

Prepared in cooperation with the Upper Elkhorn Natural Resources District and the Lower Elkhorn Natural Resources District

Trends in Streamflow Characteristics of Selected Sites in the Elkhorn River, Salt Creek, and Lower Platte River Basins, Eastern Nebraska, 1928–2004, and Evaluation of Streamflows in Relation to Instream-Flow Criteria, 1953–2004



Scientific Investigations Report 2009–5011

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Scientific Investigations Report 2009–5011

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior

KEN SALAZAR, Secretary

U.S. Geological Survey

Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2009

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Suggested citation:

Dietsch, B.J., Godberson, J.A., and Steele, G.V., 2009, Trends in streamflow characteristics of selected sites in the Elkhorn River, Salt Creek, and Lower Platte River basins, eastern Nebraska, 1928–2004, and evaluation of streamflows in relation to instream-flow criteria, 1953–2004: U.S. Geological Survey Scientific Investigations Report 2009–5011, 93 p. with appendixes.

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Conversion Factors, Abbreviations, and Datums

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
acre	4,047	square meter (m ²)
acre	0.4047	hectare (ha)
square foot (ft ²)	0.09290	square meter (m ²)
square inch (in ²)	6.452	square centimeter (cm ²)
square mile (mi ²)	2.590	square kilometer (km ²)
Volume		
gallon (gal)	3.785	liter (L)
acre-foot (acre-ft)	1,233	cubic meter (m ³)
Flow rate		
acre-foot per day (acre-ft/d)	0.01427	cubic meter per second (m ³ /s)
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m ³ /yr)
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m ³ /s)
foot per second (ft/s)	0.3048	meter per second (m/s)

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Trends in Streamflow Characteristics of Selected Sites in the Elkhorn River, Salt Creek, and Lower Platte River Basins, Eastern Nebraska, 1928–2004, and Evaluation of Streamflows in Relation to Instream-Flow Criteria, 1953–2004

By Benjamin J. Dietsch, Julie A. Godbersen, and Gregory V. Steele

Abstract

The Nebraska Department of Natural Resources approved instream-flow appropriations on the Platte River to maintain fish communities, whooping crane roost habitat, and wet meadows used by several wild bird species. In the lower Platte River region, the Nebraska Game and Parks Commission owns an appropriation filed to maintain streamflow for fish communities between the Platte River confluence with the Elkhorn River and the mouth of the Platte River. Because Elkhorn River flow is an integral part of the flow in the reach addressed by this appropriation, the Upper Elkhorn and Lower Elkhorn Natural Resources Districts are involved in overall management of anthropogenic effects on the availability of surface water for instream requirements.

The Physical Habitat Simulation System (PHABSIM) and other estimation methodologies were used previously to determine instream requirements for Platte River biota, which led to the filing of five water appropriations applications with the Nebraska Department of Natural Resources in 1993 by the Nebraska Game and Parks Commission. One of these requested instream-flow appropriations of 3,700 cubic feet per second was for the reach from the Elkhorn River to the mouth of the Platte River. Four appropriations were granted with modifications in 1998, by the Nebraska Department of Natural Resources.

Daily streamflow data for the periods of record were summarized for 17 streamflow-gaging stations in Nebraska to evaluate streamflow characteristics, including low-flow intervals for consecutive durations of 1, 3, 7, 14, 30, 60, and 183 days. Temporal trends in selected streamflow statistics were not adjusted for variability in precipitation. Results indicated significant positive temporal trends in annual flow for the period of record at eight streamflow-gaging stations – Platte River near Duncan (06774000), Platte River at North Bend (06796000), Elkhorn River at Neligh (06798500), Logan

Creek near Uehling (06799500), Maple Creek near Nickerson (06800000), Elkhorn River at Waterloo (06800500), Salt Creek at Greenwood (06803555), and Platte River at Louisville (06805500). In general, sites in the Elkhorn River Basin upstream from Norfolk showed fewer significant trends than did sites downstream from Norfolk and sites in the Platte River and Salt Creek basins, where trends in low flows also were positive.

Historical Platte River streamflow records for the streamflow-gaging station at Louisville, Nebraska, were used to determine the number of days per water year (Sept. 30 to Oct. 1) when flows failed to satisfy the minimum criteria of the instream-flow appropriation prior to its filing in 1993. Before 1993, the median number of days the criteria were not satisfied was about 120 days per water year. During 1993 through 2004, daily mean flows at Louisville, Nebraska, have failed to satisfy the criteria for 638 days total (median value equals 21.5 days per year). Most of these low-flow intervals occurred in summer through early fall. For water years 1953 through 2004, of the discrete intervals when flow was less than the criteria levels, 61 percent were 3 days or greater in duration, and 38 percent were 7 days or greater in duration. The median duration of intervals of flow less than the criteria levels was 4 consecutive days during 1953 through 2004.

Introduction

Instream-flow protection is a complex legislative and technical issue that is implemented in various ways throughout the United States. The Nebraska Department of Natural Resources (NDNR) approved appropriations on the Platte River to provide instream-flow protection primarily to maintain fish communities, whooping crane roost habitat, and wet meadows used by several migratory bird species. Instream-flow Appropriation A-17331, filed and owned by the Nebraska

Game and Parks Commission (NGPC), was established to maintain streamflow for fish communities in the Platte River between its confluence with the Elkhorn River and the mouth of the Platte. The Elkhorn River flow is an integral part of the streamflow addressed in this appropriation. As such, the Upper Elkhorn Natural Resources District (UENRD) and the Lower Elkhorn Natural Resources District (LENRD) are collecting data and developing water-management strategies to assist with water-resources planning. Of particular interest are the effect of anthropogenic stresses on the availability of surface-water resources, and the interaction of ground water and surface water in the Elkhorn River basin. Specifically, the UENRD and the LENRD are concerned with the effects of precipitation, surface-water withdrawals, ground-water withdrawals, streambed-elevation changes, and tile drains on the availability of surface water and the long-term effects of these processes (R. Wozniak, Lower Elkhorn Natural Resources District, oral commun., 2005).

In 2005 the U.S. Geological Survey (USGS), the UENRD, and the LENRD began a cooperative study to investigate instream flow as it pertains to Appropriation A-17331. This study was undertaken to (1) review and assess the methods used to determine the flows granted by NDNR in Appropriation A-17331, (2) to provide information on temporal trends in streamflow at 17 streamflow-gaging stations located on the lower Platte River or within the basins of the Elkhorn River and Salt Creek, (3) to assess the sufficiency of historical streamflow data to meet the requirements of A-17331, and (4) to evaluate the adequacy of the streamflow records for the streamflow-gaging station at Louisville, Nebraska.

Purpose and Scope

The primary purpose of this report is to present the trends in streamflow characteristics from 1928 to 2004 at selected sites in the Elkhorn River, Salt Creek, and lower Platte River basins. Also, this report describes streamflows in relation to instream-flow criteria for 1953 to 2004. Findings for seven study objectives are presented: (1) review the technical literature to determine how Appropriation A-17331 was applied to maintain fish communities, and to identify the methods used to establish Appropriation A-17331 and similar flow appropriations for the maintenance of flow for fish and wildlife; (2) review the input conditions and applicability of the Physical Habitat Simulation System (PHABSIM) model used in establishment of Appropriation A-17331; (3) analyze long-term records of streamflow at streamflow-gaging stations to detect annual and seasonal variations, including those during the months of June, July, and August, and to determine long-term streamflow trends; (4) compute 1- and 7-day low flows for each year to determine long-term surface-water trends; (5) summarize historical occurrences of daily streamflow values in the Elkhorn River basin and the Platte River at Louisville, Nebraska, that would be considered insufficient, as defined

by Appropriation A-17331, to maintain the fish community between the Platte River confluences with the Elkhorn River and the Missouri River; (6) determine the number of days that flows in the Elkhorn River basin and at the Platte River at Louisville streamflow-gaging station would be considered insufficient, as defined by Appropriation A-17331, since November 1993 (the beginning date of the appropriation) and identify the dates when junior water rights would have been suspended as a result of water shortages for Appropriation A-17331; and (7) provide quality-assurance data on the accuracy of the streamflow measurements at the Platte River at Louisville streamflow-gaging station and its effect on the adequacy of the Louisville streamflow-gaging station for management of the instream-flow appropriation.

The scope of the study includes the available streamflow data at 17 streamflow-gaging stations in the Elkhorn River, Platte River, and Salt Creek basins.

Study Area Description

Confluences with two principal tributaries of the Platte River—the Elkhorn River and Salt Creek—are located within the reach defined by Appropriation A-17331. The Elkhorn River, which drains 7,000 square miles (mi²), flows east-southeast through the Sand Hills in north-central Nebraska and the glaciated rolling hills of northeast Nebraska to its confluence with the Platte River about 20 miles downstream from Fremont, Nebraska (fig. 1). Logan Creek, a principal tributary of the Elkhorn River that drains much of the glaciated area of northeast Nebraska, enters the Elkhorn River north of Fremont. The flow regimes of the eastern and western parts of the Elkhorn River basin contrast because of the differences in the sediment composition and the increasing gradient of precipitation from west to east (Bentall and others, 1971). Streamflows in the Sand Hills or western part, which is characterized by extremely permeable sediments, are derived primarily from ground water. In contrast, streamflows in the eastern part, where loess-capped glacial deposits generally are less permeable, are more variable and responsive to precipitation events.

Surface-water use in the Elkhorn River basin includes irrigation, livestock, and recreational supplies. As of January 30, 2005, 362 surface-water appropriations with application dates later than 1970 were listed in the NDNR database (Nebraska Department of Natural Resources, 2005). These appropriations together are listed as irrigating about 29,000 acres in the Elkhorn River basin; however, the database does not include the number of appropriations or acreages adjudicated during this same period.

Salt Creek, whose confluence with the Platte River is about 7 mi downstream from the confluence of the Elkhorn and Platte Rivers, flows north to northeast through southeast Nebraska. Its 1,650-mi² basin generally slopes from southwest to northeast. Wahoo Creek, a principal tributary of Salt Creek,

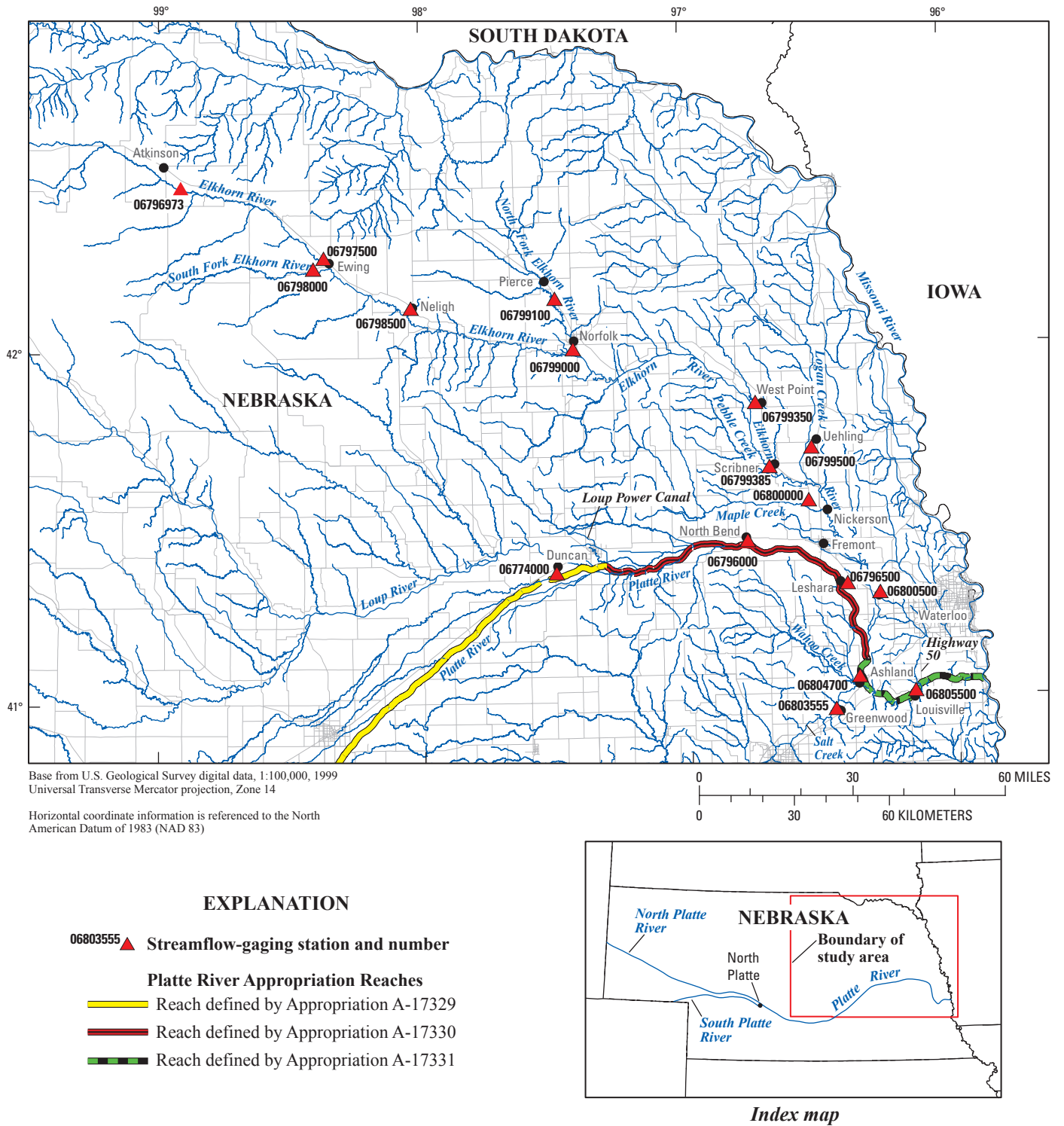


Figure 1. Study area and streamflow-gaging stations in the Elkhorn River, Salt Creek, and Platte River basins, Nebraska.

enters Salt Creek near Ashland, or upstream from the confluence with the Platte River.

The Platte River is a braided stream that begins at the confluence of the North Platte and South Platte Rivers near North Platte, Nebraska, and has a drainage area of about 71,000 mi² at the USGS Platte River at Louisville, Nebraska, streamflow-gaging station (06805500). The recorded extremes for discharge at the Louisville streamflow-gaging station (for brevity, when referring to a Platte River streamflow-gaging station, hereinafter, only the geographic location will be used) range from 124,000 cubic feet per second (ft³/s) on March 30, 1960, to 131 ft³/s on September 3, 1976. From 1953 through 2005, the mean annual discharge was 6,966 ft³/s (U.S. Geological Survey, 2006).

Background

Trends in streamflow have been studied extensively on large scales within the United States (Lins and Slack, 1999; McCabe and Wolock, 2002; Milly, 2005). Lins and Slack (1999) detected positive trends in the annual minimum and median streamflow for 395 climate-sensitive streamflow-gaging sites within the conterminous United States from 1944 through 1993 using the non-parametric Mann-Kendall test (Helsel and Hirsch, 1992). McCabe and Wolock (2002) used Kendall's Tau test (herein referred to as Kendall's Tau) to determine trends in minimum and median daily streamflow at sites within the conterminous United States. McCabe and Wolock found that the number of sites with positive trends was dependent on the time period analyzed. McCabe and Wolock stated that although monotonic trend tests such as Kendall's Tau cannot distinguish a gradual change from an abrupt change in a single data sequence, the temporal pattern of Kendall's Tau for many time periods supported the hypothesis of an abrupt step change in streamflow around 1970 being the dominant feature of temporal changes during the 1941–99 time period. McCabe and Wolock concluded that annual streamflows showed a “step” increase around 1970 rather than a gradual trend, and noted that these increases coincided with increased precipitation in the eastern United States as indicated by Karl and Knight (1998). Milly (2005) investigated trends in the water budget within the Mississippi River basin since 1949 and detected positive trends in precipitation that coincided with positive trends in runoff, but the trends in runoff also may have been emphasized at downstream sites by declines in the rate of filling of surface-water reservoirs constructed in the 1950s and 60s.

In Nebraska, instream flows for fish and wildlife purposes have been legally recognized as a beneficial use following the passage of legislation since 1984 (Aiken, 1989). Chapter 46-2 of the Nebraska State Statutes contains many of the provisions for acquiring an instream-flow appropriation. Instream-flow appropriations may be obtained by the NGPC or a Natural Resources District (NRD). The NGPC, NRD, or other state agencies must conduct detailed studies to quantify the amount

of flow requested for a specific stream reach prior to requesting approval by NDNR (Aiken, 1989; Nebraska Revised State Statutes Section 46-2, 109). The director of NDNR may approve instream appropriation applications only after determining that: (1) unappropriated water is available for appropriation at a level that the species of interest can tolerate; (2) the appropriation is necessary to preserve the instream uses for which the appropriation has been requested; (3) the appropriation will not interfere with senior surface-water appropriations; (4) the rate and timing of flows are those required to maintain the instream use for which the appropriation has been requested; and (5) the instream flow is of public interest (Aiken, 1989; Nebraska Revised State Statutes Section 46-2, 115). Instream-flow appropriations are administered in the same manner as other appropriations with the exception that releases for reservoirs with senior water rights are not required to provide sufficient water for instream-flow appropriations (Nebraska Revised State Statutes Section 46-2, 119).

Overview of Methods to Estimate Instream-Flow Requirements

Habitat model simulations are commonly used to determine instream-flow requirements. Examples include the PHABSIM and modules of various hydraulic models. The PHABSIM is a habitat-simulation model developed using principles contained within the Instream Flow Incremental Methodology (IFIM) (Bovee, 1982; Bovee and others, 1998). Similar habitat models exist; however, those models were not used to determine instream-flow requirements for Appropriation A-17331 (Nebraska Department of Natural Resources, 1998, available at <http://www.dnr.state.ne.us/legal/decision1.htm> accessed January 30, 2005). Because PHABSIM was used to estimate instream-flow requirements for Appropriation A-17331 (Nebraska Department of Natural Resources, 1998), discussion of habitat models in this report primarily will focus on PHABSIM.

The PHABSIM and similar models use hydraulic principles to simulate water depths and velocities that are based on cross-section measurements made along the stream reach. Inputs for PHABSIM include channel geometry, substrate classification, vegetative cover indexes, and habitat suitability curves. Velocities and depths generated by the hydraulic part of the model are combined with cover and substrate information and habitat suitability criteria. These data were used to produce quality and quantity tables of usable habitat area for selected species at designated streamflows. In PHABSIM, criteria for favorable habitat are expressed as suitability index curves. A decimal scale ranging from 0 (entirely unsuitable) to 1 (completely suitable) is used to relate these index curves to physical measures such as depth, velocity, substrate, and cover to score microhabitat suitability. Experts possessing knowledge of favorable habitat conditions for species in the studied reaches may be called upon to collect data, perform habitat analyses, and use professional judgment to determine suitability.

ity index curves. More than one suitability index curve may exist for a particular reach; suitability index curves may be developed for multiple combinations of species, life stage, and season. The PHABSIM uses each suitability index curve for a particular reach to generate a series of relations of discharge to habitat areas. Relations of discharge to habitat area (habitat area also is called weighted usable area or WUA) are developed for each suitability index and then reported as square feet of usable habitat per 1,000 feet of stream length for a given discharge. The WUA can be combined for all considered species by first expressing the usable habitat as the percentage of optimum habitat (POH) to eliminate bias in favor of species with large WUAs. The POH is the quotient of WUA divided by the maximum WUA simulated for each species or life stage. Where each species and life stage is given equal importance, POH values for each discharge can be averaged to determine a combined POH. Alternatively, a weighted-averaging scheme can be used to place greater emphasis on species assigned a greater importance. The flow with the greatest combined POH can be selected as the single recommended flow for a particular reach; however, the greatest combined POH may occur at an unrealistic or low-frequency discharge, and other criteria for selecting a recommended flow may be required to provide a solution practical for stakeholders involved in implementing the recommended flow.

The Tennant standard-setting method (Tennant, 1976), sometimes called the Montana method, is another widely used method for estimating instream-flow requirements (table 1). Flows are computed as fixed percentages of mean annual streamflow for general regimes. The method requires stream-flow data from a streamflow-gaging station on or near the stream reach being investigated. The Tennant method relies on the assumption that optimum habitat conditions occur near the mean annual streamflow.

A wide variety of additional methods and habitat modeling techniques exist for estimating habitat availability and for quantifying required instream flows. Methods developed by Poff and others (1997), range of variability approaches (Richter and others, 1997), and the Hydroecological Integrity Assessment Process (HIP) software tools (Henriksen and

others, 2006) utilize the components of a flow regime such as magnitudes, frequencies, durations, timing, and rate of change to correlate with biological data to determine flows suitable for maintaining fish and wildlife habitat. The MesoHABSIM habitat model integrates the use of flow regime characteristics with other hydrological models to define community-specific thresholds (Annear and others, 2004). The R2CROSS and Wetted-Perimeter methods (Espegren, 1996) use channel geometry to determine flow-regime characteristics. Computer Aided Simulation Model for Instream Flow Requirements (CASIMIR) is another modular simulation model (Jorde and others, 2001).

Overview of Appropriation A-17331

For the purpose of protecting habitat for fish and wildlife on the Platte River in central and eastern Nebraska, on November 30, 1993, the NGPC filed five applications for water appropriations with the NDNR among which was the application for Appropriation A-17331. The initial application requested 4,000 ft³/s (September 16 through January 31), 5,800 ft³/s (February 1 through June 15), and 4,000 ft³/s (June 16 through September 15) (R. Wozniak, Lower Elkhorn Natural Resources District, written commun., 2007). Efforts to estimate instream-flow requirements using PHABSIM and other estimation methodologies resulted in the revised flow-magnitude requests for the three applications listed in table 2 and described below (Nebraska Department of Natural Resources, 1998).

PHABSIM was implemented by Twelve Nine, Inc. (1990), Hardy and Associates (1992), and Schainost and others (1993). Inputs to PHABSIM included suitability index curves developed by Peters and others (1989) and Chadwick and Associates (written commun., 1994) for 12 fish species of the lower Platte River. Hydraulic data, including surveyed channel elevations, water depth and velocity measurements, and habitat data, including cover and substrate size distribution, were collected on the Platte River in 1985, 1987, and 1988 by an interagency team composed of federal, state, university, and agency personnel.

Table 1. Tennant standard-setting method for estimating instream-flow requirements (Tennant, 1976).

Flow description	Instream flow	
	October–March (Winter), as a percentage of mean annual streamflow	April–September (Summer), as a percentage of mean annual streamflow
Flushing or maximum	200	200
Optimum range	60–100	60–100
Outstanding	40	60
Excellent	30	50
Good	20	40
Fair or degrading	10	30
Poor or minimum	10	10
Severe degradation	0–10	0–10

Table 2. Summary of Nebraska Game and Parks Commission applications for instream-flow appropriations, Platte River, Nebraska (Nebraska Department of Natural Resources, 1998, available at <http://www.dnr.state.ne.us/legal/decision1.htm> accessed January 30, 2005).

Appropriation number	Purpose	Platte River reach	Time	Flow requested, in cubic feet per second
A-17329	Maintain fish community	Kearney Canal diversion downstream to Loup Power Canal return	All Year	1,000
A-17330	Maintain fish community	Loup Power Canal return to confluence with Elkhorn River	All Year	1,800
A-17331	Maintain fish community	Confluence with Elkhorn River to confluence with Missouri River	All Year	3,700

For instream-flow requests for the Platte River, the potential bias in favor of species with large WUA values was removed by converting each WUA-discharge relation to a POH-discharge relation per species or life stage. A simple average giving equal importance to all fish species and life stages was used to develop an overall POH value per discharge (Zuerlein and others, 2001). Analysis of the PHABSIM results for all fish species indicated that habitat availability in the lower Platte River rapidly declines as flows decrease below 2,000 ft³/s. Based on PHABSIM analysis, the NGPC requested instream-flow appropriations of 1,800 ft³/s and 3,700 ft³/s for the Platte River reaches from the Loup River to the Elkhorn River (A-17330) and from the Elkhorn River to the mouth of the Platte (A-17331), respectively (Zuerlein and others, 2001). Criticism during the application review process concerned use of the fixed-bed assumption in the PHABSIM model for the sandy, shifting bed of the Platte River, and whether or not an adequate number of study sites were included in the analysis (Nebraska Department of Natural Resources, 1998). However, proponents of PHABSIM argued that the relatively long reach of the Platte River was in dynamic equilibrium, and losses of microhabitat because of sediment erosion in some parts of the reach were offset by sediment deposition in other parts of the reach, and that study sites included in the analysis were representative of the river (Milhous and others, 1984; Nebraska Department of Natural Resources, 1998). Further evaluations of PHABSIM output failed to provide conclusive evidence validating or invalidating its flow recommendations (Nebraska Department of Natural Resources, 1998). Of the five applications filed by NGPC for the purpose of protecting fish and wildlife habitat in the central and eastern Platte River, four were approved for instream water appropriations by the NDNR. The following sections describe the criteria, process, and approval status of the five NGPC appropriation applications with emphasis on A-17329, A-17330, and A-17331.

Appropriation A-17329—Johnson Power Plant return to Loup Power Canal return. Water-temperature criteria were used for selecting recommended flows on the Platte River for Appropriation A-17329. NGPC was concerned that low

flows and shallow depths in the central Platte River during summer months might result in increased water temperatures and reduced concentrations of dissolved oxygen, which stress fish and potentially result in fish kills (Nebraska Department of Natural Resources, 1998). NGPC requested a 1,000 ft³/s appropriation because additional analysis using the Tennant (1976) method, a U.S. Fish and Wildlife (USFWS) fish guild PHABSIM study, a habitat richness analysis, and a water temperature compared to discharge analysis indicated that 650 ft³/s would be insufficient to protect the resources (Zuerlein and others, 2001).

Appropriation A-17330 — Loup Power Canal return to confluence with Elkhorn River; and Appropriation A-17331—Confluence with Elkhorn River to confluence with Missouri River. Both appropriations (table 2) were requested for protection of fish communities through maintenance of streamflow levels. Flow recommendations were estimated through analysis of PHABSIM simulations (Milhous and others, 1984). Based on those results, NGPC requested instream-flow appropriations of 1,800 ft³/s for the reach from the Loup River to the Elkhorn River, and 3,700 ft³/s for the reach from the Elkhorn River to the mouth of the Platte (Zuerlein and others, 2001).

In a June 26, 1998, decision issued by NDNR, the five NGPC applications for instream appropriations were approved, modified, or denied. Appropriation A-17329 was approved such that the NGPC appropriation, combined with the senior Central Platte Natural Resources District (CPNRD) instream appropriation, would equal 1,000 ft³/s in June and July (table 3). During August, the combined appropriated flow would equal 800 ft³/s at Odessa, Nebraska, and 900 ft³/s near Duncan, Nebraska. The August flow values were selected such that appropriated flow would achieve a 20-percent exceedance threshold seasonally (appropriated flow is exceeded more than 20 percent of the time for the given time period). Appropriation A-17330 was approved by NDNR as requested (table 3). Appropriation A-17331 was modified to account for the senior Metropolitan Utilities District (MUD) water right of 500 ft³/s and to meet the 20-percent threshold flow-duration value.

Table 3. Platte River instream flows appropriated by the Nebraska Department of Natural Resources to the Nebraska Game and Parks Commission on June 26, 1998 (Zuerlein and others, 2001).[ft³/s, cubic feet per second; –, appropriation not applicable; CPNRD, Central Platte Natural Resources District; MUD, Metropolitan Utilities District]

Appropriation number and approved flow (except for specified seasons)	Benefit	River segment	Season	Seasonal appropriated flow, in ft ³ /s			
				Central Platte River reach		Lower Platte River reach	
				Odessa and Grand Island streamflow-gaging stations	Duncan streamflow-gaging station	North Bend streamflow-gaging station	Louisville streamflow-gaging station
A-17329	Fish community	Kearney Canal diversion	Sept.–May	1,000	1,000	–	–
		downstream	June 1–June 23	¹ 500	¹ 500	–	–
		to Loup	June 24–July 31	¹ 400	¹ 400	–	–
		Power Canal	Aug. 1–Aug. 22	² 200	³ 300	–	–
		return	Aug. 23–Aug. 31	² 300	³ 400	–	–
A-17330	Fish community	Loup Power Canal return to confluence with Elkhorn River	Entire year	–	–	1,800	–
A-17331	Fish community	Elkhorn River	January	–	–	–	⁴ 3,100
		downstream	Feb.–July	–	–	–	⁴ 3,700
		to mouth of	August	–	–	–	⁴ 3,500
		Platte River	September	–	–	–	⁴ 3,200
			Oct.–Dec.	–	–	–	⁴ 3,700

¹Combined appropriated flows with CPNRD equal 1,000 ft³/s.²Combined appropriated flows with CPNRD equal 800 ft³/s.³Combined appropriated flows with CPNRD equal 900 ft³/s.⁴Appropriated flows reduced from 3,700 ft³/s requested for entire year to account for a MUD senior water right and to meet a 20-percent exceedance flow-duration threshold.

Methods of Study

Streamflow Characteristics

To evaluate streamflow characteristics, statistical summaries were computed for 17 streamflow-gaging stations in the Elkhorn River, Platte River, and Salt Creek drainage basins (table 4). Periods of streamflow-gaging station operation ranged from 1896 to present (September 30, 2004) in the Platte River and Elkhorn River basins and from the 1950s to present in the Salt Creek basin. Periods of daily streamflow records used for statistical calculations and trends analysis ranged from 1928 to 2004 and included data from the 2005 water year (WY) if published records were available at the time of analysis. A water year begins October 1 of each calendar year and ends September 30 of the following calendar year.

Flow duration tables describe the percentage of time specified flows were exceeded during a given period, and non-exceedance duration hydrographs graphically describe flow percentiles for each day of the calendar year based on histori-

cal daily mean flows (for example, table 5 and fig. 2). Flow duration tables provide broad summaries of streamflow data for a given period and are particularly useful for comparing different sites during similar time periods; however, duration tables do not preserve the chronological characteristics of flow. Duration hydrographs represent the flow percentiles for each calendar day in a compact plot, and are useful for evaluating seasonal variations in streamflow for the period of record. Flow duration tables and duration hydrographs provide useful tools for interpreting flows during the period included in the tables and plots but inadequately represent the sequential occurrences of low-flow events from year to year.

Daily mean streamflows were used to identify extreme low-flow periods for specific numbers of consecutive days, or *n*-day low flows for each year. Low-flow values most often are computed as the annual minimum mean flows for *n* consecutive days during a climatic year (April to March). For example, the annual 7-day low flow describes the lowest mean flow among all periods of 7 consecutive days during a year (fig. 3). Climatic years, as used in these analyses, typically are used in low-flow analyses because low flows in much of the United States often occur in late summer and early fall, and the designation of the flow period by WY (October–September) may

Table 4. Periods of operation of U.S. Geological Survey and Nebraska Department of Natural Resources streamflow-gaging stations in the Elkhorn River, Salt Creek, and Platte River basins, Nebraska.

Streamflow-gaging station number (fig. 1)	Station name	Date of station establishment ¹	Years of record ²
06774000	Platte River near Duncan, Nebraska	04/01/1941	63
06796000	Platte River at North Bend, Nebraska	04/01/1949	55
06796500	Platte River near Leshara, Nebraska	06/29/1994	10
06796973	Elkhorn River near Atkinson, Nebraska	10/01/1982	22
06797500	Elkhorn River at Ewing, Nebraska	08/01/1947	57
06798000	South Fork Elkhorn River at Ewing, Nebraska	08/01/1947	57
06798500	Elkhorn River at Neligh, Nebraska	10/01/1930	75
06799000	Elkhorn River at Norfolk, Nebraska	08/01/1896	63
06799100	North Fork Elkhorn River near Pierce, Nebraska	08/01/1960	44
06799350	Elkhorn River at West Point, Nebraska	10/01/1972	32
06799385	Pebble Creek at Scribner, Nebraska	10/01/1978	27
06799500	Logan Creek near Uehling, Nebraska	04/01/1941	63
06800000	Maple Creek near Nickerson, Nebraska	10/01/1951	53
06800500	Elkhorn River at Waterloo, Nebraska	09/01/1928	76
06803555	Salt Creek at Greenwood, Nebraska	11/01/1951	53
06804700	Wahoo Creek at Ashland, Nebraska	08/31/1990	14
06805500	Platte River at Louisville, Nebraska	06/01/1953	51

¹All streamflow-gaging stations were operational in 2004.

²Years of record may not match years computed from period of operation because of missing annual mean streamflow values or periods of temporary inactivity.

separate one low-flow period into 2 water years. Low-flow values were determined for the 17 selected sites in the study area for consecutive durations of 1-, 3-, 7-, 14-, 30-, 60-, and 183-days for the available period of record through September 30, 2004 or later if published data were available at the time of analysis.

Low-flow probability values were computed for consecutive low-flow periods using log-Pearson type III analysis (Interagency Advisory Committee on Water Data, 1982). Low-flow probability values provide an estimate of the probability of occurrence for a particular minimum n -day flow during any single year. For instance, 7-day low-flow probability values indicate that, for the 5-percent annual chance, the indicated minimum average flow for n -days of the climatic year is likely to occur 5 times, on average, during a given 100-year period. The recurrence interval (equation 1) is defined as the inverse of the percent annual chance (P), which in the previous example is equal to 20 years.

$$\text{Reference interval} = \frac{100 \text{ percent}}{P} \quad (1)$$

Generally, the measured streamflow of the Platte River at Louisville, Nebraska, is the sum of streamflows measured at streamflow-gaging stations on the Elkhorn River at Waterloo, Salt Creek at Greenwood, Wahoo Creek at Ashland, and Platte River at Ashland, plus any unmeasured inflows minus any outflows between these streamflow-gaging stations and

the Louisville streamflow-gaging station. Annual streamflow records for the streamflow-gaging stations at Elkhorn River at Waterloo, Salt Creek at Greenwood, and Wahoo Creek at Ashland were compared to streamflows measured at the Platte River at Louisville streamflow-gaging station to estimate the effects of the Salt Creek and Elkhorn River Basins on the flows of the Platte River at Louisville.

Streamflow Trends

Kendall's Tau test is widely used to detect trends in time-series data (Helsel and Hirsch, 1992). Kendall's Tau was used to detect temporal trends in selected streamflow statistics at 17 sites in the study area (all sites are located in Nebraska). The Tau statistic is a measure of the level of upward or downward change in a data set; a Tau value of +1 indicates each element in the series is greater than the previous element in the series, and -1 indicates each element in the series is less than the previous element in the series. The statistic represented by p is used to quantify the probability that the available evidence to conclude for a trend slope different from zero could have arisen when there actually was no temporal trend. A significance level of 0.95 (p -value < 0.05) was used to declare the presence of a trend. Kendall's Tau was performed for annual mean flows, monthly mean flows for each month of the year, and annual low flows (1-, 3-, 7-, 14-, 30-, 60-, and 183-day)

Table 5. Flow duration table for Platte River at Louisville, Nebraska, for water years 1953 through 2004.
[ft³/s, cubic feet per second; %, percent]

Daily mean streamflow, in ft ³ /s, equaled or exceeded for indicated percentage of time	
1%	13,194
2%	12,992
5%	12,387
10%	11,378
15%	10,369
20%	9,360
25%	8,351
30%	7,457
35%	6,898
40%	6,339
45%	5,781
50%	5,313
55%	4,860
60%	4,407
65%	4,021
70%	3,656
75%	3,290
80%	2,896
85%	2,503
90%	2,008
95%	1,479
98%	1,003
99%	725

for the period of record at each site. The streamflow values were not adjusted to remove the effect of precipitation variation.

Linear regression analyses were used to estimate the trend slope in time-series data for sites with significant temporal trends. A best-fit line (least-squares regression) was determined for the streamflow data, and the trend slope was computed using SWSTAT (Lumb and others, 1990). This slope represents the median magnitude of the annual increase or decrease in the respective streamflow statistic over the period analyzed.

Historical Streamflow Characteristics

In order to illustrate annual and seasonal variations in streamflows, flow duration tables, duration hydrographs, and low-flow probability values are presented for each selected streamflow-gaging station in Appendix 1.

