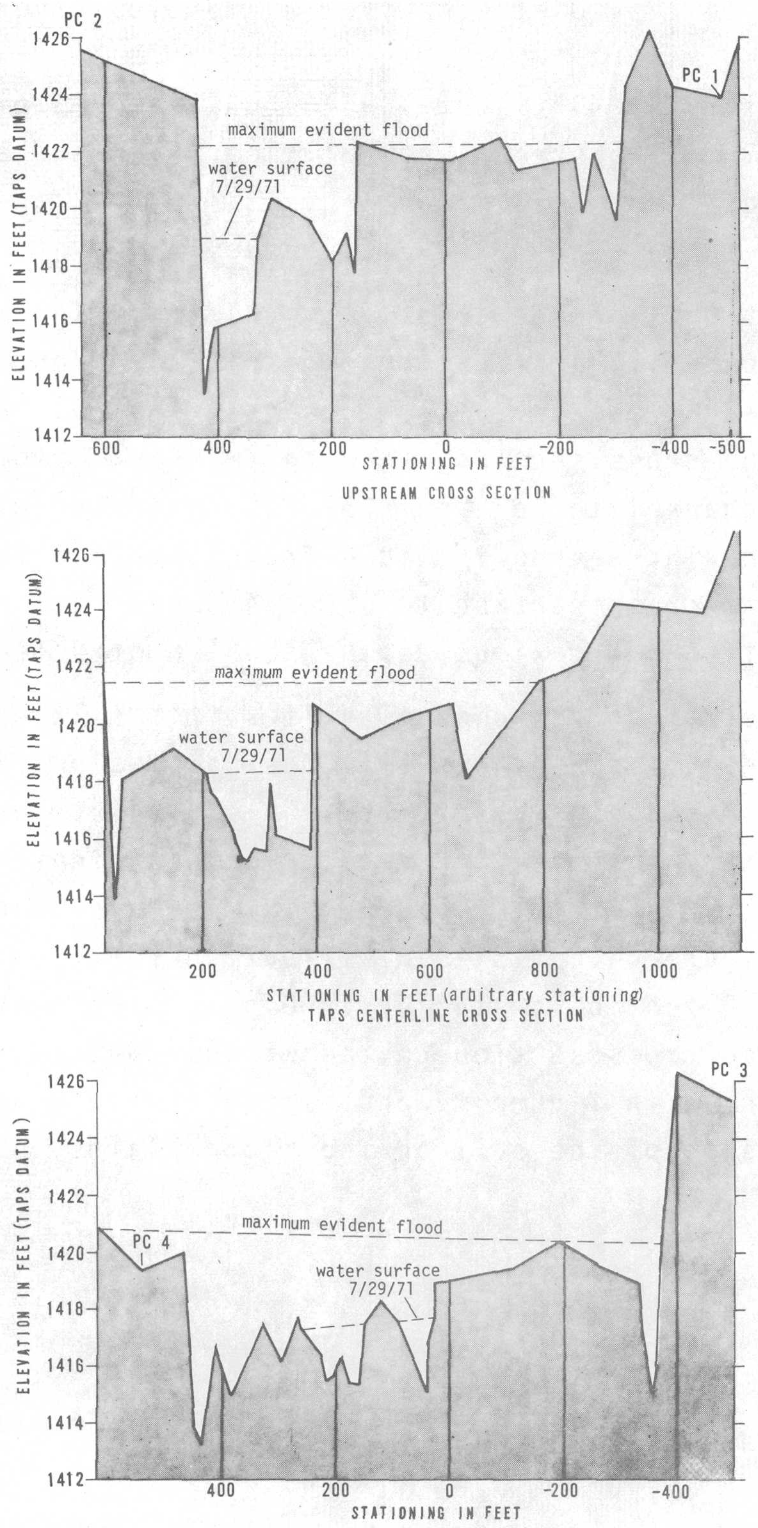
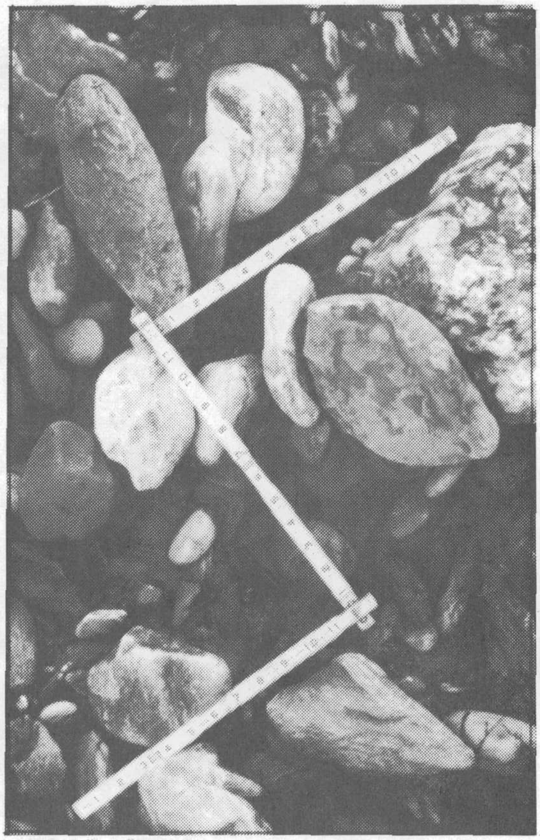


Figure 14.--Cross sections - Dietrich River at Bettles River.

Figure 15.--Aerial photograph - Dietrich River at Bettles River.



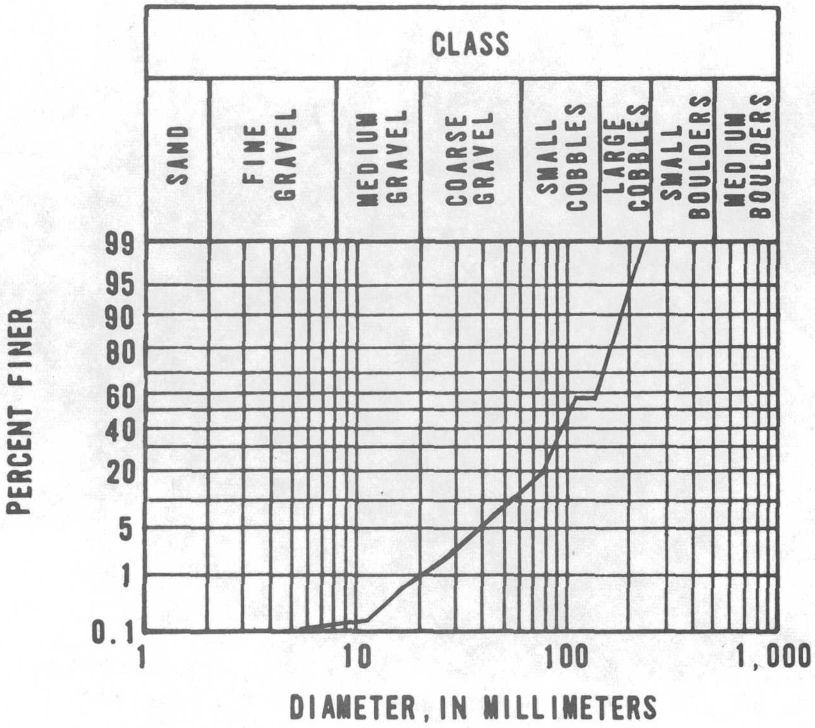


Figure 16.--Streambed material - Dietrich River at Bettles River.

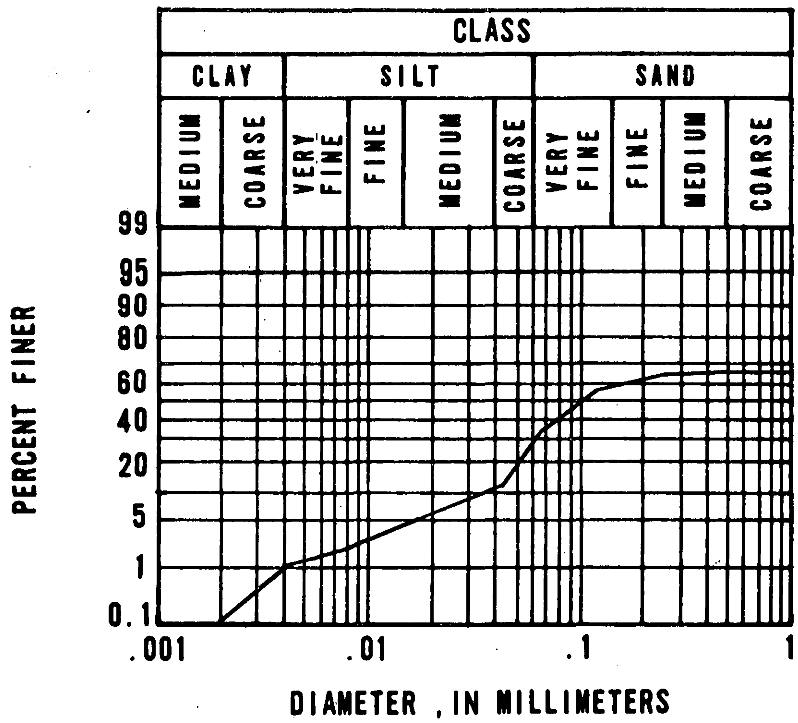


Figure 17.--Flood-plain soil sizes - Dietrich River at Bettles River.

Figures 18-24.--Middle Fork Koyukuk River at Hammond River.

Location.--Lat 67°27'45", long 150°01'38", 0.3 mile upstream from Hammond River and 4.3 miles northeast of Wiseman. (Wiseman 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 18) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 19) for locations). The maximum evident floodflow at the pipeline centerline is bankfull with the main channel about 320 feet wide and with a maximum depth of about 10 feet. Overflow channels increase the total width to about 850 feet plus a meander cutoff channel. The right bank is steep (slope = 10/20 = 0.5) and slump blocks and leaning trees indicate recent erosion. Seven cross sections (figs. 20, 21) were surveyed to define ground elevations in the proposed crossing reach of the meander cutoff channel (see aerial photograph (fig. 19) for locations). A site topographic map (fig. 22) and the cross sections show the meander cutoff channel configuration. Bankfull widths vary from about 50 feet in straight reaches with maximum depths of 5 or 6 feet to about 150 feet in meander bends with maximum depths of about 9 or 10 feet.

Bed material in the channel varies from silt on the willow-covered flood plains to cobbles on riffles and leading edge of point bars. A size distribution for bed material in the main channel downstream from the proposed pipeline crossing (fig. 23) is considered characteristic for floodflow in the main channel bed. A size distribution for flood-plain soil at TAPS centerline is shown in figure 24.

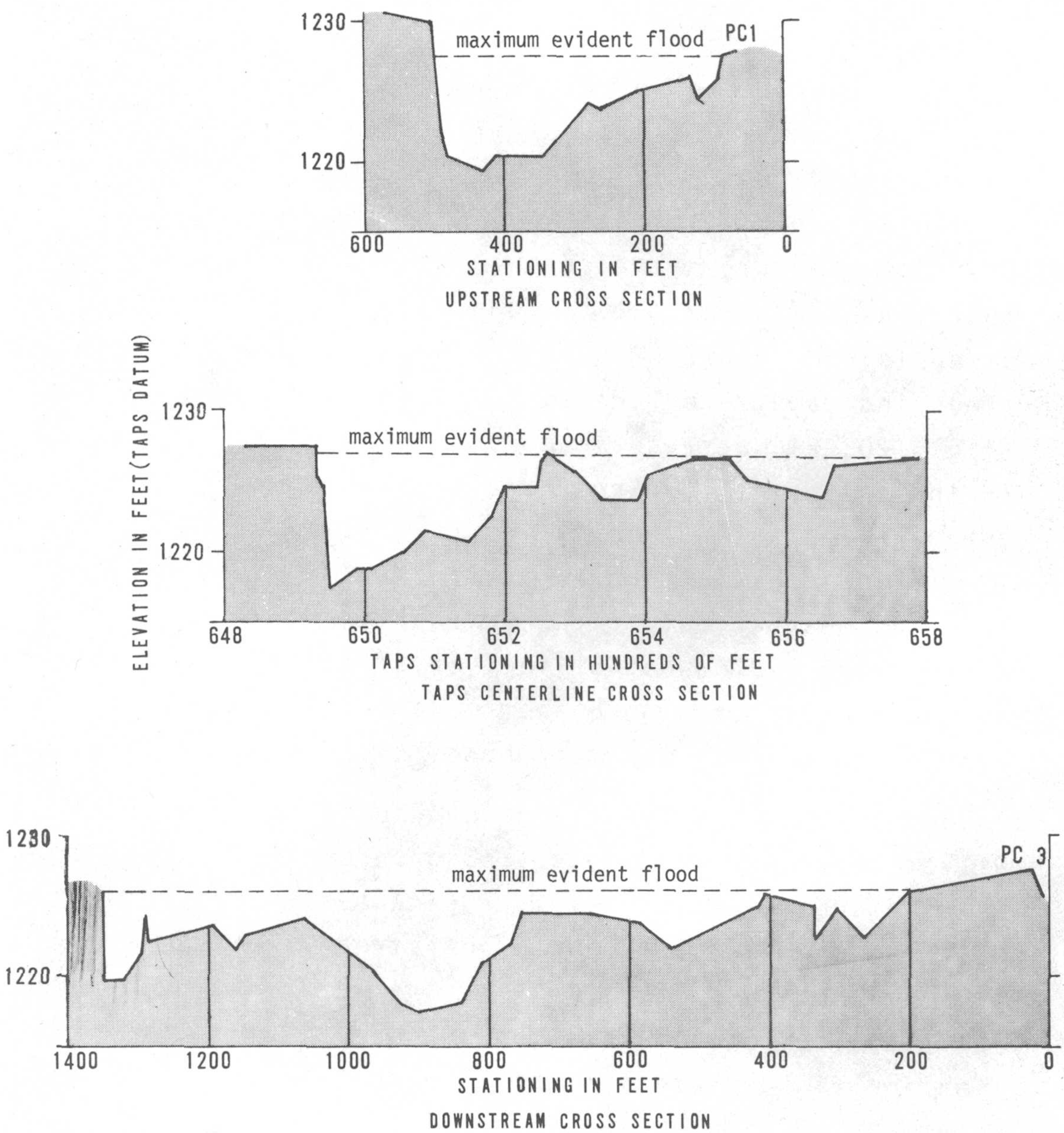


Figure 18.--Cross sections - Middle Fork Koyukuk River at Hammond River.

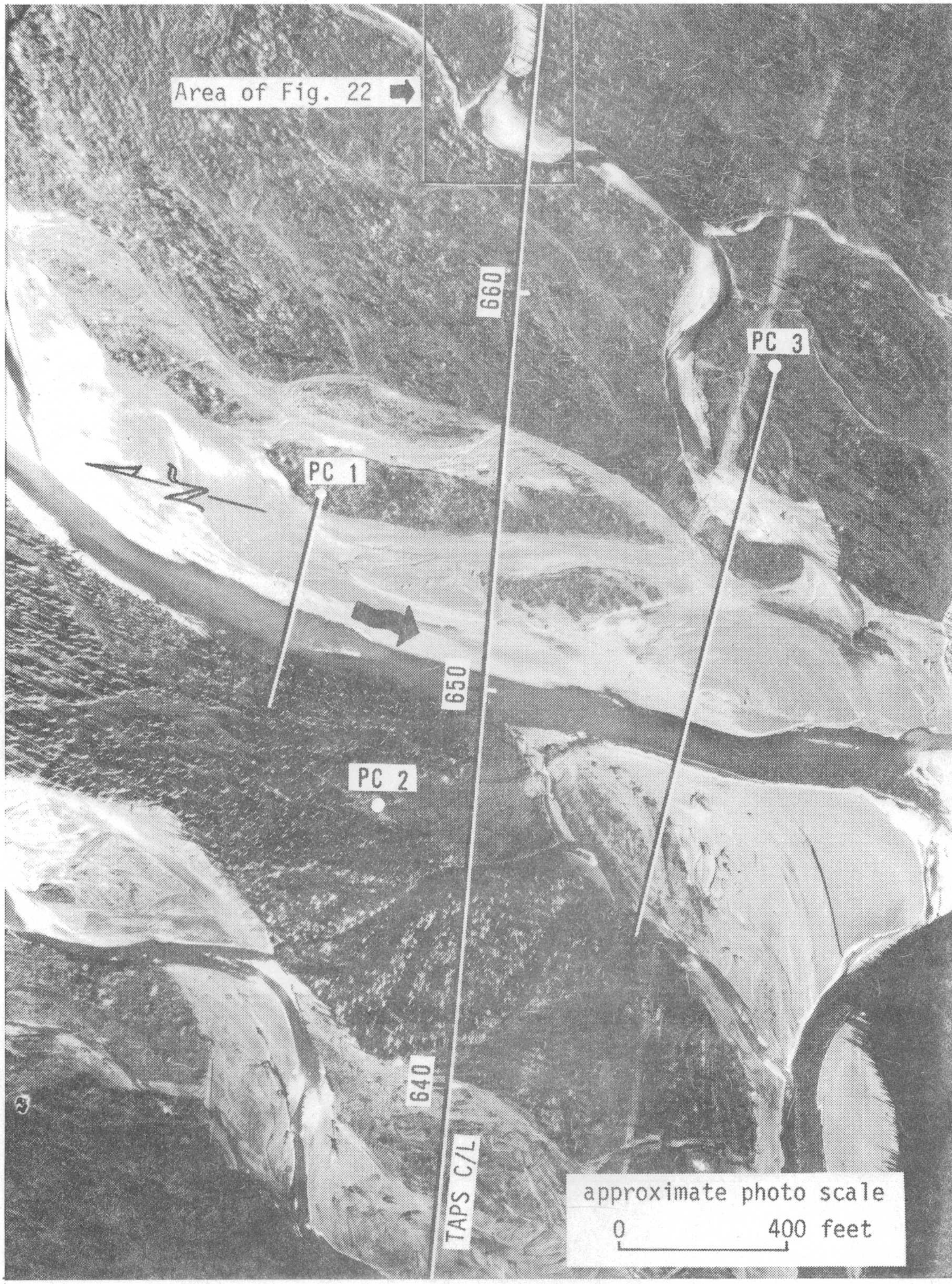


Figure 19.--Aerial photograph - Middle Fork Koyukuk River at Hammond River.

