UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HYDROLOGIC RECONNAISSANCE OF THE UNALAKLEET RIVER BASIN, ALASKA, 1982-83

By Charles E. Sloan, Donald R. Kernodle, and Ronald Huntsinger

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Cover photograph - Open lead in headwaters of the Unalakleet River

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CONVERSION TABLE

Multiply	By	To obtain
inch (in.)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
acre	0.4047	hectare
square mile (mi^2)	2.590	square kilometer (km^2)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.0109	cubic meter per second per square kilometer [$(m^3/s)/km^2$]
degree Fahrenheit (°F)	(°F-32)/1.8	degree Celsius (°C)

Other abbreviations in this report are:

mg/L, milligram per liter

µg/L, microgram per liter

µS/cm, microsiemens per centimeter at 25 °C

NTU, nephelometric turbidity unit

NOTE: The stream referred to in this report as Tenmile River is also known as Tenmile Creek.

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ABSTRACT

The Unalakleet River from its headwaters to the confluence of the Chiroskey River has been designated as a wild river and is included in the National Wild and Scenic Rivers System.

Yearly low flow, which occurs during the winter, is sustained by ground-water discharge; there are few lakes in the basin and the cold climate prevents winter runoff. The amount of winter streamflow was greatest in the lower parts of streams with the exception of the South River and was apparently proportional to the amount of unfrozen alluvium upstream from the measuring sites. Unit discharge in late winter ranged from nearly zero at the mouth of the South River to 0.24 cubic foot per second per square mile in the Unalakleet River main stem below Tenmile River.

Summer runoff at the time of the reconnaissance may have been slightly higher than normal owing to recent rains. Unit runoff ranged from a low of 1.0 cubic foot per second per square mile at the South River, to a high value of 2.4 cubic feet per second per square mile at the North Fork Unalakleet River.

Flood marks were present in the basin well above streambank levels but suitable sections to measure the maximum evident flood by slope-area methods were not found. Flood peaks were calculated for the Unalakleet River and its tributaries using basin characteristics. Calculated unit runoff for the 50-year flood ranged from about 17 to 45 cubic feet per second per square mile.

Water quality was good throughout the basin, and an abundant and diversified community of benthic invertebrates was found in samples collected during the summer reconnaissance.

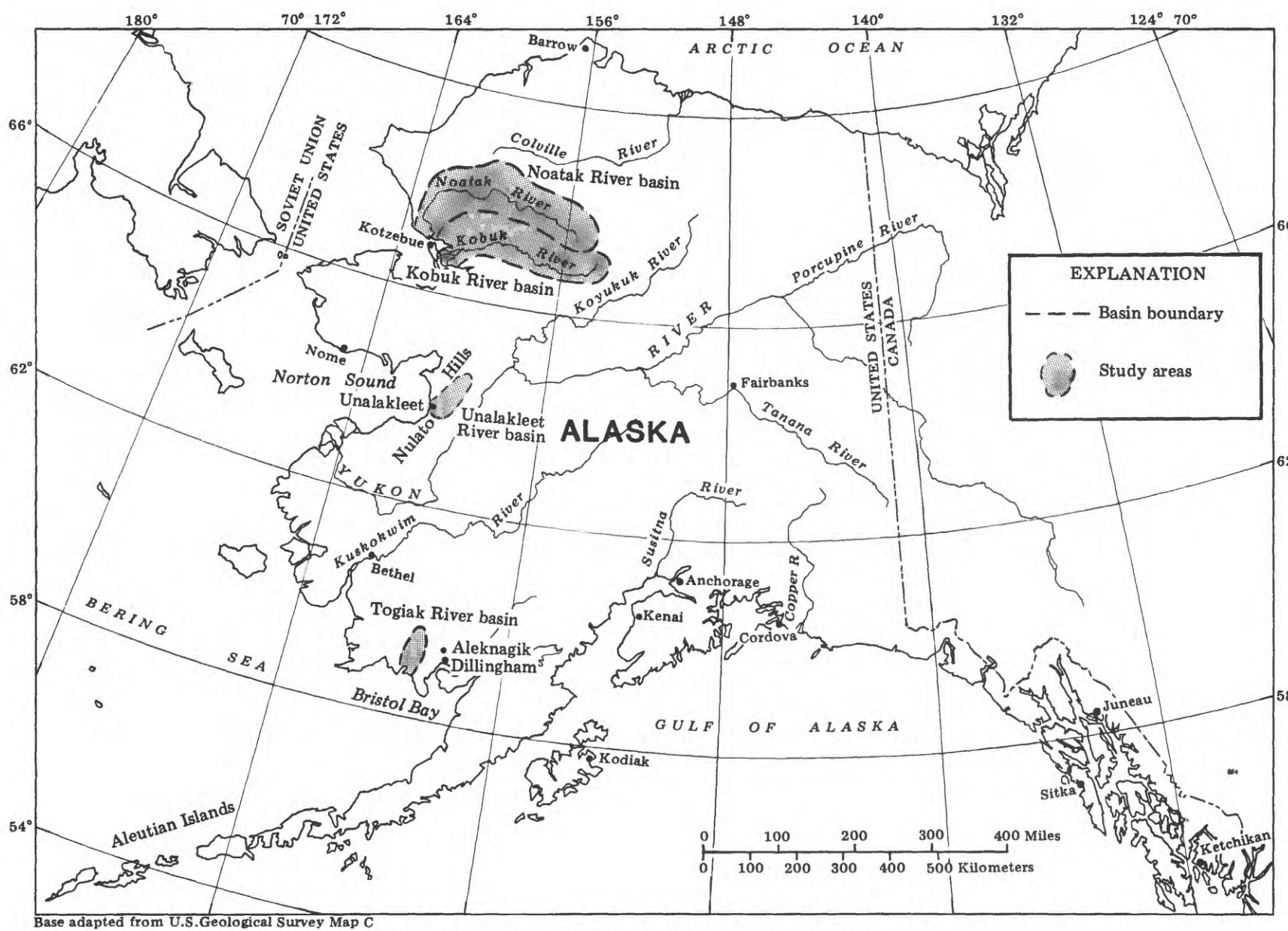
Permafrost underlies most of the basin, but ground water can be found in unfrozen alluvium in the stream valleys, most abundantly in the lower part of the main tributaries and along the main stem of the Unalakleet River. Ground water sustains river flow through the winter; an estimate of its quantity can be found through low-flow measurements. Ground-water quality in the basin appears to be satisfactory for most uses. Currently, little ground water is used within the basin. The water supply for Unalakleet is obtained from a well and gallery in a small valley north of the airport, outside the Unalakleet River basin.

INTRODUCTION

The Unalakleet River system in northwestern Alaska (fig. 1) provides spawning and rearing habitat for anadromous salmon that are important to commercial, subsistence, and sport fisheries. The rivers also form the main avenues for transportation within the region -- by boat in summer and by snowmobile, dog team, and small all-terrain vehicles in winter.