At the streamflow-gaging station at Louisville, Nebraska, flows generally were greatest in the winter and spring but declined through the summer. During parts of October through December, flow criteria required for Appropriation A-17331 generally fall between the 10th and 50th non-exceedance percentiles (fig. 2). In January, flow criteria required for Appropriation A-17331 are near the 30th percentile. During February through June, flow criteria required for Appropriation A-17331 generally are less than the 30th percentile, but fall within the range from less than the minimum recorded streamflow to the 10th percentile for many calendar days. During July through parts of October, flow criteria required for Appropriation A-17331 generally fall between the 30th and 70th percentiles.

The duration table (table 5) indicates that criteria required for Appropriation A-17331 were exceeded from 65 to 70 percent of the time at the Platte River at Louisville streamflow-gaging station. A comparison of the duration hydrographs for the streamflow-gaging stations at Platte River near Duncan and Platte River at Louisville indicated that streamflow 1 ft³/s or less occurred more frequently at the Platte River near Duncan streamflow-gaging station during its period of available streamflow data (1928 to 2004) than at the Platte River at Louisville streamflow-gaging station during its period of available streamflow data (1953 to 2004). The duration hydrograph for Platte River near Duncan streamflow-gaging station indicates that flows not exceeding 1 ft³/s occur within the minimum to 10th percentile range during parts of November, December, January, June, and July; within the 10th to 20th percentile range during parts of October, July, August, and September; and within the 20th to 30th percentile range during parts of August and September (Appendix 1).

The flows recorded at the Salt Creek at Greenwood streamflow-gaging station and the Elkhorn River at Waterloo streamflow-gaging station contribute part of the flow recorded at the Platte River at Louisville streamflow-gaging station. The remainder of the flow recorded at the Platte River at Louisville

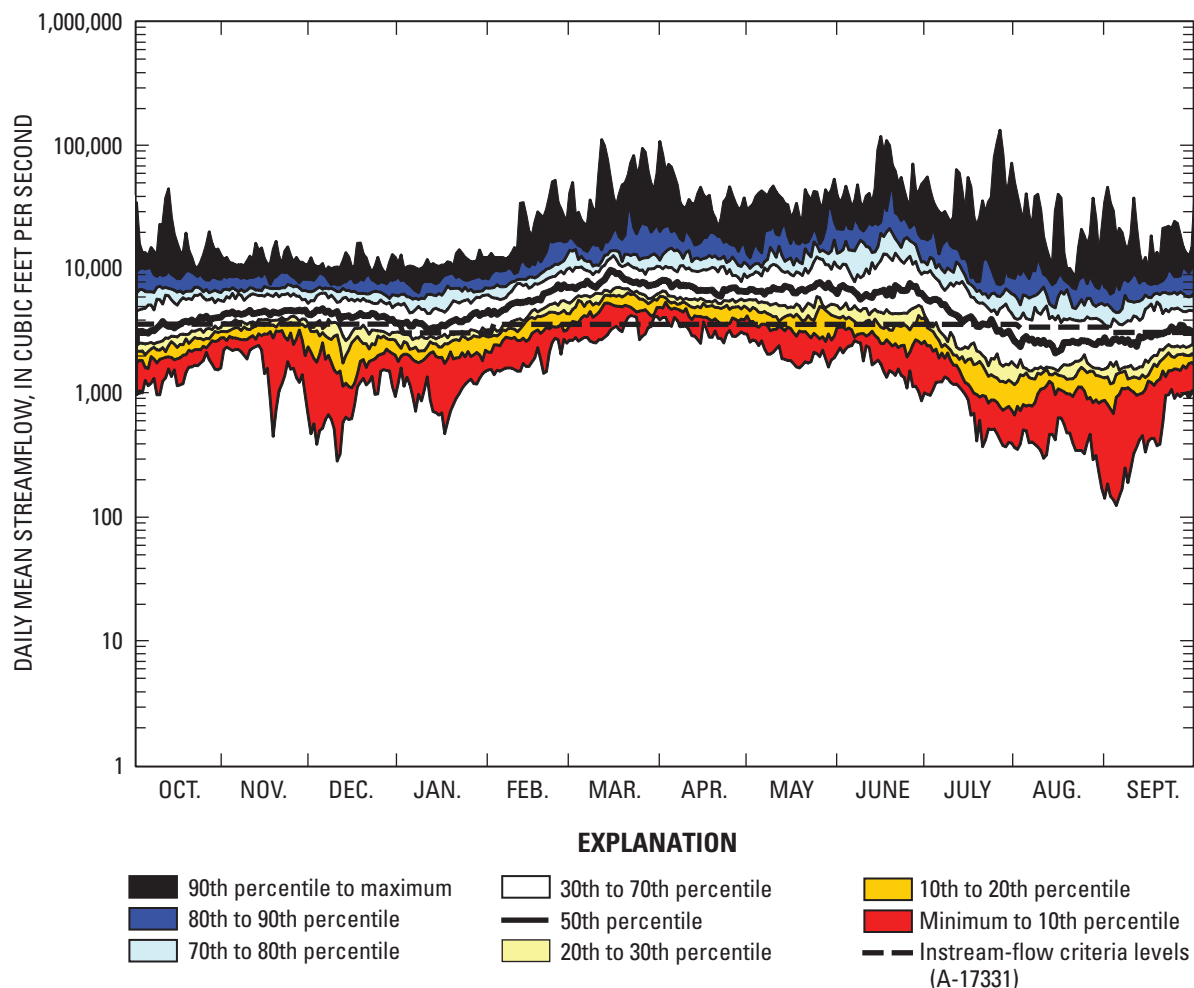


Figure 2. Non-exceedance duration hydrograph for Platte River at Louisville, Nebraska, for 1953–2004.

streamflow-gaging station can be attributed to the Platte River upstream from the mouth of the Elkhorn River, Wahoo Creek, minor inflows and outflows between the mouth of the Elkhorn River and the Platte River at Louisville streamflow-gaging station, and minor inflows and outflows between the mouth of the Elkhorn River and the Elkhorn River at Waterloo streamflow-gaging station. During WY 1954 through 2004, about 21 percent of the annual mean flows recorded at the Platte River at Louisville streamflow-gaging station was measured in the Elkhorn River at Waterloo streamflow-gaging station (table 6). Annual flows of the Elkhorn River at Waterloo streamflow-gaging station ranged from about 12 to 30 percent of annual mean flows recorded at the Platte River at Louisville streamflow-gaging station with a standard deviation of about 4 percent. During this period, flow recorded at the Salt Creek at Greenwood streamflow-gaging station composed, on average, 5 percent of the annual flow recorded at the Platte River at Louisville streamflow-gaging station, with a range of about 2 to 10 percent and a standard deviation of about 2 percent. In the years prior to the application for Appropriation A-17331 (WY 1954 through 1992), 19 percent of the annual mean flows recorded at the Platte River at Louisville streamflow-

gaging station was measured in the Elkhorn River at Waterloo streamflow-gaging station. In the years after the application for Appropriation A-17331 (WY 1993 through 2004), 25 percent of the annual mean flows measured at the Platte River at Louisville streamflow-gaging station was measured in the Elkhorn River at Waterloo streamflow-gaging station.

Results of Kendall's Tau for temporal trends in annual mean flows for the full period of record are presented in table 7 (Appendix 2). Positive trends were found for annual mean flows at eight sites: Platte River near Duncan; Platte River at North Bend; Elkhorn River at Neligh; Logan Creek near Uehling; Maple Creek near Nickerson; Elkhorn River at Waterloo; Salt Creek at Greenwood; and Platte River at Louisville. A negative trend was found for annual mean flows at the Platte River near Leshara streamflow-gaging station, though this temporal trend may be strongly affected by the short period of available data for this site. Trends in annual mean flows were not significant at these sites: Elkhorn River near Atkinson; Elkhorn River at Ewing; South Fork Elkhorn River at Ewing; Elkhorn River at Norfolk; North Fork Elkhorn River near Pierce; Elkhorn River at West Point; Pebble Creek at Scribner; and Wahoo Creek at Ashland.

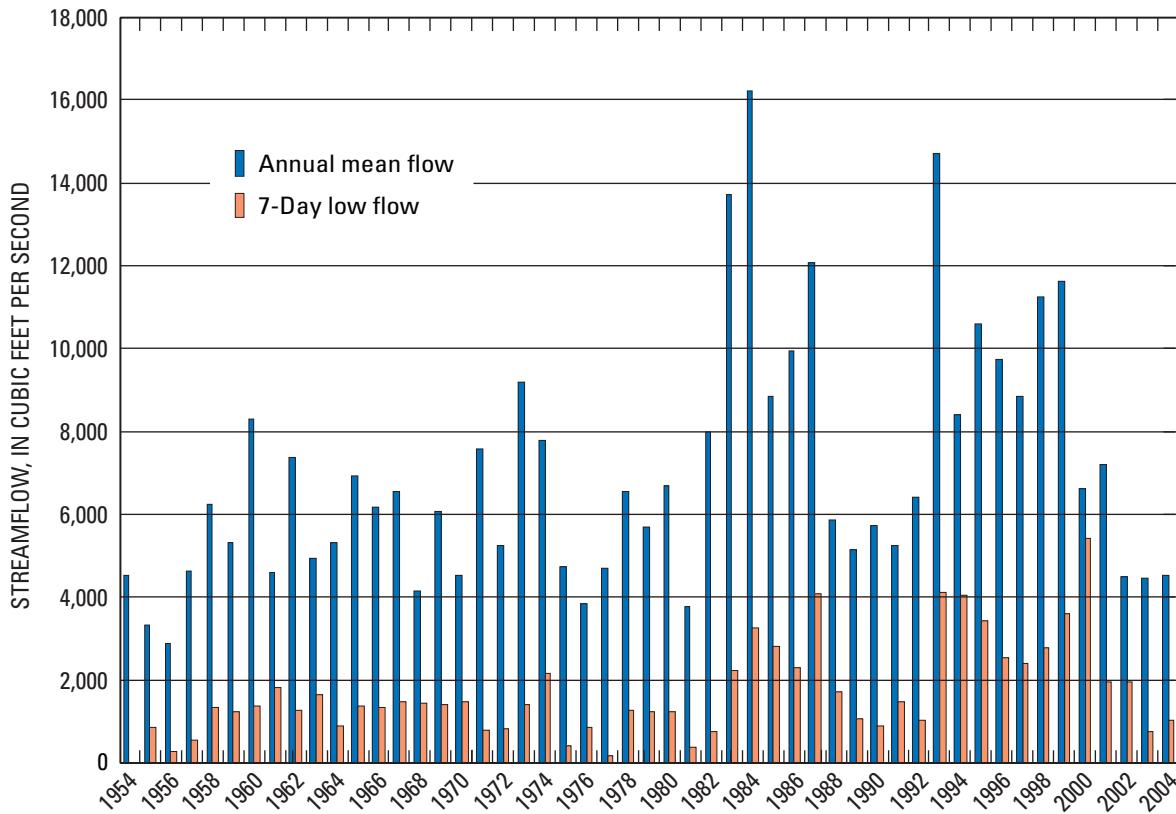


Figure 3. Annual mean streamflow and 7-day low flow of Platte River at Louisville, Nebraska, for 1954–2004.

Sites that showed positive trends for annual minimum 1-day low flows included: Platte River near Duncan; South Fork Elkhorn River at Ewing; Elkhorn River at Neligh; Pebble Creek at Scribner; Logan Creek near Uehling; Maple Creek near Nickerson; Elkhorn River at Waterloo; Salt Creek at Greenwood; and Platte River at Louisville. There were no sites with negative trends in annual minimum 1-day low flows. Trends in annual minimum 1-day low flows were not significant at these sites: Platte River at North Bend; Elkhorn River near Atkinson; Elkhorn River at Ewing; Elkhorn River at Norfolk; North Fork Elkhorn River near Pierce; Elkhorn River

at West Point; Platte River near Leshara; and Wahoo Creek at Ashland.

Sites that showed positive trends for annual minimum 7-day low flows included: Platte River near Duncan; South Fork Elkhorn River at Ewing; Elkhorn River at Neligh; Pebble Creek at Scribner; Logan Creek near Uehling; Maple Creek near Nickerson; Elkhorn River at Waterloo; Salt Creek at Greenwood; and Platte River at Louisville. There were no sites with negative trends in 7-day low flows. Trends in 7-day low flows were not significant at these sites: Platte River at North Bend; Elkhorn River near Atkinson; Elkhorn River at Ewing;

Table 6. Summary statistics for annual mean streamflow expressed as a percentage of the annual mean streamflow at the U.S. Geological Survey streamflow-gaging station on Platte River at Louisville, Nebraska (station 06805500), for water years 1954 through 2004.

Source of streamflow	Streamflow statistic, as a percentage of the Platte River at Louisville streamflow-gaging station mean annual flow				
	Mean	Median	Maximum	Minimum	Standard deviation
06803555 Salt Creek at Greenwood, Nebraska	4.7	4.8	9.7	2.5	1.6
06800500 Elkhorn River at Waterloo, Nebraska	20.5	20.6	30.5	11.9	4.3
Other sources including the Platte River upstream from the mouth of the Elkhorn River	74.6	74.5	83.6	65.1	4.6

Table 7. Median slope of significant low-flow trends at selected sites in the Elkhorn River, Salt Creek, and Platte River basins, Nebraska.

[Significant trends had *p*-values less than 0.05; I, insignificant trend; in cubic feet per second per year; POS, positive trend, slope not calculated]

U.S. Geological Survey streamflow-gaging station number and name		Period analyzed for annual mean flow (see Appendix 2 for period analyzed for other streamflow statistics)	Annual																		
			Annual mean flow	1-day low flow	2-day low flow	3-day low flow	7-day low flow	14-day low flow	30-day low flow	60-day low flow	90-day low flow	183-day low flow	1-day low flow (Oct–Nov)	3-day low flow (Oct–Nov)	7-day low flow (Oct–Nov)	14-day low flow (Oct–Nov)	30-day low flow (Oct–Nov)	60-day low flow (Oct–Nov)	June mean flow	July mean flow	August mean flow
06774000	Platte River near Duncan, Nebr.	1929–2003	+13	+1.1	+1.2	+1.3	+1.6	+2.5	+4.8	+7.5	+11	+12	+8.2	+8.7	+10	+12	+13	+14	I	I	+21
06796000	Platte River at North Bend, Nebr.	1949–2003	+26	I	I	I	I	I	+14	+19	+22	+23	+18	+24	+23	+25	+27	+30	I	I	I
06796500	Platte River near Leshara, Nebr.	1994–2004	-510	I	I	I	I	I	I	-380	-450	-430	-280	I	-330	-350	-390	-450	-1100	-610	-530
06796973	Elkhorn River near Atkin- son, Nebr.	1983–2003	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	+1	-3.5	-1.3
06797500	Elkhorn River at Ewing, Nebr.	1947–2003	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
06798000	South Fork Elkhorn Riv er at Ewing, Nebr.	1947–2003	I	+2	+2	+1	+1	I	I	I	I	I	+2	+1	I	I	I	I	I	+1	I
06798500	Elkhorn River at Neligh, Nebr.	1931–2003	+2.6	+5	+5	+5	+6	I	I	+6	+7	+8	+2.2	I	I	I	I	+7	+1.4	+3.1	I
06799000	Elkhorn River at Norfolk, Nebr.	1896–2003	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
06799100	North Fork Elk- horn River near Pierce, Nebr.	1960–2003	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
06799350	Elkhorn River at West Point, Nebr.	1973–2003	I	I	I	I	I	I	+7.2	+9.1	+9.8	+9.7	I	I	I	I	+8.3	I	I	+35	I

Table 7. Median slope of significant low-flow trends at selected sites in the Elkhorn River, Salt Creek, and Platte River basins, Nebraska.—Continued

[Significant trends had *p*-values less than 0.05; I, insignificant trend; in cubic feet per second per year; POS, positive trend, slope not calculated]

U.S. Geological Survey streamflow-gaging station number and name		Period analyzed for annual mean flow (see Appendix 2 for period analyzed for other streamflow statistics)	Annual																		
			Annual mean flow	1-day low flow	2-day low flow	3-day low flow	7-day low flow	14-day low flow	30-day low flow	60-day low flow	90-day low flow	183-day low flow	1-day low flow (Oct–Nov)	3-day low flow (Oct–Nov)	7-day low flow (Oct–Nov)	14-day low flow (Oct–Nov)	30-day low flow (Oct–Nov)	60-day low flow (Oct–Nov)	June mean flow	July mean flow	August mean flow
06799385	Pebble Creek at Scribner, Nebr.	1979–2003	I	+0.5	+0.5	+0.5	+0.5	+0.6	+0.8	+0.7	I	I	+0.8	+0.8	I	I	I	I	I	I	-18
06799500	Logan Creek near Uehling, Nebr.	1941–2003	POS	+1.4	+1.3	+1.3	+1.4	+1.4	+1.5	+1.6	+1.8	+1.8	+1.7	+1.7	+1.6	+1.6	+1.5	+1.7	POS	POS	POS
06800000	Maple Creek near Nickerson, Nebr.	1952–2003	+1.2	+2	+2	+2	+2	+3	+4	+6	+6	+7	+4	+4	+4	+4	+5	+6	I	+3.4	+1.6
06800500	Elkhorn River at Waterloo, Nebr.	1928–2003	+15	+4.1	+4.3	+4.4	+4.8	+5.4	+6	+6.6	+7.1	+7.4	+5.6	+5.5	+6.1	+6.3	+6.2	+7.8	+22	+22	+9.3
06803555	Salt Creek at Greenwood, Nebr.	1952–2003	+2.9	+1.7	+1.7	+1.7	+1.7	+1.7	+2	+2	+2	+2.2	+1.5	+1.5	+1.5	+1.7	+2	+2.6	I	I	I
06804700	Wahoo Creek at Ashland, Nebr.	1990–2004	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	-28	I
06805500	Platte River at Louisville, Nebr.	1954–2004	+70	+24	+27	+27	+28	+35	+45	+54	+57	+59	+53	+55	+58	+57	+63	+69	I	+96	+57

Elkhorn River at Norfolk; North Fork Elkhorn River near Pierce; Elkhorn River at West Point; Platte River near Leshara; and Wahoo Creek at Ashland.

Sites with positive trends in June mean flows included: Elkhorn River near Atkinson; Elkhorn River at Neligh; Logan Creek near Uehling; and Elkhorn River at Waterloo. Negative trends were indicated at the Platte River near Leshara site. Trends were not significant at: Platte River near Duncan; Platte River at North Bend; Elkhorn River at Ewing; South Fork Elkhorn River at Ewing; Elkhorn River at Norfolk; North Fork Elkhorn River near Pierce; Elkhorn River at West Point; Pebble Creek at Scribner; Maple Creek near Nickerson; Salt Creek at Greenwood; Wahoo Creek at Ashland; and Platte River at Louisville.

Sites with positive trends in July mean flows included: South Fork Elkhorn River at Ewing; Elkhorn River at Neligh; Elkhorn River at West Point; Logan Creek near Uehling; Maple Creek near Nickerson; Elkhorn River at Waterloo; and Platte River at Louisville. Negative trends were indicated at: Platte River near Leshara; Elkhorn River near Atkinson; and Wahoo Creek at Ashland. Trends were not significant at: Platte River near Duncan; Platte River at North Bend; Elkhorn River at Ewing; Elkhorn River at Norfolk; North Fork Elkhorn River near Pierce; Pebble Creek at Scribner; and Salt Creek at Greenwood.

Sites with positive trends in August mean flows included: Platte River near Duncan; Logan Creek near Uehling; Maple Creek near Nickerson; Elkhorn River at Waterloo; and Platte River at Louisville. Negative trends were indicated at: Platte River near Leshara; Elkhorn River near Atkinson; and Pebble Creek at Scribner. Trends were not significant at: Platte River at North Bend; Elkhorn River at Ewing; South Fork Elkhorn River at Ewing; Elkhorn River at Neligh; Elkhorn River at Norfolk; North Fork Elkhorn River near Pierce; Elkhorn River at West Point; Salt Creek at Greenwood; and Wahoo Creek at Ashland.

In the Elkhorn River basin, sites upstream from Norfolk, Nebraska, had fewer significant trends, whereas, generally, sites downstream from Norfolk and sites in the Platte River and Salt Creek basins showed positive trends. Positive trends for streamflow during extended low-flow periods indicated that there generally is increasing water availability during the lowest-flow periods of the year. Significant negative trends for flows during low-flow periods resulted only for the Leshara streamflow-gaging station, where the period analyzed was limited by a short period of record.

Streamflows Not Exceeding Instream-Flow Criteria Levels

Historical Platte River streamflow records for the streamflow-gaging station at Louisville, Nebraska, were used to determine the number of days per water year that would not have satisfied criteria flows corresponding to the minimum

requirements of instream Appropriation A-17331 before it was filed in 1993. The following minimum criteria for the instream flow appropriation were compared to the historical record: 3,700 ft³/s for October through December; 3,100 ft³/s for January; 3,700 ft³/s for February through July; 3,500 ft³/s for August; and 3,200 ft³/s for September. Intervals of consecutive days for which the daily mean streamflow was less than or equal to the level corresponding to the respective criteria were determined for the Platte River at Louisville streamflow-gaging station for WY 1953 through 2004.

The number of days per water year for which the daily mean streamflow was less than or equal to minimum criteria corresponding to instream flow Appropriation A-17331 are listed in table 8. For the period of record before 1993, the median number of days that did not exceed the minimum flow level was 120 days per water year, with 39 days during the July 1–August 31 season, and 76 days during the May 1–September 30 season (table 9).

The intervals during which daily mean streamflows of the Platte River at Louisville streamflow-gaging station failed to exceed the minimum flow criteria levels of Appropriation A-17331 were further summarized (table 9). During WY 1993 through 2004, 48 separate intervals of streamflow less than the criteria levels occurred. Of these intervals, 67 percent were 3 days or greater in duration, and 40 percent were 7 days or greater in duration. The median duration of intervals when streamflow was less than the criteria values was 4 consecutive days.

During 1993 through 2004, daily mean flows of the Platte River at Louisville streamflow-gaging station failed to satisfy the minimum flow levels required by Appropriation A-17331 on a total of 638 days. Most of these low-flow intervals occurred in summer through early fall. During WY 1993 through 2004, the median annual number of days not exceeding the criteria levels was 21.5 days, with 14 days during the July 1 through August 31 season, and no additional days, on average, during the May 1 through September 30 season.

During WY 1953 through 1992, 458 separate intervals of streamflow less than the criteria levels occurred. Of these, 61 percent were 3 days or greater in duration, and 38 percent were 7 days or greater in duration. The median duration of intervals of flow less than the criteria levels was 4 consecutive days. The longest interval of consecutive daily mean streamflow below Appropriation A-17331 criteria levels occurred during WY 1976 and 1977, when 143 consecutive days were recorded as having flows that failed to satisfy the minimum streamflow levels (table 8) required by Appropriation A-17331 (not enacted until 1998).

Table 8. Summary by water year of intervals in which daily mean streamflow at the U.S. Geological Survey streamflow-gaging station on the Platte River at Louisville, Nebraska (06805500), did not satisfy instream-flow criteria levels, 1953–2004.

[ft³/s, cubic feet per second; instream-flow criteria levels are as follows: 3,700 ft³/s during October through December; 3,500 ft³/s in January; 3,700 ft³/s from February through July; 3,500 ft³/s in August; 3,200 ft³/s in September]

Water year	Total number of days in non-exceedance intervals	Non-exceedance days from July 1 through August 31 (percent of 2-month period in parentheses)	Non-exceedance days from May 1 through September 30 (percent of 5-month period in parentheses)	Longest consecutive non-exceedance period beginning in water year (number of days)
1953	95	58 (95)	95 (63)	08/10/53–11/10/53 (93)
1954	163	53 (87)	86 (57)	08/26/54–10/28/54 (64)
1955	247	59 (97)	129 (85)	07/17/55–11/23/55 (130)
1956	253	56 (92)	124 (82)	09/06/56–12/29/56 (115)
1957	197	39 (64)	60 (39)	01/09/57–02/12/57 (35)
1958	96	17 (28)	45 (30)	09/20/58–11/14/58 (56)
1959	185	33 (54)	71 (47)	08/19/59–09/19/59 (32)
1960	116	29 (48)	47 (31)	10/13/59–10/30/59 (18)
1961	148	59 (97)	79 (52)	07/02/61–08/21/61 (51)
1962	81	13 (21)	27 (18)	12/10/61–12/25/61 (16)
1963	121	60 (98)	91 (60)	07/02/63–08/30/63 (60)
1964	111	37 (61)	52 (34)	10/04/63–11/05/63 (33)
1965	145	33 (54)	39 (26)	10/01/64–11/16/64 (47)
1966	97	41 (67)	77 (51)	01/20/66–02/04/66 (16)
1967	180	22 (36)	82 (54)	04/18/67–05/31/67 (44)
1968	142	56 (92)	97 (64)	07/07/68–09/01/68 (57)
1969	113	36 (59)	64 (42)	08/03/69–09/01/69 (30)
1970	108	54 (89)	80 (53)	07/09/70–09/18/70 (72)
1971	122	45 (74)	75 (49)	07/18/71–10/19/71 (94)
1972	119	39 (64)	73 (48)	08/12/72–09/10/72 (30)
1973	65	30 (49)	34 (22)	08/20/73–09/04/73 (16)
1974	100	62 (100)	99 (65)	06/24/74–10/30/74 (129)
1975	170	52 (85)	95 (63)	07/28/75–11/06/75 (102)
1976	198	62 (100)	121 (80)	06/30/76–11/19/76 (143)
1977	153	38 (62)	40 (26)	11/27/76–01/13/77 (48)
1978	126	50 (82)	83 (55)	09/22/78–10/25/78 (34)
1979	206	36 (59)	77 (51)	11/29/78–02/26/79 (90)
1980	138	59 (97)	89 (59)	08/20/80–10/16/80 (58)
1981	206	35 (57)	101 (66)	07/04/81–07/29/81 (26)
1982	48	15 (25)	15 (10)	01/08/82–01/20/82 (13)
1983	5	0 (0)	0 (0)	12/29/82–01/02/83 (5)
1984	24	13 (21)	18 (12)	08/12/84–08/23/84 (12)
1985	18	13 (21)	18 (12)	07/10/85–07/18/85 (9)
1986	7	0 (0)	0 (0)	11/21/85–11/26/85 (6)
1987	14	14 (23)	14 (9)	07/26/87–08/07/87 (13)
1988	97	52 (85)	84 (55)	08/20/88–09/15/88 (27)
1989	121	47 (77)	104 (68)	07/23/89–09/03/89 (43)
1990	111	44 (72)	74 (49)	08/23/90–10/23/90 (62)
1991	136	52 (85)	82 (54)	07/18/91–10/31/91 (106)

Table 8. Summary by water year of intervals in which daily mean streamflow at the U.S. Geological Survey streamflow-gaging station on the Platte River at Louisville, Nebraska (06805500), did not satisfy instream-flow criteria levels, 1953–2004.—Continued
[ft³/s, cubic feet per second; instream-flow criteria levels are as follows: 3,700 ft³/s during October through December; 3,500 ft³/s in January; 3,700 ft³/s from February through July; 3,500 ft³/s in August; 3,200 ft³/s in September]

Water year	Total number of days in non-exceedance intervals	Non-exceedance days from July 1 through August 31 (percent of 2-month period in parentheses)	Non-exceedance days from May 1 through September 30 (percent of 5-month period in parentheses)	Longest consecutive non-exceedance period beginning in water year (number of days)
1993	0	0 (0)	0 (0)	None
1994	4	3 (5)	4 (3)	08/30/94–08/31/94 (2)
1995	15	9 (15)	9 (6)	08/14/95–08/22/95 (9)
1996	18	0 (0)	0 (0)	01/21/96–01/27/96 (7)
1997	25	19 (31)	19 (13)	07/24/97–08/11/97 (19)
1998	0	0 (0)	0 (0)	None
1999	1	0 (0)	0 (0)	12/23/98–12/23/98 (1)
2000	56	27 (44)	70 (46)	08/06/00–09/28/00 (54)
2001	52	28 (46)	35 (23)	07/31/01–08/17/01 (18)
2002	124	57 (93)	121 (80)	06/21/02–08/21/02 (62)
2003	146	51 (84)	107 (70)	07/13/03–09/11/03 (61)
2004	197	40 (66)	75 (49)	09/17/03–11/03/03 (48)

Quality Assurance of Streamflow Measurements and Stage Records for the Platte River at Louisville, Nebraska

For this study, the quality-assurance measures used for processing and publishing of stage and streamflow data at the Platte River at Louisville, Nebraska, streamflow-gaging station, were reviewed and summarized. Discharge, or streamflow, measurement data were retrieved from the USGS National Water Information System database (<http://water-data.usgs.gov/nwis>) and summarized.

The USGS streamflow-gaging station on the Platte River at Louisville, Nebraska, is located on the left bank approximately 50 ft upstream from the State Highway 50 bridge (fig. 1). The streamflow-gaging station presently collects stage data at 15-minute intervals and is included in the USGS Nebraska Water Science Center Surface-Water Quality-Assurance Plan (P.J. Soenksen, U.S. Geological Survey, written commun., 2006). A reference wire-weight gage is located on the downstream side of the Highway 50 bridge. The station instrumentation is capable of recording stage data accurately to ± 0.01 ft. Occasional instrumentation drift requires recalibration. Corrections, called datum corrections, are applied to stage data values recorded by the datalogger to compensate for differences between the readings of the reference and recording gages (Rantz and others, 1982a). Periodically, level surveys are conducted to check the reference gage for vertical movement (Rantz and others, 1982a). Datum corrections for the

periods between level survey checks are applied to the stage record to account for these changes, if vertical movement exceeds 0.02 ft (Rantz and others, 1982a).

Standard USGS protocols require hydrographers to assign qualitative assessments of conditions affecting accuracy to individual discharge measurements—excellent, good, fair, or poor (Rantz and others, 1982a). These qualitative ratings are determined by the hydrographer based on subjective evaluation of an objectively determined suite of factors affecting measurement accuracy, which includes: number and distribution of verticals, average velocity, uniformity of flow, regularity and firmness of channel bottom, steadiness of stage and discharge during the measurement, and presence or absence of ice or debris in the flow (Sauer and Meyer, 1992).

Since the Platte River at Louisville streamflow-gaging station was established in May of 1953, more than 550 measurements have been made using standard USGS discharge measurement techniques and equipment (Corbett and others, 1943; Rantz and others, 1982a). All measurement computations were checked by USGS personnel for mathematical accuracy following methods listed in Kennedy (1983).

Discharge measurements collected before the start of WY 1985 were not computerized; therefore, the summaries of measurements were limited to WY 1985 through 2004. Of the 268 direct discharge measurements collected during that period, 93 percent of measurements were collected from the Highway 50 bridge; the remaining measurements were collected by wading or as ice measurements. The measurements of streamflows within 10 percent of the range of flows not exceeding the present criteria for minimum instream flows were summarized

Table 9. Comparison by period of intervals in which daily mean streamflow at the U.S. Geological Survey streamflow-gaging station on the Platte River at Louisville, Nebraska (station 06805500), did not exceed instream-flow criteria levels, 1953–2004.

[ft³/s, cubic feet per second; instream-flow criteria levels are as follows: 3,700 ft³/s during October through December; 3,500 ft³/s in January; 3,700 ft³/s from February through July; 3,500 ft³/s in August; 3,200 ft³/s in September]

Summary statistic	Summary time period, in water years		
	1953–2004	1953–1992	1993–2004
Intervals			
Total number of intervals	506	458	48
Average length of each interval, in days	10	11	10
Median length of each interval, in days	4	4	4
Intervals 3 or more days in length, as percentage of period	61	61	67
Intervals 7 or more days in length, as percentage of period	38	38	40
Non-exceedance days			
Total number of non-exceedance days	5,469	4,831	638
Median number of non-exceedance days per water year	112	120	21.5
Median number of non-exceedance days from July 1 through Aug. 31 per water year	36.5	39	14
Median number of non-exceedance days from May 1 through Sept. 30 per water year	72	76	14

(table 10). During WY 1985 through 2004, 55 measurements of discharges less than 4,000 ft³/s were made. The lowest flow measured during WY 1985 through 2004 was 911 ft³/s on August 7, 2002. The highest flow measured during WY 1985 through 2004 was 125,000 ft³/s on March 10, 1993. Many measurements at this site, especially low-flow measurements, required the use of horizontal-angle coefficients to adjust measured velocities when the flowlines were not normal to the measuring section. Qualitative ratings indicate that 84 percent of measurements made at discharges less than 4,000 ft³/s and 87 percent overall are considered to be accurate to within 5 percent of the true discharge.

For the Louisville streamflow-gaging station, stage-discharge relations were developed, modified, and applied following standard procedures described in Rantz and others, (1982a; 1982b); Kennedy, (1983); and Kennedy, (1984). These stage-discharge relations can be represented by tables, and also graphically as rating curves. Here the Platte River is a wide channel with a sand and gravel bed that shifts readily with changes in stage; therefore, stage-discharge rating tables are adjusted routinely by applying adjustments to stage values known as ratings shifts and as described by Kennedy (1984). During WY 1985 through 2004, five rating curves have been developed for the Platte River at Louisville streamflow-gaging

Table 10. Summary of discharge measurements from water years 1985 through 2004 for U.S. Geological Survey streamflow-gaging station on the Platte River at Louisville, Nebraska (station 06805500).

[ft³/s, cubic feet per second; %, percent; columns may not sum to 100% because of rounding]

Qualitative rating of conditions affecting measurement accuracy	Measured discharge less than 4,000 ft ³ /s (percent of all such measurements in parentheses)	All discharge measurements within period (percent of all measurements in parentheses)
Excellent (within 2 percent of the actual "true" discharge)	1 (2%)	2 (1%)
Good (within 5 percent)	45 (82%)	231 (86%)
Fair (within 8 percent)	4 (7%)	23 (9%)
Poor (measured discharge 8 percent greater or less than the actual discharge)	3 (5%)	10 (4%)
Not rated	2 (4%)	2 (1%)

station. Shift adjustments among all measurements during the period ranged from -1.95 to 1.50 ft. Shift adjustments of large magnitudes generally were associated with ice measurements or moderate to higher streamflows capable of scouring and filling the sandy streambed within a short time period during and after the higher flow occurred. For measurements of discharges less than 4,000 ft³/s not affected by ice, shift adjustments ranged from 0.18 to 0.40 ft. The shift adjustments for measurements of flows less than 4,000 ft³/s were applied routinely to adjust the rating table for the effects of shifting sand and seasonal changes in vegetation.

The USGS follows standard procedures for collecting and adjusting continuous stage data and periodic discharge data, and for processing those data to produce continuous records of discharge. Those procedures include, but are not limited to, making stage-reference measurements to adjust stage records, documenting non-perpendicular flow angles in the cross section to adjust discharge measurements accordingly, and comparing computed discharge records with those for other stations that are hydrologically similar. The discharge records are assigned a qualitative rating of accuracy based on a number of factors, including some of those listed in Sauer and Meyer (1992), and then are independently checked and reviewed. On this basis, the published discharge records for the Platte River at Louisville streamflow-gaging station are considered to be accurate within the assigned limits indicated by the qualitative rating (table 10) (P.J. Soenksen, U.S. Geological Survey, written commun., 2008).

Summary and Conclusions

Instream-flow protection is a complex legislative and technical issue. The Nebraska Department of Natural Resources established appropriations on the Platte River to provide instream-flow protection primarily to maintain the fish community, whooping crane roost habitat, and wet meadows. In 2005, the USGS, in cooperation with the Upper Elkhorn Natural Resources District and the Lower Elkhorn Natural Resources District, initiated a cooperative study to review the methods used to calculate the streamflow requirements for the Nebraska Game and Parks Commission instream appropriation on the Platte River in Nebraska, to review the historical streamflow records for the Platte River at Louisville streamflow-gaging station, and to indicate the quality of the data for the Platte River at Louisville streamflow-gaging station for managing flows on the appropriated reach of the Platte River from its confluence with the Elkhorn River to the mouth.

