HYDROLOGIC RECONNAISSANCE OF STREAMS AND SPRINGS IN EASTERN BROOKS RANGE, ALASKA — JULY 1972

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
Water Resources Division, Alaska District

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By

J. M. Childers, C. E. Sloan, and J. P. Meckel

BASIC-DATA REPORT

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HYDROLOGIC RECONNAISSANCE OF STREAMS AND SPRINGS IN EASTERN BROOKS RANGE, ALASKA - JULY 1972

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ABSTRACT

Estimates of bankfull discharge and maximum evident flood peak discharge by slope-conveyance methods were made for selected streams in the eastern Brooks Range, based on field observations. Flood discharges for 2-year (Q_2) and 50-year (Q_{50}) average recurrence intervals were estimated for the same sites using regression equations that relate flood discharge to basin physical and climatic characteristics.

Discharge, temperature, and specific conductance of selected springs were measured during the reconnaissance and water samples were collected for chemical analysis. All but one of the springs discharged from limestone bedrock or associated colluvial and alluvial deposits. Water from the springs is of the calcium bicarbonate type and has low total dissolved solids. Discharge, at time of measurement, ranged from about 4 to 36 cfs and temperature ranged from about 3° to 9°C.

INTRODUCTION

On July 10-13, 1972, the authors travelled southeast from Prudhoe Bay across the Arctic Coastal Plain to the Canning River, and thence through the Brooks Range along the west and south sides of the Arctic Wildlife Range, making stops at selected sites for reconnaissance hydrologic observations. This report contains the results of these observations on selected streams including descriptions of drainage basins and channels, estimates of flood peak magnitude and frequencies, and bankfull and maximum evident flood peak discharges. This report also contains information on selected springs on the north side of the Brooks Range, which were located by aerial reconnaissance in May 1972 and visited in the field during the same period by the authors. Observations of the springs dealt primarily with the quantity and quality of the water.

STREAMS

The reconnaissance party stopped at 11 stream sites which are numbered on the location map (fig. 1). The streams and the approximate site locations were first preselected on topographic maps followed by air reconnaissance to select reasonably uniform channel reaches for ground study. An oblique aerial photograph of each site was made. The party then surveyed the channel cross section and longitudinal profiles of the water surface, the bank tops, and the maximum evident flood high-water marks upstream and downstream from the cross section. A photograph was made of an area of the streambed considered to be representative of floodflow conditions.

The results of the stream site studies are shown in table 1 (p. 24). The table shows the site name, location, and channel, drainage basin, and flood characteristics.

The channel characteristics are shown for the bankfull main channel. Bankfull was determined by observing the flood-plain surface (Leopold and Skibitzke, 1967) and also the edge of mature flood-plain forest (Sigafoos, 1964). Discharge was estimated by slope-conveyance methods (Dalrymple and Benson, 1967).

The drainage basin physical and climatic characteristics shown in table 1 include:

Area of glaciers (G) in percentage of drainage area.

Area of lakes and ponds (S_t) in percentage of drainage area.

Drainage area (A) in square miles, the total drainage area upstream from the stream site.

Main-channel slope (S) in feet per mile, the average slope between points 10 percent and 85 percent of the distance from the gaging site to the basin divide (stream length).

Mean annual precipitation (P) in inches, as determined from U.S. Weather Bureau publication, "Climate of Alaska" (Searby, 1968).

Mean basin elevation (E) in thousands of feet above sea level.

Mean minimum January temperature (t_1) in degrees F, from U.S. Weather Bureau publication "Climate of Alaska" (Searby, 1968).

Precipitation intensity (I) in inches, the maximum rainfall expected in 24 hours each 2 years as determined from U.S. Weather Bureau Technical Paper 47 (U.S. Weather Bur., 1963).

Stream length (L) in miles, the length of the main channel between the gaging station and the basin divide measured along the channel that drains the largest basin.

Table 1 shows the flood discharges for 2-year (Q_2) and 50-year (Q_{50}) average recurrence intervals. No stream-gaging records are available for the streams so the flood discharges were estimated from regression equations relating flood discharges to basin physical and climatic characteristics (Childers, 1970).

Flood observations were made at a site on the Sagavanirktok River at Franklin Bluffs. Pictures (fig. 2) at the Franklin Bluffs site were taken by Gary Anderson, U.S. Geological Survey hydrologist, while on a field trip in July 1961. These pictures show overbank flooding. Good flood high-water marks (willow debris), perhaps deposited by the 1961 flooding, were found 2 to 3 feet above the bank tops of the main channel. The main channel bed was composed mostly of cobbles. The floodway width was estimated as 1.5 to 2 miles.

An oblique aerial photograph and a photograph of representative streambed material are given for each of the 11 stream study sites (figs. 3-13). The cross-section lines show the width dimensions in feet of the channel at bankfull stage and at the maximum evident flood.