The Unalakleet River was added to the National Wild and Scenic Rivers System by Public Law 96-487 of December 2, 1980. Called the "Alaska National Interest Lands Conservation Act" (ANILCA), the law defined the main stem of the Unalakleet River from its headwaters to the confluence of the Chiroskey River as a wild river area. As a result of that classification, the U.S. Bureau of Land Management (BLM) developed a management plan for the Unalakleet River. Because of the lack of any hydrologic information for the basin, the U.S. Geological Survey was asked to cooperate with BLM in a reconnaissance study of the water resources, giving particular emphasis to definition of stream-flow characteristics. In addition to information from the reconnaissance studies, peak discharges were calculated for selected sites based on the analysis of basin characteristics.

An initial reconnaissance was made in August 1982, by Don Kernodle and Andy Records of U.S. Geological Survey and Ron Huntsinger and Mark Phillips of BLM. The trip was made in two boats from the mouth of the river at Unalakleet to Old Woman River and return, with side excursions into the major tributaries. Stream discharge and field water-quality constituents were measured and dip-net samples of benthic invertebrates were collected near the mouths of the tributaries. Indirect measurements of the maximum evident flood were attempted but even though flood marks were readily



Base adapted from U.S.Geological Survey Map C

Figure 1.--Location of the Unalakleet River basin and other study areas in this series of reports.

apparent, channel and flood-plain conditions prevented the necessary surveys. Rainstorms during and preceding the reconnaissance caused streamflow that was probably slightly higher than normal for late August, particularly in the upper part of the basin.

A second reconnaissance was made in March 1983, by Don Kernodle and Charles Sloan of the U.S. Geological Survey and Ron Huntsinger of the BLM using a helicopter for transportation. Streamflow and water-quality measurements were made at sites in the headwaters of the major tributaries of the Unalakleet River, on each tributary near its confluence with the main stem, and along the main stem of the Unalakleet. Flow in the streams at this time, probably at or near the minimum for the year, is virtually all discharge of ground water from the unfrozen alluvium.

This is the fourth U.S. Geological Survey report of a reconnaissance-level hydrology study of a river basin in remote areas of Alaska. Prior studies and reports include those on the Noatak River (Childers and Kernodle, 1981), Kobuk River (Childers and Kernodle, 1983), and the Togiak River (Kernodle and others, 1983) (fig. 1).

PHYSICAL ASPECTS OF THE BASIN

General setting

The Unalakleet River and its tributaries in the Nulato Hills drain an area of about 2,100 mi^2 at the eastern end of Norton Sound (figs. 1 and 2). Unalakleet, located at the mouth of the river, about 150 mi southeast of Nome, is the only community within the basin of the Unalakleet River. Islolated cabins and campsites, used seasonally for hunting and fishing, are located along the main stem of the Unalakleet between Old Woman River and North River. Additionally, there are three agricultural sites and two communications sites (currently abandoned), a musk-ox farm, and a sport-fishing lodge in the lower basin. Transportation within the basin is by boat in summer, by snowmobile and dog sled in winter, and by aircraft year-round. A limited road system connects Unalakleet to the communications sites and musk-ox farm.

The main channel of the Unalakleet River flows southwestward to Norton Sound from its headwaters in the central Nulato Hills. The stream drops 2,000 ft in altitude over its length. Average stream gradient decreases gradually from more than 25 ft/mi in the headwaters to about 11 ft/mi in the Old Woman River to Chiroskey River reach to less than 5 ft/mi in the lower basin (fig. 3). Tributaries are steeper than the main channel. Channel sinuosity, the ratio of channel length to down-valley distance, ranges from 1.15 in the headwaters to 2.3 in the lower basin.

Climate

The Unalakleet River basin lies within the Continental climatic zone of Alaska (Selkregg, 1976). Temperature records for Unalakleet village indicate an average daily maximum of about 10 °F and daily minimum of -4 °F for the winter months (December through March). Summer average temperatures range from 42 °F to 61 °F. Extremes recorded for the basin include a low of -52 °F on December 31, 1974 and a high of 87 °F on July 7, 1972. Average annual temperature is 26 °F. Records for the village show average annual precipitation of 14 in., including snowfall of 37 in. August is the wettest month (3.6 in.) and the smallest amount of precipitation is from December through February (fig. 4). Winds average 11 knots, with a recorded extreme of 56 knots. Prevailing wind direction is ENE most of the year (Unalakleet means "place where the east wind blows"), changing to west during June and July. Fog, rain, snow, and low clouds are common conditions in the basin.

Vegetation

Land cover distribution in the Unalakleet basin (table 1) was determined by an analysis of Landsat spectral data (Meyer and Spencer, 1983). The upper parts of the South and Chiroskey River basins are not included in the table because the Landsat scene used for classification of the land cover types did not extend far enough south to cover the entire area. It did cover about 96 percent of the total area, however.

Wetlands and wet and shrub tundra cover nearly 70 percent of the Unalakleet basin. Conifer/deciduous forest, indicative of areas free of permafrost, covers only about 2 percent of the basin. Much of this cover type includes riparian cottonwoods and white spruce, intermixed with willow, along the river. The black spruce shrub type (fig. 5) covers nearly 30 percent of the basin.

