News of this new strike spread quickly. By the summer of 1899, an estimated 3,000 people had descended on the new community of Nome. By the fall of 1899, Nome was a booming city of 5,000 people. The discovery of gold on the beaches led to a full scale stampeed during the following year. The population of the community exploded to a size of 20,000 (Cole 1984:24-55). At the conclusion of the mining season in the autumn of 1900, some 15,000 disappointed miners left Nome before winter freeze up. This brought to an end the famous Nome Gold Rush. However, gold mining had become firmly established in the Nome and Council areas, providing a small but stable population that would change the character of the region.

Early Gold Mining in the Solomon River Basin

The Bonanza Mining District, which included the Solomon River, was organized June 8, 1899 at a miners meeting convened at the junction of California and Alta creeks (McElwaine 1901:265). The Solomon River was named by Pierce Thomas, one of the prospectors who was traveling along the coast of the Seward Peninsula looking for gold. Thomas staked the discovery claim on the Solomon River near the mouth of Big Hurrah Creek in June of 1899. The claim produced $150 in gold for the three men who worked it that season (Smith 1910:13, 155, 166). In September of 1899, a U. S. Coast and Geodetic Survey vessel conducted a survey of the coast along Safety Sound (Shrader and Brooks 1900:39). A U. S. Geological Survey team visited the area at about the same time. The team noted that there were a number of propsectors giving attention to the Bonanza and Solomon river areas. The latter was the seat of small mining operations (Smith 1910:13). The geologists reported that "little or no systematic development had begun" in the area. "Good diggings are reported to have been found on most of the rivers," they reported, and the region was said to have afforded "good prospects" (Shrader and Brooks 1900:26-27, 49).

The prospect of gold brought several thousand miners to the area east of Cape Nome during the following season. Prospectors found evidence of gold in the gravels throughout almost the entire length of the Solomon River and many of its tributaries. A nugget worth $157 was found at the mouth of Big Hurrah Creek (McElwaine 1901:267). Placer claims were filed on Manila and Jerome Creeks, and on the tributaries of Shovel Creek such as Mystery, Problem, West, Kasson and Adams creeks. However, the results of the 1900 season were not what many had expected. Gold was found in all of these creeks, but not in paying quantities. The only productive mining operations during 1900 were on Penny Creek and Big Hurrah Creek. It was believed by some geologists, however, that the tundra and bench deposits in the Solomon River area "may contain placers similar to those of the Nome Region." Since much of the activity in the area involved prospecting, very little development work was completed. Gold production on the Solomon River and its tributaries that year amounted to only $10,000 (Brooks 1901:66, 100-102).

During the following two seasons, attention continued to be focused on creek mining. Prospectors used mainly picks and shovels, and small hand-made sluice boxes. By 1902 and 1903 several small dredges had been built and successfully operated. A steam shovel was being used on the Solomon River at the mouth of Shovel Creek. The primary mining methods employed, however, were hand digging (Smith 1910:155, 162-63). By 1904, one small and one large

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HYDROLOGIC RECONNAISSANCE OF THE TULUKSAK RIVER BASIN, ALASKA, 1984-85

By

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Alaska Division of
Geological and Geophysical Surveys

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THIS REPORT HAS NOT BEEN REVIEWED FOR TECHNICAL CONTENT (EXCEPT AS NOTED IN TEXT) OR FOR CONFORMITY TO THE EDITORIAL STANDARDS OF DGGS.

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PROJECT DESCRIPTION

Alaska DGGS personnel reconnoitered the Tuluksak River basin in southwestern Alaska in June 1984 and March 1985 to collect hydrologic data to describe the flow characteristics and quality of the surface water in the basin under both summer (high-flow) and winter (low-flow) conditions.

The 86-mi-long Tuluksak River drains approximately 830 mi^2 in southwestern Alaska. From its headwaters in the Kilbuck Mountains the river drops 1400 ft to enter the Kuskokwim River at the village of Tuluksak. The Tuluksak River is a slow moving, meandering stream over most of its length, cutting through several tundra areas in its lower section. The Fog River, a major tributary, drains a large area of tundra and contributes significantly to the brown color of the water in the lower section (Alt, 1977).

