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Temporal Differences in the Hydrologic Regime of the Lower Platte River, Nebraska, 1895–2006

Scientific Investigations Report 2007–5267

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

Front cover.—Photograph of the Platte River looking upstream toward the Lied Bridge from the observation tower at the Platte River State Park, May 26, 2003 (photograph taken by Ronald B. Zelt, U.S. Geological Survey, Lincoln, Nebraska).

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Flow fall/rise rate	
cubic foot per second per day [(ft^3/s)/day]	0.02832	cubic meter per second per day [(m^3/s)/day]

Water year is defined as the 12-month period October 1 through September 30.

The water year is designated by the calendar year in which it ends.

Acronyms

CIS	cumulative impact study
CV	coefficient of variation
HI	hydrologic index
HIP	hydroecological integrity assessment process
NCDC	National Climate Data Center
PCA	principal component analysis
PHDI	Palmer Hydrological Drought Index
USGS	U.S. Geological Survey

Temporal Differences in the Hydrologic Regime of the Lower Platte River, Nebraska, 1895–2006

By Daniel Ginting, Ronald B. Zelt, and Joshua I. Linard

Abstract

In cooperation with the Lower Platte South Natural Resources District for a collaborative study of the cumulative effects of water and channel management practices on stream and riparian ecology, the U.S. Geological Survey (USGS) compiled, analyzed, and summarized hydrologic information from long-term gaging stations on the lower Platte River to determine any significant temporal differences among six discrete periods during 1895-2006 and to interpret any significant changes in relation to changes in climatic conditions or other factors. A subset of 171 examined hydrologic indices (HIs) were selected for use as indices that (1) included most of the variance in the larger set of indices, (2) retained utility as indicators of the streamflow regime, and (3) provided information at spatial and temporal scale(s) that were most indicative of streamflow regime(s). The study included the most downstream station within the central Platte River segment that flowed to the confluence with the Loup River and all four active streamflow-gaging stations (2006) on the lower Platte River main stem extending from the confluence of the Loup River and Platte River to the confluence of the Platte River and Missouri River south of Omaha. The drainage areas of the five streamflow-gaging stations covered four (of eight) climate divisions in Nebraska—division 2 (north central), 3 (northeast), 5 (central), and 6 (east central).

Historical climate data and daily streamflow records from 1895 through 2006 at the five streamflow-gaging stations were divided into six 11-water-year periods: 1895–1905, 1934–44, 1951–61, 1966–76, 1985–95, and 1996–2006. Analysis of monthly climate variables—precipitation and Palmer Hydrological Drought Index—was used to determine the degree of hydroclimatic association between streamflow and climate. Except for the 1895–1905 period, data gaps in the streamflow record were filled by data estimation techniques, and 171 hydrologic indices were calculated using the Hydroecological Integrity Assessment Process software developed by the U.S. Geological Survey. A subset of 27 nonredundant indices (of the 171 indices) was selected using principal component analysis. Indices that described monthly streamflow—mean, maximum, minimum, skewness, and coefficients of variation—also were used. Comparison of these selected indices allowed determination of temporal differences among the six 11-water-year periods for each gaging station.

The lower Platte River basin was affected by moderate to severe drought conditions in the 1934–44 period. The widespread drought was preceded by mildly to moderately wet conditions in the 1895–1906 period, followed by incipient drought to incipiently wet conditions in the 1951–61 periods and mildly wet conditions in 1966–76 period, moderately wet conditions in the 1985–1995 period, and incipient drought to mildly wet conditions in the 1996–2006 period. Monthly streamflow of the Platte River from Duncan through Louisville, Nebraska, correlated significantly with the monthly Palmer Hydrological Drought Index. Temporal differences in median values of monthly-mean and monthly-maximum streamflow measured at Duncan, North Bend, and Ashland stations between the two moderately wet periods (1895–1905 and 1985–95) indicated that streamflow storage reservoirs and regulation some time after 1906 significantly reduced monthly streamflow magnitude and amplitude—the difference between the highest and lowest median values of monthly mean streamflow. Effects of storage reservoirs on the median values of monthly-minimum streamflow were less obvious. Temporal differences among the other five periods, from 1934 through 2006 when streamflow was affected by storage and regulation, indicated the predominant effects of contrasting climate conditions on median values of monthly mean, maximum, and minimum streamflow. Significant temporal differences in monthly streamflow values were evident mainly between the two periods of greatly contrasting climate conditions: the monthly flows in the 1934–44 drought period were significantly lower than those in the 1985–96 moderately wet period.

The monthly coefficients of skewness and variation of streamflow, and the counts of nonredundant indices showing temporal differences among the periods, together pointed to difference in streamflow regimes between the central Platte River system and the lower Platte River system. Seven out of 13 indices of the discharge from the central Platte River system at Duncan station that demonstrated potential temporal differences were indices of streamflow variability; five of nine indices for two or more of the lower Platte River stations that showed potential temporal differences were indices of streamflow variability. The nonredundant indices of the streamflow regime from the central Platte River system computed for Duncan station during the 1934–44 and 1951–61 periods had

potential differences from the other periods, that is, the largest variability in base flow and monthly minimum streamflow values, highest frequency of low-flow pulses, lowest flood frequency, largest number and least variability of zero-flow days, and largest variability of the daily and monthly flows.

Nonredundant indices for the lower Platte River that demonstrated potential temporal differences at two or more stations were: high-peak streamflow, variability in low-flood pulse count, variability in high-flow pulse count, flood frequency, annual minimum daily streamflow, variability in low-flow pulse duration, variability of annual maximum of 1-day moving average streamflow, variability of annual maximum of 3-day moving average streamflow, and number of streamflow fluctuations. The variability in low-flood pulse count and variability in high-flow pulse count were generally highest in the 1996–2006 period because this period was a mixture of five wet years (1996–2000) and six drought years. The number of streamflow fluctuations was higher in the 1966–76, 1985–95, and 1996–2006 periods than those in the 1934–44 and 1951–61 periods for the North Bend and Leshara stations, which was associated with climate and increasing water regulation and management.

Introduction

Physical processes that control the streamflow regime and channel characteristics govern the distribution of habitat availability and quality for fish (Moir and others, 1998), and similarly may affect nesting habitat for shore birds (Dinan and others, 1993). Fish and other aquatic organisms in lotic water bodies are subjected to a wide range of streamflow, and the spatially and temporally dynamic nature of current hydraulics and micro-scale velocity patterns that arise from the interaction between streamflow and channel form (Stalnaker and others, 1996). Supply, delivery, and quality of both runoff and sediment affect aquatic habitat through the influences of channel gradient and streamflow (McKenney, 1997; Moir and others, 1998) and through influences of bed substrate characteristics, hydraulic obstructions, and turbulent vortices (McKenney, 1997; Fitzpatrick and others, 1998); therefore, even moderate changes in streamflow regime can produce large shifts in available habitat (Nebraska Game and Parks Commission, 1993; Stalnaker and others, 1996; McKenney, 1997). Pallid sturgeon, which prefers turbid main-channel habitats, has experienced population declines linked to alterations in the natural flow regimes of its native rivers (Dryer and Sandvol, 1993).

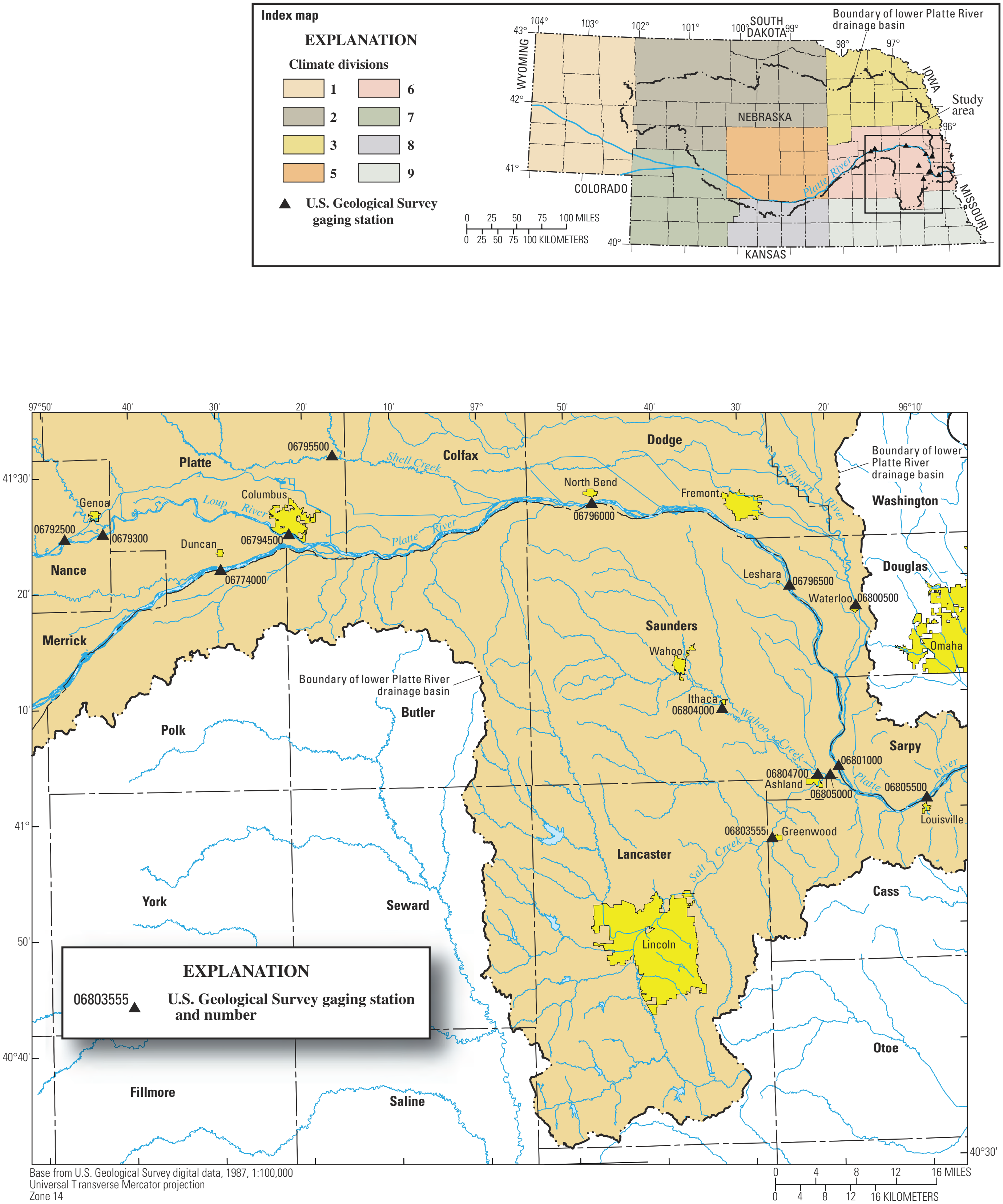
The lower Platte River ecosystem provides riverine habitat for forage, reproduction, or living space of resident and migratory fish and wildlife species including state- and federally listed endangered species, that is, pallid sturgeon, piping plover, interior least tern, and river otter (Nebraska Game and Parks Commission, 1993; U.S. Fish and Wildlife Service 1990, 1994). Considering the importance of the lower Platte River ecosystem, a cumulative impact study (CIS) for the lower Platte River was deemed necessary. A CIS consortium was formed to include both federal (U.S. Geological Survey, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service) and Nebraska institutions (Lower Platte River Corridor Alliance, Nebraska Environmental Trust, Nebraska Game and Parks Commission, Nebraska Department of Natural Resources, Nebraska Department of Roads, three Natural Resources Districts, and the University of Nebraska-Lincoln). The goal of the consortium was to analyze past, present, and future changes in infrastructure, land use, river management, and hydrology to understand how each of these general factors is interrelated to the river, its floodplain, and the bluff-to-bluff corridor. As part of this consortium, the U.S. Geological Survey (USGS) compiled, analyzed, and summarized hydrologic information from long-term gaging stations on the lower Platte River to determine any significant temporal differences among targeted time periods and to interpret any significant changes in relation to changes in climatic conditions or other factors.

Hydrologic indices that are ecologically and biologically relevant are needed to address the temporal changes in hydrologic conditions (National Research Council, 2005). Therefore, researchers have developed and examined a large number of hydrologic indices to describe various characteristics of streamflow that are biologically relevant. Olden and Poff (2003) examined 171 hydrologic indices (HIs) simultaneously to select a list of highly informative and nonredundant indices for six different types of streams. These indices can be used to make quantitative comparisons among segments of the same river or to track changes in the condition of rivers over time in response to regulatory programs, management practices, or climate variations (National Research Council, 2005).

Purpose and Scope

The purpose of this report is to present the temporal differences in hydrologic indices for the lower Platte River, Nebraska, for six discrete periods from 1895 through 2006. A subset of 171 examined HIs were selected for use as indices that (1) included most of the variance in the larger set of indices, (2) retained utility as indicators of the streamflow regime, and (3) provided information at the spatial and temporal scale(s) that were most indicative of streamflow regime(s). Hydrologic indices examined in this study included the five major categories of the flow regime—magnitude, duration, frequency, timing, and rate of change (Poff and Ward, 1989; Poff and others, 1997).

The lower Platte River is defined as the segment extending from the confluence of the Loup River and Platte River to the confluence of the Platte River and Missouri River south of Omaha, Nebraska (fig. 1), which receives streamflow primarily from four (of eight) climate divisions in Nebraska (National Climatic Data Center, 2007). The scope of this report included all four active (2006) lower Platte River mainstem stations and also the most downstream station within



Base from U.S. Geological Survey digital data, 1987, 1:100,000
Universal Transverse Mercator projection
Zone 14

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

Figure 1. Location of study area and gaging stations on the Platte River and contributing tributaries, Nebraska.

the central Platte River segment that flowed to the confluence with the Loup River where streamflow was seasonally gaged for more than 10 water years from 1895 to 2006. That downstream station on the central Platte River was near Columbus, Nebraska, during the early part of the study period, but in 1928 was relocated to its current site (2006) near Duncan, Nebraska. The six discrete time periods selected for the study corresponded to the dates selected for companion studies within the larger CIS that were dependent upon detailed mapping efforts based on available aerial photography collections or detailed historical maps.

Data and Methodology

Daily streamflow for the lower Platte River main stem and major tributaries (fig. 1) and monthly climatic data from 1895 through 2006 were divided into six discrete 11-water-year periods: 1895–1905, 1934–44, 1951–61, 1966–76, 1985–95, and 1996–2006. Gaging stations of interest on the Platte River main stem and tributaries are listed in tables 1 and 2.

Streamflow Data

Data (table 1) indicate three possible levels of record availability at each station and period: complete, partial, or no record. The term “partial” refers to unavailable discharge data (record gap) for part of the period. The term “no record” refers to unavailable discharge data for the entire period. Estimated data use records from one or more stations (index stations) to fill the record gap at other gaging station(s). Index stations are station(s) on the Platte River or contributing tributaries (table 2) that have complete records for the period of the record gap.

Period 1895–1905

Daily streamflow data for the period 1895–1905 were located in USGS reports (Stevens, 1909; U.S. Geological Survey, 1958) and transferred into electronic format for analysis. Daily streamflow data in this period were sparse and available only for the Duncan station on the Platte River main stem and for two tributaries—Loup River and Elkhorn River. Daily streamflows at the North Bend station were estimated as the sum of concurrent daily streamflows of two stations—the Platte River near Duncan and the Loup River at Columbus. Daily streamflows of the lower Platte River near Ashland were estimated as the sum of concurrent streamflows at the three stations—Platte River near Duncan, Loup River at Columbus, and Elkhorn River at Waterloo. Because daily streamflow data for other contributing tributaries were not available, daily streamflow at the North Bend and Ashland stations were probably underestimated for this period. Because no streamflow records for this period were known for tributaries downstream from the Elkhorn River, no estimation of daily streamflow was made for Platte River stations near Leshara and at Louisville. Because of sparse concurrent streamflow data among stations along the main stem and tributaries, no estimation of daily streamflow by linear regression or numerical modeling was attempted for this period.

Period 1934–2006

Daily streamflow records at five gaging stations on the Platte River were acquired from the National Water Information System (U.S. Geological Survey, 2007) for these periods: 1934–44, 1951–61, 1966–76, 1985–95, and 1996–2006. Estimated data were required to fill the record gap at gaging stations for periods with a “partial” or “no record” availability in table 1.

Estimation of Missing Daily Streamflow Data

Two estimation techniques were applied for missing daily streamflow data, depending on record availability of the index stations. The first technique was based on routing streamflow from upstream stations with DAFLOW (Jobson, 1989), a physically based numerical model. The second technique was based on a statistical approach. Using either technique, a quality assurance standard of data estimation was set to meet a preset condition. The condition was that for each 11-year period, the mean of estimated monthly streamflow of a station is not less than 100 cubic feet per second (ft^3/s) of the mean monthly flow at the next upstream station and not more than 100 ft^3/s of the mean monthly flow of the next downstream station.

DAFLOW Simulation

Physically based routing is useful to predict streamflow for stations when no data are available from two or more consecutive stations within the same period. Discharges at one or more stations on the main-stem channel can be estimated simultaneously. Because DAFLOW is a routing model, the index stations have to be located upstream from the station(s) to be estimated. Streamflow data available at other downstream station(s) for the same period of interest are used to calibrate and validate the model.

Because contributions of ground-water flow and other ungaged areas are not considered in DAFLOW, the model often underestimated the streamflow at downstream stations and did not meet the requirement of quality assurance for estimated values. Therefore, the DAFLOW modeling technique was used only for the two consecutive stations, North Bend and Leshara, that had no available record in the 1934–44 period because simulation estimates were better than those from the statistical approach. A second technique was applied for the other periods and stations, by using a combination of linear regression and routing factors, referred to as the “statistical approach.”

Table 1. Completeness of available records of daily streamflow at selected gaging stations on the Platte River, Nebraska.

[C, central Platte River system; L, lower Platte River system]

Station name and number	Period of record	1895–1905	1934–44	1951–61	1966–76	1985–95	1996–2006
Duncan (C) 06774000	May 3, 1895–September 30, 2006	Partial (missing 273 days in 1895, 245 days in 1896, 229 days in 1897, 276 days in 1898, 212 days in 1899, 233 days in 1900, 236 days in 1901, 134 days in 1902, 104 days in 1903, 186 days in 1904, 110 days in 1905)	Complete	Complete	Complete	Complete	Complete
North Bend (L) 06796000	April 4, 1949–September 30, 2006	No record	No record	Complete	Complete	Complete	Complete
Leshara (L) 06796500	June 6, 1994–September 30, 2006	No record	No record	No record	No record	No record	Complete
Ashland (L) 06801000	September 1, 1928–September 30, 2006	No record	Complete	Partial (missing all days in 1961)	No record	Partial (missing all days from 1985 to 1987, and 295 days in 1988)	Complete
Louisville (L) 06805500	June 1, 1953–September 30, 2006	No record	No record	Partial (missing all days in 1951, 1952, and 245 days in 1953)	Complete	Complete	Complete

Table 2. Completeness of available records of daily streamflow at selected gaging stations on the tributaries of the lower Platte River, Nebraska.

Station name and number	Period of record	1895–1905	1934–1944	1951–1961	1966–1976	1985–1995	1996–2006
Loup River near Genoa 06793000	April 1, 1929–September 30, 2006	No record	Partial (missing all days from 1934 to 1942 and 30 days in 1943)	Complete	Complete	Complete	Complete
Loup River at Columbus 06794500	May 3, 1895–October 10, 1978	Partial (missing 270 days in 1895, 245 days in 1896, 215 days in 1897, 261 days in 1898, 212 days in 1899, 151 days in 1900, 214 days in 1901, 134 days in 1902, 104 days in 1903, 189 days in 1904, 110 days in 1905)	Partial (missing 182 days in 1934)	Complete	Complete	No record	No record
Loup River Power Canal near Genoa 06792500	January1, 1937–September 30, 2006	No record	Partial (missing all days from 1934 to 1936, and 92 days in 1937)	Complete	Complete	Complete	Complete
Shell Creek near Columbus 06795500	September 1, 1947–September 30, 2006	No record	No record	Complete	Partial (missing all days in 1976)	Complete	Complete
Elkhorn River at Waterloo 06800500	April 28, 1899–September 30, 2006	Partial (missing all days from 1895 through 1898, 227 days in 1899, 151 days in 1900, 127 days in 1901, 100 days in 1902, 116 days in 1903, 314 days in 1904, 364 days in 1905)	Complete	Complete	Complete	Complete	Complete
Salt Creek at Greenwood 06803555	November 1, 1951–September 30, 2006	No record	No record	Partial (missing all days in 1951 and 33 days in 1952	Complete	Complete	Complete
Wahoo Creek near Ithaca 06804000	October 10, 1949–September 30, 2006	No record	No record	Complete	Complete	Complete	Complete
Salt Creek near Ashland 06805000	October 1, 1947–September 30, 1969	No record	No record	Complete	Partial (missing all days from 1970 to 1976)	No record	No record

Statistical Approach

The statistical approach required a specific statistical model for each station and period of interest. Also the index stations used were the next stations upstream or next downstream from the station to be estimated, assuming that the closest location likely provided relatively similar physical settings and the least stream travel time between the stations.

A linear relation in streamflow between the index station(s) and the station to be predicted was assumed in the statistical approach. Because streamflow data were highly skewed, the linear relation was developed using a logarithmic transformation. The simple routing component embedded in the statistical technique assumed a time lag between index stations and stations to be estimated, depending on the distance and streamflow. Because streamflow velocity was not known, the time lag was assumed to be represented by weighting factors. For example, streamflow of Platte River at Louisville station (to be estimated) was the sum of flow of Platte River at Ashland and two tributaries, Wahoo Creek near Ithaca and Salt Creek at Greenwood (fig. 1). The relation was represented as:

$$Q_{Lou}(t)= [a*Q_{Ash}(t-1)+b*Q_{Ash}(t)] + [c*Q_{Ith}(t-1)+d*Q_{Ith}(t)] + [e*Q_{Gw}(t-1)+f*Q_{Gw}(t)], \quad (1)$$

where Q was daily mean flow (ft^3/s) and (t) was day t. Lou, Ash, Ith, and Gw were gaging stations at or near Louisville, Ashland, Ithaca, and Greenwood, respectively. Ground-water inflow was unknown, but that quantity was included implicitly within the regression parameters. The a, b, c, d, e, and f were time-lag weighted coefficients, where a + b = 1, c + d = 1, and e + f = 1. Although a, b, c, d, e, and f were unknown, the values were derived iteratively to maximize the coefficient of determination (R^2) of a linear regression.