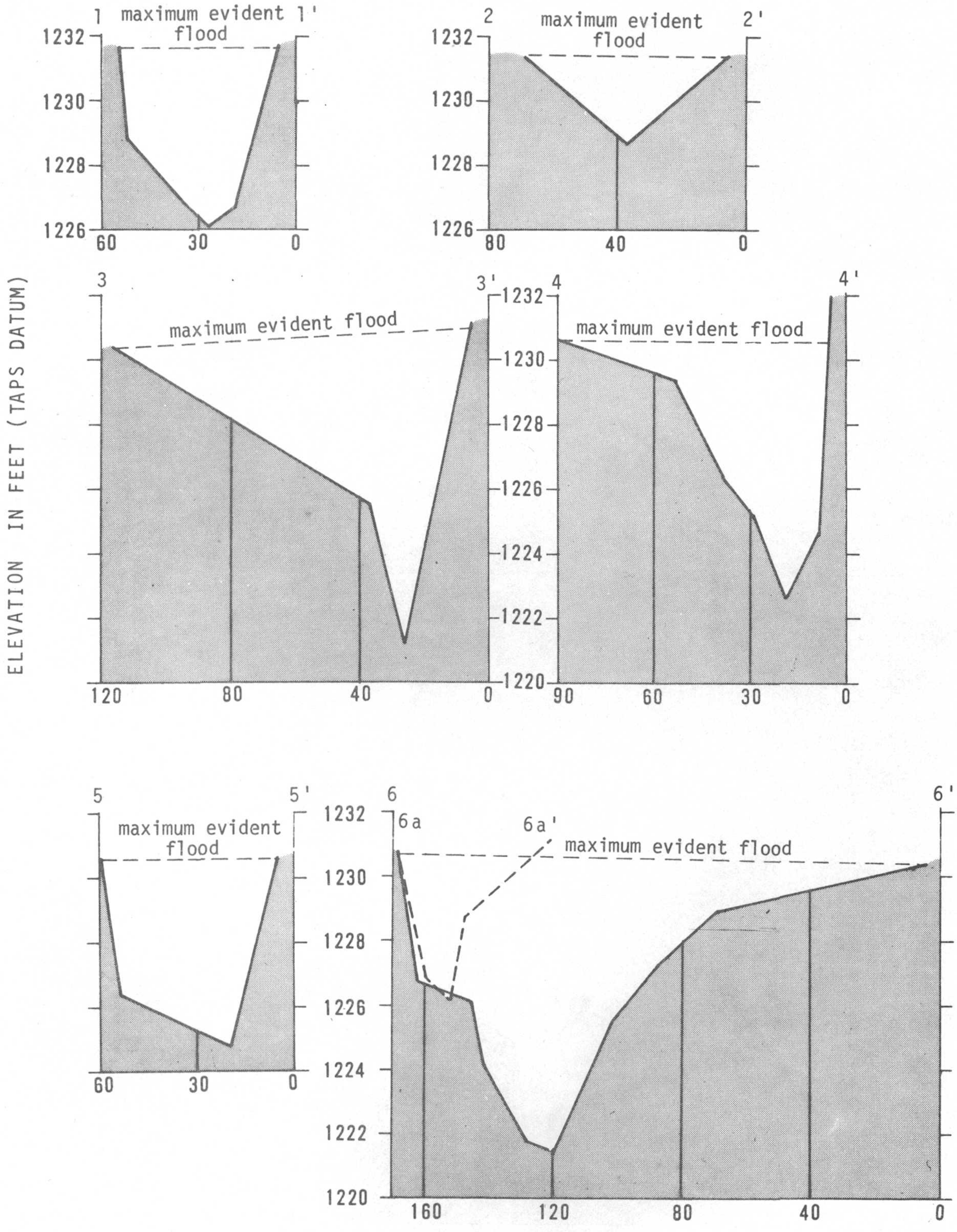
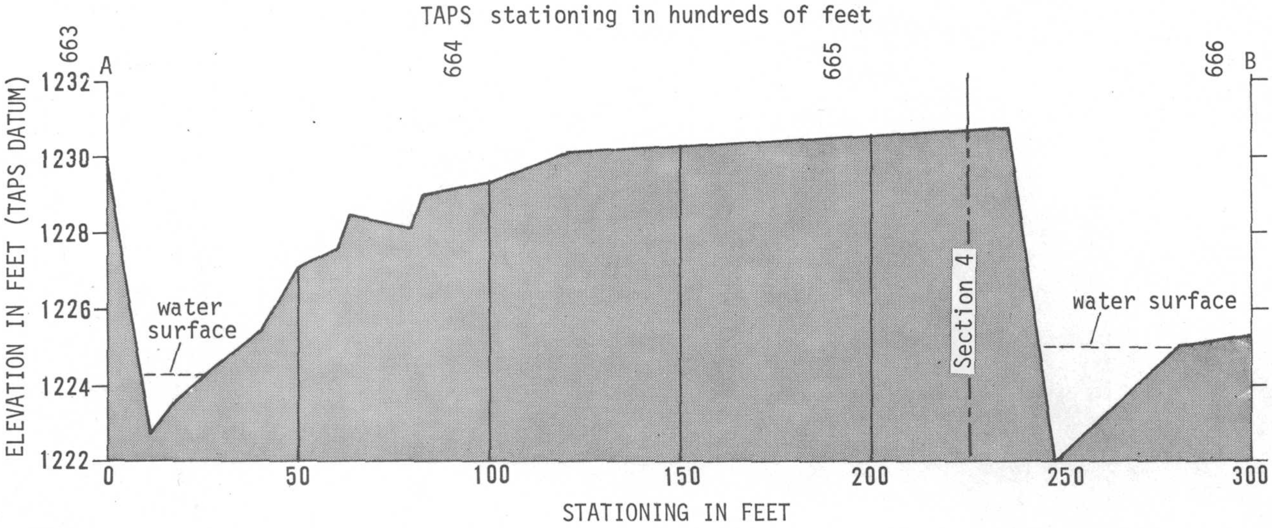


Figure 20.--Meander cutoff channel - cross sections - Middle Fork Koyukuk River at Hammond River.



PIPELINE CENTERLINE CROSS SECTION

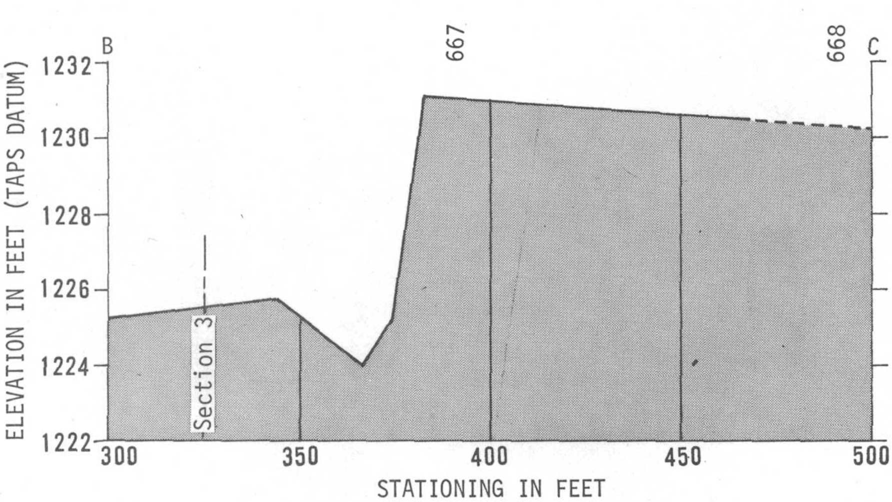


Figure 21.--Meander cutoff channel - cross sections - Middle Fork Koyukuk River at Hammond River.

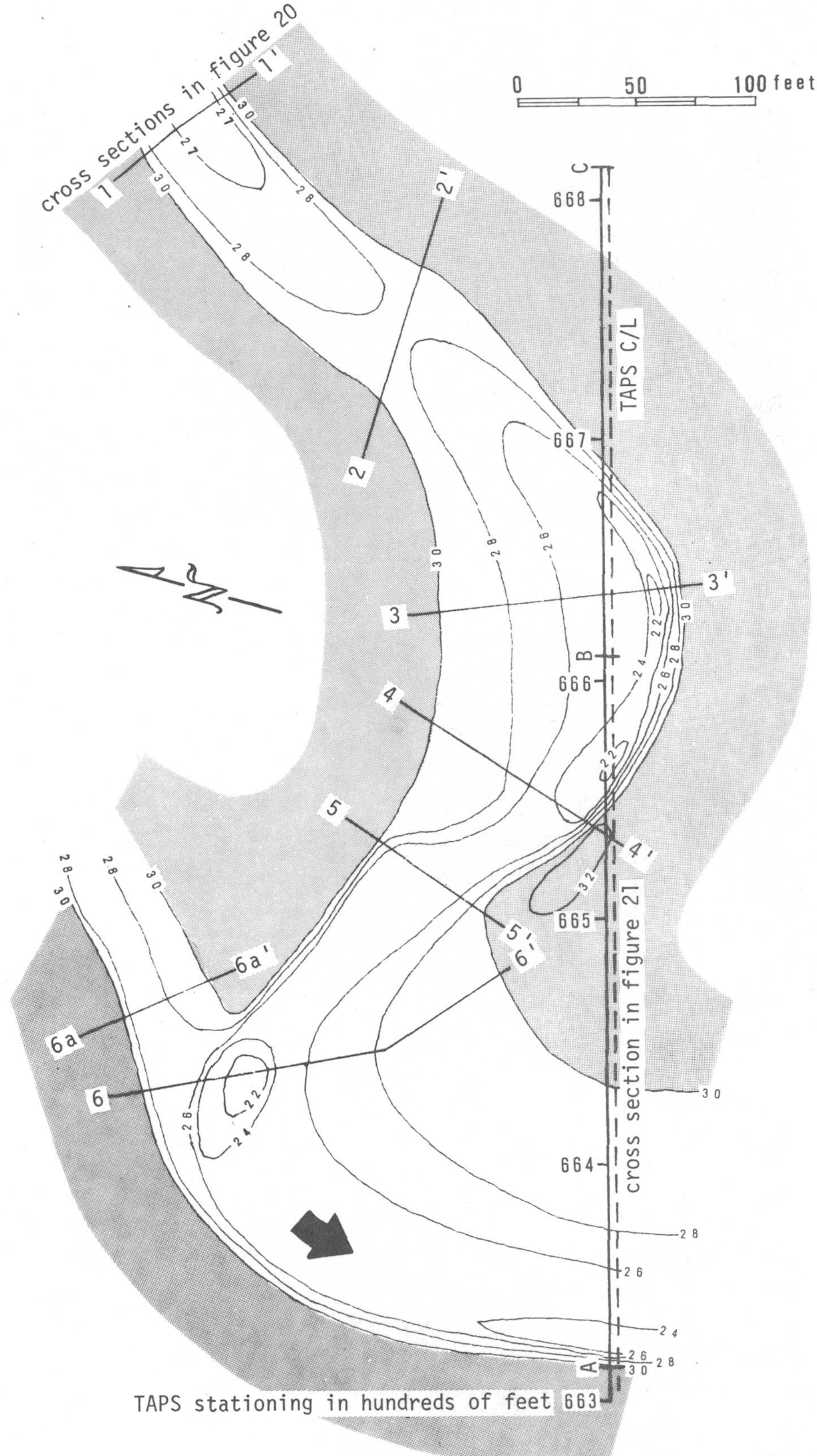
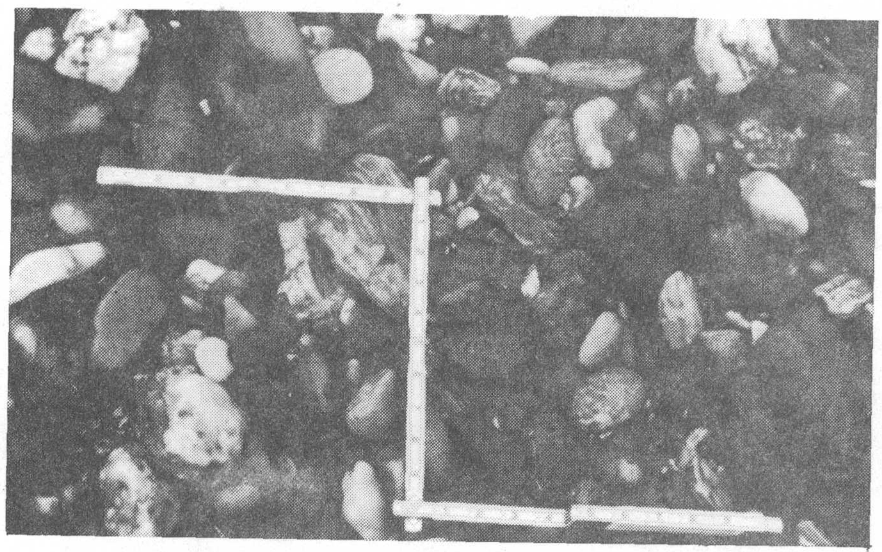


Figure 22.--Meander cutoff channel - site map - Middle Fork Koyukuk River at Hammond River.



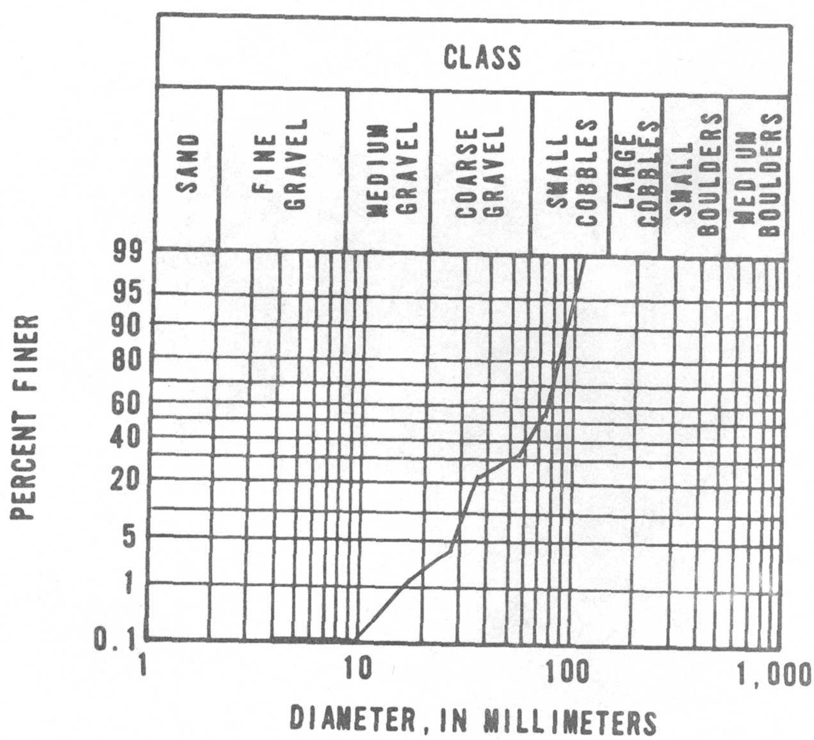


Figure 23.--Streambed material - Middle Fork Koyukuk River at Hammond River.

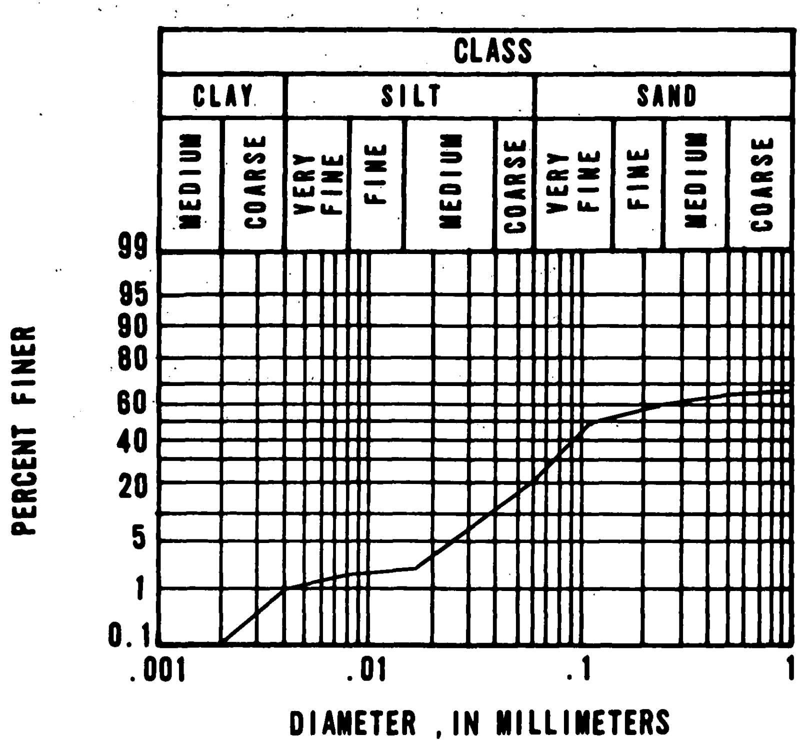


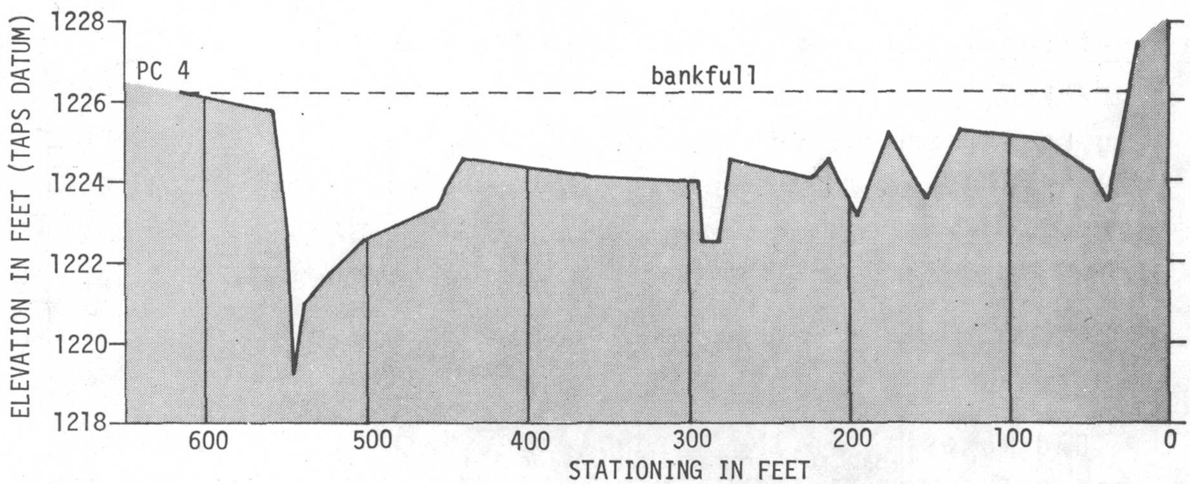
Figure 24.--Flood-plain soil sizes - Middle Fork Koyukuk River at Hammond River.