The upper Tuluksak basin is comprised of tightly folded Cretaceous rocks with interbedded layers of graywacke and shale, intruded by Cretaceous granitic rocks. Jurassic volcanic and sedimentary rocks in the foothills give way to Quaternary silt and sand deposits on the extensive lowlands (Beikman, 1974). The basin is generally underlain by moderately thick to thin permafrost, with isolated masses of permafrost in the mountains. Bedrock is exposed in parts of the upper basin, with alpine tundra, sedges, mosses, low shrubs and scattered stands of black spruce interspersed. Tundra vegetation dominates in the lowlands, with willow, alder, spruce, birch and cottonwood lining the major stream courses (Selkregg, 1976; Rieger and others, 1979; Alt, 1977).

The Tuluksak River basin lies within the transitional climatic zone of Alaska.

Continuous records kept for Nyac (9 to 14 years) show a summer temperature range of 37°F to 66°F and winter temperature range of -4°F to 12°F with recorded extremes of -49°F and 87°F. Precipitation averaged 23 in. including 43 in. of snow (Selkregg, 1976). Local variations in temperature and precipitation can be expected within the basin. Freeze-up generally occurs around the end of October and streams remain frozen until April or May.

Two significant settlements are located within the Tuluksak River basin. Tuluksak, a native village of approximately 260 people, is located at the mouth of the Tuluksak River. A largely subsistence economy relies heavily on fishing in the Tuluksak and Kuskokwim Rivers. Recurrent ice-jam flooding and some river-bank erosion occur (Alaska Department of Environmental Conservation, 1984). The mining camp of Nyac is located near mile 70 of the Tuluksak River in the upper part of the basin. Named for the "New York Alaska [Gold Dredging] Corporation", it has been the site of a placer gold mining operation since early in this century (Heiner, 1977). Extensive tailings occupy the floodplain of the Tuluksak River, Bear Creek and other smaller tributaries in this area.

DGGS personnel floated the Tuluksak River from mile 64 to its mouth in June 1984. Additional data-collection sites upriver were reached by truck from Nyac. The sites were revisited by helicopter in March 1985. Discharge, water-quality and stream-channel measurements were obtained.

Information in this report can be used to assess runoff and baseflow conditions of the river system and to estimate the year-round regimen of this southwestern Alaska river basin.

EXPLANATION OF GRAPHICS

Figure 1 is an index of U.S. Geological Survey (USGS) 1:250,000- and 1:63,360-scale topographic maps of the Tuluksak River basin.

Figure 2 shows the generalized physiography of the basin superimposed over a diagrammatic representation of the riverine system.

Figure 3 is a profile of the Tuluksak River and selected tributaries compiled from USGS 1:63,360-scale topographic maps. Comparative gradients along river segments and the position of tributaries and data-collection sites are shown.

Figure 4 contains a channel cross section of each data-collection site. Cross sections were developed from survey measurements taken during the June 1984 reconnaissance. Bankfull channel stage was determined from the flood-plain surface and the lower limits of permanent vegetation (Childers and Kernodle, 1983); maximum-evident-flood (MEF) stage was extrapolated from high-water marks found on the riverbanks.

Table 1 is a summary of the channel geometry and discharge measurements taken during the two reconnaissance trips and the calculated unit runoff based on these measurements. Unit runoff, obtained by dividing stream discharge by drainage area, can be used to compare seasonal water yields in a basin or subbasin (Childers and Kernodle, 1983).

Table 2 contains calculations based on the observed data. From the channel cross sections, the approximate discharge for bankfull and MEF conditions are calculated with the simplified slope-area method (Riggs, 1979). The bankfull discharge indicates the maximum amount of flow that may be expected without flooding, and the MEF discharge indicates the maximum instantaneous peak discharge at the site in recent years (Childers and Kernodle, 1983). Drainage-basin characteristics are used to calculate predicted 2-yr and 50-yr floods using Lamke's (1979) method. (A 2-yr flood has a 50 percent chance of being exceeded in a particular year, whereas a 50-yr flood has a 2 percent chance of being exceeded; these values are based on multiple regression analysis of streamflow records, which are very scanty in Alaska.) The Froude number is a mathematical relationship between mean velocity, mean depth and the gravitational constant and is used to compare states of flow at the sites. (In a rectangular channel, flow is tranquil if the Froude number is less than 1.0 and is rapid if greater than 1.0 [Dalrymple and Benson, 1968].) Observed summer conditions were used as a basis in calculating discharge using the simplified slope-area method and may be compared to the actual discharge values in Table 1. Site-specific conditions, such as changes in slope and nonuniformity of flow due to a nonideal channel reach, cause discrepancies between calculated and measured discharge values.