The simple linear regression was constructed using the concurrent records between index station(s) and the station to be predicted. As for the example case given (Louisville), concurrent data were used to fit with the regression model:

$$Log(Y)=A*Log(X), \quad (2)$$

where Y is $Q_{Lou}(t) + 1$, and

$$X= [a*Q_{Ash}(t-1)+b*Q_{Ash}(t)] + [c*Q_{Ith}(t-1)+d*Q_{Ith}(t)] + [e*Q_{Gw}(t-1)+f*Q_{Gw}(t)] +1.$$

Clearly Y and X had to be larger than zero, so the constant was added to each equation to prevent logarithm of a zero streamflow. Estimates of missing daily streamflow for a station were computed by entering known concurrent daily streamflow for the index stations. Because the regression equations were fit using log-transformed values, predicted streamflow estimates were derived by exponentiating the model-predicted values back into the original units and subtracting the constant.

Climate Data and Association with Streamflow Gages

Platte River basins draining to the main-stem gages were located within four Nebraska climate divisions, that is, divisions 2, 3, 5, and 6 (fig. 1). North Bend gaging station measured streamflow originating from the central Platte and from the Loup Rivers and Shell Creek, which were within Nebraska climate divisions 2 and 5. Leshara gaging station measured streamflow from basins within climate divisions 2, 5, and 6. Ashland and Louisville gaging stations measured streamflow from basins within climate divisions 2, 3, 5, and 6.

Monthly precipitation and Palmer Hydrological Drought Index (PHDI) data for climate divisions were obtained from the National Climatic Data Center (National Climatic Data Center, 2007). The PHDI indicated the severity of a dry or wet spell, and is based on the principles of a balance between moisture supply and demand to assess long-term moisture supply. The index generally ranged from -6 to +6, with negative values indicating dry spells, and positive values indicating wet spells. The PHDI was classified (National Climatic Data Center, 2007) as follows: 0 to -0.5 = normal; -0.5 to -1.0 = incipient drought; -1.0 to - 2.0 = mild drought; -2.0 to -3.0 = moderate drought; -3.0 to -4.0 = severe drought; and less than -4.0 = extreme drought. These adjectives also were attached to corresponding ranges of positive values for wet spells. Man-made changes such as increased irrigation, new reservoirs, and added industrial water use were not considered by the National Climatic Data Center in the computation of the PHDI.

Selection of Nonredundant Hydrologic Indices

Daily-mean and annual-peak streamflow data for each station-period combination were formatted to meet the input requirement of the Hydroecological Integrity Assessment Process (HIP) software (Henriksen and others, 2006). A total of 171 HIs were calculated with the HIP software for each station-period combination, except for the 1895–1905 period because of sparse streamflow data.

To aid in description, the 171 indices were grouped into five major categories following Richter and others (1996) and Poff and others (1997). The major categories were indices of magnitude, frequency, duration, timing, and rate of change. Magnitude indices were subsequently divided into three types of streamflow conditions—average, low, and high. Frequency and duration indices were subsequently divided into low- and high-flow conditions. This classification produced a total of nine subcategories of hydrologic indices that described different facets of the streamflow regime. Each hydrologic index had a definition and alphanumeric code (table 3). The first letter of the alphanumeric code referred to the first letter of the major category of the streamflow regime (*M,* magnitude;

F, frequency; *D,* duration; *T,* timing; *R,* rate of change). The second letter of the alphanumeric code referred to the types of flow condition (*A*, average; *L*, low; *H*, high). Indices were numbered successively within each category. For example, MA12 and MA23 were the 12th and the 23th indices within the magnitude category of average streamflow condition for January and December, respectively; ML1 and ML12 were the first and the 12th indices within the magnitude category of low-flow condition for January and December, respectively; the MH1 and MH12 were the first and the 12th indices within the magnitude category of the high-flow condition for January and December, respectively (table 3).

The calculated values of the 171 HIs for all station-period combinations were then combined into a single file in a format suitable for selection of nonredundant indices using the PRINCOMP procedure of SAS (SAS Institute Inc., 1989). The PRINCOMP procedure performed the principal component analysis (PCA) on the correlation matrix of the 171 HIs. Contribution of variance (eigenvalues) among the principal components was used to determine significant principal components. Analysis indicated that the first four principal components (I, II, III, and IV) explained 90 percent of the total variance. Groups of indices that exhibit the largest absolute loadings (eigenvectors) on the four principal component axes were identified as described in detail by Olden and Poff (2003). In brief, the selection of HIs for each of the nine subcategories of the streamflow regime was based on the largest absolute loading in each significant principal component. For example in this study, the PCA resulted in four principal components that described most of the variability. Because there are four significant principal components, four indices were selected for each of the nine subcategories of the flow regime. Each selected index had the largest loading on one principal component among all the indices within the same subcategory. The selection process would result in a maximum of 36 indices, which were relatively independent of each other and so-called nonredundant indices.

Several additional indices of streamflow magnitude that add clarity to the interpretation of nonredundant indices were computed using the UNIVARIATE procedure of SAS (SAS Institute Inc., 1989) and added to the selected set. These are the median of the monthly mean, maximum, minimum, skewness and coefficient of variation of streamflow. Definitions for the monthly streamflow indices are listed in table 3.

Because daily streamflow records were sparse in the 1895–1905 period, only the monthly streamflow indices were computed using the UNIVARIATE procedure of SAS (SAS Institute Inc., 1989). Only the months that had 15 or more daily streamflow values were eligible for calculation of monthly mean flow. A minimum of 3 years of each eligible month was required for the calculation of the monthly streamflow indices. Because of these two data restrictions, HIs of monthly streamflow magnitude were not available for certain months for the 1895–1905 period. No nonredundant hydrologic indices were computed for this period because insufficient data were available for use of the HIP software.

Statistical Analysis and Tests

Monthly streamflow indices and nonredundant HIs were compared among targeted periods using statistical tests to determine the significance of differences among those periods for each streamflow-gaging station. Existence of significant differences among periods may indicate occurrence and the period of occurrence of natural and/or anthropogenic alterations of the streamflow regime. The data flow from data preparation through temporal comparison among the 11-water-year periods is summarized in fig. 2.

Two-Sided Nonparametric Prediction Interval for Indices

Nonparametric prediction interval (PI) with confidence level alpha (α) is simply the interval between the $\alpha/2$ and 1-$\alpha/2$ percentiles of the distribution (Helsel and Hirsch, 1992), that is

$$PI = X_{\alpha/2\bullet(n+1)} \quad to \quad X_{[1-(\alpha/2)]\bullet(n+1)} \tag{3}$$

where n was number of observations. The PI is bounded by the values of the observations with ranks of $\alpha/2\bullet n$ and $(1-\alpha/2)\bullet n$, respectively. When the rank was not an integer, then the value of the rank was interpolated from the values of the two nearest integer ranks. Each 11-water-year period in this study contains 11 annual values for summary by each monthly or nonredundant index, which resulted in n=11 for most indices. The small size of n=11 was only sufficient to allow reliable percentile computations for the 25th and 75th percentiles or α=0.50. Following Jordan (1991), the minimum number of n=10 was required for the 25th, 50th, and 75th percentile computations.

Comparison of Nonredundant Hydrologic Indices

Because the HIP software reported the 25th and 75th percentiles of most of the indices but did not report the values (usually annual) from which the percentiles were derived, conclusive nonparametric statistical tests of differences among periods could not be attempted. Instead, only qualitative comparisons based on the lower- and upper-interquartile values are reported. Interquartile ranges of an index that overlapped for two station-period combinations were assumed to have come from the same distribution, and conversely. Therefore, if the two interquartile ranges did not overlap, the two periods potentially differed.

The HIP software did not or could not compute the quartile values for some of the nonredundant indices (for example because of lack of peak-flow data) and thus interquartile-range comparison was not possible. For these indices, qualitative comparisons among the time periods at a station sometimes

Table 3. Definition and alphanumeric code of the monthly streamflow indices and the nonredundant hydrologic indices for the Platte River from Duncan through Louisville, Nebraska (modified from Henriksen and others, 2006).

[ft^3/s, cubic feet per second]

Code	Definition
MA12 to MA23	Median of monthly mean streamflow for each month. Using the daily mean streamflow, monthly mean streamflow was computed for each month in each year in the period. The median of monthly mean streamflow was the 50th percentile of the monthly mean streamflow values for each month across all years in the period. For example, the MA12 for the 1934–44 period was the median of 11 monthly mean streamflow values for January in the period.
MA24 to MA35	Median of variability of monthly streamflow for each month. The standard deviation, the mean, and the coefficient of variation (CV=standard deviation divided by the mean) was computed for each month in each year in the period. The median of variability of monthly streamflow values was the 50th percentile of monthly CV values for each month across all years in the period. For example, the MA24 for the 1934–44 period was the median of 11 monthly CV values for January in the period.
ML1 to ML12	Median of monthly minimum streamflow for each month. Using the daily mean streamflow, the monthly minimum streamflow was computed for each month in each year in the period. The median of minimum streamflow for each month was the 50th percentile of the monthly minimum values across all years in the period. For example, the ML1 for the 1934–44 period was the median of 11 minimum-streamflow values for January in the period.
MH1 to MH12	Median of monthly maximum streamflow for each month. Using the daily mean streamflow, the monthly maximum streamflow was computed for each month in each year in the period. The median of maximum streamflow for each month was the 50th percentile of monthly maximum values across all years in the period. For example, the MH1 for the 1934–44 period was the median of 11 maximum-streamflow values for January in the period.
MA43	Variability across annual discharge. The MA43 was derived by computing the first (25th percentile) and third (75th percentile) quartiles for the 11 annual-mean streamflow (every year in the period). The MA43 was the third quartile minus the first quartile divided by the median of the 11 annual-mean streamflow (dimensionless).
ML13	Variability across monthly minimum streamflow values. The ML13 was derived by computing the mean and standard deviation for the monthly minimum streamflow in the period. The ML13 was the standard deviation times 100 divided by the mean of monthly minimum streamflow for all years in the period (percent).
ML20	Ratio of total discharge and base streamflow. The ML20 was derived by dividing the daily streamflow record into 5-day blocks, finding the minimum streamflow for each block, and assigning the minimum streamflow as a base streamflow for that block if 90 percent of that minimum streamflow was less than the minimum streamflow for the blocks on either side; otherwise, it was set to zero, and the zero values were filled using linear interpolation. Then, the total streamflow and the total base streamflow for the entire record were calculated. The ML20 was the ratio of total streamflow to total base streamflow (dimensionless).
ML18	Variability in base streamflow. The ML18 was derived by computing the standard deviation for the ratios of 7-day moving average streamflow to mean annual streamflow for each year. The ML18 was the standard deviation times 100 divided by the mean of the ratios (percent).
MH26	High peak streamflow ratio. The MH26 was derived by computing the average peak streamflow value for streamflow events above a threshold equal to seven times the median streamflow for the entire record in the period. The MH26 was the average peak streamflow divided by the median streamflow for the entire record in period (dimensionless).
FL2	Variability in low-flood pulse count. The FL2 was derived by computing the standard deviation in the annual counts for low-flood pulses (FL1). The FL2 was 100 times the standard deviation divided by the mean low-flood pulse counts (percent). The low-flood pulse count, FL1, was derived by computing the average number of streamflow events with streamflow below a threshold equal to the 25th percentile value for the entire streamflow record in the period. The FL1 was the average number of events per year.
FL3	Frequency of low pulse spells. The FL3 was derived by computing the average number of streamflow events with streamflow below a threshold equal to 5 percent of the median streamflow value for the entire streamflow record in the period. The FL3 was the average number of events per year.
FH2	Variability in high-streamflow pulse count. The FH2 was derived by computing the standard deviation in high-flood pulse count FH1. The FH2 was 100 times the standard deviation divided by the mean pulse count (number of events per year). The FH1 was derived by computing the average number of streamflow events with streamflow above a threshold equal to the 75th percentile value for the entire streamflow record in period.
FH7	Flood frequency using a threshold equal to seven times the median streamflow. The FH7 was derived by computing the average number of streamflow events with streamflow above a threshold equal to seven times the median streamflow value for the entire streamflow record in period. The FH7 was the average number of events per year.

Table 3. Definition and alphanumeric code of the monthly streamflow indices and the nonredundant hydrologic indices for the Platte River from Duncan through Louisville, Nebraska (modified from Henriksen and others, 2006).—Continued

[ft^3/s, cubic feet per second]

Code	Definition
FH8	Flood frequency using a threshold equal to 25-percent exceedence. The FH8 was derived by computing the average number of streamflow events with streamflow above a threshold equal to 25-percent exceedence value for the entire streamflow record in the period. The FH8 was the average number of events per year.
DL1	Annual minimum daily streamflow. The DL1 was derived by computing the minimum 1-day average streamflow for each year. The DL1 was the mean of these values (ft^3/s).
DL14	Low exeedence streamflow. The DL14 was derived by computing the 75-percent exeedence value for the entire streamflow record in the period. The DL14 was the exceedence value divided by the median for the entire record in the period (dimensionless).
DL17	Variability in low-streamflow pulse duration. The DL17 was derived by computing the standard deviation for the yearly average of low-streamflow pulse durations. The DL17 was 100 times the standard deviation divided by the mean of the yearly average low-streamflow pulse durations (percent).
DL19	Variability in the number of zero-streamflow days. The DL19 was derived by computing the standard deviation for the annual number of zero-streamflow days. The DL19 was 100 times the standard deviation divided by the mean annual number of zero-streamflow days (percent).
DH1	Annual maximum of daily streamflow. The DH1 was derived by computing the maximum of a 1-day moving average streamflow for each year. The DH1 was the mean of these values (ft^3/s) for the period.
DH2	Annual maximum of 3-day moving-average streamflow. The DH2 was derived by computing the maximum of a 3-day moving-average streamflow for each year. The DH2 was the mean of these values (ft^3/s).
DH6	Variability of annual maximum of 1-day moving-average streamflow. The DH6 was derived by computing the standard deviation for the maximum 1-day moving averages. The DH6 was 100 times the standard deviation divided by the mean (percent).
DH7	Variability of annual maximum of 3-day moving-average streamflow. The DH7 was derived by computing the standard deviation for the maximum 3-day moving averages. The DH7 was 100 times the standard deviation divided by the mean (percent).
DH14	Flood duration. The DH14 was derived by computing the mean of the mean monthly streamflow values and finding the 95th percentile for the mean monthly streamflow. The DH14 was the 95th percentile value divided by the mean of the mean monthly (dimensionless).
TA3	Seasonal predictability of flooding. The TA3 was derived by dividing the water year into 2-month periods (that was, October–November, December–January, and so forth) and counting the number of flood days (streamflow events with streamflow greater than 1.67-year flood) over the entire streamflow record in the period. The TA3 was the maximum number of flood days in any one period divided by the total number of flood days.
TL4	Seasonal predictability of non-low streamflow. The TL4 was derived by computing the number of days that streamflow was above the 5-year flood threshold, expressed as the ratio of the number of days to 365 or 366 (leap year) for each year. The TL4 was the maximum of the yearly ratios (dimensionless).
TH3	Seasonal predictability of non-flooding. The TH3 was computed as the maximum proportion of a 365-day year that the streamflow was less than the 1.67-year flood threshold and also occurs in all years. Non-flood days that span all years were then accumulated. TH3 was maximum length of those flood-free periods divided by 365 (dimensionless).
RA1	Rise rate. The RA1 was derived by computing the change in streamflow for days in which the change was positive for the entire streamflow record in the period. The positive change occurred when the streamflow at day n was lower than the streamflow at day $n+1$. The RA1 was the mean of these values (ft^3/s per day).
RA2	Variability of rise rate. The RA2 was derived by computing the standard deviation for the positive streamflow changes. The RA2 was 100 times the standard deviation divided by the mean (percent).
RA3	Fall rate. The RA3 was derived by computing the change in streamflow for days in which the change was negative for the entire streamflow record in the period. The negative change at day n occurred when the streamflow at day n was larger than the streamflow at day $n+1$. The RA3 was the mean of these values (ft^3/s per day).
RA4	Variability in fall rate. The RA4 was derived by computing the standard deviation for the negative streamflow changes. The RA4 was 100 times the standard deviation divided by the mean (percent).
RA8	Number of fluctuations. Streamflow fluctuation was the number of days in each year when the streamflow fluctuated from one day to the next. Fluctuation in streamflow for day n occurred if the streamflow on day n was greater or lower than the streamflow at the previous day (day $n-1$) and next day (day $n+1$). The RA8 was derived by computing the number of days in each year for period, when the streamflow fluctuated (days per year).

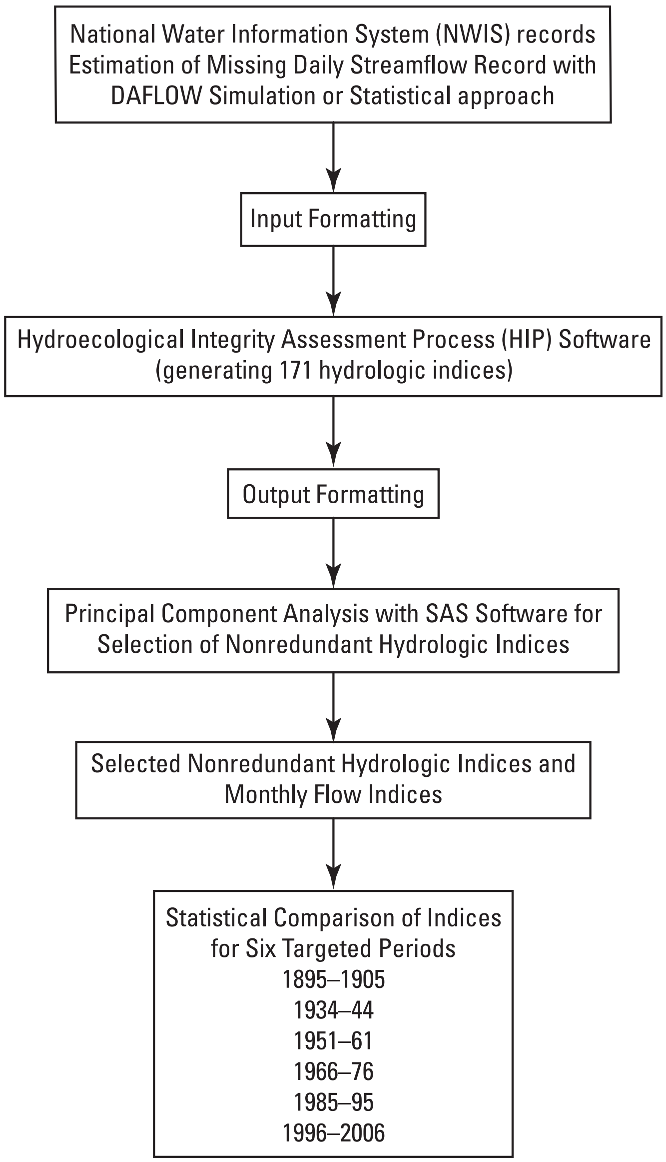


Figure 2. Sequence of data analysis for hydrologic indices.

were attempted because of the consistency of differences with those for all other stations.

Nonparametric Statistical Comparison of Monthly Climate and Monthly Streamflow

Comparisons among periods in monthly climate and monthly streamflow for each station, were made with nonparametric methods using the analysis of variance (ANOVA) approximation of the Kruskal-Wallis test (Helsel and Hirsch, 1992). A one-way ANOVA applied to the ranks of the response variable is equivalent to the Kruskal-Wallis k-sample test. *F*-test statistic generated by the parametric procedure applied to the ranks was often more robust than the *Chi square* approximation used by Kruskal-Wallis (SAS Institute Inc., 1990). The ranks of monthly streamflow and climate variables for each station-month combination were obtained using RANK procedure of SAS. The one-way ANOVA on the ranks for each station used the GLM procedure of SAS (SAS Institute, 1990) and the Duncan's multiple-range test (Duncan, 1955) was used to indicate significant differences of one time period from the others. Significant differences among periods were declared using a 95-percent confidence level, alpha=0.05; *p*-value less than alpha indicated that at least one period was significantly different from the other periods.

Association of Monthly Climate and Streamflow

The degree of association between monthly climate and streamflow for each station-month combination was determined using the Kendall's tau (Kendall and Gibbons, 1990). Tau, a rank-based correlation procedure, measures the strength of monotonic relation between two variables (Helsel and Hirsch, 1992). Kendall's tau was calculated using the CORR procedure (SAS Institute Inc., 1989). Significant correlation was declared when *p*-value was less than alpha=0.05.

Temporal Differences in Climate and Hydrologic Indices

Median values and statistical test results for temporal differences in monthly climate and monthly streamflow indices, and potential temporal differences in nonredundant HIs are discussed. Lower and upper quartile values of the monthly climate and monthly streamflow indices are presented in Appendix 1 to 7.

Temporal Differences in Climate and Association with Monthly Streamflow

Temporal differences among the periods in monthly precipitation varied consistently with month and climate-division combinations. Monthly precipitation from January through June and from September through November in all climatic divisions was not significantly different among the 11-water-year periods (table 4).