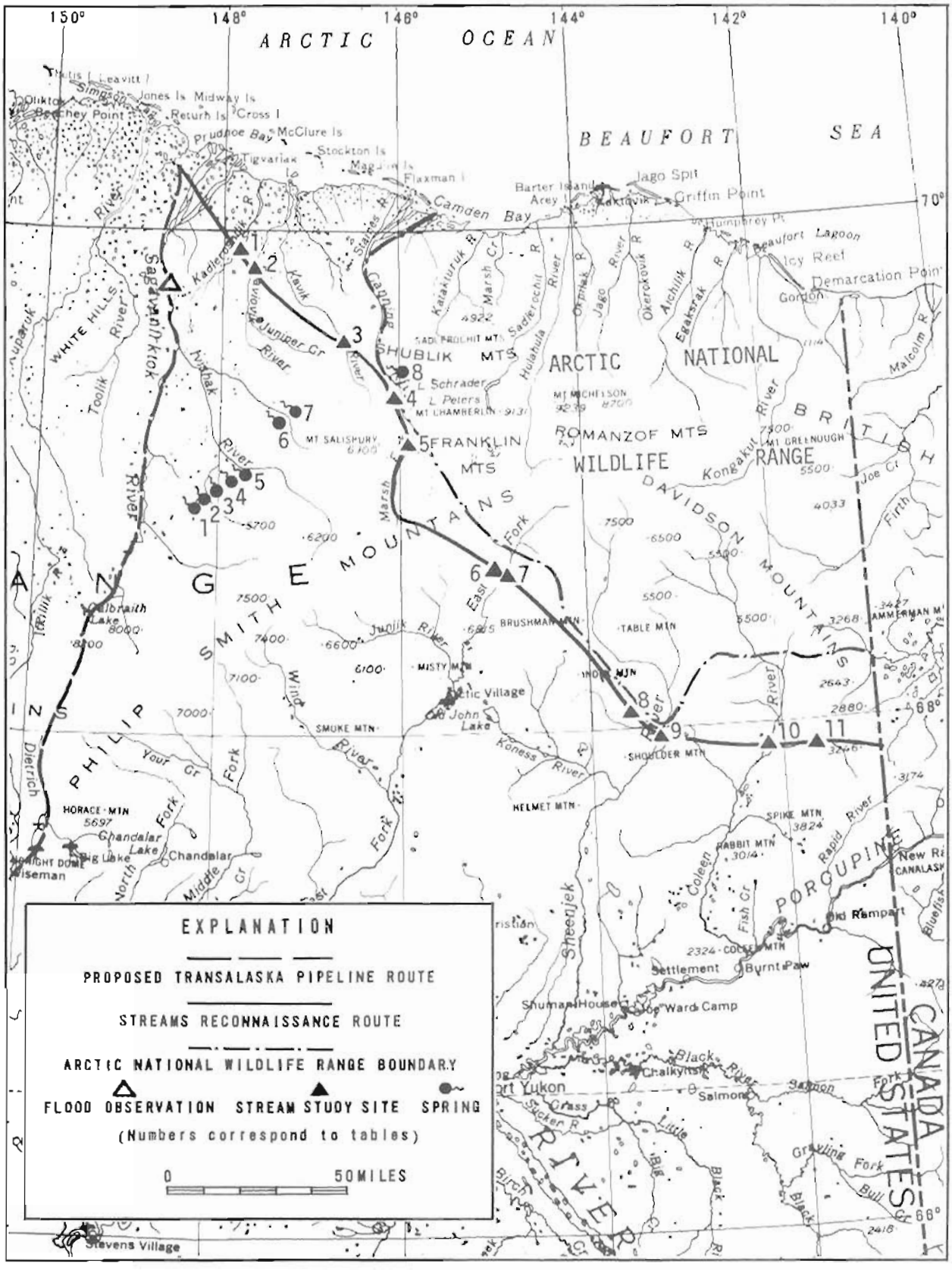
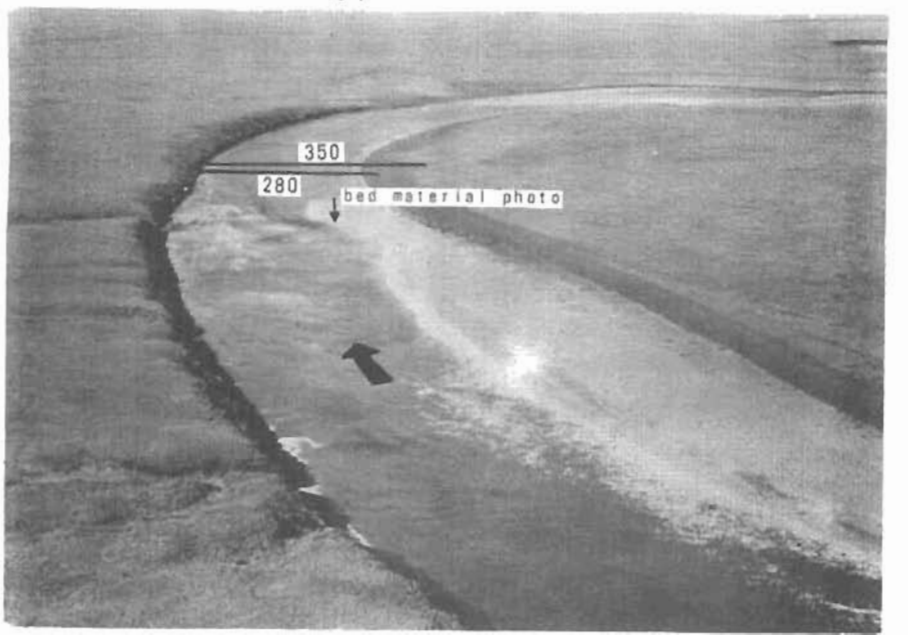


Figure 1.--Stream study sites and springs observed.

Figure 2.--Sagavanirktok River at Franklin Bluffs in flood of July 1961 (airplane parked on inundated flood plain).
(Photos by G.S. Anderson, USGS)

Figures 3-13.--Photographs of sites. Upper photograph shows channel width in feet. Arrow indicates direction of flow. Lower photograph shows typical streambed material.



