

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.

Cold spring temperatures throughout Alaska, following a relatively normal winter, resulted in low and record low monthly flows in March and April, in southeast Alaska, through June, in interior Alaska. Cold temperatures delayed spring breakup in south-central and interior rivers. During spring 2002, ice remained strong until rapid warming induced snowmelt runoff that initiated breakup. Large ice blocks formed ice jams throughout southwest, western, and interior Alaska. A Federal Disaster was declared for villages along the Tanana, Kuskokwim, and Yukon Rivers and scattered villages in southwest Alaska. The USGS operates few streamflow gaging stations in this region, and the existing stations are generally sited to avoid reaches affected by frequent ice jams. An elevation station, Kuskokwim at Aniak, 15304060, recorded a peak of record on May 18 as a result of ice-jam flooding. Water backed up behind the ice jam at Aniak overtopped a flood control dike for most of 3 days, May 13-15. Other areas in the state affected by ice-jam flooding were not measured by USGS.

Summer storms in arctic Alaska resulted in record high August monthly flows and a maximum daily flow for non-snowmelt periods on the Kuparuk River. During the same week, separate storms in the Chena River basin flooded local roads and campgrounds, but Moose Creek Flood Control Project regulated flows in Fairbanks.

Hubbard Glacier, the largest calving glacier in North America (25 percent larger than Rhode Island), advanced across the entrance to 35-mile-long Russell Fiord during June, temporarily turning it into a lake. Hubbard Glacier has been advancing for more than 100 years and has twice closed the entrance to Russell Fiord during the last 16 years, during the summers of 1986 and 2002. Water flowing into the cutoff fiord from mountain streams and glacier melt causes the level of Russell Lake to rise. A stage-only gage on Russell Fiord/Lake documented both rises, and are presented here. However, both dams failed before the lake altitude rose enough for water to spill over a low pass at the far end of the fiord and enter the Situk River drainage, a world-class sport and commercial fishery near Yakutat.

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 2002, 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 21 wells in Fairbanks to monitor ground water levels in the vicinity of the Chena River dam. Water levels were measured intermittently in 15 wells and continuously in 4 wells in Juneau for studies of the interaction between ground water and water in anadromous fish streams.

Water levels in the long-term monitoring wells in Juneau, Anchorage, and Fairbanks were within the range of historical values. 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. Spring 2002 recorded record low flows in these channels and extreme low water levels in some of these wells.

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, where-

as 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 2002 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 Sitka National Historical Park.

In 2002 sampling at 5 stations in the Yukon Basin continued as part of the National Stream-Quality Assessment Program (NASQAN), the second year of a five year monitoring program. The Alaska District 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 at Eagle to Yukon River near Stevens Village.

A majority of stream temperatures at continuous water temperature stations had their maximum annual water temperature occur on August 3-5, 2002. Nearly the whole state had clear skies during this period.

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 2002, 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 ($\mu\text{g/L}$) 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 $\mu\text{g/L}$ 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 District 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 this District 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 this district 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 1990-2002, Alaska's population increased 17 percent, which was one of the Nation's larger percentage increases. In 2002, Alaska's population increased by 2 percent. In 2002, about 60 percent of the State's population lived in the Anchorage, Fairbanks, and Juneau areas.

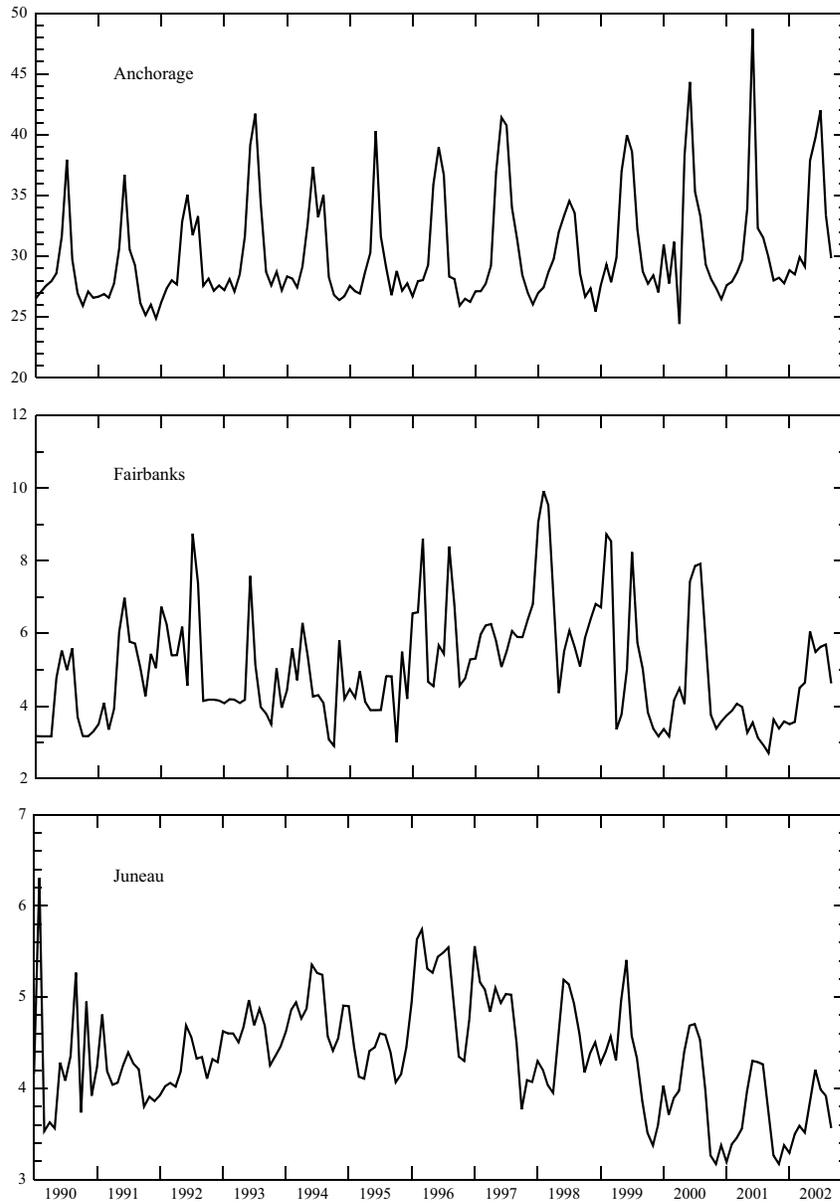
Because of the population increase and building water supply distribution systems in many villages in rural Alaska, public-supply use of water is also increasing. In 2000, 67 percent of the State's population received their water from a public-supply utility; the remainder supplied their own water. Mining 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 2002 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 2002 State's public-water supply in these three cities, while ground water is the source for the remainder. Anchorage receives 87 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 71 percent of public-supply water from ground-water sources in 2002. 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.

MONTHLY MEAN WATER WITHDRAWAL RATE, MILLION GALLONS PER DAY



Monthly mean water withdrawal rate for public supply in the Anchorage, Fairbanks, and Juneau area, 1990 to 2002.