SUMMARY OF HYDROLOGIC CONDITIONS

Surface Water

Alaska contains more than 40 percent of the Nation's surface-water resources. The highest runoff rates per unit area are in southeast Alaska and in other areas influenced by the maritime climate of the Northern Pacific Ocean and the Gulf of Alaska. In the interior and northern parts of the State, runoff rates are markedly lower than in the maritime-influenced areas. Runoff generally increases with altitude throughout the State, and year-to-year runoff variability increases from south to north.

Seasonal runoff characteristics differ from southern to northern Alaska. Areas influenced by maritime climates usually have two periods with high runoff: a spring snowmelt period and a fall rainfall period. High water can occur throughout the year, but the highest instantaneous peak discharges are more prevalent in the fall months; low-water periods usually occur in late spring and mid-summer, prior to the rainy fall period. Farther north, most of the total runoff and floods occur in the period from May through September; low-flow periods usually occur during late winter, shortly before spring snowmelt.

Record-setting precipitation and unusually warm temperatures produced widespread flooding in south-central Alaska in the fall of 2002. The unusual weather patterns persisted in the region for more than two months. On the Kenai Peninsula, heaviest rainfall and most severe flooding occurred October 22-24, and November 23, 2002. Flooding was most severe on the western part of the peninsula, especially between Ninilchik and Homer. Floods on eight streams exceeded previous record peak streamflows and many others reached near-record streamflows (table 1). The flooding destroyed critical portions of the limited road system, isolated communities, damaged private property, and damaged spawning and riparian habitat.

The same weather patterns were responsible for remarkably high winter flows throughout Alaska. In Southeast Alaska, 46 percent of the monthly mean discharges were at levels equalled or exceeded less than 25 percent of the time during October through January. In Southcentral and Southwestern Alaska and in the Yukon Basin, nearly all rivers measured for more than 10 years experienced flows in the upper 25th percentile for the most of the fall and winter, and 32 percent of the monthly mean discharges were record highs. Even streams in Northwestern Alaska and on the Arctic Slope were affected. Of those streams that did not freeze completely during the winter, most experienced flows in the upper 25th percentile all the winter. Warm fall rains resulted in generally low winter snowpack, and the resulting spring runoff was relatively low throughout the state. Summer rain in the Chena Basin and the Arctic Slope resulted in higher than normal flows, and flows in the Chena basin were restricted by Moose Creek dam during July 29 to August 2 and again during September 4-5.

Table 1. Peak gage heights and streamflows during October and November, 2002, and 100-year flood magnitude for selected stations on the Kenai Peninsula, Alaska.