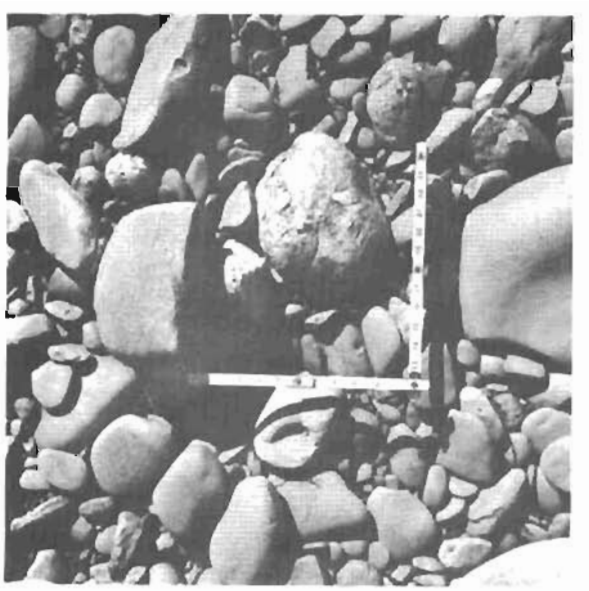


Figure 3.--Site 1, Kadleroshilik River.

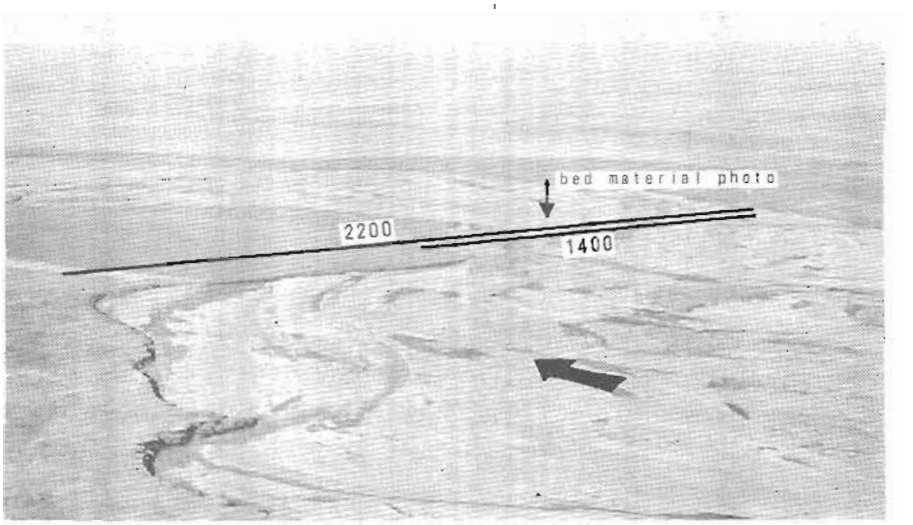


Figure 4.--Site 2, Shaviovik River.

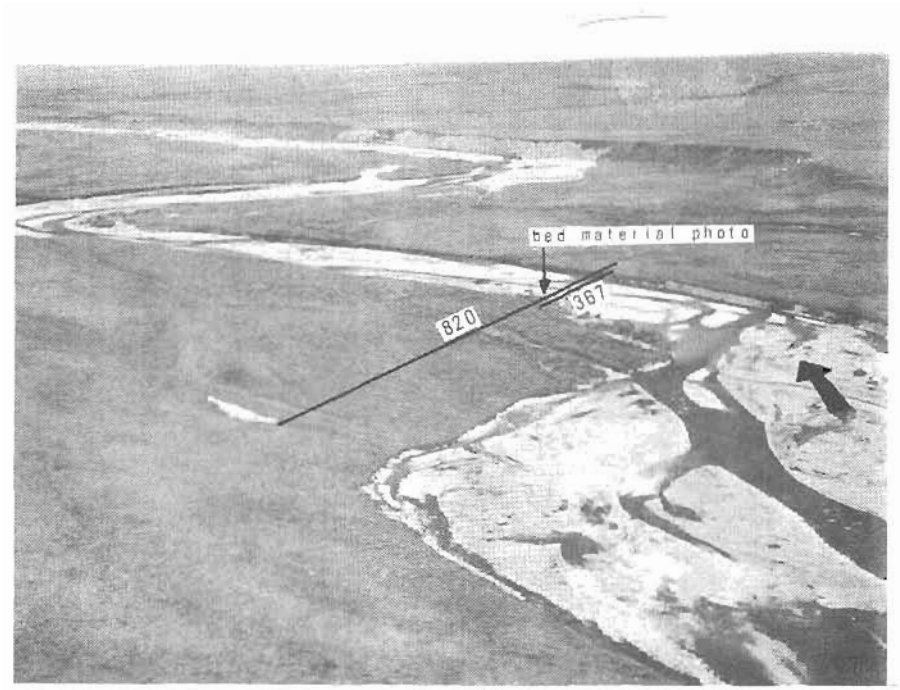


Figure 5.--Site 3, Kavik River.