Confluences with two principal tributaries of the Platte River—the Elkhorn River and Salt Creek—are located within the reach regulated by Appropriation A-17331. The Elkhorn River flows east-southeast from the Sand Hills in north-central Nebraska through the glaciated rolling hills of northeast Nebraska to its confluence with the Platte River just downstream from Fremont, Nebraska. Streamflows in the Sand Hills

in the western part of the drainage basin originate principally from ground water; streamflows in the eastern part of the basin generally are more variable and responsive to precipitation events. Salt Creek flows into the Platte River from the south just downstream from the confluence of the Elkhorn and Platte Rivers.

Surface-water use in the Elkhorn River basin includes irrigation, livestock, and recreational supplies. As of January 30, 2005, 362 surface-water appropriations were listed in the NDNR database with application dates later than 1970 (Nebraska Department of Natural Resources, 2005). These appropriations are listed as irrigating about 29,000 acres in the Elkhorn River basin.

The Platte River has a drainage area of about 71,000 mi² upstream from the USGS streamflow-gaging station at Louisville, Nebraska. Extremes for discharge at this station have ranged from a low of 131 ft³/s to a high of 124,000 ft³/s, and the mean discharge (1953 through 2005) was 6,966 ft³/s.

PHABSIM, a habitat simulation model, and other estimation methodologies had been used in previous studies to estimate instream-flow requirements of the fish community of the lower Platte River. To estimate instream-flow requirements, PHABSIM uses hydraulic principles to simulate water depths and velocities on the basis of empirical data, such as channel geometry, substrate classification, vegetative cover indexes, and other measurements collected along the stream reach. In PHABSIM, criteria for favorable habitat are expressed as suitability index curves, which relate physical features to a microhabitat-suitability score.

Efforts to estimate instream-flow requirements using PHABSIM and other estimation methodologies resulted in the flow magnitude requests in five applications for instream appropriations filed by NGPC in 1993 for the purpose of maintaining fish and wildlife in the central and eastern Platte River. Analysis of PHABSIM results for all fish species indicated that habitat availability rapidly declines as flows fall below 2,000 ft³/s.

Based on results of PHABSIM analysis, NGPC requested an instream-flow appropriation (Appropriation A-17331) of 3,700 ft³/s for the reach from the Elkhorn River to the mouth of the Platte River. This appropriation was granted with modifications in 1998, having been modified to account for the Metropolitan Utilities District's senior water right of 500 ft³/s and to meet a 20-percent exceedance flow-duration threshold.

Statistical summaries were computed for 17 selected streamflow-gaging stations in the study area for an analysis of streamflow characteristics. Streamflow records from 1928 through 2004 in the Platte River and Elkhorn River basins and from the 1950s through 2004 in the Salt Creek basin were summarized. From WY 1954 through 1992, an average of 19 percent of the mean annual flows at the Platte River at Louisville streamflow-gaging station was measured at the Elkhorn River at Waterloo streamflow-gaging station. From WY 1993 through 2004, an average of 25 percent of the mean annual flow at the Platte River at Louisville streamflow-gaging station

was measured at the Elkhorn River at Waterloo streamflow-gaging station.

Generally, the streamflow of the Platte River at Louisville streamflow-gaging station is the sum of streamflows of the Elkhorn River, Salt Creek, Wahoo Creek, and the Platte River at Ashland, Nebraska; plus ungaged inflows minus outflows between the streamflow-gaging stations on these streams and the Louisville streamflow-gaging station. Annual mean flow of the Elkhorn River at Waterloo streamflow-gaging station ranged from 12 to 30 percent of the annual mean flow at the Platte River at Louisville streamflow-gaging station during WY 1954 through 2004, with a standard deviation of 4.3 percent.

Daily mean streamflows were used to identify extreme low-flow periods of various durations, or n -day low flows. Annual low-flow values were computed as the minimum mean flows for n consecutive days during a climatic year (April to March), for durations of 1, 3, 7, 14, 30, 60, and 183 days for 17 selected streamflow-gaging stations in the study area.

Kendall's Tau test was used to detect temporal trends in selected flow statistics. The streamflow values were not adjusted to remove the precipitation variation. In this study, analysis of the results of Kendall's Tau for trends in annual streamflow indicated significant p -values and the presence of positive trends for the period of record at eight sites – Platte River near Duncan; Platte River at North Bend; Elkhorn River at Neligh; Logan Creek near Uehling; Maple Creek near Nickerson; Elkhorn River at Waterloo; Salt Creek at Greenwood; and Platte River at Louisville. Generally, fewer significant positive trends resulted for sites in the Elkhorn River basin upstream from Norfolk, whereas results for sites in the Elkhorn River basin downstream from Norfolk, on the Platte River, and in Salt Creek basin, indicated generally positive trends for annual mean flow and n -day low flows.

Historical streamflow records at the USGS streamflow-gaging station at Platte River at Louisville, Nebraska, were used to determine the number of days per water year that discharge would not have satisfied instream-flow criteria levels corresponding to the minimum requirements of Appropriation A-17331 before it was filed. The following criteria levels for instream flow were compared to the historical record: 3,700 ft³/s for October through December; 3,500 ft³/s for January; 3,700 ft³/s for February through July; 3,500 ft³/s for August; and 3,200 ft³/s for September. For the period of record before 1993, the median number of days that discharge failed to exceed the criteria levels was 120 days per water year, with 39 days during the July 1–August 31 period, and 76 days during the May 1–September 30 period.

Of the 458 periods of consecutive days in which the daily mean flow did not exceed criteria levels corresponding to instream flow appropriation A-17331 at the Platte River at Louisville streamflow-gaging station (WY 1953–1992), 61 percent were 3 days or greater in duration, and 38 percent were 7 days or greater in duration. The median duration of flow less than the threshold was 4 consecutive days for WY 1953–92 and also for 1993 through 2004. The longest period

of flow below the threshold levels occurred during WY 1976 through 1977, when for 143 consecutive days the recorded daily mean streamflow was at or below the minimum streamflow later required by Appropriation A-17331.

Since 1993, daily mean flows for 638 days have failed to exceed the minimum flow requirements of A-17331 at the Platte River at Louisville, Nebraska, USGS streamflow-gaging station. Most of these low-flow periods occurred in summer through early fall. For WY 1993 through 2004, the median number of days that did not exceed the flow criteria was about 21 days per water year, with 14 days during the July 1–August 31 period, and no additional days during the May 1–September 30 period.

Since the Platte River at Louisville streamflow-gaging station was established in May 1953, more than 550 streamflow measurements have been made. Summaries of streamflow measurements were limited to WY 1985 through 2004. Of the 268 discharge measurements during that period, 93 percent were collected from the Highway 50 bridge, whereas the remaining measurements were made in or on the water (wading or ice measurements). During WY 1985 through 2004, 55 measurements of discharges less than 4,000 ft³/s were made, with the lowest flow measured as 911 ft³/s on August 7, 2002. Qualitative ratings indicate that 84 percent of measurements made at discharges less than 4,000 ft³/s, and 87 percent overall, are considered to be accurate to within 5 percent of the true discharge.

Stage-discharge relations were developed as rating tables and rating curves, modified, and applied following standard USGS procedures, and stage-discharge rating tables were routinely adjusted by applying adjustments to stage called ratings shifts. During WY 1985 through 2004, shift adjustments ranged from -1.95 to 1.50 ft among all measurements, and from -0.18 to 0.40 ft for measurements of discharge less than 4,000 ft³/s.

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Appendix 1. Streamflow Characteristics

06774000 PLATTE RIVER NEAR DUNCAN, NEBR.

LOCATION.--Lat 41°22'06", long 97°29'43", in SE ¼ SW ¼ sec.12, T.16 N., R.2 W., Platte County, Hydrologic Unit 10200103, on left bank near north-west corner of county bridge, 1.5 mi south of Duncan, and 15.3 mi upstream from Loup River, and at mile 114.

DRAINAGE AREA.--59,300 mi² of which 4,670 mi² probably is noncontributing.

STREAMFLOW RECORDS

PERIOD OF RECORD.--June 1895 to December 1909 (irrigation seasons only 1885-1900). July 1910 to December 1911 (gage heights and stream-flow measurements only), April 1912 to September 1915, June 1928 to current year. Published as "near Columbus" 1895-1915.

REVISED RECORDS.--WSP 956: 1935. WSP 1390: 1897, 1899-1901, 1903-05, 1929-32, 1935(M), 1936. WDR NE-94-1: Drainage area.

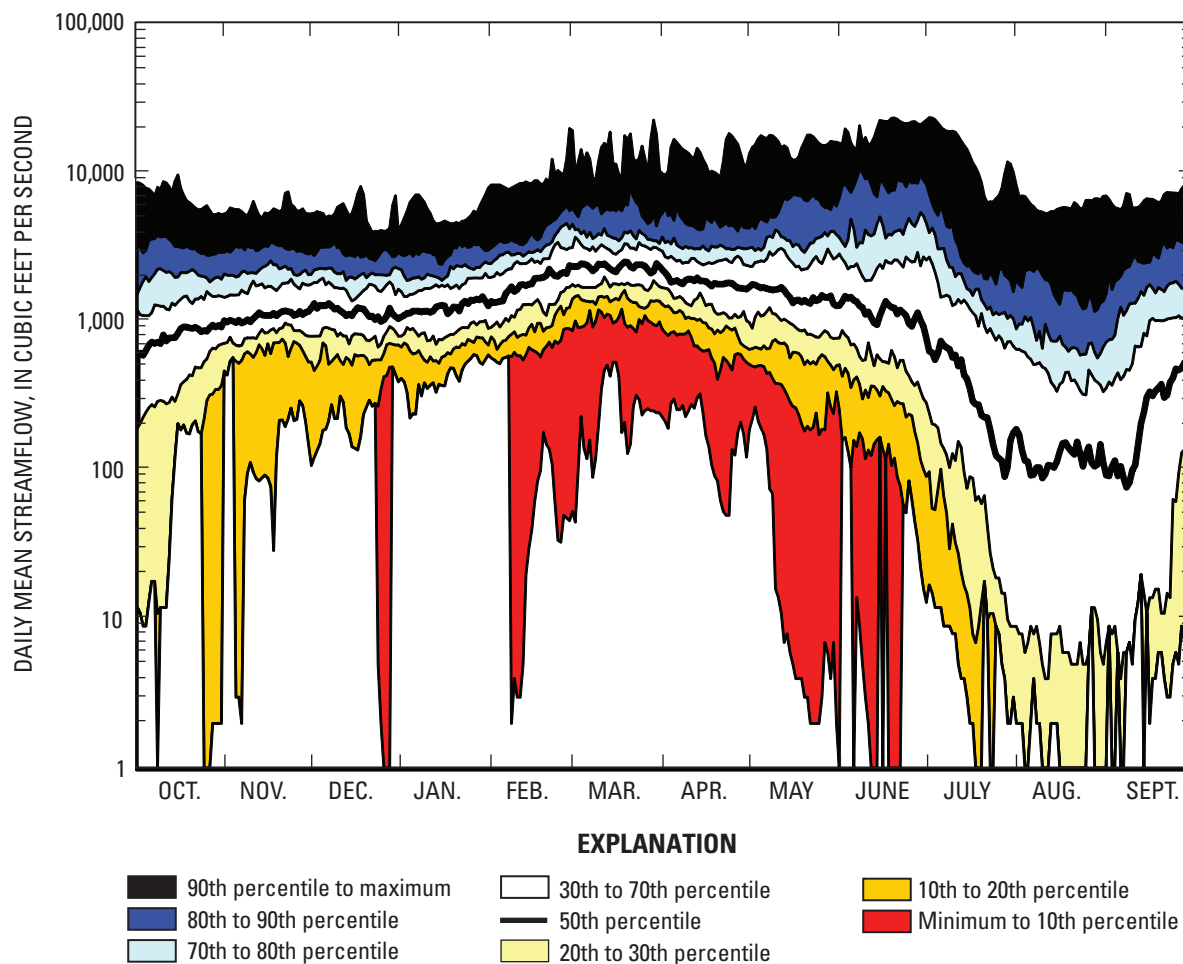
GAGE.--Water-stage recorder with satellite telemetry. Datum of gage is 1,476.82 ft above sea level. June 1895 to December 1909, April 1912 to September 1915, and June to October 1928, non-recording gage at site 7 mi downstream at different datums. Oct. 25, 1928, to Feb. 20, 1935, non-recording gage, and Feb. 20, 1935 to Mar. 21, 1984, recording gage both at present site at 2.00 ft higher datum. Mar. 22, 1984, to Mar. 4, 1987, at site 300 ft downstream at present datum. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor. Natural flow of stream affected by transmountain diversions, storage reservoirs, power developments, ground-water withdrawals and diversions for irrigation, and return flow from irrigated areas.

EXTREMES FOR PERIOD OF RECORD.--1895-1909, 1912-15, 1928-84: Maximum streamflow observed, 44,100 ft³ June 23, 1905 (gage height, 6.50 feet, site and datum then in use); no flow at times in 1931, 1933-42, 1944, 1952-57, 1959, 1963, 1974, 1976, 1978.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum streamflow, 44,100 ft³/s June 23, 1905, gage height 6.50 ft, site and datum than in use. No flow at times in 1896, 1902, 1904-05, 1910-11, 1913-14, 1928, all at site downstream, 1931, 1933-41.

Non-exceedance duration hydrograph for Platte River near Duncan, Nebr. (06774000) (1928-2004 period of record)



06774000 PLATTE RIVER NEAR DUNCAN, NEBR.

Monthly and annual streamflow, 1942–2005

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard devia- tion	Coef- ficient of varia- tion
October	6,673	0	1,334	1,340	1.00
November	5,617	0	1,491	1,089	0.73
December	5,107	16	1,475	961	0.65
January	5,603	45	1,541	953	0.62
February	8,795	269	2,248	1,413	0.63
March	9,531	714	2,839	1,582	0.56
April	13,410	362	2,437	1,943	0.80
May	15,450	150	2,551	2,635	1.03
June	18,320	11	2,784	3,426	1.23
July	12,590	0	1,371	1,969	1.44
August	6,135	0	629	1,012	1.61
September	6,785	0	922	1,289	1.40
Annual	6,652	287	1,798	1,192	0.66

Magnitude and probability of annual low flow based on period of record, 1928–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	38	5	2	1	0	0
2	37	6	2	1	0	0
3	39	5	2	1	0	0
7	40	4	1	0	0	0
14	57	4	1	0	0	0
30	81	8	2	1	0	0
60	200	16	3	0	0	0
90	361	44	10	2	0	0
183	1,025	165	30	5	0	0
October–November						
1	493	87	26	8	2	1
2	532	95	28	9	2	1
3	561	100	29	9	2	1
7	684	103	25	6	1	0
14	851	147	39	10	2	0
30	1,008	143	30	6	1	0
60	1,588	282	55	9	1	0

Duration of daily mean flow based on period of record, 1928–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time						
1%	10,590	8,553	5,545	3,948	3,141	2,688
10%	10,590	8,553	5,545	3,948	3,141	2,688
20%	10,590	8,553	5,545	3,948	3,141	2,688
30%	10,590	8,553	5,545	3,948	3,141	2,688
40%	10,590	8,553	5,545	3,948	3,141	2,688
50%	10,590	8,553	5,545	3,948	3,141	2,688
60%	10,590	8,553	5,545	3,948	3,141	2,688
70%	10,590	8,553	5,545	3,948	3,141	2,688
80%	10,590	8,553	5,545	3,948	3,141	2,688
85%	10,590	8,553	5,545	3,948	3,141	2,688
90%	10,590	8,553	5,545	3,948	3,141	2,688
95%	10,590	8,553	5,545	3,948	3,141	2,688
98%	10,590	8,553	5,545	3,948	3,141	2,688
99%	10,590	8,553	5,545	3,948	3,141	2,688

06796000 PLATTE RIVER AT NORTH BEND, NEBR.

LOCATION.--Lat 41°27'10", long 96°46'32", in SE ¼ SE ¼ sec.7, T.17 N., R.6 D., Dodge County, Hydrologic Unit 10200201, on left bank 80 ft upstream from bridge on State Highway 79, 1 mi south of North Bend, 5 mi downstream from Shell Creek, and at mile 73.0.

DRAINAGE AREA.--70,400 mi² of which 12,600 mi² probably is noncontributing.

STREAMFLOW RECORDS

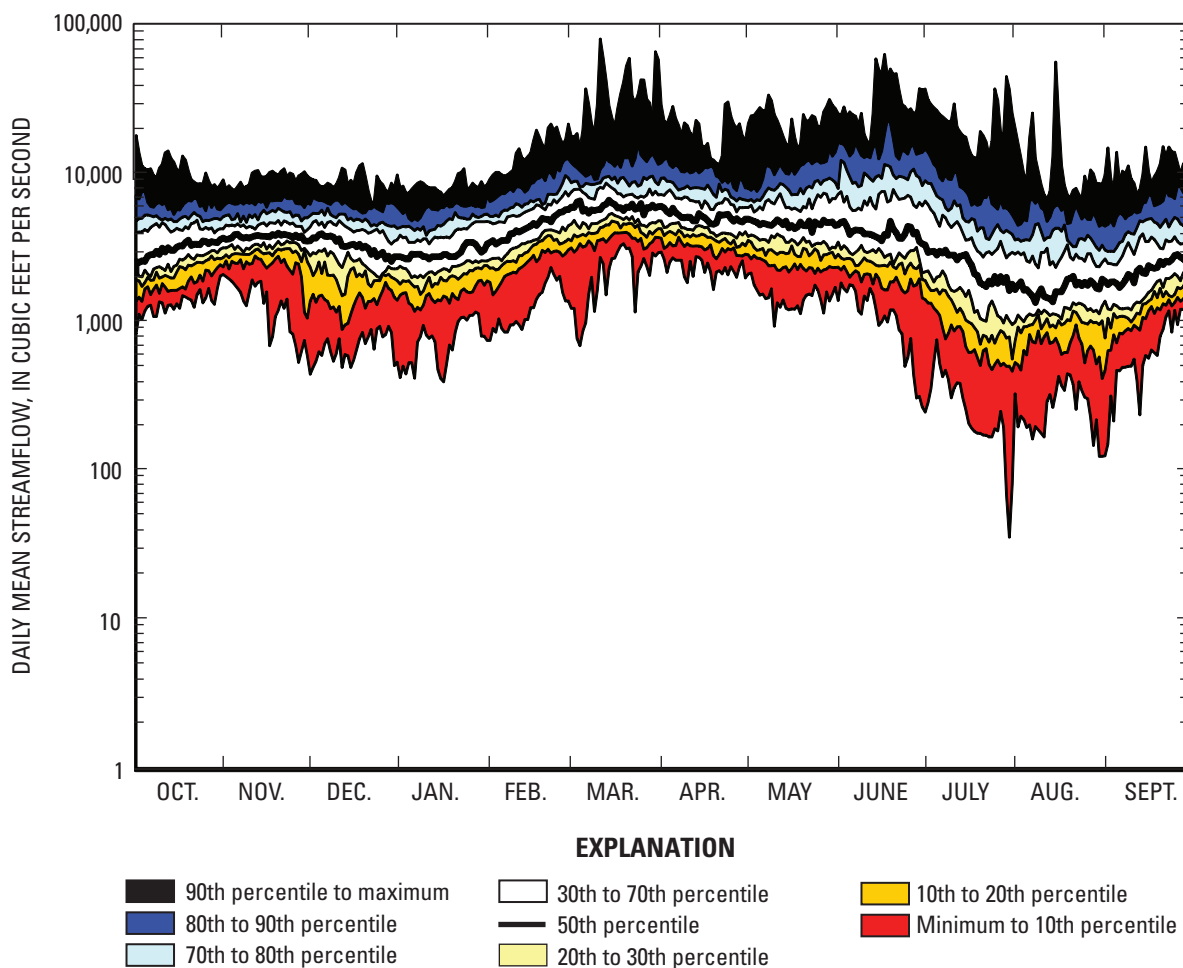
PERIOD OF RECORD.--April 1949 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,262.32 ft above sea level. Prior to Sept. 12, 1951, nonrecording gage and Sept. 12, 1951 to Sept. 30, 1970 waterstage recorder, at present site at datum 2.00 ft higher. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor. Natural flow of stream affected by trans-mountain diversions, storage reservoirs, power developments, ground-water withdrawals and diversions for irrigation, and return flow from irrigated areas.

EXTREMES FOR PERIOD OF RECORD.--Maximum streamflow, 112,000 ft³ March 29, 1960 (gage height, 10.04 feet); maximum gage height, 15.55 feet, March 19, 1978 (backwater from ice); minimum daily streamflow, 36 ft³ July 29, 1974.

Non-exceedance duration hydrograph for Platte River at North Bend, Nebr. (06796000) (1949–2004 period of record)



06796000 PLATTE RIVER AT NORTH BEND, NEBR.

Monthly and annual streamflow, 1949–2005

	Maximum (ft ³ /s)	Mini- mum (ft ³ /s)	Mean (ft ³ /s)	Stan- dard devia- tion	Coef- ficient of varia- tion
October	10,130	1,624	3,762	1,755	0.47
November	9,462	1,938	4,130	1,453	0.35
December	8,581	1,413	3,558	1,356	0.38
January	7,361	932	3,377	1,419	0.42
February	11,850	2,689	5,217	1,994	0.38
March	16,870	3,683	7,210	2,970	0.41
April	19,400	2,672	5,982	2,738	0.46
May	21,770	1,952	5,868	3,301	0.56
June	25,340	1,932	6,490	4,960	0.76
July	17,070	381	3,606	3,162	0.88
August	8,021	442	2,461	1,697	0.69
September	9,022	936	3,020	1,934	0.64
Annual	10,850	2,201	4,635	4,635	0.66

Magnitude and probability of annual low flow based on period of record, 1949–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	619	318	209	142	88	63
2	678	359	243	171	111	82
3	716	384	263	187	123	92
7	842	474	340	253	179	140
14	1,087	618	443	330	232	181
30	1,402	825	610	468	343	277
60	1,816	1,127	865	690	530	442
90	2,154	1,417	1,137	947	771	672
183	2,859	2,078	1,778	1,571	1,375	1,262
October–November						
1	1,899	1,132	849	663	498	408
2	2,131	1,288	968	756	565	461
3	2,213	1,364	1,042	826	631	524
7	2,467	1,706	1,416	1,218	1,032	925
14	2,804	2,010	1,701	1,487	1,283	1,165
30	3,218	2,345	1,996	1,751	1,514	1,376
60	3,619	2,730	2,387	2,149	1,923	1,792

Duration of daily mean flow based on period of record, 1949–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	11,977
2%	11,598
5%	10,459
10%	8,562
15%	7,184
20%	6,342
25%	5,600
30%	5,179
35%	4,759
40%	4,339
45%	4,037
50%	3,746
55%	3,456
60%	3,179
65%	2,919
70%	2,658
75%	2,386
80%	2,095
85%	1,780
90%	1,418
95%	1,012
98%	656
99%	483

06796500 PLATTE RIVER NEAR LESHARA, NEBR.

LOCATION.--Lat 41°19'12", long 96°24'14", in NW ¼ NW ¼ sec.34, T.16 N., R.9 E., Douglas County, Hydrologic Unit 10200202, on left bank 25 ft downstream from bridge on Nebraska Highway 64, 1.0 mi southeast of Leshara, NE.

DRAINAGE AREA.—

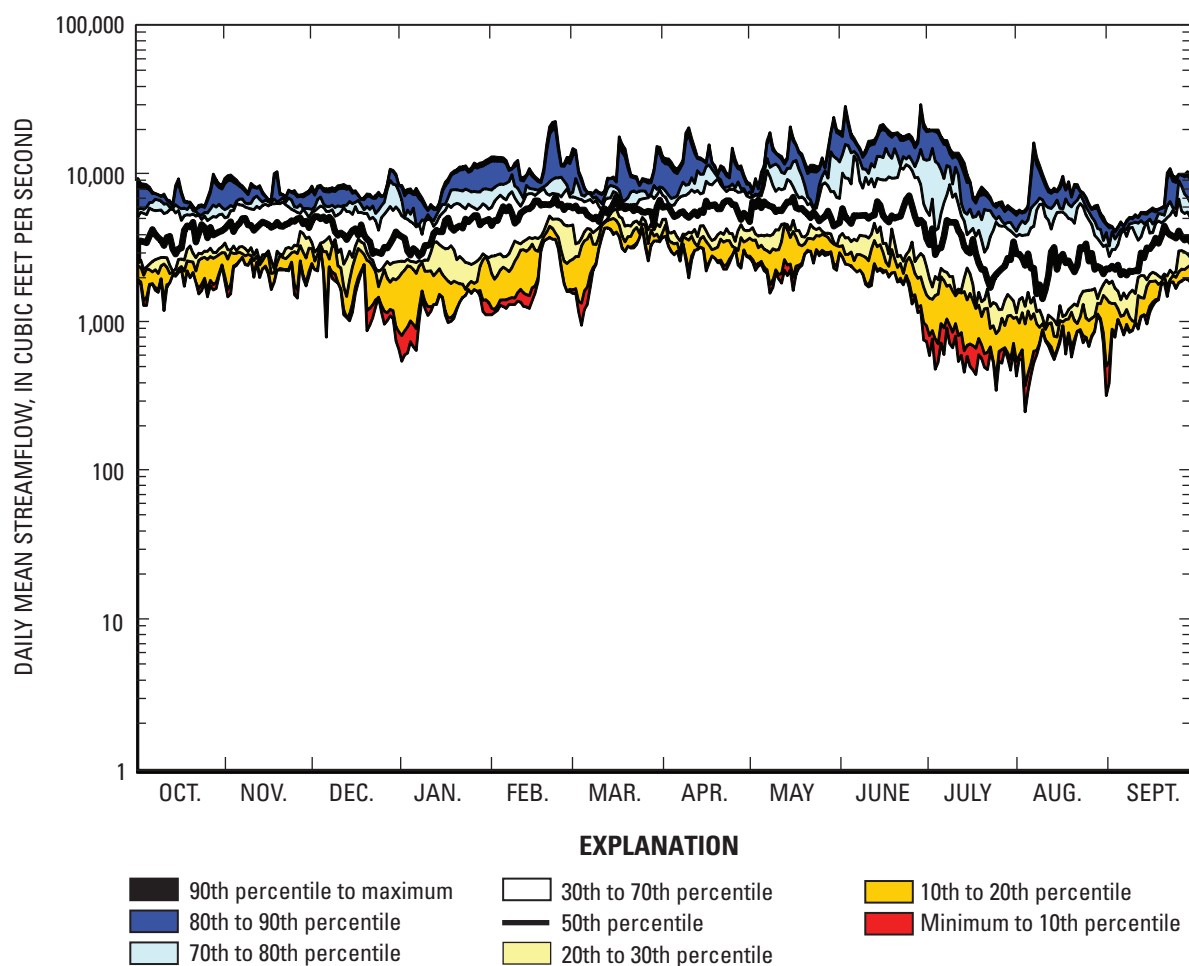
STREAMFLOW RECORDS

PERIOD OF RECORD.--June 1994 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,143.86 ft above sea level. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for Platte River near Leshara, Nebr. (06796500) (1994–2004 period of record)



06796500 PLATTE RIVER NEAR LESHARA, NEBR.

Monthly and annual streamflow, 1994–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard devia- tion	Coef- ficient of varia- tion
October	6,733	1,924	4,282	1,726	0.40
November	7,784	2,324	4,798	1,754	0.37
December	6,762	1,984	4,372	1,643	0.38
January	7,552	1,276	3,957	1,914	0.48
February	10,040	2,984	5,741	2,335	0.41
March	7,960	4,079	5,999	1,374	0.23
April	11,300	3,054	6,348	2,681	0.42
May	10,650	3,180	6,585	2,487	0.38
June	17,460	2,446	7,444	4,991	0.67
July	10,540	595	4,089	2,901	0.71
August	7,163	948	3,171	2,126	0.67
September	6,793	1,710	3,390	1,654	0.49
Annual	7,444	2,703	4,994	1,878	0.38

Magnitude and probability of annual low flow based on period of record, 1994–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	904	484	339	248	172	133
2	966	524	377	285	207	166
3	1,047	602	449	352	267	222
7	1,233	733	562	452	356	303
14	1,552	897	667	520	391	322
30	1,947	1,080	773	577	410	323
60	2,444	1,324	930	682	472	366
90	2,884	1,699	1,259	971	715	579
183	3,550	2,350	1,871	1,539	1,227	1,051
October–November						
1	2,907	1,920	1,519	1,241	979	830
2	3,065	2,035	1,616	1,324	1,048	891
3	3,140	2,114	1,701	1,414	1,141	985
7	3,391	2,335	1,903	1,599	1,307	1,138
14	3,571	2,496	2,055	1,743	1,443	1,269
30	3,912	2,720	2,225	1,874	1,535	1,339
60	4,282	3,007	2,473	2,094	1,725	1,511

Duration of daily mean flow based on period of record, 1994–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	11,872
2%	11,568
5%	10,658
10%	9,141
15%	7,624
20%	7,133
25%	6,658
30%	6,183
35%	5,708
40%	5,332
45%	4,958
50%	4,584
55%	4,212
60%	3,849
65%	3,485
70%	3,145
75%	2,829
80%	2,513
85%	2,155
90%	1,752
95%	1,232
98%	857
99%	666

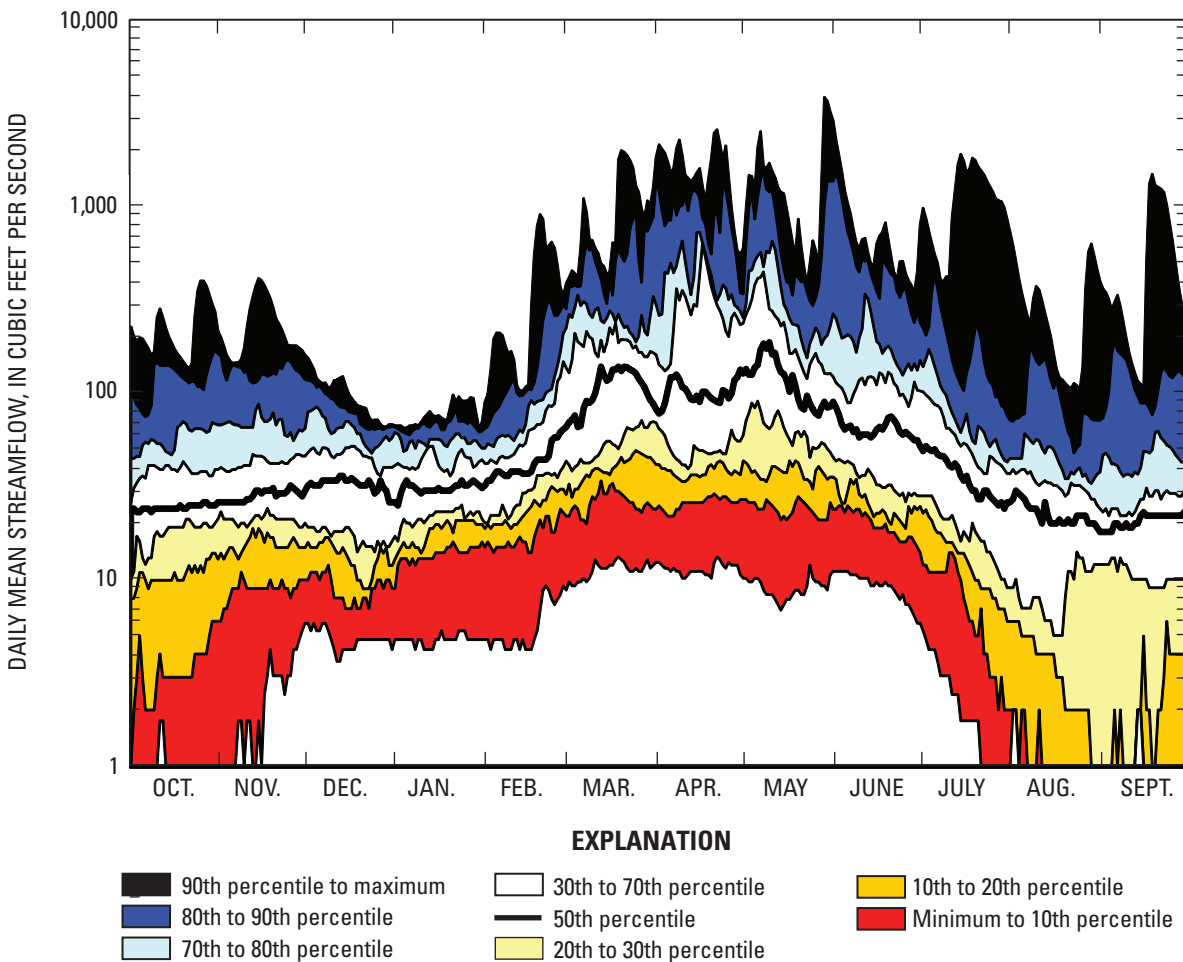
06796973 ELKHORN RIVER NEAR ATKINSON, NEBR.

LOCATION.--Lat 42°29'12", long 98°54'43", Holt County, Hydrologic Unit 10220001**DRAINAGE AREA.**--586 mi².

STREAMFLOW RECORDS

PERIOD OF RECORD.--October 1982 to current year.**GAGE.**-- Datum of gage is 2042 ft above sea level.**REMARKS.**--Records good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for Elkhorn River near Atkinson, Nebr. (06796973) (1982–2004 period of record)



06796973 ELKHORN RIVER NEAR ATKINSON, NEBR.

Monthly and annual streamflow, 1982–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard devia- tion	Coef- ficient of varia- tion
October	213	1	42	49	1.19
November	220	3	48	52	1.07
December	92	7	38	26	0.68
January	74	7	35	19	0.53
February	288	14	68	63	0.92
March	760	23	186	182	0.98
April	1,010	21	274	294	1.07
May	1,332	17	241	281	1.17
June	566	19	136	160	1.17
July	1,040	3	95	218	2.30
August	215	1	38	54	1.44
September	448	1	50	96	1.92
Annual	303	11	105	77	0.73

Magnitude and probability of annual low flow based on period of record, 1982–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	9	2	1	0	0	0
2	9	2	1	0	0	0
3	10	2	1	0	0	0
7	10	3	1	0	0	0
14	11	3	1	1	0	0
30	13	4	1	1	0	0
60	17	5	2	1	0	0
90	20	6	3	1	1	0
183	25	11	7	4	3	2
October–November						
1	18	5	2	1	0	0
2	18	6	3	1	1	0
3	19	6	3	1	1	0
7	21	7	3	2	1	0
14	22	7	4	2	1	0
30	25	9	4	2	1	1
60	28	11	7	4	3	2

Duration of daily mean flow based on period of record, 1982–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time			
1%	1,333	10%	229
		5%	420
		2%	852
		15%	146
		20%	109
		25%	85
		30%	69
		35%	58
		40%	49
		45%	44
		50%	39
		55%	34
		60%	30
		65%	27
		70%	24
		75%	21
		80%	18
		85%	15
		90%	10
		95%	4
		98%	1
		99%	0

06797500 ELKHORN RIVER AT EWING, NEBR.

LOCATION.--Lat 42°16'07", long 98°20'22", in NW ¼ SW ¼ sec.35, T.27 N., R.9 W., Holt County, Hydrologic Unit 10220001, on left bank 10 ft downstream from bridge on State Highway L-45B, 0.8 mi north of Ewing, 1.5 mi upstream from South Fork Elkhorn River, and at mile 199.

DRAINAGE AREA.--1,400 mi², of which 660 mi² probably is noncontributing.