Site No. (fig. 1)	Station no.	Station name	Drainage area (mi^2)	Period of Record for peak data	October 2002 maximum peak data: Date (month /day)	Gage height (ft)	Streamflow (ft^3/s)	Peak basin yield ($(ft^3/s)/mi^2$)	November 2002 maximum peak data: Date (month /day)	Gage height (ft)	Streamflow (ft^3/s)	Peak basin yield [$(ft^3/s)/mi^2$]	100 yr flood (ft^3/s)[1]: For data through 1999	For data through 2002
1	15237730	Grouse Creek at Lake Outlet near Seward	6.24	1997-P	10/24	8.05	451*	72.3	11/23	7.87	401	64.5	1,080[2]	--
2	15238600	Spruce Creek near Seward	9.26	1967-P	10/23	6.63	1,560	168	11/23	6.04	835	90.2	4,090	3,910
3	15238820	Barabara Creek near Seldovia	20.7	1972-92	10/23	4.00	1,450	70.0	--	--	--	--	2,640	2,640[3]
4	15238978	Battle Creek diversion above Bradley Lake near Homer	0.95	1992-P	10/23	7.50	151*	159	11/23	6.60	80	11.6	159[4]	188
5	15239050	Middle Fork Bradley River near Homer	9.25	1980-P	10/23 10/24	9.49	1,310	142	11/23	8.99	259	28.0	1,660	1,770
6	15239500	Fritz Creek near Homer	10.4	1963-P	10/24	12.1	700e	67.3	11/23	11.37	530	51.0	664	819
7	15239800	Diamond Creek near Homer	5.35	1963-81	10/24	15.50	357*	66.7	11/23	14.33	282	52.7	342	418
8	15239900	Anchor River near Anchor Point	137	1965-74, 1978-87, 1991-92, 2000-P	10/24	9.30	8,000	58.4	11/23	9.1	9,000*	65.7	6,090	8,300
9	15240000	Anchor River at Anchor Point	224	1953-66, 1984-92	10/24	9.38	13,400	59.8	11/23	9.60	14,500*	66.1	8,670	14,000
10	15240500	Cook Inlet Tributary near Ninilchik	5.19	1966-81	10/24	17.16	359*	72.2	11/23	15.72	255	49.1	169	284
11	15241500	Deep Creek near Ninilchik	220	--	10/24	23.2	22,000	100	11/23	21.2	--	--	7,300[2]	--
12	15241600	Ninilchik River at Ninilchik	135	1963-85, 1999-P	10/24	9.39	6,600*	48.8	11/23	6.96	3,200	23.7	1,780	4,880
13	15242000	Kasilof River near Kasilof	738	1949-74, 1977	10/24	5.70	7,700	10.4	--	--	--	--	14,400	14,400[3]
14	15243900	Snow River near Seward	128	1970, 1974, 1977, 1997-P	10/24	13.22	12,600	98.4	11/23	10.95	6,870	53.7	--	--
15	15243950	Porcupine Creek near Primrose	16.8	1963-89	10/24	20.64	1,540	92.3	--	--	--	--	4,550	4,550[3]
16	15248000	Trail River near Lawing	181	1947-77, 1987	10/24	11.09	8,200*	45.3	--	--	--	--	8,890	9,360
17	15258000	Kenai River at Cooper Landing	634	1947-P	10/26	14.64	15,300	24.1	--	--	--	--	26,400[6]	26,100[6]
18	15261000	Cooper Creek at mouth near Cooper Landing	48.6	1958-64, 1998 to P	10/23	12.45	1,230*	25.3		11.28	337	6.9		
19	15269500	Granite Creek near Portage	28.2	1967-81	--[5]	10.85	1,800	63.8	--	--	--	--	3,090	3,090[3]
20	15271000	Sixmile Creek near Hope	234	1979-90, 1997-P	10/24	13.56	10,800*	46.2	11/23	11.68	4,170	17.8	10,600	13,000

[1] 100-year flood calculated using observed station data and regional weighted skew from Curran and others (2003), unless otherwise noted.

[2] Less than 10 years of systematic observed peak flow data, used regional flood-frequency equation from Curran and others, 2003.

[3] October and November, 2002 peaks are less than highest systematic peak and not used in computations following Bulletin 17-B guidelines (Interagency Committee on Water Data, 1982).

[4] Used data through 2001.

[5] Exact date of peak unknown, but did occur on October 23 or 24, 2002.

[6] 100-year flood calculated using only observed station data. See Curran and others (2003) for details.

e Estimated.

P Present

(mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; $(ft^3/s)/mi^2$, cubic feet per second per square mile; --, no data; *, new peak of record)

Ground Water

Alaska's vast area and small population preclude a comprehensive evaluation of its ground-water resources. Throughout much of the State, aquifers are poorly defined. In many areas, wells have not been drilled and little is known about seasonal and long-term changes in ground-water storage. During water year 2003, the long-term monitoring of water levels in one well in Juneau, one well in Anchorage, and three wells in Fairbanks continued. Water levels were also measured in 19 wells in Fairbanks to monitor ground water levels in the vicinity of the Chena River dam. Water levels were measured intermittently in 18 wells and continuously in 3 wells in Juneau for studies of the interaction between ground water and water in anadromous fish streams. Water levels were measured intermittently at Anaktuvuk Pass during the summer for a study of surface water-ground water interactions affected by permafrost.