The lower Platte River basin was under a widespread drought (moderate to severe) during the 1934–1944 period; the median of monthly PHDI was uniformly < -2 (table 5) except -1.93 for February in climate division 3. The widespread drought was preceded by a widespread wet period (mildly to moderately wet) during the 1895–1905 period, followed by an incipient drought to incipiently wet period (1951–61) and an incipient drought to mildly wet period (1966–76), another widespread wet condition (moderately wet) during the 1985–95 period, and an incipient drought to mildly wet period (1996–2006). Note that climate conditions in all climate

Table 4. Median value and rank comparisons among selected time periods of monthly precipitation for four climate divisions drained by the Platte River from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are the median precipitation for each combination of climate division, time period, and month, in inches; Character following each median indicates results of rank comparison tests among time periods within each combination of climate division and month: periods within each climate division and month that are indexed by the same character are not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of climate division and month are equal; Bold values indicate significant differences at *p*-value less than 0.05; Lower and upper quartile values of monthly precipitation for each combination of climate division, time period, and month are presented in Appendix 1]

Climate division	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
2	1895–1905	0.33 a	0.56 a	1.11 a	2.06 a	3.02 a	3.99 a	2.77 a	2.89 a	2.09 a	1.39 a	0.48 a	0.19 a
	1934–1944	.46 a	.68 a	.96 a	2.60 a	3.23 a	3.39 a	2.13 a	1.76 c	1.06 a	.49 a	.32 a	.43 a
	1951–1961	.29 a	.68 a	.97 a	1.83 a	3.53 a	3.48 a	2.09 a	2.64 abc	1.74 a	1.15 a	.61 a	.25 a
	1966–1976	.50 a	.28 a	.68 a	2.24 a	2.88 a	3.20 a	2.57 a	2.01 bc	1.55 a	.97 a	.52 a	.50 a
	1985–1995	.40 a	.48 a	1.27 a	2.31 a	3.23 a	3.14 a	3.03 a	2.65 ab	2.51 a	1.44 a	1.23 a	.37 a
	1996–2006	.29 a	.53 a	1.05 a	2.83 a	3.40 a	3.11 a	2.93 a	2.62 abc	2.37 a	1.19 a	1.08 a	.21 a
	p-value	.3689	.3902	.6039	.8596	.7308	.7615	.2490	**.0404**	.1933	.4026	.0571	.0580
3	1895–1905	.37 a	.87 a	1.12 a	2.21 a	4.06 a	4.53 a	4.35 a	3.02 a	2.57 a	2.43 a	.68 a	.42 a
	1934–1944	.67 a	.99 a	1.07 a	2.11 a	2.77 a	4.79 a	2.33 a	2.47 a	2.04 a	.9 a	.66 a	.62 a
	1951–1961	.34 a	.86 a	1.86 a	2.16 a	3.99 a	3.81 a	2.98 a	2.89 a	1.82 a	1.17 a	.74 a	.32 a
	1966–1976	.37 a	.40 a	.82 a	2.01 a	3.09 a	3.85 a	2.51 a	2.36 a	2.24 a	1.45 a	.55 a	.70 a
	1985–1995	.60 a	.51 a	1.84 a	2.71 a	4.11 a	3.98 a	3.05 a	3.29 a	3.38 a	1.65 a	1.17 a	.68 a
	1996–2006	.47 a	.84 a	.97 a	3.13 a	3.82 a	3.75 a	3.28 a	3.41 a	3.25 a	1.39 a	2.03 a	.35 a
	p-value	.3914	.2260	.3940	.6867	.5107	.9955	.5428	.2693	.3756	.2626	.1325	.1488
5	1895–1905	.28 a	.52 a	.61 a	2.77 a	3.66 a	4.42 a	3.73 a	3.01 a	2.42 a	1.95 a	.58 a	.43 a
	1934–1944	.54 a	.54 a	.92 a	2.37 a	3.45 a	3.82 a	2.23 b	1.77 c	1.76 a	.65 a	.23 a	.59 a
	1951–1961	.33 a	.64 a	1.20 a	2.60 a	4.33 a	3.69 a	2.56 ab	2.31 abc	1.72 a	.93 a	.42 a	.34 a
	1966–1976	.43 a	.42 a	.70 a	2.16 a	2.77 a	4.25 a	3.20 a	2.17 bc	1.67 a	1.46 a	.46 a	.70 a
	1985–1995	.59 a	.62 a	1.55 a	2.29 a	4.00 a	3.40 a	3.22 a	3.01 abc	2.44 a	1.52 a	1.06 a	.47 a
	1996–2006	.32 a	.61 a	1.07 a	2.01 a	3.45 a	3.06 a	2.87 ab	3.73 ab	2.16 a	1.3 a	1.10 a	.10 b
	p-value	.6781	.8068	.4477	.6136	.4152	.7115	**.0488**	**.0472**	.8313	.1252	.1568	**.0013**
6	1895–1905	.52 a	.94 a	.84 a	2.84 a	4.62 a	4.47 a	4.71 a	4.04 a	2.86 a	2.7 a	.84 a	.47 abc
	1934–1944	.56 a	1.01 a	1.12 a	1.98 a	2.62 a	3.82 a	2.22 a	2.42 b	2.29 a	1.56 a	.59 a	.81 abc
	1951–1961	.64 a	.95 a	1.99 a	2.45 a	3.69 a	4.14 a	3.00 a	4.65 a	2.66 a	1.13 a	.66 a	.45 bc
	1966–1976	.61 a	.69 a	.79 a	2.52 a	3.39 a	3.41 a	3.03 a	2.48 b	3.12 a	2.69 a	1.04 a	.90 a
	1985–1995	.68 a	.57 a	2.22 a	2.23 a	4.44 a	4.24 a	4.03 a	2.78 ab	3.09 a	1.71 a	1.10 a	.84 ab
	1996–2006	.72 a	.99 a	1.13 a	3.03 a	4.48 a	3.94 a	2.76 a	3.13 ab	2.76 a	1.54 a	1.53 a	.37 c
	p-value	.9969	.2495	.1747	.5900	.5976	.7876	.1638	**.0379**	.6075	.1269	.1580	**.0357**

divisions during the 1951–61 (except climate division 6) and 1996–2006 periods (except climate division 3) were mixed type; that is, monthly drought and wet conditions occurred within each period. The monthly climate conditions during the 1966–76 period were wet (incipiently to mildly wet), except for the mixed-type climate conditions in climate division 2.

Temporal differences in the monthly PHDI varied among the month and climate division combinations. For instance, median PHDI values for climate divisions 2 and 3 during 1951–61 were consistently less (drier) than those during 1996–2006 (with the exception of May in climate division 3). But for climate division 6, the situation was reversed: median PHDI values were negative (except for July) and uniformly less (drier) during 1996–2006 than during 1951–61. Also during the 1951–61 period, drought was not the average climatic condition for the entire lower Platte River basin because none of the medians of the monthly PHDI values were negative for climate division 6.

Kendall's tau values indicated a positive correlation between monthly streamflow and monthly PHDI. Rank correlations of monthly streamflow and monthly PHDI were stronger than those of streamflow and monthly precipitation (table 6). Correlations of monthly streamflow with monthly PHDI were significant for all months and stations; whereas, correlations with precipitation were significant only from May through September for stations upstream from Louisville, and from April through November for the Louisville station.

Temporal Differences in Monthly Streamflow Indices

The rank comparisons of monthly mean (table 7) and monthly maximum streamflow (table 8) between the 1895–1905 and 1985–95 periods revealed the combined effects of streamflow regulation and other anthropogenic activities on streamflow magnitude. Although rank comparison was not significant (number of observations, n=11, in each period limited the statistical power of comparison), median values of monthly PHDI were less during the 1895–1905 period than that during the 1985–95 period for all climate divisions (table 5). However, monthly streamflow at Duncan, North Bend, and Ashland stations (where concurrent monthly streamflow data were available for the two periods) were sometimes higher during the 1895–1905 period than those during the 1985–95 period. April streamflow was higher in the 1895–1905 period for Duncan and North Bend stations (tables 7 and 8) than in the 1985–95 period; for Duncan, North Bend, and Ashland stations from May to July [typically wet months and historically the months when mountain snowmelt would course through the lower Platte (Wohl, 2001)], streamflow was the highest in the 1895–1905 period, the period prior to building of most major storage reservoirs (Eschner and others, 1983) and many other water management projects in the Platte River basin. The temporal difference confirms that monthly mean and monthly maximum streamflow were higher prior to building of major storage reservoirs. However, during the post-snowmelt months from August through November, the monthly mean and monthly maximum streamflow in the 1895–1905 period were either less than or more similar to those in the 1985–95 period. This contrast of monthly streamflow between wet and dry months indicated wider amplitude of monthly streamflow in the period prior to building major storage reservoirs. Streamflow amplitude was defined as the difference between the highest and lowest median values of monthly mean streamflow. The effects of major reservoirs on monthly minimum streamflow (table 9) were less obvious. For all three stations and months compared, except May and June, the monthly minimum streamflow in the 1895–1905 period was similar to or less than the monthly minimum streamflow in the 1985–1995 period.

Among the other five periods from 1934 to 2006, periods when major reservoirs were operational on both North Platte River and South Platte River and streamflow was increasingly managed (for flood prevention, hydroelectricity, agriculture, residential and industrial consumption, recreation, aquatic habitats, and other purposes), the rank comparisons of monthly mean, maximum, and minimum streamflow (tables 7, 8, and 9) indicated the effects of varying climate conditions. When there were significant differences among the periods, the differences were mainly evident between the two periods of greatest contrast in climate conditions; the monthly streamflow in the 1934–44 moderate- to severe-drought period were significantly lower than those in the 1985–95 moderately wet period. When the contrast in climatic conditions between two periods was not very pronounced, generally the monthly streamflow between the two periods were similar. For example, most of the monthly streamflow for the moderately wet period (1985–95), the incipient drought to incipiently wet period (1951–61) and incipient drought to mildly wet period (1996–2006), and the mildly wet period (1966–76) did not significantly differ. Most of the monthly streamflow for the 1934–44, 1951–61, 1966–76, and 1996–2006 periods did not significantly differ.

The median of monthly skewness coefficients of streamflow from February to September at the Platte River mainstem stations were all positive values (table 10). The monthly skewness coefficients of streamflow for other months, were either positive or negative depending on the station-period combinations. Statistical ranking differences for coefficients of monthly skewness and coefficients of variation of streamflow were evident mainly for comparisons among time periods for the central Platte River system at Duncan station. Median values of monthly skewness coefficients of streamflow at Duncan station in either the 1934–44 or the 1951–61 periods were generally largest among the periods, except for May and June; the coefficients of skewness were generally smallest in the 1985–95 or 1996–2006 periods. Monthly skewness coefficients of streamflow at Duncan station in either the 1934–44 or 1951–61 periods differed significantly (for seven months) from one or more 11-water-year periods (table 10). Large coefficients of variation and skewness, and positive monthly values of skewness of streamflow from the central Platte River

Table 5. Median value and rank comparisons among selected time periods of monthly Palmer Hydrological Drought Index for four climate divisions drained by the Platte River from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are the median PHDI for each combination of climate division, time period, and month; Character following each median indicates results of rank comparison tests among time periods within each combination of climate division and month: periods within each combination of climate division and month that are indexed by same character were not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of climate division and month are equal; Bold values indicate significant differences at *p*-value less than 0.05; Lower and upper quartile values of monthly Palmer Hydrological Drought Index for each combination of climate division, time period, and month are presented in Appendix 2]

Climate division	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
2	1895–1905	1.46 a	1.22 a	1.22 a	1.37 a	1.22 a	1.54 a	1.63 a	1.21 a	1.42 a	1.76 a	1.68 a	1.45 a
	1934–1944	-2.70 b	-2.55 b	-2.54 b	-2.84 b	-2.36 b	-2.23 b	-2.58 b	-2.88 b	-2.71 b	-2.88 b	-2.98 b	-3.02 b
	1951–1961	-1.12 a	-1.05 a	-1.18 a	-1.37 ab	-.8 ab	-1.14 ab	-.62 ab	1.2 a	0.64 a	.94 a	.78 a	.58 a
	1966–1976	-.7 a	-.56 a	-.88 a	.18 a	-1.48 ab	-.81 ab	-.93 ab	-.92 ab	-.98 ab	-.87 a	-.94 a	-.7 a
	1985–1995	2.99 a	3.29 a	2.64 a	2.66 a	2.73 a	2.3 a	2.51 a	2.96 a	3.32 a	2.59 a	2.77 a	3.01 a
	1996–2006	1.32 a	.85 a	-.47 a	1.46 a	1.99 a	1.41 a	2.00 a	2.21 a	2.27 a	1.97 a	2.22 a	1.71 a
	p-value	**.0005**	**.0026**	**.0021**	**.0067**	**.0272**	**.0410**	**.0177**	**.0080**	**.0050**	**.0011**	**.0004**	**.0006**
3	1895–1905	1.16 a	1.05 a	.9 a	.79 a	.48 a	1.39 a	1.89 a	1.76 a	1.53 a	1.8 a	1.36 a	1.43 a
	1934–1944	-2.29 b	-1.93 b	-2.22 b	-2.48 b	-2.93 b	-3.00 a	-3.19 b	-2.9 b	-2.84 b	-2.88 b	-2.68 b	-2.6 b
	1951–1961	-.68 a	1.02 a	.89 a	-.68 a	1.77 a	1.00 a	1.05 a	1.09 a	.56 ab	.67 a	-.67 a	-.89 a
	1966–1976	1.67 a	1.63 a	1.64 a	1.25 a	1.31 a	1.29 a	1.86 a	1.5 a	.95 ab	1.74 a	1.76 a	1.88 a
	1985–1995	2.17 a	2.06 a	2.3 a	3.18 a	3.09 a	2.66 a	2.77 a	3.08 a	3.64 a	3.28 a	3.08 a	2.7 a
	1996–2006	1.43 a	1.05 a	1.27 a	1.73 a	1.69 a	1.5 a	1.92 a	1.81 a	2.03 a	2.19 a	1.91 a	1.59 a
	p-value	**.0013**	**.0057**	**.0176**	**.0380**	**.0390**	.0608	**.0342**	**.0186**	**.0187**	**.0011**	**.0005**	**.0006**
5	1895–1905	1.73 ab	1.59 ab	1.4 ab	1.53 ab	1.61 ab	2 ab	2.2 a	2.15 a	2.13 a	2.29 a	2.17 a	1.98 ab
	1934–1944	-4.33 d	-4.35 d	-4.19 c	-4.47 d	-3.74 c	-3.98 c	-3.91 c	-4.62 c	-4.53 c	-4.2 c	-4.3 c	-4.45 d
	1951–1961	-1.24 c	-1.39 c	-1.26 b	-1.28 c	1.36 b	1.19 b	0.93 b	1 b	-1.12 bc	1.49 b	1.05 b	.64 c
	1966–1976	1.39 ab	1.4 ab	1.31 ab	1.29 abc	.9 ab	1.56 ab	1.68 ab	1.15 ab	.97 ab	1.47 ab	1.45 ab	1.49 ab
	1985–1995	3.34 a	3.13 a	3.5 a	3.7 a	3.65 a	3.09 a	3.07 a	3.45 a	3.42 a	3.16 a	3.25 a	3.29 a
	1996–2006	.71 bc	.55 bc	.57 b	-1.31 bc	.08 b	.72 b	0.1 b	.63 b	-.93 b	-.69 ab	1.35 ab	.83 bc
	p-value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**.0002**	**.0002**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**
6	1895–1905	.06 ab	0.46 a	-.53 a	.64 a	.7 a	1.47 a	1.54 a	1.51 a	1.36 a	1.37 a	1.03 a	.47 a
	1934–1944	-3.72 c	-3.51 b	-3.72 b	-3.01 b	-3.78 b	-3.2 b	-3.93 b	-4.18 b	-3.63 b	-4.26 b	-4.07 b	-4.26 b
	1951–1961	1.07 ab	1.07 a	1.49 a	1.93 a	1.37 a	.68 a	.65 a	.01 a	.96 a	1.42 a	1.23 a	.87 a
	1966–1976	1.42 ab	.98 a	.65 a	.63 a	1.62 a	1.74 a	1.19 a	.86 a	1.09 a	1.69 a	1.7 a	1.43 a
	1985–1995	2.56 a	2.28 a	2.42 a	2.8 a	2.01 a	2.21 a	2.66 a	2.6 a	2.5 a	3.14 a	2.84 a	2.58 a
	1996–2006	-1.43 b	-1.13 a	-1.23 a	-1.04 a	-.23 a	-.48 a	.64 a	-.38 a	-.35 a	-1.2 a	-1 a	-1.11 a
	p-value	**.0001**	**.0003**	**.0008**	**.0016**	**.0028**	**.0041**	**.0023**	**.0012**	**.0023**	**<.0001**	**.0001**	**<.0001**

Table 6. Kendall's tau rank correlation of monthly streamflow with monthly precipitation and monthly Palmer Hydrological Drought Indices for four climatic divisions drained by the Platte River from Duncan through Louisville, Nebraska, 1895–2006.

[Div., climate division; only Kendall's tau values followed by *,**, and *** are significantly different from zero at *p*-value less than 0.05, 0.01, and 0.001, respectively]

Station name	Div.	Precipitation											
		January	February	March	April	May	June	July	August	September	October	November	December
Duncan	2	-0.02	-0.02	-0.04	0.01	0.30 ***	0.19 *	0.31 ***	0.19 *	0.30 ***	0.18 *	0.08	0.01
	5	-.11	.03	-.09	.16	.29 ***	.16	.32 ***	.27 **	.25 **	.16	.08	.03
North Bend	2	-.06	.03	-.02	.05	.33 ***	.27 **	.36 ***	.25 **	.35 ***	.15	.17 *	-.09
	5	-.09	.05	-.02	.19 *	.40 ***	.27 **	.32 ***	.33 ***	.27 **	.13	.12	-.01
Leshara	2	-.05	.06	-.06	.04	.28 **	.24 **	.29 **	.22 *	.36 ***	.17	.10	-.02
	5	-.07	.05	.02	.11	.39 ***	.29 **	.27 **	.33 ***	.33 ***	.17	.05	.03
	6	-.03	.05	.05	.12	.38 ***	.15	.16	.37 ***	.28 **	.13	.06	.06
Ashland	2	.05	.05	-.09	.11	.20 *	.21 *	.31 ***	.27 **	.30 ***	.14	.11	.02
	3	.06	.07	.02	.13	.35 ***	.20 *	.30 ***	.32 ***	.27 **	.14	.05	.03
	5	.01	.04	.04	.18 *	.27 **	.11	.28 **	.39 ***	.26 **	.10	.09	.04
	6	.02	.03	.05	.21 *	.38 ***	.21 *	.25 **	.28 **	.24 **	.15	.07	.07
Louisville	2	.01	.04	-.04	.14	.39 ***	.29 **	.42 ***	.27 **	.36 ***	.22 *	.23 *	-.01
	3	-.02	-.05	.08	.27 **	.52 ***	.39 ***	.44 ***	.44 ***	.35 ***	.26 **	.18 *	.03
	5	.02	.08	.06	.21 *	.45 ***	.18	.36 ***	.41 ***	.29 **	.22 *	.21 *	.01
	6	-.04	-.05	.09	.32 ***	.59 ***	.41 ***	.42 ***	.34 ***	.32 ***	.26 **	.20 *	.07

Table 6. Kendall's tau rank correlation of monthly streamflow with monthly precipitation and monthly Palmer Hydrological Drought Indices for four climatic divisions drained by the Platte River from Duncan through Louisville, Nebraska, 1895–2006.—Continued

[Div., climate division; only Kendall's tau values followed by *,**, and *** are significantly different from zero at *p*-value less than 0.05, 0.01, and 0.001, respectively]

Station name	Div.	Palmer Hydrological Drought Indices											
		January	February	March	April	May	June	July	August	September	October	November	December
Duncan	2	0.40 ***	0.43 ***	0.35 ***	0.41 ***	0.49 ***	0.44 ***	0.49 ***	0.50 ***	0.47 ***	0.51 ***	0.48 ***	0.49 ***
	5	.48 ***	.56 ***	.39 ***	.52 ***	.46 ***	.44 ***	.50 ***	.55 ***	.56 ***	.59 ***	.54 ***	.57 ***
North Bend	2	.34 ***	.34 ***	.33 ***	.39 ***	.42 ***	.34 ***	.43 ***	.41 ***	.36 ***	.39 ***	.41 ***	.55 ***
	5	.37 ***	.45 ***	.34 ***	.44 ***	.38 ***	.31 ***	.43 ***	.37 ***	.36 ***	.41 ***	.40 ***	.52 ***
Leshara	2	.42 ***	.42 ***	.41 ***	.56 ***	.44 ***	.40 ***	.36 ***	.43 ***	.43 ***	.39 ***	.45 ***	.36 ***
	5	.41 ***	.44 ***	.50 ***	.56 ***	.46 ***	.34 ***	.34 ***	.39 ***	.44 ***	.44 ***	.47 ***	.32 ***
	6	.33 ***	.40 ***	.51 ***	.54 ***	.49 ***	.37 ***	.32 ***	.37 ***	.38 ***	.33 ***	.39 ***	.18 *
Ashland	2	.31 ***	.40 ***	.47 ***	.57 ***	.46 ***	.38 ***	.42 ***	.45 ***	.44 ***	.32 ***	.42 ***	.37 ***
	3	.22 *	.38 ***	.50 ***	.46 ***	.44 ***	.36 ***	.40 ***	.40 ***	.38 ***	.29 ***	.37 ***	.33 ***
	5	.31 ***	.42 ***	.55 ***	.56 ***	.47 ***	.38 ***	.44 ***	.46 ***	.43 ***	.33 ***	.44 ***	.33 ***
	6	.25 **	.37 ***	.55 ***	.51 ***	.48 ***	.39 ***	.40 ***	.43 ***	.37 ***	.25 **	.36 ***	.21 *
Louisville	2	.43 ***	.44 ***	.49 ***	.60 ***	.64 ***	.43 ***	.52 ***	.56 ***	.55 ***	.60 ***	.61 ***	.55 ***
	3	.38 ***	.43 ***	.43 ***	.56 ***	.59 ***	.42 ***	.50 ***	.56 ***	.49 ***	.60 ***	.54 ***	.44 ***
	5	.51 ***	.57 ***	.51 ***	.66 ***	.53 ***	.39 ***	.50 ***	.56 ***	.52 ***	.67 ***	.67 ***	.58 ***
	6	.39 ***	.45 ***	.52 ***	.62 ***	.58 ***	.40 ***	.51 ***	.55 ***	.44 ***	.57 ***	.57 ***	.40 ***

Table 7. Median value and rank comparisons among selected time periods of monthly mean streamflow at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1895–2006.