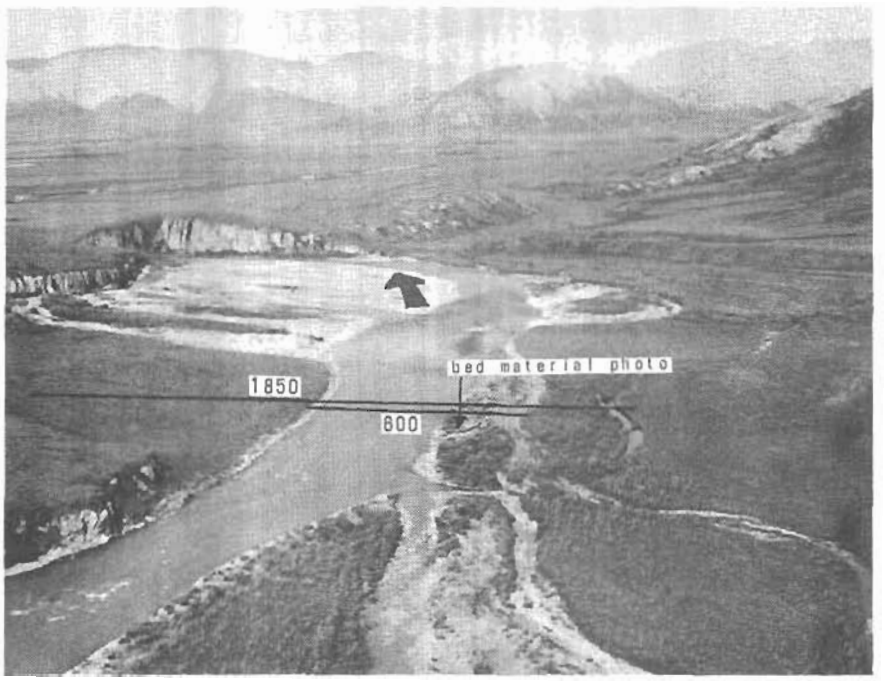
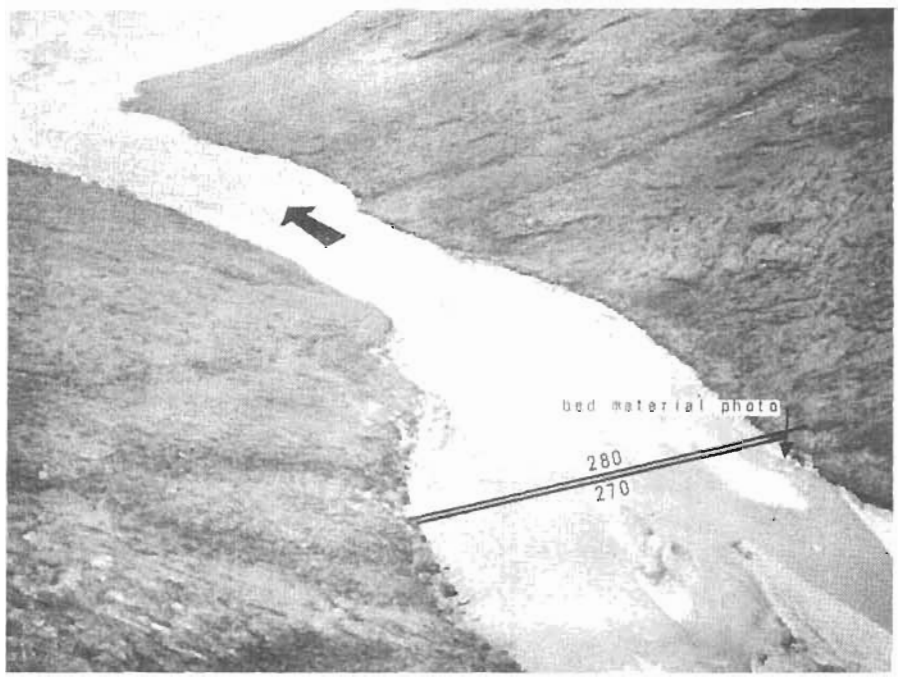


Figure 6.--Site 4, Canning River.



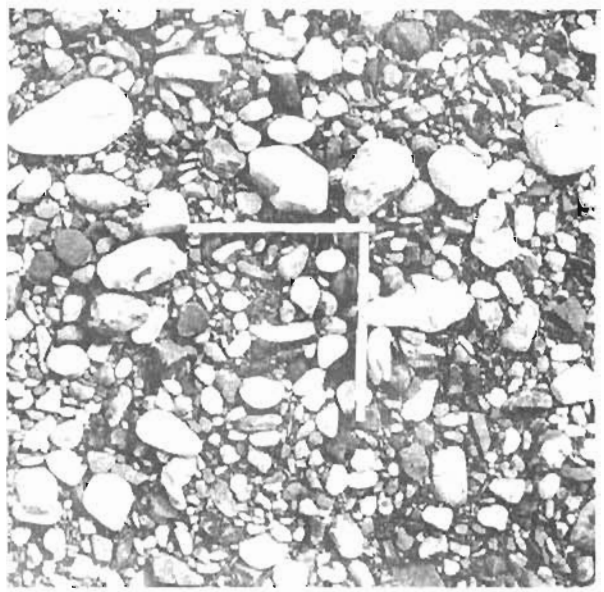


Figure 7.--Site 5, Marsh Fork Canning River.

Figure 8.--Site 6, Cane Creek.

Figure 9.--Site 7, East Fork Chandalar River.

Figure 10.--Site 8, Monument Creek.

Figure 11.--Site 9, Sheenjek River.

Figure 12.--Site 10, Coleen River.