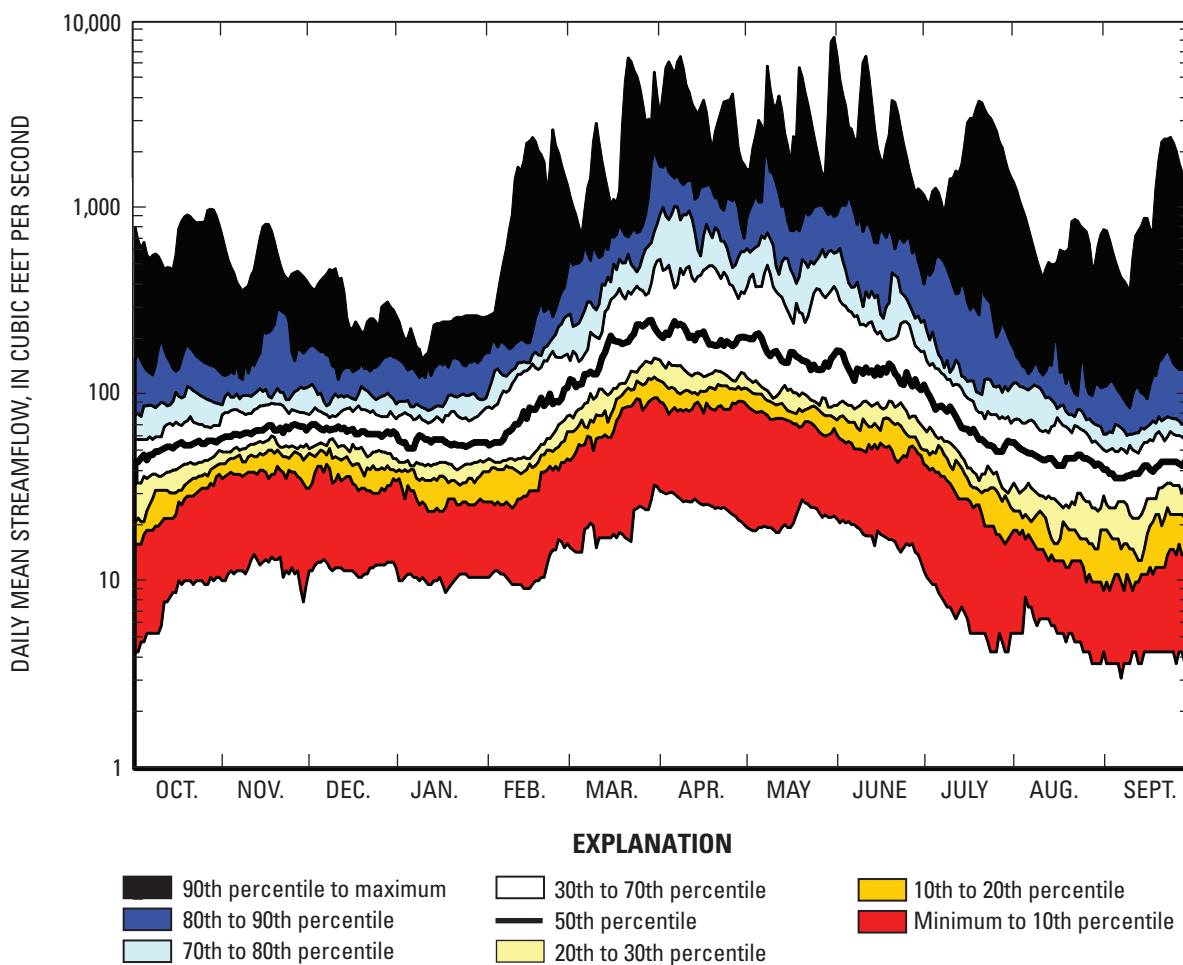
STREAMFLOW RECORDS

PERIOD OF RECORD.--August 1947 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,836.24 ft above sea level, levels by Nebraska Department of Roads. From August 1, 1947 to October 22, 1952 at site 300 ft downstream at same datum. From October 23, 1952 to Sept. 30, 1996 at site 500 ft downstream at same datum. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for Elkhorn River at Ewing, Nebr. (06797500) (1947–2004 period of record)



06797500 ELKHORN RIVER AT EWING, NEBR.

Monthly and annual streamflow, 1947–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard devia- tion	Coef- ficient of varia- tion
October	671	15	86	117	1.36
November	443	23	92	85	0.92
December	250	24	80	52	0.65
January	226	19	70	44	0.62
February	1,172	26	137	175	1.27
March	2,144	61	344	349	1.01
April	2,081	60	488	536	1.10
May	2,243	52	408	435	1.07
June	2,690	46	305	426	1.40
July	1,993	11	159	292	1.83
August	444	11	74	89	1.20
September	882	6	75	132	1.75
Annual	543	43	194	143	0.74

Magnitude and probability of annual low flow based on period of record, 1947–2004

Period (con- secutive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	904	484	339	248	172	133
2	966	524	377	285	207	166
3	1,047	602	449	352	267	222
7	1,233	733	562	452	356	303
14	1,552	897	667	520	391	322
30	1,947	1,080	773	577	410	323
60	2,444	1,324	930	682	472	366
90	2,884	1,699	1,259	971	715	579
183	3,550	2,350	1,871	1,539	1,227	1,051
October–November						
1	36	20	15	12	9	8
2	37	21	15	12	9	8
3	38	21	16	12	10	8
7	42	24	18	14	11	9
14	45	26	20	17	14	12
30	50	32	26	23	20	19
60	59	38	33	29	27	26

Duration of daily mean flow based on period of record, 1947–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	2,065
2%	1,389
5%	760
10%	410
15%	268
20%	198
25%	160
30%	134
35%	113
40%	99
45%	87
50%	79
55%	70
60%	64
65%	58
70%	53
75%	48
80%	42
85%	37
90%	30
95%	20
98%	13
99%	10

06798000 SOUTH FORK ELKHORN RIVER AT EWING, NEBR.

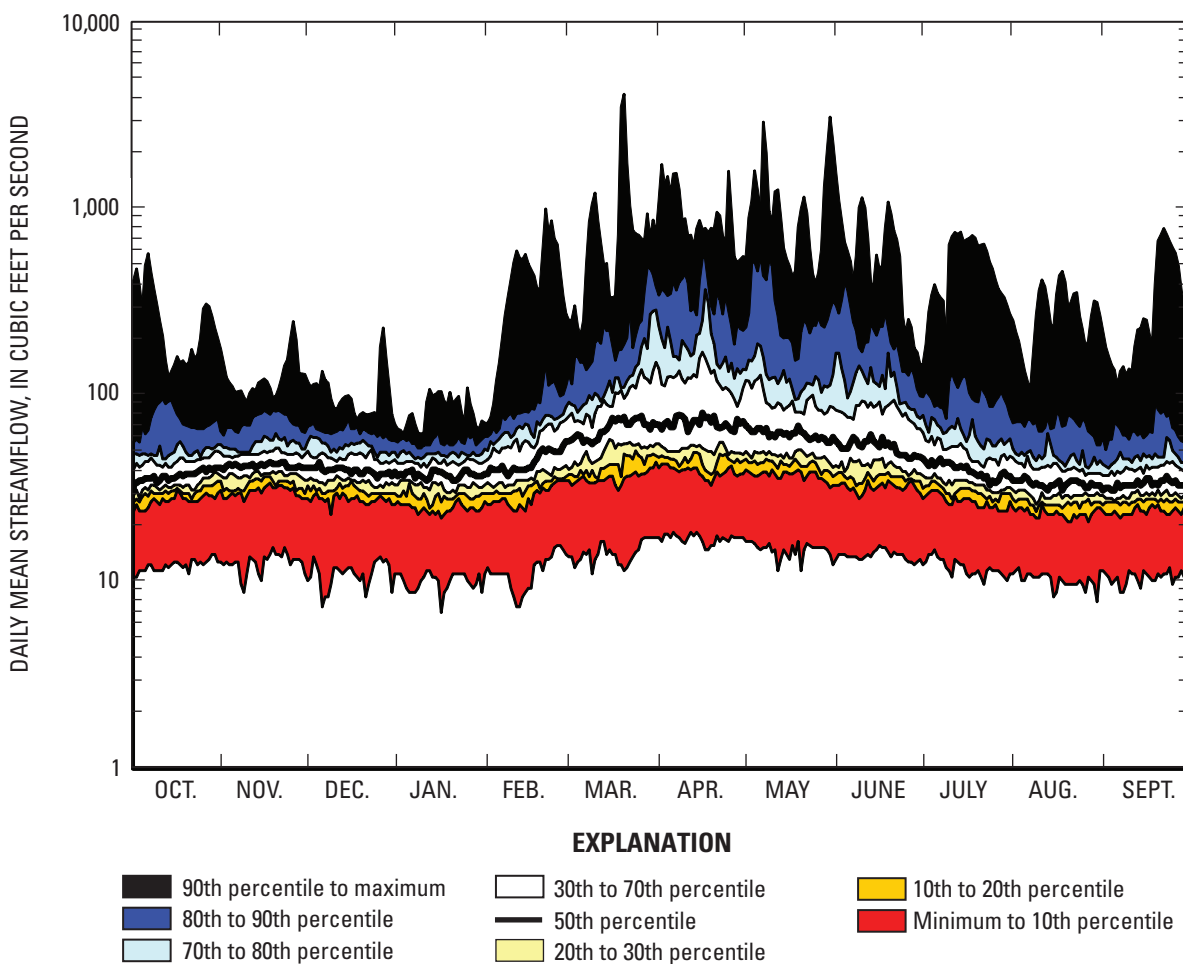
LOCATION.--Lat 42°14'29", long 98°23'54", in SE ¼ NE ¼ sec.7, T.26 N., R.9 W., Holt County, Hydrologic Unit 10220001, on right bank 7 feet downstream and 80 feet landward from bridge on county highway, 3.1 mi southwest of U.S. highway 275 bridge at Ewing, and 5.5 mi upstream from mouth.

DRAINAGE AREA.--314 mi², approximately, of which about 190 mi² contributes directly to surface runoff

STREAMFLOW RECORDS

PERIOD OF RECORD.--October 1947 to September 1953, August 1960 to September 1972, October 1977 to present.

Non-exceedance duration hydrograph for South Fork Elkhorn River at Ewing, Nebr. (06798000) (1947–2004 period of record)



06798000 SOUTH FORK ELKHORN RIVER AT EWING, NEBR.

Monthly and annual streamflow, 1948–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coefficient of variation
October	203	31	52	46	0.88
November	87	30	43	13	0.29
December	61	25	37	8	0.22
January	47	21	34	8	0.22
February	306	26	57	63	1.10
March	411	36	116	101	0.86
April	449	42	113	100	0.88
May	323	37	96	79	0.83
June	421	36	99	95	0.96
July	275	28	56	56	1.00
August	159	23	46	36	0.78
September	134	24	44	31	0.70
Annual	127	35	66	31	0.48

Magnitude and probability of annual low flow based on period of record, 1948–2004

Period (con- secutive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	22	17	14	13	11	10
2	22	18	15	14	12	11
3	23	18	16	15	13	12
7	25	20	18	17	15	14
14	26	22	20	18	17	16
30	29	24	22	21	19	18
60	31	26	24	23	22	21
90	32	28	26	25	25	24
183	36	31	30	29	29	29
October–November						
1	27	21	19	17	16	15
2	28	22	20	19	17	17
3	29	23	21	20	19	18
7	31	26	24	23	22	21
14	34	28	26	25	24	24
30	36	30	29	28	27	27
60	40	33	31	30	29	29

Duration of daily mean flow based on period of record, 1948–2004

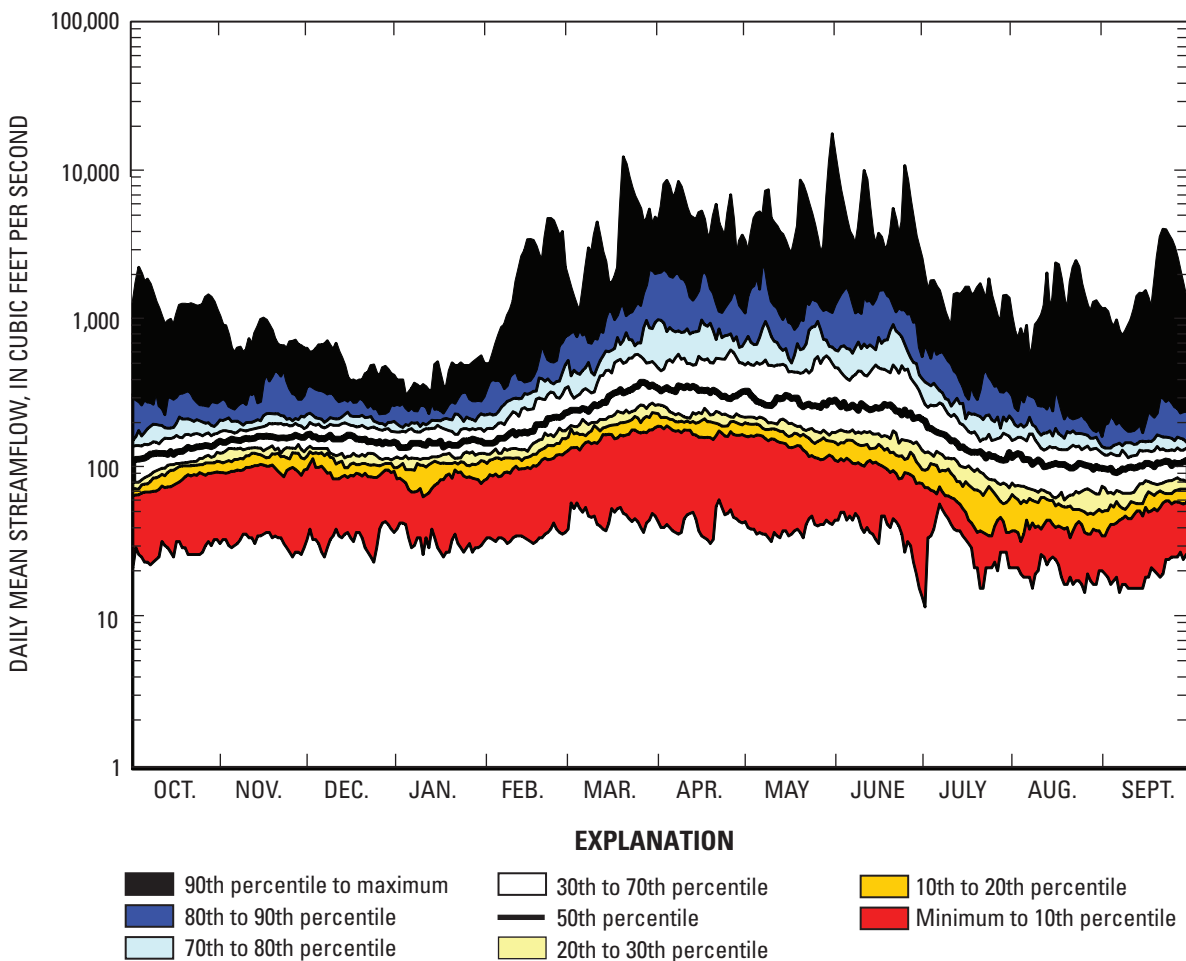
Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time		Duration of daily mean flow based on period of record, 1948–2004	
1%	621	1%	115
		2%	414
		5%	198
		10%	115
		15%	86
		20%	74
		25%	64
		30%	59
		35%	54
		40%	49
		45%	47
		50%	45
		55%	42
		60%	40
		65%	38
		70%	36
		75%	34
		80%	32
		85%	30
		90%	28
		95%	24
		98%	22
		99%	19

06798500 ELKHORN RIVER AT NELIGH, NEBR.

LOCATION.--Lat 42°07'23", long 98°02'37", in NW ¼ SW ¼ sec.20, T.25 N., R.6 W., Antelope County, Hydrologic Unit 10220001, at State Highway 14 bridge, 0.9 mi southwest of Neligh, 1.2 mi downstream from Hail Creek, and 1.5 mi downstream from Antelope Creek.

DRAINAGE AREA.--2,200 mi², of which 1,000 mi² probably is noncontributing.

Non-exceedance duration hydrograph for Elkhorn River at Neligh, Nebr. (06798500) (1930–2004 period of record)



06798500 ELKHORN RIVER AT NELIGH, NEBR.

Monthly and annual streamflow, 1931–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coefficient of variation
October	1,189	71	179	192	1.07
November	616	85	176	88	0.50
December	479	86	163	63	0.39
January	324	67	152	52	0.34
February	1,617	96	230	227	0.99
March	2,008	183	432	369	0.85
April	3,141	176	520	515	0.99
May	2,589	126	490	483	0.99
June	3,387	86	544	675	1.24
July	1,043	45	220	238	1.08
August	1,060	28	150	176	1.17
September	877	30	132	132	1.00
Annual	935	108	282	181	0.64

Magnitude and probability of annual low flow based on period of record, 1931–2004

Period (con- secutive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	61	35	26	19	14	11
2	63	36	26	20	14	12
3	64	37	27	21	15	12
7	68	41	30	23	17	14
14	75	46	35	27	21	17
30	84	52	40	31	24	20
60	96	60	47	38	29	25
90	106	68	53	44	35	30
183	128	87	73	64	56	51
October–November						
1	99	64	50	40	32	27
2	102	66	52	42	33	29
3	105	68	53	43	34	29
7	113	73	58	48	39	33
14	122	79	64	53	44	39
30	134	89	73	63	53	48
60	151	99	82	71	61	56

Duration of daily mean flow based on period of record, 1931–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time						
1%	2,906	1,895	1,063	606	440	15%
						10%
						5%
						2%
						1%
						2%
						3%
						4%
						5%
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						97%
						98%
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						100%

06799000 ELKHORN RIVER AT NORFOLK, NEBR.

LOCATION.--Lat 42°00'14", long 97°31'22", in SW ¼ SW ¼ sec.34, T.24 N., R.1 W., Madison County, Hydrologic Unit 10220001, on left bank 200 ft downstream from U.S. Highway 81 bridge, 1 mi south of intersection of U.S. Highways 81 and 275, and 3.6 mi upstream from North Fork Elkhorn River, and at mile 129.

DRAINAGE AREA.--2,790 mi² of which 1,000 mi² probably is noncontributing.

STREAMFLOW RECORDS

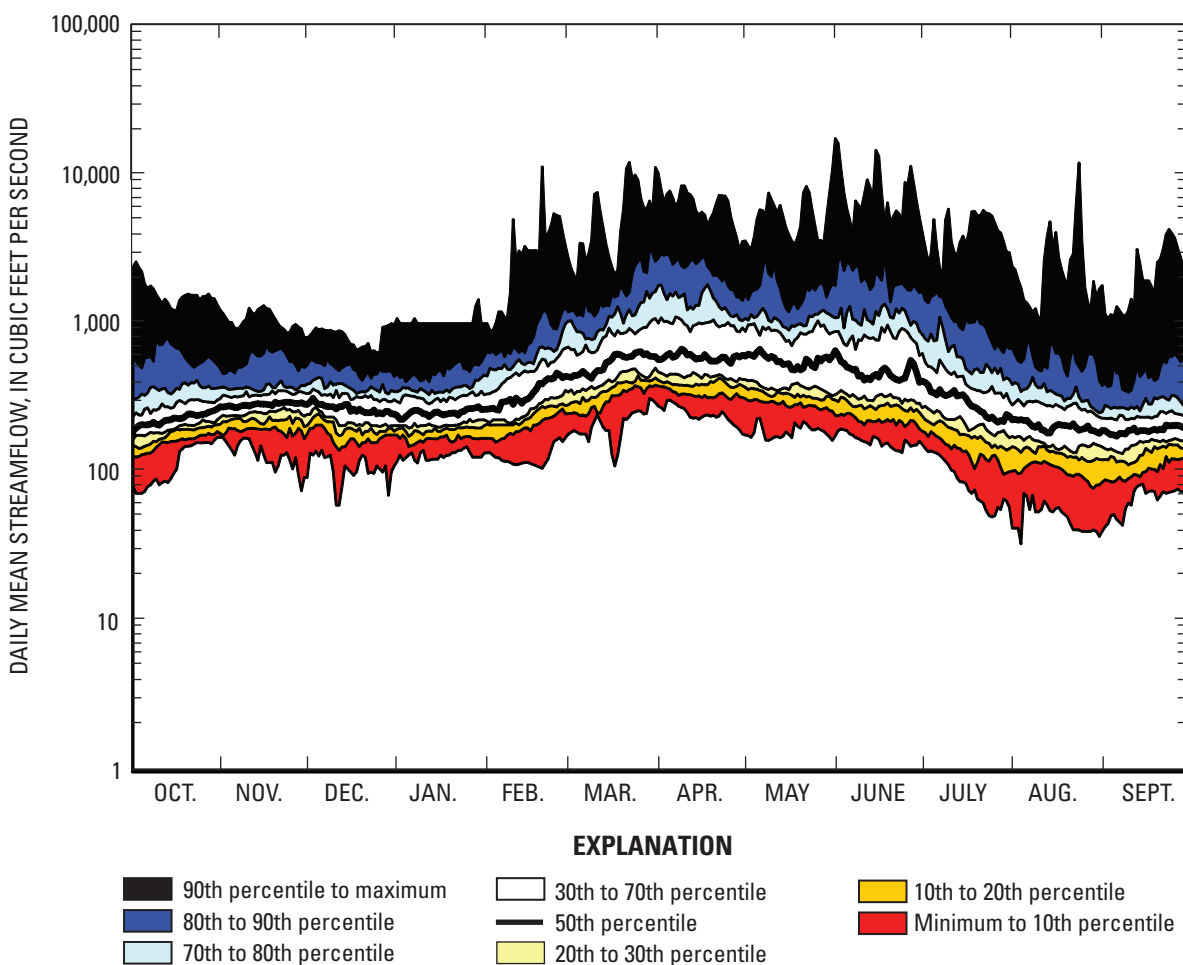
REVISED RECORDS.--WSP 1390: 1898-1900. WSP 1730: Drainage area.

PERIOD OF RECORD.--July 1896 to November 1903 (no winter records), October 1945 to current year. Gage height records collected at site 200 ft upstream from May 10, 1941 to Sept. 26, 1945 are contained in reports of U.S. Weather Bureau. Published as "near Norfolk" from October 1957 to September 1977.

GAGE.--Water-stage recorder. Datum of gage is 1,500.95 ft above sea level. See WSP 1918 for history of changes prior to Aug. 30, 1958. Aug. 30, 1958, to July 27, 1978, water-stage recorder at site 3.2 mi upstream at datum 19.88 ft higher and July 28, 1978 to Mar. 18, 1987, present site at datum 4.00 ft higher. Mar. 19, 1987, to Mar. 31, 1995, present site at datum 2.00 ft higher. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for Elkhorn River at Norfolk, Nebr. (06799000) (1896–2004 period of record)



06799000 ELKHORN RIVER AT NORFOLK, NEBR.

Monthly and annual streamflow, 1945–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coef- ficient of varia- tion
October	1,418	140	327	280	0.86
November	847	169	310	127	0.41
December	607	156	273	95	0.35
January	1,000	158	289	156	0.54
February	1,862	213	481	327	0.68
March	2,360	320	813	502	0.62
April	3,338	341	930	740	0.80
May	2,682	246	789	566	0.72
June	4,673	227	1,000	1,012	1.01
July	1,479	125	470	358	0.76
August	1,398	91	330	306	0.93
September	1,323	87	268	216	0.81
Annual					

Magnitude and probability of annual low flow based on period of record, 1945–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	113	76	60	49	38	32
2	118	79	62	51	40	34
3	122	81	64	52	41	34
7	134	88	69	56	44	37
14	145	95	75	61	48	40
30	161	109	88	73	58	50
60	184	129	107	92	78	69
90	202	144	122	108	94	86
183	240	182	164	152	143	138
October–November						
1	175	126	107	94	82	75
2	179	131	113	101	89	83
3	184	135	116	104	92	86
7	200	146	126	114	102	95
14	215	156	136	123	111	104
30	236	179	160	149	139	135
60	264	202	184	173	165	161

Duration of daily mean flow based on period of record, 1945–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	4,105
2%	2,885
5%	1,644
10%	1,067
15%	805
20%	662
25%	558
30%	477
35%	428
40%	386
45%	347
50%	324
55%	301
60%	277
65%	258
70%	240
75%	223
80%	205
85%	184
90%	162
95%	131
98%	99
99%	81

06799100 NORTH FORK ELKHORN RIVER NEAR PIERCE, NEBR.

LOCATION.--Lat 42°08'54", long 97°28'43", in NE ¼ NW ¼ sec.18, T.25 N., R.1 W., Pierce County, Hydrologic Unit 10220002, on right bank 4 ft downstream and 25 ft from end of bridge, 4.5 mi southeast of Pierce, and at mile 20.8.

DRAINAGE AREA.--701 mi² of which 30 mi² probably is noncontributing.

STREAMFLOW RECORDS

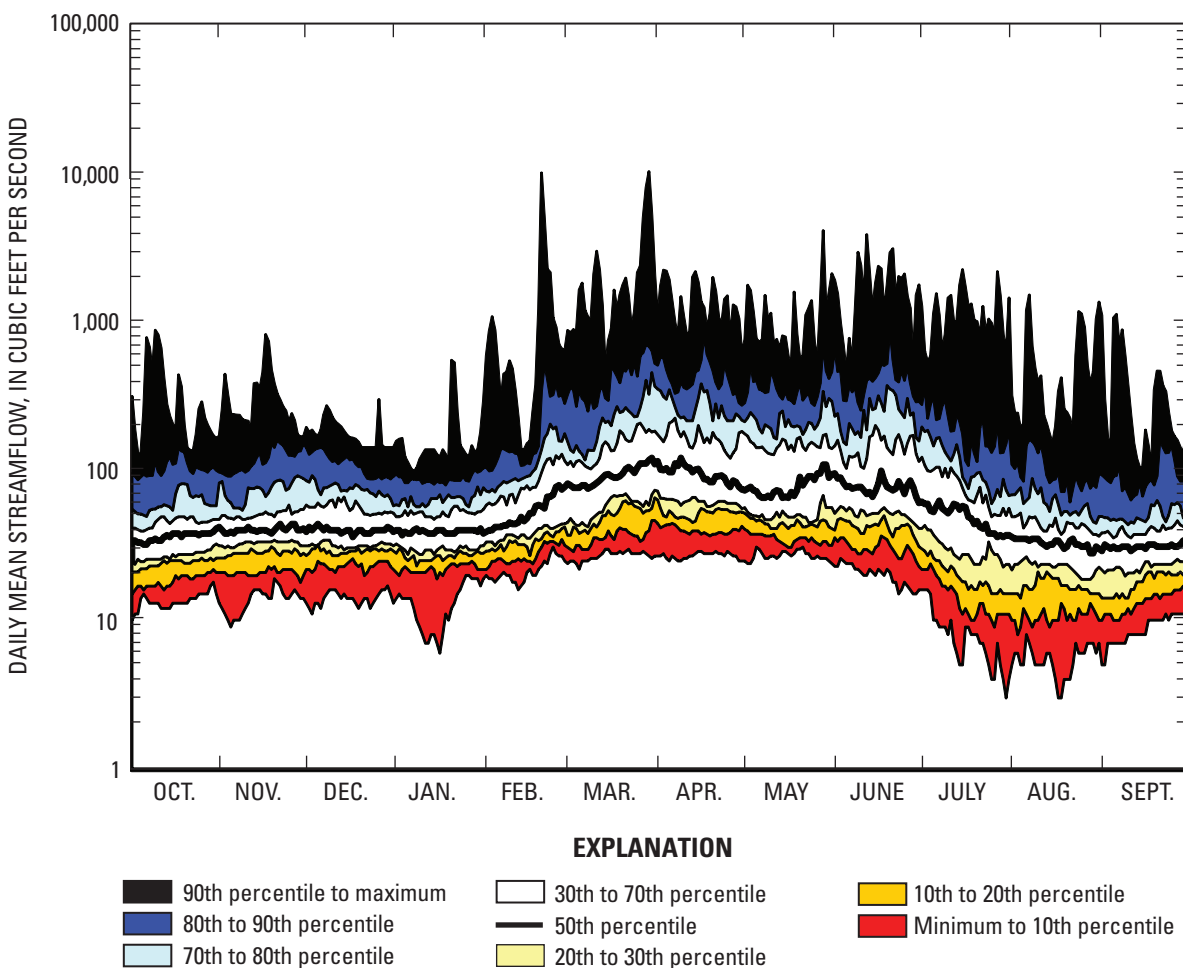
REVISED RECORDS.--WDR NE-94-1: Drainage area.

PERIOD OF RECORD.--August 1960 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,542.88 ft above sea level (U.S. Weather Service levels). Aug. 19, 1960 to Oct. 7, 1997, water-stage recorder at site 2 mi upstream at datum 10.19 ft higher. Data collection platform at station.

REMARKS.--Record good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for North Fork Elkhorn River near Pierce, Nebr. (06799100) (1960–2004 period of record)



06799100 NORTH FORK ELKHORN RIVER NEAR PIERCE, NEBR.

Monthly and annual streamflow, 1960–2004

	Maximum (ft ³ /s)	Mini- mum (ft ³ /s)	Mean (ft ³ /s)	Stan- dard devia- tion	Coef- ficient of varia- tion
October	241	14	52	46	0.88
November	233	15	59	50	0.85
December	156	15	53	34	0.63
January	111	16	49	26	0.53
February	834	24	113	149	1.32
March	1,120	30	200	205	1.03
April	1,004	29	187	189	1.01
May	663	28	162	140	0.87
June	799	22	181	174	0.96
July	834	12	99	140	1.41
August	226	7	54	53	0.99
September	191	10	46	43	0.94
Annual	287	22	104	66	0.64

Magnitude and probability of annual low flow based on period of record, 1960–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	18	9	6	4	3	2
2	19	10	6	4	3	2
3	20	10	7	5	3	2
7	21	11	8	6	4	3
14	23	13	9	7	5	4
30	26	15	11	9	6	5
60	29	18	13	10	8	6
90	32	19	15	12	9	8
183	39	24	19	16	13	11
October–November						
1	28	19	16	13	11	10
2	29	19	16	14	12	11
3	29	20	16	14	12	11
7	31	20	17	15	13	12
14	33	22	18	16	14	13
30	36	23	19	17	15	14
60	41	25	21	18	15	14

Duration of daily mean flow based on period of record, 1960–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time		Duration of daily mean flow based on period of record, 1960–2004	
1%	1,056	1%	9
2%	655	2%	11
5%	354	5%	16
10%	201	10%	22
15%	143	15%	26
20%	112	20%	29
25%	94	25%	32
30%	81	30%	35
35%	69	35%	38
40%	61	40%	41
45%	54	45%	45
50%	49	50%	49
55%	45	55%	54
60%	41	60%	61
65%	38	65%	69
70%	35	70%	81
75%	32	75%	94
80%	29	80%	112
85%	26	85%	143
90%	22	90%	201
95%	16	95%	354
98%	11	98%	655
99%	9	99%	1,056

06799350 ELKHORN RIVER AT WEST POINT, NEBR.

LOCATION.--Lat 41°50'22", long 96°43'38" , in SW ¼ NW ¼ sec.34, T.22 N., R.6 E., Cuming County, Hydrologic Unit 10220003, on right bank near right downstream wing wall of bridge on State Highway 32, 1 mi west of West Point, and at mile 79.8.

DRAINAGE AREA.--4,676 mi² of which 576 mi² probably is noncontributing.

STREAMFLOW RECORDS

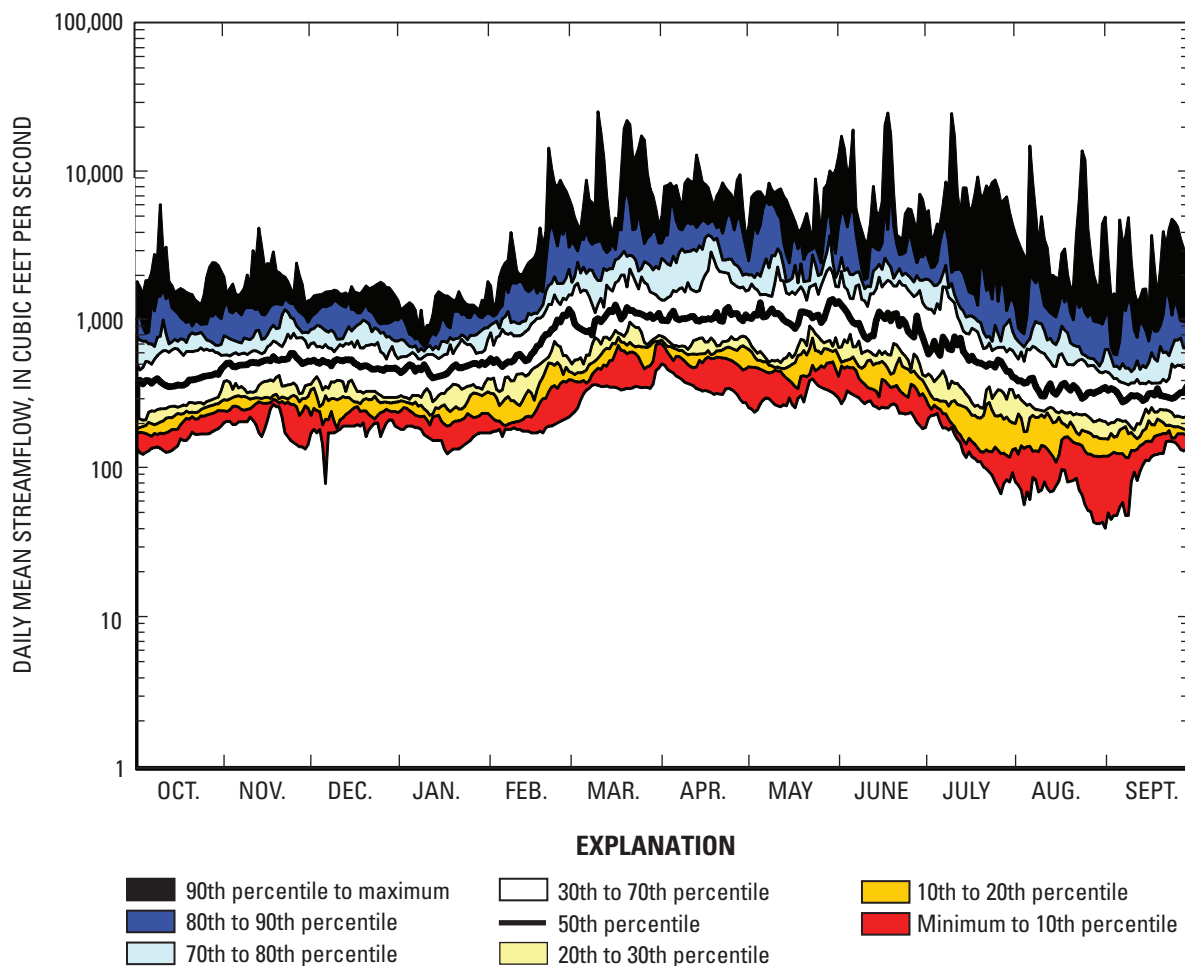
PERIOD OF RECORD.--October 1972 to current year. March 1960 to September 1972 (no winter records 1960-68) in files of Corps of Engineers. Gage-height records collected since 1940 are in reports of U.S. Weather Service.

GAGE.--Water-stage recorder. Datum of gage is 1,291.26 ft above sea level. Prior to May 18, 1976, at site on left bank 50 ft upstream from bridge at same datum. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor. Some small diversions above station for irrigation.

EXTREMES FOR PERIOD OF RECORD.--Maximum streamflow estimated 33,000 ft³, June 25, 1969, gage height 13.21 feet; minimum daily, 41 ft³, Aug. 31, 1976. Flood of March 31, 1960, reached a stage of 16.09 feet, backwater from ice; observed by Corps of Engineers. Flood stage is 12.00 feet gage datum.