Figures 25-28.--Hammond River near Wiseman.

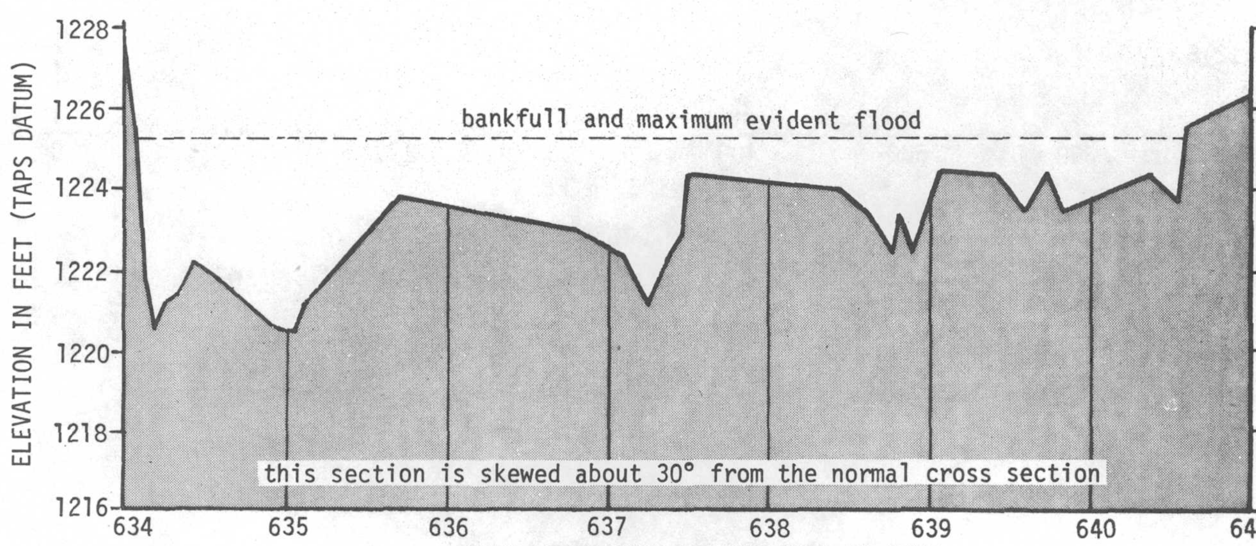
Location.--Lat 67°27'45", long 159°01'38", 0.3 mile upstream from Hammond River and 4.3 miles northeast of Wiseman. (Wiseman 1:250,000, U.S, Geol. Survey map.)

Channel conditions.--Three cross sections (figs. 25, 26) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 27) for locations). The maximum evident floodflow at the pipeline centerline was bankfull with the main channel about 565 feet wide and with a maximum depth of about 5 feet. An overflow channel on the left bank between the Hammond River and the Middle Fork Koyukuk River was about 30 feet wide and 5 feet deep.

Bed material in the channel varied from silt on the willow-covered flood plain to large cobbles in the main channel. Bank material was sampled 1.5 feet below the surface overlying gravel and cobbles on the terrace at PC 5. Size distribution of the sample is shown in figure 28.

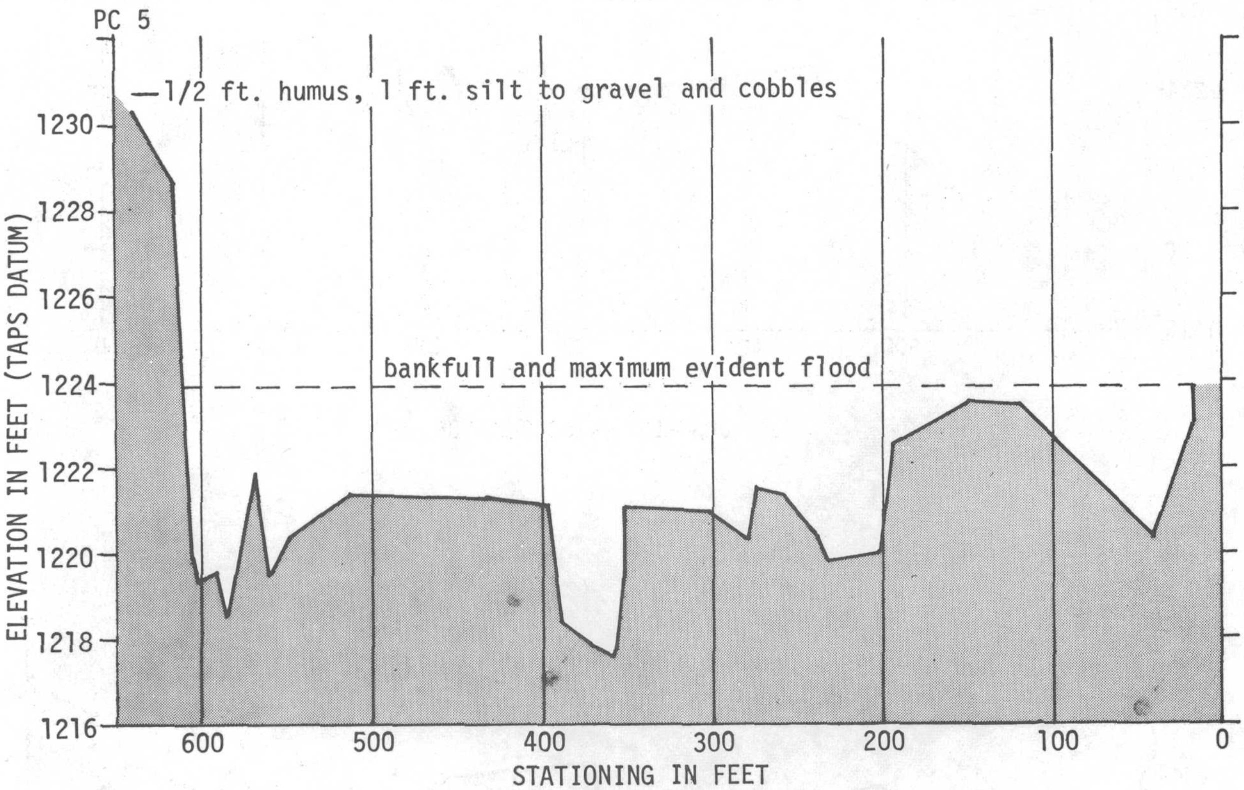


UPSTREAM CROSS SECTION



TAPS CENTERLINE CROSS SECTION

Figure 25.--Cross sections - Hammond River near Wiseman.



DOWNSTREAM CROSS SECTION

Figure 26.--Cross section - Hammond River near Wiseman.

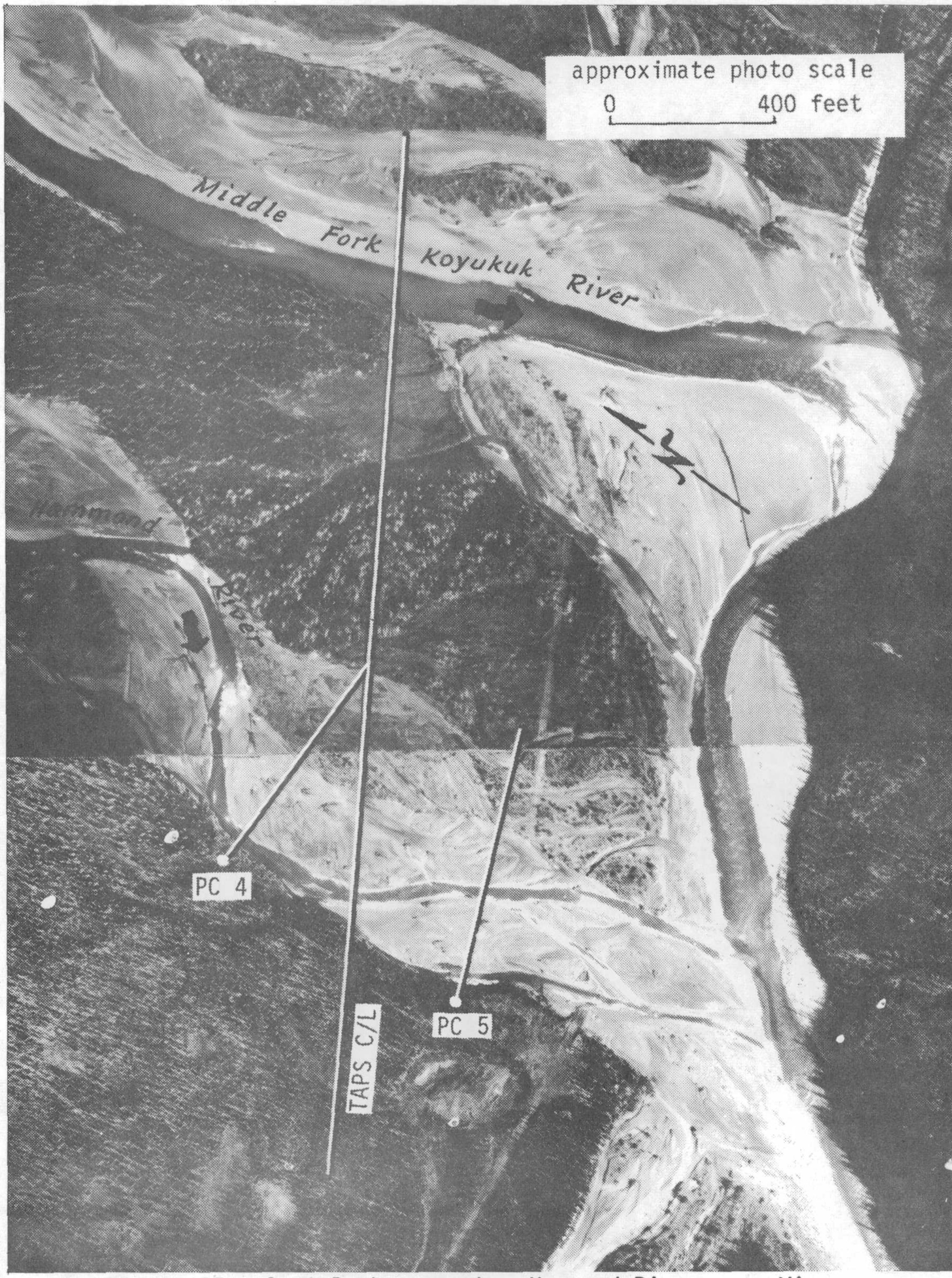


Figure 27.--Aerial photograph - Hammond River near Wiseman.

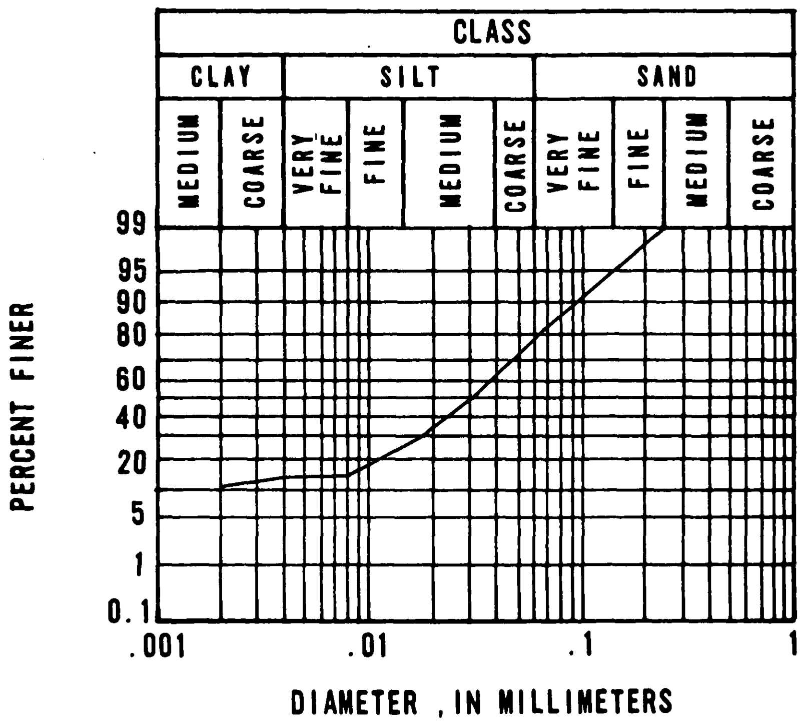


Figure 28.--Terrace soil sizes - Hammond River near Wiseman.

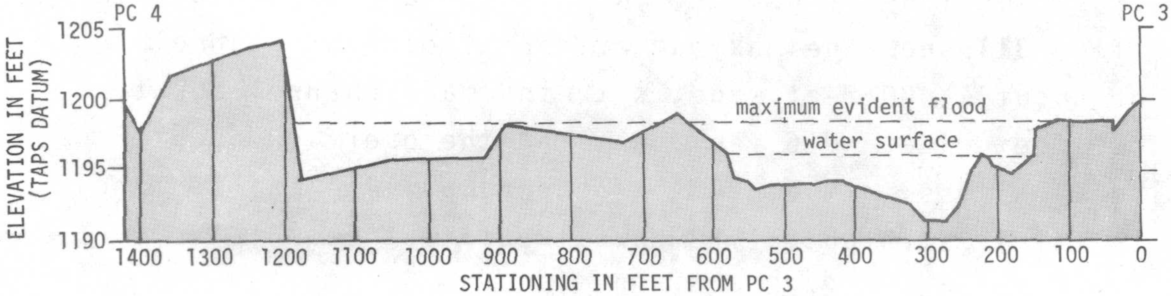
Figures 29-33.--Middle Fork Koyukuk River near Wiseman.

Location.--Lat 67°26'05', long 150°04'45", at TAPS proposed pipeline crossing, 1.5 miles upstream from Wiseman and 2.5 miles downstream from the Hammond River. (Wiseman 1:250,000, U.S. Geol. Survey map.)

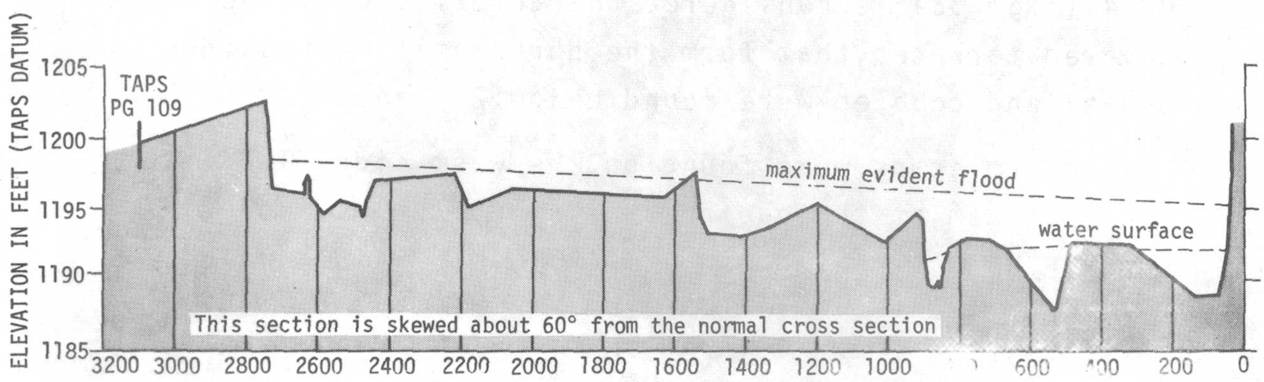
Channel conditions.--Three cross sections were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 31) for locations). The cross sections (figs. 29, 30) and the aerial photograph (fig. 31) show the maximum evident floodflow channel to be about 1,000 feet wide, with the main channel about 500 feet wide and 6 feet deep and the overflow about 3 feet or less in the overflow channels. The main channel is fairly straight. The downstream east bank is very steep (slope = 12/20 = 0.60).

Bed material in the channel varies from silt on the willow-covered flood plains to boulders on riffles. A size distribution for bed material at the gaging station .25 mile upstream (fig. 32) is considered characteristic for floodflow in the main channel bed. A size distribution for flood-plain soil 2.0 feet below the surface at PC 4 (fig. 33) is considered characteristic of the spruce-covered terraces that form the banks at the crossing. Gravel and cobbles were found below 2.0 feet.

Ice jam scars were found on the west side flood plain and upstream at the gaging station on the east bank.



UPSTREAM CROSS SECTION



TAPS CENTERLINE CROSS SECTION

Figure 29.--Cross sections - Middle Fork Koyukuk River near Wiseman.

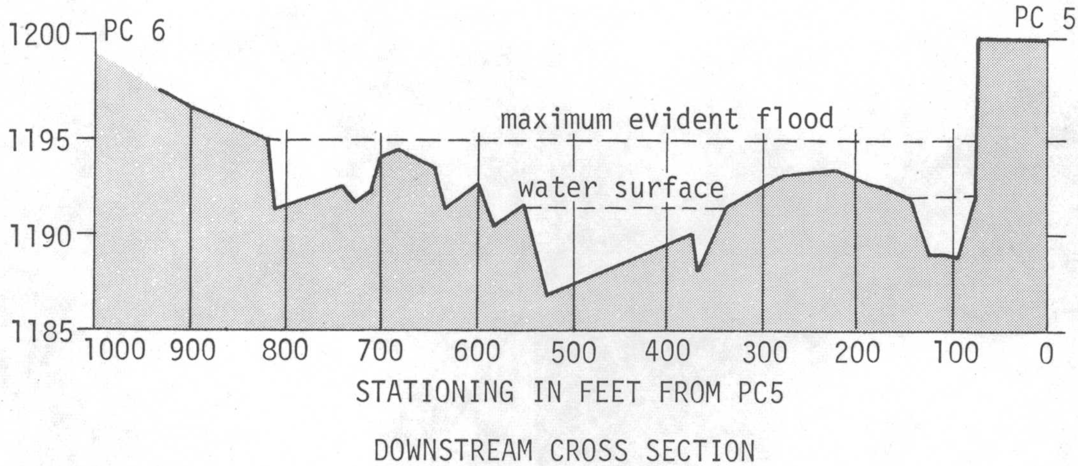


Figure 30.--Cross section - Middle Fork Koyukuk River near Wiseman.