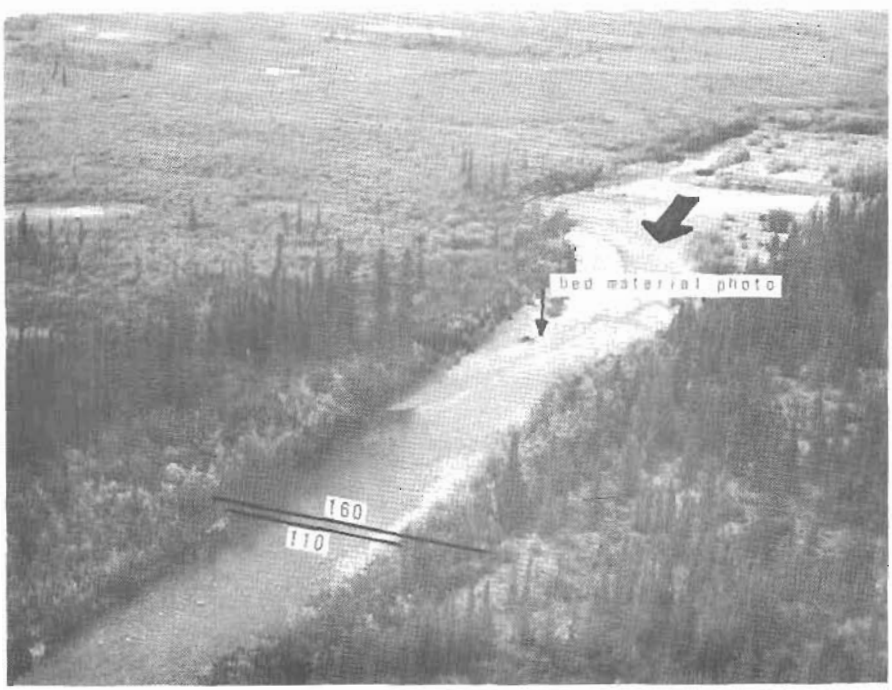


Figure 13.--Site 11, Strangle Woman Creek.

SPRINGS

Many springs were found in an aerial reconnaissance of icings and springs in the central Brooks Range during May 1972. Most of the large springs occur near the northern edge of the mountain range. Selected springs in the upper Sagavanirktok River basin and Shublik Spring on the Canning River (fig. 1) were visited during the July 1972 reconnaissance. Discharge, temperature, and specific conductance of the springs were measured in the field and water samples were collected for laboratory analysis. Results of the field measurements and laboratory analyses are shown in table 2 (p. 24). Laboratory results of specific conductance are shown, although field measurements were almost identical.

Spring discharge ranged from 4.2 to 36.5 cfs (cubic feet per second), and spring water temperatures ranged from 2.8° to 9.2°C. Shublik Spring (fig. 14) is the only spring of this group that had been previously measured by the U.S. Geological Survey. In August 1969, Shublik Spring discharged 37.3 cfs at 3.6°C compared to 36.2 cfs at 5.3°C in July 1972. Such small differences are within the limits of accuracy of the equipment and methods used to make the measurements. Water discharging from the springs is of the calcium bicarbonate type and is low in total dissolved solids, ranging from 126 to 156 mg/l (milligrams per liter). Water temperature and composition indicate that recharge is local and occurs during the melt season directly into permeable limestone bedrock and associated talus and alluvial deposits.

Most of the springs discharge from limestone of the Lisburne Group or its associated alluvial deposits (figs. 15 and 16). The location of many of the springs is marked by verdant groves of cottonwoods (fig. 17), which are favored by the warm microclimate of the springs. The springs are also recognizable in summer because their perennial flow supports a rich green flora of grasses, mosses, and lichens.

The most obvious manifestations of the springs are the large aufeis areas (icings) that they produce throughout the winter months, which are readily apparent from the air. Although all icings are not fed by springs, most icings are sustained by discharge of ground water. The larger, more spectacular, ones in the Brooks Range are clearly related to springs. Figure 18 shows the discharge zone of the spring on the west side of the Echooka River. Figure 19 is a general view of the icing produced by the spring and the extended open-water lead that exists downstream from the spring. The distance across the icing from bank to bank in the right foreground of the photograph is slightly over 2 miles. Figure 20 shows aufeis along an eroded channel in the Echooka River icing; the ice is about 16 feet thick. The layering in the ice is caused by successive overflows that froze on the surface of the icing field.

Owing to their comparative warmth and large discharge, these springs provide an ideal winter environment for spawning Arctic char. The springs could be useful as a high-quality water supply if ever needed, but such use will require consideration of the impact on char populations.

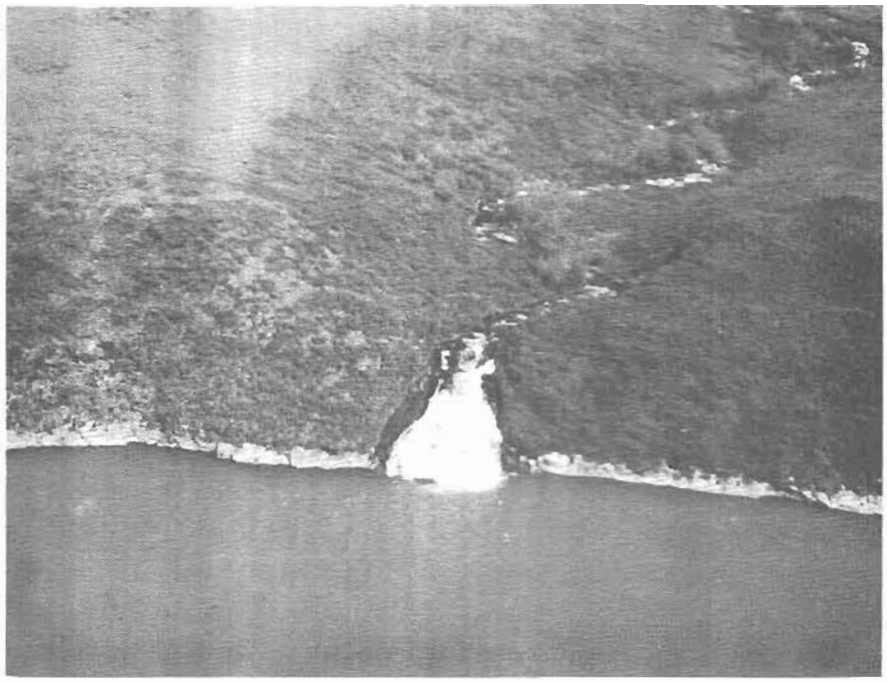


Figure 14.--Shublik Springs (Site 8) at point of discharge to the Canning River. Flow rate about 37 cfs.