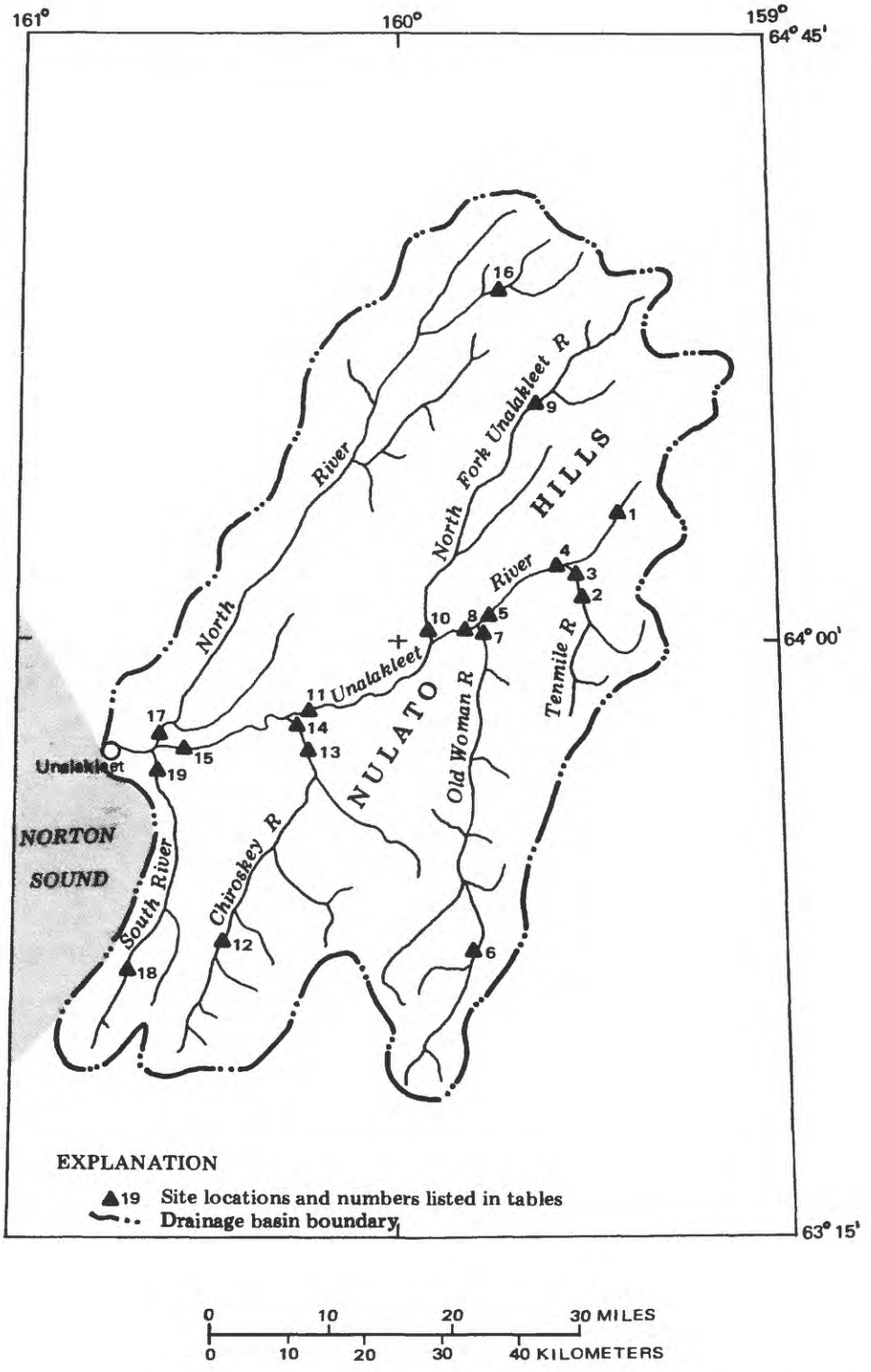


Figure 2.--Unalakleet River basin and site locations of August 1982 and March 1983.

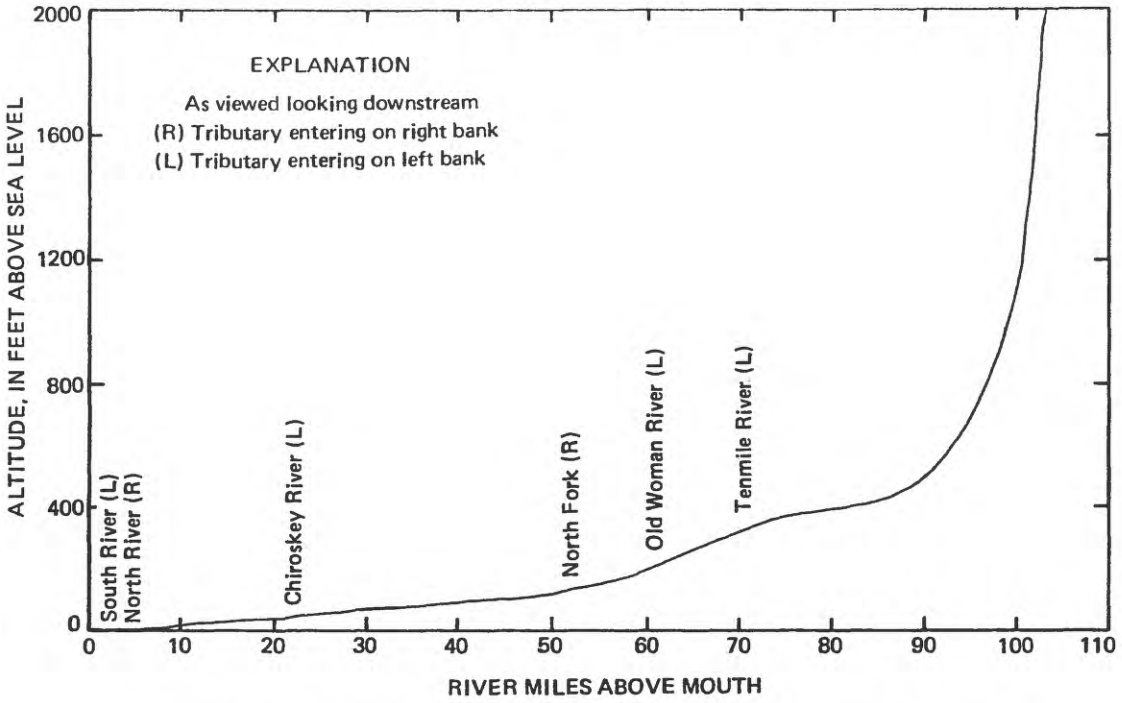


Figure 3.--Profile of Unalakleet River and location of tributary junctions.

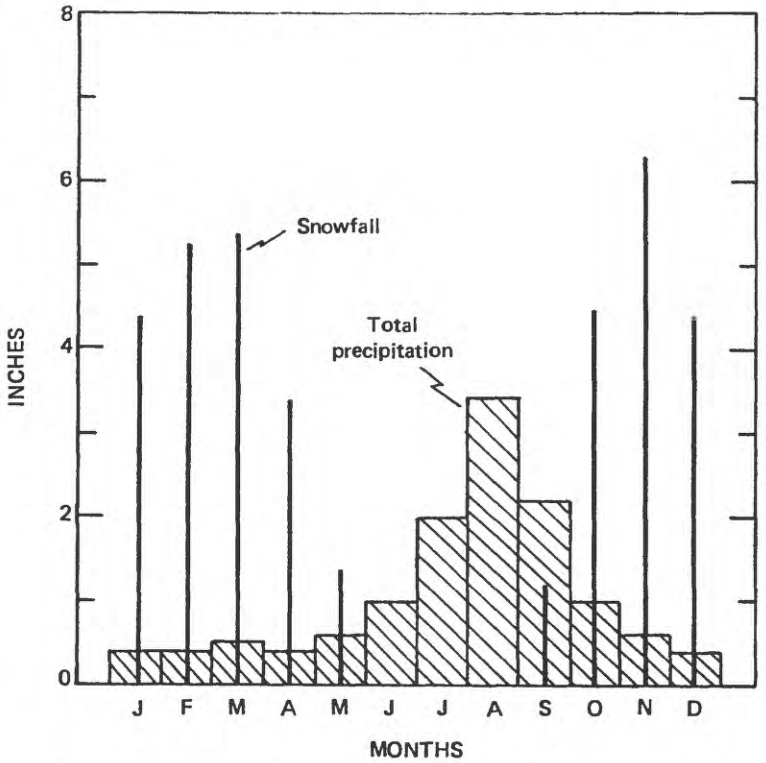


Figure 4.--Average monthly snowfall and precipitation at Unalakleet, 1941-1979. (Data from Alaska Climate Center)

Table 1.--Land cover distribution in Unalakleet basin

[Acres, by sub-basin]

Land cover	South River*	North River	Main Unalakleet River	North Fork	Tenmile River	Old Woman River	Chiroskey River*	Basin total	Percent of total cover
Wetlands and wet tundra	8,823	20,644	65,205	5,956	1,564	9,930	22,382	134,504	10.4
Shrub tundra	47,202	192,585	118,734	120,353	32,150	140,450	99,714	751,184	58.2
Black spruce shrub	9,426	94,506	114,716	41,280	15,023	46,915	49,828	371,694	28.8
Conifer/deciduous forest	543	6,482	9,785	3,830	2,195	2,851	1,282	26,914	2.1
Barrens	270	1,472	2,100	1,584	448	1,015	626	7,515	.05