Water levels in the long-term monitoring wells in Juneau, Anchorage, and Fairbanks were within the range of historical values. Water levels in most of the 19 short-term wells in Fairbanks recorded the highest levels since the summer of 2001 during August and September, following a period during which flows were impounded behind Moose Creek Dam. Water levels in wells in the Duck and Jordan Creek watersheds in Juneau are closely related to the infiltration of rain and snowmelt and the level of water in nearby streams. Some of these wells are in stream channels or on flood plains and are intermittently flooded; most water levels in these wells were within 10 feet of land surface.

Water Quality

General Overview

Information on the concentration and composition of constituents in Alaska’s surface water is markedly variable in coverage. Some subregions have had regular or periodic sampling for many years at many stream points and at a number of lakes. Information in other subregions consists of only a few miscellaneous samples. Although the chemical characteristics of water in the streams and lakes of Alaska seem variable, the ranges in concentration are not as great as those found in the conterminous United States. Most Alaskan streams above tidal reaches contain water of a calcium bicarbonate type, generally containing less than 200 mg/L dissolved solids. In these streams, the hardness generally increases with increased dissolved-solids content. The streams draining lowlands and intermontane basins usually contain harder water than the streams in the higher mountains. Some streams, especially those draining areas overlain by organic-rich deposits, can have excessive iron content.

In Alaska, the mineral content of water in lakes is more variable than that in rivers. The water in some mountain lakes is very low in dissolved-solids content and is little more concentrated than rainwater. Other lakes occupying lowlands near the sea, including many near the Arctic coastal plain, have become mineralized periodically by salts brought in from the sea either by overland flooding during storms or as ocean spray. The water in lakes in the lowlands remote from the sea is commonly very similar in chemical character to water in the larger rivers adjacent to them.

The character and distribution of suspended sediment are relatively complex in Alaska because glaciers contribute large amounts of very fine material (glacial flour) to many streams. In general, during the summer, suspended-sediment concentrations in nonglacial streams seldom exceed

100 mg/L, but can be greater than 2,000 mg/L for glacial streams. Nonglacial streams often transport the highest sediment loads during the spring breakup or during periods of high rainfall, whereas glacial streams transport the greatest sediment loads during periods of maximum glacial melting, usually in middle or late summer. The normal suspended-sediment concentration between January and April is usually less than 20 mg/L for most nonurban streams. Thus, less than 15 percent of the annual suspended-sediment load is carried during this period. The percentage of material finer than 0.062 millimeter (the silt-clay fraction as generally defined) transported by nonglacial streams is less than 50 percent in contrast to more than 50 percent for glacial streams.

Outside of the major urban areas, almost all ground water is obtained from unconsolidated aquifers. Most sampled water contains less than the State's recommended limit of 500 mg/L dissolved solids. Calcium and magnesium, which along with bicarbonate contribute to the hardness of water, are the major dissolved ions. In most wells, hardness concentrations are about 60 to 80 percent of dissolved-solids concentrations. Water of sodium bicarbonate or sodium chloride type is present in numerous community wells drilled near the coast.

Iron is present in high concentrations in a large number of shallow wells in most areas of the State. Concentrations in excess of 1.0 mg/L are common. Iron concentrations of more than about 0.3 mg/L can cause staining of laundry and plumbing fixtures and impart an unpleasant taste to the water.

The bedrock aquifers in most of Alaska are undeveloped and very little is known about their water quality. In general, the concentration of dissolved solids in water from bedrock aquifers is higher than that found in the unconsolidated aquifers and the chemical quality of water in bedrock aquifers is more variable.

Most of the State's ground-water resources have, for the present, been unaffected by humans. However, in the major urban areas and in some outlying villages, ground-water quality has been locally degraded, primarily from septic systems, landfills, and abandoned fuel storage tanks. Most ground-water contamination problems in Alaska are caused by petroleum products, primarily from leaky fuel tanks.

In 2003 as part of the Clean Water Action Plan, water-quality, and bed-material samples were collected at sites in Gates of the Arctic National Park and Preserve, Cape Krusenstern National Monument, and Lake Clark National Park and Preserve.