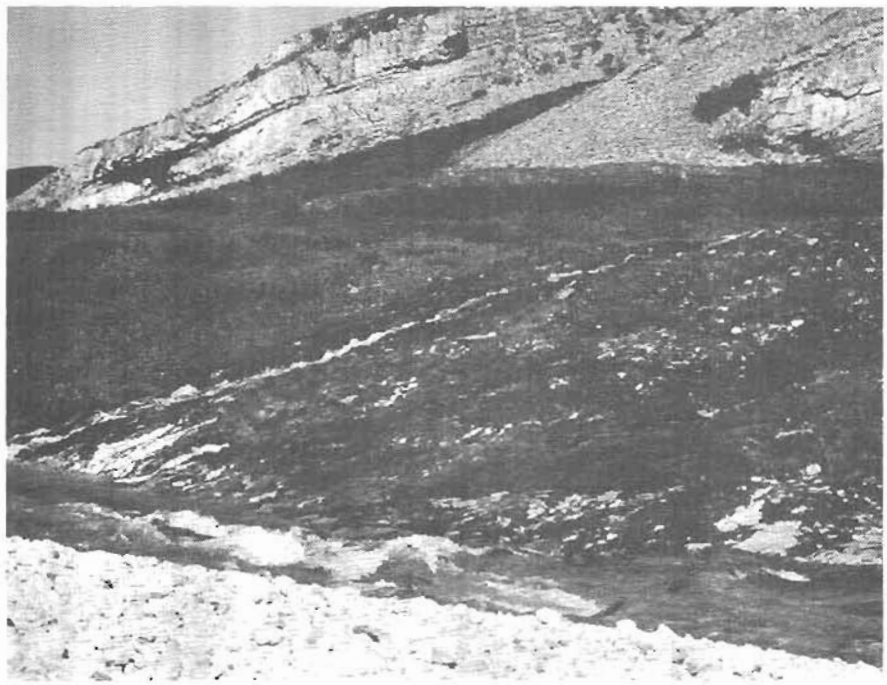


Figure 15.--Flood Creek Spring (Site 4) discharging from limestone of the Lisburne Group.

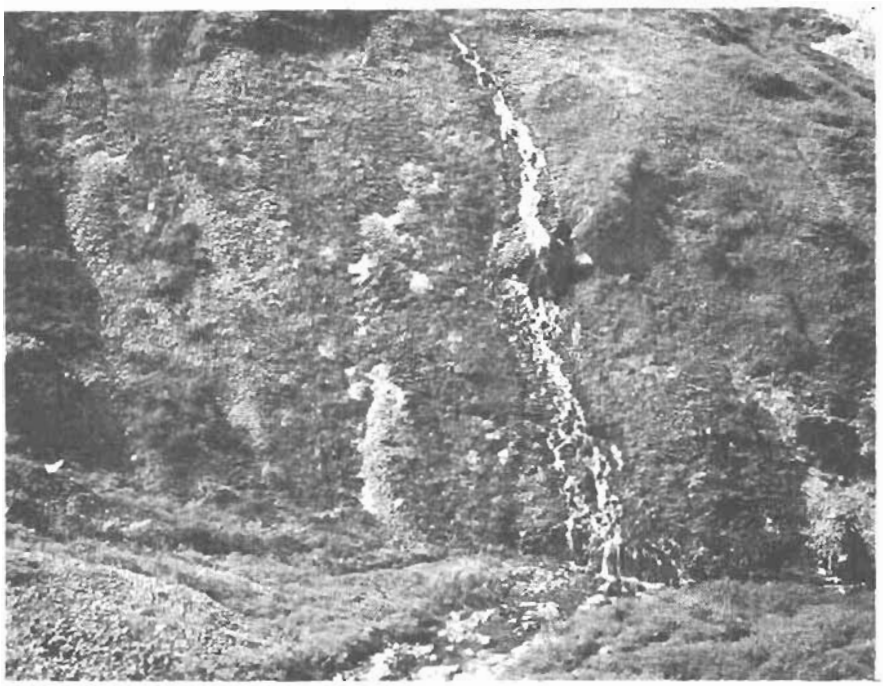


Figure 16.--Ivishak Hillside Spring (Site 5) discharging from limestone talus of the Lisburne Group.

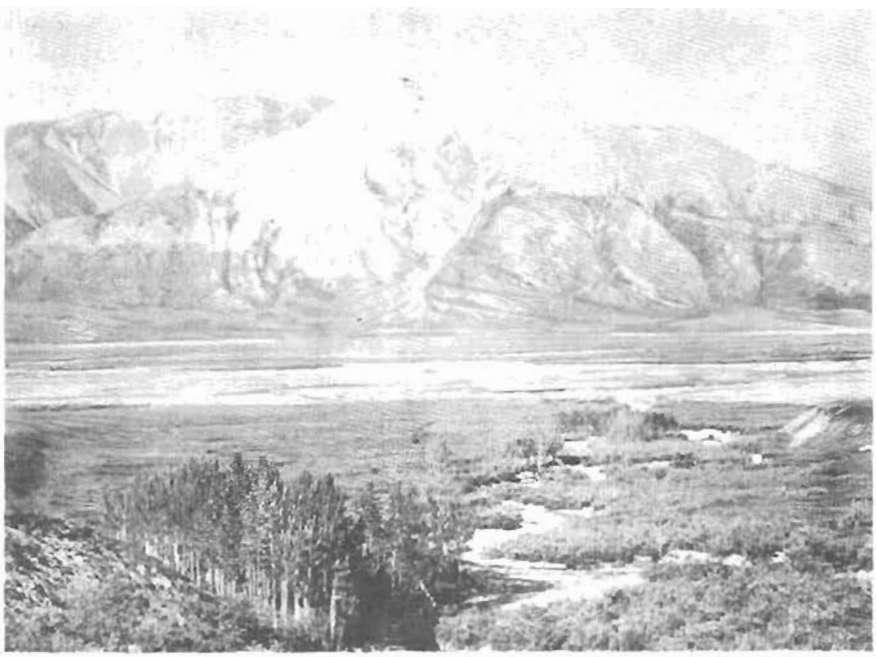


Figure 17.--Cottonwood trees at Ivishak Hillside Spring at edge of Ivishak valley.