[Tabled values are the median streamflow for each combination of station, time period, and month, in cubic feet per second; Character following each median indicates results of rank comparison tests among time periods within each combination of station and month: periods within each station and month that are indexed by same character are not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of station and month are equal; Bold values indicate significant differences at *p*-value less than 0.05; NC, not computed; Lower and upper quartile values of monthly mean streamflow for each combination of station, time period, and month are presented in Appendix 3]

Station name	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
Duncan	1895–1905	NC	NC	4,914 a	6,532 a	8,611 a	11,278 a	4,522 a	2,398 a	846 a	643 ab	898 ab	NC
	1934–1944	645 b	1,442 c	2,799 a	907 c	789 b	681 b	114 d	2 c	0 b	2 c	412 b	594 b
	1951–1961	888 b	1,431 bc	2,176 a	1,704 bc	1,831 b	1,484 b	341 cd	68 bc	19 b	350 bc	947 ab	938 b
	1966–1976	1,426 ab	2,193 ab	2,859 a	2,009 b	1,601 b	1,230 b	753 bc	210 b	408 a	1,493 a	1,592 a	1,623 a
	1985–1995	1,916 a	2,307 a	3,225 a	2,387 b	2,353 b	1,644 b	1,340 b	688 a	1,216 a	1,572 a	1,655 a	1,438 a
	1996–2006	1,480 ab	1,866 abc	2,202 a	2,106 bc	1,787 b	1,300 b	510 bcd	517 b	391 ab	1,151 ab	2,142 a	1,607 a
	p-value	**.0096**	**.0193**	.1044	**.0029**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**.0013**	**<.0001**	**.0044**	**.0042**
North Bend	1895–1905	NC	NC	9,828 a	13,063 a	17,283 a	18,725 a	9,045 a	4,796 a	1,692 a	1,286 c	1,797 b	NC
	1934–1944	2,145 a	3,607 b	4,910 bc	3,603 c	3,890 b	4,063 b	2,421 c	1,411 b	2,015 a	2,066 c	2,424 b	2,373 b
	1951–1961	3,126 a	5,186 a	7,317 ab	5,934 ab	6,819 b	6,540 b	2,595 bc	2,257 a	2,175 a	2,872 b	3,942 a	3,282 a
	1966–1976	2,956 a	5,452 a	5,868 abc	5,193 bc	3,928 b	3,682 b	2,124 bc	1,367 b	1,725 a	3,236 ab	3,902 a	3,255 a
	1985–1995	4,379 a	4,869 a	7,377 ab	5,143 bc	5,309 b	5,632 b	3,733 b	2,866 a	3,786 a	4,624 a	4,256 a	4,235 a
	1996–2006	3,294 a	4,286 ab	5,002 c	4,892 bc	5,105 b	3,475 b	3,045 bc	1,799 ab	2,892 a	3,602 ab	4,260 a	3,601 a
	p-value	.0623	**.0273**	**.0063**	**.0029**	**<.0001**	**<.0001**	**<.0001**	**.0180**	.0608	**<.0001**	**<.0001**	**.0044**
Leshara	1934–1944	1,994 c	2,976 a	2,709 c	2,046 b	3,243 b	3,794 a	2,017 a	1,906 a	2,355 a	3,656 a	3,223 a	2,699 a
	1951–1961	3,135 b	5,116 a	7,252 a	6,010 a	6,871 a	6,593 a	2,656 a	2,321 a	2,211 a	2,859 a	3,916 a	3,304 a
	1966–1976	2,975 ab	5,459 a	5,950 ab	5,235 a	3,982 ab	3,697 a	2,151 a	1,381 a	1,718 a	3,192 a	3,941 a	3,274 a
	1985–1995	4,602 a	5,536 a	8,182 a	5,380 a	5,878 a	5,718 a	4,307 a	3,087 a	4,087 a	4,685 a	4,307 a	4,571 a
	1996–2006	3,676 ab	4,876 a	5,965 b	5,379 a	5,999 a	4,099 a	3,047 a	1,665 a	3,231 a	3,174 a	3,697 a	4,395 a
	p-value	**.0010**	.2190	**<.0001**	**<.0001**	**.0101**	.1262	.1035	.0831	.0564	.2702	.1699	.2212
Ashland	1895–1905	NC	NC	NC	10,351 a	17,133 a	20,594 a	14,184 a	10,672 a	3,828 ab	4,372 a	2,658 c	NC
	1934–1944	3,501 b	3,420 a	3,384 b	1,817 b	2,983 c	3,976 c	1,863 c	2,016 a	2,943 ab	4,745 a	4,096 abc	4,708 a
	1951–1961	3,041 b	5,611 a	8,515 a	6,920 a	7,514 b	6,333 b	3,974 bc	2,413 a	2,214 b	2,742 a	3,795 bc	3,547 a
	1966–1976	3,489 ab	6,664 a	8,105 a	6,876 a	5,115 b	5,517 b	3,181 bc	2,040 a	2,017 b	3,859 a	4,760 abc	3,975 a
	1985–1995	5,152 a	5,989 a	9,980 a	7,678 a	7,340 b	9,269 b	3,957 b	4,336 a	5,116 a	5,354 a	5,816 a	5,647 a
	1996–2006	3,915 ab	6,124 a	7,107 a	7,256 a	8,108 b	6,210 b	4,396 bc	2,225 a	4,067 ab	4,556 a	5,343 ab	4,929 a
	p-value	**.0176**	.1633	**<.0001**	**.0006**	**<.0001**	**.0008**	**.0037**	.0616	**.0280**	.1656	**.0331**	.0599
Louisville	1934–1944	2,565 c	3,188 c	6,586 b	4,447 b	4,274 a	5,387 a	2,850 b	1,947 b	2,426 b	2,382 c	2,981 c	2,578 c
	1951–1961	3,158 c	5,896 bc	9,015 b	7,163 a	8,200 a	6,539 a	4,446 b	2,898 ab	2,572 b	2,888 bc	3,977 b	3,546 bc
	1966–1976	3,709 b	6,843 b	8,602 b	7,067 a	5,605 a	5,827 a	3,356 b	2,217 b	2,191 b	3,989 ab	4,910 a	4,231 b
	1985–1995	10,606 a	11,003 a	13,506 a	9,377 a	9,204 a	13,006 a	6,573 a	7,604 a	6,651 a	6,403 a	7,275 a	7,680 a
	1996–2006	5,247 b	6,726 b	8,296 b	7,924 a	9,274 a	7,096 a	5,544 ab	2,761 a	4,463 ab	4,643 a	5,920 a	5,370 a
	p-value	**<.0001**	**<.0001**	**.0132**	**.0016**	**.1005**	.4574	**.0177**	**.0064**	**.0043**	**<.0001**	**<.0001**	**<.0001**

Table 8. Median value and rank comparisons among selected time periods of monthly maximum streamflow at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1895–2006.

[Tabled values are the median streamflow for each combination of station, time period, and month in cubic feet per second; Character following each median indicates results of rank comparison tests among time periods within each station and month: periods within each station and month that are indexed by same character are not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of station and month are equal; NC, not computed; Bold values indicate significant differences at *p*-value less than 0.05; Lower and upper quartile values of monthly maximum streamflow for each combination of station, time period, and month are presented in Appendix 4]

Station name	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
Duncan	1895–1905	NC	NC	8,080 a	14,500 a	17,800 a	18,000 a	10,650 a	4,580 a	2,440 a	3,180 a	989 ab	NC
	1934–1944	1,010 a	2,680 a	5,450 a	2,420 b	1,780 b	1,970 b	642 d	8 c	1 b	3 c	966 b	899 a
	1951–1961	1,600 a	3,190 a	4,160 a	2,720 b	4,620 b	3,010 b	1,440 cd	456 bc	227 b	870 bc	1,500 ab	1,860 a
	1966–1976	2,500 a	3,200 a	3,800 a	3,000 b	2,920 b	3,190 b	2,770 bc	599 b	966 a	2,240 a	2,340 a	2,330 a
	1985–1995	2,590 a	3,770 a	5,350 a	2,880 b	3,680 b	5,420 b	3,110 b	2,210 a	2,590 a	2,380 a	2,280 a	2,200 a
	1996–2006	2,000 a	2,301 a	2,850 a	2,630 b	3,400 b	2,320 b	1,420 bcd	1,190 b	592 ab	1,720 ab	2,710 ab	2,210 ab
	p-value	.0756	.2630	.1220	**.0203**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**.0045**	**<.0001**	**.0296**	.0565
North Bend	1895–1905	NC	NC	16,160 a	27,200 a	35,725 a	39,300 a	21,200 a	9,160 a	4,880 a	6,360 ab	1,978 b	NC
	1934–1944	4,028 a	5,972 a	9,820 ab	5,506 c	8,530 b	8,882 bc	4,835 b	2,640 b	3,390 a	3,060 c	3,374 b	3,511 b
	1951–1961	4,680 a	9,100 a	12,600 ab	9,000 ab	13,100 b	19,200 b	6,450 b	5,930 a	4,230 a	4,200 bc	5,260 a	5,980 a
	1966–1976	5,390 a	8,900 a	11,800 ab	6,990 bc	7,050 b	14,100 bc	6,520 b	2,710 b	3,000 a	5,280 ab	5,680 a	5,650 a
	1985–1995	6,000 a	7,400 a	15,900 a	8,660 bc	10,400 b	11,700 bc	7,120 b	5,070 ab	6,530 a	7,470 a	5,930 a	6,400 a
	1996–2006	4,500 a	7,660 a	7,950 b	7,030 bc	9,260 b	6,640 c	6,090 b	3,350 ab	5,270 a	5,190 ab	6,500 a	5,640 a
	p-value	.2818	.3895	**.0322**	**.0113**	**<.0001**	**.0001**	**.0003**	**.0242**	.3139	**.0010**	**<.0001**	**.0053**
Leshara	1934–1944	3,445 b	6,562 a	4,021 c	2,513 b	6,106 a	6,525 b	4,133 a	3,613 a	3,591 ab	7,146 a	4,178 a	6,748 a
	1951–1961	4,660 ab	9,075 a	11,657 ab	8,833 a	12,573 a	19,054 a	5,398 a	6,157 a	3,916 ab	4,068 a	5,279 a	5,898 a
	1966–1976	5,243 a	8,877 a	11,271 ab	6,869 a	6,831 a	13,494 ab	6,421 a	2,558 a	2,866 b	4,881 a	4,982 a	5,324 a
	1985–1995	5,967 a	8,053 a	16,636 a	8,999 a	11,656 a	12,231 ab	7,873 a	5,576 a	6,459 a	7,583 a	5,918 a	6,488 a
	1996–2006	5,400 ab	8,161 a	8,217 b	7,410 a	10,300 a	8,106 b	6,200 a	3,770 a	5,710 ab	4,410 a	5,988 a	6,000 a
	p-value	**.0464**	.5955	**.0001**	**<.0001**	.0718	**.0223**	.0908	.0732	**.0443**	.1725	.4938	.6720
Ashland	1895–1905	NC	NC	NC	19,760 a	31,004 a	39,954 a	29,645 a	19,670 a	10,080 ab	8,445 a	3,020 a	NC
	1934–1944	7,100 a	10,100 a	5,420 b	2,640 b	6,460 c	7,370 c	3,200 c	4,080 a	5,920 ab	12,100 a	5,700 a	10,800 a
	1951–1961	5,283 a	9,831 a	13,100 a	8,680 a	13,800 bc	18,600 b	7,760 bc	4,570 a	3,600 b	3,930 a	4,790 a	6,220 a
	1966–1976	5,861 a	11,910 a	12,244 a	11,274 a	8,305 bc	25,174 b	8,213 bc	2,992 a	3,844 b	5,830 a	6,258 a	6,247 a
	1985–1995	7,500 a	9,390 a	23,737 a	12,300 a	16,100 b	20,849 b	8,350 b	7,610 a	10,100 a	7,120 a	7,480 a	7,200 a
	1996–2006	5,200 a	12,000 a	13,400 a	9,921 a	18,051 ab	19,500 b	8,640 b	4,760 a	6,150 ab	7,110 a	7,850 a	6,960 a
	p-value	.0685	.7561	**.0003**	**.0008**	**.0042**	**.0058**	**.0036**	.2338	**.0154**	.1091	.2093	.1249
Louisville	1934–1944	4,505 c	10,195 b	13,358 a	7,408 a	10,392 a	17,266 a	7,973 b	4,120 a	4,701 b	3,355 b	4,244 c	4,622 c
	1951–1961	4,721 c	10,713 b	14,018 a	9,262 a	15,334 a	21,893 a	12,070 b	5,426 a	4,310 b	4,250 b	5,260 bc	6,295 bc
	1966–1976	6,000 b	12,100 ab	12,600 a	11,500 a	9,530 a	25,400 a	8,440 b	3,280 a	3,970 b	5,950 a	6,410 ab	6,400 b
	1985–1995	15,200 a	19,200 a	30,100 a	14,900 a	18,100 a	31,400 a	21,300 a	14,000 a	15,300 a	8,650 a	8,690 a	11,000 a
	1996–2006	6,800 bc	13,300 ab	15,000 a	11,562 a	24,227 a	17,600 a	12,200 ab	4,980 a	6,480 ab	7,060 a	8,370 a	7,550 b
	p-value	**<.0001**	**.0121**	.2197	.1098	.2235	.5774	**.0368**	.0576	**.0073**	**.0006**	**<.0001**	**<.0001**

Table 9. Median value and rank comparisons among selected time periods of monthly minimum streamflow at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1895–2006.

[Tabled values are the median streamflow for each combination of station, time period, and month in cubic feet per second; Character following each median indicates results of rank comparison tests among time periods within each combination of station and month: periods within each station and month that are indexed by same character are not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of station and month are equal; Bold values indicate significant differences at *p*-value less than 0.05; NC, not computed; Lower and upper quartile values of monthly minimum streamflow for each combination of station, time period, and month are presented in Appendix 5]

Station name	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
Duncan	1895–1905	NC	NC	2,280 a	1,750 a	3,365 a	5,100 a	1,008 a	100 ab	5 b	188 bc	775 ab	NC
	1934–1944	275 c	350 b	730 c	420 b	123 c	97 c	0 d	0 c	0 b	0 c	2 c	160 b
	1951–1961	435 c	590 b	950 bc	1,230 a	775 bc	276 bc	6 cd	1 bc	0 b	7 bc	510 bc	322 b
	1966–1976	900 ab	1,250 a	2,000 ab	1,340 a	980 bc	435 b	92 bc	44 ab	58 ab	740 a	1,300 a	820 a
	1985–1995	1,300 a	1,400 a	1,950 a	1,500 a	1,240 b	517 b	290 ab	184 a	299 a	670 a	600 ab	820 a
	1996–2006	700 b	960 a	1,400 abc	1,450 a	734 bc	430 bc	125 bc	156 ab	248 ab	709 ab	502 ab	608 a
	p-value	**<.0001**	**<.0001**	**.0015**	**.0016**	**<.0001**	**<.0001**	**<.0001**	**.0015**	**.0063**	**<.0001**	**.0003**	**.0001**
North Bend	1895–1905	NC	NC	4,560 a	3,960 a	6,730 a	10,000 a	2,015 a	200 bc	10 c	376 d	1,550 b	NC
	1934–1944	1,220 b	1,674 b	3,352 a	2,456 b	2,360 c	1,984 b	977 a	940 abc	1,285 ab	1,659 c	1,489 b	1,001 a
	1951–1961	1,410 b	2,480 a	3,700 a	4,380 a	4,130 ab	3,280 b	1,130 a	1,260 ab	1,240 a	1,770 bc	2,200 ab	1,200 a
	1966–1976	1,700 ab	3,700 a	4,360 a	3,280 ab	2,340 bc	1,610 b	680 a	610 c	730 b	2,080 ab	3,020 ab	1,600 a
	1985–1995	2,000 a	2,800 a	4,040 a	3,630 ab	3,830 bc	2,500 b	1,150 a	1,450 a	2,130 a	3,130 a	2,430 ab	2,200 a
	1996–2006	1,700 ab	2,919 a	2,840 a	3,500 ab	2,830 bc	2,320 b	1,180 a	813 abc	1,470 a	2,550 ab	2,510 a	1,000 a
	p-value	**.0349**	**.0047**	.0584	**.0112**	**.0020**	**<.0001**	.1169	**.0199**	**<.0001**	**<.0001**	**.0343**	.0699
Leshara	1934–1944	1,325 c	1,692 b	1,653 c	1,273 b	1,606 b	1,984 a	1,256 a	1,151 a	1,647 a	1,475 c	1,176 b	1,828 a
	1951–1961	1,460 bc	2,547 ab	4,028 ab	4,447 a	4,344 a	3,423 a	1,165 a	1,299 a	1,382 a	1,858 bc	2,488 ab	1,268 a
	1966–1976	1,778 bc	3,530 a	4,690 ab	3,505 a	2,522 a	1,672 a	747 a	660 a	811 a	2,153 abc	3,416 a	1,673 a
	1985–1995	2,427 a	3,262 a	4,828 a	3,943 a	4,381 a	2,802 a	1,135 a	1,514 a	2,211 a	3,214 a	2,533 a	2,327 a
	1996–2006	2,700 ab	3,108 a	3,500 b	3,890 a	3,267 a	2,496 a	1,191 a	776 a	1,530 a	2,645 ab	2,825 a	1,183 a
	p-value	**.0019**	**.016**	**<.0001**	**<.0001**	**.0011**	.0841	.3848	.0688	.1073	**.0205**	**.0394**	.1496
Ashland	1895–1905	NC	NC	NC	4,078 a	8,182 a	11,620 a	4,565 a	4,179 a	1,255 a	2,150 abc	2,150 bc	NC
	1934–1944	1,220 b	1,600 c	1,730 d	786 b	1,220 c	1,400 c	1,150 b	819 a	1,440 a	1,610 c	1,300 c	2,160 a
	1951–1961	1,410 b	2,250 bc	3,860 c	5,140 a	4,930 ab	2,800 b	1,339 b	1,280 a	1,537 a	1,790 bc	2,130 bc	1,260 a
	1966–1976	1,898 ab	3,871 a	4,914 ab	4,720 a	3,251 b	2,423 b	1,172 b	1,022 a	1,227 a	2,477 abc	3,959 ab	2,089 a
	1985–1995	2,500 a	3,600 ab	6,160 a	5,036 a	5,311 ab	3,980 b	1,657 ab	1,890 a	2,650 a	3,650 a	3,500 ab	2,608 a
	1996–2006	2,600 ab	4,198 ab	4,234 bc	4,939 a	4,300 ab	3,440 b	2,030 b	1,350 a	1,820 a	3,930 ab	3,630 a	1,936 a
	p-value	**.0298**	**.0076**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**.0231**	.1134	.0868	**.0021**	**.0014**	.1630
Louisville	1934–1944	1,034 d	1,320 c	2,969 c	2,980 b	2,904 b	2,434 a	1,376 b	978 c	1,407 bc	1,728 b	1,709 b	851 d
	1951–1961	1,410 cd	2,469 b	3,985 bc	5,298 a	5,278 ab	3,290 a	1,225 b	1,303 abc	1,462 bc	1,913 b	2,241 b	1,306 c
	1966–1976	2,000 bc	3,990 a	5,430 a	4,980 a	3,550 ab	2,590 a	1,280 b	1,120 bc	1,370 c	2,600 a	4,100 a	2,200 b
	1985–1995	3,670 a	4,700 a	7,120 a	6,210 a	6,190 a	5,300 a	2,390 a	2,520 a	3,610 a	4,610 a	5,390 a	3,800 a
	1996–2006	3,980 ab	4,651 a	5,040 ab	5,840 a	5,280 a	4,350 a	2,570 ab	1,610 ab	1,990 ab	3,890 a	4,170 a	2,219 ab
	p-value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**.0075**	.1643	**.0118**	**.0058**	**.0093**	**<.0001**	**<.0001**	**<.0001**

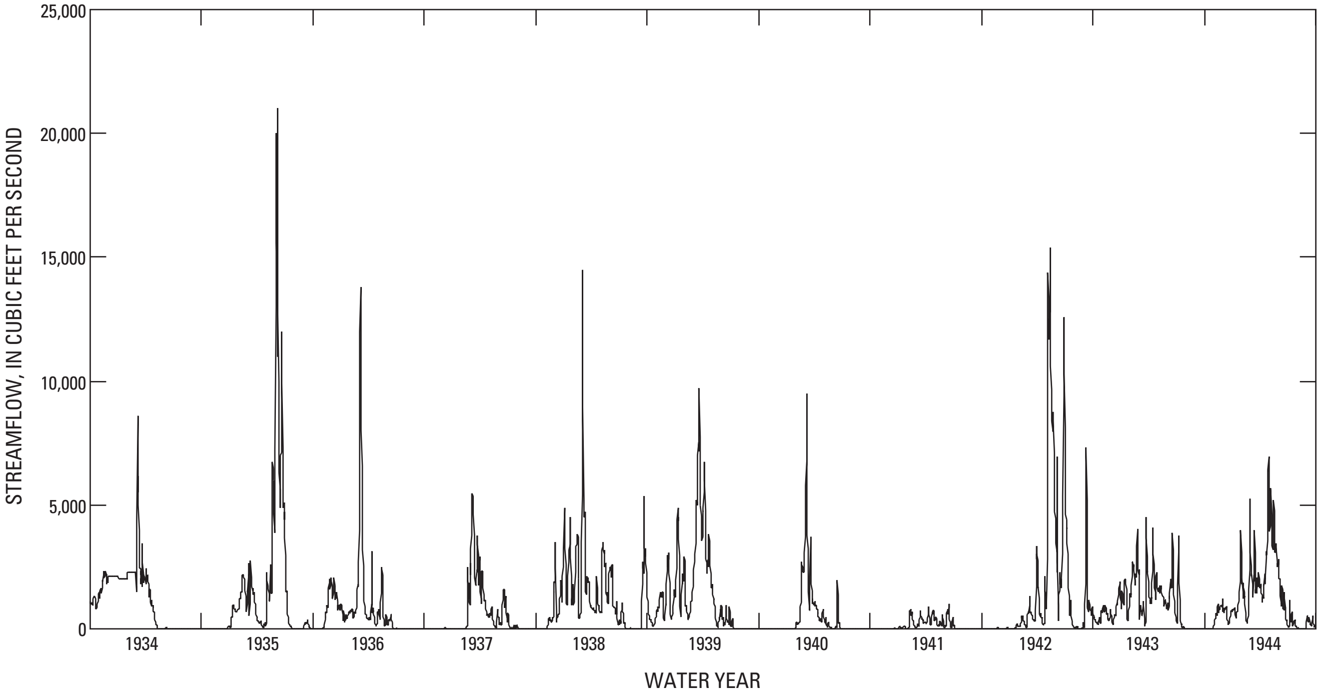


Figure 3. Daily streamflow hydrograph for the central Platte River system near Duncan, Nebraska, during the 1934–44 drought period.

system in the 1934–44 drought period, especially from August to September, were indicative of large numbers of low or zero values of daily mean streamflow but with some extremely high values as well (fig. 3). During a moderately wet 1985–95 period, the skewness was generally less than that for the 1934–1944 period, indicating that daily streamflow values were more evenly distributed around the mean (fig. 4).

Generally the monthly coefficients of skewness and variation in streamflow for the lower Platte River stations were not significantly different among the periods. However, monthly coefficients of skewness of streamflow in either the 1934–1944 or 1951–1961 periods were larger than one or more other 11-water-year periods for month and station combinations that showed significant temporal differences in skewness. Coefficients of skewness and variation were likely to be smaller in the 1985–95 or 1996–2006 periods than those in the 1934–44 period (table 10 and 11). Neither of the 1985–95 or 1996–2006 periods was persistently in drought, except in climate division 6, whereas the 1934–44 and 1951–61 periods contained several drought years, and multiple months had median PHDI values less than -1(mild drought or worse) in climate division 2 and 5.

There was no difference among the periods in coefficients of skewness of streamflow for all months (table 10) at Louisville station, the most downstream station on the lower Platte River. At Louisville, the influence of climatic conditions in climate division 6 is greater than at the upstream stations, and the conditions (PHDI median values) during the 1951–1961 and 1996–2006 periods in climate division 6 tended to offset those in other parts of the Platte River basin, probably reducing the coefficient of skewness.

Temporal Differences in Nonredundant Hydrologic Indices

Eighteen indices of the 27 selected nonredundant HIs indicated existence of temporal differences among the periods (table 12). Eleven of the nonredundant indices were indicators of streamflow variability. The monthly coefficients of skewness and coefficients of variation of streamflow, and the count of nonredundant indices that evidenced temporal differences among the periods, together pointed to the different streamflow regimes of the central Platte River system at Duncan station and the stations on the lower Platte River system. Seven of 13 indices for the central Platte River system at Duncan station that indicated temporal differences were indices of flow variability; for the lower Platte River stations, five of nine indices that evidenced temporal differences were indices of streamflow variability.