Table 3 is a summary of water-quality data gathered at all sites during the 1984 and 1985 reconnaissance trips.

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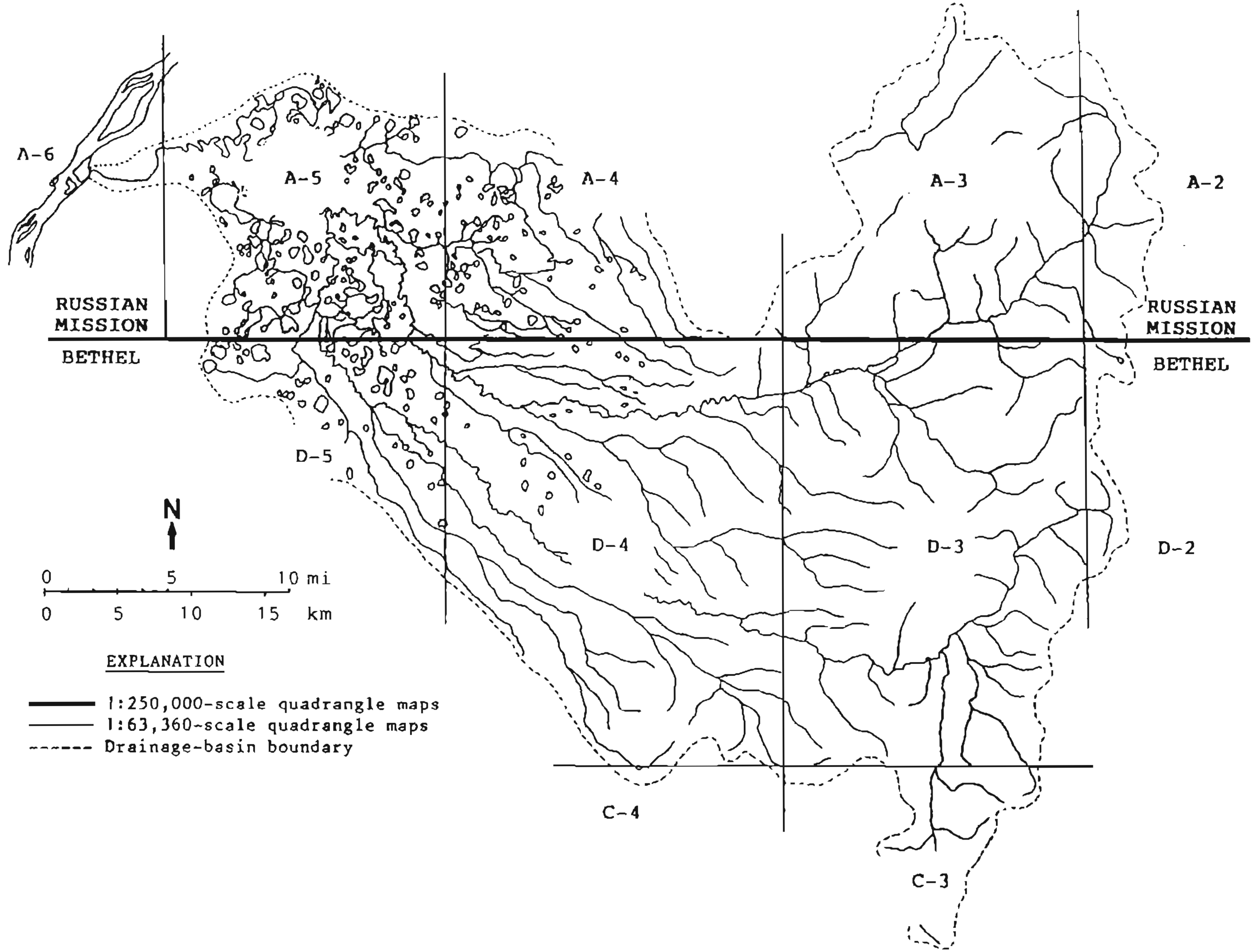

Figure 1. Index of U.S. Geological Survey topographic maps by quadrangle for the Tuluksak River basin, Alaska.