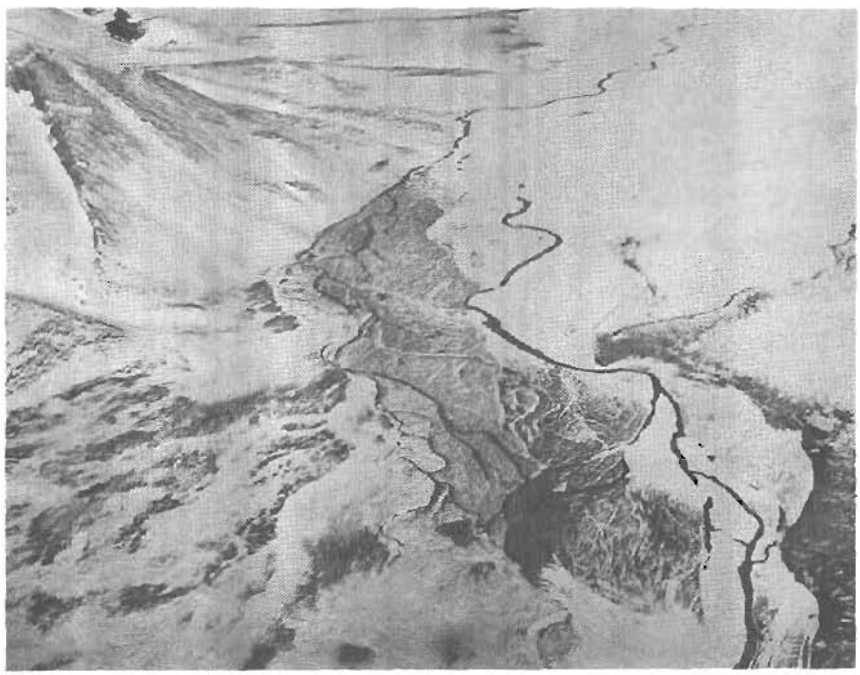


Figure 18.--Discharge zone of Echooka West Spring (Site 6).

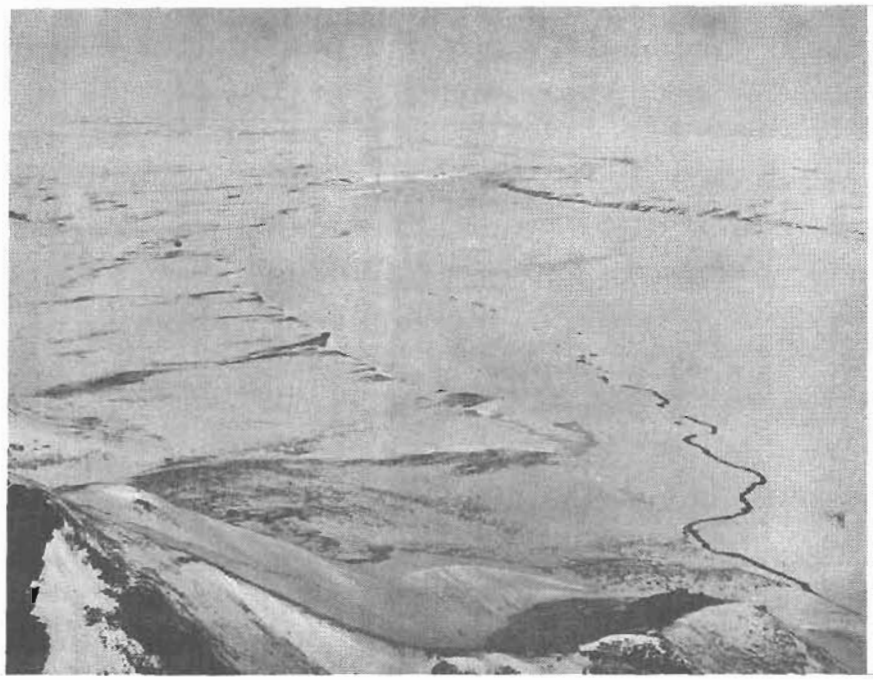


Figure 19.--Echooka River icing in May 1972. View downstream to north.

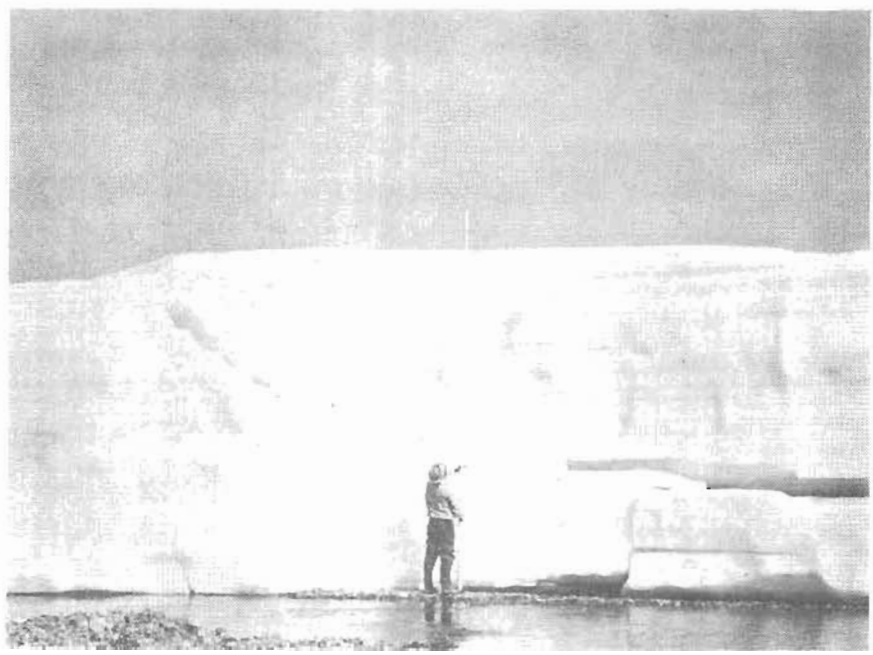


Figure 20.--Echooka River icing in July 1972. Ice is about 16 feet thick.