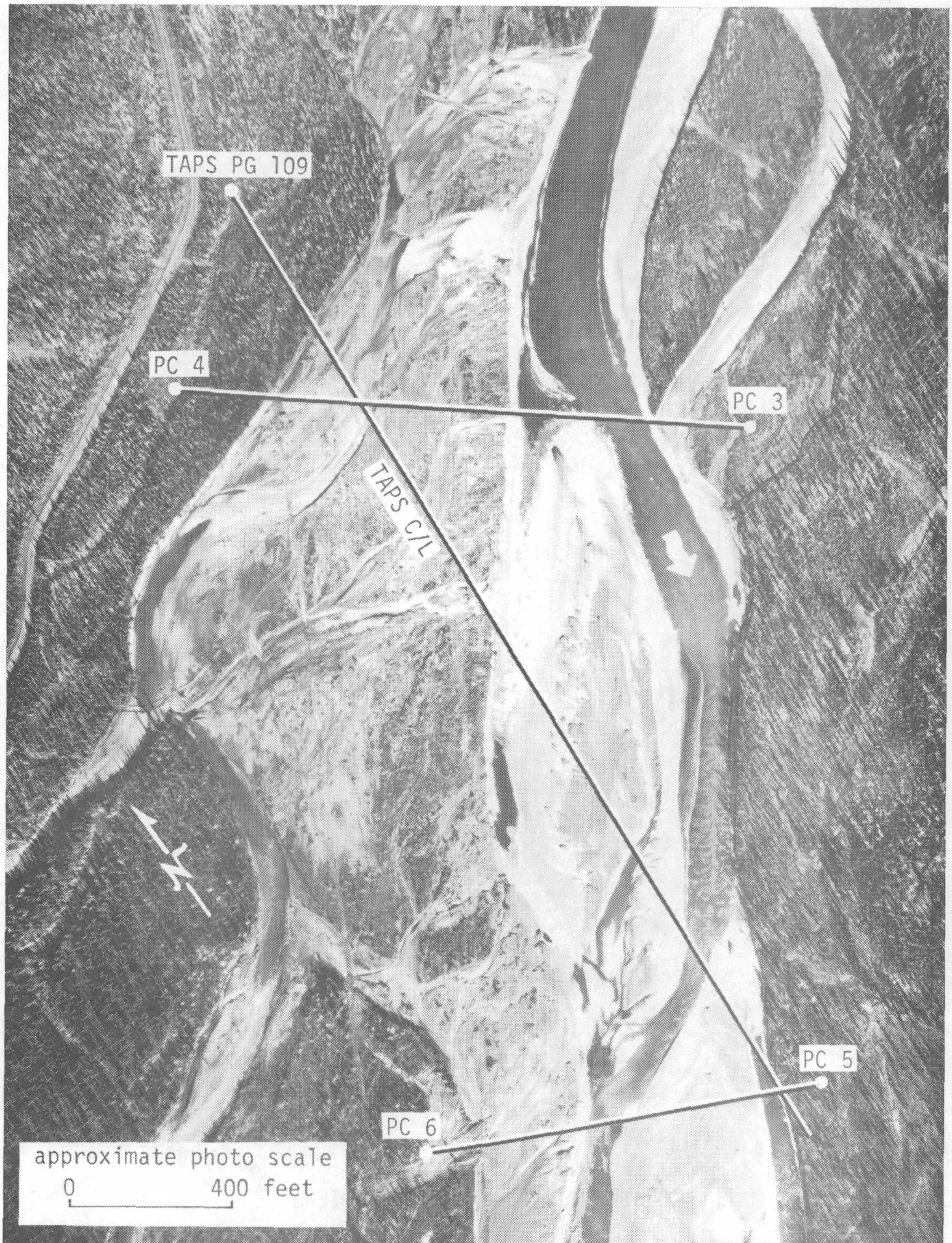


Figure 31.--Aerial photograph - Middle Fork Koyukuk River near Wiseman.

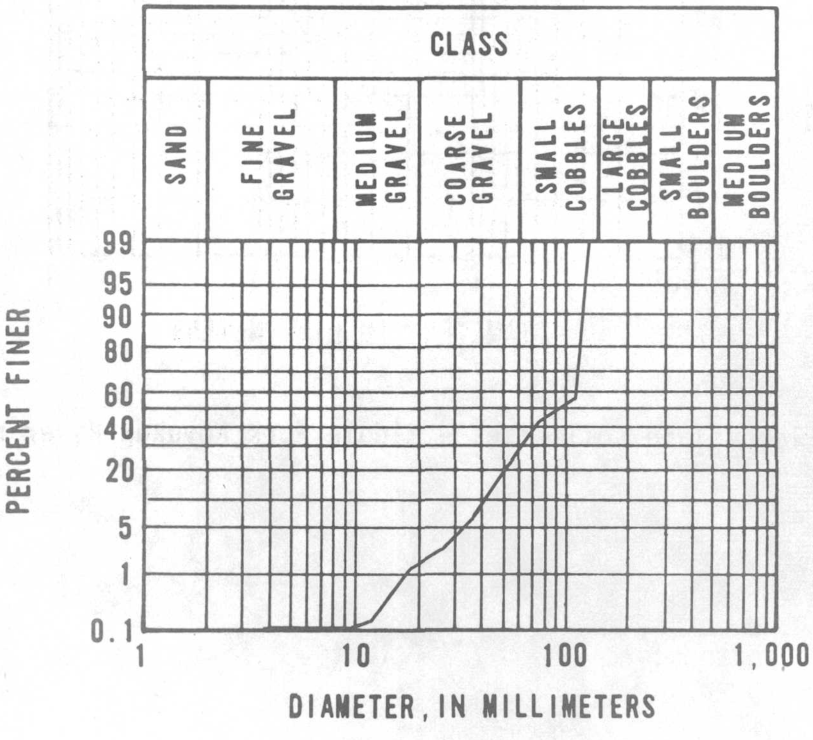


Figure 32.--Streambed material - Middle Fork Koyukuk River near Wiseman.

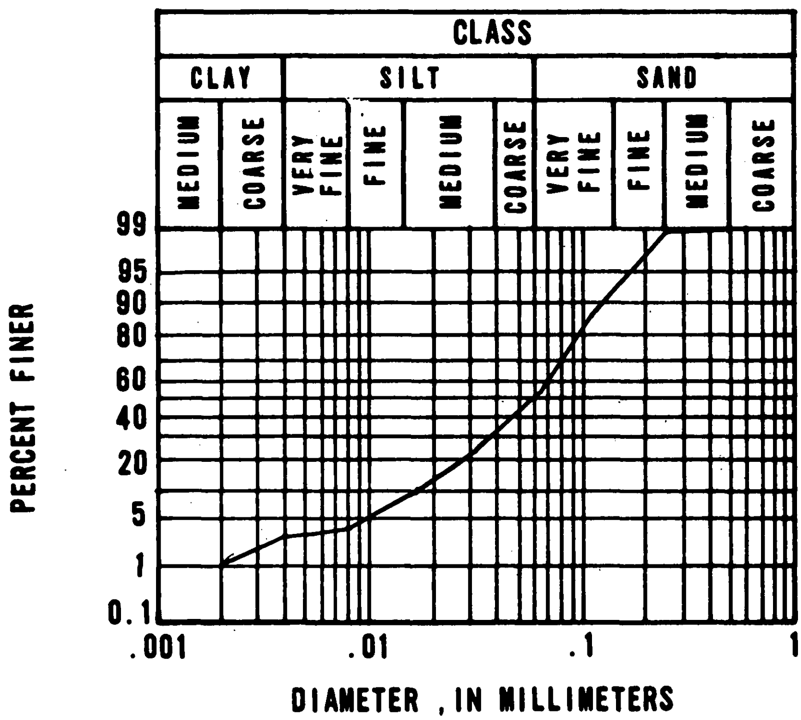


Figure 33.--Flood-plain soil sizes - Middle Fork Koyukuk River near Wiseman.

Figures 34-37.--South Fork Koyukuk River near Wiseman.

Location.--Lat 67°01'10", long 150°16'40", at TAPS proposed pipeline crossing, 11 miles upstream from the Gold Bench Mine and 40 miles northeast of Bettles. (Wiseman 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections were surveyed to define present ground elevations in the proposed crossing reach (see aerial photograph (fig. 35) for locations). The cross sections (fig. 34) and the aerial photograph (fig. 35) show the maximum evident floodflow channel to vary in width from about 600-1,000 feet, with the main channel about 400-600 feet wide and about 8-10 feet deep and the overflow about 6 feet deep in the side channel. The main channel is fairly straight. The banks are not very steep or high at the crossing (slope = 7/25 = 0.28 at right bank).

Bed material in the channel varies from silt on the willow-covered flood plains to cobbles on riffles. A size distribution for bed material (fig. 36) in the main channel bed near the TAPS crossing is considered characteristic for floodflow in the main channel bed at the crossing. A size distribution for soil 1.6 feet below the surface and just above frost near PC 1 (fig. 37) is considered characteristic of spruce-covered terraces that form the banks at the crossing. Frost was found in both banks at depths of about 1-2 feet. Gravel was found in the banks near the main channel (see locations on the cross sections (fig. 34).

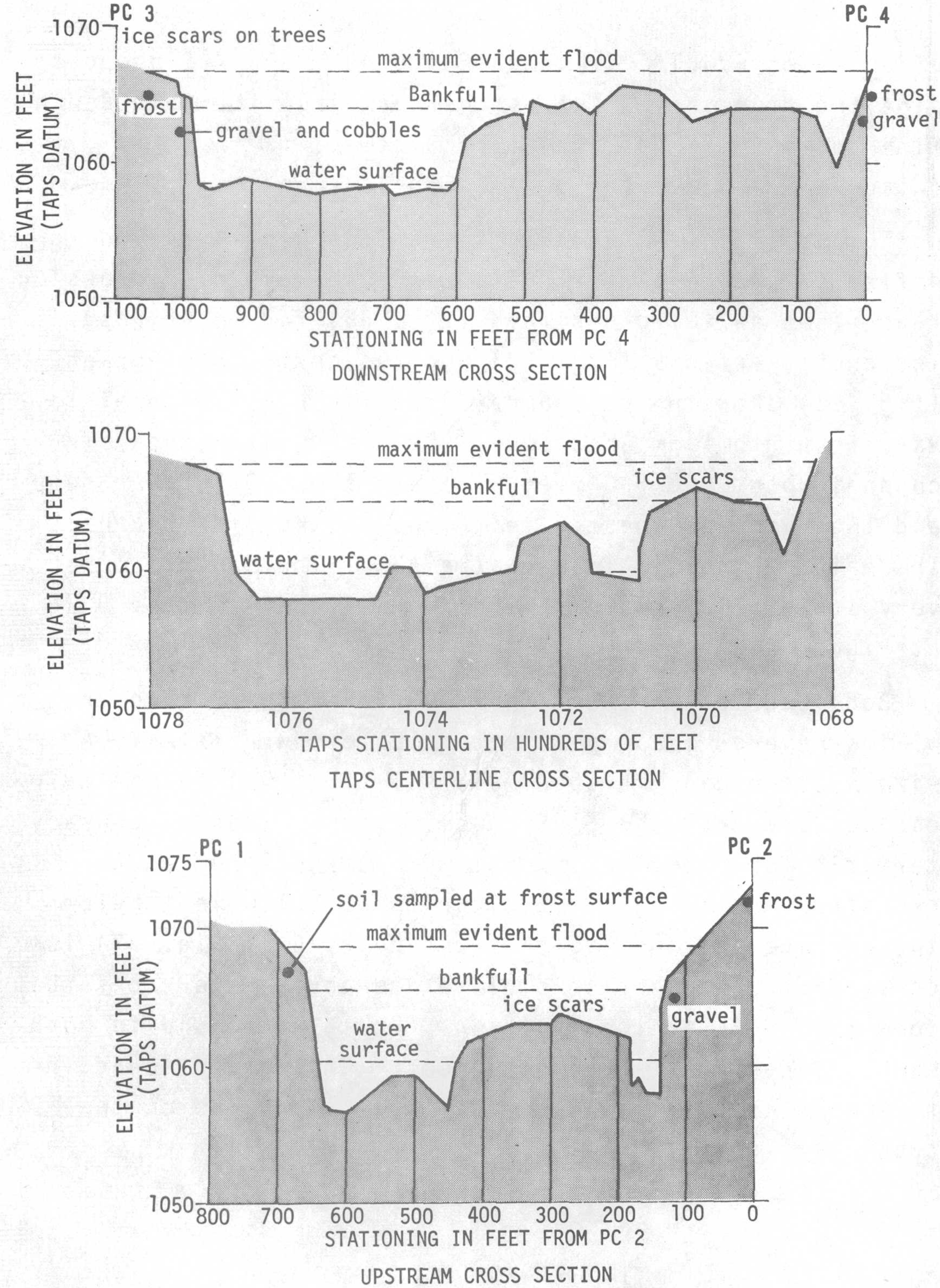


Figure 34.--Cross sections - South Fork Koyukuk River near Wiseman.

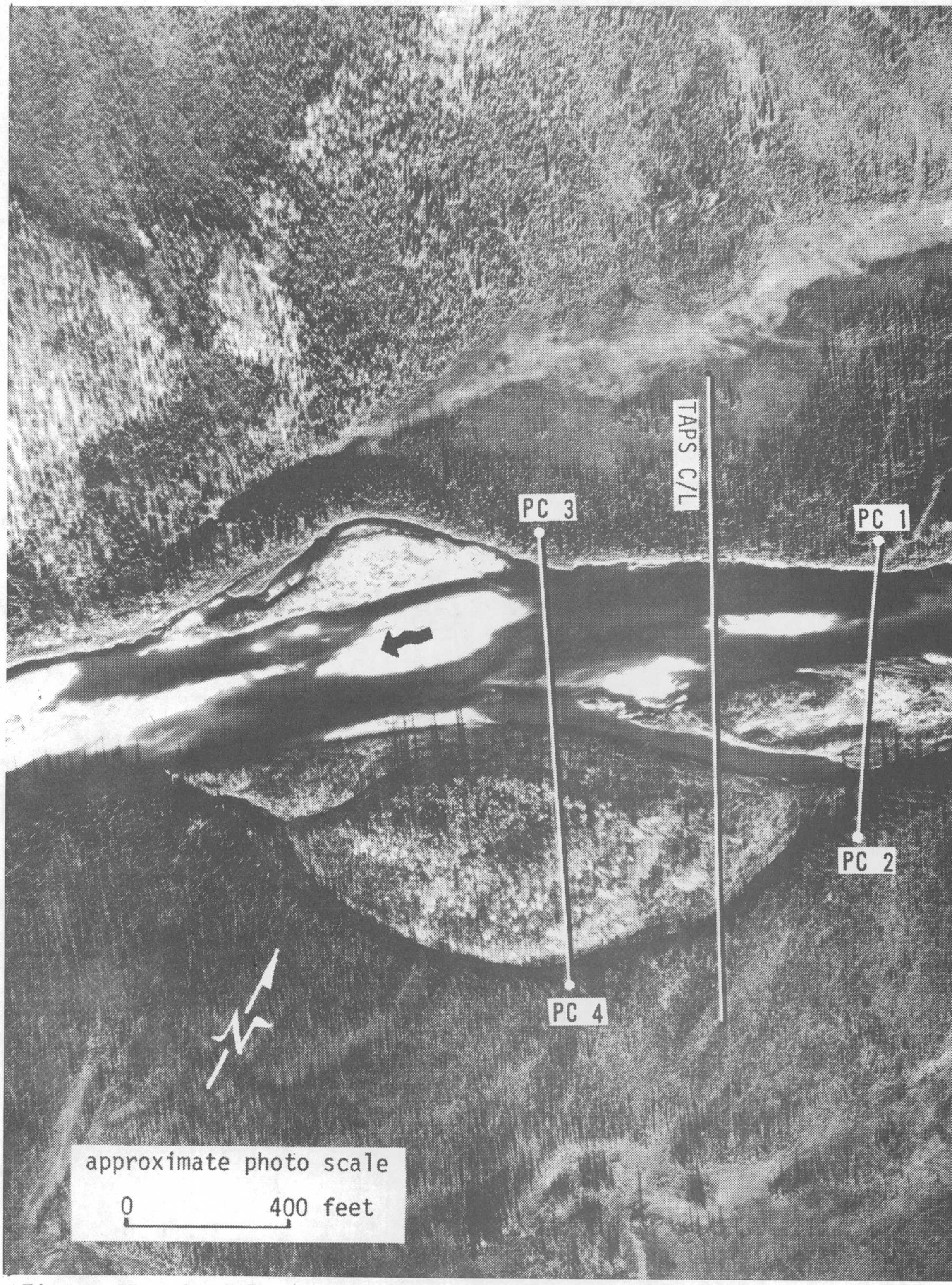
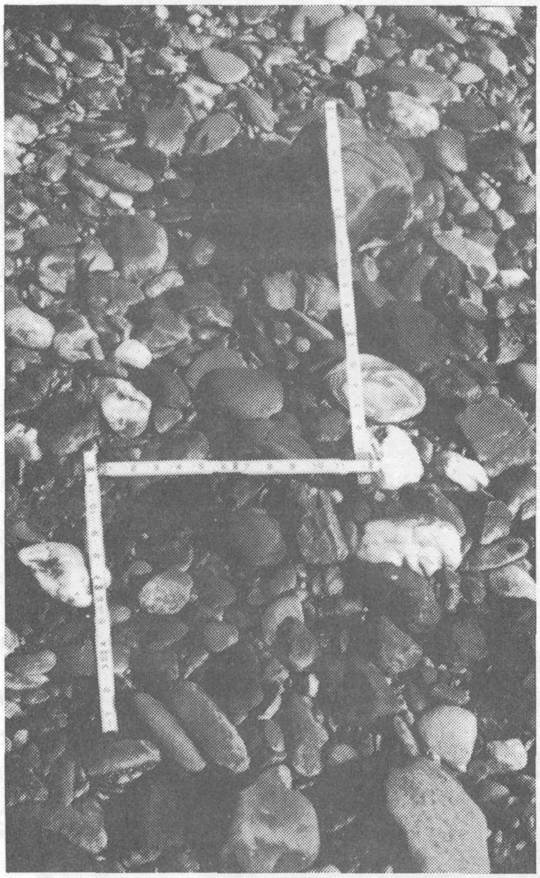


Figure 35.--Aerial photograph - South Fork Koyukuk River near Wiseman.