Magnitude of Streamflow Events

There was generally no potential difference among the periods in streamflow magnitude indices for the lower Platte River stations; but for the streamflow magnitude indices from the central Platte River system at Duncan station, three of five potentially differed among periods (table 13). Variability across annual discharge (MA43) for Duncan station in the

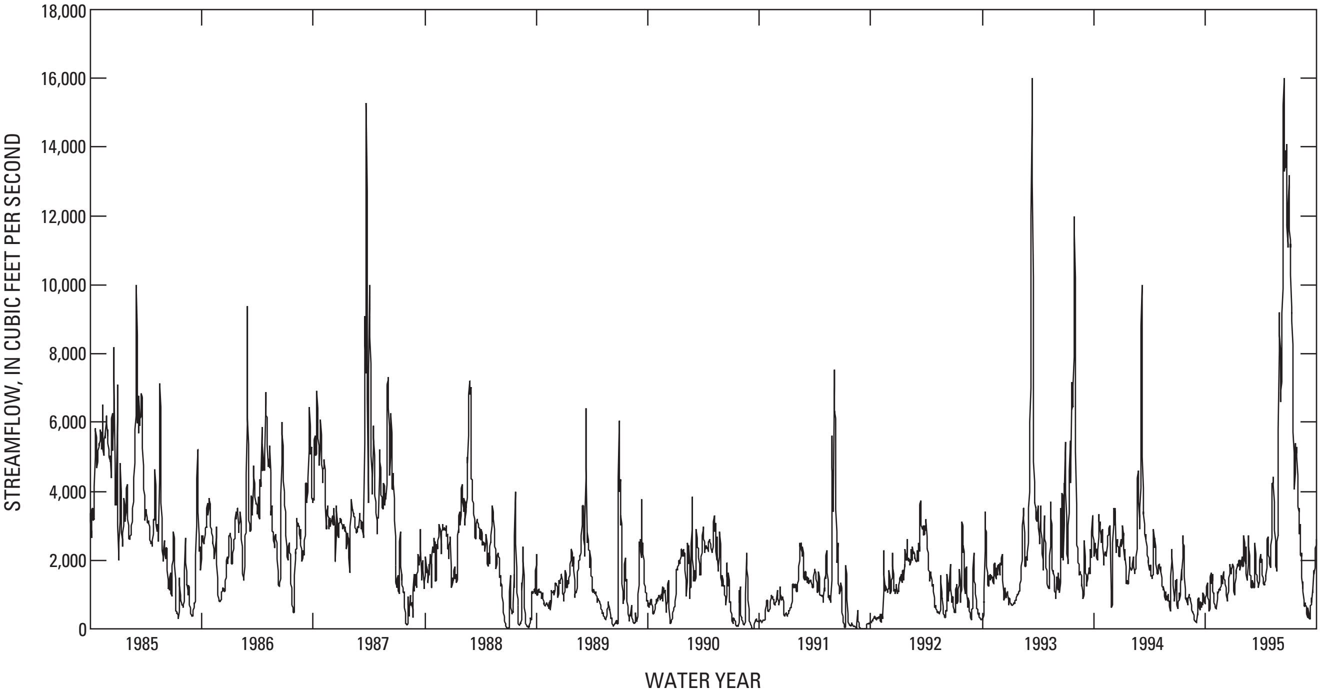


Figure 4. Daily streamflow hydrograph for the central Platte River system near Duncan, Nebraska during the 1985–95 moderately wet period.

1996–2006 period was highest among the periods, perhaps because this period contained five wet years (1996–2000) and six drought years (2001–2006). Variability across monthly minimum streamflow values (ML13) was highest in the 1934–44 period indicating that when expressed as a percentage, variability of streamflow tends to be larger when mean streamflow is less; the ratio of total discharge to base flow (ML20) also was the lowest in the 1934–44 period. Variability in base flow (ML18) in the 1934–44 and 1951–61 periods also was higher than that in the other periods. High peak flow (MH26) potentially did not differ among the periods for the two stations upstream from Leshara, but for each of the three downstream stations, relative magnitude of peak flows was potentially less during 1996–2006 than during one or more of the periods during 1934–95. Recalling that, based on the median PHDI values, the drought during the 1996–2006 period was more pronounced in climate division 6 than in the remaining climate divisions considered for this study, the probable temporal differences involving the 1996–2006 period at or downstream from Leshara is reasonable. Also, these results may indicate that during this period there were fewer high streamflow values meeting the streamflow criterion (equal or greater than seven times of median streamflow during each period) to be included in the set used to calculate MH26 (a criterion that varies relative to the median streamflow during each period).

Frequency of Streamflow Events

There were potential temporal differences in flood frequency in all three stations downstream from North Bend, using a minimum threshold equal to the streamflow with 25-percent exceedence (FH8) (table 13). At each station, the frequency of HIP-defined high-flow events potentially was greater during the 1934–1944 drought period than during the mildly wet 1966–1976 period. Once again, note that the criterion for inclusion of high-flow events in the set used to calculate FH8 varies relative to the threshold during each period for each station. Variability in low-flood pulse count (FL2) and the variability in high-flow pulse count (FH2) were highest in the 1996–2006 period (table 13) because this period was a mixture of five wet years (1996–2000) and six drought years. Recalling HIP-defined low flood (table 13), the maximum threshold for inclusion of low flood count varies among period and station combinations; therefore, the mean counts of low-flood pulses also varies among period and station combinations. Except for the streamflow from the central Platte River system, the frequency of low-pulse spells (FL3) and flood frequency using a threshold equal to seven times the median flow (FH7) generally indicated no differences among the periods. The FL3 and FH7 during the 1934–44 and 1951–61 periods in the central Platte River system at Duncan station were higher than those in the other periods (table 13).

Table 10. Median value and rank comparisons among selected time periods of monthly coefficients of skewness of streamflow at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1895–2006.

[Tabled values are the median coefficient for each combination of station, time period, and month; Character following each median indicates results of rank comparison tests among time periods within each combination of station and month: periods within each station and month that are indexed by same character are not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of station and month are equal; NC, not computed; Bold values indicate significant differences at *p*-value less than 0.05; Lower and upper quartile values of monthly coefficients of skewness of streamflow distribution for each combination of station, time period, and month are presented in Appendix 6]

Station name	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
Duncan	1895–1905	NC	NC	0.25 a	1.39 a	0.72 ab	0.41 a	0.80 c	0.53 b	0.89 ab	1.81 ab	0.36 a	NC
	1934–1944	0.61 a	0.65 a	1.40 a	.87 abc	.74 ab	.85 a	1.74 a	3.73 a	.84 ab	2.31 a	1.50 a	0.58 a
	1951–1961	.35 ab	.74 a	.90 a	.83 ab	1.10 a	.43 a	1.46 ab	2.55 a	2.33 a	.39 bc	.32 a	.42 a
	1966–1976	.24 ab	.59 a	1.03 a	.61 abc	.21 b	1.07 a	1.73 ab	.86 b	.35 b	.18 c	-.04 a	.16 a
	1985–1995	-.01 bc	.70 a	1.01 a	.54 c	1.27 a	.57 a	.95 bc	1.10 b	.43 b	-.05 c	-.16 a	.52 a
	1996–2006	-.60 c	.55 a	.71 a	.32 bc	.64 ab	.65 a	1.48 ab	.26 b	.46 b	.47 bc	.37 a	.24 a
	p-value	**.0070**	.9349	.2419	**.0269**	**.0461**	.2360	**.0115**	**<.0001**	**.0054**	**.0003**	.1928	.4561
North Bend	1895–1905	NC	NC	.25 a	1.39 a	.71 a	.79 a	.72 a	.57 a	.89 a	1.81 a	.36 a	NC
	1934–1944	.59 a	.47 a	1.06 a	.83 ab	1.30 a	1.08 a	1.17 a	1.74 a	1.36 a	1.17 a	-.62 a	-.31 a
	1951–1961	-.40 a	.58 a	.89 a	1.40 a	1.49 a	1.67 a	.81 a	1.84 a	1.02 a	-.06 b	.29 a	.26 a
	1966–1976	.42 a	.98 a	1.28 a	.20 c	.84 a	1.34 a	1.21 a	1.00 ab	.42 a	1.09 a	.14 a	-.02 a
	1985–1995	-.10 a	.36 a	1.07 a	.82 abc	.62 a	.93 a	.87 a	.92 ab	.78 a	.41 ab	-.18 a	.41 a
	1996–2006	-.24 a	.72 a	.41 a	.58 bc	1.17 a	1.12 a	.82 a	.08 b	.71 a	.18 b	-.07 a	-.32 a
	p-value	.0906	.9070	.4435	**.0058**	.1210	.3337	.6905	**.0027**	.4858	**.0013**	.5778	.4954
Leshara	1934–1944	1.15 a	.59 a	.65 a	.12 c	1.02 a	.90 a	.78 a	.39 bc	.83 a	.98 ab	1.05 a	.94 a
	1951–1961	-.36 b	.58 a	.77 a	1.31 a	1.16 a	1.66 a	.52 a	1.67 a	.78 a	.05 c	.16 a	.16 ab
	1966–1976	.51 ab	.91 a	1.12 a	.13 bc	.81 a	1.32 a	1.13 a	.76 bc	.37 a	.96 a	-.12 a	-.01 ab
	1985–1995	-.14 b	.39 a	1.12 a	.68 ab	.62 a	.94 a	1.01 a	1.01 ab	.79 a	.37 abc	-.06 a	.26 ab
	1996–2006	-.17 b	.41 a	1.24 a	.57 bc	1.33 a	.70 a	.90 a	.05 c	.60 a	.39 bc	.10 a	-.54 b
	p-value	**.0150**	.9439	.4026	**.0038**	.3237	.3273	.7902	**.0106**	.3078	**.0254**	.0777	**.0438**
Ashland	1895–1905	NC	NC	NC	1.02 a	.43 a	1.16 a	.62 a	.23 a	1.03 a	.15 a	-.17 a	NC
	1934–1944	1.12 a	.78 a	.71 a	.22 b	.84 a	.59 a	.66 a	1.04 a	.69 a	1.31 a	1.18 a	1.16 a
	1951–1961	-.39 a	.47 a	1.12 a	1.32 a	1.12 a	1.50 a	1.16 a	1.49 a	.84 a	.17 a	-.14 a	.15 b
	1966–1976	.27 a	1.08 a	1.00 a	.87 a	.53 a	1.12 a	.78 a	.57 a	.38 a	.95 a	-.03 a	.38 b
	1985–1995	.46 a	.55 a	1.54 a	1.28 a	1.35 a	1.81 a	.78 a	1.02 a	.74 a	.70 a	.27 a	-.58 bc
	1996–2006	-.03 a	.75 a	1.35 a	.60 ab	1.37 a	1.19 a	1.19 a	.98 a	.91 a	.41 a	.14 a	-.70 c
	p-value	.0533	.8845	.1494	**.0129**	.3946	.0820	.2817	.1191	.3236	.6443	.0715	**<.0001**
Louisville	1934–1944	.67 a	.35 a	1.18 a	.83 a	1.33 a	1.54 a	1.31 a	1.45 a	1.45 a	.56 a	.21 a	-.14 a
	1951–1961	-.41 a	.72 a	1.13 a	1.32 a	1.16 a	1.65 a	1.11 a	1.53 a	.71 a	.10 a	-.17 a	.20 a
	1966–1976	.30 a	1.05 a	.94 a	1.11 a	.91 a	1.10 a	.80 a	.57 a	.47 a	1.05 a	-.01 a	.56 a
	1985–1995	.32 a	.52 a	1.45 a	.80 a	1.19 a	1.78 a	1.17 a	1.82 a	1.32 a	.87 a	.36 a	-.23 a
	1996–2006	-.10 a	.68 a	.85 a	.63 a	1.34 a	1.43 a	1.20 a	1.14 a	.73 a	.56 a	1.01 a	-.60 a
	p-value	.1427	.8905	.9647	.4272	.9349	.6974	.6658	.1130	.1051	.2282	.3297	.2561

Table 11. Median value and rank comparisons among selected time periods of monthly coefficient of variation of streamflow at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1895–2006.

[Tabled values are the median coefficient for each combination of station, time period, and month, in percent; Character following each median indicates results of rank comparison tests among time periods within each combination of station and month: periods within each station and month that are indexed by same character are not significantly different (alpha=0.05); *p*-value is the probability of incorrectly rejecting the hypothesis that all time periods within each combination of station and month are equal; Bold values indicate significant differences at *p*-value less than 0.05; NC, not computed; Lower and upper quartile values of monthly coefficients of variation of streamflow for each combination of station, time period, and month are presented in Appendix 7]

Station name	Period of water years	January	February	March	April	May	June	July	August	September	October	November	December
Duncan	1895–1905	NC	NC	41 ab	48 a	40 a	30 c	61 b	65 b	88 ab	87 a	20 bc	NC
	1934–1944	50 a	67 a	55 a	46 a	62 a	74 a	145 a	172 a	95 ab	65 a	88 a	59 a
	1951–1961	39 ab	38 ab	35 ab	28 b	52 a	68 ab	111 a	157 a	131 a	77 ab	29 b	42 a
	1966–1976	31 bc	25 c	19 b	18 c	32 a	67 ab	98 a	81 b	74 ab	22 b	12 c	24 b
	1985–1995	20 c	31 bc	23 b	22 bc	32 a	43 b	52 b	63 b	64 b	19 b	20 bc	25 b
	1996–2006	20 c	21 c	36 b	26 bc	41 a	44 b	107 a	55 b	41 b	21 b	28 bc	25 b
	p-value	**<.0001**	**.0037**	**.0048**	**<.0001**	.0832	**<.0001**	**.0003**	**.0003**	**.0168**	**.0038**	**.0002**	**.0010**
North Bend	1895–1905	NC	NC	41 a	51 a	42 a	35 b	59 a	65 a	88 a	87 a	20 a	NC
	1934–1944	38 a	41 a	49 a	27 b	37 a	49 a	45 a	30 c	31 b	15 b	16 a	37 a
	1951–1961	31 ab	31 a	27 a	21 b	37 a	57 a	50 a	58 ab	32 b	20 b	20 a	38 a
	1966–1976	35 a	30 a	26 a	20 b	27 a	56 a	67 a	49 ab	35 b	23 b	15 a	33 a
	1985–1995	24 b	30 a	41 a	24 b	28 a	34 ab	51 a	37 c	37 b	18 b	15 a	29 a
	1996–2006	16 b	33 a	22 a	20 b	37 a	39 ab	37 a	40 bc	35 b	16 b	14 a	34 a
	p-value	**.0082**	.7821	.3610	**.0028**	.3292	**.0346**	.0619	**.0031**	**.0375**	**.0012**	.8682	.8063
Leshara	1934–1944	25 ab	40 a	20 a	19 a	38 a	43 a	28 b	31 a	41 a	41 a	37 a	30 a
	1951–1961	29 a	32 a	25 a	20 a	32 a	59 a	45 a	55 a	33 a	20 bc	16 b	36 a
	1966–1976	35 a	30 a	25 a	19 a	26 a	51 a	62 a	46 a	32 a	22 ab	13 b	30 a
	1985–1995	21 b	28 a	34 a	23 a	28 a	31 a	56 a	38 a	37 a	16 bc	14 b	24 a
	1996–2006	14 b	29 a	27 a	16 a	34 a	38 a	55 a	42 a	33 a	14 c	15 b	29 a
	p-value	**.0018**	.6271	.6648	.553	.6034	.2481	**.0033**	.0747	.8204	**.0044**	**.0236**	.6083
Ashland	1895–1905	NC	NC	NC	40 a	36 a	33 a	48 a	45 a	62 a	35 a	17 b	NC
	1934–1944	49 a	45 a	16 a	30 a	44 a	43 a	37 a	47 a	45 a	48 a	38 a	47 a
	1951–1961	32 ab	31 a	25 a	25 a	34 a	59 a	51 a	38 a	32 a	21 ab	24 b	37 a
	1966–1976	37 ab	30 a	25 a	23 a	28 a	51 a	65 a	38 a	29 a	22 ab	15 b	31 ab
	1985–1995	23 b	31 a	40 a	24 a	33 a	36 a	47 a	36 a	44 a	16 b	13 b	24 b
	1996–2006	23 b	26 a	27 a	20 a	30 a	41 a	51 a	42 a	32 a	15 b	16 b	29 b
	p-value	**.0456**	.3166	.4439	.5166	.8273	.1197	.0505	.9616	.1726	**.0021**	**.0064**	**.0164**
Louisville	1934–1944	41 a	46 a	43 a	23 a	39 a	53 a	56 a	45 a	36 a	19 a	21 a	43 a
	1951–1961	31 ab	31 a	26 a	24 a	35 a	61 a	53 a	39 a	31 a	21 a	23 a	38 ab
	1966–1976	36 a	30 a	24 a	23 a	31 a	49 a	59 a	37 a	29 a	21 a	15 a	30 abc
	1985–1995	33 a	37 a	41 a	31 a	33 a	63 a	60 a	39 a	40 a	16 a	11 a	22 bc
	1996–2006	17 b	24 a	21 a	15 a	31 a	38 a	46 a	39 a	29 a	15 a	15 a	22 c
	p-value	**.0138**	.2951	.0628	.4678	.7336	.1865	.2559	.6653	.3796	.1340	.3563	**.0143**

Table 12. Existence of probable temporal differences in nonredundant hydrologic indices of streamflow-regime categories for Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1934–2006.

[x, statistical comparisons indicated that temporal differences potentially existed among the 11-water-year periods: 1934–1944, 1951–1961, 1966–1976, 1985–1995, and 1996–2006; --, statistical comparison indicated no temporal difference among period; Definitions of hydrologic indices are presented in table 3]

Category	Nonredundant hydrologic indices	Stations				
		Duncan	North Bend	Leshara	Ashland	Louisville
Magnitude	Variability across annual discharge (MA43)	x	--	--	--	--
	Variability across minimum monthly streamflow values (ML13)	x	--	--	--	--
	Ratio of total discharge and base streamflow (ML20)	x	--	--	--	--
	Variability in base streamflow (ML18)	x	--	--	--	--
	High peak streamflow (MH26)	--	--	x	x	x
Frequency	Variability in low-flood pulse count (FL2)	x	x	x	x	x
	Frequency of low pulse spells (FL3)	x	--	--	--	--
	Variability in high-streamflow pulse count (FH2)	x	x	x	x	x
	Flood frequency (FH7)	x	--	--	--	--
	Flood frequency (FH8)	--	--	x	x	x
Duration	Annual minimum daily streamflow (DL1)	x	--	--	x	x
	Low exeedence streamflow (DL14)	x	--	--	--	--
	Variability in low pulse duration (DL17)	x	x	x	x	x
	Variability in the number of zero-streamflow days (DL19)	x	--	--	--	--
	Annual maximum daily streamflow (ft^3/s) (DH1)	--	--	--	--	--
	Annual maximum of 3-day moving average streamflow (ft^3/s) (DH2)	--	--	--	--	--
	Variability of annual maximum of 1-day moving average streamflow (DH6)	--	--	x	x	x
	Variability of annual maximum of 3-day moving average streamflow (DH7)	--	--	x	x	x
	Flood duration (DH14)	--	--	--	--	--
Timing	Seasonal predictability of flooding (TA3)	--	--	--	--	--
	Seasonal predictability of nonlow streamflow (TL4)	x	--	--	--	--
	Seasonal predictability of nonflooding (TH3)	--	--	--	--	--
Rate of change	Rise rate (RA1)	--	--	--	--	--
	Fall rate (RA3)	--	--	--	--	--
	Variability (coefficient of variation) of rise rate (RA2)	--	--	--	--	--
	Variability in fall rate (RA4)	--	--	--	--	--
	Streamflow fluctuations (RA8)	--	x	x	--	--

Table 13. Nonredundant hydrologic indices of streamflow magnitude and frequency at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1934–2006.

[MA43, variability across annual discharge; ML13, variability across minimum monthly streamflow values, in percent; ML20, ratio of total discharge and base streamflow; ML18, variability in base streamflow, in percent; MH26, upper and lower quartile of high peak streamflow ratio; FL2, variability in low-flood pulse count, in percent; FL3, lower and upper quartile of frequency of low pulse spells, in events/year; FH2, variability in high-streamflow pulse count, in events/year; FH7, lower and upper quartile of flood frequency using a threshold equals to seven times of median streamflow values, in events/year; FH8, lower and upper quartile of flood frequency using a threshold equal to 25-percent exeedence, in events per year]

Station name	Period of water years	MA43	ML13	ML20	ML18	MH26	FL2	FL3	FH2	FH7	FH8
Duncan	1934–1944	0.70	189	0.52	210	7.6 – 15.8	55	2 – 7	52	3 – 8	8 – 14
	1951–1961	.91	115	.61	297	7.4 – 10.8	45	3 – 5	43	0 – 1	6 – 13
	1966–1976	.98	115	.79	117	7.4 – 12.5	68	1 – 4	67	0 – 1	8 – 12
	1985–1995	.83	88	.73	107	7.9 – 9.2	54	0 – 2	54	0 – 1	8 – 17
	1996–2006	1.45	105	.75	124	7.5 – 9.6	86	0 – 3	97	0 – 1	5 – 19
North Bend	1934–1944	.43	60	.65	28	7.7 – 12.3	36	0 – 0	29	0 – 1	8 – 14
	1951–1961	.30	63	.64	46	8.8 – 14.1	37	0 – 0	46	0 – 2	6 – 13
	1966–1976	.49	77	.70	61	7.5 – 16.3	44	0 – 0	42	0 – 2	8 – 12
	1985–1995	.54	61	.70	49	8.2 – 12.2	43	0 – 0	37	0 – 1	8 – 17
	1996–2006	.72	65	.71	41	8.0 – 10.6	56	0 – 0	67	0 – 0	5 – 19
Leshara	1934–1944	.43	60	.65	29	7.7 – 12.1	34	0 – 0	27	0 – 1	8 – 13
	1951–1961	.31	61	.66	44	7.4 – 13.0	31	0 – 0	45	0 – 2	5 – 11
	1966–1976	.48	74	.73	58	7.7 – 13.8	47	0 – 0	51	0 – 1	6 – 8
	1985–1995	.52	59	.71	54	7.2 – 11.8	45	0 – 0	24	0 – 1	10 – 14
	1996–2006	.75	64	.73	47	7.1 – 7.3	79	0 – 0	79	0 – 0	5 – 20
Ashland	1934–1944	.53	74	.59	31	8.2 – 12.3	37	0 – 0	29	0 – 3	10 – 15
	1951–1961	.66	71	.63	52	8.1 – 11.6	40	0 – 0	31	0 – 1	6 – 10
	1966–1976	.49	71	.68	51	7.6 – 11.5	51	0 – 0	57	0 – 1	5 – 10
	1985–1995	.72	62	.67	51	8.8 – 15.8	54	0 – 0	49	0 – 1	5 – 14
	1996–2006	.72	62	.71	52	7.6 – 8.0	74	0 – 0	63	0 – 0	4 – 15
Louisville	1934–1944	.53	72	.59	31	8.0 – 11.7	32	0 – 0	32	0 – 4	10 – 14
	1951–1961	.68	71	.63	45	8.4 – 11.3	40	0 – 0	29	0 – 1	7 – 10
	1966–1976	.50	69	.68	47	7.8 – 10.4	52	0 – 0	57	0 – 2	5 – 9
	1985–1995	.72	57	.64	45	7.9 – 11.7	66	0 – 0	41	0 – 1	8 – 17
	1996–2006	.79	59	.73	41	7.5 – 8.3	86	0 – 0	61	0 – 0	5 – 14

Duration of Streamflow Events

Temporal differences for low-flow duration indices were mainly evident for the outflow from the central Platte River system at Duncan; annual minimum daily streamflow (DL1), low exceedence flows (DL14), and variability in the number of zero-flow days (DL19) were lowest in the 1934–44 drought period especially compared to the moderately wet 1985–95 period (table 14). Temporal differences in DL1 between the dry 1934–44 period and the wet 1985–95 period also were evidenced for the lower Platte River system at Ashland and Louisville stations. Once again, these potential temporal differences contrast the driest and wettest periods, based on the PHDI values. Variability in low-flow pulse duration (DL17) for all stations consistently was highest in the 1966–76 period.