* Incomplete survey

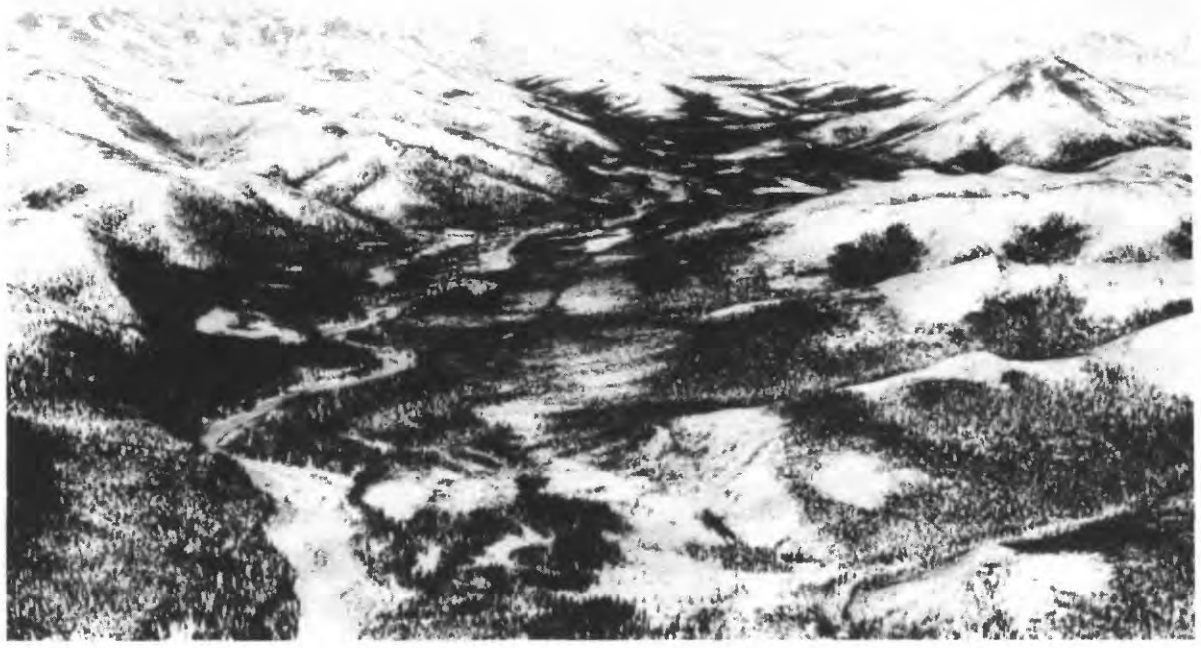


Figure 5.--Black spruce shrub type of vegetation in the Nulato Hills along the North River, March 24, 1983.

Geology

The Unalakleet River basin is underlain by sedimentary bedrock consisting of graywacke, shale, grit, and conglomerate (Cass, 1959a, 1959b). Coarse clastic rocks form rubble-covered ridges and hills; shale underlies the slopes and valleys. The bedrock is tightly folded and in places is overturned along fold axes that trend northeast. Large faults traverse the basin, both along the trend and across the trend of the folding. Two small intrusive bodies have been mapped--one in the divide at the head of the Chiroskey River and the other on the south margin of the Unalakleet Valley between the Chiroskey and Old Woman Rivers. The only other bedrock unit mapped is a small outcrop of volcanic rocks in the extreme southeastern corner of the basin at the headwaters of Old Woman River. The absence of springs in bedrock in the basin indicates that there is little ground water in the bedrock.

Fluvial deposits of silt, sand and gravel, and cobbles are found in streambeds, flood plains, and terraces. The Unalakleet River flows in a broad alluvial valley downstream from Old Woman River. Baseflow measurements in late winter suggest that unfrozen zones in the alluvium discharge ground water to the streams.

Permafrost is present in most of the basin but its extent and thickness has not been determined. Ice-wedge polygons in the alluvium, indicating the presence of permafrost, can be found throughout the basin but are especially evident along and near the coast. Unfrozen zones occur in the alluvium underlying and adjacent to the streams. Certain types of vegetation, such as aspen trees, indicate that some of the well-drained, south-facing slopes also may be free of permafrost.

SEASONAL STREAMFLOW CONDITIONS

Late Summer Conditions

Late summer streamflow conditions are important for salmon movement and spawning in the Unalakleet River system. Pink salmon (Oncorhynchus gorbuscha) had completed spawning at the time of the August survey and many salmon carcasses were seen on exposed gravel bars. This would indicate higher water levels earlier in the summer. Coho salmon (Oncorhynchus kisutch) and Dolly Varden trout (Salvelinus malma) were common in the streams visited. Grayling (Thymallus arcticus) were present in the lower basin but were much more abundant in the upper stream reaches. Boats commonly used on the river have "V"-bottom aluminum hulls, 16 to 18 ft long, and are powered by 40- to 60-horsepower, propeller-equipped outboard motors. Boat travel was common on Old Woman, Chiroskey, North, and Unalakleet Rivers, and indicate channel depths of at least 2 ft. River travel on the Unalakleet River was not possible upstream from the mouth of Old Woman River due to shallow water, braided channels, and log jams.

Stream discharge was measured at nine sites along the Unalakleet River and its tributaries in August 1982 (table 2). Sites measured in both reconnaissance periods are numbered in downstream order. Locations are shown in figure 2. Discharge measurements made during the period August 24-30, 1982, provide estimates of late summer runoff in the basin. Field observations indicated that most streams were about half a foot higher than normal; grassy areas on shore were commonly inundated. Discharge measured in tributaries to the Unalakleet River ranged from 137 ft^3/s at South River (site 19) to 1,050 ft^3/s at North River (site 17). Discharge of the Unalakleet River increased from 595 ft^3/s at site 5 above Old Woman River to 2,170 ft^3/s at site 15 above North River.

Unit runoff, computed by dividing discharge by drainage area, is used to compare runoff rates between sites. The highest computed value was 2.4 $(ft^3/s)/mi^2$ based on an August 26 discharge measurement of 637 ft^3/s at the North Fork Unalakleet River (site 10). The lowest value found was 1.0 $(ft^3/s)/mi^2$, based on an August 30 discharge measurement of 137 ft^3/s at South River (site 19) in the lower Unalakleet River basin. Unit runoff from the northern tributaries was substantially higher than from the southern tributaries. These higher discharges suggest that the higher terrain in the northern part of the basin receives more precipitation and results in more runoff than the dryer southern part of the basin.

Stream-channel widths on the Unalakleet River increased downstream from 66 ft at site 5 above Old Woman River to 318 ft at site 15 above North River. Mean water depths on the Unalakleet River were about 2.6 ft. The only area to vary significantly from this was at site 11 (fig. 6) above Chiroskey River, where the mean depth was 4.1 ft.