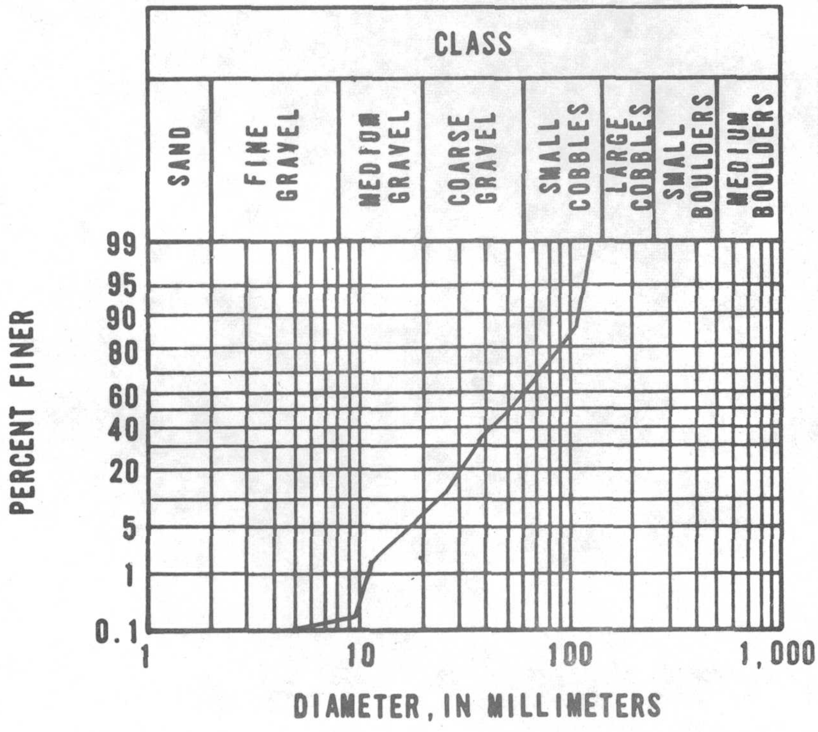


Figure 36.--Streambed material - South Fork Koyukuk River near Wiseman.

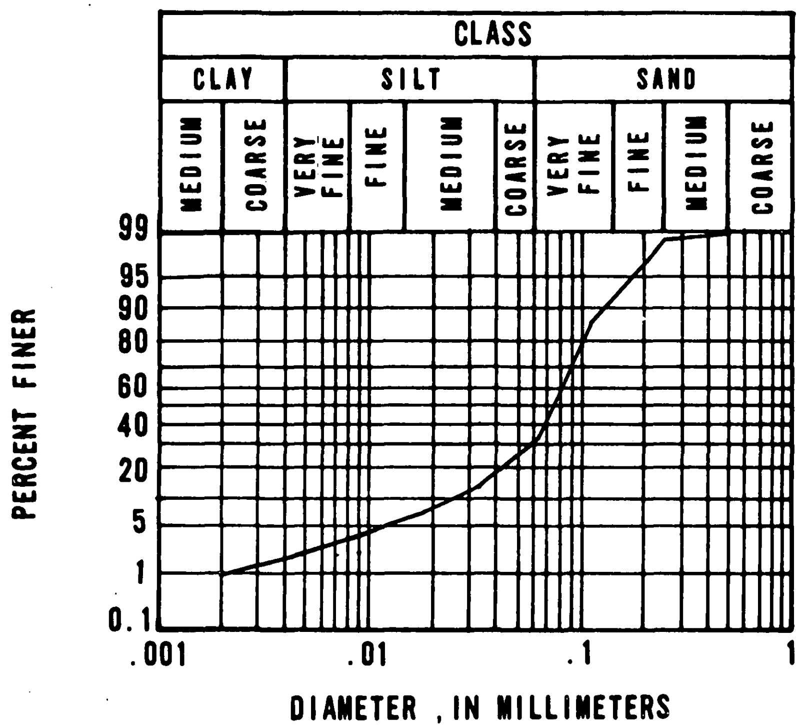


Figure 37.--Terrace soil sizes - South Fork Koyukuk River near Wiseman.

Figures 38-41.--Jim River near Prospect Creek Camp.

Location.--Lat 66°53'00", long 150°31'00", 3 miles upstream from Douglas Creek and 32 miles east of Bettles Field. (Bettles 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 38) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 39) for approximate locations). The cross sections show the maximum evident flood overflow on the left bank at the proposed crossing. High-water marks were found about 1 foot over the ground through the spruce-covered left bank flood plain. The main channel at the proposed pipeline crossing is about 150 feet wide with an average depth of about 5 feet and maximum depth of 8 feet. The right bank is steep (slope = 5/10 = 0.5) and leaning trees indicate recent bank erosion.

Bed material in the channel varies from silt on the flood plains to boulders in the riffles. A size distribution for flood-plain soil 3.5 feet below the surface, overlying frozen silt, at PC 2 is shown in figure 40, and it is considered characteristic for the vegetated flood plains that form the banks at the crossing. A size distribution for main channel bed material at the proposed crossing is shown in figure 41, and it is considered characteristic of the floodflow streambed.

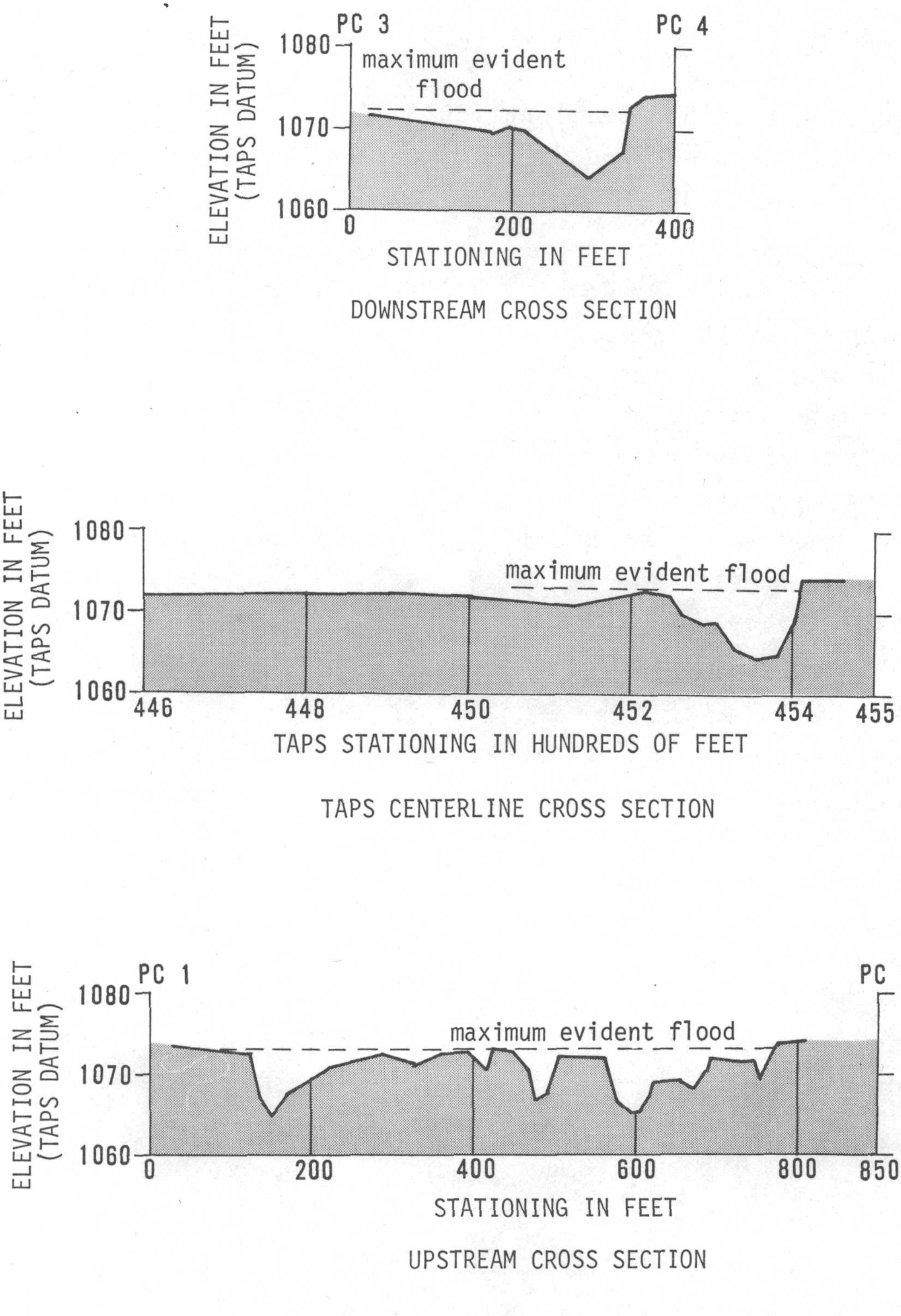


Figure 38.--Cross sections - Jim River near Prospect Creek Camp.

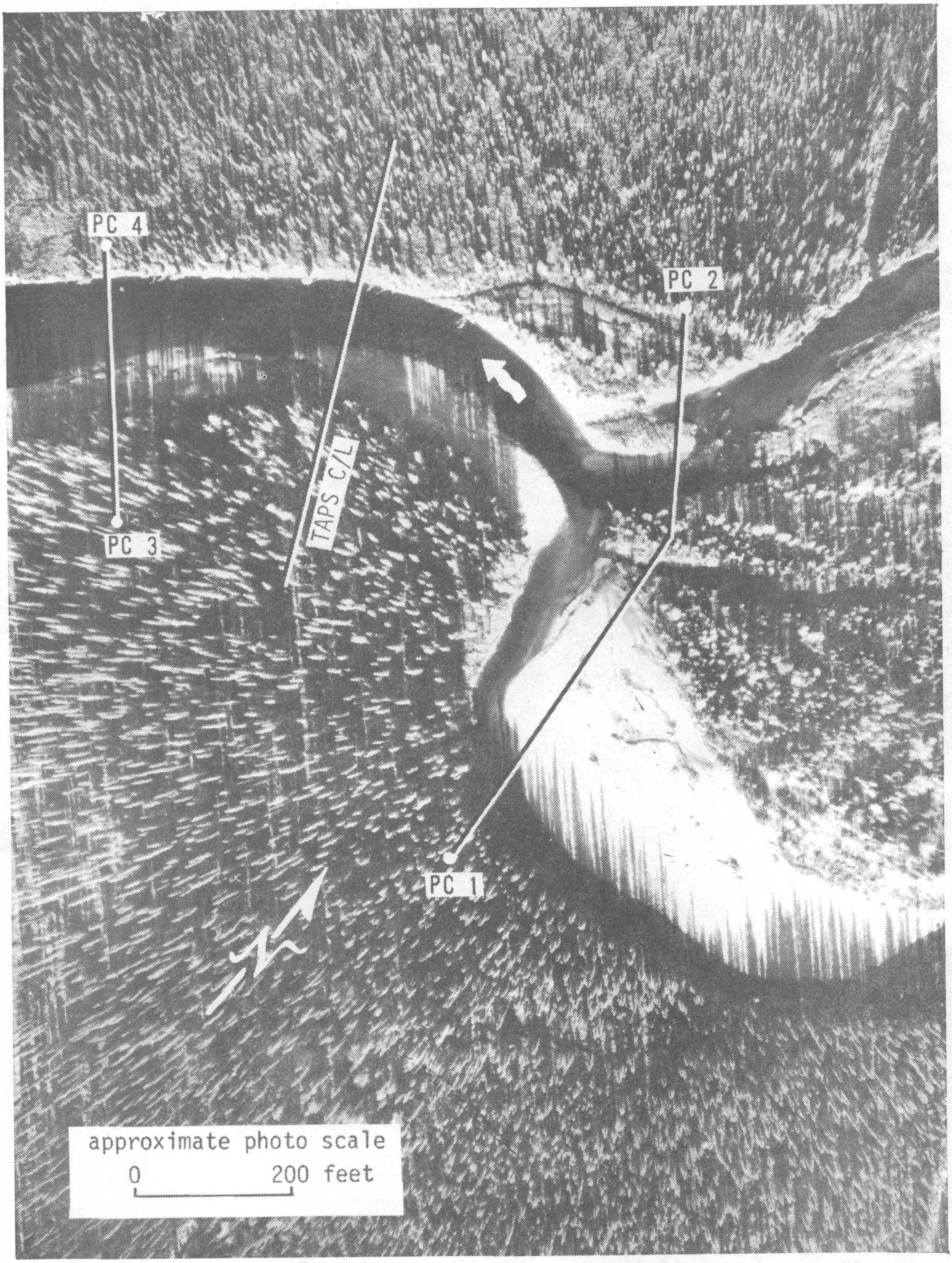


Figure 39.--Aerial photograph - Jim River near Prospect Creek Camp.

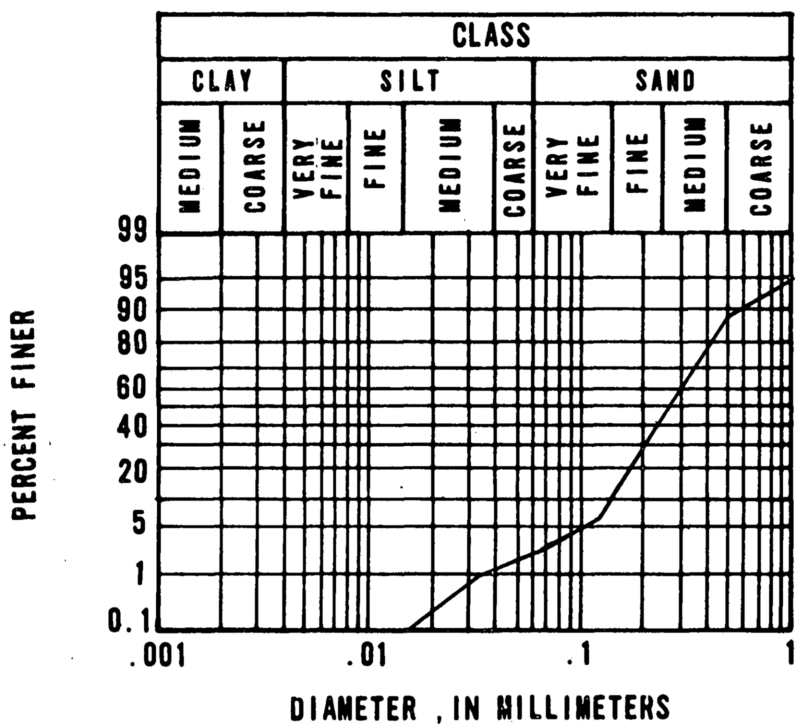
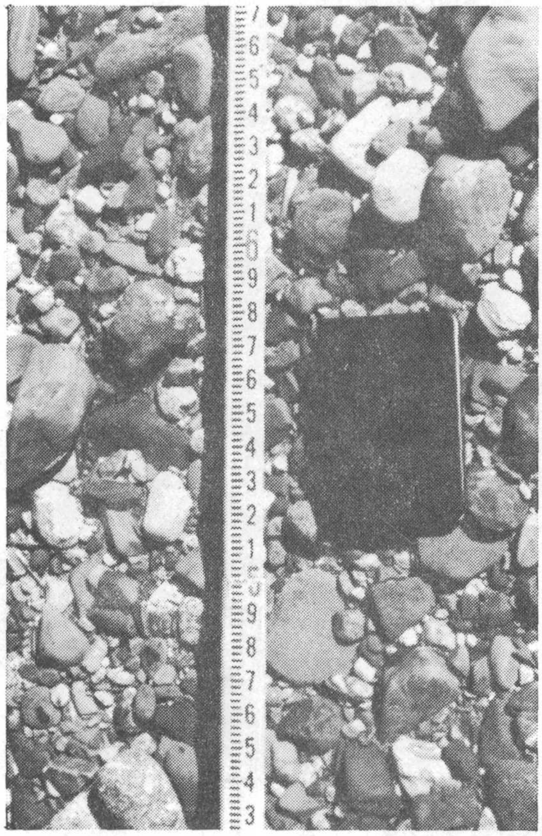


Figure 40.--Flood-plain soil sizes - Jim River near Prospect Creek Camp.



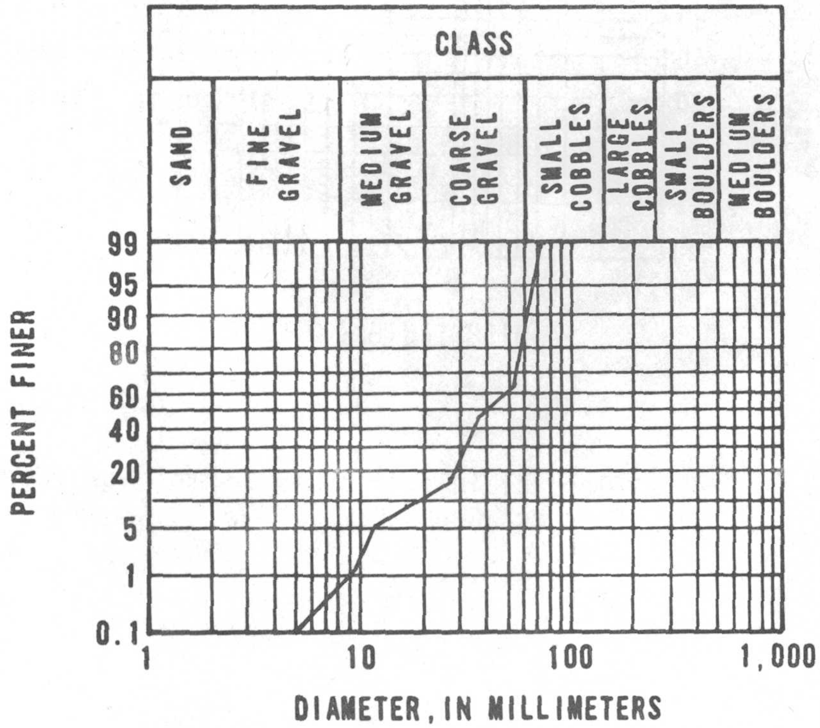


Figure 41.--Streambed material - Jim River near Prospect Creek Camp.

Figures 42-44.--Prospect Creek near Prospect Creek Camp.

Location.--Lat 66°46'50", long 150°40'30", 2 miles upstream from Jim River and approximately 28 miles east of Bettles. (Bettles 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 42) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 43) for locations). The cross sections show the maximum evident flood channel to be about 130-150 feet wide with the main channel about 80 feet wide and 10 feet maximum depth. The upstream right bank is bedrock, but otherwise the channel is formed in alluvium through the crossing reach. The banks are steep (slope = 8/16 = 0.50) but appear to be stable.

Bed material in the channel varies from silt on the flood plains to gravel in the main channel. A size distribution for terrace soil 1.0 foot below the surface, overlying frozen silt, at PC 1 is shown in figure 44.