Three of five high-streamflow duration indices, that is, annual maximum daily flow (DH1), annual maximum of 3-day moving-average flow (DH2), and flood duration (DH14) did not differ among the periods. The other two, that is, variability of annual maximum of 1-day moving-average flows (DH6) and variability of annual maximum of 3-day moving-average flows (DH7) (table 14) evidenced potential differences among periods. The DH6 and DH7 variability indices were the least during the 1996–2006 period for all the stations on the lower Platte River. Once again, note that the DH6 and DH7 were calculated relative to the mean of annual maximum of 1-day moving-average streamflow and the mean of annual maximum of 3-day moving-average streamflow values, respectively, which varied among station and period combinations.

Timing of Streamflow Events

Temporal differences among the periods in streamflow timing indices were inconclusive, in part because of lack of peak streamflow data for years when gaging stations were inactive. Seasonal predictability of flooding (TA3), the seasonal predictability of nonlow streamflow (TL4), and the seasonal predictability of nonflooding (TH3) indices for some station-period combinations could not be computed by the HIP software because peak streamflow data were unavailable (table 15). This limitation did not affect Duncan station, which indicated that the TL4 values were the least in the dry 1934–44 period. The TL4 refers to the maximum proportion of the year (number of days/365) during which streamflow was above the 5-year-flood threshold (table 3).

Rate of Change of Streamflow Events

Generally there were no temporal differences in the indices of rate of change for the rise rate (RA1), variability of rise rate (RA2), fall rate (RA3), and variability in fall rate (RA4) for any stations on the Platte River. Number of streamflow fluctuations (RA8) for the lower Platte River gaging stations was generally higher in the 1966–76, 1985–95, and 1996–2006 periods than in the 1934–44 and 1951–61 periods for North Bend and Leshara stations (table 15). The temporal differences in part were caused by the climate differences among these periods. The majority of streamflow at North Bend and Leshara stations originates from the Loup River and Shell Creek systems, which are under climatic division 2 and 5. Correlation analysis evidenced positive and significant correlation of the annual streamflow fluctuations at North Bend with annual median PHDI values of climate division 5 (Kendall's tau=0.22, p=0.02); although at Leshara station, the correlation was positive but not significant (Kendall's tau=0.22, p=0.18). Positive correlation indicated more streamflow fluctuations as the PHDI increased (wetter).

Additional inspection of annual number of fluctuations also indicated that the variability in annual streamflow fluctuations was higher in the 1985–95 and 1996–2006 periods for North Bend and Leshara stations. Streamflow at North Bend and Leshara stations are mainly from the Loup River, whose water is diverted to the Loup Power Canal (*http://www.loup.com/elec-gen.asp*, verified November 14, 2007). Perhaps streamflow fluctuations from hydroelectric generation traveled and were detected downstream at North Bend and Leshara stations. As the streamflow traveled further downstream and joined the streamflow from the Elkhorn River, no potential temporal difference in streamflow fluctuations was observed for Ashland station and further downstream at Louisville station. Note that RA8 indicates count of streamflow fluctuations, not the rate of fluctuations (table 3). These results and the variation in annual streamflow fluctuations indicates that increased streamflow regulation and management since 1962 may also play a part in the potential increased number of these fluctuations.

Summary and Conclusion

In cooperation with the Lower Platte South Natural Resources District for a collaborative study of the cumulative effects of water and channel management practices on stream and riparian ecology, the U.S. Geological Survey (USGS) compiled, analyzed, and summarized hydrologic information from long-term gaging stations on the lower Platte River to determine any significant temporal differences among six discrete periods during 1895–2006 and to interpret any significant changes in relation to changes in climatic conditions or other factors.

The lower Platte River basin was affected by moderate to severe drought conditions in the 1934–44 period. The widespread drought was preceded by mildly to moderately wet conditions in the 1895–1906 period, followed by incipient drought to incipiently wet conditions in the 1951–61 period and mildly wet condition in 1966–76 period, moderately wet conditions in the 1985–1995 period, and incipient drought to mildly wet conditions in the 1996–2006 period. Rank correlations of monthly streamflow and monthly Palmer Hydrological Drought Index (PHDI) were stronger than those of

Table 14. Nonredundant hydrologic indices of streamflow duration at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1934–2006.

[DL1, lower and upper quartile of annual minimum daily streamflow, in cubic feet per second; DL14, low exeedence streamflow; DL17, variability in low pulse duration, in percent ; DL19, variability in the number of zero-streamflow days, in percent; DH1, lower and upper quartile of annual maximum daily streamflow, in cubic feet per second; DH2, lower and upper quartile of annual maximum of 3-day moving average streamflow, in cubic feet per second; DH6, variability of annual maximum of 1-day moving average streamflow, in percent; DH7, variability of annual maximum of 3-day moving average streamflow, in percent; DH14, flood duration, dimensionless]

Station name	Period of water years	DL1	DL14	DL17	DL19	DH1	DH2	DH6	DH7	DH14
Duncan	1934–1944	0 – 0	0.01	62	66	5,450 – 14,500	5,377 – 12,767	57	57	0
	1951–1961	0 – 6	.13	50	169	4,160 – 7,690	3,853 – 6,080	77	74	0
	1966–1976	1 – 82	.50	94	267	5,370 – 12,000	5,287 – 10,800	63	65	.05
	1985–1995	6 – 290	.54	29	332	6,400 – 15,300	5,423 – 13,567	47	49	.18
	1996–2006	0 – 380	.34	69	122	2,470 – 9,603	2,030 – 9,123	63	65	0
NorthBend	1934–1944	490 – 827	.71	44	0	11,680 – 30,750	9,370 – 21,660	52	55	.32
	1951–1961	388 – 1,030	.65	52	0	15,800 – 52,300	13,700 – 45,667	85	81	.32
	1966–1976	269 – 648	.62	73	0	13,000 – 32,200	11,333 – 30,200	69	61	.26
	1985–1995	500 – 1,190	.68	42	0	17,900 – 38,000	16,267 – 30,000	66	59	.39
	1996–2006	321 – 720	.65	47	0	8,620 – 21,500	7,250 – 18,267	54	50	.32
Leshara	1934–1944	416 – 818	.71	61	0	11,100 – 27,010	9,443 – 21,620	54	55	.32
	1951–1961	431 – 1,054	.65	42	0	14,458 – 49,850	13,562 – 45,729	79	80	.32
	1966–1976	337 – 811	.62	77	0	12,049 – 31,823	11,390 – 30,734	63	61	.25
	1985–1995	511 – 1,367	.69	42	0	17,828 – 34,173	16,405 – 27,165	46	42	.38
	1996–2006	299 – 1,700	.61	62	0	10,400 – 20,700	9,917 – 19,100	39	38	.27
Ashland	1934–1944	416 – 620	.62	29	0	12,500 – 39,400	11,200 – 37,100	65	62	.27
	1951–1961	260 – 1,100	.63	41	0	19,700 – 44,100	16,567 – 38,500	71	69	.30
	1966–1976	532 – 1,129	.64	101	0	17,093 – 46,729	15,369 – 42,093	73	76	.21
	1985–1995	840 – 2,410	.69	40	0	26,136 – 62,700	22,604 – 55,712	58	57	.33
	1996–2006	417 – 1,940	.65	59	0	19,500 – 32,200	15,567 – 30,000	32	34	.28
Louisville	1934–1944	468 – 775	.63	19	0	13,358 – 40,781	11,930 – 38,864	63	61	.30
	1951–1961	330 – 1,150	.64	38	0	21,334 – 45,512	17,861 – 39,848	75	72	.29
	1966–1976	625 – 1,280	.64	146	0	17,900 – 47,700	15,800 – 43,200	70	73	.22
	1985–1995	1,120 – 2,470	.68	57	0	33,700 – 88,300	28,733 – 69,667	53	53	.28
	1996–2006	685 – 1,760	.62	61	0	19,000 – 40,800	15,200 – 37,133	40	39	.32

Table 15. Nonredundant hydrologic indices of streamflow timing and rate of change at the Platte River gaging stations near Duncan, North Bend, Leshara, Ashland, and Louisville, Nebraska, 1934–2006.

[TA3, seasonal predictability of flooding, unitless; TL4, seasonal predictability of non-low streamflow, unitless; TH3, seasonal predictability of non flooding, unitless; RA1, lower and upper quartile of rise rate, in cubic feet per second per year; RA3, lower and upper quartile of fall rate, in cubic feet per second per day; RA2, variability (coefficient of variation) of rise rate, in percent; RA4, variability in fall rate, in percent; RA8, lower and upper quartile of number of streamflow fluctuations, in days per year; NC, not computed]

Station Name	Period of water years	TA3	TL4	TH3	RA1	RA2	RA3	RA4	RA8
Duncan	1934–1944	0.50	0.11	0.42	20 – 250	240	-210 – -15	-203	66 – 101
	1951–1961	.64	.20	.36	33 – 220	211	-180 – -20	-206	89 – 114
	1966–1976	.36	.46	.34	40 – 200	213	-190 – -33	-175	87 – 118
	1985–1995	.57	.26	.42	50 – 256	164	-220 – -48	-150	90 – 111
	1996–2006	.50	.73	.39	32 – 200	190	-180 – -29	-154	84 – 106
North Bend	1934–1944	NC	NC	NC	54 – 393	258	-437 – -64	-204	103 – 127
	1951–1961	.63	.16	.41	120 – 640	302	-723 – -140	-228	125 – 137
	1966–1976	.67	.17	.44	110 – 600	270	-635 – -140	-219	153 – 181
	1985–1995	.50	.08	.43	160 – 770	255	-810 – -180	-177	148 – 182
	1996–2006	.44	.22	.39	130 – 568	194	-640 – -136	-134	152 – 180
Leshara	1934–1944	NC	NC	NC	56 – 444	225	-406 – -58	-186	98 – 113
	1951–1961	NC	NC	NC	90 – 533	288	-575 – -92	-240	94 – 105
	1966–1976	NC	NC	NC	82 – 424	255	-445 – -92	-217	111 – 130
	1985–1995	.00	.00	1.00	165 – 774	237	-843 – -170	-167	152 – 181
	1996–2006	.40	.29	.39	127 – 549	185	-610 – -130	-129	148 – 186
Ashland	1934–1944	.67	.10	.35	100 – 680	253	-670 – -110	-210	117 – 151
	1951–1961	.50	.07	.41	100 – 660	284	-710 – -120	-208	113 – 147
	1966–1976	NC	NC	NC	109 – 635	280	-688 – -116	-253	141 – 167
	1985–1995	.63	.09	.44	169 – 900	260	-940 – -168	-236	139 – 171
	1996–2006	.40	.06	.39	139 – 668	234	-700 – -160	-170	139 – 165
Louisville	1934–1944	NC	NC	NC	104 – 714	249	-703 – -117	-207	117 – 149
	1951–1961	.50	.16	.41	114 – 693	292	-777 – -137	-210	118 – 147
	1966–1976	.38	.10	.39	130 – 700	274	-708 – -140	-253	132 – 165
	1985–1995	.42	.10	.23	220 – 1,398	246	-1,450 – -230	-247	144 – 167
	1996–2006	.50	.13	.54	150 – 742	233	-760 – -170	-175	141 – 166

streamflow and monthly precipitation. Correlations of monthly streamflow with monthly PHDI were significant for all months and stations.

The temporal differences in monthly mean and monthly maximum streamflow between the two wet periods (1895–1905 and 1985–95) indicated the effects of increased storage and flow regulation on streamflow magnitude and amplitude—the difference between the highest and lowest median values of monthly mean streamflow. Monthly mean and monthly maximum streamflow from April through July (typically wet months) were the highest in the 1895–1905 period, the period prior to building of most major storage reservoirs and many other water management projects in the Platte River basin; however, during August through November (post-snowmelt months) the monthly streamflow in the 1895–1905 period were either less than or similar to those in the 1985–95 period. The effects of storage reservoirs and streamflow regulation on monthly minimum streamflow were less obvious.

The temporal differences among the other five periods, from 1934 through 2006 when major storage reservoirs were operational and streamflows were largely affected by regulation and water management, were dominated by contrasts between the periods with climate differences; the monthly mean, maximum, and minimum streamflow in the 1934–44 drought period were significantly lower than those in the 1985–96 moderately wet period. The temporal differences among the periods in monthly coefficients of streamflow skewness and variability were evident mainly for the central Platte River system at Duncan station. Skewness and variability of monthly streamflow generally were highest either in the 1934–44 or 1951–61 period for Duncan station, the periods of drought and mixed climatic conditions, respectively; the skewness coefficients generally were smallest in the 1985–1995 or 1996–2006 periods.

The skewness and variability of monthly flow, and the count of nonredundant indices that showed potential temporal differences among the periods, both pointed to a difference in streamflow regimes between the central Platte River system at Duncan station and the stations on the lower Platte River. Seven out of 13 indices for the central Platte River system at Duncan station that evidenced potential temporal differences were indices of flow variability; for the lower Platte River stations, five out of nine indices that evidenced potential temporal differences were indices of streamflow variability.

The nonredundant indices of the streamflow regime from the central Platte River system computed for Duncan station potentially had the largest variability in base flow and monthly minimum streamflow values, highest frequency of low-flow pulses, lowest flood frequency, largest number and least variability of zero-flow days, and largest variability of the daily and monthly flows during the 1934–44 and 1951–61 periods.

Nonredundant indices that evidenced potential temporal differences at two or more stations on the lower Platte River were: high peak streamflow (MH26), variability in low-flood pulse count (FL2), variability in high-flow pulse count (FH2), flood frequency (FH8), annual minimum daily streamflow (DL1), variability in low-flow pulse duration (DL17), variability of annual maximum of 1-day moving-average streamflow (DH6), variability of annual maximum of 3-day moving-average streamflow (DH7), and number of streamflow fluctuations (RA8). No other nonredundant indices indicated existence of temporal differences for the lower Platte River stations. The FL2 and FH2 indices were generally highest in the 1996–2006 period because this period was a mixture of five wet years (1996–2000) and six drought years. The RA8 was higher in the 1966–76, 1985–95, and 1996–2006 periods than those in the 1934–44 and 1951–61 periods, which associated with climate, streamflow regulation, and water management.

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Appendixes

Appendix 1. Lower and upper quartile values of monthly precipitation for the 11-water-year periods for four Nebraska climate divisions drained by the lower Platte River from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are precipitation in inches]

Climate division	Period of water years	January	February	March	April	May	June
2	1895–1905	0.19 – 0.52	0.39 – 0.88	0.60 – 1.85	1.38 – 3.37	1.84 – 4.35	2.97 – 4.92
	1934–1944	0.31 – 0.81	0.45 – 1.00	0.91 – 1.56	1.46 – 3.33	1.73 – 4.74	2.70 – 4.17
	1951–1961	0.16 – 0.52	0.36 – 1.11	0.78 – 1.33	1.23 – 3.03	2.66 – 4.75	2.75 – 3.80
	1966–1976	0.31 – 0.64	0.21 – 0.47	0.43 – 1.11	1.5 – 3.46	2.04 – 3.64	2.82 – 4.28
	1985–1995	0.20 – 0.59	0.36 – 0.90	0.66 – 2.24	0.95 – 3.52	1.51 – 5.21	2.50 – 4.59
	1996–2006	0.21 – 0.47	0.31 – 0.70	0.57 – 1.80	1.66 – 3.83	2.63 – 3.69	2.43 – 5.08
3	1895–1905	0.18 – 0.8	0.47 – 1.18	0.42 – 1.28	1.68 – 3.31	2.53 – 5.25	3.50 – 4.72
	1934–1944	0.39 – 1.48	0.68 – 1.60	0.67 – 2.2	0.99 – 3.99	2.36 – 4.28	3.10 – 5.21
	1951–1961	0.21 – 0.98	0.65 – 1.39	0.99 – 2.11	1.70 – 4.00	2.61 – 5.23	2.96 – 5.32
	1966–1976	0.34 – 1.07	0.16 – 1.27	0.59 – 1.49	1.42 – 3.08	2.66 – 4.1	2.54 – 5.97
	1985–1995	0.24 – 0.86	0.34 – 0.86	0.90 – 2.98	1.36 – 4.21	3.03 – 4.75	1.97 – 5.27
	1996–2006	0.32 – 0.71	0.26 – 1.02	0.79 – 3.00	2.12 – 4.38	2.67 – 5.76	3.13 – 5.9
5	1895–1905	0.17 – 0.51	0.36 – 1.00	0.35 – 1.17	1.72 – 5.03	2.01 – 4.77	3.78 – 5.57
	1934–1944	0.20 – 0.96	0.46 – 0.86	0.54 – 1.33	1.46 – 2.86	1.20 – 4.39	2.90 – 4.99
	1951–1961	0.17 – 0.59	0.41 – 1.02	0.68 – 1.79	1.65 – 3.28	3.02 – 5.81	2.75 – 4.64
	1966–1976	0.14 – 0.59	0.12 – 0.78	0.40 – 1.19	1.38 – 2.73	1.49 – 3.85	2.36 – 4.93
	1985–1995	0.27 – 1.17	0.26 – 0.85	0.44 – 2.84	0.78 – 2.68	2.52 – 4.39	3.22 – 4.88
	1996–2006	0.18 – 0.48	0.14 – 0.90	0.50 – 2.24	1.51 – 4.35	2.61 – 4.01	2.05 – 5.27
6	1895–1905	0.34 – 0.84	0.38 – 1.43	0.52 – 1.23	2.18 – 3.86	2.28 – 6.53	3.43 – 5.27
	1934–1944	0.20 – 1.28	0.74 – 1.19	0.73 – 1.99	1.13 – 3.07	1.99 – 4.74	3.35 – 5.17
	1951–1961	0.33 – 0.79	0.74 – 1.70	0.85 – 2.62	1.84 – 3.48	2.20 – 5.41	3.13 – 5.72
	1966–1976	0.30 – 0.91	0.15 – 1.27	0.73 – 1.31	1.86 – 3.51	3.08 – 6.07	1.90 – 4.96
	1985–1995	0.34 – 1.08	0.30 – 0.82	0.24 – 3.08	1.42 – 3.51	2.93 – 4.83	2.31 – 5.86
	1996–2006	0.46 – 1.01	0.62 – 1.27	0.86 – 3.11	2.49 – 3.92	2.59 – 5.54	2.39 – 4.38
Climate division	**Period of water years**	**July**	**August**	**September**	**October**	**November**	**December**
2	1895–1905	2.22 – 5.15	2.42 – 3.18	1.15 – 2.95	0.99 – 1.66	0.34 – 0.79	0.13 – 0.63
	1934–1944	1.31 – 2.65	1.70 – 2.24	0.71 – 2.59	0.19 – 1.42	0.21 – 0.54	0.11 – 0.64
	1951–1961	1.24 – 3.76	1.64 – 3.06	0.42 – 2.31	0.38 – 1.72	0.35 – 0.91	0.18 – 0.76
	1966–1976	2.02 – 3.71	1.24 – 2.71	0.99 – 2.00	0.69 – 1.76	0.21 – 1.03	0.41 – 0.71
	1985–1995	2.23 – 4.56	2.27 – 3.19	1.68 – 3.4	0.54 – 2.00	0.66 – 1.39	0.22 – 0.50
	1996–2006	1.45 – 3.6	1.35 – 2.96	1.35 – 3.39	0.60 – 3.02	0.19 – 1.4	0.18 – 0.31
3	1895–1905	1.99 – 5.64	2.79 – 4.56	1.69 – 3.76	1.27 – 2.91	0.34 – 1.14	0.15 – 1.06
	1934–1944	1.91 – 3.17	1.50 – 3.05	0.74 – 4.25	0.31 – 1.89	0.26 – 1.06	0.20 – 0.93
	1951–1961	1.99 – 4.06	2.25 – 4.45	0.90 – 2.93	0.47 – 2.47	0.51 – 1.31	0.18 – 0.89
	1966–1976	1.66 – 3.59	1.20 – 3.44	1.30 – 2.71	1.25 – 3.02	0.22 – 1.58	0.59 – 1.02
	1985–1995	1.97 – 5.74	2.49 – 4.26	2.66 – 4.05	0.58 – 3.11	0.95 – 1.36	0.51 – 0.73
	1996–2006	1.66 – 3.85	1.65 – 4.86	1.09 – 4.11	0.77 – 3.09	0.48 – 2.55	0.14 – 0.49
5	1895–1905	2.09 – 5.16	2.82 – 3.55	1.21 – 3.96	0.75 – 2.52	0.25 – 0.98	0.17 – 0.78
	1934–1944	0.93 – 2.95	1.34 – 2.19	0.78 – 2.79	0.23 – 1.13	0.11 – 0.68	0.10 – 0.84
	1951–1961	1.90 – 3.24	1.62 – 3.28	0.66 – 2.45	0.35 – 2.01	0.15 – 0.62	0.15 – 0.56
	1966–1976	2.42 – 4.03	1.31 – 2.41	1.30 – 3.04	0.97 – 2.13	0.16 – 1.89	0.39 – 1.08
	1985–1995	2.03 – 4.99	1.83 – 3.36	1.41 – 3.74	0.67 – 2.14	0.50 – 1.39	0.37 – 0.92
	1996–2006	1.13 – 3.81	1.58 – 3.90	0.66 – 4.41	0.69 – 2.6	0.26 – 2.03	0.08 – 0.26
6	1895–1905	2.15 – 5.73	2.81 – 5.41	1.83 – 5.12	1.79 – 3.08	0.23 – 1.17	0.33 – 1.25
	1934–1944	1.65 – 3.86	1.92 – 3.33	0.87 – 3.66	0.43 – 2.11	0.14 – 1.62	0.17 – 1.29
	1951–1961	2.26 – 3.88	3.02 – 5.82	1.34 – 3.32	0.43 – 2.17	0.45 – 1.71	0.20 – 0.93
	1966–1976	1.89 – 3.45	1.12 – 3.67	1.40 – 4.30	0.67 – 3.59	0.20 – 2.31	0.73 – 1.57
	1985–1995	2.73 – 6.73	2.12 – 4.88	2.12 – 5.08	1.10 – 2.76	0.73 – 1.91	0.67 – 1.12
	1996–2006	2.09 – 4.16	1.71 – 4.40	1.03 – 3.98	0.79 – 2.75	0.74 – 2.57	0.25 – 0.60

Appendix 2. Lower and upper quartile values of monthly Palmer Hydrological Drought Index, by climate division and 11-water-year period, for four Nebraska climate divisions drained by the lower Platte River from Duncan through Louisville, Nebraska, 1895–2006.