Table 2.--Stream-site descriptions of August 1982 in Unalakleet River basin

Site No. (fig. 2)	Site name	Day	Drainage area (mi^2)	Discharge (ft^3/s)	Unit runoff [$(ft^3/s)/mi^2$]	Width (ft)	Mean depth (ft)	Max. depth (ft)	Mean velocity (ft/s)	Max. velocity (ft/s)	Bed material
5	Unalakleet River above Old Woman River	25	292	595	2.0	66	2.6	3.9	3.5	5.2	Cobble.
7	Old Woman River at mouth	24	315	500	1.6	77	1.6	2.5	4.4	5.4	Cobble.
8	Unalakleet River below Old Woman River	25	611	1,070	1.7	204	2.6	3.4	2.2	3.3	Gravel, cobble, some sand.
10	North Fork Unalakleet River	26	267	637	2.4	169	2.4	3.6	1.7	2.6	Cobble, gravel, some sand.
11	Unalakleet River above Chiroskey River	27	1,032	1,990	1.9	164	4.1	7.4	2.8	3.4	Gravel, cobble.
14	Chiroskey River above mouth	28	296	367	1.2	92	1.7	2.6	2.6	3.4	Gravel, sand, some cobble.
15	Unalakleet River above North River	29	1,388	2,170	1.6	318	2.7	3.8	2.4	2.8	Sand, gravel, some cobble.
17	North River at mouth	29	495	1,050	2.1	204	2.2	3.4	2.7	3.9	Sand, gravel, some small cobble.
19	South River near mouth	30	140	137	1.0	65	0.9	1.3	2.4	3.6	Cobble.

Figure 6.--Measuring site on the Unalakleet River above the Chiroskey River, August 27, 1982.

Streambed material is chiefly cobble and/or gravel, which also forms the normal flow banks. In a few places sand was present or replaced these materials as the main bottom cover (sites 15 and 17).

Late Winter Conditions

A second reconnaissance of the Unalakleet River basin was made in late March 1983 to determine low-flow discharges and other "late winter" stream conditions. Data were collected at the sites established in August 1982 and at 10 additional sites (fig. 2). Open-water reaches resulting from ground-water discharge could usually be found in the headwaters and near the mouths of most streams. Measurements were made at these sections. High unit discharge in the Unalakleet River below Tenmile River (site 4) indicates that ground-water discharge as springs is concentrated along the Unalakleet River above the Tenmile River confluence.

Areas of overflow and icings (aufeis) were common in the middle reaches of most basins. Only two sites had any appreciable ice cover; both of these were on the Unalakleet River. Unalakleet River above Chiroskey River (site 11) had a complete ice cover, about 4.0 to 5.5 ft thick. At Unalakleet River above North River (site 15), 70 percent of the flow was under about 3.0 ft of ice (fig. 7).

Figure 7.--Drilling through ice cover on the Unalakleet River above North River to measure streamflow and sample water quality, March 25, 1983.

Discharge data gathered during the March 1983 trip are shown in table 3. Measured discharge in headwater reaches of the streams ranged from 0.5 ft^3/s in Unalakleet River (site 1) to 6.2 ft^3/s in Tenmile River (site 2). Discharge of main streams ranged from no flow in South River (site 19) to 116 ft^3/s in Unalakleet River above North River (site 15). Although no flow was found in the South River, water in the channel at this site was free of ice probably because of the influence of comparatively warm ground water in the underlying and adjacent unfrozen alluvium.

The quantity of baseflow discharge in the Unalakleet basin is directly proportional to the volume of unfrozen alluvium and bedrock that discharges to streams and indirectly proportional to the rate of water loss to ice storage and ground water.

Table 3.--Stream-site descriptions of March 1983 in Unalakleet River basin

Site No. (fig.2)	Site name	Day	Drainage area (mi^2)	Discharge (ft^3/s)	Unit discharge [$(ft^3/s)/mi^2$]	Width (ft)	Mean depth (ft)	Max. depth (ft)	Mean velocity (ft/s)	Max. velocity (ft/s)
1	Unalakleet River (headwaters)	24	26	0.5	0.02	12	0.2	0.4	0.2	0.4
2	Tenmile River	23	66	6.2	.09	7	.4	.5	2.4	4.4
3	Tenmile River at mouth	23	80	5.7	.07	22	.4	.5	.8	1.3
4	Unslakleet River below Tenmile River	23	164	40	.24	38	.4	.8	2.3	4.6
5	Unalakleet River above Old Woman River	24	292	39	.13	37	.6	.9	2.0	2.9
6	Old Woman River (headwaters)	23	53	4.3	.08	6	.4	.6	1.8	2.8
7	Old Woman River at mouth	23	316	42	.13	25	1.3	1.4	1.4	1.9
8	Unalakleet River below Old Woman River	25	611	61	.10	68	1.0	1.5	1.0	1.8
9	North Fork Unalakleet River (headwaters)	24	103	3.8	.04	22	.2	.3	.7	1.0
10	North Fork Unalakleet River near mouth	24	267	16	.06	59	.5	.8	.6	1.0
11	Unalakleet River above Chiroskey River	25	1,032	84	.08	85	1.5	2.3	.7	.8
12	Chiroskey River (headwaters)	22	80	.7	.01	10	.2	.2	.4	.5
13	Chiroskey River (lower reach)	22	289	.9	.00	5	.2	.2	.9	1.4
15	Unalakleet River above North River	25	1,388	116	.08	123	.6	1.2	1.4	3.3
16	North River (headwaters)	24	41	4	.10	28	.4	.5	.4	.7
17	North River at mouth	25	496	65	.13	53	.8	1.0	1.6	2.2
18	South River (headwaters)	22	32	1.2	.04	5	.2	.3	1.0	2.4
19	South River near mouth	22	140	0.0	0	57	2.0	2.0	0	0

FLOODS AND EROSION

Flood hazards can be evaluated by a study of the evidence left by past floods. One of the objectives of the summer reconnaissance was to determine the magnitude of the maximum evident flood at selected stream cross sections within the basin. Although ample flood evidence was found at elevations 2 to 3 ft higher than existing banks, wide, densely vegetated flood plains with numerous overflow channels were impractical to survey. Therefore, maximum evident flood discharge was not computed for any of the sites.

Some cutoff channels isolated from the main channel were present on the flood plain in the upper reaches of the Unalakleet River and its tributaries. Such channels were more numerous and better defined in the lower reaches, and commonly showed evidence of overflow. Field observations and conversations with local residents indicate that spring floods cause considerable changes in channel size and location on the upper Unalakleet River and some of its tributaries. Newly formed braided channels and log jams prevented travel on the Unalakleet River above Old Woman River (site 5) and on the North Fork Unalakleet River (site 10).

Water levels on streams surveyed in August were somewhat higher than normal (inundating grass along the shore) and generally receded slowly during the trip. Drift lines 4 to 5 ft above river levels at the time of visit indicated recent (probably past spring) high water in some areas along the Unalakleet River.

Basin characteristics that influence floods of Alaska streams (Lamke, 1979) were used in multiple-regression equations to determine discharges for the 2-year flood (Q_2) and the 50-year flood (Q_{50}) (table 4). A Q_2 flood discharge has a 50 percent chance of being equalled or exceeded in a particular year; a Q_{50} flood discharge has a 2 percent chance of being equalled or exceeded. Estimates of mean annual precipitation used to calculate these floods are subject to considerable error. The calculated flood discharges are useful, however, to give an idea of the magnitude of floods that could be expected, and to indicate the relative size of floods on different tributaries in the basin.