In 2003 sampling at 5 stations in the Yukon Basin continued as part of the National Stream-Quality Assessment Program (NASQAN), the third year of a five year monitoring program. The Alaska Water Resources Office is also collecting samples for personnel from the National Research Program to help extend the normal NASQAN data and assisted on 2 synoptic sampling trips from Yukon River near Stevens Village to Yukon River near Pilot Station.

Water-quality sampling is also done for projects throughout Alaska. The analyses for these samples are published in reports discussing these projects. For more information on reports published in 2003, contact the Chief, Water Resources Office (see p. ii) or the Alaska Water Resources Office webpage at http://ak.water.usgs.gov.

Remark Codes

The following remark codes may appear with the water-quality data in this section:

PRINTED OUTPUT	REMARK
E	Value is estimated.
>	Actual value is known to be greater than the value shown.
<	Actual value is known to be less than the value shown.
M	Presence of material verified, but not quantified.
N	Presumptive evidence of presence of material.
U	Material specifically analyzed for, but not detected.
A	Value is an average.
V	Analyte was detected in both the environmental sample and the associated blanks.
S	Most probable value.

Dissolved Trace-Element Concentrations

Traditionally, dissolved trace-element concentrations have been reported at the microgram per liter (μg/L) level. Recent evidence, mostly from large rivers, indicates that actual dissolved-phase concentrations for a number of trace elements are within the range of 10's and 100's of nanograms per liter (ng/L). Present data above the μg/L level should be viewed with caution. Such data may actually represent elevated environmental concentrations from natural or human causes. However, these data could reflect contamination introduced during sampling, processing, or analysis. To confidently produce dissolved trace-element data with insignificant contamination, the U.S. Geological Survey began using new trace-element protocols at some stations in water year 1994. Full implementation of the protocols took place during the 1995 water year.

Quality-control data

Data generated from quality-control (QC) samples are a requisite for evaluating the quality of the sampling and processing techniques as well as data from the actual samples themselves. Without QC data, environmental sample data cannot be adequately interpreted because the errors associated with the sample data are unknown. The various types of QC samples collected by this office are described in the following section. Procedures have been established for the storage of water-quality-control data within the USGS. These procedures allow for storage of all derived QC data and are identified so that they can be related to corresponding environmental samples.

BLANK SAMPLES – blank samples are collected and analyzed to ensure that environmental samples have not been contaminated by the overall data-collection process. The blank solution used to develop specific types of blank samples is a solution that is free of the analytes of interest. Any measured value signal in a blank samples for an analyte (a specific component measured in a chemical analysis) that was absent in the blank solution is believed to be due to contamination. There are many types of blank samples possible, each designed to segregate a different part of the overall data-collection process. The types of blank samples collected in the Alaska Water Resources Office are:

Source solution blank – a blank solution that is transferred to a sample bottle in an area of the office laboratory with an atmosphere that is relatively clean and protected with respect to target analytes.

Ambient blank – a blank solution that is put in the same type of bottle used for an environmental sample, kept with the set of sample bottles before sample collection, and opened at the site and exposed to the ambient conditions.

Field blank – a blank solution that is subjected to all aspects of sample collection, field processing preservation, transportation, and laboratory handling as an environmental sample.

Trip blank – a blank solution that is put in the same type of bottle used for an environmental sample and kept with the set of sample bottles before and after sample collection.

Equipment blank – a blank solution that is processed through all equipment used for collecting and processing an environmental sample (similar to a field blank but normally done in the more controlled conditions of the office.)

Sampler blank – a blank solution that is poured or pumped through the same field sampler used for collecting an environmental sample.

Pump blank – a blank solution that is processed through the same pump-and-tubing system used for an environmental sample.

Standpipe blank – a blank solution that is poured from the containment vessel (stand-pipe) before the pump is inserted to obtain the pump blank.

Filter blank – a blank solution that is filtered in the same manner and through the same filter apparatus used for an environmental sample.

Splitter blank - a blank solution that is mixed and separated using a field splitter in the same manner and through the same apparatus used for an environmental sample.

Preservation blank – a blank solution that is treated with the sampler preservatives used for an environmental sample.

Canister blank – a blank solution that is taken directly from a stainless steel canister just before the VOC sampler is submerged to obtain a field blank sample.