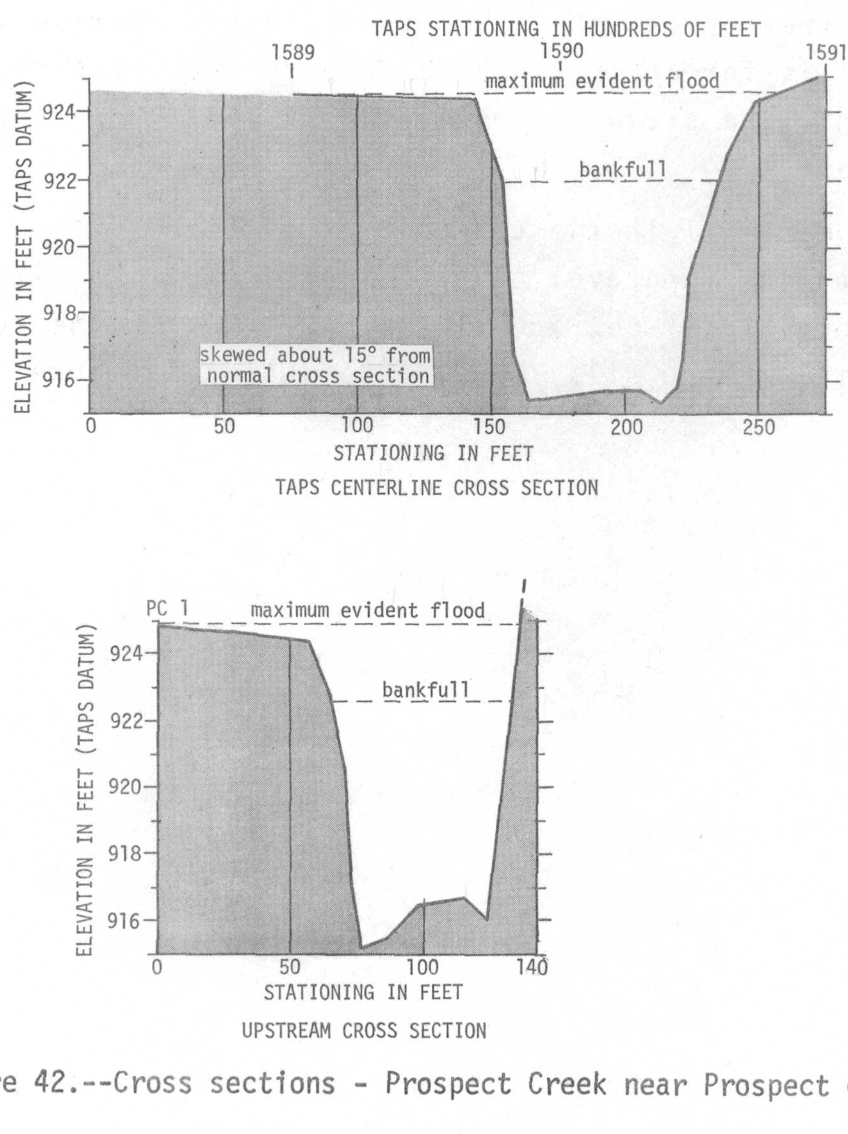


Figure 42.--Cross sections - Prospect Creek near Prospect Creek Camp.

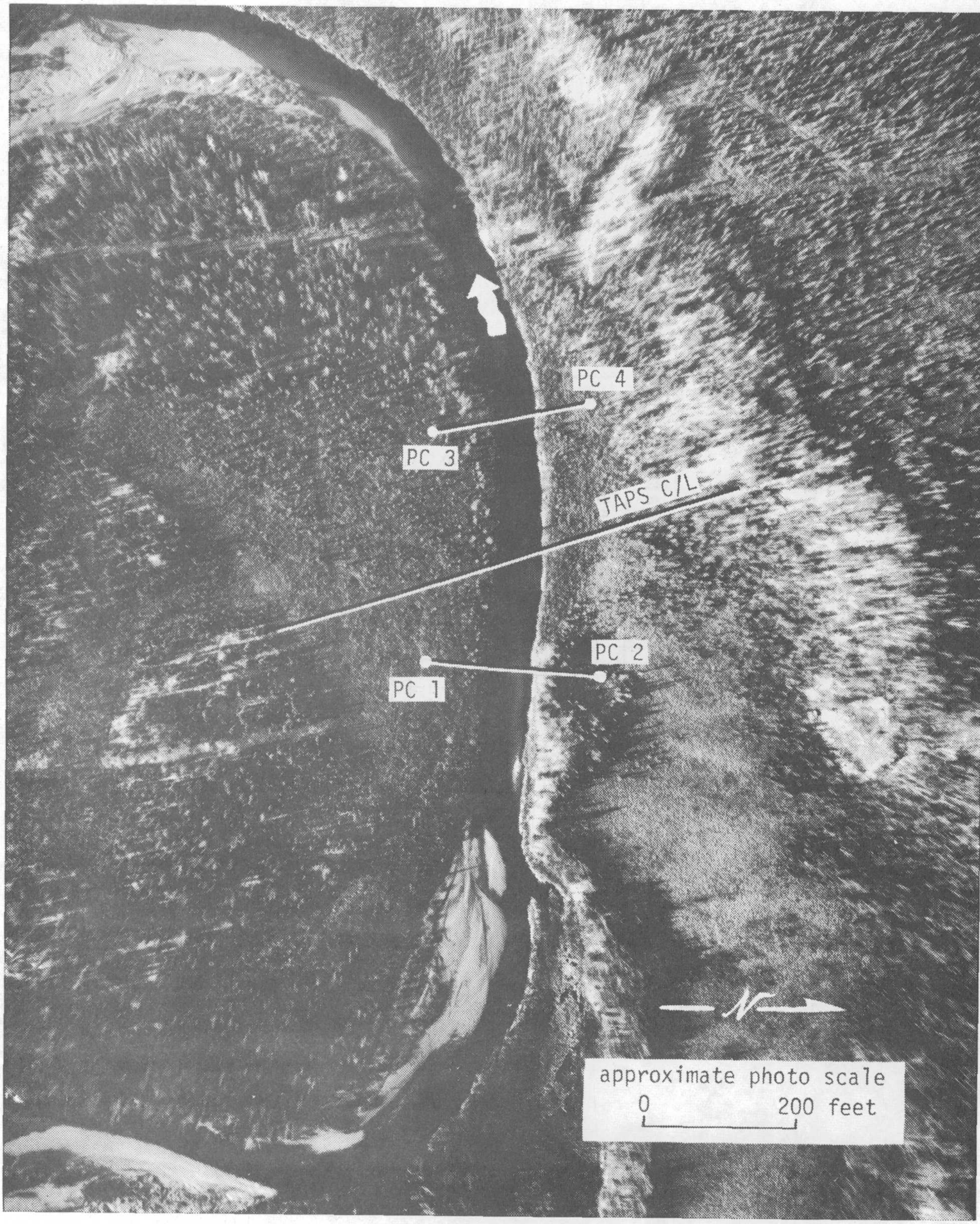


Figure 43.--Aerial photograph - Prospect Creek near Prospect Creek Camp.

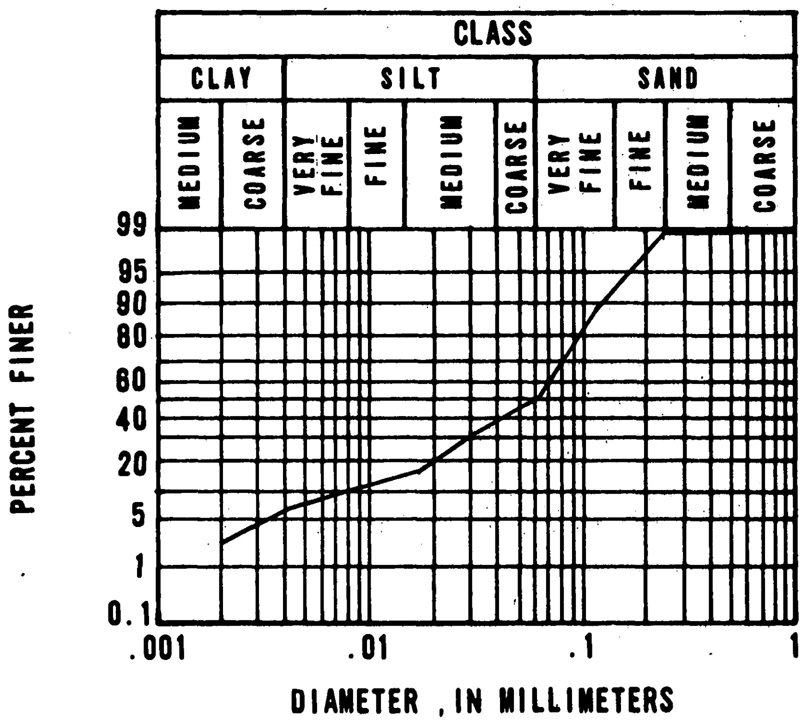


Figure 44.--Terrace soil sizes - Prospect Creek near Prospect Creek Camp.

Figures 45-47.--Kanuti River near Bettles.

<u>Location</u>.--Lat 66°26'30", long 150°37'30", at TAPS proposed pipeline crossing, 5 miles northeast of Caribou Mountain and approximately 44 miles south-southeast of Bettles. (Bettles 1:250,000, U.S. Geol. Survey map.)

<u>Channel conditions</u>.--Three cross sections (fig. 45) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 46) for locations). The cross sections show the maximum evident flood channel to be about 150-200 feet wide with the main channel about 80-100 feet wide and maximum depth of 9 feet at the crossing reach. Flood-plain overflow was about 2 feet deep. The banks are steep (slope = 5/10 = 0.50) and slumping, probably because of permafrost thaw.

Bed material in the channel was mostly angular rocks from gravel to boulders with sand. A size distribution for terrace soil 2.2 feet below the surface, and overlying frost, about 25 feet from the bank near PC 1 is shown in figure 47. Higher on the terrace at PC 1 ice was found just under the mossy tussocks about 1 foot from the surface.

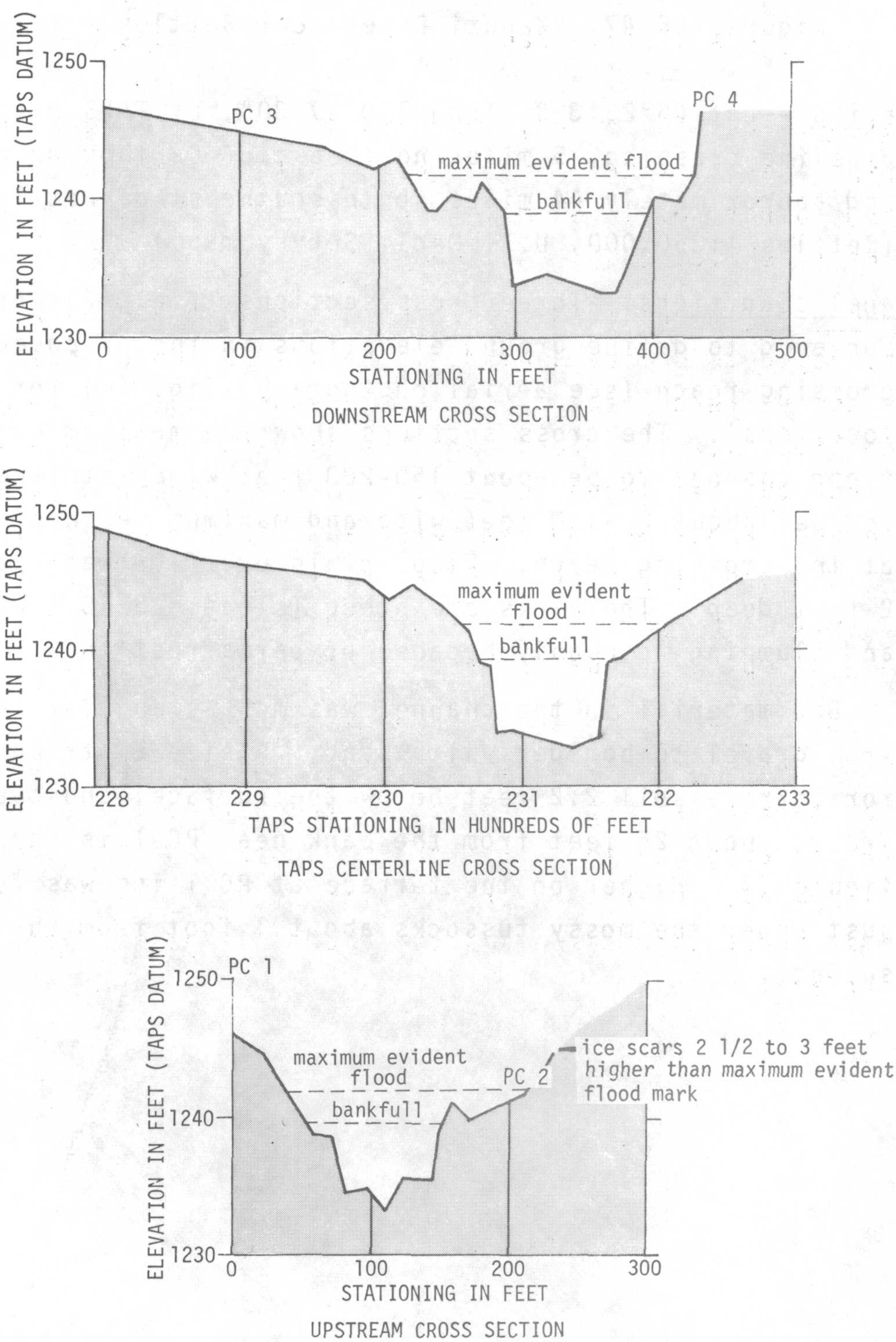


Figure 45.--Cross sections - Kanuti River near Bettles.

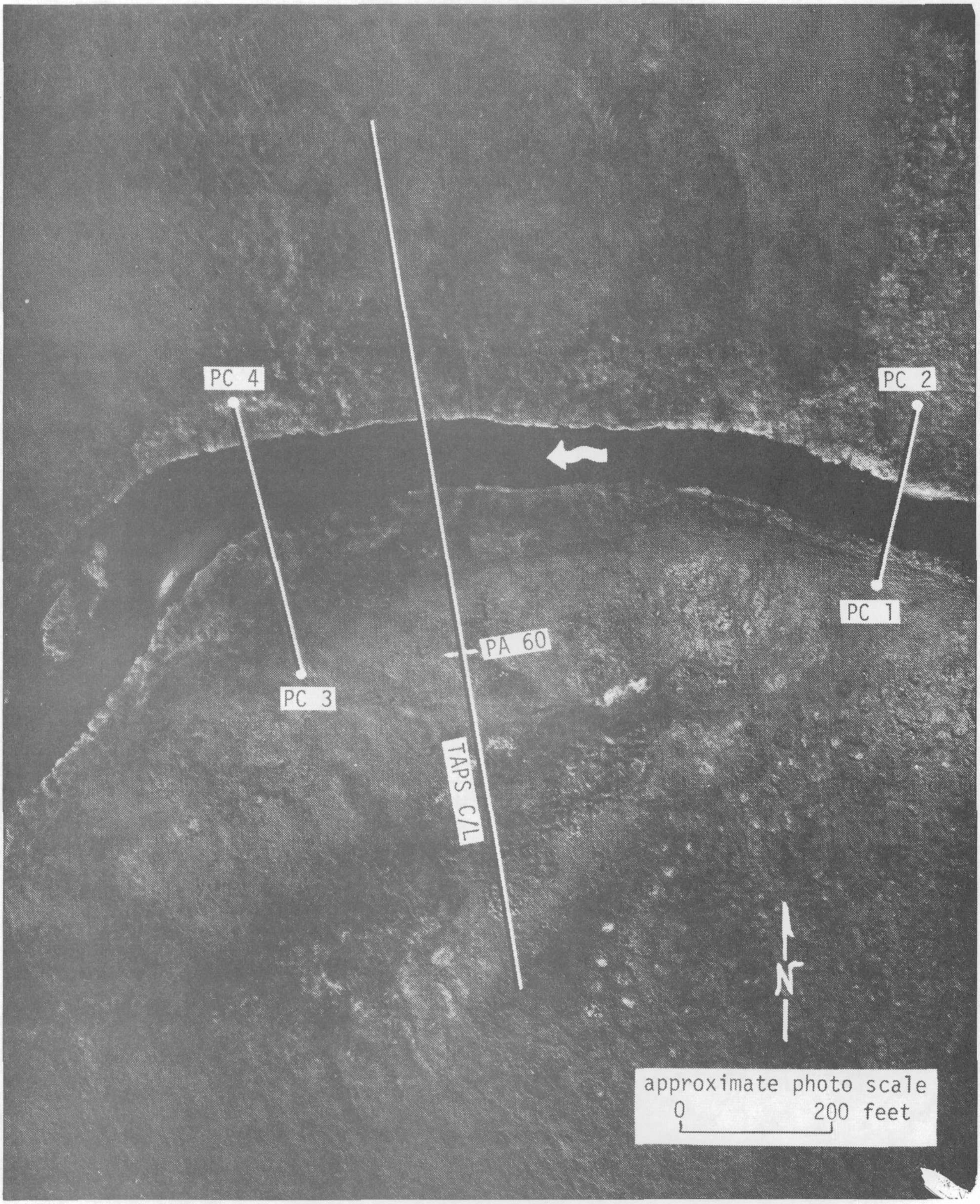


Figure 46.--Aerial photograph - Kanuti River near Bettles.