Table 4.--Unalakleet River basin and streamflow characteristics

Site No. (fig. 2)	Site name	Basin characteristics: Slope (ft/mi)	Drainage area (mi^2)	Estimated mean annual precip-itation (in.)	Mean minimum Jan. temp. (°F)	Area (percent): Forest	Lakes ponds swamps	Flood characteristics (ft^3/s): Q_2 (2-yr flood)	Q_{50} (50-yr flood)	Unit runoff [$(ft^3/s)/mi^2$]: Q_2	Q_{50}
5	Unalakleet River above Old Woman River	30	292	22	-10	44	1	4,200	11,760	14	40
7	Old Woman River at mouth	23	315	23	-10	53	0	4,500	12,500	14	40
8	Unalakleet River below Old Woman River	33	611	22	-10	49	1	4,320	10,600	7	17
10	North Fork Unalakleet River	31	267	23	-9	31	1	4,270	11,900	16	45
11	Unalakleet River above Chiroskey River	12	1,032	20	-8	44	1	12,700	29,100	12	28
14	Chiroskey River above mouth	16	296	22	-8	43	1	3,790	10,200	13	34
15	Unalakleet River above North River	9	1,388	19	-7	43	3	12,700	27,200	9	20
17	North River at mouth	19	495	22	-7	55	1	5,800	14,400	12	29
19	South River near mouth	29	140	18	-7	29	<1	1,940	5,650	14	40
	Total basin at mouth	7	2,054	22	-8	45	2	21,100	43,900	10	21

The Unalakleet River had pool/riffle sequences that ranged in length from 500 to 600 ft in the upper reaches to 1,000 to 1,200 ft in the middle part of the basin. Bottoms of the pools usually consisted of gravel and cobble with some sand.

Little evidence of ice gouging was observed on vulnerable stream-side trees along the Unalakleet River and no ice "bulldozing" of gravel was found on exposed river bars. This indicates that most streams within the basin "break up" by forming open channels where the river ice gradually melts in place.

Bank sloughing was largely confined to the upper reaches of the Unalakleet River and upper basin tributaries such as the area around the Old Woman River confluence. Banks in the middle and lower reaches appeared to be fairly stable; no appreciable areas showed evidence of erosion. A few areas in the lower reach of the Unalakleet River showed evidence of minor bank scour. Bank material most commonly consisted of a silt/gravel mix.

WATER QUALITY

Selected water quality and related properties of the stream waters were measured during the August 1982 and March 1983 field trips (tables 5 and 6). Measurements were made at nine sites in August: four on the Unalakleet River and five sites on tributary streams. Dip net samples of stream biota

were collected at each site. In March, measurements were made at 18 sites, some of which were the same as those visited during the August trip. Field measurements at both times consisted of stream discharge, specific conductance, temperature, pH, dissolved oxygen, percent oxygen saturation, and alkalinity. Data presented in this report indicate the general characteristics of water quality in the Unalakleet drainage basin.

Table 5.--Field-water quality and related properties from sites in the Unalakleet River basin, August 1982

Site No. (fig. 2)	Site name	Day	Time	Discharge (ft^3/s)	Specific condctance (µS/cm)	Temperature (°C)	pH (units)	Dissolved oxygen (mg/L)	Dissolved oxygen (percent saturation)	Alkalinity (mg/L as $CaCO_3$)
5	Unalakleet River above Old Woman River	25	10:00	595	115	7.0	7.3	11.1	90	62
7	Old Woman River at mouth	24	16:00	500	115	9.0	6.8	11.0	94	56
8	Unalakleet River below Old Woman River	25	14:00	1,070	105	8.0	7.4	11.6	97	59
10	North Fork Unalakleet River	26	11:30	637	120	7.0	7.5	11.2	91	65
11	Unalakleet River above Chiroskey River	27	16:30	1,990	118	10.0	6.7	10.8	96	58
14	Chiroskey River above mouth	28	15:30	367	155	8.0	7.3	11.1	94	69
15	Unalakleet River above North River	29	15:30	2,170	125	9.0	7.5	11.3	98	63
17	North River at mouth	29	19:30	1,050	205	9.0	8.4	12.6	110	111
19	South River near mouth	30	11:00	137	210	9.0	7.8	10.8	94	115
	Ranges of collected data			Main 595–2,170; trib. 137–1,050	105–210	7.0–10.0	6.7–8.4	10.8–12.6	90–110	56–115

Median specific conductance values measured during the August and March trips were similar: 120 and 125 µS/cm, respectively. Specific conductance values for the North River and South River during both summer and winter trips were generally the highest recorded during this investigation.

Water temperature ranged from 7.0 °C to 10.0 °C with a median value of 9.0 °C in August; and ranged from 0.0 °C to 1.0 °C with a median temperature of 0.0 °C in March. Values of pH showed only small seasonal variations in maximum, median, and minimum values. Median values of dissolved oxygen were about 11.0 mg/L in both summer and winter with percent saturation levels lowest (51 percent) during winter when the stream is ice covered and ground water is a large component of streamflow.

The following statements can be made based on water-quality information collected during the two field trips:

* Chiroskey, North, and South Rivers had higher specific conductance values than did other tributaries in both summer and winter.

* Values of specific conductance measured in March on North River and South River differed little from headwaters to the mouth.

* The lowest measured dissolved-oxygen level (51 percent) was at the mouth of the South River in March. (Intensive salmon spawning activity was observed at this site in August.)

* Except for the sites at South River near mouth and Unalakleet River above North River, dissolved-oxygen saturation levels were about 70 percent or greater in both August and March.

* Water temperatures were about 9 °C in August and just above freezing (0 °C) in March. Temperatures varied only slightly between tributaries and main stem.

* Although tides affected the stage and velocity of the Unalakleet River to a point a short distance upstream from the mouth of the North River, specific conductance values indicate little, if any, salt water intrusion in this area.