Non-exceedance duration hydrograph for Elkhorn River at West Point, Nebr. (06799350) (1972–2004 period of record)



06799350 ELKHORN RIVER AT WEST POINT, NEBR.

Monthly and annual streamflow, 1972–2004

	Maximum (ft ³ /s)	Mini- mum (ft ³ /s)	Mean (ft ³ /s)	Stan- dard devia- tion	Coef- ficient of varia- tion
October	1,606	174	542	357	0.66
November	1,802	241	631	353	0.56
December	1,314	203	588	310	0.53
January	1,106	168	537	236	0.44
February	2,744	201	1,022	664	0.65
March	5,256	411	1,739	1,229	0.71
April	6,171	378	1,786	1,428	0.80
May	5,618	325	1,627	1,073	0.66
June	3,844	339	1,529	980	0.64
July	6,945	154	1,000	1,235	1.23
August	1,994	90	593	518	0.87
September	1,646	137	476	354	0.74
Annual	2,253	333	1,000	510	0.51

Magnitude and probability of annual low flow based on period of record, 1972–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	188	113	84	64	47	37
2	193	116	87	67	49	39
3	199	119	88	67	49	39
7	218	130	95	73	53	42
14	240	141	103	78	56	44
30	272	166	125	98	74	60
60	329	203	156	124	96	81
90	374	228	176	142	111	94
183	457	288	228	188	152	132
October–November						
1	303	201	162	136	112	99
2	310	206	166	139	115	100
3	318	210	169	141	115	101
7	345	221	175	145	117	101
14	373	234	185	152	123	107
30	406	260	209	176	147	130
60	491	313	250	210	173	153

Duration of daily mean flow based on period of record, 1972–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	7,169
2%	5,428
5%	3,190
10%	2,071
15%	1,599
20%	1,301
25%	1,097
30%	956
35%	815
40%	740
45%	667
50%	599
55%	551
60%	503
65%	455
70%	405
75%	354
80%	314
85%	276
90%	234
95%	188
98%	145
99%	116

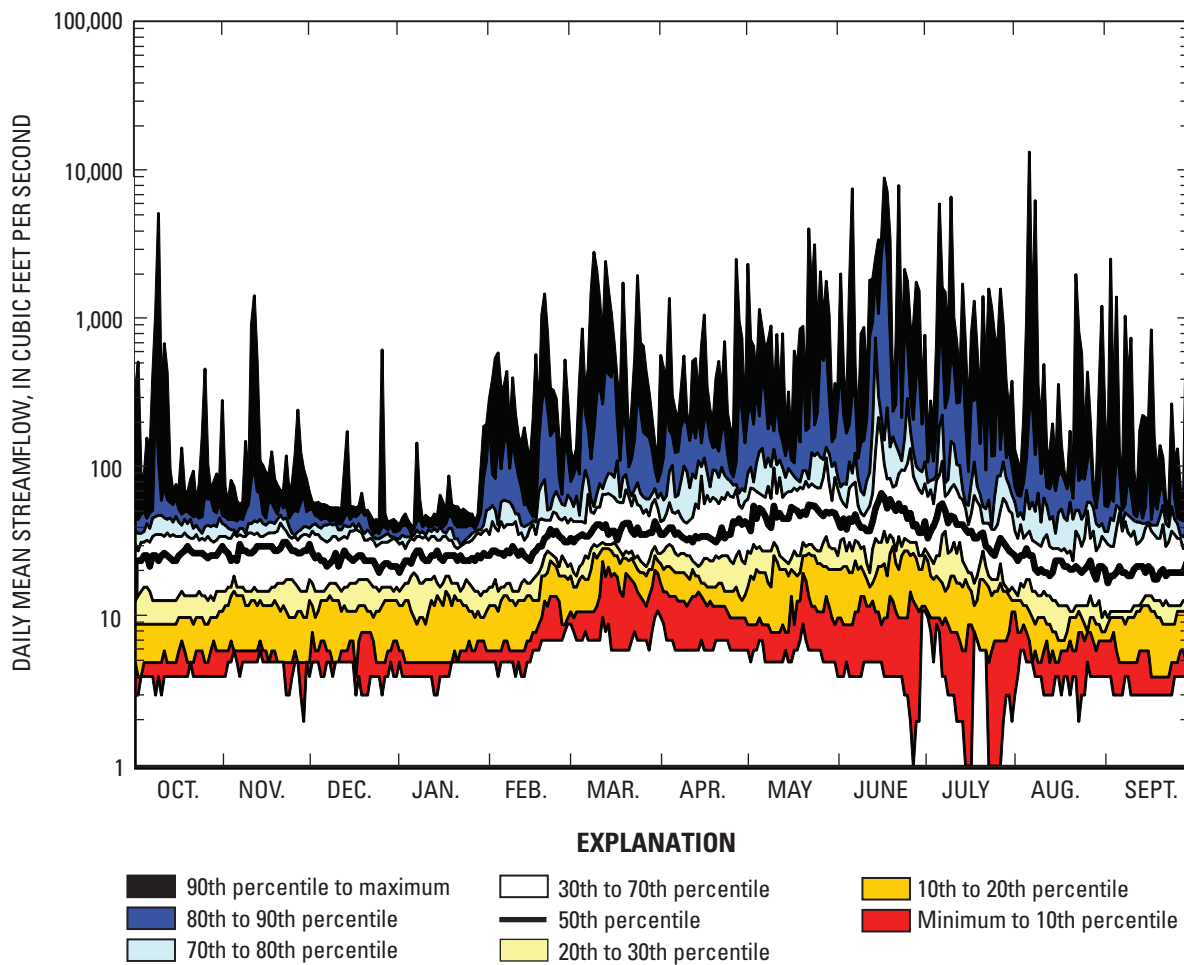
06799385 PEBBLE CREEK AT SCRIBNER, NEBR.

LOCATION.--Lat 41°39'32", long 96°41'03", in SW ¼ NW ¼ sec.34, T.22 N., R.6 E., Dodge County, Hydrologic Unit 10220003.

STREAMFLOW RECORDS

PERIOD OF RECORD.--October 1993 to current year.

Non-exceedance duration hydrograph for Pebble Creek at Scribner, Nebr. (06799385) (1978–2004 period of record)



06799385 PEBBLE CREEK AT SCRIBNER, NEBR.

Monthly and annual streamflow, 1978–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coef- ficient of variation
October	55	12	34	14	0.42
November	108	13	41	25	0.62
December	51	13	33	12	0.35
January	48	13	34	11	0.33
February	103	27	52	22	0.43
March	130	26	62	30	0.48
April	206	32	74	53	0.72
May	257	28	123	75	0.61
June	496	27	187	160	0.86
July	399	22	110	108	0.98
August	549	14	113	172	1.52
September	131	12	40	34	0.84
Annual	144	38	75	39	0.52

Magnitude and probability of annual low flow based on period of record, 1978–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	13	5	2	1	0	0
2	13	5	2	1	1	0
3	14	5	3	1	1	0
7	14	6	3	2	1	0
14	15	7	4	2	1	1
30	16	8	5	4	2	2
60	20	11	7	5	3	2
90	22	12	8	6	4	3
183	28	14	10	7	4	3
October–November						
1	17	8	5	3	2	1
2	17	8	5	3	2	1
3	17	8	5	4	2	2
7	18	9	6	4	3	2
14	20	10	6	4	3	2
30	22	11	7	5	3	2
60	26	12	8	6	4	3

Duration of daily mean flow based on period of record, 1978–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	932
2%	497
5%	181
10%	96
15%	69
20%	57
25%	49
30%	44
35%	39
40%	36
45%	34
50%	31
55%	28
60%	25
65%	22
70%	20
75%	17
80%	15
85%	12
90%	8
95%	5
98%	4
99%	4

06799500 LOGAN CREEK NEAR UEHLING, NEBR.

LOCATION.--Lat 41°42'46", long 96°31'19", in SE ¼ SE ¼ sec.9, T.20 N., R.8 E., Dodge County, Hydrologic Unit 10220004, near left bank on upstream side of bridge on county road, 2 mi southwest of Uehling and 8.8 mi upstream from mouth.

DRAINAGE AREA.--1015 mi².

STREAMFLOW RECORDS

REVISED RECORDS.--WDR NE-94-1: Drainage Area.

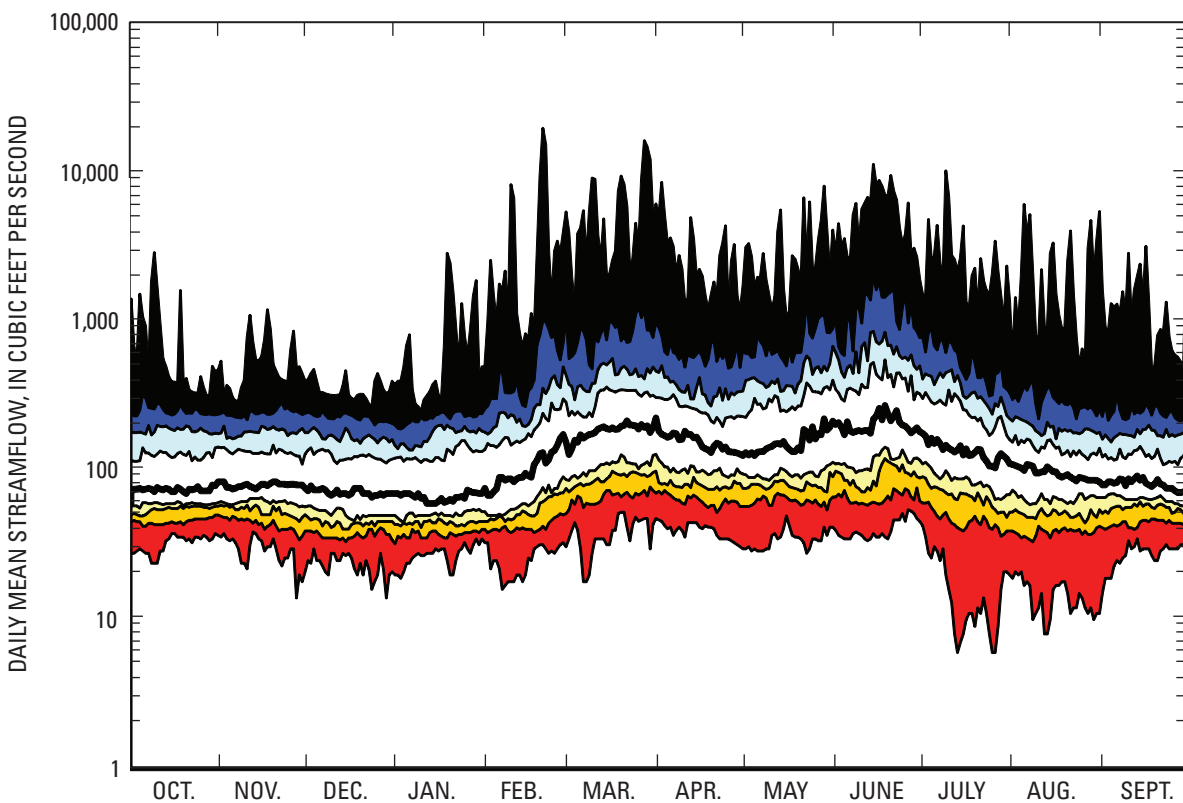
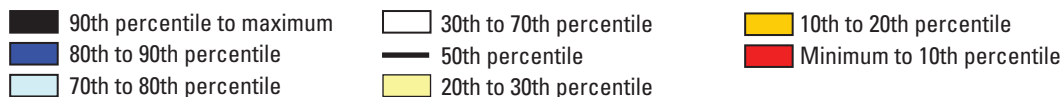
PERIOD OF RECORD.--March 1941 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,208.73 ft above sea level. See WSP 1918 for history of changes prior to July 15, 1963. July 16, 1963 to Mar. 27, 1989, near right bank on downstream side of bridge at present site and datum. Mar. 28, 1989 to Mar. 22, 1990, 250 ft upstream on left bank at same datum. Data collection platform at station.

COOPERATION.--Records provided by Nebraska Department of Natural Resources and reviewed by the U.S. Geological Survey.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for Logan Creek near Uehling, Nebr. (06799500) (1941–2004 period of record)

**EXPLANATION**

06799500 LOGAN CREEK NEAR UEHLING, NEBR.

Monthly and annual streamflow, 1941–2004

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coef- ficient of variation
October	499	33	123	99	0.80
November	453	38	118	87	0.74
December	337	32	103	73	0.70
January	583	34	111	95	0.85
February	2,177	38	263	320	1.22
March	2,388	57	409	408	1.00
April	1,742	43	287	318	1.11
May	1,417	40	324	272	0.84
June	2,766	57	502	492	0.98
July	1,843	17	266	271	1.02
August	1,056	15	165	179	1.08
September	613	32	133	115	0.87
Annual	710	66	234	141	0.60

Magnitude and probability of annual low flow based on period of record, 1941–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	44	24	17	13	10	8
2	45	25	18	14	11	9
3	46	26	19	15	11	9
7	50	29	22	17	13	12
14	55	31	24	19	15	13
30	61	37	29	24	20	18
60	69	42	33	27	22	20
90	74	46	37	31	26	23
183	88	54	43	36	30	27
October–November						
1	62	35	26	21	16	14
2	64	37	28	22	17	15
3	66	38	29	24	19	17
7	70	42	34	28	24	21
14	74	46	37	32	27	24
30	80	51	42	36	31	28
60	90	56	45	38	33	30

Duration of daily mean flow based on period of record, 1941–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	2,427
2%	1,474
5%	729
10%	427
15%	319
20%	259
25%	223
30%	191
35%	166
40%	144
45%	125
50%	108
55%	96
60%	85
65%	78
70%	71
75%	64
80%	58
85%	52
90%	45
95%	39
98%	31
99%	28

06800000 MAPLE CREEK NEAR NICKERSON, NEBR.

LOCATION.--Lat 41°33'37", long 96°32'27", in SW ¼ NW ¼ sec.4, T.18 N., R.8 E., Dodge County, Hydrologic Unit 10220003, on right bank 8 ft downstream from county road bridge 2 mi upstream from U.S. Highways 77 and 275, 5 mi northwest of Nickerson, and 4 mi upstream from mouth.

DRAINAGE AREA.--368 mi².

STREAMFLOW RECORDS

REVISED RECORDS.--WSP 1630: 1957-58. WDR NE-98: Drainage area.

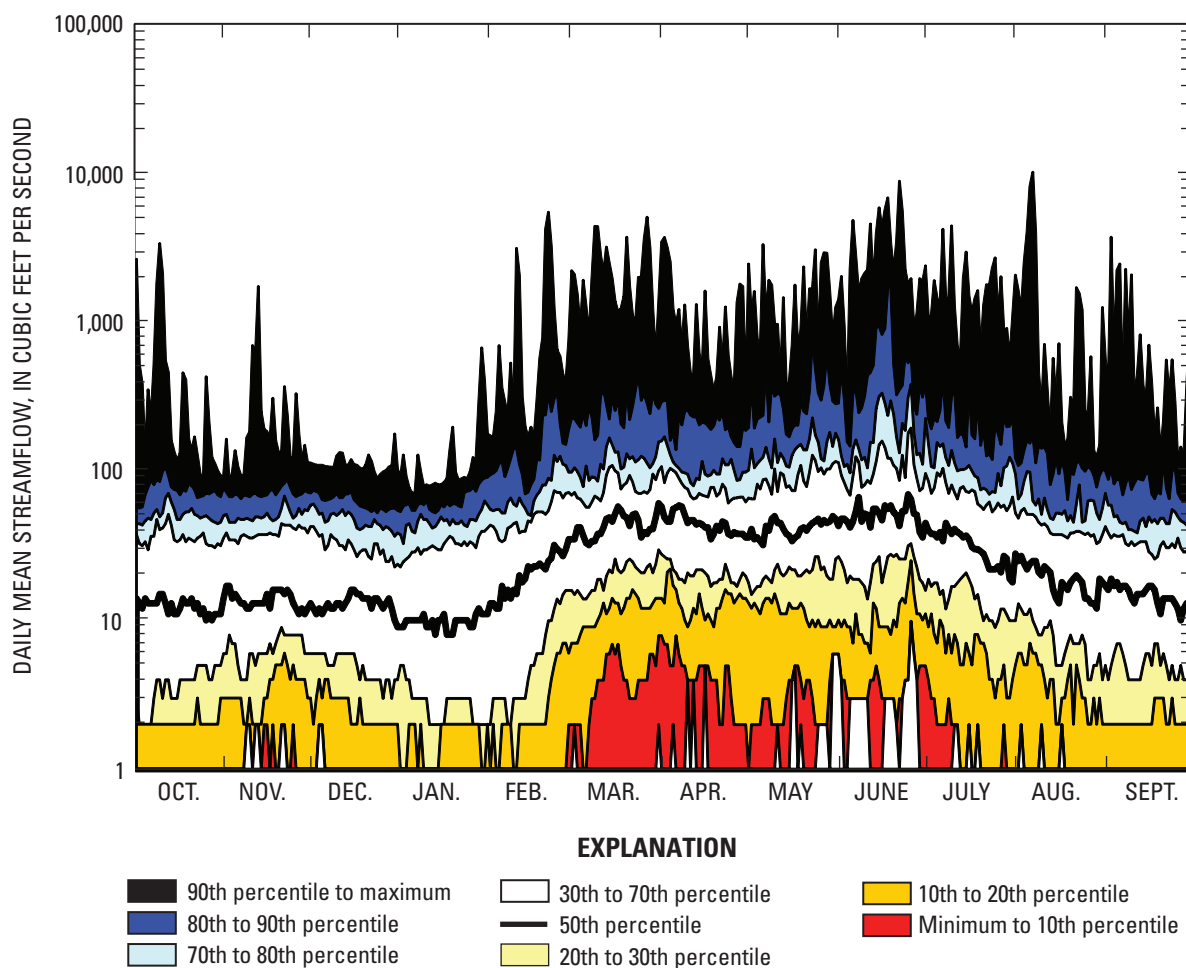
PERIOD OF RECORD.--October 1951 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,211.62 ft above sea level. Prior to July 28, 1960, non-recording gage at highway bridge, July 28, 1960 to July 28, 1987, water-stage recorder 180 ft upstream from highway bridge and July 29, 1987 to July 23, 1991 water-stage recorder 30 ft downstream from highway bridge. All at/near U.S. Highway 77 bridge, 2 mi downstream from present gage, at datum 17.06 ft lower. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

EXTREMES FOR PERIOD OF RECORD.--Maximum streamflow, 13,700 ft³, Aug. 6, 1996, (gage height 17.33 feet, (gage datum); maximum gage height, 17.65 feet, (gage datum), June 17, 1984 from flood mark, minimum daily streamflow, 0.1 ft³, Jan. 15, 16, 1956.

Non-exceedance duration hydrograph for Maple Creek near Nickerson, Nebr. (06800000) (1951–2004 period of record)



06800000 MAPLE CREEK NEAR NICKERSON, NEBR.

Monthly and annual streamflow, 1951–2005

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coef- ficient of variation
October	323	0	37	55	1.50
November	158	1	30	35	1.16
December	102	1	24	25	1.07
January	83	0	24	25	1.06
February	446	1	69	82	1.19
March	674	1	131	153	1.17
April	590	1	94	122	1.30
May	642	1	124	134	1.08
June	1,252	3	212	273	1.28
July	1,023	1	102	159	1.56
August	762	1	67	124	1.85
September	383	0	46	72	1.57
Annual	264	5	79	60	0.76

Magnitude and probability of annual low flow based on period of record, 1951–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	3	1	0	0	0	0
2	3	1	0	0	0	0
3	3	1	0	0	0	0
7	3	1	0	0	0	0
14	4	1	0	0	0	0
30	6	1	1	0	0	0
60	8	2	1	1	0	0
90	10	3	1	1	0	0
183	15	4	2	1	0	0
October–November						
1	6	1	1	0	0	0
2	6	2	1	0	0	0
3	7	2	1	0	0	0
7	8	2	1	0	0	0
14	9	2	1	1	0	0
30	11	3	1	1	0	0
60	15	4	2	1	1	0

Duration of daily mean flow based on period of record, 1951–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	1,208
2%	589
5%	254
10%	135
15%	94
20%	75
25%	62
30%	53
35%	45
40%	38
45%	31
50%	25
55%	20
60%	15
65%	12
70%	9
75%	6
80%	4
85%	2
90%	1
95%	1
98%	0
99%	0

06800500 ELKHORN RIVER AT WATERLOO, NEBR.

LOCATION.--Lat 41°17'36", long 96°17'02", in SE ¼ SW ¼ sec.3, T.15 N., R.10 E., Douglas County, Hydrologic Unit 10220003, on right bank at Nebraska Highway 64 bridge at north edge of Waterloo, 3.5 mi downstream from Rawhide Creek, and at mile 13.8.

DRAINAGE AREA.--6,900 mi² of which 1,030 mi² probably is noncontributing.

STREAMFLOW RECORDS

REVISED RECORDS.--WSP 1390: 1914 (M), 1915, 1936, 1943(M). WDR NE-94-1: Drainage area.

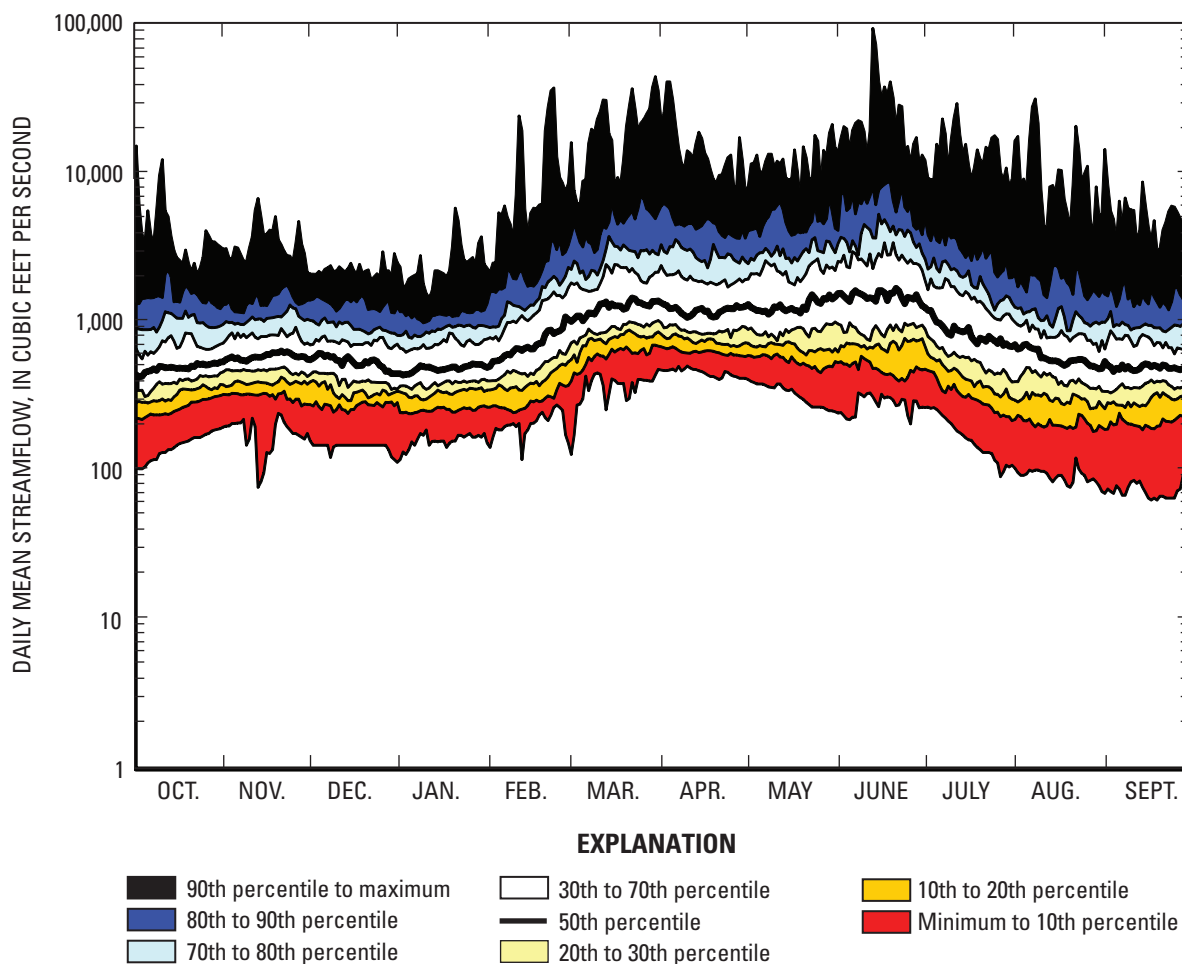
PERIOD OF RECORD.--April 1899 to November 1903, May 1911 to September 1915, August 1928 to current year. Published as "at Arlington" 1899-1903, July 1913 to September 1915. Monthly streamflow only for some periods, published in WSP 1310.

GAGE.--Water-stage recorder. Datum of gage is 1,104.73 ft above sea level. Oct. 1, 1960, to July 27, 1978, at datum 2.00 ft higher. See WSP 1918 for history of changes prior to Oct. 1, 1960. July 28, 1978 to Nov. 17, 1993, at site 800 ft downstream at present datum. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor. Some small diversions above station for irrigation.

EXTREMES FOR PERIOD OF RECORD.--1899 to 1903, 1911-15, 1928-65: Maximum streamflow, 100,000 ft³ June 12, 1944 (gage height, 16.6 feet, from flood mark in the gage well, site and datum then in use), from rating curve extended from above 22,000 ft³, on the basis of current meter measurements of the peak flow in the main channel and velocity/area studies of the overflow section; minimum observed, 50 ft³ Nov. 12, 1940. Stage and streamflow of the flood of June 12, 1944, are the greatest known since at least 1880.

Non-exceedance duration hydrograph for Elkhorn River at Waterloo, Nebr. (06800500) (1928-2004 period of record)



06800500 ELKHORN RIVER AT WATERLOO, NEBR.

Monthly and annual streamflow, 1928–2005

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard deviation	Coef- ficient of variation
October	2,780	150	725	566	0.78
November	2,792	240	761	482	0.63
December	1,803	150	669	388	0.58
January	1,650	180	631	353	0.56
February	6,439	257	1,205	1,018	0.84
March	8,082	489	2,237	1,774	0.79
April	10,450	512	2,060	1,878	0.91
May	7,565	327	2,100	1,530	0.73
June	11,950	405	2,830	2,484	0.88
July	11,470	173	1,444	1,506	1.04
August	4,755	117	943	943	1.00
September	2,705	88	725	557	0.77
Annual	3,870	417	1,359	774	0.57

Magnitude and probability of annual low flow based on period of record, 1928–2004

Period (con- secutive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	245	147	114	93	74	64
2	256	153	118	96	76	65
3	263	158	121	98	78	66
7	293	174	133	106	82	69
14	329	194	146	115	87	72
30	373	223	169	134	102	85
60	431	268	210	171	137	118
90	477	306	246	207	172	152
183	562	365	298	255	216	195
October–November						
1	368	223	172	138	109	93
2	382	233	181	146	115	98
3	392	241	187	151	120	102
7	432	269	212	174	140	121
14	472	297	236	197	162	142
30	520	333	269	228	191	171
60	585	375	306	262	223	202

Duration of daily mean flow based on period of record, 1928–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time			
1%	10,190	2%	7,506
		5%	4,316
		10%	2,784
		15%	2,076
		20%	1,686
		25%	1,388
		30%	1,216
		35%	1,064
		40%	952
		45%	840
		50%	756
		55%	683
		60%	610
		65%	559
		70%	509
		75%	459
		80%	410
		85%	362
		90%	308
		95%	243
		98%	186
		99%	150

06803555 SALT CREEK AT GREENWOOD, NEBR.

LOCATION.--Lat 40°57'56", long 96°27'16", in SW ¼ NE ¼ sec.31, T.12 N., R.9 E., Cass County, Hydrologic Unit 10200203, on right bank just downstream from county road bridge, 0.5 mi west of Greenwood, and at mile 13.0.

DRAINAGE AREA.--1050 mi².

STREAMFLOW RECORDS

REVISED RECORDS.--WDR NE-94-1: Drainage area.

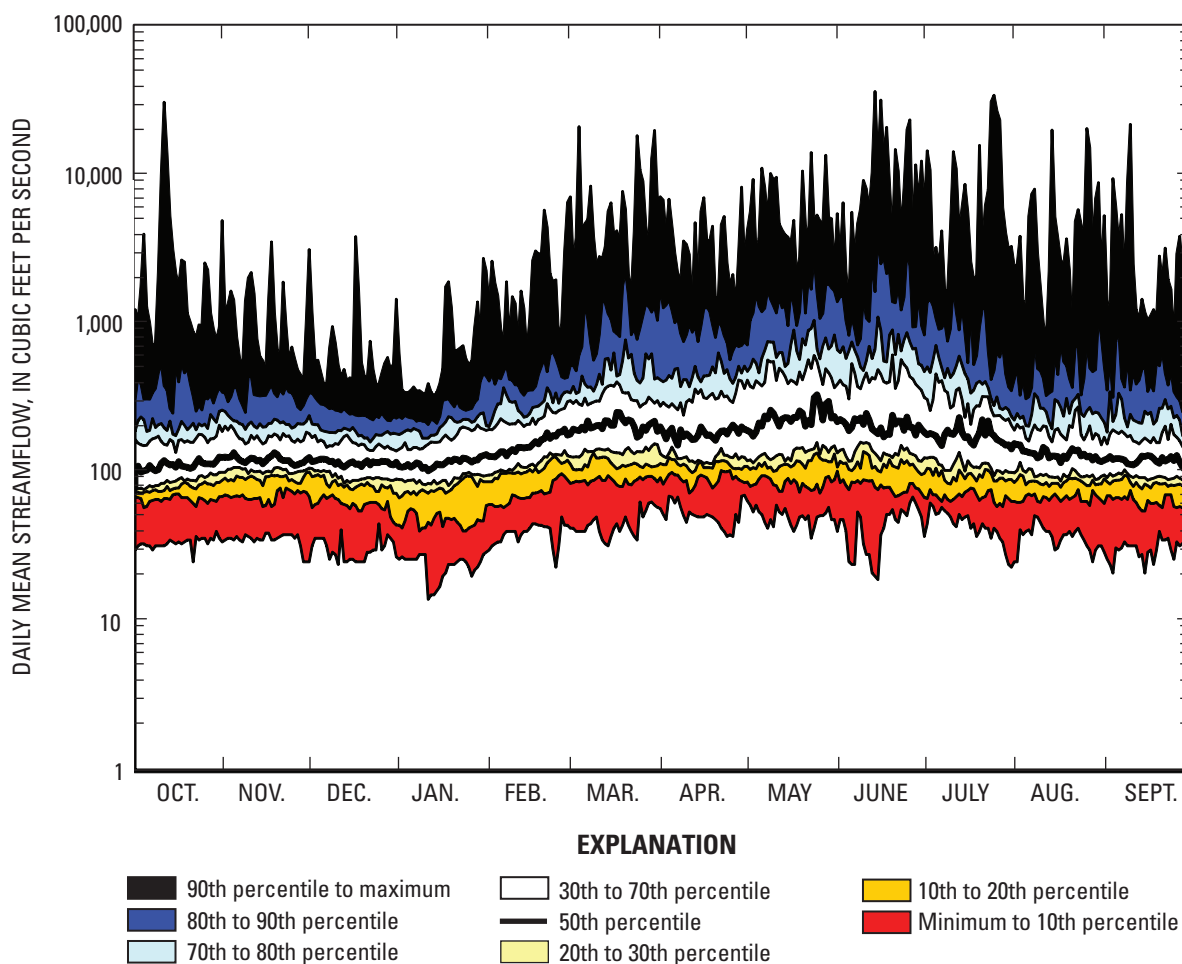
PERIOD OF RECORD.--November 1951 to current year. Records furnished by Corps of Engineers prior to Oct. 1, 1972.

GAGE.--Water-stage recorder. Datum of gage is 1,066.14 ft above sea level. Datum lowered 2.00 ft Feb. 6, 2002. Prior to Nov. 5, 1964, non-recording gage at same site. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

EXTREMES FOR PERIOD OF RECORD.--Maximum streamflow 41,000 ft³, June 24, 1963, G.H. 23.46 feet; maximum gage height, 23.50 feet, Oct. 11, 1973, from flood mark; minimum daily streamflow 14 ft³, Jan. 10, 1957.

Non-exceedance duration hydrograph for Salt Creek at Greenwood, Nebr. (06803555) (1951–2004 period of record)



06803555 SALT CREEK AT GREENWOOD, NEBR.

Monthly and annual streamflow, 1951–2004

	Maximum (ft ³ /s)	Mini- mum (ft ³ /s)	Mean (ft ³ /s)	Stand- ard devia- tion	Coeff- icient of varia- tion
October	2,681	36	247	450	1.82
November	638	35	176	116	0.66
December	465	37	146	89	0.61
January	520	26	157	105	0.67
February	952	41	261	182	0.70
March	3,481	51	489	602	1.23
April	2,023	58	397	421	1.06
May	2,383	55	591	591	1.00
June	4,101	66	698	768	1.10
July	5,461	56	501	781	1.56
August	1,748	43	307	340	1.11
September	1,534	53	251	262	1.05
Annual	1,054	108	350	223	0.64

Magnitude and probability of annual low flow based on period of record, 1951–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	69	41	30	23	17	13
2	71	42	31	24	17	13
3	73	43	32	24	17	14
7	78	48	36	28	20	16
14	83	53	40	32	24	20
30	94	60	47	37	29	24
60	108	72	57	47	38	32
90	116	77	62	52	42	36
183	140	91	73	62	52	46
October–November						
1	89	57	45	36	29	25
2	90	59	47	39	32	28
3	92	60	48	41	33	29
7	95	63	52	44	36	32
14	103	69	56	47	39	35
30	118	77	63	53	44	39
60	138	87	73	65	58	55

Duration of daily mean flow based on period of record, 1951–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time																								
	1%	2%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	98%	99%	
3,979	2,439	1,109	581	411	324	267	234	201	182	164	148	138	128	117	108	100	92	83	72	57	40	33		

06804700 WAHOO CREEK AT ASHLAND, NEBR.

LOCATION.--Lat 41°03'13", long 96°22'04", in SW ¼ NW ¼ sec.36, T.1 3., R.9 E., Saunders County, Hydrologic Unit 10200203, at right upstream side of bridge near end of guard rail on State Highway 63, 1 mi north of Ashland, and at mile 2.6.

DRAINAGE AREA.--416 mi².

STREAMFLOW RECORDS

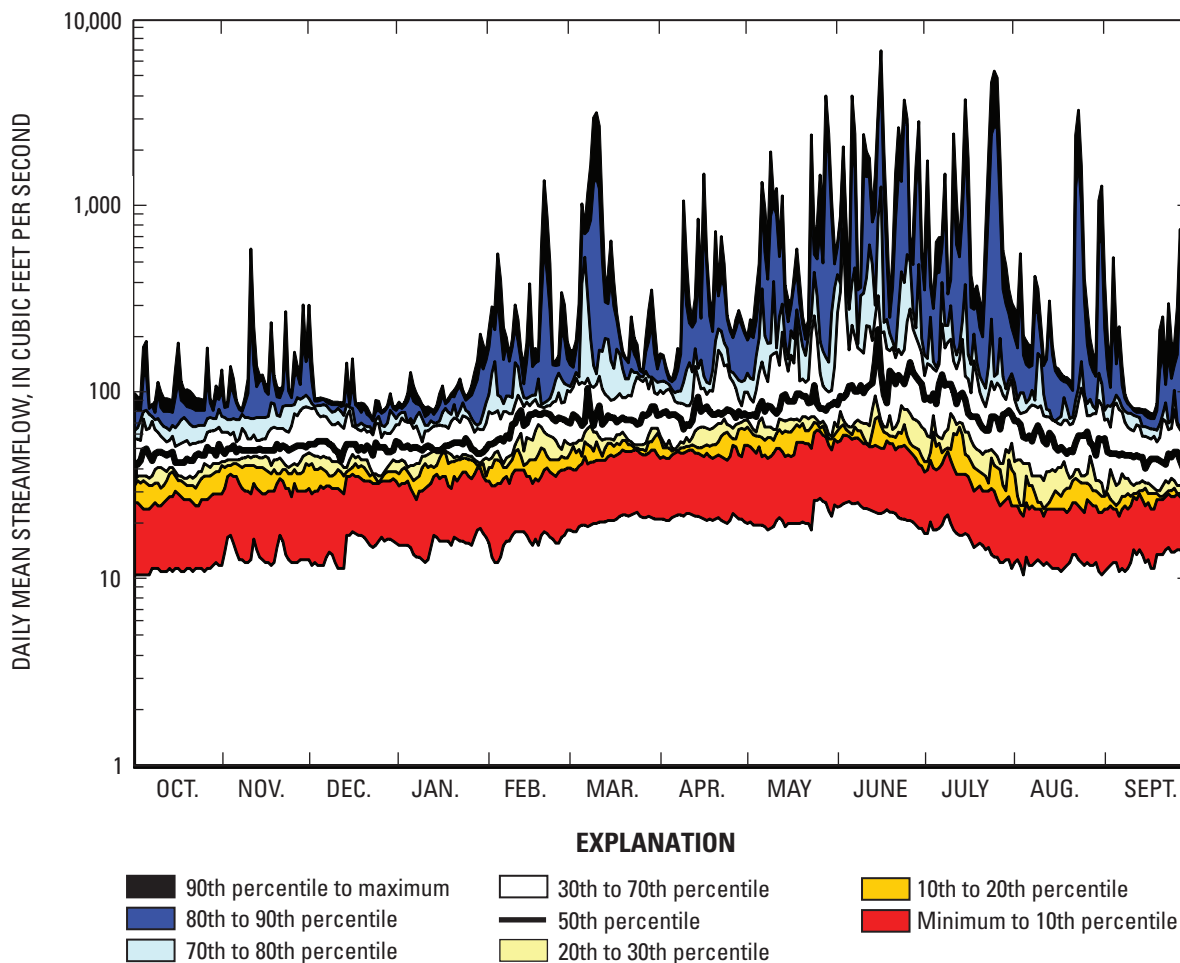
REVISED RECORDS.--WDR NE-99-1: Datum.