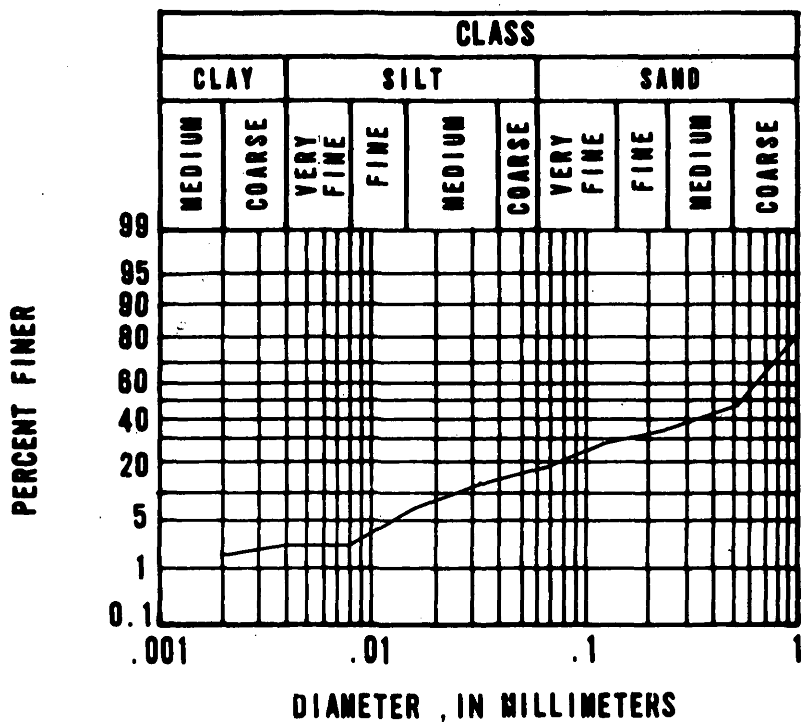


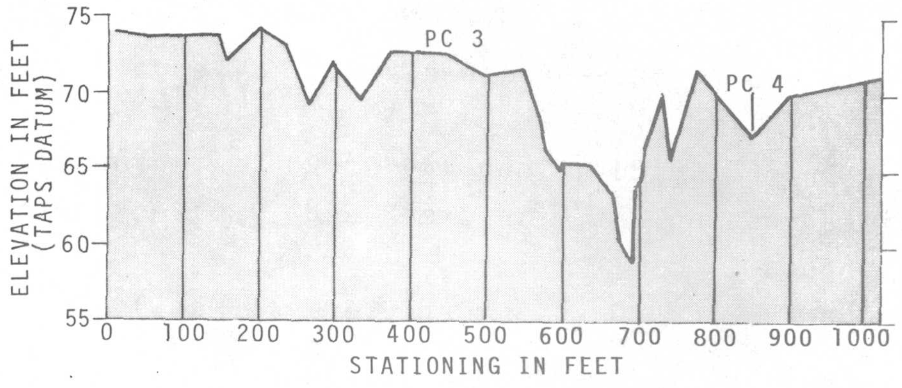
Figure 47.--Terrace soil sizes - Kanuti River near Bettles.

Figures 48-52.--Hess Creek near Livengood.

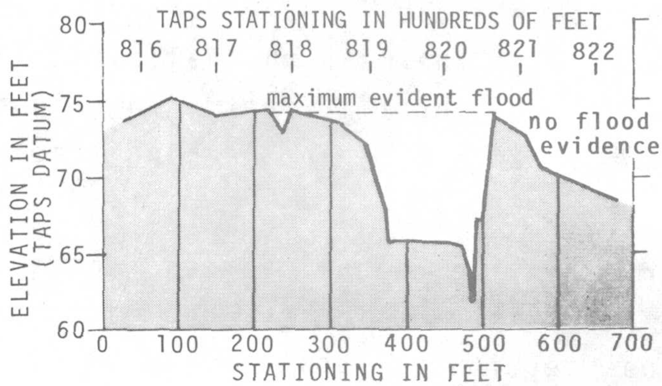
Location.--Lat 65°40'30", long 149°04'20", at proposed pipeline crossing, at Fish Creek and 19 miles northwest of Livengood.
(Livengood 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (figs. 48-49) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 50) for locations). The cross sections show the maximum evident flood channel to be about 250-300 feet wide through the crossing reach, with the main channel about 190 feet wide and maximum depth of about 12 feet. The right bank is steep (slope = 12/24 = 0.5) and leaning trees indicate recent erosion.

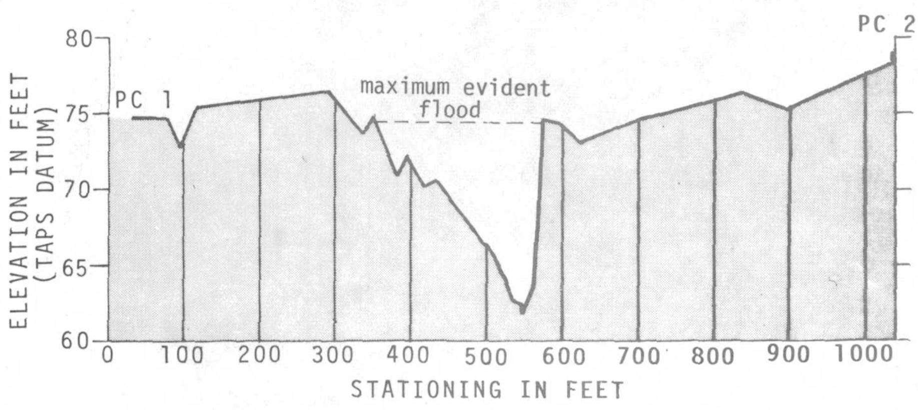
Bed material in the channel varies from sand to small cobbles. A size distribution for bed material at the upstream cross section is shown in figure 51. A size distribution for flood-plain soil 2.8 feet beneath the surface, overlying gravelly sand, on TAPS centerline near Station 819 is shown in figure 52. Near PC 1 frost was found 1 foot beneath the surface.



DOWNSTREAM CROSS SECTION



TAPS CENTERLINE CROSS SECTION



UPSTREAM CROSS SECTION

Figures 48-49.--Cross sections - Hess Creek near Livengood.

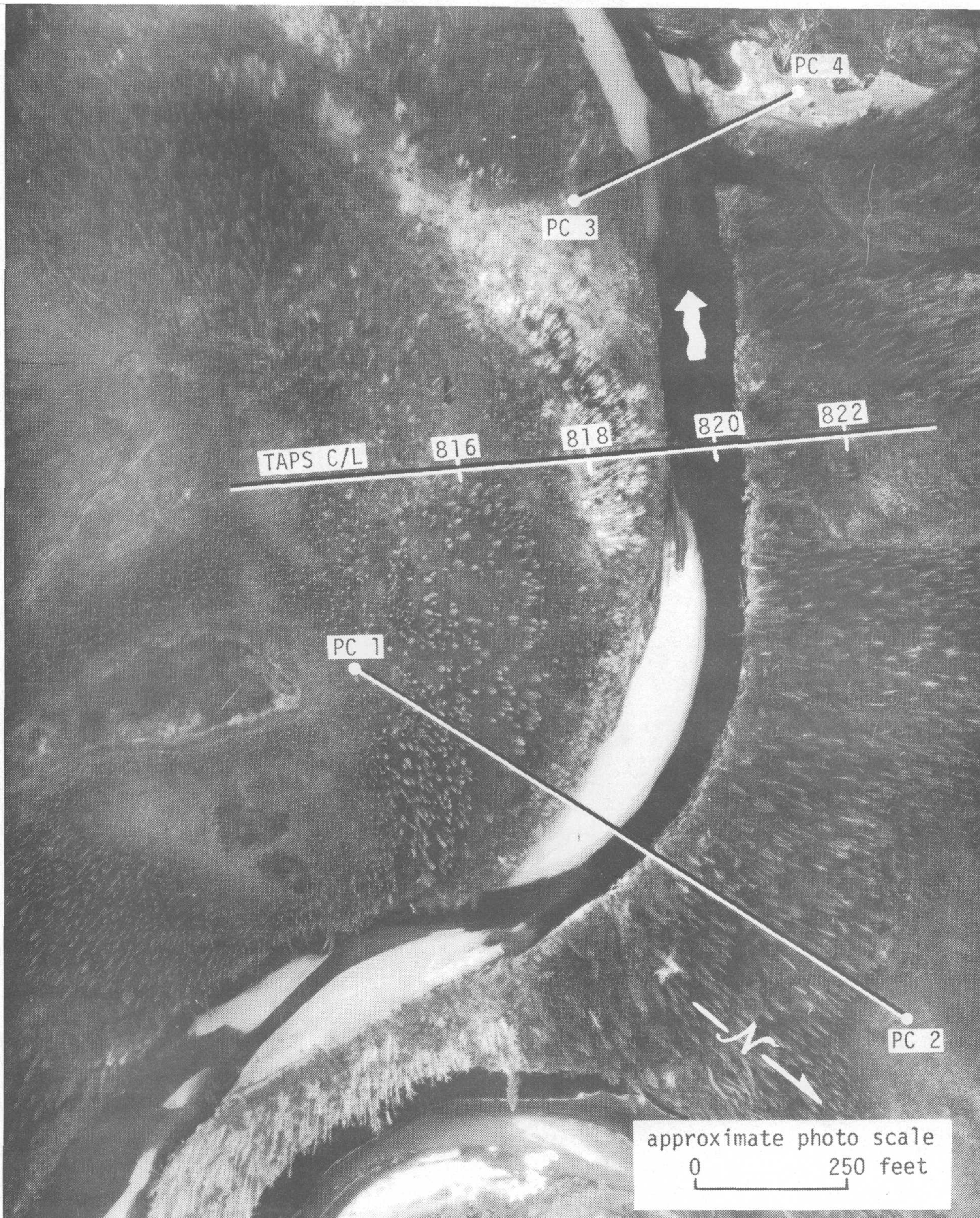
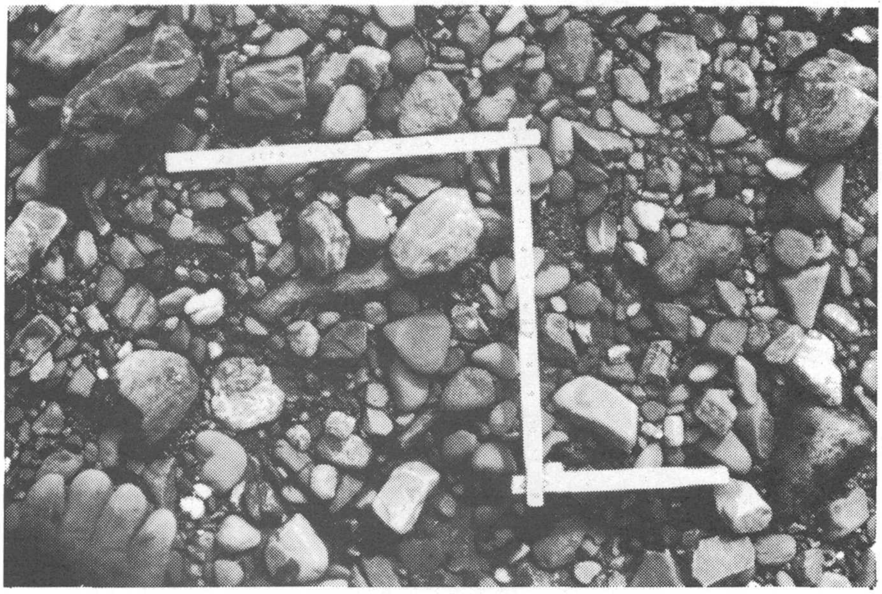


Figure 50.--Aerial photograph - Hess Creek near Livengood.



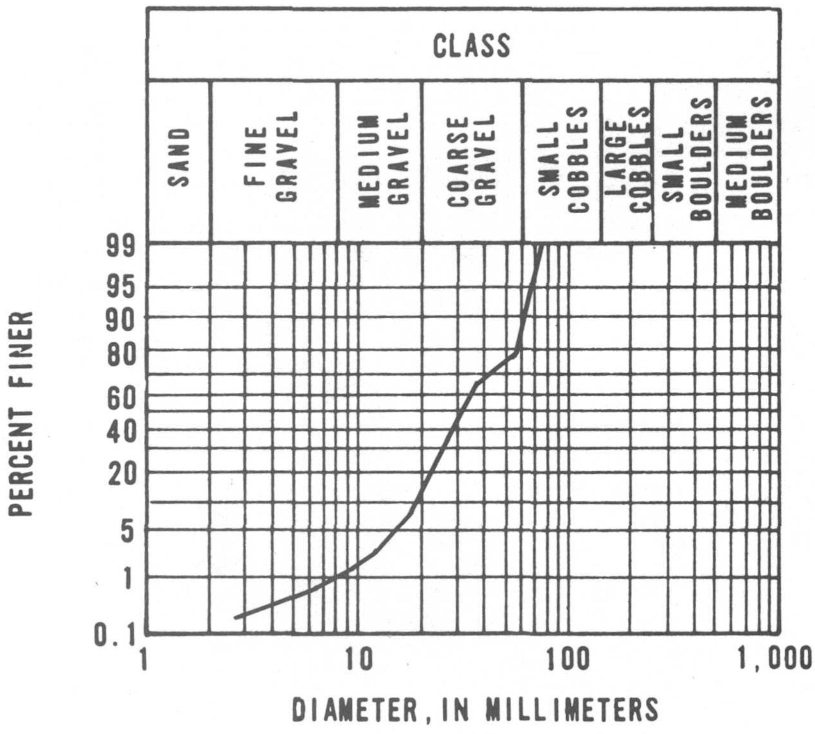


Figure 51.--Streambed material - Hess Creek near Livengood.

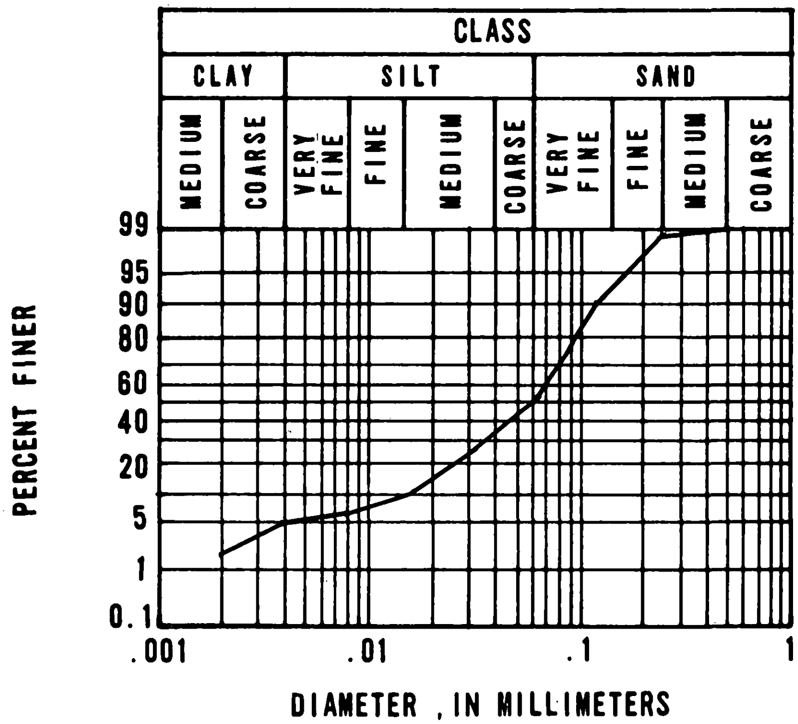


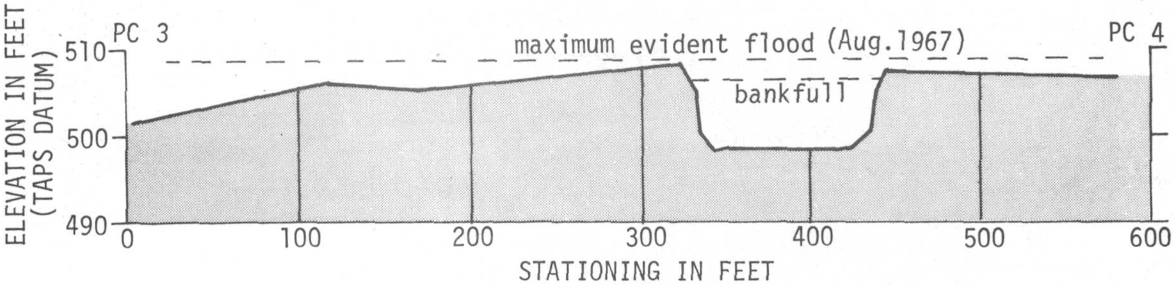
Figure 52.--Flood-plain soil sizes - Hess Creek near Livengood.

Figures 53-57.--Chatanika River near Olnes.

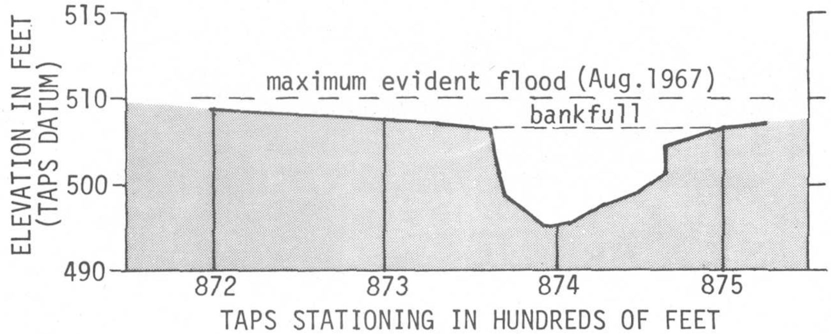
Location.--Lat 65°03'41", long 147°48'39", at TAPS proposed pipeline crossing, approximately 4.5 miles west of Olnes, and 15 miles north of Fairbanks.
(Livengood 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 53) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 54) for locations). The cross sections show the maximum evident flood overflow on the flood plains beyond the survey bounds, with the main channel about 100 feet wide and maximum depth of 15 feet. The right bank upstream from the crossing is steep and leaning trees indicate recent erosion. Undercutting of the vegetation mat at the site can be seen in figure 55.

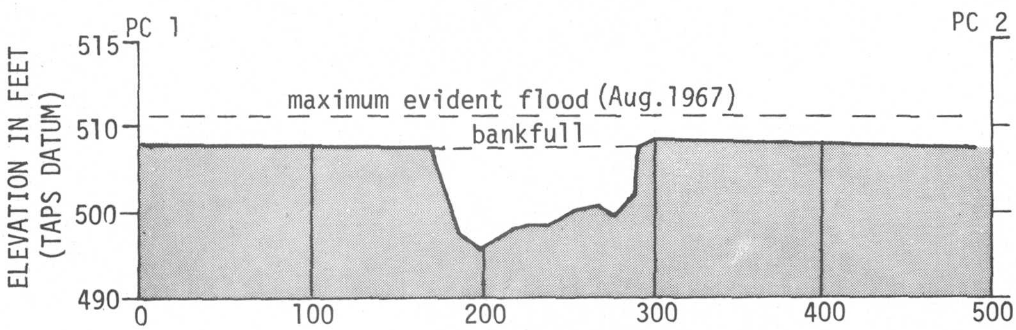
A size distribution for bed material is shown in figure 56. A size distribution for flood-plain soil 2.8 feet beneath the surface at the water table at PC 3 is shown in figure 57. This sample site underlies a muddy soil.