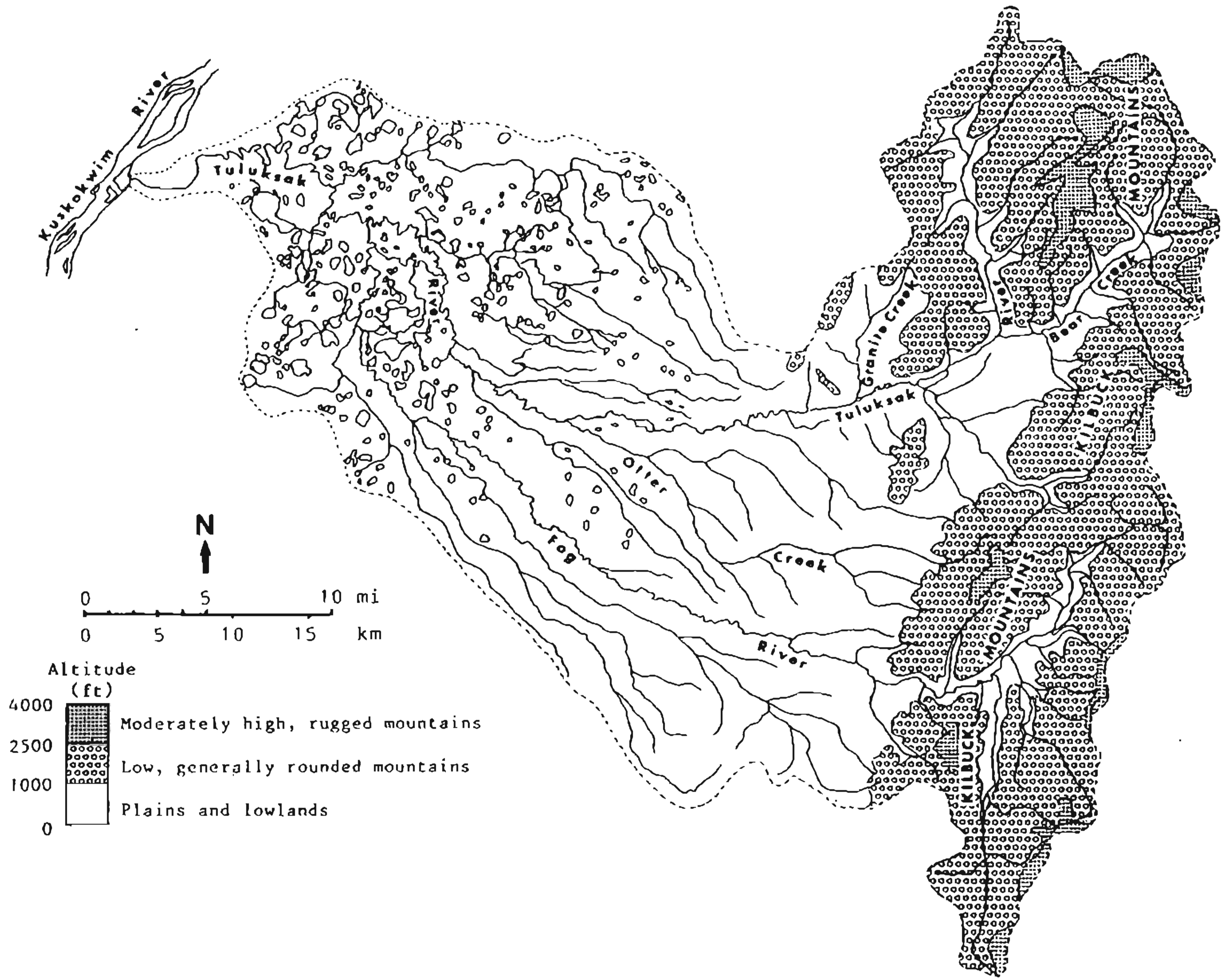

Figure 2. Generalized physiography, Tuluksak River basin, Alaska.