PERIOD OF RECORD.--September 1990 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,048.77 ft above sea level.

REMARKS.--Records good except for estimated daily streamflows, which are poor.

Non-exceedance duration hydrograph for Wahoo Cr at Ashland, Nebr. (06804700) (1990–2004 period of record)



06804700 WAHOO CREEK AT ASHLAND, NEBR.

Monthly and annual streamflow, 1990–2004

	Maximum (ft ³ /s)	Mini- mum (ft ³ /s)	Mean (ft ³ /s)	Stan- dard devia- tion	Coef- ficient of varia- tion
October	98	29	53	18	0.35
November	125	36	62	25	0.41
December	86	37	56	17	0.30
January	92	36	58	19	0.32
February	199	36	88	45	0.51
March	581	47	130	136	1.05
April	247	47	109	63	0.57
May	552	68	187	154	0.82
June	1,031	56	299	276	0.92
July	1,032	34	179	246	1.37
August	341	23	90	86	0.96
September	150	28	55	32	0.58
Annual	223	50	114	54	0.48

Magnitude and probability of annual low flow based on period of record, 1990–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	32	24	21	19	17	16
2	33	25	22	19	17	16
3	33	25	22	20	18	16
7	35	27	23	21	19	18
14	38	29	25	22	19	17
30	43	31	27	23	20	18
60	48	36	30	26	22	20
90	49	37	32	28	25	22
183	56	42	36	32	28	25
October–November						
1	40	29	24	21	18	16
2	41	29	25	21	18	16
3	42	30	25	22	18	16
7	43	31	26	22	19	17
14	45	33	27	24	20	18
30	48	35	29	25	21	18
60	53	38	32	28	23	21

Duration of daily mean flow based on period of record, 1990–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time		Duration of daily mean flow based on period of record, 1990–2004	
Streamflow, in ft ³ /s	Percentage of time	Streamflow, in ft ³ /s	Percentage of time
1,277	1%	600	2%
278	5%	166	10%
129	15%	129	15%
106	20%	106	20%
95	25%	95	25%
85	30%	85	30%
80	35%	80	35%
75	40%	75	40%
70	45%	70	45%
65	50%	65	50%
61	55%	61	55%
57	60%	57	60%
53	65%	53	65%
50	70%	50	70%
46	75%	46	75%
43	80%	43	80%
39	85%	39	85%
35	90%	35	90%
29	95%	29	95%
24	98%	24	98%
22	99%	22	99%

06805500 PLATTE RIVER AT LOUISVILLE, NEBR.

LOCATION.--Lat 41°00'55", long 96°09'28", in NW ¼ NW ¼ sec.14, T.12 N., R.11 E., Sarpy County, Hydrologic Unit 10200202, on the left bank at the upstream side of bridge on Nebraska Highway 50, 1 mi north of Louisville, and at mile 16.5.

DRAINAGE AREA.--85,329 mi² of which 14,329 mi² probably is noncontributing.

STREAMFLOW RECORDS

REVISED RECORDS.--WDR NE-97-1: Drainage area; 1995.

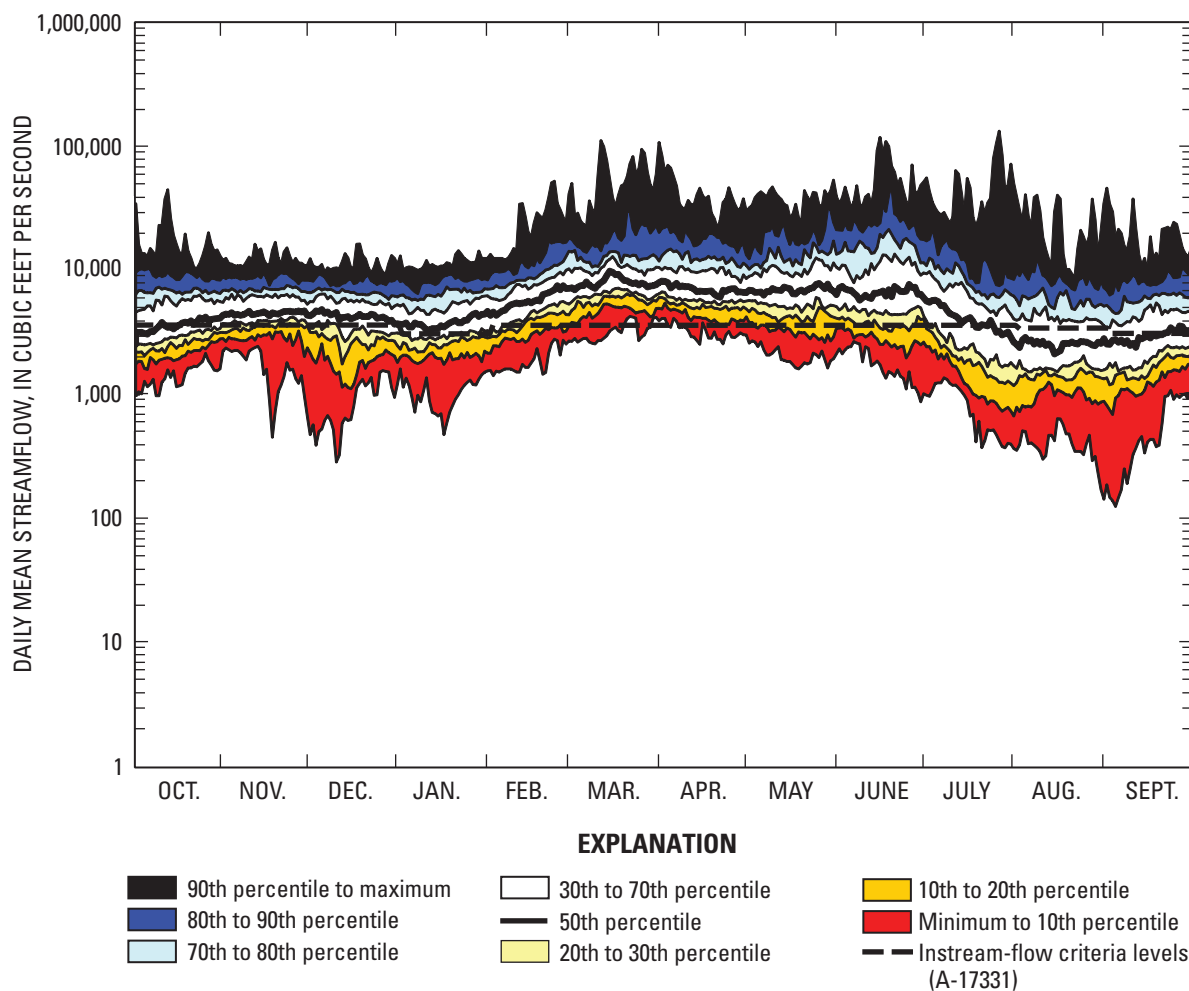
PERIOD OF RECORD.--May 1953 to current year. October 1961 to September 1973 published as Platte River at South Bend.

GAGE.--Water-stage recorder. Datum of gage is 1,007.10 ft above sea level. Dec. 5, 1961 to Sept. 30, 1973 at site 7 mi upstream at datum 31.43 ft higher. Data collection platform at station.

REMARKS.--Records good except for estimated daily streamflows, which are poor. Natural flow of stream affected by storage reservoirs, power developments, ground-water withdrawals and diversions for irrigation, and return flow from irrigated areas.

EXTREMES FOR PERIOD OF RECORD.--Maximum streamflow, 124,000 ft³ Mar. 30, 1960, gage height, 12.45 feet; minimum daily, 131 ft³ Sept. 3, 1976. Flood stage is 9.0 feet, gage datum.

Non-exceedance duration hydrograph for Platte River at Louisville, Nebr. (06805500) (1953–2004 period of record)



06805500 PLATTE RIVER AT LOUISVILLE, NEBR.

Monthly and annual streamflow, 1953–2005

	Maximum (ft ³ /s)	Minimum (ft ³ /s)	Mean (ft ³ /s)	Standard devia- tion	Coef- ficient of varia- tion
October	15,630	1,604	5,064	2,998	0.59
November	10,580	2,234	5,456	2,125	0.39
December	10,910	1,456	4,870	2,020	0.41
January	10,810	1,822	4,711	2,121	0.45
February	17,270	3,237	7,441	3,184	0.43
March	27,010	4,898	10,907	5,264	0.48
April	34,250	3,701	9,782	5,736	0.59
May	35,350	2,548	9,802	5,818	0.59
June	39,430	2,493	11,075	8,175	0.74
July	43,440	978	6,148	6,302	1.02
August	13,890	519	4,029	3,027	0.75
September	12,870	975	4,196	2,925	0.70
Annual	16,210	2,885	6,967	2,947	0.42

Magnitude and probability of annual low flow based on period of record, 1953–2004

Period (con- secu- tive days)	Streamflow, in ft ³ /s, for indicated recurrence interval, in years, and non-exceedance probability, in percent					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	1,136	602	420	307	213	165
2	1,202	637	445	326	227	176
3	1,266	673	470	344	238	185
7	1,492	792	545	391	263	198
14	1,778	942	647	463	309	233
30	2,208	1,221	869	645	454	355
60	2,829	1,664	1,229	944	691	556
90	3,204	1,997	1,548	1,249	977	828
183	4,017	2,758	2,279	1,954	1,648	1,474
October–November						
1	2,779	1,576	1,131	843	594	464
2	2,864	1,688	1,253	968	715	580
3	2,966	1,815	1,385	1,100	842	701
7	3,253	2,128	1,709	1,427	1,166	1,020
14	3,641	2,440	1,989	1,684	1,401	1,241
30	4,084	2,801	2,317	1,987	1,679	1,504
60	4,649	3,302	2,804	2,469	2,157	1,980

Duration of daily mean flow based on period of record, 1953–2004

Streamflow, in ft ³ /s, which was equaled or exceeded for indicated percentage of time	
1%	13,194
2%	12,992
5%	12,387
10%	11,378
15%	10,369
20%	9,360
25%	8,351
30%	7,457
35%	6,898
40%	6,339
45%	5,781
50%	5,313
55%	4,860
60%	4,407
65%	4,021
70%	3,656
75%	3,290
80%	2,896
85%	2,503
90%	2,008
95%	1,479
98%	1,003
99%	725

Appendix 2. Trends in Streamflow Characteristics

Table 2–1. Trends in streamflow of Platte River at Duncan, Nebraska (06774000).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1942–2004	0.108	0.103	--
November mean flow	1942–2004	.059	.378	--
December mean flow	1942–2004	.135	.042	18
January mean flow	1942–2004	.161	.016	18
February mean flow	1942–2004	.065	.331	--
March mean flow	1942–2004	.020	.759	--
April mean flow	1942–2004	.023	.732	--
May mean flow	1942–2004	.064	.335	--
June mean flow	1942–2004	.024	.721	--
July mean flow	1942–2004	.048	.474	--
August mean flow	1942–2004	.148	.026	21
September mean flow	1942–2004	.131	.049	20
Annual mean flow	1929–2003	.201	.011	13
Low flow				
1-day low flow	1930–2004	.397	< .001	1.1
2-day low flow	1930–2004	.391	< .001	1.2
3-day low flow	1930–2004	.394	< .001	1.3
7-day low flow	1930–2004	.389	< .001	1.6
14-day low flow	1930–2004	.401	< .001	2.5
30-day low flow	1930–2004	.444	< .001	4.8
60-day low flow	1930–2004	.412	< .001	7.5
90-day low flow	1930–2004	.361	< .001	11
183-day low flow	1930–2004	.307	< .001	12
1-day low flow (Oct–Nov)	1928–2003	.274	< .001	8.2
2-day low flow (Oct–Nov)	1928–2003	.261	.001	8.4
3-day low flow (Oct–Nov)	1928–2003	.260	.001	8.7
7-day low flow (Oct–Nov)	1928–2003	.267	.001	10
14-day low flow (Oct–Nov)	1928–2003	.270	.001	12
30-day low flow (Oct–Nov)	1928–2003	.244	.002	13
60-day low flow (Oct–Nov)	1928–2003	.225	.004	14

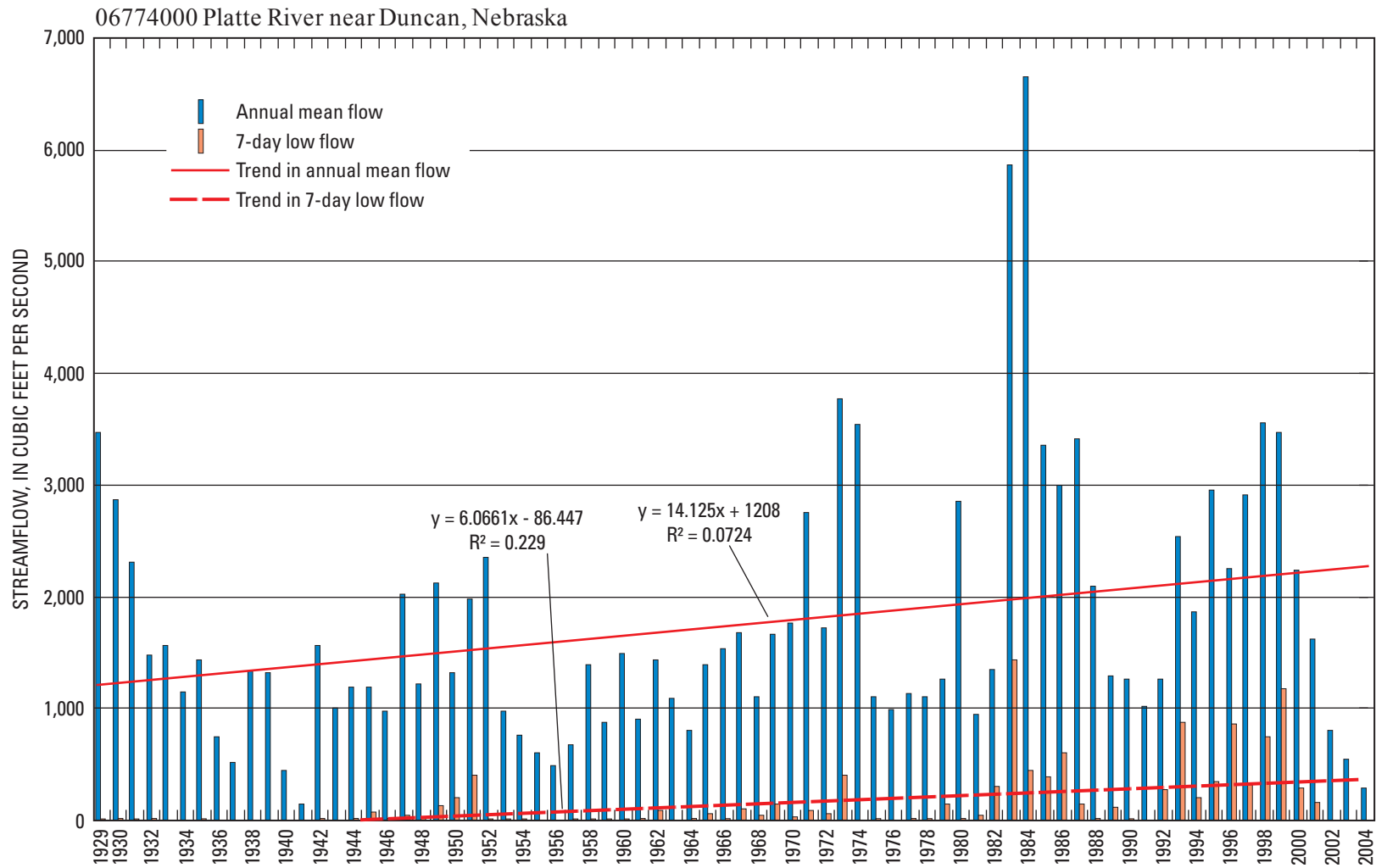


Figure 2-1. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Platte River near Duncan, Nebr.

Table 2–2. Trends in streamflow of Platte River at North Bend, Nebraska (06796000).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1949–2004	0.200	0.029	29
November mean flow	1949–2004	.190	.038	27
December mean flow	1949–2004	.239	.009	29
January mean flow	1949–2004	.176	.055	--
February mean flow	1949–2004	.032	.729	--
March mean flow	1949–2004	-.036	.692	--
April mean flow	1949–2004	.057	.534	--
May mean flow	1949–2004	.044	.631	--
June mean flow	1949–2004	.045	.621	--
July mean flow	1949–2004	.062	.497	--
August mean flow	1949–2004	.129	.162	--
September mean flow	1949–2004	.170	.064	--
Annual mean flow	1949–2003	.194	.039	26
Low flow				
1-day low flow	1950–2004	.104	.264	--
2-day low flow	1950–2004	.087	.353	--
3-day low flow	1950–2004	.099	.289	--
7-day low flow	1950–2004	.134	.151	--
14-day low flow	1950–2004	.156	.095	--
30-day low flow	1950–2004	.192	.039	14
60-day low flow	1950–2004	.201	.031	19
90-day low flow	1950–2004	.184	.048	22
183-day low flow	1950–2004	.230	.014	23
1-day low flow (Oct–Nov)	1948–2003	.198	.033	18
2-day low flow (Oct–Nov)	1948–2003	.228	.014	23
3-day low flow (Oct–Nov)	1948–2003	.230	.014	24
7-day low flow (Oct–Nov)	1948–2003	.231	.013	23
14-day low flow (Oct–Nov)	1948–2003	.236	.011	25
30-day low flow (Oct–Nov)	1948–2003	.226	.015	27
60-day low flow (Oct–Nov)	1948–2003	.235	.012	30

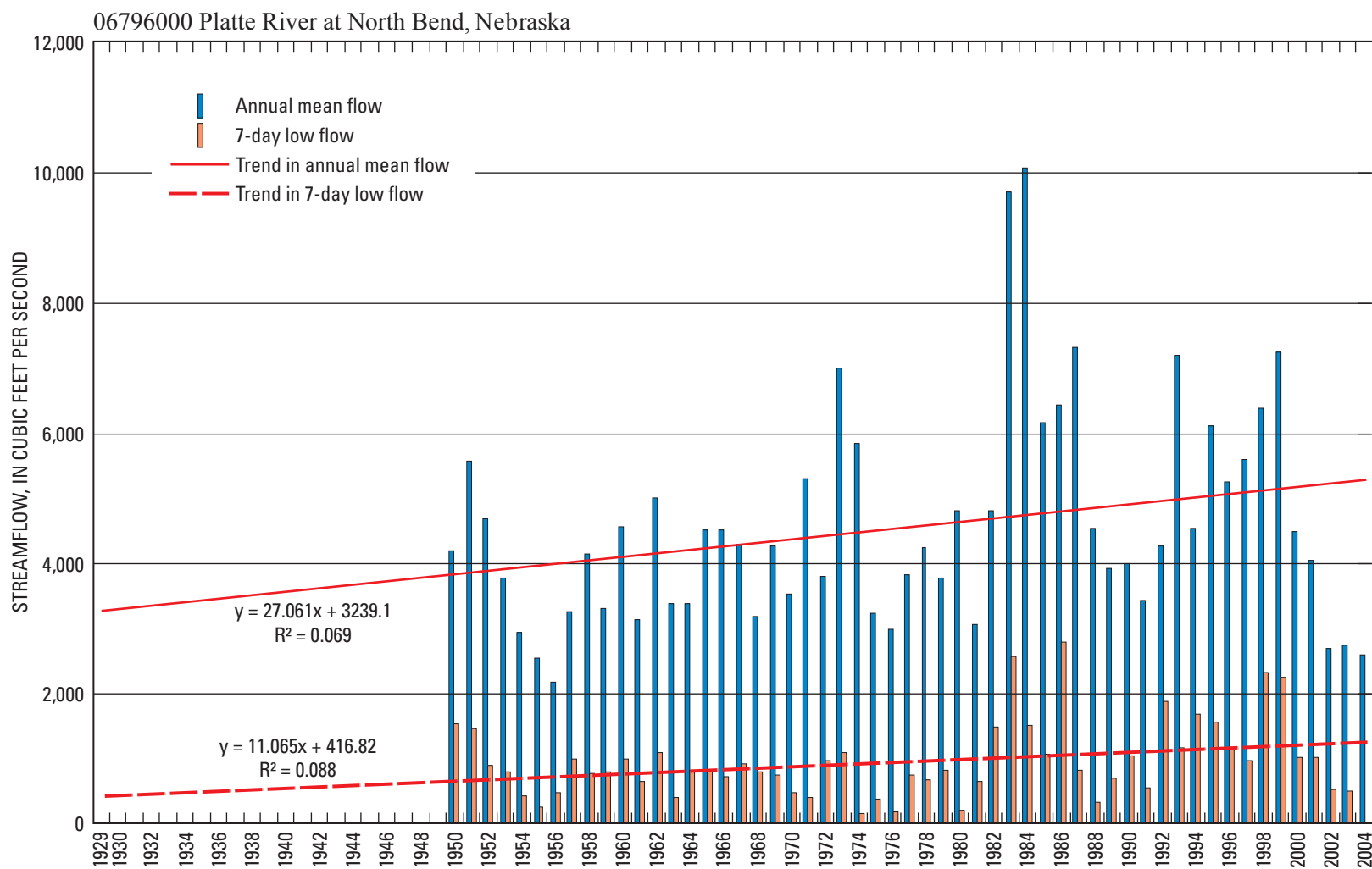


Figure 2-2. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Platte River at North Bend, Nebr.

Table 2–3. Trends in streamflow of Platte River near Leshara, Nebraska (06796500).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1995–2005	-0.600	0.010	-400
November mean flow	1995–2005	-.564	.016	-380
December mean flow	1995–2005	-.564	.016	-390
January mean flow	1995–2005	-.582	.012	-410
February mean flow	1995–2005	-.455	.052	--
March mean flow	1995–2005	-.273	.243	--
April mean flow	1995–2005	-.418	.073	--
May mean flow	1995–2005	-.418	.073	--
June mean flow	1995–2005	-.527	.024	-1,100
July mean flow	1995–2005	-.600	.010	-610
August mean flow	1995–2005	-.491	.036	-530
September mean flow	1995–2005	-.709	.002	-420
Annual mean flow	1994–2004	-.511	.049	-510
Low flow				
1-day low flow	1995–2005	-.378	.152	--
2-day low flow	1995–2005	-.378	.152	--
3-day low flow	1995–2005	-.378	.152	--
7-day low flow	1995–2005	-.467	.074	--
14-day low flow	1995–2005	-.467	.074	--
30-day low flow	1995–2005	-.467	.074	--
60-day low flow	1995–2005	-.511	.049	-380
90-day low flow	1995–2005	-.511	.049	-450
183-day low flow	1995–2005	-.600	.020	-430
1-day low flow (Oct–Nov)	1994–2005	-.491	.043	-280
2-day low flow (Oct–Nov)	1994–2005	-.455	.062	--
3-day low flow (Oct–Nov)	1994–2005	-.455	.062	--
7-day low flow (Oct–Nov)	1994–2005	-.491	.043	-330
14-day low flow (Oct–Nov)	1994–2005	-.527	.029	-350
30-day low flow (Oct–Nov)	1994–2005	-.600	.013	-390
60-day low flow (Oct–Nov)	1994–2005	-.673	.005	-450

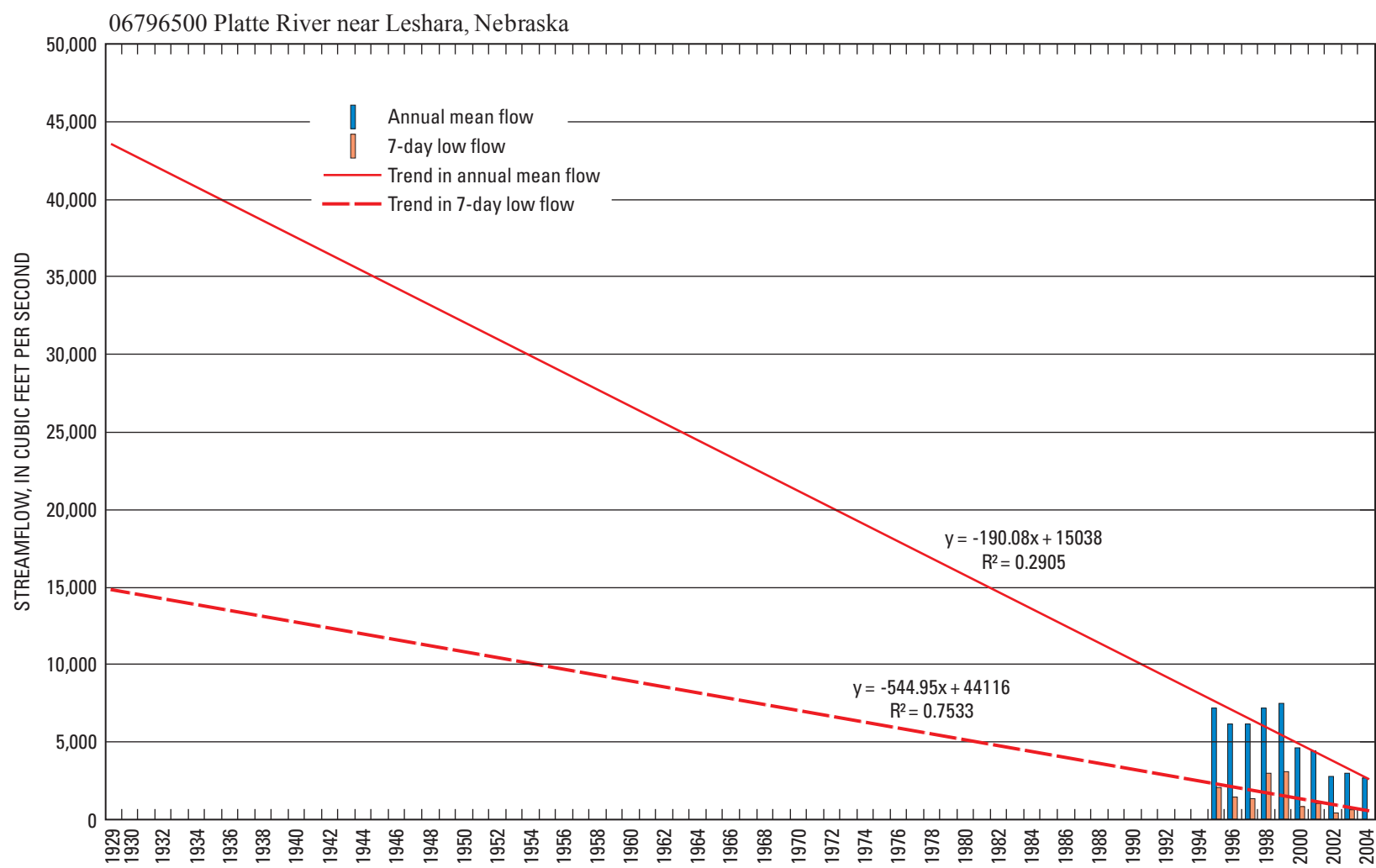


Figure 2-3. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Platte River near Leshara, Nebr.

Table 2–4. Trends in streamflow of Elkhorn River near Atkinson, Nebraska (06796973).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1983–2004	-0.600	0.010	-1.2
November mean flow	1983–2004	-.564	.016	0
December mean flow	1983–2004	-.564	.016	-0.2
January mean flow	1983–2004	-.582	.012	-.6
February mean flow	1983–2004	-.455	.052	--
March mean flow	1983–2004	-.273	.243	--
April mean flow	1983–2004	-.418	.073	--
May mean flow	1983–2004	-.418	.073	--
June mean flow	1983–2004	-.527	.024	1.0
July mean flow	1983–2004	-.600	.010	-3.5
August mean flow	1983–2004	-.491	.036	-1.3
September mean flow	1983–2004	-.709	.002	-4.2
Annual mean flow	1983–2003	-.158	.347	--
Low flow				
1-day low flow	1984–2004	-.195	.242	--
2-day low flow	1984–2004	-.200	.230	--
3-day low flow	1984–2004	-.200	.230	--
7-day low flow	1984–2004	-.189	.256	--
14-day low flow	1984–2004	-.179	.284	--
30-day low flow	1984–2004	-.200	.230	--
60-day low flow	1984–2004	-.221	.183	--
90-day low flow	1984–2004	-.221	.183	--
183-day low flow	1984–2004	-.200	.230	--
1-day low flow (Oct–Nov)	1982–2003	-.157	.333	--
2-day low flow (Oct–Nov)	1982–2003	-.157	.334	--
3-day low flow (Oct–Nov)	1982–2003	-.157	.334	--
7-day low flow (Oct–Nov)	1982–2003	-.152	.349	--
14-day low flow (Oct–Nov)	1982–2003	-.152	.349	--
30-day low flow (Oct–Nov)	1982–2003	-.152	.349	--
60-day low flow (Oct–Nov)	1982–2003	-.200	0.216	--

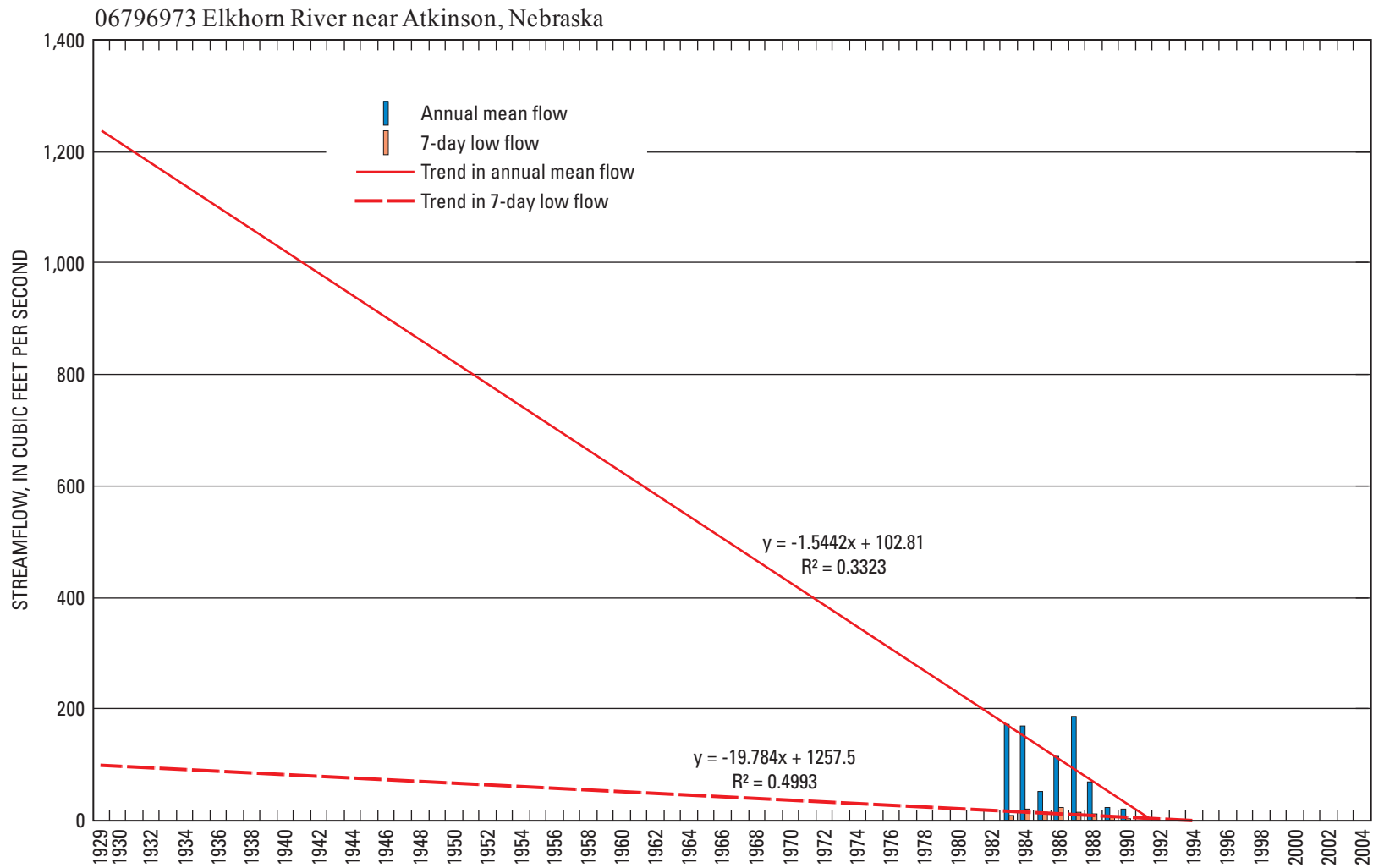


Figure 2-4. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Elkhorn River near Atkinson, Nebr.