Table 1.--*Results of stream studies.*

Map no.	Stream site	Latitude	Longitude	Bankfull channel: Streambed material	Slope (ft/ft)	Width (ft)	Mean depth (ft)	Maximum depth (ft)	Discharge (cfs)	Maximum evident flood: Width (ft)	Discharge (cfs)	Basin characteristics *: G	S_t	A	S	P	E	t_1	I	L	Flood characteristics: Q_2	Q_{50}
1	Kadleroshilik River	69°56'06"	147°51'15"	Small cobble	0.0022	280	5.0	7	8,400	350	23,000	0	2	451	14.5	6	0.54	-18	0.65	48	1,100	4,400
2	Shaviovik River	69°52'21"	147°38'44"	Coarse gravel	0.0020	1,400	1.9	7	7,800	2,200	21,000	0	1	660	22.2	6	1.74	-18	.65	46	1,700	6,200
3	Kavik River	69°32'10"	146°39'44"	Large cobble	0.0060	370	2.6	7	5,200	820	13,000	0	0	237	72.1	7	2.52	-18	.87	31	1,100	3,700
4	Canning River above Eagle Creek	69°21'10"	146°02'31"	Large cobble	0.0018	600	5.0	9	17,000	1,850	22,000	1	0	1,326	2.64	8	4.15	-16	1.25	126	6,900	15,000
5	Marsh Fork Canning River near mouth	69°09'53"	145°53'30"	Coarse gravel	0.0054	270	4.1	6	9,400	280	18,000	0	0	588	44.4	8	3.67	-16	1.25	48	3,300	8,200
6	Cane Creek near mouth	68°39'39"	144°54'11"	Coarse gravel	0.0036	190	3.4	6	3,400	260	5,600	0	0	116	127	8	4.7	-16	1.25	21	760	2,400
7	E F Chandalar River below Cane Creek	68°37'09"	144°55'18"	Coarse gravel	0.0038	1,480	2.8	7	19,000	2,000	27,000	0	0	627	63	8	4.47	-16	1.25	37	3,500	8,600
8	Monument Creek	68°04'11"	143°50'36"	Large cobble	0.0070	85	3.6	5	1,800	490	6,400	0	0	101	59.3	8	3.09	-20	1.25	18	680	2,200
9	Sheenjek River	67°57'15"	143°16'54"	Coarse gravel	0.0028	600	3.9	12	14,000	1,000	18,000	0	0	2,230	13.9	8	3.63	-20	1.25	96	11,000	22,000
10	Coleen River	67°53'46"	142°07'16"	Coarse gravel	0.0027	650	4.7	9	20,000	650	20,000	0	0	1,700	36.4	8	2.79	-24	1.15	86	8,100	18,000
11	Strangle Woman Creek	67°53'34"	141°51'05"	Small cobble	0.0040	110	3.0	5	1,900	160	5,400	0	0	246	4.13	8	2.18	-24	1.15	22	1,400	4,100

* Basin characteristics defined on page 3.

Table 2.--*Physical and chemical characteristics of selected springs.*

(Chemical constituents in milligrams per liter)

Map no.	Name	Location: Latitude	Location: Longitude	Date sampled	Discharge (cfs)	Temperature (°C)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Total alkalinity as $CaCO_3$	Dissolved solids calculated	Specific conductance (micromhos at 25°C)	pH
1	Lupine	68°51'45"	148°12'20"	7/ 9/72	5.8	9.2	3.3	48	8.2	0.5	0.1	160	10	1.0	0.5	0	153	12	85	156	271	8.6
2	Saviukviaynk W.	68°54'10"	148°05'10"	7/10/72	12.9	2.8	3.1	42	7.4	.5	0	154	7	1.0	.4	0	135	9	76	137	243	8.5
3	Saviukviaynk Trib.	68°56'20"	147°58'45"	7/10/72	10.7	5.3	4.2	37	8	.2	0.1	130	11	2.0	.5	0.2	125	18	64	127	226	8.4
4	Flood Creek	68°58'40"	147°51'30"	7/11/72	36	8.5	5.1	35	8.5	.4	.2	131	11	2.0	.6	.3	122	15	64	127	224	8.4
5	Ivishak Hillside	69°01'50"	147°43'00"	7/11/72	4.2	8.0	4.8	35	9	.3	.1	134	11	0.8	.5	0	125	15	66	128	225	8.4
6	Echooka West	69°15'35"	147°22'50"	7/12/72	36.5	6.6	4.9	36	9.8	1.2	.2	132	22	1.5	.3	0	131	23	65	141	245	8.4
7	Echooka East	69°16'00"	147°20'25"	7/12/72	34.9	5.0	3.9	34	8.6	0.5	.1	126	16	1.0	.2	0.1	120	17	62	126	222	8.4
8	Shublik	69° 28'20"	146°11'50"	7/12/72	36.2	5.3	4.3	39	11	1.5	.3	128	35	1.8	.4	0	142	37	63	156	265	8.4

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