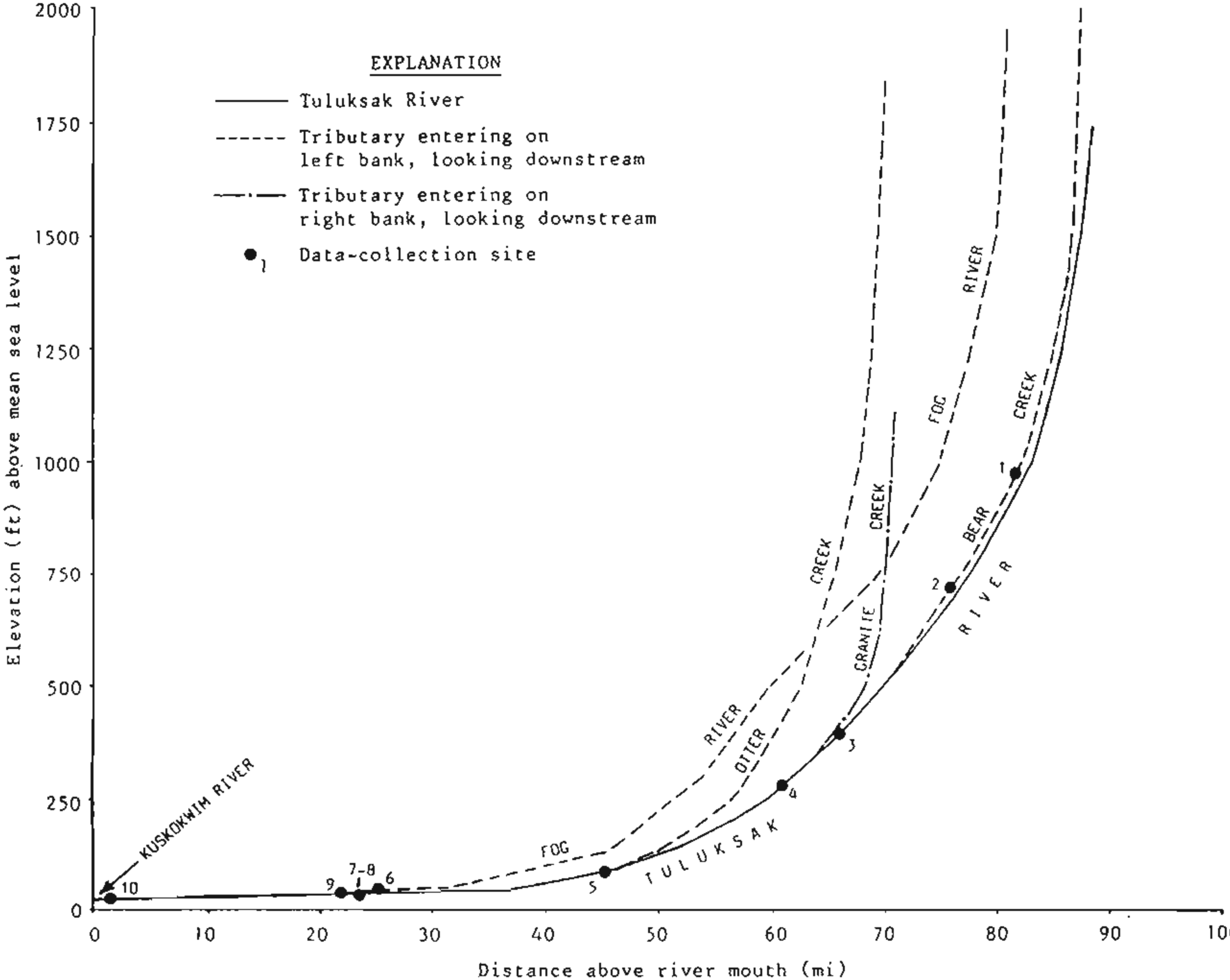

Figure 3. Profile of Tuluksak River and selected tributaries, Alaska.