REFERENCE SAMPLES – Reference material is a solution or material prepared by a laboratory whose composition is certified for one or more properties so that it can be used to assess a measurement method. Samples of reference material are submitted for analysis to ensure that an analytical method is accurate for the known properties of the reference material. Generally, the selected reference material properties are similar to the environmental sample properties.

REPLICATE SAMPLES – Replicate samples are a set of environmental samples collected in a manner such that the samples are thought to be essentially identical in composition. Replicate is the general case for which a duplicate is the special case consisting of two samples. Replicate samples are collected and analyzed to establish the amount of variability in the data contributed by some part of the collection and analytical process. There are many types of replicate samples possible, each of which may yield slightly different results in a dynamic hydrologic setting, such as a flowing stream. The types of replicate samples collected in The Alaska Water Resources Office are:

Concurrent sample – a type of replicate sample in which the samples are collected simultaneously with two or more samplers or by using one sampler and alternating collection of samples into two or more compositing containers.

Sequential sample – a type of replicate sample in which the samples are collected one after the other, typically over a short time.

Split sample – a type of replicate sample in which a sample is split into subsamples contemporaneous in time and space.

SPIKE SAMPLES – Spike samples are samples to which known quantities of a solution with one or more well-established analyte concentrations have been added. These samples are analyzed to determine the extent of matrix interference or degradation on the analyte concentration during sample processing and analysis.

Concurrent sample – a type of spike sample that is collected at the same time with the same sampling and compositing devices then spiked with the same spike solution containing laboratory-certified concentrations of selected analytes.

Split sample – a type of spike sample in which a sample is split into subsamples contemporaneous in time and space then spiked with the same spike solution containing laboratory-certified concentrations of selected analytes.

Water Use

Water use in the broad sense deals with man's interaction with and influence on the hydrologic cycle. In a technical sense, water use refers to water that is actually used for a specific purpose, such as domestic use, commercial needs, or industrial processing. The offstream water use for the state of Alaska was estimated for the year 2000. Fewer water use categories were estimated in 2000 than in previous surveys.

The largest water uses are probably instream uses for hydroelectric power generation, and fish and wildlife resources. The Alaska Water Use Act was amended in 1980 to include instream flow as a use. The amendments provide the opportunity for private individuals, and local, State, and Federal governments to legally acquire instream flow water rights. Either one or a combination of the four following types of uses can be acquired: 1) protection of fish and wildlife habitat, migration, and propagation; 2) recreation and parks; 3) navigation and transportation; and 4) sanitation and water quality. Eleven instream flow rights applications have been granted.

From 1990-2003, Alaska's population increased 18 percent, which was one of the Nation's larger percentage increases. In 2003, Alaska's population increased by 1 percent. In 2003, about 60 percent of the State's population lived in the Anchorage, Fairbanks, and Juneau areas.

Because of the population increase and building water supply distribution systems in many villages in rural Alaska, public-supply use of water is also increasing. In 2000, 67 percent of the State's population received their water from a public-supply utility; the remainder supplied their own water. Mining was the largest category of water use in 2000 when including saline water use. This use was mostly production of hard rock minerals and fossil fuels.

In 2000, the water utilities in the Anchorage, Fairbanks, and Juneau areas used 61 percent of all water withdrawn in the State for public supply. The monthly mean rate of water withdrawn by the principal public-supply utilities servicing these three areas from January 1990 to September 2003 is shown in figure 1. (Data are from Municipality of Anchorage, Fort Richardson, City of Fairbanks, and City and Borough of Juneau.) The higher usage shown during the summer months in Anchorage and Fairbanks is probably due to tourism and other commercial activity, increased industrial activity, and seasonal climatic effects.

The State's 2000 average use from public supply was 190 gallons per day per person, while the nation's average is 180 gallons per day. One of the nation's lowest per capita use of all public-supply customers of 10 gallons per day has been reported on the North Slope.