Table 2–5. Trends in streamflow of Elkhorn River at Ewing, Nebraska (06797500).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p < 0.05)
Mean flow				
October mean flow	1948–2004	0.014	0.874	--
November mean flow	1948–2004	.081	.374	--
December mean flow	1948–2004	.100	.273	--
January mean flow	1948–2004	.150	.100	--
February mean flow	1948–2004	.150	.098	--
March mean flow	1948–2004	.023	.799	--
April mean flow	1948–2004	-.009	.923	--
May mean flow	1948–2004	.050	.582	--
June mean flow	1948–2004	-.048	.596	--
July mean flow	1948–2004	-.025	.783	--
August mean flow	1948–2004	-.100	.274	--
September mean flow	1948–2004	-.053	.558	--
Annual mean flow	1947–2003	.091	.326	--
Low flow				
1-day low flow	1948–2004	-.072	.437	--
2-day low flow	1948–2004	-.077	.404	--
3-day low flow	1948–2004	-.069	.458	--
7-day low flow	1948–2004	-.064	.493	--
14-day low flow	1948–2004	-.077	.408	--
30-day low flow	1948–2004	-.068	.462	--
60-day low flow	1948–2004	-.053	.572	--
90-day low flow	1948–2004	-.023	.805	--
183-day low flow	1948–2004	.032	.729	--
1-day low flow (Oct–Nov)	1946–2003	.018	.852	--
2-day low flow (Oct–Nov)	1946–2003	.018	.853	--
3-day low flow (Oct–Nov)	1946–2003	.029	.751	--
7-day low flow (Oct–Nov)	1946–2003	.061	.504	--
14-day low flow (Oct–Nov)	1946–2003	.038	.680	--
30-day low flow (Oct–Nov)	1946–2003	.028	.762	--
60-day low flow (Oct–Nov)	1946–2003	.033	.720	--

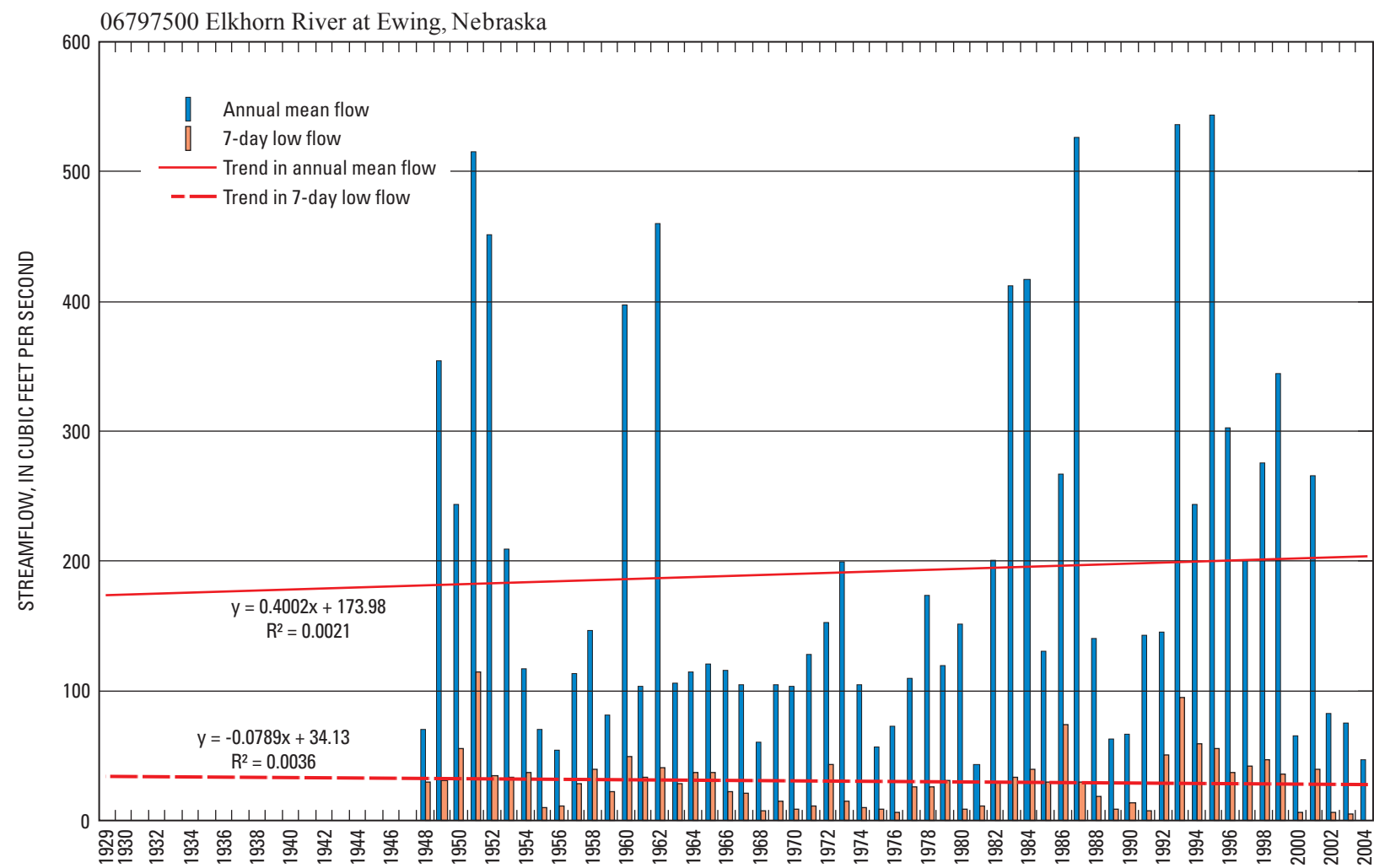


Figure 2-5. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Elkhorn River at Ewing, Nebr.

Table 2-6. Trends in streamflow of South Fork Elkhorn River at Ewing, Nebraska (06798000).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1948–2004	0.088	0.395	--
November mean flow	1948–2004	-.078	.451	--
December mean flow	1948–2004	.052	.618	--
January mean flow	1948–2004	.344	.001	0.4
February mean flow	1948–2004	.064	.538	--
March mean flow	1948–2004	-.358	.001	-2.0
April mean flow	1948–2004	-.208	.044	-1.5
May mean flow	1948–2004	-.043	.674	--
June mean flow	1948–2004	.099	.338	--
July mean flow	1948–2004	.224	.030	2.1
August mean flow	1948–2004	.197	.053	--
September mean flow	1948–2004	.091	.373	--
Annual mean flow	1947–2003	-.012	.917	--
Low flow				
1-day low flow	1948–2004	.290	.009	.2
2-day low flow	1948–2004	.263	.017	.2
3-day low flow	1948–2004	.235	.034	.1
7-day low flow	1948–2004	.219	.047	.1
14-day low flow	1948–2004	.178	.108	--
30-day low flow	1948–2004	.118	.289	--
60-day low flow	1948–2004	.108	.334	--
90-day low flow	1948–2004	.095	.395	--
183-day low flow	1948–2004	.100	.370	--
1-day low flow (Oct–Nov)	1946–2003	.210	.043	.2
2-day low flow (Oct–Nov)	1946–2003	.217	.036	.2
3-day low flow (Oct–Nov)	1946–2003	.214	.039	.1
7-day low flow (Oct–Nov)	1946–2003	.192	.064	--
14-day low flow (Oct–Nov)	1946–2003	.123	.237	--
30-day low flow (Oct–Nov)	1946–2003	.127	.221	--
60-day low flow (Oct–Nov)	1946–2003	.098	.348	--

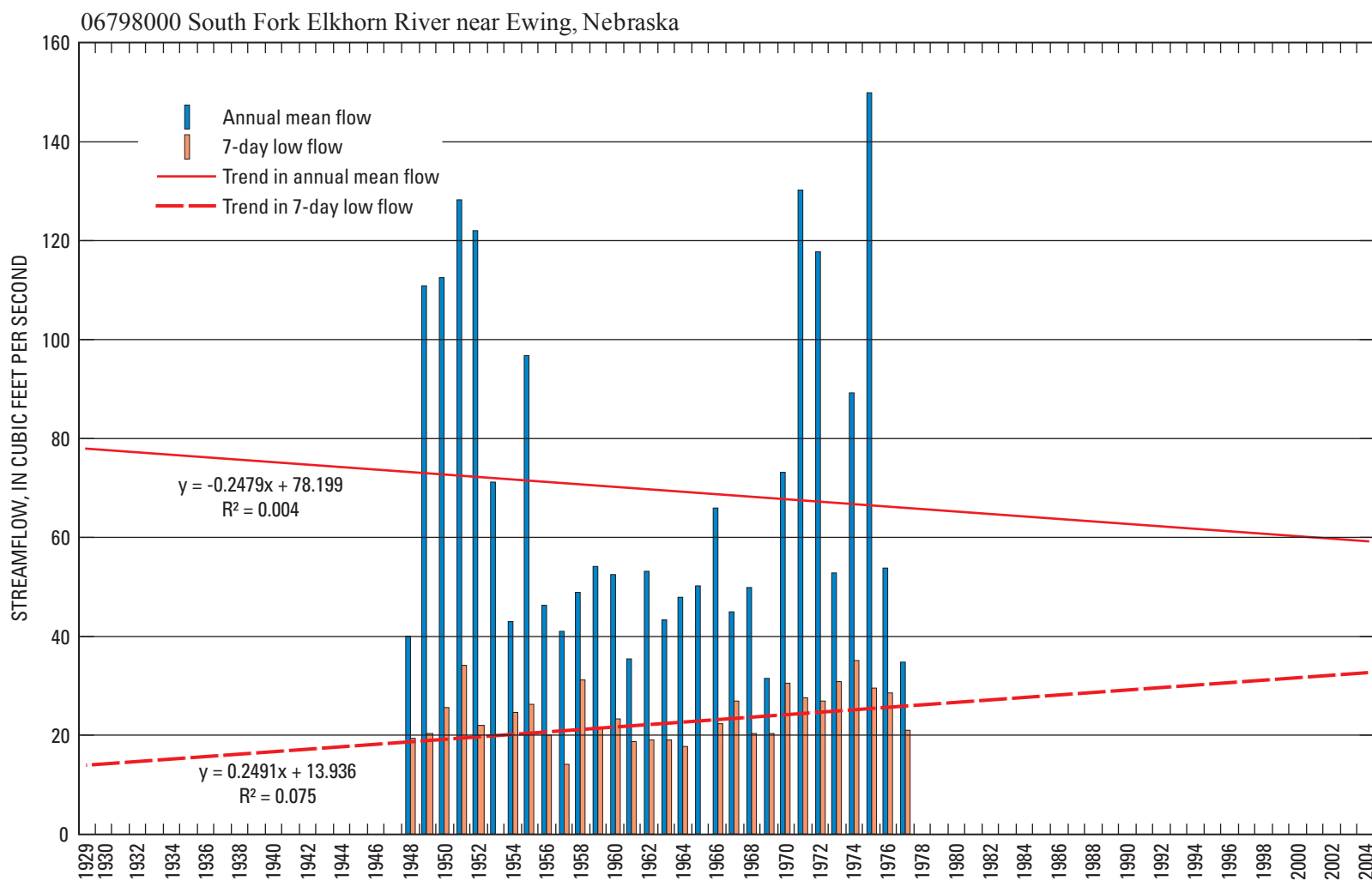


Figure 2-6. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of South Fork Elkhorn River near Ewing, Nebr.

Table 2-7. Trends in streamflow of Elkhorn River at Neligh, Nebraska (06798500).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1931–2002	0.346	< 0.001	0.9
November mean flow	1931–2002	.444	< .001	1.5
December mean flow	1931–2002	.498	< .001	1.1
January mean flow	1931–2002	.473	< .001	1.3
February mean flow	1931–2002	.225	.009	3.0
March mean flow	1931–2002	.101	.240	--
April mean flow	1931–2002	.287	.001	9.7
May mean flow	1931–2002	.300	.001	7.4
June mean flow	1931–2002	.182	.035	1.4
July mean flow	1931–2002	.214	.013	3.1
August mean flow	1931–2002	.162	.061	--
September mean flow	1931–2002	.282	.001	1.4
Annual mean flow	1931–2003	.234	.004	2.6
Low flow				
1-day low flow	1932–2004	.178	.032	.5
2-day low flow	1932–2004	.172	.038	.5
3-day low flow	1932–2004	.172	.039	.5
7-day low flow	1932–2004	.191	.022	.6
14-day low flow	1932–2004	.158	.058	--
30-day low flow	1932–2004	.162	.051	--
60-day low flow	1932–2004	.178	.032	.6
90-day low flow	1932–2004	.177	.033	.7
183-day low flow	1932–2004	.208	.012	.8
1-day low flow (Oct–Nov)	1931–2004	.213	.009	2.2
2-day low flow (Oct–Nov)	1930–2003	.129	.112	--
3-day low flow (Oct–Nov)	1930–2003	.140	.084	--
7-day low flow (Oct–Nov)	1930–2003	.140	.085	--
14-day low flow (Oct–Nov)	1930–2003	.144	.077	--
30-day low flow (Oct–Nov)	1930–2003	.157	.053	--
60-day low flow (Oct–Nov)	1930–2003	.188	.021	.7

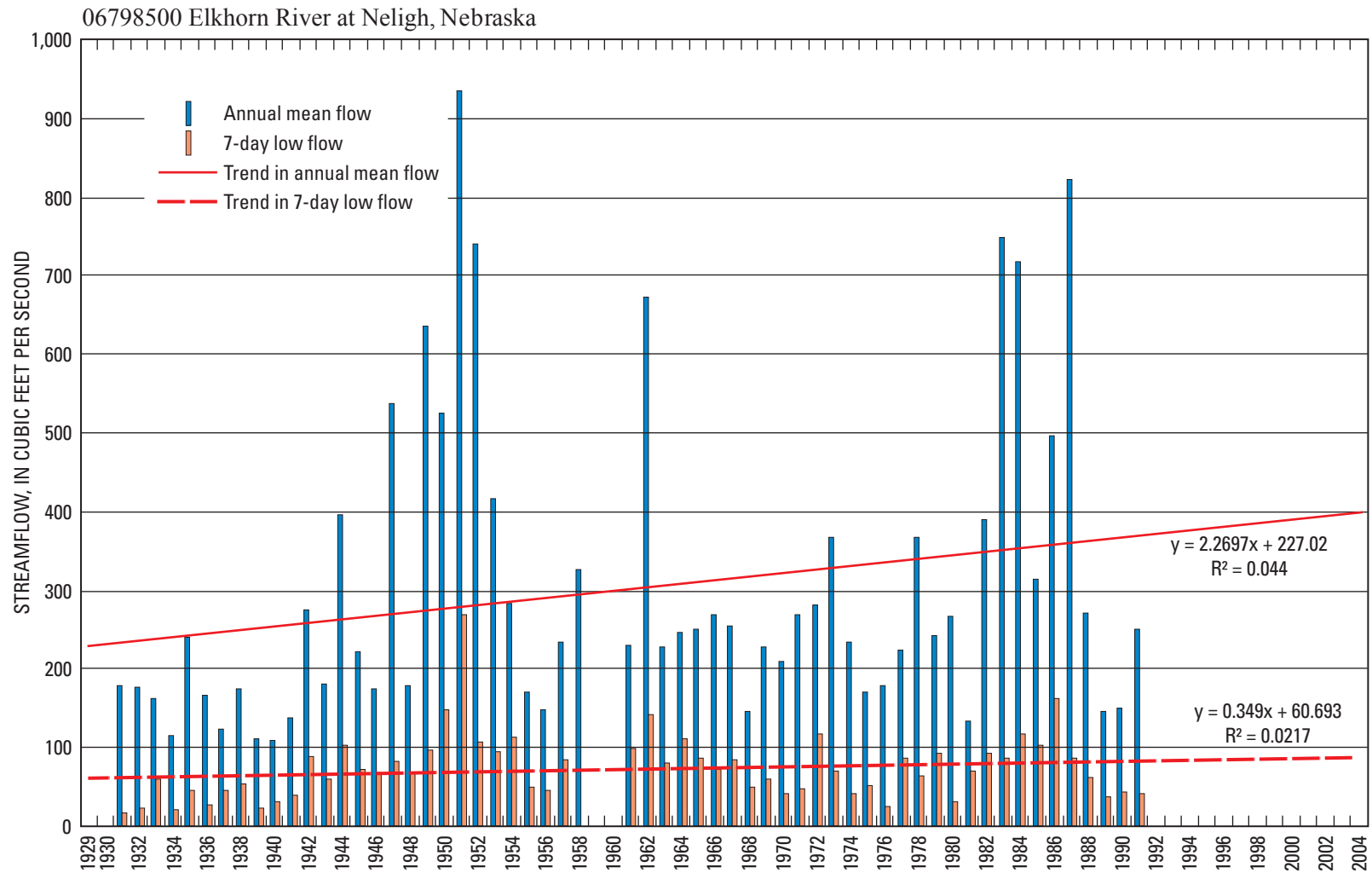


Figure 2-7. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Elkhorn River at Neligh, Nebr.

Table 2–8. Trends in streamflow of Elkhorn River at Norfolk, Nebraska (06799000).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1946–2004	0.037	0.676	--
November mean flow	1946–2004	.124	.164	--
December mean flow	1946–2004	.185	.038	1.6
January mean flow	1946–2004	.157	.080	--
February mean flow	1946–2004	.103	.250	--
March mean flow	1946–2004	-.016	.860	--
April mean flow	1946–2004	.021	.814	--
May mean flow	1946–2004	.106	.234	--
June mean flow	1946–2004	-.043	.633	--
July mean flow	1946–2004	.014	.875	--
August mean flow	1946–2004	-.020	.824	--
September mean flow	1946–2004	-.034	.700	--
Annual mean flow	1896–2003	.066	.464	--
Low flow				
1-day low flow	1897–2004	-.004	.968	--
2-day low flow	1897–2004	-.005	.957	--
3-day low flow	1897–2004	.004	.968	--
7-day low flow	1897–2004	-.027	.773	--
14-day low flow	1897–2004	-.041	.658	--
30-day low flow	1897–2004	-.026	.778	--
60-day low flow	1897–2004	.048	.601	--
90-day low flow	1897–2004	.056	.537	--
183-day low flow	1897–2004	.049	.592	--
1-day low flow (Oct–Nov)	1895–2003	.045	.606	--
2-day low flow (Oct–Nov)	1895–2003	.042	.631	--
3-day low flow (Oct–Nov)	1895–2003	.050	.572	--
7-day low flow (Oct–Nov)	1895–2003	.039	.662	--
14-day low flow (Oct–Nov)	1895–2003	.032	.716	--
30-day low flow (Oct–Nov)	1895–2003	.024	.785	--
60-day low flow (Oct–Nov)	1895–2003	.063	.474	--

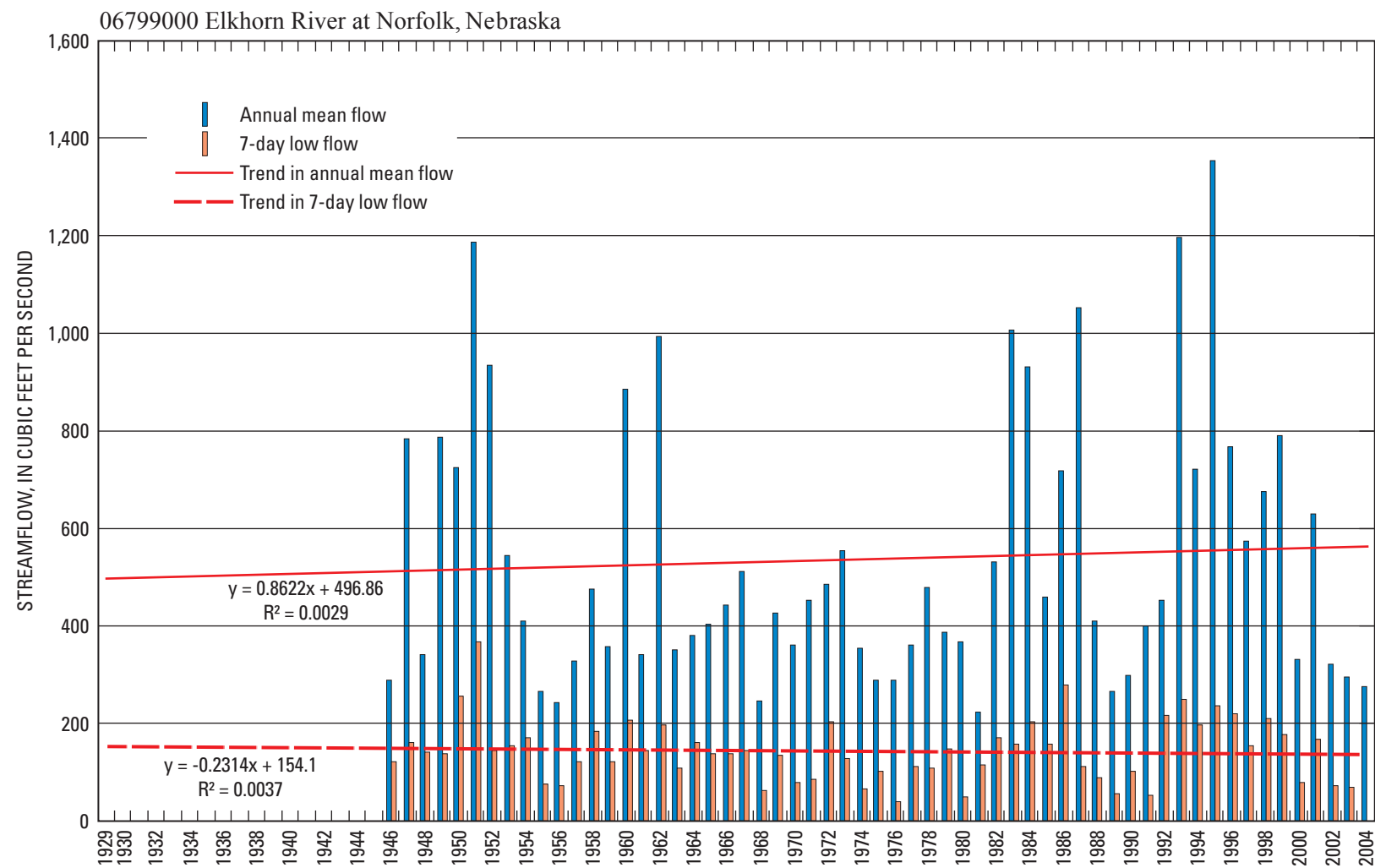


Figure 2–8. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Elkhorn River at Norfolk, Nebr.

Table 2–9. Trends in streamflow of North Fork Elkhorn River near Pierce, Nebraska (06799100).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1961–2004	-0.025	0.808	--
November mean flow	1961–2004	.122	.245	--
December mean flow	1961–2004	.172	.099	--
January mean flow	1961–2004	.106	.311	--
February mean flow	1961–2004	.085	.418	--
March mean flow	1961–2004	.073	.485	--
April mean flow	1961–2004	.111	.288	--
May mean flow	1961–2004	.212	.042	3.6
June mean flow	1961–2004	.066	.531	--
July mean flow	1961–2004	.145	.166	--
August mean flow	1961–2004	.040	.700	--
September mean flow	1961–2004	-.023	.824	--
Annual mean flow	1960–2003	.136	.202	--
Low flow				
1-day low flow	1961–2004	.065	.543	--
2-day low flow	1961–2004	.063	.558	--
3-day low flow	1961–2004	.047	.668	--
7-day low flow	1961–2004	.040	.714	--
14-day low flow	1961–2004	.040	.714	--
30-day low flow	1961–2004	.011	.925	--
60-day low flow	1961–2004	.034	.754	--
90-day low flow	1961–2004	.045	.675	--
183-day low flow	1961–2004	.081	.451	--
1-day low flow (Oct–Nov)	1959–2003	.042	.693	--
2-day low flow (Oct–Nov)	1959–2003	.037	.731	--
3-day low flow (Oct–Nov)	1959–2003	.026	.808	--
7-day low flow (Oct–Nov)	1959–2003	-.006	.960	--
14-day low flow (Oct–Nov)	1959–2003	-.019	.863	--
30-day low flow (Oct–Nov)	1959–2003	-.005	.968	--
60-day low flow (Oct–Nov)	1959–2003	.044	.678	--

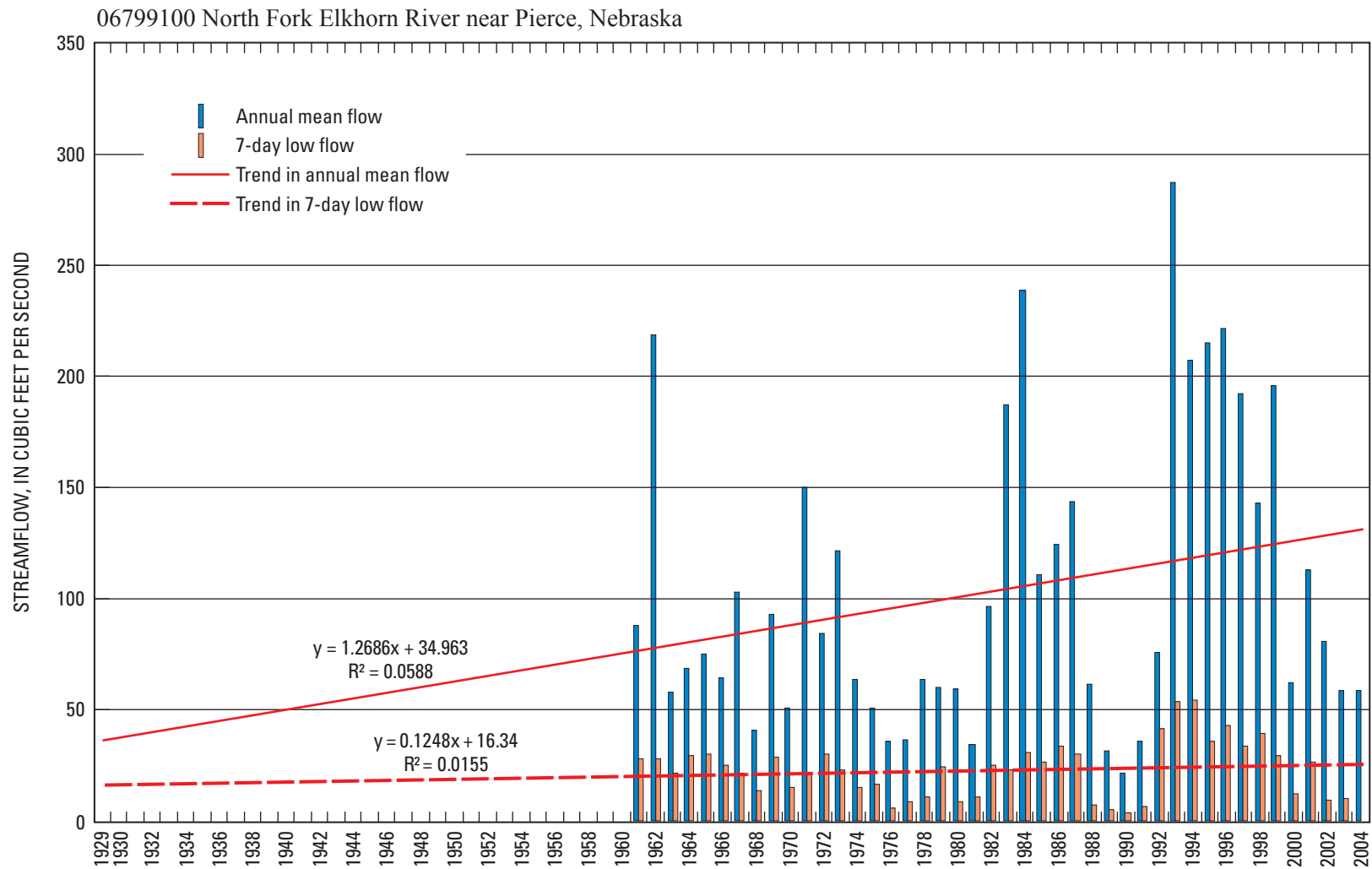


Figure 2-9. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of North Fork Elkhorn River near Pierce, Nebr.

Table 2–10. Trends in streamflow of Elkhorn River at West Point, Nebraska (06799350).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1973–2004	0.230	0.065	--
November mean flow	1973–2004	.258	.038	13
December mean flow	1973–2004	.335	.007	16
January mean flow	1973–2004	.250	.044	8.4
February mean flow	1973–2004	.133	.284	--
March mean flow	1973–2004	-.044	.721	--
April mean flow	1973–2004	.056	.650	--
May mean flow	1973–2004	.222	.074	--
June mean flow	1973–2004	.157	.206	--
July mean flow	1973–2004	.331	.008	35
August mean flow	1973–2004	.181	.144	--
September mean flow	1973–2004	.210	.092	--
Annual mean flow	1973–2003	.209	.103	--
Low flow				
1-day low flow	1974–2004	.155	.227	--
2-day low flow	1974–2004	.151	.241	--
3-day low flow	1974–2004	.163	.202	--
7-day low flow	1974–2004	.204	.110	--
14-day low flow	1974–2004	.191	.135	--
30-day low flow	1974–2004	.260	.041	7.2
60-day low flow	1974–2004	.320	.012	9.1
90-day low flow	1974–2004	.295	.021	9.8
183-day low flow	1974–2004	.316	.013	9.7
1-day low flow (Oct–Nov)	1972–2003	.185	.140	--
2-day low flow (Oct–Nov)	1972–2003	.179	.154	--
3-day low flow (Oct–Nov)	1972–2003	.202	.108	--
7-day low flow (Oct–Nov)	1972–2003	.242	.054	--
14-day low flow (Oct–Nov)	1972–2003	.242	.054	--
30-day low flow (Oct–Nov)	1972–2003	.262	.036	8.3
60-day low flow (Oct–Nov)	1972–2003	.242	.054	--

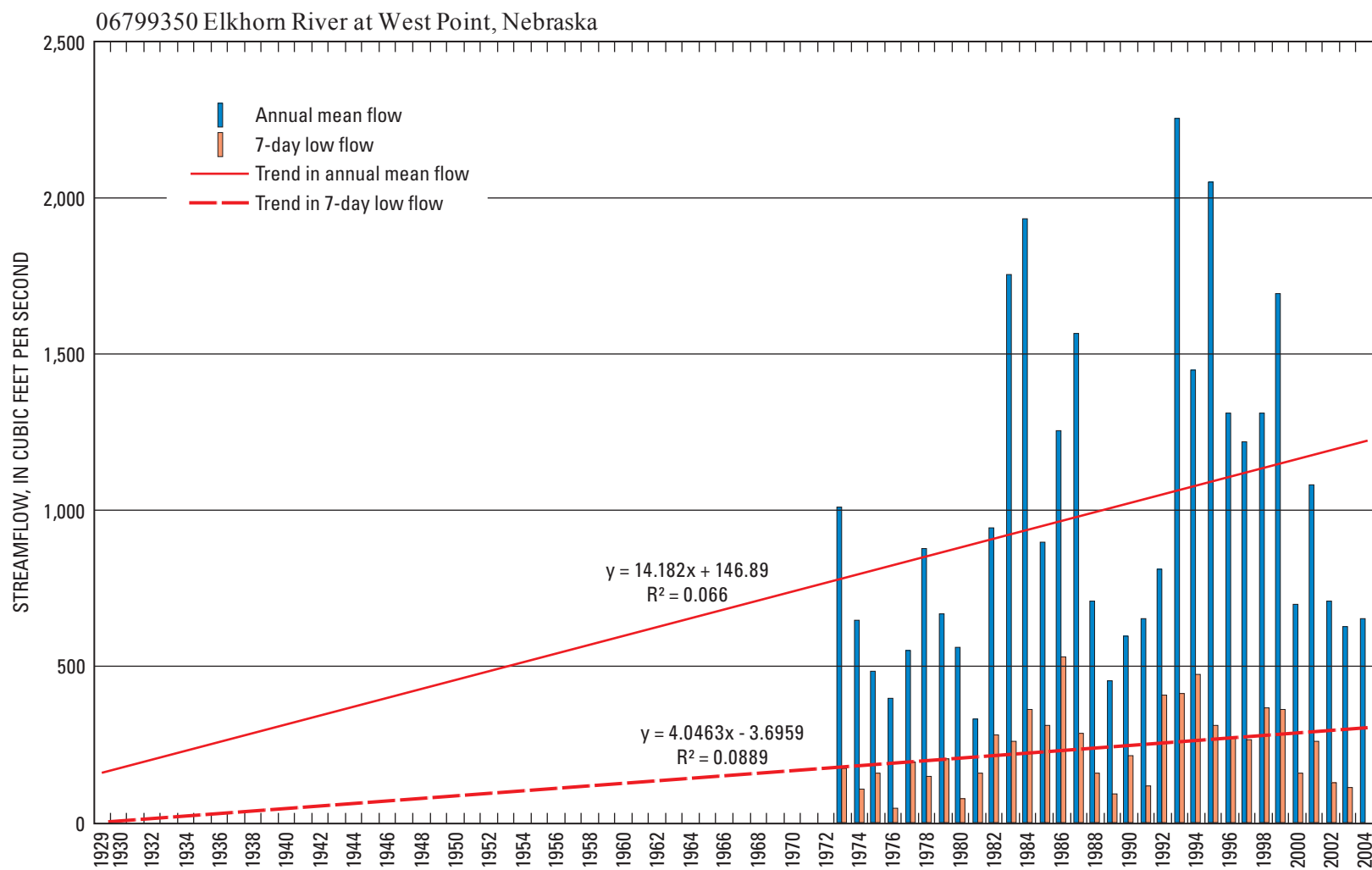


Figure 2-10. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Elkhorn River at West Point, Nebr.

Table 2–11. Trends in streamflow of Pebble Creek at Scribner, Nebraska (06799385).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1980–2004	-0.382	0.102	--
November mean flow	1980–2004	-.164	.484	--
December mean flow	1980–2004	-.491	.036	-2.3
January mean flow	1980–2004	-.273	.243	--
February mean flow	1980–2004	-.491	.036	-3.8
March mean flow	1980–2004	-.091	.697	--
April mean flow	1980–2004	.018	.938	--
May mean flow	1980–2004	.200	.392	--
June mean flow	1980–2004	-.273	.243	--
July mean flow	1980–2004	-.382	.102	--
August mean flow	1980–2004	-.527	.024	-18
September mean flow	1980–2004	-.564	.016	-5.0
Annual mean flow	1979–2003	.053	.726	--
Low flow				
1-day low flow	1980–2004	.287	.047	0.5
2-day low flow	1980–2004	.293	.042	.5
3-day low flow	1980–2004	.297	.040	.5
7-day low flow	1980–2004	.320	.027	.5
14-day low flow	1980–2004	.327	.023	.6
30-day low flow	1980–2004	.413	.004	.8
60-day low flow	1980–2004	.287	.047	.7
90-day low flow	1980–2004	.240	.097	--
183-day low flow	1980–2004	.127	.388	--
1-day low flow (Oct–Nov)	1978–2003	.323	.022	.8
2-day low flow (Oct–Nov)	1978–2003	.317	.024	.8
3-day low flow (Oct–Nov)	1978–2003	.314	.026	.8
7-day low flow (Oct–Nov)	1978–2003	.262	.064	--
14-day low flow (Oct–Nov)	1978–2003	.243	.086	--
30-day low flow (Oct–Nov)	1978–2003	.212	.134	--
60-day low flow (Oct–Nov)	1978–2003	.138	.332	--

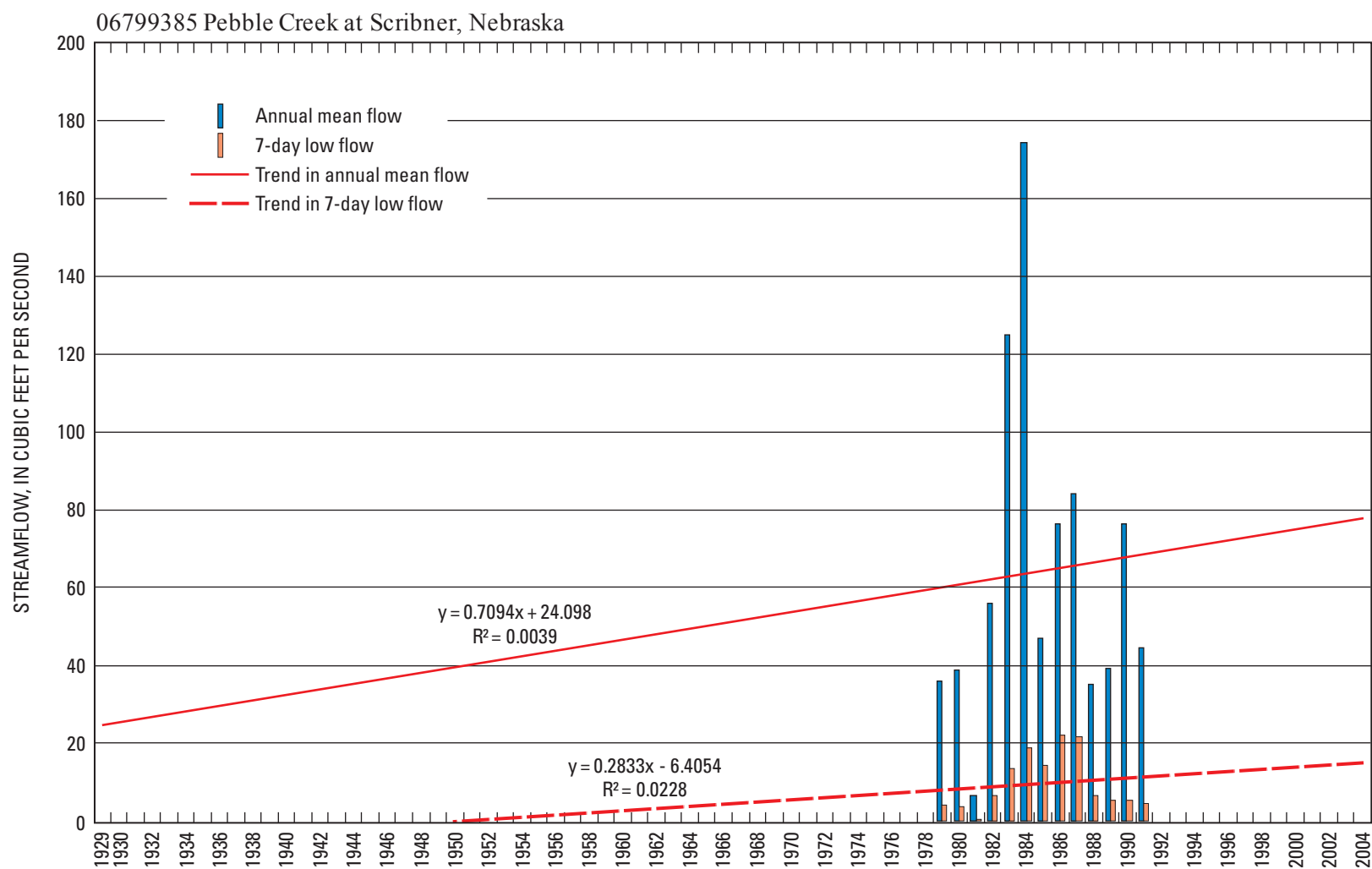


Figure 2–11. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Pebble Creek at Scribner, Nebr.