Table 6.--Field-water quality and related properties from sites in the Unalakleet River basin, March 1983

Site No. (fig. 2)	Site name	Lat. long.	Day	Time	Discharge (ft^3/s)	Specific conductance (µS/cm)	Water temp. (°C)	pH (units)	Dissolved oxygen (mg/L)	Dissolved oxygen (percent saturation)	Alkalinity (mg/L as $CaCO_3$)
1	Unalakleet River (headweters) near Kaltag	64°15'12" 159°21'13"	24	12:30	0.5	160	1.0	6.9	11.0	80	62
2*	Tenmile River near Unalakleet	64°03'48" 159°33'47"	23	13:30	6.2	115	.0	6.9	--	--	49
3*	Tenmile River st mouth near Unalakleet	64°05'34" 159°37'38"	23	15:30	5.7	--	--	--	--	--	--
4*	Unalakleet River below Tenmile River near Unalakleet	64°05'31" 159°37'43"	23	15:00	40	110	.0	6.7	12.6	87	49
5	Unalakleet River above Old Woman River near Unalakleet	64°01'40" 159°49'38"	24	11:00	40	110	.0	6.8	10.7	73	49
6*	Old Woman River (headwaters) near Unalakleet	63°37'42" 159°48'50"	23	10:00	4.3	100	.0	6.6	13.1	92	96
7	Old Woman River at mouth near Unalekleet	64°01'37" 159°49'40"	23	16:00	42	125	.0	6.7	10.5	72	55
8	Unalakleet River below Old Woman River near Unalakleet	64°01'11" 159°52'48"	25	10:00	61	124	.0	7.0	10.6	73	56
9*	North Fork Unalakleet River (headwaters) near Kaltag	64°17'33" 159°40'24"	24	13:00	3.8	114	.0	6.9	12.5	88	56
10	North Fork Unalakleet River near Unalakleet	63°58'56" 159°58'16"	24	09:30	16	130	.5	6.8	10.2	71	62
11	Unalakleet River above Chirosky River near Unalakleet	63°55'38" 160°20'22"	25	12:30	84	100	.0	6.8	9.8	67	46
12*	Chiroskey River (headwaters) near Unalakleet	63°38'46" 160°27'33"	22	13:30	.7	140	.0	6.4	10.4	73	52
13*	Chiroskey River (lower reach) near Unalakleet	63°51'46" 160°15'26"	22	14:30	.9	235	.0	6.7	11.0	76	71
14	Chiroskey River above mouth	63°55'14" 160°19'29"	This site not visited during winter trip								
15**	Unalakleet River above North River near Unelakleet	63°52'35" 160°36'43"	25	16:00	116	105	.0	6.8	8.0	54	49
16*	North River (headwaters) near Kaltag	64°24'54" 159°48'15"	24	14:00	4	285	.0	7.5	13.0	92	143
17	North River at mouth near Unalakleet	63°52'40" 160°38'50"	25	14:00	65	255	.0	7.2	10.3	70	102
18*	South River (headweters) near Unelakleet	63°34'56" 160°43'22"	22	12:00	1.2	180	.0	6.7	11.8	84	85
19	South River neer mouth near Unalakleet	63°51'40" 160°39'20"	22	10:00	.0	188	.0	6.6	7.5	51	78
	Ranges of collected deta				0.0-116	100-285	0.0-1.0	6.4-7.5	7.5-13.1	51-92	46-143

* New sites established on March trip.
** Additional laboratory analysis of sample collected at this site (table 7).

A sample for laboratory analysis was collected in March at the Unalakleet River site above North River (site 15). The analysis (table 7) indicates the following characteristics of water at this site:

* The water is relatively soft; hardness as calcium carbonate ($CaCO_3$) is 49 mg/L. Water containing less than 60 mg/L $CaCO_3$ is considered soft.
* The water is a calcium bicarbonate type.
* The water is low in nutrients.
* The water is low in trace metals.

Table 7.--Laboratory analysis of sample collected March 25, 1983, Unalakleet River above North River (site 15)

[Dissolved constituents analyzed from sample filtering through a 0.45 micron membrane filter]

Constituent	Value in milligrams per liter, except as noted	Metal (dissolved)	Value in micrograms per liter
Specific conductance (µS/cm)	115	Aluminium (as Al)	< 10
pH	6.8	Arsenic (as As)	< 1
Turbidity (NTU)	.5	Barium (as Ba)	20
*Dissolved solids residue at 180°C	61	Beryllium (as Be)	< 0.5
Calculated sum	69	Cadmium (as Cd)	< 1
Silica, dissolved (as SiO_2)	8.7	Chromium (as Cr)	< 1
Hardness ($CaCO_3$)	49	Cobalt (as Co)	< 3
Noncarbonate hardness (as $CaCO_3$)	0	Copper (as Cu)	2
Calcium, dissolved (as Ca)	12	Iron (as Fe)	110
Magnesium, dissolved (as Mg)	4.6	Lead (as Pb)	1
Sodium, dissolved (as Na)	3.5	Lithium (as Li)	8
Potassium, dissolved (as K)	.6	Manganese (as Mn)	36
Alkalinity (as $CaCO_3$)	51	Mercury (as Hg)	< .1
Sulfate, dissolved (as SO_4)	7.0	Molybdenum (as Mo)	< 10
Chloride, dissolved (as Cl)	1.2	Nickel (as Ni)	1
Fluoride, dissolved (as F)	< .1	Selenium (as Se)	< 1
NO_2 + NO_3, total (as N)	.3	Silver (as Ag)	< 1
Nitrogen, total (as N)	1.2	Strontium (as Sr)	110
Nitrogen, NH_4 + organic, total (as N)	.9	Vanadium (as V)	< 6
Nitrogen, total (as NO_3)	5.3	Zinc (as Zn)	< 3
Phosphorus, dissolved (as P)	.01		
Phosphorus, total (as P)	.01		

*Dissolved residue is calculated from the sum of following constituents: Ca, Mg, Na, K, alkalinity, Cl, SO_4 and SiO_2

AQUATIC ORGANISMS

A qualitative assessment of aquatic organisms was made at nine sites in the Unalakleet River basin during the August 1982 trip. Four of the nine sites were on the Unalakleet River and five on tributaries. Organisms were collected using a dip net (fig. 8) following procedures outlined by Childers and Kernodle (1981, 1983). No biological sampling was done during the March 1983 trip; at most sites, however, algae, Trichoptera larva, and Plecoptera and Ephemenoptera nymphs were commonly observed on streambed material.

Figure 8.--Sampling benthic invertebrates with a dip net in the South River, August 30, 1982.

Biological samples were collected at or near the same locations as the water quality and discharge data described earlier in this report. Results of the analyses of these samples (table 8) are given as percentages of total numbers of organisms collected per sample. The number of taxa (major groups of organisms having similar physical characteristics) denotes the relative degree of diversity among sites sampled and indicates general community structure present in the basin. The greater the diversity in a given invertebrate population, the more likely the surface water has been unaltered from its natural state and is in good biological health. In contrast, polluted water generally has only a few taxa, each containing large numbers of organisms. The number of taxa per site ranged from 10 at North Fork Unalakleet River (site 10) and North River (site 8) to 14 at South River (site 9).

The Diptera family Chironomidae (midge larva) represented the largest group found at most sites. The Unalakleet River above North River (site 15) had the highest percentage of chironomids, 53 percent. The dominant organisms (fig. 9) at the nine sites sampled were chironomid larva at six sites, mayfly nymphs at two sites, and stonefly nymphs at one site. The presence of these pollution-sensitive nymphs substantiates the presence of well-oxygenated water.

Although Trichoptera larva (caddis flies) were found at all sites, they represented a significant percentage of the total sample population for only one site -- Unalakleet River above Chiroskey River (site 11).

Identification of specimens collected during the limited biological sampling effort conducted in August 1982 indicates a reasonably diverse population of aquatic organisms. The benthic invertebrates that were most prevalent are also those that provide an important source of fish food and generally indicate unpolluted waters.