Climate division	Period of water years	January	February	March	April	May	June
2	1895–1905	-1.06 – 3.88	-0.86 – -3.69	-0.79 – 3.24	-0.44 – 3.25	-1.23 – 3.07	0.61 – 3.81
	1934–1944	-3.97 – -1.58	-3.91 – -1.20	-3.83 – -1.26	-3.50 – -0.90	-4.27 – -0.79	-4.59 – -1.28
	1951–1961	-2.29 – 2.46	-1.90 – 2.52	-2.45 – 2.30	-3.58 – 2.61	-2.10 – 2.94	-1.61 – 2.81
	1966–1976	-1.40 – 1.97	-1.63 – 1.81	-1.83 – 1.29	-1.81 – 1.43	-2.35 – 1.80	-1.63 – 1.33
	1985–1995	-0.61 – 3.83	0.73 – 3.52	0.77 – 4.02	-2.04 – 4.94	-1.44 – 3.78	-1.18 – 3.69
	1996–2006	-1.05 – 3.84	-1.10 – 3.67	-2.00 – 2.73	-2.18 – 3.29	-1.89 – 3.02	-2.26 – 3.71
3	1895–1905	-0.95 – 3.24	-0.91 – 3.49	-1.22 – 2.92	-0.88 – 3.26	-0.78 – 2.80	-0.37 – 2.36
	1934–1944	-4.61 – -1.30	-4.39 – -1.14	-4.66 – -1.47	-3.93 – 0.60	-4.37 – -0.69	-3.73 – -0.30
	1951–1961	-2.10 – 2.13	-2.16 – 2.25	-1.77 – 2.56	-2.46 – 2.70	-3.27 – 3.61	-2.62 – 3.98
	1966–1976	-0.95 – 2.98	-0.99 – 2.97	-1.75 – 2.59	-1.50 – 1.98	-1.88 – 1.88	-0.96 – 2.43
	1985–1995	-2.21 – 4.62	-2.41 – 4.08	-2.4 – 4.94	-2.09 – 4.66	-2.14 – 3.99	-3.17 – 3.51
	1996–2006	0.59 – 3.49	-0.57 – 3.50	-0.82 – 2.99	0.85 – 2.43	0.43 – 3.29	0.60 – 2.70
5	1895–1905	-0.63 – 4.91	0.08 – 4.30	-1.07 – 3.34	0.73 – 3.32	0.11 – 3.18	-0.52 – 3.87
	1934–1944	-5.23 – -1.38	-5.01 – -1.09	-5.57 – -1.59	-5.06 – -1.78	-4.92 – -1.63	-5.03 – -1.11
	1951–1961	-3.22 – 1.70	-3.03 – 2.09	-3.52 – 2.1	-4.54 – 2.40	-3.82 – 2.89	-3.01 – 2.07
	1966–1976	0.70 – 2.01	0.67 – 2.28	-1.31 – 3.29	-1.02 – 3.20	-1.59 – 1.96	-0.74 – 2.40
	1985–1995	1.02 – 4.41	0.92 – 4.07	0.47 – 4.32	0.26 – 4.10	0.91 – 4.13	0.50 – 3.79
	1996–2006	-1.20 – 2.49	-1.48 – 2.44	-1.27 – 2.1	-1.81 – 2.25	-2.32 – 2.09	-3.04 – 1.42
6	1895–1905	-0.75 – 3.40	-0.62 – 3.63	-0.90 – 3.03	-0.75 – 3.54	-0.72 – 3.08	-0.69 – 3.06
	1934–1944	-5.55 – -1.64	-5.44 – -1.21	-5.22 – -1.39	-5.19 – -1.53	-4.98 – -1.72	-5.16 – -1.33
	1951–1961	-2.59 – 2.06	-2.50 – 2.63	-2.86 – 2.48	-3.32 – 2.75	-4.15 – 3.20	-3.62 – 3.21
	1966–1976	-1.21 – 3.43	-1.51 – 3.73	-1.47 – 3.22	-0.84 – 3.03	-0.99 – 2.75	-0.91 – 2.43
	1985–1995	-0.70 – 3.92	-1.06 – 3.74	0.47 – 3.72	0.56 – 3.64	-1.57 – 3.84	-1.54 – 2.83
	1996–2006	-1.84 – 1.66	-1.85 – 1.67	-1.99 – 1.06	-1.99 – 1.44	-1.48 – 1.79	-2.29 – 1.09

Climate division	Period of water years	July	August	September	October	November	December
2	1895–1905	-0.72 – 4.52	0.02 – 4.96	1.11 – 4.69	0.76 – 4.29	-0.52 – 3.82	-0.89 – 3.73
	1934–1944	-4.86 – -1.45	-5.36 – -1.76	-5.25 – -1.65	-4.75 – -2.26	-4.57 – -2.33	-4.47 – -2.24
	1951–1961	-2.20 – 3.21	-1.87 – 2.89	-1.79 – 2.70	-1.52 – 3.27	-1.96 – 3.26	-2.20 – 2.83
	1966–1976	-1.83 – 1.46	-2.19 – 1.32	-2.49 – 1.31	-1.44 – 1.99	-1.38 – 2.08	-1.34 – 2.02
	1985–1995	-1.69 – 4.94	-2.14 – 4.83	-2.02 – 4.83	-1.40 – 4.70	-0.78 – 4.71	-1.01 – 4.35
	1996–2006	-2.31 – 3.38	-3.09 – 3.56	-3.22 – 3.51	-2.35 – 4.72	-1.77 – 4.75	-1.77 – 4.31
3	1895–1905	-0.80 – 3.89	-0.51 – 5.00	-0.50 – 5.32	-0.24 – 3.96	-0.24 – 3.24	-0.66 – 2.99
	1934–1944	-4.77 – -0.61	-4.84 – -1.39	-4.88 – 0.92	-5.11 – -1.99	-4.74 – -2.07	-4.62 – -2.06
	1951–1961	-3.05 – 3.48	-3.79 – 3.93	-2.46 – 3.34	-1.93 – 2.66	-1.70 – 2.36	-1.95 – 2.02
	1966–1976	-1.63 – 2.86	-1.82 – 2.23	-1.53 – 2.54	-0.99 – 2.72	-1.01 – 2.88	-0.91 – 3.31
	1985–1995	-2.49 – 3.88	-2.41 – 4.38	-2.54 – 4.06	-2.71 – 5.06	-2.44 – 4.90	-2.33 – 5.10
	1996–2006	-1.62 – 2.43	0.24 – 3.29	1.20 – 2.43	1.03 – 3.19	0.86 – 3.86	0.58 – 3.55
5	1895–1905	0.58 – 4.93	1.15 – 5.15	1.3 – 5.41	1.48 – 5.89	0.94 – 5.29	0.71 – 4.67
	1934–1944	-6.05 – -1.39	-6.38 – -1.16	-6.64 – -1.26	-6.39 – -1.59	-5.75 – -1.80	-5.30 – -2.00
	1951–1961	-4.05 – 3.27	-2.84 – 2.77	-3.44 – 2.28	-2.82 – 2.49	-3.16 – 2.27	-3.43 – 1.93
	1966–1976	0.92 – 1.98	0.90 – 2.20	0.69 – 1.83	0.94 – 2.56	1.20 – 2.16	1.08 – 2.23
	1985–1995	0.17 – 4.36	0.54 – 4.20	1.33 – 3.8	0.98 – 4.86	1.00 – 4.86	0.98 – 4.84
	1996–2006	-2.36 – 1.04	-2.92 – 2.21	-2.68 – 2.83	-2.59 – 3.12	-1.78 – 3.22	-1.86 – 2.82
6	1895–1905	0.30 – 3.92	0.60 – 4.80	-0.79 – 5.59	-0.98 – 4.13	-0.92 – 3.41	-0.99 – 3.09
	1934–1944	-5.02 – -0.92	-5.36 – -1.05	-5.98 – -1.29	-5.78 – -1.79	-5.79 – -1.88	-5.71 – -1.65
	1951–1961	-3.21 – 3.28	-2.41 – 3.93	-2.56 – 3.07	-3.11 – 2.73	-2.72 – 2.26	-2.53 – 2.01
	1966–1976	-0.94 – 2.43	-1.34 – 2.06	-1.68 – 1.66	-1.00 – 2.41	-1.16 – 2.57	-1.16 – 3.36
	1985–1995	1.26 – 2.98	0.69 – 3.47	-0.99 – 3.60	-0.91 – 3.53	-0.99 – 3.61	-0.86 – 3.74
	1996–2006	-1.87 – 0.80	-1.80 – 1.81	-1.21 – 1.99	-1.58 – 1.69	-1.86 – 1.85	-2.07 – 1.72

Appendix 3. Lower and upper quartile values of monthly mean streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are streamflow in cubic feet per second; NC, not computed]

Station name	Period of water years	January	February	March	April	May	June
Duncan	1895–1905	NC	NC	2,817 – 9,688	4,339 – 8,136	5,430 – 11,568	8,362 – 14,689
	1934–1944	42 – 2,000	616 – 2,161	1,226 – 3,362	560 – 1,868	236 – 3,172	274 – 1,491
	1951–1961	697 – 1,370	1,117 – 2,157	1,445 – 2,846	1,053 – 2,922	1,121 – 2,367	438 – 2,186
	1966–1976	1,205 – 1,863	1,691 – 3,076	1,813 – 3,686	1,736 – 2,817	1,001 – 3,092	733 – 7,866
	1985–1995	1,664 – 2,734	1,893 – 3,225	2,118 – 5,535	1,439 – 2,944	1,239 – 3,600	956 – 3,048
	1996–2006	822 – 2,553	988 – 3,531	929 – 3,253	837 – 3,038	738 – 2,723	272 – 3,648
North Bend	1895–1905	NC	NC	5,633 – 19,376	8,678 – 16,965	10,860 – 21,866	16,781 – 26,751
	1934–1944	1,951 – 3,559	2,575 – 4,709	3,611 – 7,313	3,327 – 4,709	2,885 – 7,897	3,583 – 6,361
	1951–1961	2,461 – 3,692	3,493 – 6,918	6,409 – 9,145	5,120 – 8,240	5,604 – 7,757	5,232 – 8,866
	1966–1976	2,810 – 3,355	3,709 – 7,646	5,030 – 9,212	4,357 – 5,495	2,993 – 6,956	3,337 – 11,764
	1985–1995	2,945 – 5,194	4,285 – 6,350	5,586 – 10,378	4,498 – 7,331	3,303 – 7,451	3,185 – 7,615
	1996–2006	1,884 – 5,161	2,885 – 6,532	3,829 – 6,466	3,763 – 8,031	3,056 – 6,508	2,925 – 8,255
Leshara	1934–1944	1,766 – 2,367	2,211 – 5,672	2,010 – 3,732	1,361 – 3,077	2,379 – 4,148	2,845 – 4,767
	1951–1961	2,496 – 3,657	3,467 – 6,597	6,454 – 9,407	5,154 – 8,325	5,644 – 7,696	5,348 – 9,867
	1966–1976	2,810 – 3,356	3,742 – 7,688	5,067 – 9,372	4,391 – 5,645	3,055 – 7,154	3,421 – 11,882
	1985–1995	3,405 – 5,319	4,981 – 6,656	6,216 – 10,276	4,895 – 7,821	3,825 – 8,537	3,116 – 8,174
	1996–2006	2,061 – 5,352	3,154 – 7,697	4,122 – 7,203	3,609 – 8,526	3,392 – 7,668	2,790 – 9,289
Ashland	1895–1905	NC	NC	NC	6,607 – 14,322	11,768 – 22,758	18,262 – 21,102
	1934–1944	1,836 – 4,461	2,342 – 7,231	1,975 – 4,365	1,346 – 3,607	2,293 – 4,035	2,877 – 5,138
	1951–1961	2,360 – 4,131	3,403 – 6,976	6,313 – 11,384	4,901 – 10,262	5,934 – 10,723	5,122 – 12,127
	1966–1976	3,407 – 3,956	4,770 – 10,223	6,252 – 13,988	5,547 – 9,197	4,309 – 10,742	4,307 – 15,883
	1985–1995	3,893 – 8,026	5,491 – 8,075	7,770 – 15,604	5,498 – 14,829	5,605 – 11,882	4,873 – 13,661
	1996–2006	2,675 – 5,710	4,118 – 8,978	5,460 – 9,554	5,728 – 11,557	6,126 – 12,163	5,138 – 15,094
Louisville	1934–1944	1,993 – 3,768	2,497 – 5,672	5,478 – 8,474	4,073 – 5,597	3,813 – 10,516	4,204 – 13,312
	1951–1961	2,471 – 4,280	3,596 – 7,434	6,616 – 12,345	5,050 – 10,666	6,397 – 11,255	5,585 – 12,858
	1966–1976	3,516 – 4,129	4,943 – 10,563	6,420 – 14,788	5,769 – 10,204	4,589 – 11,589	4,520 – 16,115
	1985–1995	6,456 – 12,277	7,607 – 13,511	9,118 – 24,839	6,705 – 18,913	7,926 – 14,899	6,596 – 16,572
	1996–2006	3,148 – 6,597	4,495 – 10,321	5,906 – 11,244	6,296 – 13,457	6,187 – 14,140	6,078 – 18,618

Appendix 3. Lower and upper quartile values of monthly mean streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.—Continued

[Tabled values are streamflow in cubic feet per second; NC, not computed]

Station name	Period of water years	July	August	September	October	November	December
Duncan	1895–1905	2,903 – 5,850	414 – 3,514	459 – 1,175	613 – 1,060	735 – 1,463	NC
	1934–1944	3 – 658	0 – 6	0 – 237	0 – 394	1 – 936	5 – 1,498
	1951–1961	19 – 911	4 – 136	1 – 63	10 – 914	756 – 1,179	739 – 1,152
	1966–1976	71 – 2,249	97 – 480	219 – 668	986 – 1,835	1,166 – 2,071	1,266 – 1,952
	1985–1995	973 – 1,782	581 – 1,547	684 – 2,032	675 – 3,056	940 – 2,503	1,119 – 2,632
	1996–2006	75 – 1,594	0 – 2,274	5 – 2,552	41 – 3,151	293 – 3,125	764 – 2,647
North Bend	1895–1905	5,805 – 12,188	862 – 6,989	918 – 2,349	1,227 – 2,121	1,469 – 2,926	NC
	1934–1944	1,262 – 3,374	963 – 1,604	1,560 – 2,756	1,663 – 2,372	1,977 – 2,798	1,822 – 3,253
	1951–1961	2,195 – 6,093	1,972 – 4,764	1,594 – 3,241	2,192 – 3,926	3,439 – 4,417	2,810 – 4,354
	1966–1976	1,235 – 4,590	800 – 1,960	1,264 – 2,497	2,710 – 4,552	3,246 – 4,928	3,103 – 3,899
	1985–1995	2,346 – 5,292	1,669 – 5,053	2,747 – 5,352	3,420 – 5,796	3,631 – 5,208	3,138 – 5,690
	1996–2006	1,427 – 3,450	1,486 – 4,168	1,804 – 4,623	2,354 – 5,572	2,935 – 6,057	2,634 – 5,218
Leshara	1934–1944	1,345 – 3,892	940 – 3,234	1,726 – 3,532	2,371 – 5,121	1,559 – 4,532	2,486 – 5,174
	1951–1961	2,298 – 6,360	2,024 – 4,874	1,603 – 3,335	2,206 – 3,920	3,508 – 4,461	2,786 – 4,390
	1966–1976	1,293 – 4,699	825 – 2,021	1,248 – 2,551	2,746 – 4,628	3,257 – 4,982	3,143 – 3,966
	1985–1995	2,420 – 6,125	1,720 – 5,523	2,687 – 5,661	3,452 – 5,911	3,806 – 5,192	3,529 – 5,936
	1996–2006	1,613 – 3,811	1,222 – 5,348	1,923 – 5,139	2,458 – 5,983	3,001 – 6,150	2,835 – 5,523
Ashland	1895–1905	10,060 – 21,945	2,262 – 11,894	2,056 – 5,600	3,111 – 5,633	1,971 – 5,496	NC
	1934–1944	1,275 – 4,086	1,474 – 3,663	2,360 – 4,671	2,786 – 6,635	1,579 – 5,255	2,780 – 9,326
	1951–1961	2,160 – 5,506	1,610 – 4,780	1,520 – 2,633	2,137 – 3,635	3,404 – 4,202	2,705 – 4,477
	1966–1976	2,185 – 5,511	1,114 – 2,837	1,442 – 3,142	3,253 – 5,496	3,726 – 6,025	3,402 – 5,095
	1985–1995	2,785 – 9,817	2,162 – 6,490	3,389 – 6,329	3,385 – 7,287	4,021 – 8,328	4,391 – 7,335
	1996–2006	2,526 – 5,601	1,698 – 7,523	2,095 – 5,668	2,985 – 7,153	3,684 – 7,935	3,618 – 6,240
Louisville	1934–1944	1,768 – 5,363	1,458 – 2,331	1,772 – 3,454	1,800 – 2,918	2,388 – 3,194	2,013 – 3,695
	1951–1961	2,273 – 6,083	1,952 – 5,614	1,624 – 2,889	2,247 – 3,858	3,525 – 4,307	2,815 – 4,576
	1966–1976	2,381 – 5,849	1,256 – 2,982	1,546 – 3,274	3,366 – 5,942	3,840 – 6,310	3,559 – 5,216
	1985–1995	5,135 – 12,759	2,288 – 8,170	4,015 – 10,552	4,205 – 9,261	4,842 – 9,992	5,723 – 10,906
	1996–2006	3,105 – 6,840	2,168 – 8,329	2,435 – 6,953	3,089 – 7,613	3,998 – 8,264	4,049 – 6,817

Appendix 4. Lower and upper quartile values of monthly maximum streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are streamflow in cubic feet per second; NC, not computed]

Station name	Period of water years	January	February	March	April	May	June
Duncan	1895–1905	NC	NC	5,660 – 13,600	7,800 – 22,100	10,700 – 23,200	14,900 – 24,600
	1934–1944	192 – 3,970	1,900 – 4,010	3,340 – 9,700	1,140 – 4,090	598 – 5,690	938 – 3,880
	1951–1961	1,190 – 2,010	2,000 – 4,600	2,280 – 6,210	2,120 – 4,780	2,190 – 5,840	1,390 – 4,700
	1966–1976	1,900 – 2,770	2,600 – 5,600	2,820 – 5,790	2,370 – 3,970	1,540 – 4,920	1,800 – 11,000
	1985–1995	2,100 – 3,500	2,700 – 7,200	2,980 – 10,000	2,490 – 3,730	1,900 – 6,460	2,000 – 7,320
	1996–2006	1,220 – 3,300	1,610 – 4,740	1,750 – 4,750	1,610 – 4,030	1,140 – 6,960	600 – 7,900
North Bend	1895–1905	NC	NC	11,320 – 27,200	15,600 – 50,500	21,400 – 45,800	29,800 – 49,200
	1934–1944	2,060 – 6,631	4,724 – 10,540	7,389 – 14,450	5,023 – 9,748	4,600 – 13,730	6,130 – 22,150
	1951–1961	4,200 – 5,760	5,910 – 13,900	9,450 – 19,900	8,180 – 14,400	8,560 – 21,200	8,080 – 24,600
	1966–1976	4,600 – 6,000	4,900 – 15,000	8,600 – 13,100	6,000 – 9,200	4,840 – 10,900	6,380 – 24,800
	1985–1995	4,500 – 7,660	6,500 – 17,000	10,000 – 38,000	6,040 – 13,300	6,640 – 11,400	7,400 – 21,000
	1996–2006	2,934 – 6,200	4,600 – 9,000	6,380 – 10,300	5,450 – 14,400	5,100 – 16,400	4,350 – 19,000
Leshara	1934–1944	2,150 – 4,847	3,512 – 21,770	2,626 – 7,646	2,030 – 3,999	5,290 – 6,634	5,657 – 10,830
	1951–1961	4,149 – 5,728	5,814 – 13,806	8,972 – 19,035	7,673 – 13,986	8,673 – 17,126	8,001 – 32,265
	1966–1976	4,602 – 5,678	5,275 – 15,453	8,372 – 13,038	5,753 – 9,367	4,974 – 10,429	6,039 – 18,893
	1985–1995	4,764 – 7,223	7,312 – 13,824	10,170 – 30,465	7,174 – 13,523	7,510 – 12,753	7,727 – 21,984
	1996–2006	3,100 – 6,750	5,000 – 11,000	7,600 – 14,600	4,899 – 15,100	5,670 – 19,057	6,061 – 16,000
Ashland	1895–1905	NC	NC	NC	12,439 – 35,995	23,670 – 40,420	30,540 – 47,770
	1934–1944	5,000 – 10,500	4,400 – 25,900	2,310 – 7,040	1,740 – 4,410	3,870 – 8,710	4,120 – 13,800
	1951–1961	4,000 – 6,160	5,780 – 23,500	9,360 – 29,300	7,520 – 19,700	8,400 – 24,000	10,700 – 43,300
	1966–1976	5,196 – 7,902	7,374 – 18,125	9,174 – 21,461	7,764 – 15,052	7,000 – 21,092	7,119 – 29,572
	1985–1995	5,400 – 13,705	8,113 – 14,708	11,600 – 36,572	7,980 – 27,865	9,290 – 26,400	9,665 – 40,000
	1996–2006	4,181 – 7,400	5,800 – 15,800	9,810 – 18,500	7,870 – 20,400	9,270 – 30,100	11,100 – 26,000
Louisville	1934–1944	2,668 – 7,229	4,222 – 12,983	12,039 – 17,776	5,757 – 9,483	7,634 – 21,824	9,830 – 36,744
	1951–1961	4,111 – 6,223	6,085 – 24,491	9,918 – 30,703	8,235 – 20,616	9,167 – 24,568	11,460 – 44,707
	1966–1976	5,400 – 8,080	7,600 – 18,700	9,300 – 25,200	8,260 – 15,800	7,130 – 24,800	7,420 – 30,800
	1985–1995	12,100 – 24,100	14,000 – 31,700	13,100 – 81,200	10,100 – 38,600	12,600 – 41,600	13,000 – 51,900
	1996–2006	5,023 – 9,400	6,400 – 18,000	10,100 – 17,300	7,730 – 22,100	10,500 – 32,000	11,800 – 34,100