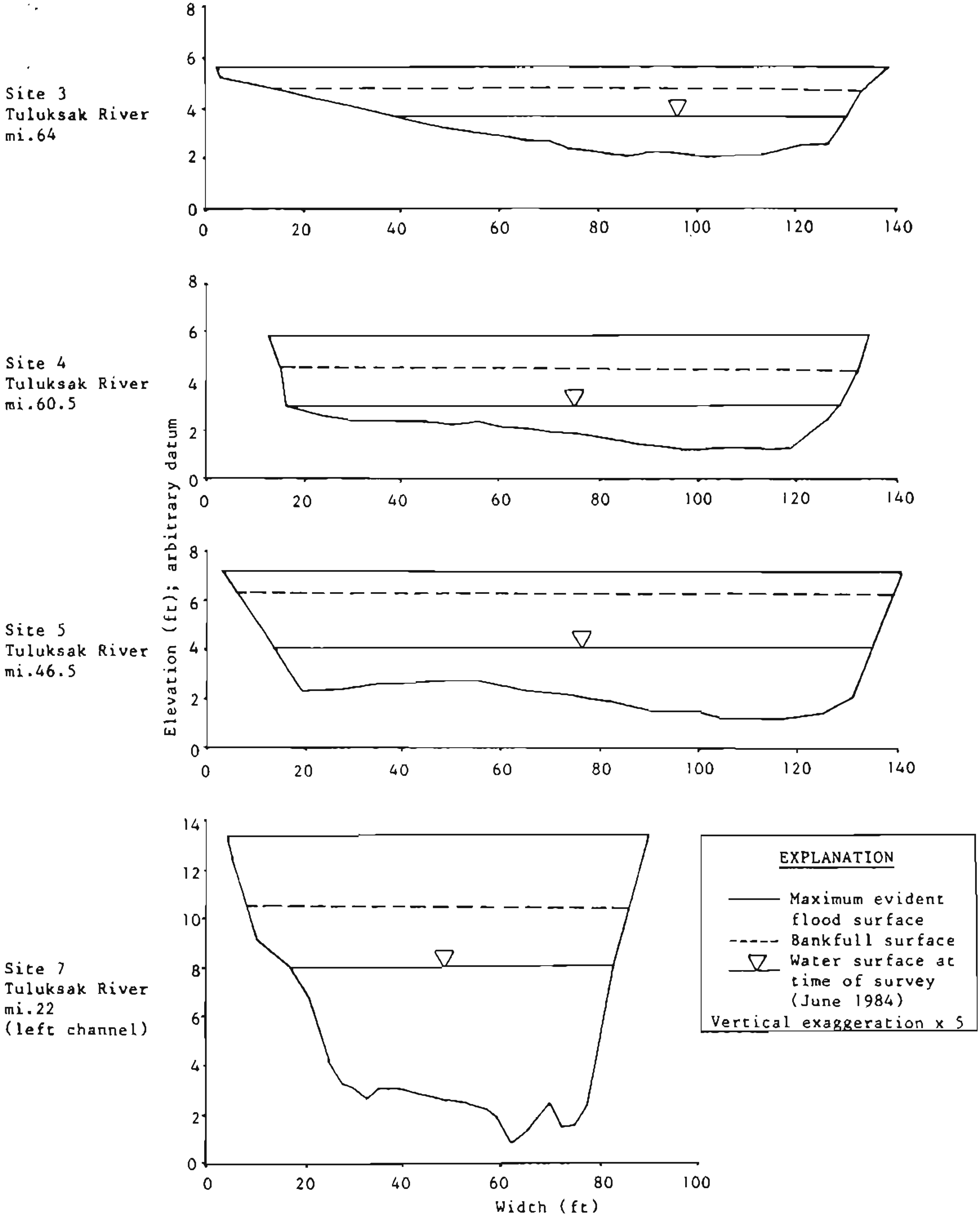

Figure 4. Channel cross-sections, Tuluksak River basin, June 1984.

Table 1. Summary of observed discharge and cross-sectional data, Tuluksak River basin, Alaska, 1984-85.

Data collection site	Bed material	Slope (ft/ft)	Cross-sectional area-ft² winter[a]	Cross-sectional area-ft² summer	Water-surface width (ft) winter	Water-surface width (ft) summer	Mean depth (ft) winter	Mean depth (ft) summer	Maximum depth (ft) winter	Maximum depth (ft) summer	Mean velocity (fps) winter	Mean velocity (fps) summer	Maximum velocity (fps) winter	Maximum velocity (fps) summer	Discharge (cfs) winter	Discharge (cfs) summer	Unit runoff (cfs/mi²) winter	Unit runoff (cfs/mi²) summer
3. Tuluksak River mi 64	cobbles, gravel	0.0049	10	101	11	95	0.8	1.0	1.9	1.7	0.9	1.9	2.4	4.3	14	250	0.07	1.24
4. Tuluksak River mi 60.5	cobbles, gravel	0.0015	40	112	43	112	0.8	1.0	1.7	1.8	1.1	1.9	2.2	4.0	53	267	0.23	1.15
5. Tuluksak River mi 46.5	gravel	0.0007	52	231	61	122	0.9	1.8	3.0	2.8	0.6	1.4	2.4	2.4	71	343	0.22	1.07
7. Tuluksak River (left channel) mi 22[c]	silt, sand	0.0004	[b]-	319	-	66	-	4.9	-	7.2	-	1.4	-	2.3	-	473	-	-
9. Tuluksak River mi 21.5	silt, sand	-	190	-	90	-	1.9	-	3.9	-	0.7	-	2.0	-	182	-	0.25	-

[a] 'Winter' refers to reconnaissance of March 26-27, 1985; 'summer' to June 18-22, 1984.
[b] No measurements made.
[c] Data for this site represents only the larger of two divergent channels and does not indicate total flow or runoff from this drainage area.