DOWNSTREAM CROSS SECTION



TAPS CENTERLINE CROSS SECTION

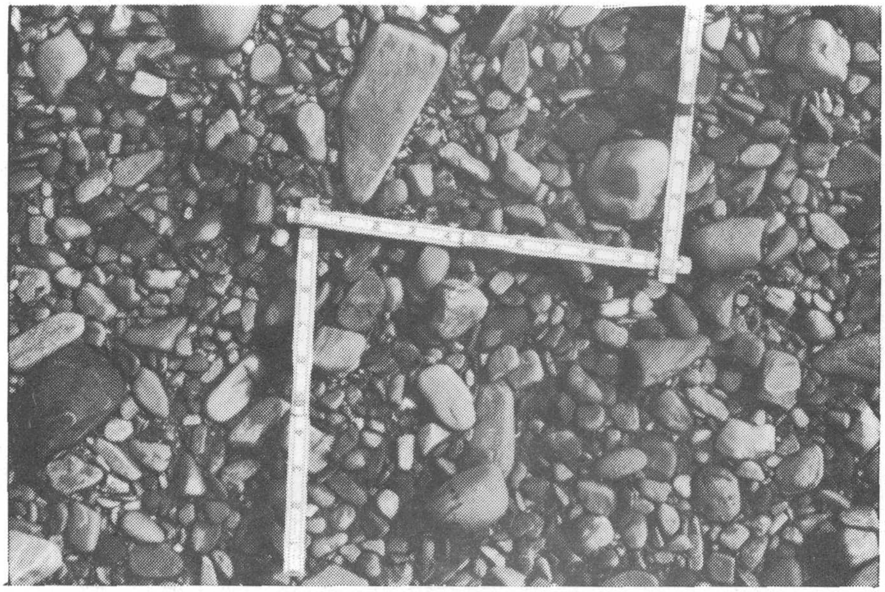


UPSTREAM CROSS SECTION

Figure 53.--Cross sections - Chatanika River near Olnes.

Figure 54.--Aerial photograph - Chatanika River near Olnes.

Figure 55.--Right bank - Chatanika River near Olnes.



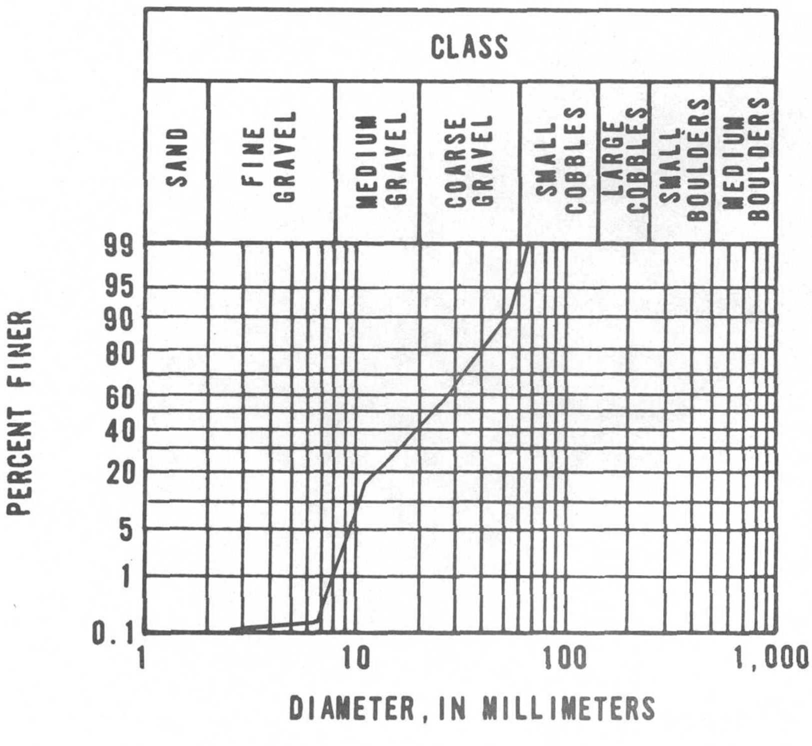


Figure 56.--Streambed material - Chatanika River near Olnes.

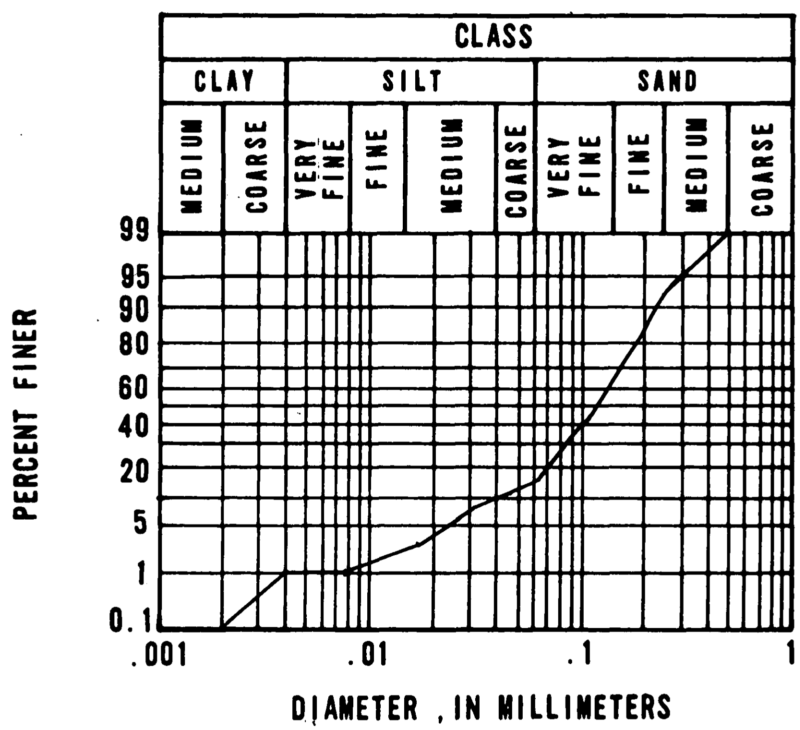


Figure 57.--Flood-plain soil sizes - Chatanika River near Olnes.

Figures 58-62.--Salcha River near Salchaket.

Location.--Lat 64°29'00", long 146°39'30", at TAPS proposed pipeline crossing, and about 9.5 miles upstream from the Richardson Highway.
(Big Delta 1:250,000, U.S. Geol. Survey map.)

Channel conditions.--Three cross sections (fig. 58) were surveyed to define ground elevations in the proposed crossing reach (see aerial photograph (fig. 59) for locations). Maximum evident floodmarks were observed over the flood plains throughout the reach. Inadvertently the high-water marks were not surveyed. The right bank is steep, with leaning trees and slumping vegetal mat, at the proposed crossing. Numerous overflow channels cross the tree-covered flood plains. The bankfull channel is about 600-1,000 feet wide with maximum depth about 18 feet. At a site approximately 1.5 miles downstream, the maximum evident flood surface was about 3-4 feet above bankfull.

A size distribution for bed material on the upstream side of the point bar at the crossing is shown in figure 60. A size distribution for bed material on the downstream side of the bar near PC 3 is shown in figure 61. A size distribution for flood-plain soil 1.5 feet beneath the surface overlying gravel about 100 feet back from the bank near PC 2 is shown in figure 62.

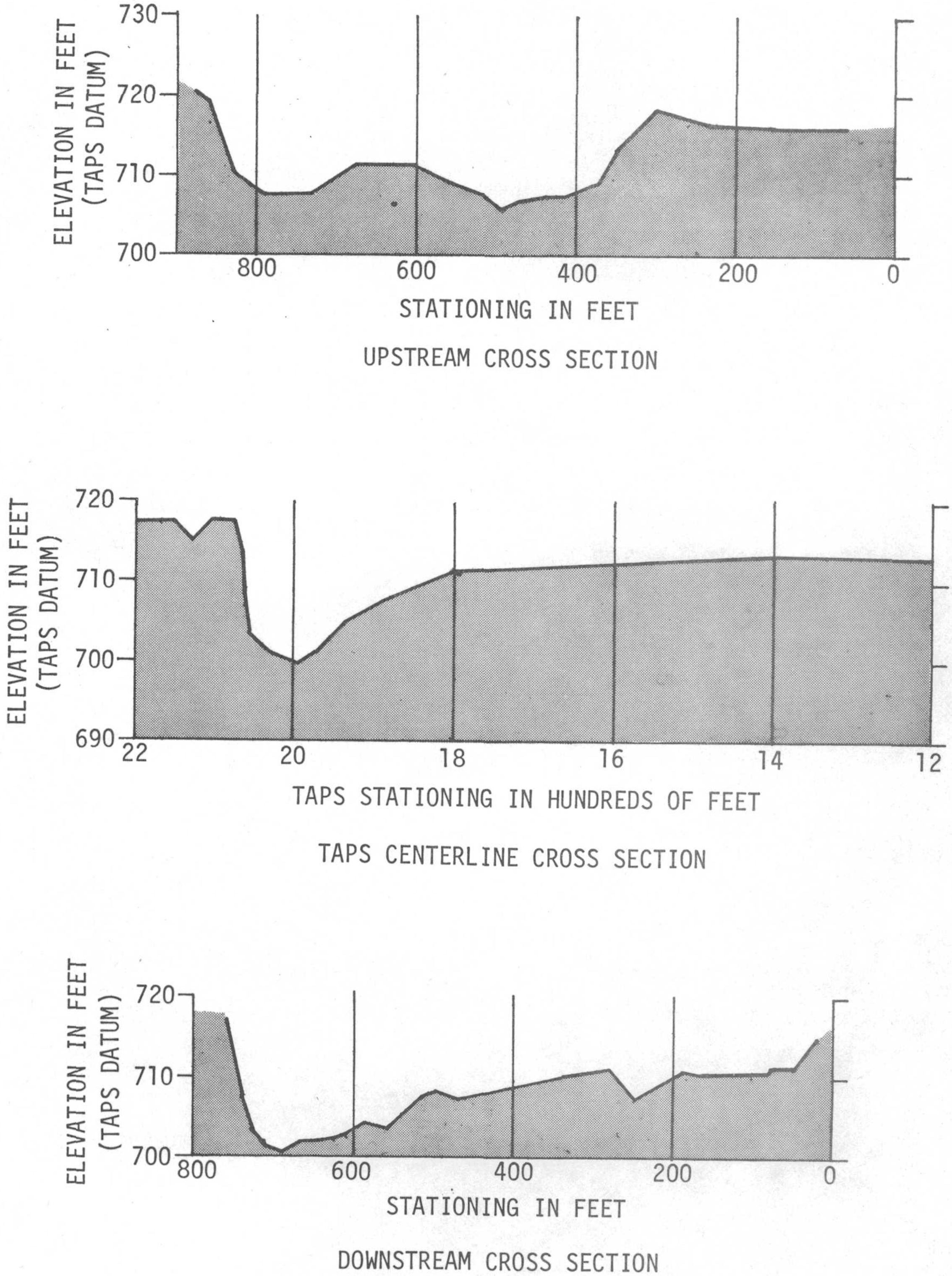


Figure 58.--Cross sections - Salcha River near Salchaket.

Figure 59.--Aerial photograph - Salcha River near Salchaket.

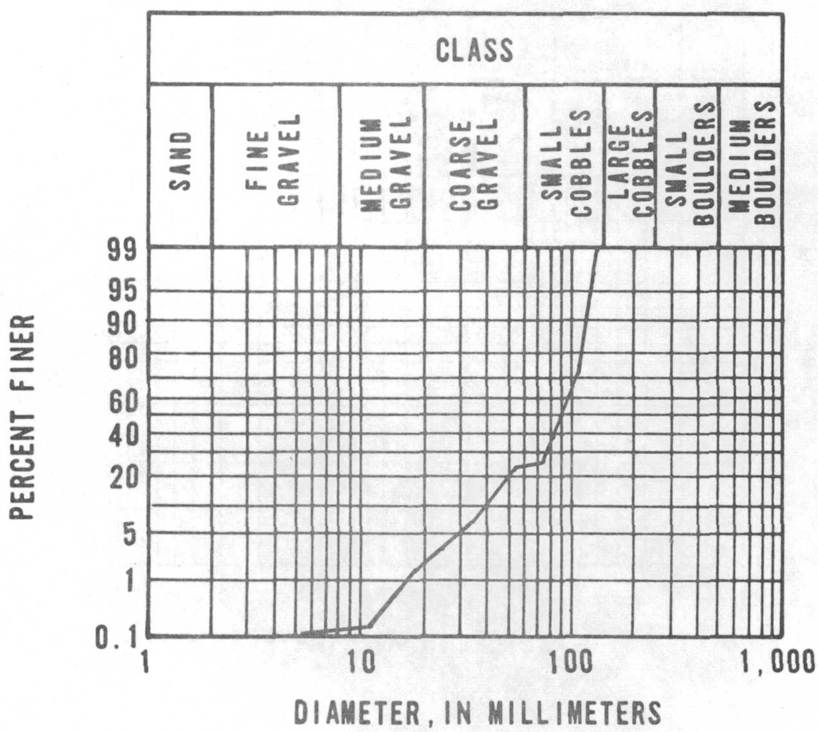
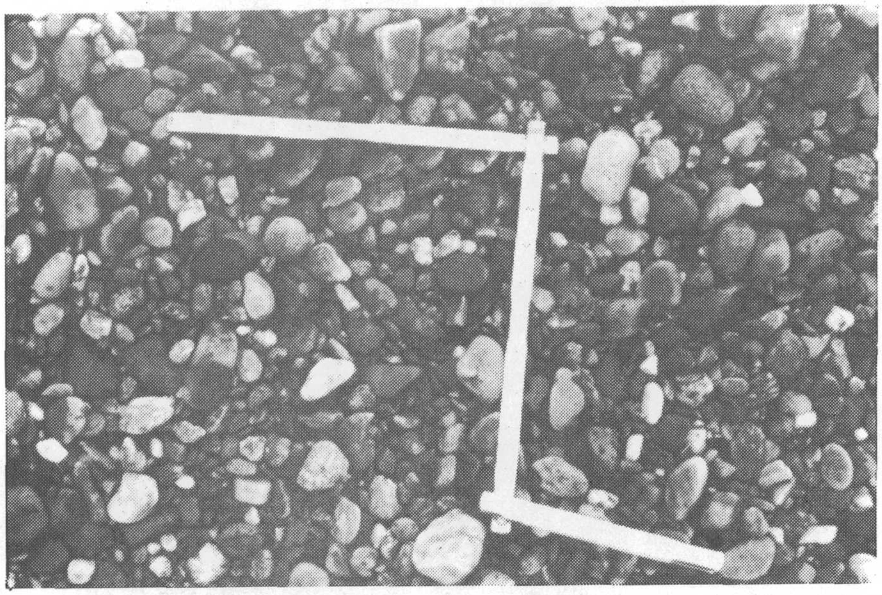


Figure 60.--Streambed material - Salcha River near Salchaket.



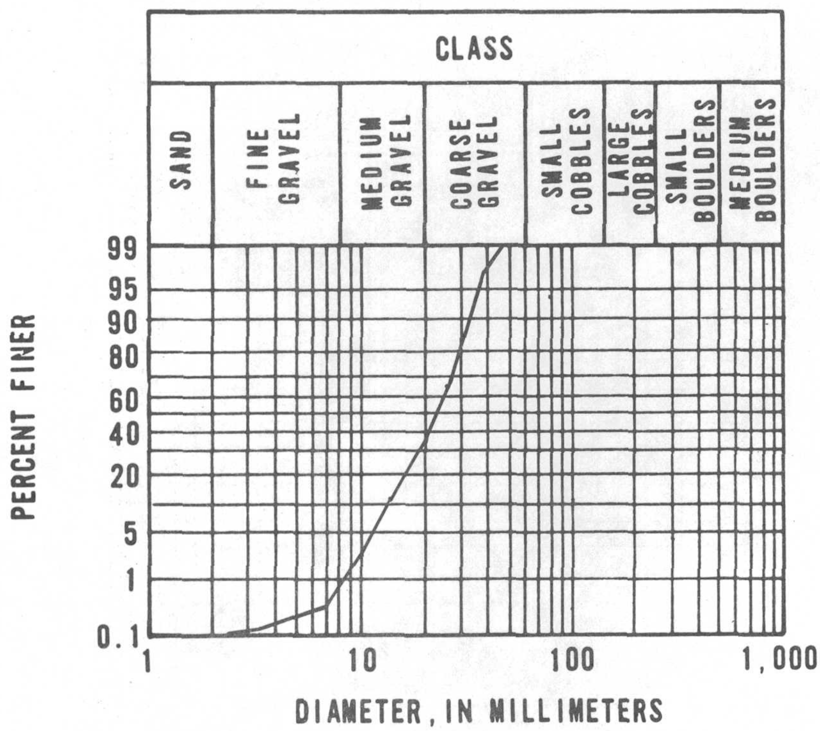


Figure 61.--Streambed material - Salcha River near Salchaket.

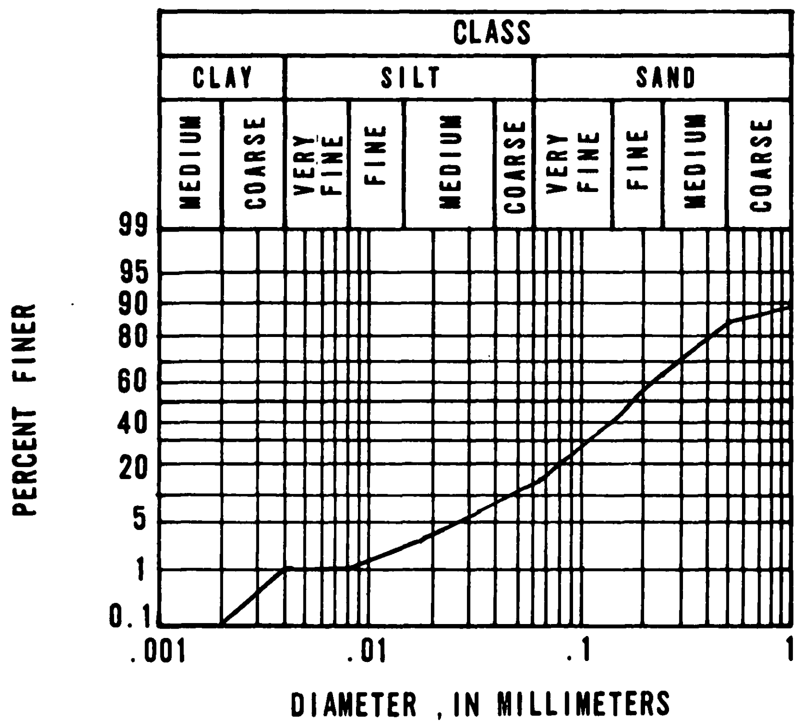


Figure 62.--Flood-plain soil sizes - Salcha River near Salchaket.