Table 2–12. Trends in streamflow of Logan Creek near Uehling, Nebraska (06799500).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant; NC, slope not calculated]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1941–2004	0.351	< 0.000	NC
November mean flow	1941–2004	.446	< .000	NC
December mean flow	1941–2004	.501	< .000	NC
January mean flow	1941–2004	.474	< .000	NC
February mean flow	1941–2004	.238	.005	NC
March mean flow	1941–2004	.103	.226	NC
April mean flow	1941–2004	.305	< .000	NC
May mean flow	1941–2004	.317	< .000	NC
June mean flow	1941–2004	.180	.034	NC
July mean flow	1941–2004	.202	.017	NC
August mean flow	1941–2004	.181	.033	NC
September mean flow	1941–2004	.300	< .000	NC
Annual mean flow	1941–2003	.285	.001	NC
Low flow				
1-day low flow	1942–2004	.475	< .001	1.4
2-day low flow	1942–2004	.457	< .001	1.3
3-day low flow	1942–2004	.458	< .001	1.3
7-day low flow	1942–2004	.445	< .001	1.4
14-day low flow	1942–2004	.438	< .001	1.4
30-day low flow	1942–2004	.462	< .001	1.5
60-day low flow	1942–2004	.458	< .001	1.6
90-day low flow	1942–2004	.450	< .001	1.8
183-day low flow	1942–2004	.361	< .001	1.8
1-day low flow (Oct–Nov)	1940–2003	.487	< .001	1.7
2-day low flow (Oct–Nov)	1940–2003	.477	< .001	1.7
3-day low flow (Oct–Nov)	1940–2003	.471	< .001	1.7
7-day low flow (Oct–Nov)	1940–2003	.467	< .001	1.6
14-day low flow (Oct–Nov)	1940–2003	.434	< .001	1.6
30-day low flow (Oct–Nov)	1940–2003	.420	< .001	1.5
60-day low flow (Oct–Nov)	1940–2003	.395	< .001	1.7

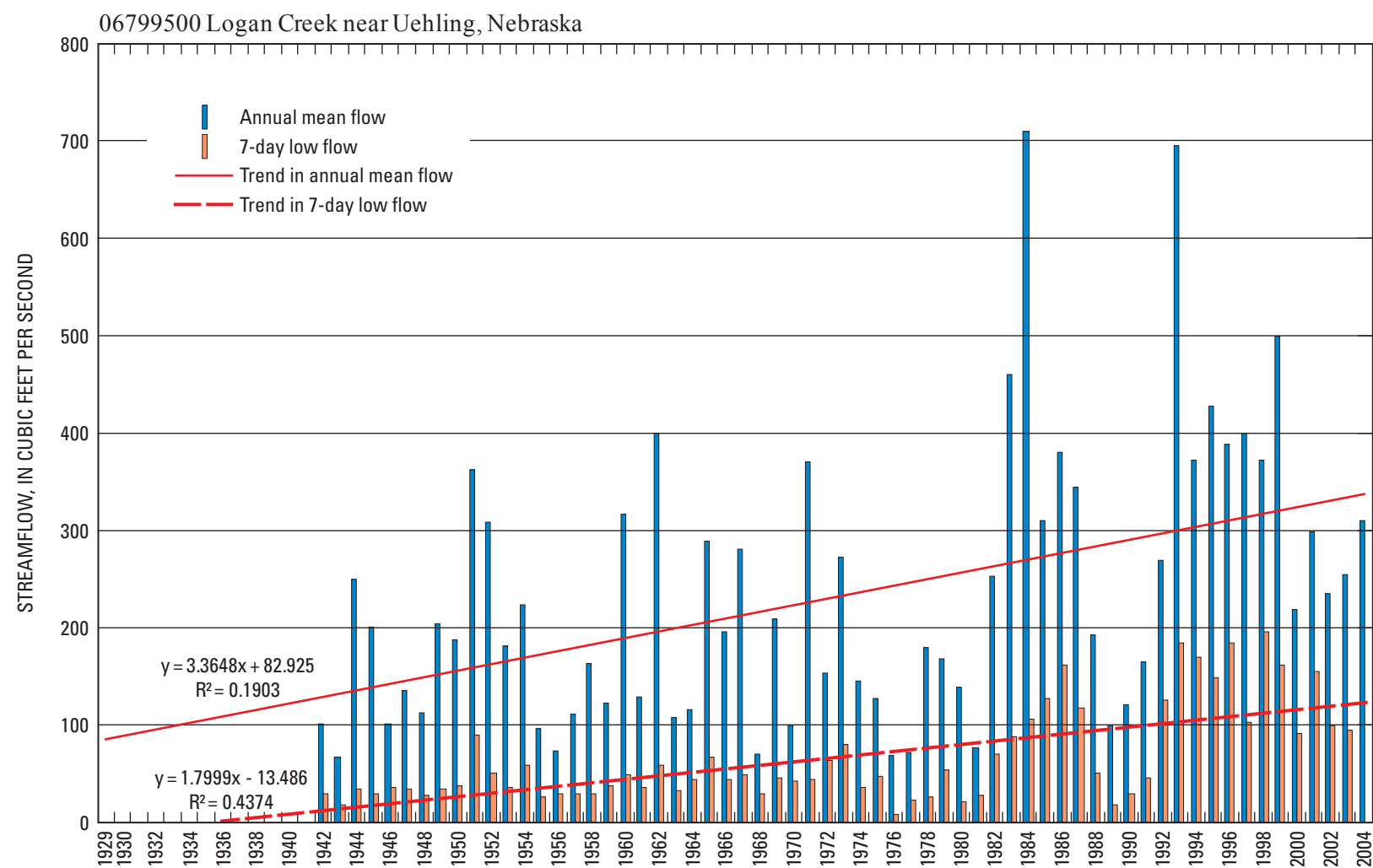


Figure 2-12. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Logan Creek near Uehling, Nebr.

Table 2–13. Trends in streamflow of Maple Creek near Nickerson, Nebraska (06800000).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1953–2004	0.229	0.016	0.9
November mean flow	1953–2004	.347	< .001	1.2
December mean flow	1953–2004	.342	< .001	1.0
January mean flow	1953–2004	.306	.001	.9
February mean flow	1953–2004	.173	.068	--
March mean flow	1953–2004	.165	.080	--
April mean flow	1953–2004	.241	.011	1.5
May mean flow	1953–2004	.261	.006	2.5
June mean flow	1953–2004	.118	.214	--
July mean flow	1953–2004	.231	.014	3.4
August mean flow	1953–2004	.198	.036	1.6
September mean flow	1953–2004	.258	.006	.9
Annual mean flow	1952–2003	.275	.004	1.2
Low flow				
1-day low flow	1953–2004	.345	< .001	.2
2-day low flow	1953–2004	.341	< .001	.2
3-day low flow	1953–2004	.334	< .001	.2
7-day low flow	1953–2004	.321	.001	.2
14-day low flow	1953–2004	.318	.001	.3
30-day low flow	1953–2004	.345	< .001	.4
60-day low flow	1953–2004	.360	< .001	.6
90-day low flow	1953–2004	.380	< .001	.6
183-day low flow	1953–2004	.311	.001	.7
1-day low flow (Oct–Nov)	1951–2003	.294	.002	.4
2-day low flow (Oct–Nov)	1951–2003	.292	.002	.4
3-day low flow (Oct–Nov)	1951–2003	.291	.002	.4
7-day low flow (Oct–Nov)	1951–2003	.279	.003	.4
14-day low flow (Oct–Nov)	1951–2003	.271	.004	.4
30-day low flow (Oct–Nov)	1951–2003	.274	.004	.5
60-day low flow (Oct–Nov)	1951–2003	.293	.002	1.7

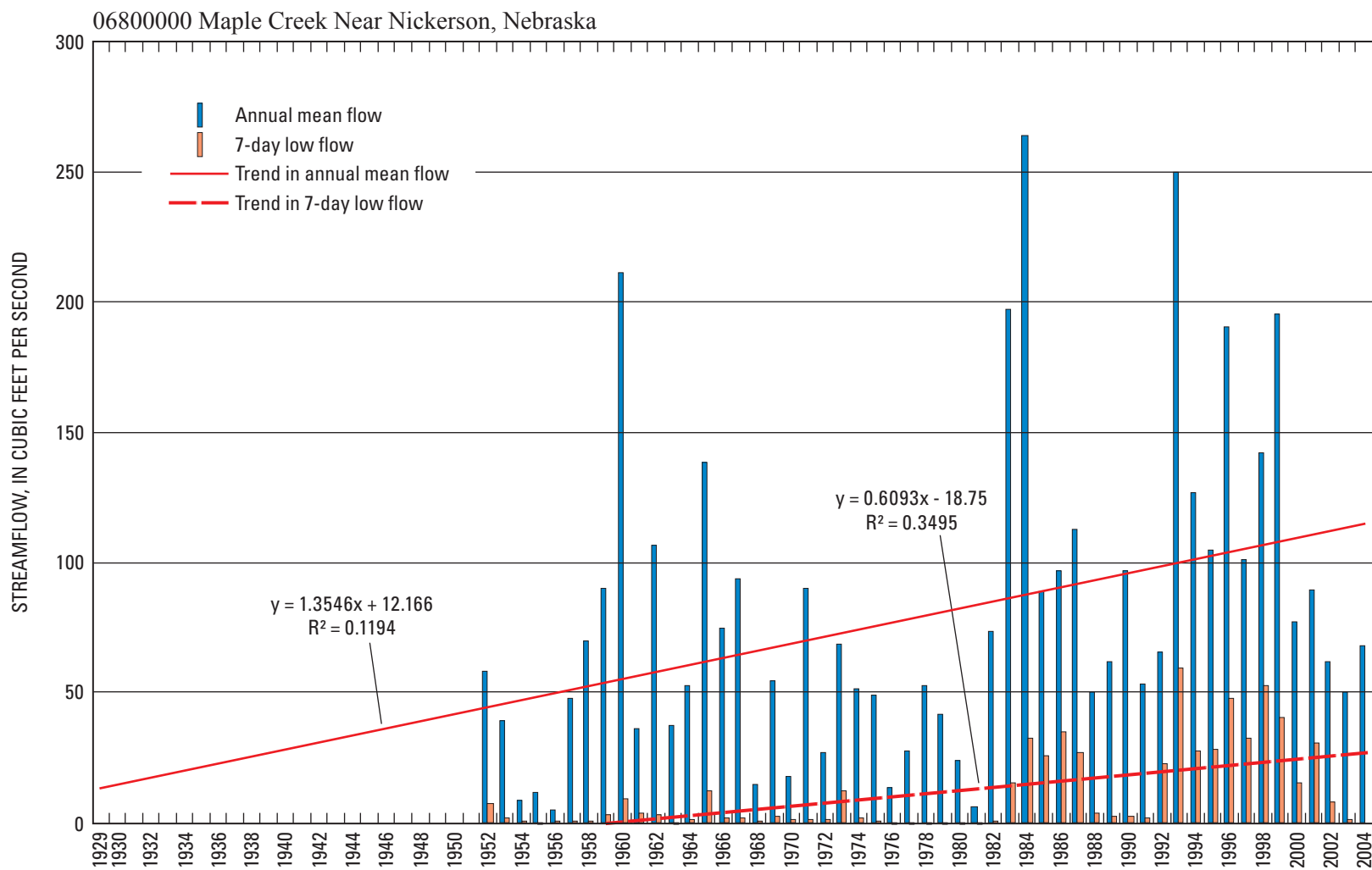


Figure 2-13. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Maple Creek Near Nickerson, Nebr.

Table 2–14. Trends in streamflow of Elkhorn River at Waterloo, Nebraska (06800500).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1929–2004	0.301	< 0.001	10
November mean flow	1929–2004	.392	< .001	11
December mean flow	1929–2004	.431	< .001	11
January mean flow	1929–2004	.397	< .001	9.3
February mean flow	1929–2004	.353	< .001	17
March mean flow	1929–2004	.204	.009	18
April mean flow	1929–2004	.315	< .001	29
May mean flow	1929–2004	.303	< .001	27
June mean flow	1929–2004	.196	.012	22
July mean flow	1928–2004	.256	.001	22
August mean flow	1929–2004	.180	.021	9.3
September mean flow	1929–2004	.201	.010	7.9
Annual mean flow	1928–2003	.341	< .001	15
Low flow				
1-day low flow	1929–2004	.383	< .001	4.1
2-day low flow	1929–2004	.385	< .001	4.3
3-day low flow	1929–2004	.381	< .001	4.4
7-day low flow	1929–2004	.355	< .001	4.8
14-day low flow	1929–2004	.361	< .001	5.4
30-day low flow	1929–2004	.363	< .001	6.0
60-day low flow	1929–2004	.380	< .001	6.6
90-day low flow	1929–2004	.398	< .001	7.1
183-day low flow	1929–2004	.393	.000	7.4
1-day low flow (Oct–Nov)	1927–2003	.381	< .001	5.6
2-day low flow (Oct–Nov)	1927–2003	.382	< .001	5.5
3-day low flow (Oct–Nov)	1927–2003	.376	< .001	5.5
7-day low flow (Oct–Nov)	1927–2003	.376	< .001	6.1
14-day low flow (Oct–Nov)	1927–2003	.352	< .001	6.3
30-day low flow (Oct–Nov)	1927–2003	.331	< .001	6.2
60-day low flow (Oct–Nov)	1927–2003	.358	< .001	7.8

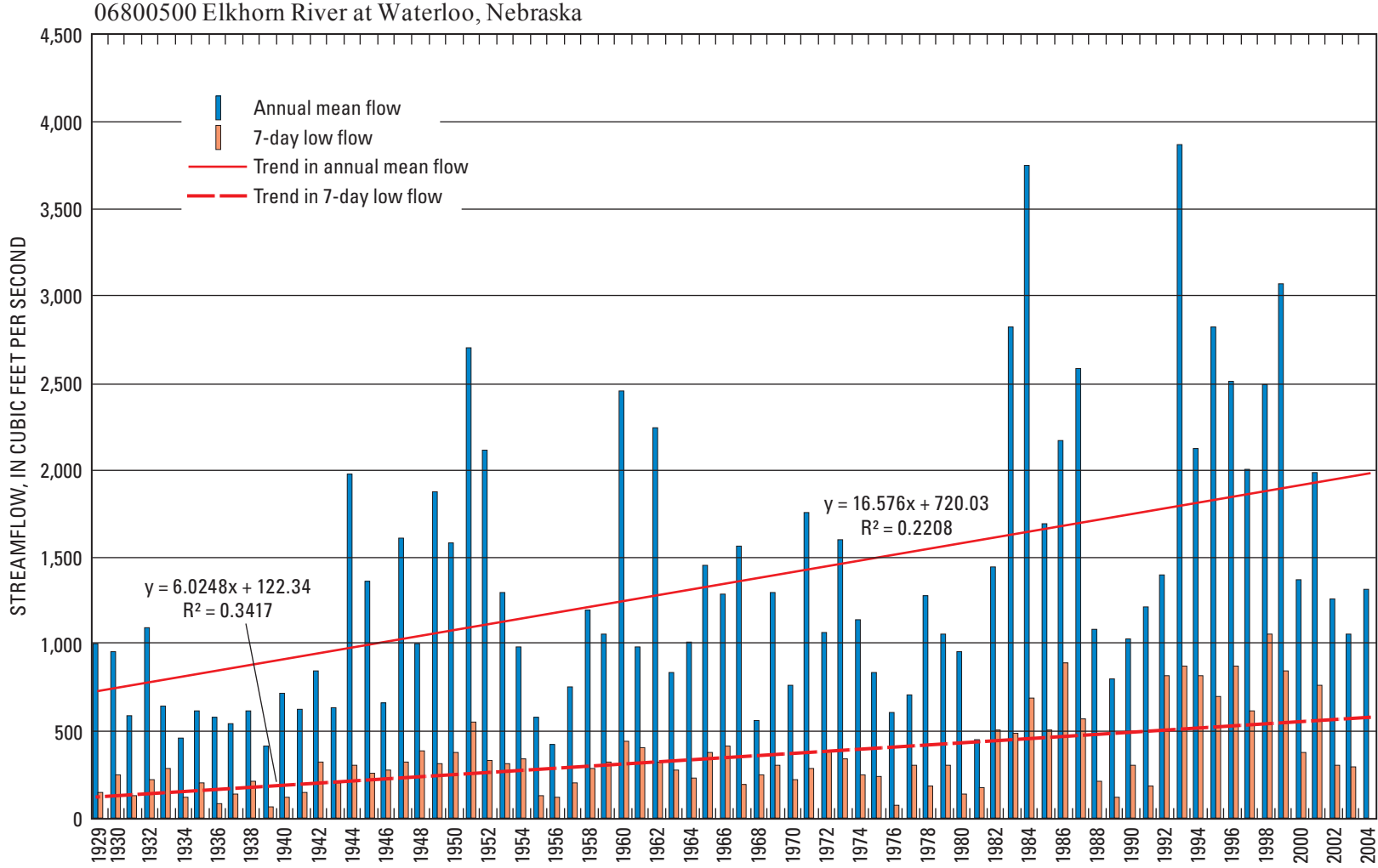


Figure 2-14. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Elkhorn River at Waterloo, Nebr.

Table 2–15. Trends in streamflow of Salt Creek at Greenwood, Nebraska (06803555).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p < 0.05)
Mean flow				
October mean flow	1953–2004	0.257	0.007	2.5
November mean flow	1953–2004	.472	< .001	3.4
December mean flow	1953–2004	.478	< .001	2.4
January mean flow	1953–2004	.380	< .001	1.9
February mean flow	1953–2004	.141	.137	--
March mean flow	1953–2004	.102	.283	--
April mean flow	1953–2004	.191	.044	3.0
May mean flow	1953–2004	.277	.003	11
June mean flow	1953–2004	.131	.165	--
July mean flow	1953–2004	.159	.093	--
August mean flow	1953–2004	.101	.286	--
September mean flow	1953–2004	.145	.125	--
Annual mean flow	1952–2003	.198	.039	2.9
Low flow				
1-day low flow	1953–2004	.560	< .001	1.7
2-day low flow	1953–2004	.541	< .001	1.7
3-day low flow	1953–2004	.526	< .001	1.7
7-day low flow	1953–2004	.498	< .001	1.7
14-day low flow	1953–2004	.488	< .001	1.7
30-day low flow	1953–2004	.480	< .001	2.0
60-day low flow	1953–2004	.495	< .001	2.0
90-day low flow	1953–2004	.498	< .001	2.0
183-day low flow	1953–2004	.419	.000	2.2
1-day low flow (Oct–Nov)	1951–2003	.449	< .001	1.5
2-day low flow (Oct–Nov)	1951–2003	.446	< .001	1.5
3-day low flow (Oct–Nov)	1951–2003	.435	< .001	1.5
7-day low flow (Oct–Nov)	1951–2003	.429	< .001	1.5
14-day low flow (Oct–Nov)	1951–2003	.428	< .001	1.7
30-day low flow (Oct–Nov)	1951–2003	.463	< .001	2.0
60-day low flow (Oct–Nov)	1951–2003	.391	< .001	2.6

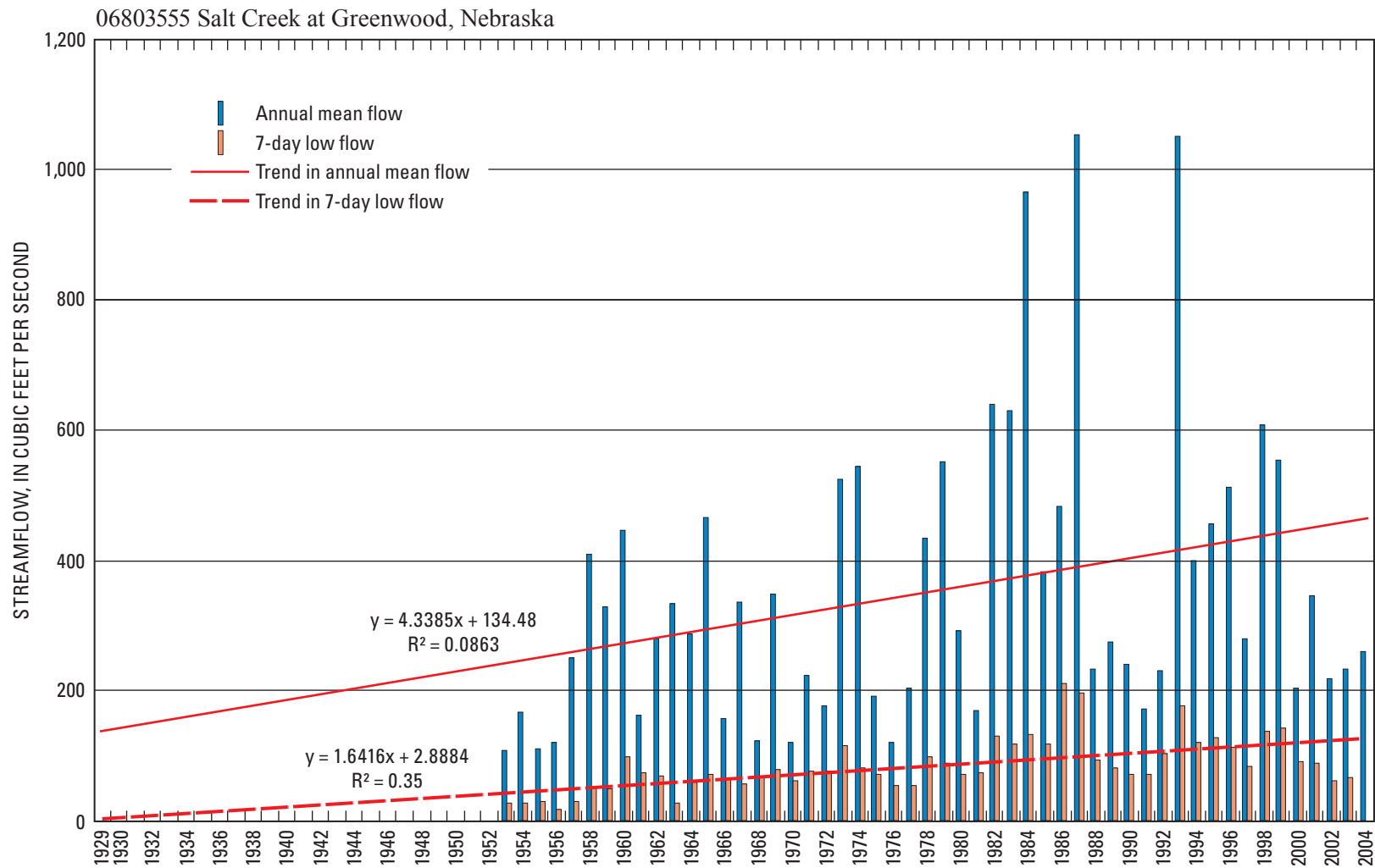


Figure 2–15. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Salt Creek at Greenwood, Nebr.

Table 2–16. Trends in streamflow of Wahoo Creek at Ashland, Nebraska (06804700).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1991–2005	-0.181	0.347	--
November mean flow	1991–2005	-.181	.347	--
December mean flow	1991–2005	-.210	.276	--
January mean flow	1991–2005	-.295	.125	--
February mean flow	1991–2005	-.086	.656	--
March mean flow	1991–2005	-.276	.151	--
April mean flow	1991–2005	-.181	.347	--
May mean flow	1991–2005	.067	.729	--
June mean flow	1991–2005	-.276	.151	--
July mean flow	1991–2005	-.581	.003	-28
August mean flow	1991–2005	-.276	.151	--
September mean flow	1991–2005	-.371	.054	--
Annual mean flow	1990–2004	-.333	.127	--
Low flow				
1-day low flow	1991–2005	-.090	.714	--
2-day low flow	1991–2005	-.090	.714	--
3-day low flow	1991–2005	-.090	.714	--
7-day low flow	1991–2005	-.103	.669	--
14-day low flow	1991–2005	-.103	.669	--
30-day low flow	1991–2005	-.154	.502	--
60-day low flow	1991–2005	-.179	.428	--
90-day low flow	1991–2005	-.179	.428	--
183-day low flow	1991–2005	-.282	.200	--
1-day low flow (Oct–Nov)	1989–2004	-.229	.254	--
2-day low flow (Oct–Nov)	1989–2004	-.219	.275	--
3-day low flow (Oct–Nov)	1989–2004	-.210	.298	--
7-day low flow (Oct–Nov)	1989–2004	-.200	.322	--
14-day low flow (Oct–Nov)	1989–2004	-.200	.322	--
30-day low flow (Oct–Nov)	1989–2004	-.257	.198	--
60-day low flow (Oct–Nov)	1989–2004	-.219	.276	--

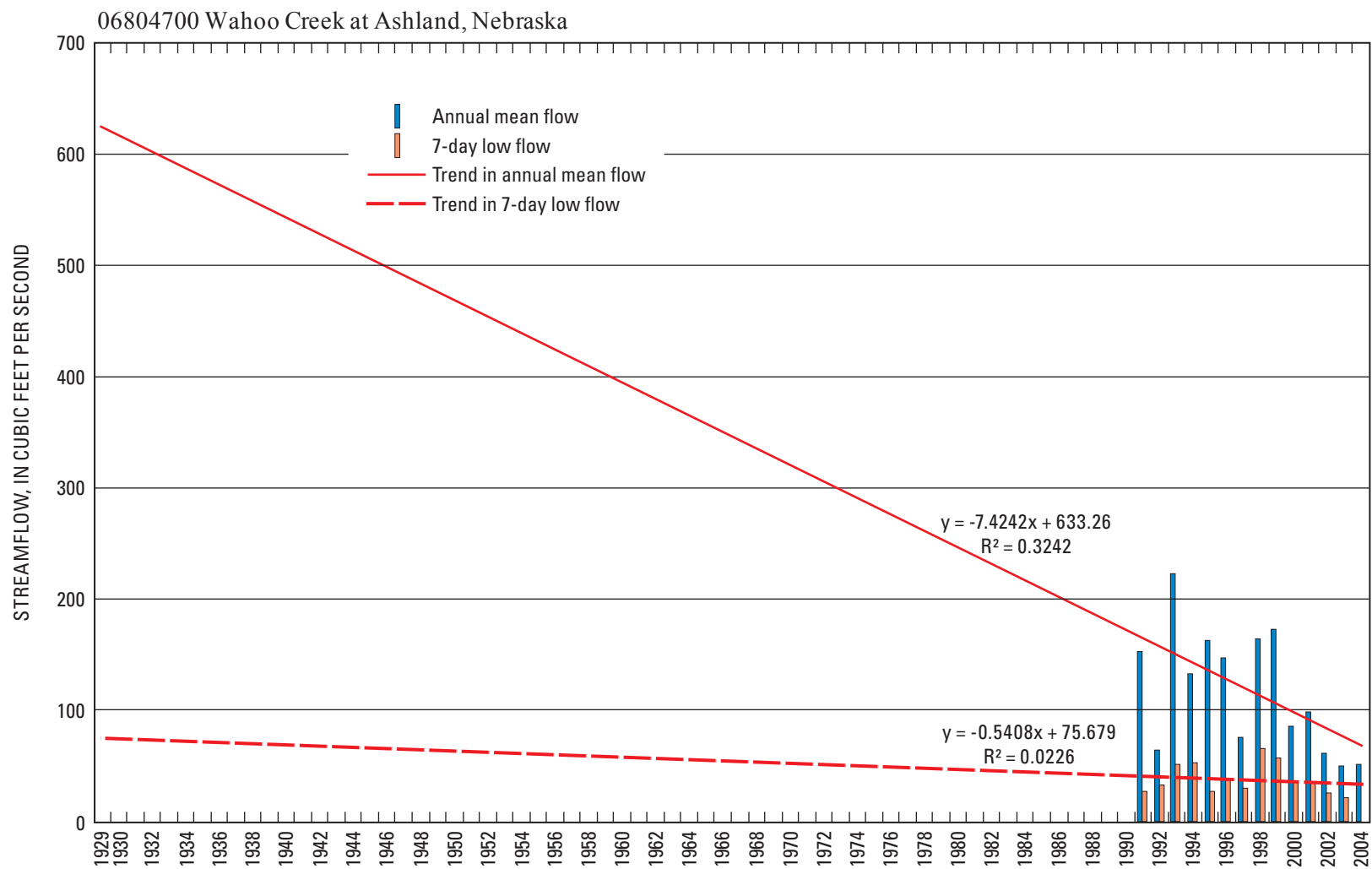


Figure 2-16. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Wahoo Creek at Ashland, Nebr.

Table 2–17. Trends in streamflow of Platte River at Louisville, Nebraska (06805500).

[period analyzed is given as water years; p-value quantifies the probability of the available evidence to conclude for a trend slope different from zero could have arisen when there was actually no temporal trend; ft³/s, cubic feet per second; <, less than; --, not significant]

Streamflow statistic	Period analyzed	Kendall's tau	p-value	Median slope of trend, in ft ³ /s per year (p< 0.05)
Mean flow				
October mean flow	1954–2004	0.229	0.016	63
November mean flow	1954–2004	.347	< .001	63
December mean flow	1954–2004	.342	< .001	66
January mean flow	1954–2004	.306	.001	68
February mean flow	1954–2004	.173	.068	--
March mean flow	1954–2004	.165	.080	--
April mean flow	1954–2004	.241	.011	72
May mean flow	1954–2004	.261	.006	100
June mean flow	1954–2004	.118	.214	--
July mean flow	1954–2004	.256	.001	96
August mean flow	1954–2004	.180	.021	57
September mean flow	1954–2004	.201	.010	56
Annual mean flow	1954–2004	.282	.004	70
Low flow				
1-day low flow	1954–2004	.344	< .001	24
2-day low flow	1954–2004	.354	< .001	27
3-day low flow	1954–2004	.334	.001	27
7-day low flow	1954–2004	.291	.003	28
14-day low flow	1954–2004	.252	.010	35
30-day low flow	1954–2004	.260	.008	45
60-day low flow	1954–2004	.267	.006	54
90-day low flow	1954–2004	.276	.005	57
183-day low flow	1954–2004	.314	.001	59
1-day low flow (Oct–Nov)	1952–2003	.357	< .001	53
2-day low flow (Oct–Nov)	1952–2003	.357	< .001	54
3-day low flow (Oct–Nov)	1952–2003	.351	< .001	55
7-day low flow (Oct–Nov)	1952–2003	.365	< .001	58
14-day low flow (Oct–Nov)	1952–2003	.322	.001	57
30-day low flow (Oct–Nov)	1952–2003	.311	.001	63
60-day low flow (Oct–Nov)	1952–2003	.315	.001	69

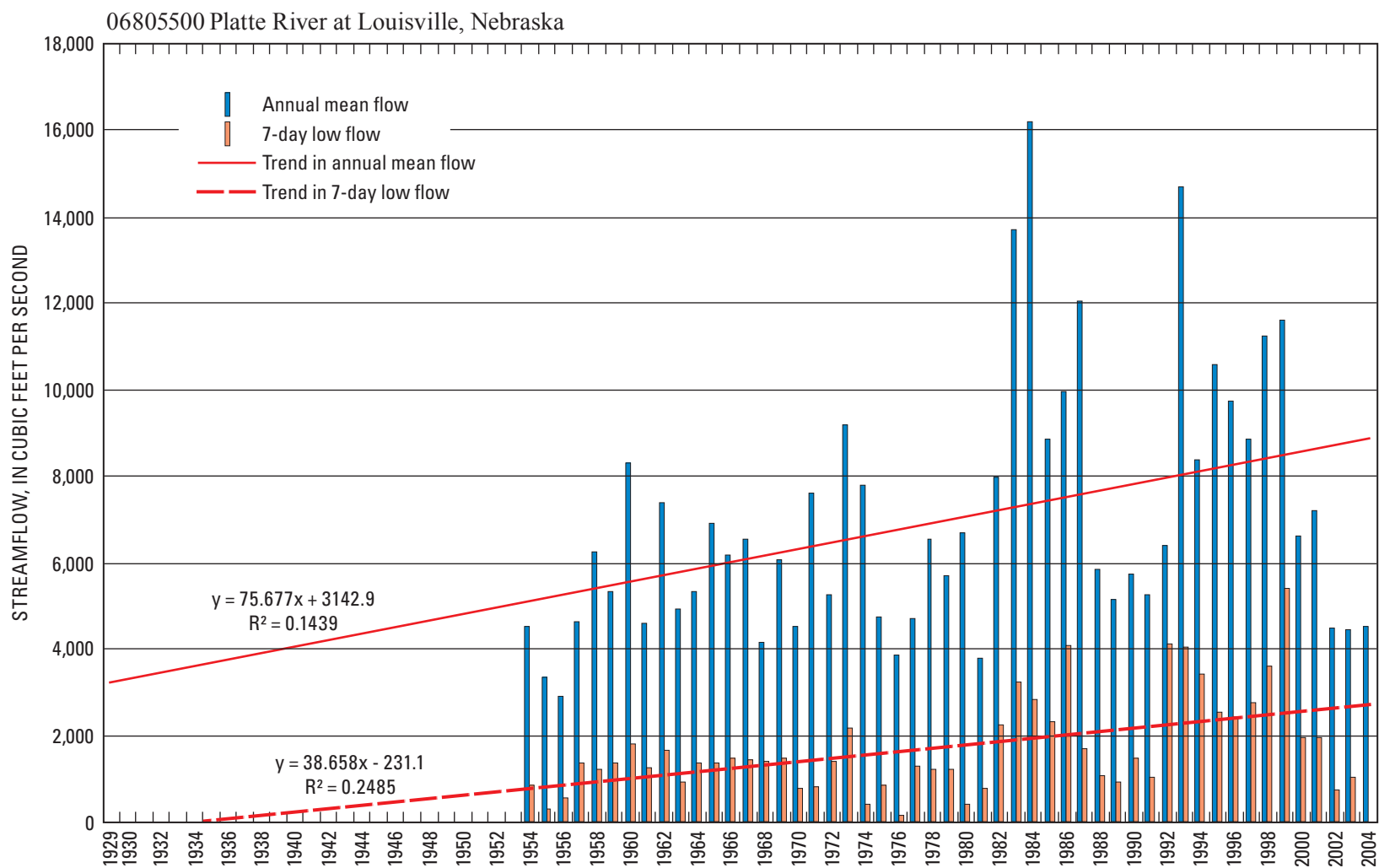


Figure 2-17. Annual mean flow, 7-day lowflow, trend in annual mean flow, and trend in 7-day low flow of Platte River at Louisville, Nebr.

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