Table 2. Summary of calculated discharge and cross-sectional data, Tuluksak River basin, Alaska, 1984-85.

Data collection site	Calculated bankfull characteristics: Cross-sectional area (ft²)	Water-surface width (ft)	Mean depth (ft)	Maximum depth (ft)	Mean velocity (fs)	Discharge (cfs)	Calculated MEF characteristics: Cross-sectional area (ft²)	Discharge (cfs)	Unit runoff (cfs/mi²)	Drainage basin characteristics[a]: Area (mi²)	Mean annual precipitation (in.)	Mean minimum temperature, January (°F)	% of basin forested	% of basin under lakes	Predicted flood Q_2 (cfs) 2-year flood	Q_{50} 50-year flood	Froude number (6/84 flow)	Calculated slope-area discharge at observed 6/84 stage (cfs)
3. Tuluksak River mi. 64	215	118	1.8	2.8	5.3	1,130	336	2,030	10.1	202	20	-4	21	0	1,820	4,860	0.34	414
4. Tuluksak River mi. 60.5	297	118	2.5	3.4	3.9	1,170	441	1,970	8.5	233	20	-4	24	0	2,040	5,350	0.34	319
5. Tuluksak River mi. 46.5	510	132	3.9	5.1	3.5	1,790	645	2,440	7.6	322	20	-4	19	0	2,850	7,180	0.18	623
6. Fog River	-[b]	-	-	-	-	-	-	-	-	327	20	-4	6	2	2,740	6,860	-	-
7. Tuluksak River (left channel) mi. 22[c]	495	79	6.3	9.6	2.7	1,360	337	2,310	-	-	-	-	-	-	-	-	0.11	758
9. Tuluksak River mi. 21.5	-	-	-	-	-	-	-	-	-	715	20	-4	32	2	3,190	11,700	-	-
10. Tuluksak River mi. 1.5	-	-	-	-	-	-	-	-	-	825	20	-4	12	3	5,620	12,400	-	-

[a] Mean annual precipitation and mean minimum January temperature from Lamke (1979); other characteristics planimetrically determined from USGS topographic maps.
[b] No measurements made.
[c] Data for this site represents only the larger of two divergent channels and does not indicate total flow or runoff from this drainage area.

Table 3. Water quality at selected sites, Tuluksak River basin, Alaska, 1984-85.

Data collection site	Water temperature (°C)		Specific conductance (umhos/cm @ 25°C)		Oxygen dissolved (mg/l)		Oxygen dissolved (percent saturation)		Bicarbonate Alkalinity field (mg/l)		pH (units)		Calcium dissolved (mg/l)	Magnesium dissolved (mg/l)	Sodium dissolved (mg/l)	Potassium dissolved (mg/l)
	winter[a]	summer	winter	summer	winter	summer	winter	summer	winter	summer	winter	summer	winter	winter	winter	winter
1. Bear Creek above Nyac Dredge	0	13.0	81	72	14.3	10.4	100	97	34	-	6.3	6.7	2.52	1.04	2.90	0.34
2. Bear Creek below Nyac Dredge	0	11.5	91	74	14.0	11.2	97	100	37	-	6.7	6.5	2.54	1.08	2.81	0.42
3. Tuluksak River mi. 64	0	8.5	73	68	14.0	11.2	96	95	37	36	6.8	7.0	2.49	1.01	2.66	0.34
4. Tuluksak River mi. 60.5	0	9.9	83	67	13.2	11.5	91	100	37	34	6.5	6.2	2.22	0.99	1.50	0.33
5. Tuluksak River mi. 46.5	0	9.5	80	65	11.2	11.5	77	100	38	35	6.6	7.1	2.12	1.01	1.71	0.22
6. Fog River	0	-	86	-	0.0	-	0	-	39	-	7.1	-	1.59	1.15	3.96	0.60
7. Tuluksak River (left channel) mi. 22	-	12.9	-	72	-	10.5	-	99	-	-	-	-	-	-	-	-
9. Tuluksak River mi. 21.5	0	-	84	-	7.0	-	47	-	39	-	6.2	-	2.25	1.03	3.18	0.48

[a] 'Winter' refers to reconnaissance of March 26-27, 1985; 'summer' to June 18-22, 1984.