Table 8.--Aquatic organisms collected within the Unalakleet River basin, August 1982

[Results shown as percentages of total number of organisms collected per sample; P - present but less 1 percent]

Phylum	Class	Order	Family	Site name / Site number / Day / Common name	Unalakleet River above Old Woman River	Old Woman River at mouth	Unalakleet River below Old Woman River	North Fork Unalakleet River	Unalakleet River above Chiroskey River	Chiroskey River above mouth	Unalakleet River above North River	North River at mouth	South River near mouth
				Site number	5	7	8	10	11	14	15	17	19
				Day	25	24	25	26	27	28	29	29	30
Arthropoda	Insecta	Diptera	Chironomidae	Midges	30	31	34	25	33	26	53	48	41
			Emphididae	Dance flies	--	--	--	--	--	--	--	--	P
			Psychodidae	Moth flies	P	P	1	1	2	--	2	P	6
			Rhagionidae	Snips flies	--	--	--	--	--	--	--	--	P
			Simuliidae	Blackflies	P	P	2	4	5	4	--	2	P
			Tipulidae	Crane flies	P	P	1	1	P	P	--	2	3
		Collembole		Springtails	P	--	P	--	--	--	--	P	P
		Ephemeroptera		Mayflies	49	37	33	26	13	21	1	13	27
		Plecoptera		Stone flies	14	25	27	30	6	22	P	18	6
		Trichoptera		Caddis flies	2	P	P	1	24	6	3	1	5
		Acarina		Water mites	3	4	1	4	14	3	9	5	8
	Crustacea	Amphipoda		Side swimmers	--	P	--	--	--	--	--	--	--
		Eucopepoda		Copepods	P	P	P	--	1	P	3	--	P
		Podocopa		Seed shrimps	P	P	P	--	1	3	12	--	P
Annelida	Oligochaeta			Aquatic earthworms	P	P	--	6	P	12	13	9	1
Nematoda				Roundworms	--	--	--	--	--	--	3	--	--
Chordata	Osteichthyes	Piaces	Cottidae	Sculpins	P	P	P	1	--	P	P	--	--
Number of taxa per sample					13	13	12	10	11	11	11	10	14
Number of organisms collected per sample					2,005	3,447	2,454	320	510	116	493	219	307

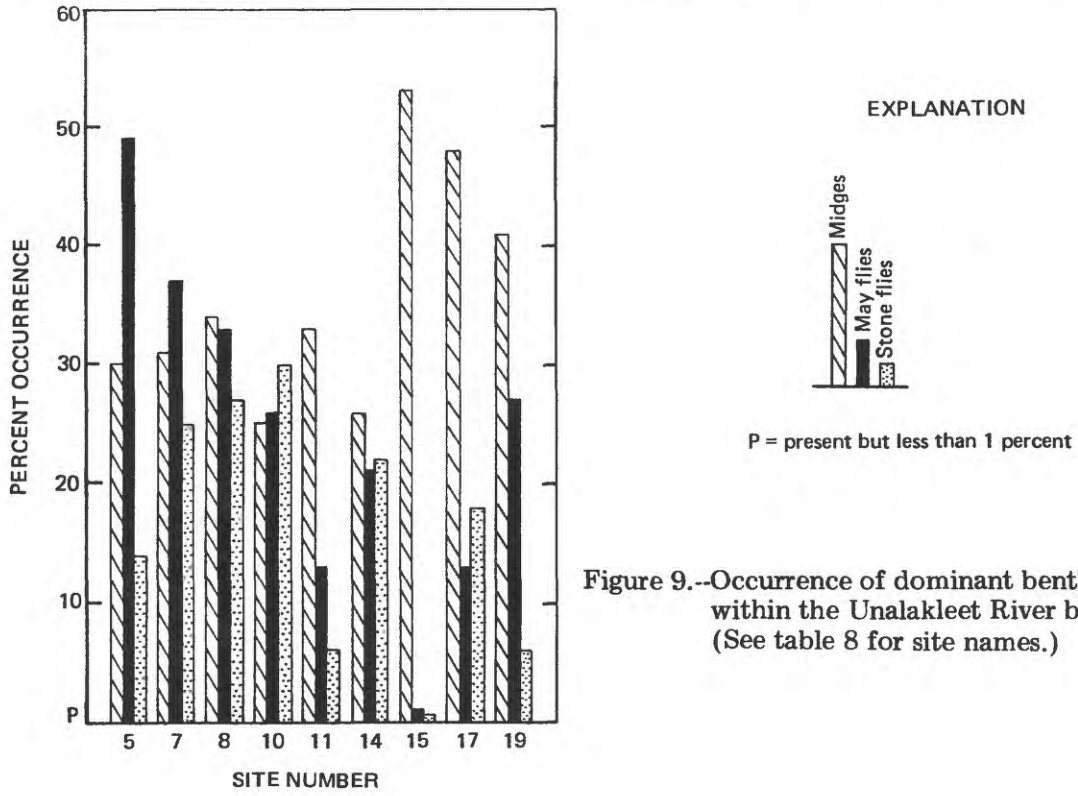


Figure 9.--Occurrence of dominant benthic invertebrates within the Unalakleet River basin, August 1982. (See table 8 for site names.)

GROUND WATER

Late-winter low flow in the Unalakleet River basin is derived almost totally from ground-water discharge. Prior to the onset of snowmelt in the spring, streamflow is sustained by discharge of ground water stored in alluvium adjacent to and underlying the major streams (fig. 10). Owing to the presence of permafrost and low-permeability bedrock in most of the basin, ground water is both recharged and discharged principally along stream courses in alluvium. The absence of upland springs indicates that bedrock is not a major source of ground water. The main stem of the Unalakleet River and the major tributaries are generally aligned along major faults, so there is some possibility of interconnection of the alluvial aquifers with fractured bedrock buried beneath the valleys.

The rich spawning and fisheries habitat of the Unalakleet River that is so important to the economy of the area is almost totally dependent on the flow of ground water into the streams during the winter months.

Ground-water resources within the basin are virtually unused for water supply. A well near a tributary of the Unalakleet River, once used to supply the White Alice communications site, is now abandoned. Well points driven into the alluvium provide water supply at several cabins in the basin.

The community of Unalakleet has obtained ground water in the past from shallow wells in the village and from a collection gallery under a small stream northeast of the village. At present, water is piped from a developed gallery and well under a small stream north of the airport, which is outside the Unalakleet River basin.

Figure 10.--Open water in the headwaters of the North River representing ground-water discharge, March 24, 1983.

CONCLUSIONS

Seasonal variations in streamflow and the estimated magnitude of floods in the Unalakleet River basin are about as would be expected for this part of Alaska, given its climatic characteristics. Bank erosion is fairly rapid in some of the upper parts of the basin, leading to the transport of trees with resultant log jams in the streams. Such conditions, although hampering boat travel, have little effect on the aquatic resources of the basin. Ground-water conditions in the Unalakleet River basin are critical in sustaining winter low flow and the resultant productivity of the fisheries in the system. High baseflow occurred in the North River, Old Woman River and in the main stem of the Unalakleet River above the Tenmile River confluence. Baseflow in the South River at the mouth essentially ceases in winter and is quite low in the Chiroskey River. Baseflow along the main stem downstream from Tenmile River is fairly uniform. The quality of the water is excellent and the flow is dependable throughout most of the system.

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