Surface water is the source for around 60 percent of the 2003 State's public-water supply in these three cities, while ground water is the source for the remainder. Anchorage receives 85 percent of its water from surface-water sources. Surface water became the primary source when water from Eklutna Lake was brought into production in 1988. Juneau obtained 70 percent of public-supply water from ground-water sources in 2003. Juneau has reduced using its surface-water source because of cost to meet water-quality regulations. Fairbanks obtains 100 percent of public-supply water from ground-water sources. Of the water withdrawn in Fairbanks, about two-thirds is treated to be suitable for domestic use, and the other one-third is for thermoelectric power use.

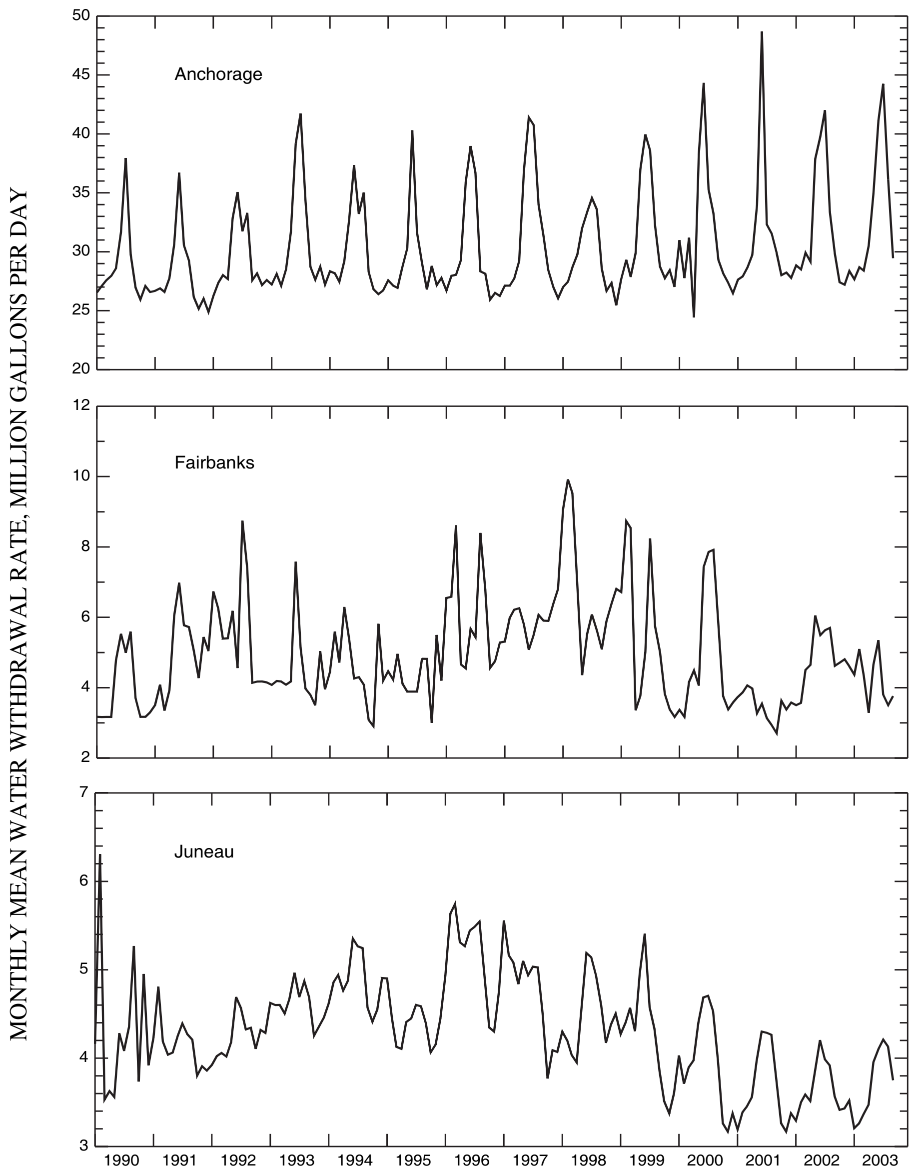

Figure 1. Monthly mean water withdrawal rate for public supply in the Anchorage, Fairbanks, and Juneau area, 1990 to 2003.