Table 3 (part II)

Data collection site	Sulfate dissolved (mg/l) winter[a]	Chloride dissolved (mg/l) winter	Silica dissolved (mg/l) winter	Turbidity (NTU) winter	Turbidity (NTU) summer	Suspended sediment concentration (mg/l) summer	Strontium total (ug/l) summer	Vanadium total (ug/l) summer	Barium total (ug/l) summer	Aluminum total (ug/l) summer	Beryllium total (ug/l) summer	Silver total (ug/l) summer	Nickel total (ug/l) summer	Chromium total (ug/l) summer
1. Bear Creek above Nyac Dredge	8.51	1.82	2.62	0.3	4	-	60	< 10	20	710	< 2	< 2	< 5	< 5
2. Bear Creek below Nyac Dredge	9.81	1.59	2.19	0.4	4	-	60	< 10	20	90	< 2	< 2	< 5	< 5
3. Tuluksak River mi. 64	6.29	1.71	2.26	0.3	10	4	60	< 10	< 10	78	< 2	< 2	< 5	< 5
4. Tuluksak River mi. 60.5	5.63	1.68	2.43	0.3	20	2	60	< 10	< 10	55	< 2	< 2	< 5	< 5
5. Tuluksak River mi. 46.5	5.03	1.80	2.34	1	70	6	60	< 10	< 10	170	< 2	< 2	< 5	< 5
6. Fog River	3.94	2.05	3.84	20	-	-	-	-	-	-	-	-	-	-
7. Tuluksak River (left channel) mi. 22	-	-	-	-	80	18	60	< 10	30	260	< 2	< 2	< 5	< 5
8. Tuluksak River (right channel) mi. 22	-	-	-	-	110	-	60	< 10	20	60	< 2	< 2	< 5	< 5
9. Tuluksak River mi. 21.5	4.45	1.90	2.81	6	-	-	-	-	-	-	-	-	-	-
10. Tuluksak River mi. 1.5	-	-	-	11	-	-	-	-	-	-	-	-	-	-

[a] 'Winter' refers to reconnaissance of March 26-27, 1985; 'summer' to June 18-22,1984.

Table 3 (part III)

Data collection site	Antimony total (ug/l) summer[a]	Titanium total (ug/l) summer	Cadmium total (ug/l) summer	Zinc total (ug/l) summer	Lead total (ug/l) summer	Selenium total (ug/l) summer	Mercury total (ug/l) summer	Iron total (ug/l) summer	Boron total (ug/l) summer	Manganese total (ug/l) summer	Magnesium total (ug/l) summer	Copper total (ug/l) summer	Arsenic total (ug/l) summer
1. Bear Creek above Nyac Dredge	< 10	< 50	< 0.5	6	< 5	< 2	< 0.05	610	< 50	21	1700	< 5	< 2
2. Bear Creek below Nyac Dredge	< 10	< 50	< 0.5	2	< 5	< 2	< 0.05	65	< 50	< 20	1800	< 5	< 2
3. Tuluksak River mi. 64	< 10	< 50	< 0.5	3	< 5	< 2	< 0.05	52	< 50	< 20	1800	< 5	< 2
4. Tuluksak River mi. 60.5	< 10	< 50	< 0.5	3	< 5	< 2	< 0.05	57	< 50	< 20	1700	< 5	< 2
5. Tuluksak River mi. 46.5	< 10	< 50	< 0.5	2	< 5	< 2	< 0.05	470	< 50	38	1700	< 5	< 2
7. Tuluksak River (left channel) mi. 22	< 10	< 50	< 0.5	4	< 5	< 2	< 0.05	2000	< 50	97	2400	< 5	2
8. Tuluksak River (right channel) mi. 22	< 10	< 50	< 0.5	2	< 5	< 2	< 0.05	1200	< 50	81	1800	< 5	< 2

[a] 'Winter' refers to reconnaissance of March 26-27, 1985; 'summer' to June 18-22, 1984.

Notes

Specific conductance, dissolved oxygen concentration, and bicarbonate alkalinity concentration showed little seasonal variation at most sites despite seasonal variation in streamflow and water temperature. The concentration of dissolved solids (as indicated by specific conductance and major ion concentrations) was similar among sites. There was a progressive increase in turbidity from headwater to lower Tuluksak sites.

Water samples had undetectable concentrations of most trace metals and minor elements. Strontium, barium, aluminum, zinc, iron, and manganese were detected in relatively low concentrations, except for elevated iron values at lower Tuluksak sites in the summer.