Appendix 4. Lower and upper quartile values of monthly maximum streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.—Continued

[Tabled values are streamflow in cubic feet per second; NC, not computed]

Station name	Period of water years	July	August	September	October	November	December
Duncan	1895–1905	8,200 – 13,600	1,770 – 7,210	975 – 4,750	2,500 – 5,000	952 – 2,050	NC
	1934–1944	28 – 3,670	1 – 89	0 – 550	1 – 808	7 – 1,900	34 – 2,100
	1951–1961	170 – 2,980	21 – 720	12 – 288	80 – 1,410	1,110 – 2,360	1,500 – 2,090
	1966–1976	644 – 6,300	371 – 1,480	590 – 1,290	1,450 – 3,660	1,540 – 2,720	1,900 – 2,530
	1985–1995	2,730 – 4,360	1,250 – 3,230	1,050 – 3,760	902 – 3,810	1,220 – 3,040	1,600 – 3,500
	1996–2006	545 – 2,920	0 – 3,690	52 – 4,210	246 – 3,810	615 – 3,920	1,180 – 4,400
North Bend	1895–1905	13,610 – 27,200	4,000 – 14,420	1,950 – 9,500	5,000 – 10,000	1,903 – 4,100	NC
	1934–1944	2,304 – 10,080	1,947 – 4,852	2,080 – 9,169	2,264 – 3,616	2,501 – 3,754	2,551 – 4,689
	1951–1961	4,960 – 18,300	4,040 – 13,600	2,490 – 8,360	2,960 – 5,890	4,340 – 6,400	5,150 – 6,360
	1966–1976	3,520 – 9,960	1,370 – 5,070	2,380 – 3,730	4,000 – 13,400	4,500 – 6,400	4,740 – 7,600
	1985–1995	5,060 – 14,900	3,450 – 8,520	4,850 – 15,200	4,860 – 9,700	5,170 – 7,800	4,940 – 8,200
	1996–2006	2,770 – 8,000	2,604 – 7,040	2,940 – 8,620	3,127 – 7,120	3,650 – 8,490	3,850 – 7,670
Leshara	1934–1944	2,162 – 6,466	1,358 – 5,234	2,687 – 7,591	3,072 – 15,100	3,354 – 10,010	3,351 – 10,370
	1951–1961	4,343 – 17,380	3,980 – 11,980	2,767 – 7,581	2,928 – 5,283	4,280 – 5,520	4,903 – 6,289
	1966–1976	3,402 – 9,375	1,303 – 4,439	2,309 – 3,446	3,789 – 13,793	4,299 – 6,224	4,706 – 7,135
	1985–1995	5,650 – 17,255	3,857 – 9,749	5,189 – 16,962	4,961 – 9,813	5,194 – 7,681	5,164 – 8,072
	1996–2006	3,030 – 8,960	2,195 – 7,780	3,000 – 8,990	3,200 – 7,480	3,830 – 8,460	3,887 – 8,400
Ashland	1895–1905	20,824 – 39,740	4,340 – 21,394	3,600 – 16,560	4,080 – 12,810	2,581 – 7,940	NC
	1934–1944	2,330 – 7,950	3,340 – 8,170	4,510 – 11,700	3,810 – 21,000	3,310 – 15,800	4,430 – 24,400
	1951–1961	4,570 – 17,800	3,060 – 21,700	2,110 – 5,740	2,890 – 5,250	3,977 – 5,930	5,140 – 6,762
	1966–1976	5,979 – 10,982	1,914 – 5,465	2,281 – 4,471	4,373 – 16,928	5,036 – 7,410	5,020 – 7,608
	1985–1995	5,922 – 22,200	5,040 – 19,870	7,200 – 16,100	4,260 – 11,309	5,580 – 11,037	5,740 – 10,100
	1996–2006	5,720 – 18,700	2,830 – 23,200	3,880 – 11,000	3,789 – 10,200	4,470 – 13,200	5,270 – 8,920
Louisville	1934–1944	4,077 – 16,354	2,863 – 7,316	3,069 – 9,077	2,539 – 4,078	3,905 – 5,475	3,583 – 5,984
	1951–1961	5,107 – 18,276	3,663 – 24,963	2,354 – 6,204	3,054 – 5,604	4,901 – 6,038	5,241 – 6,781
	1966–1976	6,680 – 11,200	2,020 – 5,840	2,390 – 4,900	4,790 – 20,400	5,170 – 7,660	5,170 – 7,850
	1985–1995	11,500 – 35,300	3,850 – 27,400	11,400 – 30,200	5,600 – 13,000	6,050 – 13,200	8,410 – 15,800
	1996–2006	6,240 – 19,000	3,658 – 21,900	3,830 – 14,000	3,981 – 10,600	4,870 – 12,900	5,110 – 10,100

Appendix 5. Lower and upper quartile values of monthly minimum streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are streamflow in cubic feet per second; NC, not computed]

Station name	Period of water years	January	February	March	April	May	June
Duncan	1895–1905	NC	NC	995 – 7,050	1,300 – 3,240	2,050 – 6,700	4,320 – 6,700
	1934–1944	0 – 461	33 – 700	310 – 1,500	133 – 995	34 – 805	2 – 305
	1951–1961	300 – 510	450 – 750	590 – 1,640	578 – 1,730	385 – 1,100	23 – 622
	1966–1976	620 – 1,000	1,100 – 2,000	1,230 – 2,680	1,180 – 2,220	527 – 1,560	110 – 1,270
	1985–1995	960 – 1,630	1,100 – 2,600	1,390 – 2,840	764 – 2,400	764 – 1,940	351 – 1,230
	1996–2006	380 – 960	627 – 2,400	500 – 1,820	449 – 2,110	346 – 1,290	21 – 1,560
North Bend	1895–1905	NC	NC	1,990 – 14,100	2,600 – 6,480	3,430 – 10,930	8,620 – 11,000
	1934–1944	897 – 1,828	1,240 – 2,176	2,238 – 3,604	2,166 – 3,063	1,631 – 3,397	1,246 – 2,387
	1951–1961	794 – 2,000	1,630 – 3,350	2,710 – 4,980	3,850 – 5,320	3,430 – 5,050	2,300 – 4,310
	1966–1976	1,300 – 1,800	2,350 – 4,500	2,940 – 6,000	2,470 – 4,380	1,690 – 5,170	1,140 – 4,610
	1985–1995	1,850 – 4,000	2,700 – 3,760	2,990 – 5,850	2,970 – 4,100	1,830 – 4,570	1,460 – 3,570
	1996–2006	423 – 2,900	1,250 – 5,200	2,080 – 4,030	2,180 – 5,020	2,290 – 3,330	1,390 – 3,720
Leshara	1934–1944	837 – 2,021	1,289 – 2,271	1,311 – 2,108	921 – 1,964	1,249 – 2,107	1,210 – 2,275
	1951–1961	901 – 2,220	1,666 – 3,486	2,757 – 5,257	3,912 – 5,474	3,506 – 5,131	2,602 – 4,803
	1966–1976	1,367 – 1,946	2,401 – 4,581	3,209 – 6,150	2,677 – 4,483	1,772 – 5,250	1,370 – 4,464
	1985–1995	2,326 – 4,345	3,151 – 4,422	4,502 – 6,545	3,259 – 4,426	2,125 – 5,208	1,810 – 3,721
	1996–2006	1,350 – 3,600	1,600 – 5,000	2,650 – 5,200	2,371 – 5,830	2,563 – 4,330	1,520 – 4,660
Ashland	1895–1905	NC	NC	NC	2,916 – 5,377	4,562 – 11,865	9,162 – 11,640
	1934–1944	733 – 2,620	1,010 – 2,390	1,450 – 2,570	654 – 1,740	902 – 1,970	850 – 2,260
	1951–1961	673 – 2,620	1,680 – 3,600	2,720 – 4,860	3,780 – 6,430	3,450 – 5,660	2,230 – 3,859
	1966–1976	1,779 – 2,455	2,652 – 5,135	4,203 – 7,846	4,043 – 5,460	2,317 – 6,649	2,020 – 4,783
	1985–1995	2,162 – 4,240	1,870 – 4,530	4,850 – 7,261	4,530 – 7,578	3,240 – 6,639	2,747 – 5,936
	1996–2006	1,200 – 4,000	2,100 – 6,400	3,400 – 7,200	3,810 – 7,210	3,720 – 6,550	2,940 – 6,370
Louisville	1934–1944	771 – 1,552	1,066 – 1,552	2,130 – 3,815	2,122 – 4,008	1,698 – 4,261	1,438 – 4,236
	1951–1961	742 – 2,738	1,785 – 3,803	2,779 – 6,021	3,883 – 6,645	3,646 – 6,534	2,489 – 4,310
	1966–1976	1,900 – 2,600	2,800 – 5,400	4,310 – 8,110	4,200 – 5,610	2,440 – 6,760	2,130 – 5,190
	1985–1995	2,390 – 5,690	2,470 – 6,520	5,780 – 9,180	5,300 – 9,810	5,780 – 8,560	4,180 – 7,800
	1996–2006	1,800 – 4,960	2,700 – 7,000	4,170 – 7,220	4,800 – 8,640	4,660 – 7,310	3,630 – 7,990

Appendix 5. Lower and upper quartile values of monthly minimum streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.—Continued

[Tabled values are streamflow in cubic feet per second; NC, not computed]

Station name	Period of water years	July	August	September	October	November	December
Duncan	1895–1905	285 – 1,730	0 – 1,375	0 – 8	0 – 190	463 – 1,050	NC
	1934–1944	0 – 6	0 – 1	0 – 2	0 – 120	0 – 297	0 – 350
	1951–1961	0 – 116	0 – 11	0 – 6	0 – 420	3 – 777	170 – 510
	1966–1976	2 – 396	2 – 92	1 – 227	525 – 1,170	776 – 1,720	480 – 1,550
	1985–1995	78 – 595	108 – 350	46 – 1,160	269 – 2,450	530 – 1,380	700 – 1,940
	1996–2006	0 – 698	0 – 629	0 – 981	0 – 2,200	120 – 2,400	349 – 1,500
North Bend	1895–1905	1,510 – 3,460	0 – 2,760	0 – 16	0 – 380	925 – 2,100	NC
	1934–1944	692 – 1,557	710 – 1,110	912 – 1,647	1,192 – 1,774	1,239 – 2,011	509 – 1,346
	1951–1961	756 – 2,160	906 – 1,760	1,150 – 2,060	1,440 – 2,400	900 – 3,340	1,040 – 2,090
	1966–1976	332 – 1,160	269 – 694	380 – 1,440	1,890 – 2,400	1,230 – 3,770	1,100 – 1,750
	1985–1995	551 – 2,700	706 – 2,490	1,080 – 2,970	2,170 – 3,890	1,300 – 3,990	1,340 – 3,000
	1996–2006	458 – 1,810	321 – 1,730	1,120 – 2,850	1,508 – 4,100	2,050 – 5,440	720 – 2,000
Leshara	1934–1944	901 – 1,805	496 – 1,731	900 – 1,916	954 – 2,300	749 – 2,682	1,457 – 3,675
	1951–1961	791 – 2,199	948 – 1,896	1,255 – 2,105	1,535 – 2,532	976 – 3,570	1,080 – 2,261
	1966–1976	416 – 1,279	337 – 955	531 – 1,692	1,987 – 2,551	2,180 – 3,877	1,184 – 1,870
	1985–1995	736 – 2,766	668 – 2,214	845 – 3,121	2,239 – 3,983	1,397 – 4,060	1,635 – 3,130
	1996–2006	361 – 1,930	299 – 2,100	900 – 2,910	2,014 – 4,530	1,800 – 4,960	816 – 2,300
Ashland	1895–1905	2,647 – 8,892	877 – 4,290	750 – 1,760	1,760 – 2,540	1,313 – 2,995	NC
	1934–1944	630 – 1,930	476 – 2,000	764 – 1,930	1,270 – 2,300	890 – 2,860	1,000 – 4,290
	1951–1961	688 – 1,590	869 – 1,700	1,100 – 1,870	1,400 – 2,462	1,100 – 3,457	1,040 – 2,030
	1966–1976	720 – 2,046	532 – 1,273	660 – 1,809	2,211 – 3,086	2,262 – 4,392	1,199 – 2,669
	1985–1995	1,260 – 4,470	930 – 3,312	1,250 – 3,690	2,820 – 5,385	2,746 – 5,320	1,400 – 4,140
	1996–2006	1,149 – 3,130	564 – 4,270	1,160 – 4,310	2,250 – 5,700	2,500 – 6,040	1,090 – 2,130
Louisville	1934–1944	772 – 1,810	805 – 1,272	895 – 2,091	1,292 – 1,930	1,638 – 2,414	697 – 1,087
	1951–1961	881 – 1,923	1,067 – 1,884	1,150 – 2,023	1,462 – 2,400	1,253 – 3,334	1,040 – 2,147
	1966–1976	792 – 2,300	634 – 1,410	758 – 2,000	2,300 – 3,230	2,400 – 4,560	1,300 – 3,000
	1985–1995	1,740 – 6,570	1,290 – 4,130	1,430 – 5,740	3,580 – 6,200	3,640 – 6,300	2,120 – 6,990
	1996–2006	1,359 – 4,070	967 – 4,970	1,640 – 4,900	2,430 – 6,430	2,930 – 7,100	1,480 – 3,500

Appendix 6. Lower and upper quartile values of monthly coefficients of skewness of streamflow distribution, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.

[NC, not computed]

Station name	Period of water years	January	February	March	April	May	June
Duncan	1895–1905	NC	NC	0.15 – 0.52	0.60 – 1.46	0.16 – 0.94	0.13 – 1.12
	1934–1944	0.40 – 1.65	0.38 – 1.20	0.66 – 1.94	0.35 – 1.28	-0.12 – 0.84	0.68 – 1.12
	1951–1961	-0.12 – 0.98	-0.37 – 1.47	0.35 – 2.33	0.75 – 1.51	0.72 – 1.59	0.19 – 1.87
	1966–1976	-0.27 – 0.74	0.18 – 1.08	0.40 – 1.60	-0.01 – 1.16	0.06 – 0.43	0.84 – 1.46
	1985–1995	-0.81 – 0.56	0.43 – 1.08	0.35 – 1.30	0.00 – 0.68	0.36 – 1.54	0.15 – 0.84
	1996–2006	-1.09 – -0.04	-0.37 – 1.59	0.03 – 1.11	-0.10 – 0.95	0.28 – 1.76	0.25 – 1.08
North Bend	1895–1905	NC	NC	0.15 – 0.52	0.53 – 1.66	0.21 – 1.17	0.33 – 1.26
	1934–1944	0.18 – 1.24	-0.03 – 1.31	0.51 – 1.52	0.57 – 1.41	0.60 – 1.73	0.60 – 1.72
	1951–1961	-0.61 – 0.74	-0.22 – 1.33	-0.16 – 1.79	0.92 – 1.65	0.96 – 1.67	0.96 – 2.22
	1966–1976	0.27 – 0.52	0.00 – 1.36	0.87 – 2.16	-0.27 – 0.87	0.18 – 1.07	0.85 – 3.18
	1985–1995	-0.24 – 0.26	-0.26 – 1.49	0.70 – 2.24	0.33 – 1.78	0.52 – 1.57	0.11 – 2.19
	1996–2006	-0.61 – 0.37	0.21 – 1.51	0.13 – 1.88	0.07 – 1.14	0.21 – 1.78	0.51 – 1.49
Leshara	1934–1944	0.53 – 1.46	0.19 – 1.44	0.16 – 1.07	-0.11 – 0.38	0.65 – 1.77	0.01 – 1.26
	1951–1961	-0.59 – 0.74	-0.34 – 1.41	-0.16 – 1.59	0.80 – 1.55	0.94 – 1.39	0.83 – 2.14
	1966–1976	0.15 – 0.60	0.08 – 1.33	0.77 – 2.15	-0.11 – 0.76	-0.22 – 1.15	0.90 – 2.39
	1985–1995	-0.37 – 0.2	-0.46 – 1.73	0.50 – 2.00	0.34 – 1.74	0.50 – 1.82	0.08 – 2.28
	1996–2006	-0.56 – 0.33	-0.09 – 1.24	-0.07 – 1.51	-0.01 – 1.14	0.38 – 1.78	0.40 – 1.55
Ashland	1895–1905	NC	NC	NC	0.7 – 1.82	-0.29 – 0.97	0.84 – 1.52
	1934–1944	-0.28 – 1.85	0.46 – 1.66	-0.04 – 0.96	-0.56 – 0.73	0.56 – 2.04	0.11 – 1.97
	1951–1961	-0.62 – 0.73	-0.18 – 2.33	0.08 – 1.77	0.91 – 1.60	0.71 – 1.70	1.32 – 2.23
	1966–1976	0.12 – 0.70	0.25 – 1.72	-0.01 – 1.66	0.46 – 1.59	0.30 – 1.60	0.92 – 2.63
	1985–1995	0.02 – 1.03	-0.41 – 2.02	0.68 – 2.26	0.68 – 1.97	0.87 – 2.09	1.29 – 2.83
	1996–2006	-0.88 – 0.16	0.1 – 1.69	0.15 – 2.09	0.36 – 1.18	0.49 – 1.65	1.00 – 2.04
Louisville	1934–1944	-0.41 – 0.82	-0.11 – 0.95	0.50 – 1.65	0.13 – 1.43	0.48 – 2.12	0.72 – 2.32
	1951–1961	-0.76 – 0.71	-0.18 – 2.32	0.09 – 1.81	0.91 – 1.60	0.75 – 1.72	1.18 – 2.45
	1966–1976	0.17 – 0.68	0.26 – 1.73	0.18 – 1.66	0.47 – 1.63	0.36 – 1.73	0.90 – 2.62
	1985–1995	0.18 – 1.32	0.18 – 1.67	0.48 – 1.65	0.53 – 2.13	0.74 – 1.74	1.38 – 2.54
	1996–2006	-0.92 – 0.37	-0.13 – 1.32	0.35 – 1.86	0.45 – 1.06	0.42 – 1.79	0.70 – 2.08

Appendix 6. Lower and upper quartile values of monthly coefficients of skewness of streamflow distribution, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.—Continued

[NC, not computed]

Station name	Period of water years	July	August	September	October	November	December
Duncan	1895–1905	0.22 – 1.14	0.26 – 1.16	0.71 – 1.35	1.30 – 1.93	-0.81 – 0.38	NC
	1934–1944	1.06 – 2.31	2.49 – 4.13	0.49 – 2.09	1.11 – 3.17	-0.22 – 3.72	0.38 – 1.59
	1951–1961	1.13 – 1.84	1.19 – 3.22	1.28 – 4.56	0.22 – 1.07	-1.24 – 1.04	0.05 – 1.39
	1966–1976	1.11 – 2.00	0.51 – 1.18	-0.07 – 1.04	-0.02 – 0.93	-0.29 – 1.07	-0.64 – 0.73
	1985–1995	0.66 – 1.49	0.46 – 1.83	0.04 – 0.76	-0.18 – 0.38	-0.83 – 0.16	-0.41 – 0.84
	1996–2006	1.31 – 1.77	0.00 – 2.05	0.02 – 0.78	0.11 – 1.42	0.22 – 0.60	-0.51 – 0.79
North Bend	1895–1905	0.2 – 1.05	0.26 – 1.43	0.71 – 1.35	1.30 – 1.93	-0.81 – 0.38	NC
	1934–1944	0.83 – 1.8	0.67 – 2.57	0.47 – 2.33	0.60 – 2.02	-1.17 – 0.04	-0.52 – 0.41
	1951–1961	0.47 – 2.02	0.91 – 2.00	0.29 – 1.87	-0.14 – 0.48	-0.26 – 0.59	-0.41 – 0.34
	1966–1976	0.75 – 1.84	0.35 – 1.12	0.06 – 1.06	0.66 – 1.70	-0.40 – 0.63	-0.75 – 0.93
	1985–1995	0.64 – 1.56	0.53 – 1.52	0.58 – 1.42	0.22 – 1.14	-0.74 – 0.38	-0.50 – 0.61
	1996–2006	0.50 – 1.42	-0.16 – 0.46	0.15 – 1.50	-0.13 – 0.68	-0.63 – 0.58	-0.77 – 0.18
Leshara	1934–1944	0.05 – 1.34	-0.23 – 0.92	0.69 – 2.43	-0.02 – 1.33	-0.23 – 1.58	-0.16 – 2.34
	1951–1961	0.26 – 1.55	0.68 – 1.78	0.26 – 2.35	-0.35 – 0.34	-0.28 – 0.36	-0.38 – 0.41
	1966–1976	0.72 – 1.72	0.34 – 1.06	0.10 – 0.89	0.69 – 1.61	-0.4 – /0.69	-0.8 – 0.84
	1985–1995	0.52 – 1.44	0.47 – 1.66	0.54 – 1.42	0.25 – 1.15	-0.73 – 0.47	-0.58 – 0.48
	1996–2006	0.60 – 1.20	-0.16 – 0.82	-0.06 – 1.47	-0.09 – 0.58	-0.90 – 0.89	-0.74 – -0.07
Ashland	1895–1905	0.19 – 0.99	0.21 – 0.40	0.44 – 1.62	-0.78 – 1.08	-0.57 – 0.09	NC
	1934–1944	0.17 – 1.11	0.12 – 1.47	0.59 – 1.23	-0.06 – 1.56	0.44 – 2.13	0.45 – 1.77
	1951–1961	0.5 – 1.41	0.59 – 1.84	0.37 – 1.40	-0.06 – 0.94	-0.34 – 0.52	-0.65 – 0.28
	1966–1976	0.72 – 1.26	0.17 – 0.76	-0.10 – 0.76	-0.03 – 2.23	-0.37 – 0.68	-0.92 – 0.78
	1985–1995	0.50 – 1.65	0.79 – 2.41	0.60 – 1.87	0.03 – 1.27	-0.79 – 0.48	-0.71 – 0.02
	1996–2006	0.72 – 2.17	-0.07 – 2.69	0.53 – 1.42	0.11 – 0.92	-0.49 – 1.87	-0.93 – -0.33
Louisville	1934–1944	1.05 – 1.99	1.20 – 2.00	0.81 – 1.76	0.04 – 1.46	-1.04 – 0.95	-0.66 – 0.32
	1951–1961	0.62 – 1.36	0.57 – 1.82	0.29 – 1.37	-0.05 – 0.95	-0.35 – 0.61	-0.68 – 0.33
	1966–1976	0.72 – 1.26	0.18 – 0.75	-0.05 – 1.05	0.12 – 2.41	-0.36 – 0.68	-0.91 – 0.79
	1985–1995	0.49 – 2.22	0.64 – 2.67	0.79 – 2.10	0.13 – 1.57	-0.19 – 0.69	-1.04 – 0.97
	1996–2006	0.53 – 1.98	0.07 – 2.38	0.58 – 1.31	-0.32 – 1.21	0.37 – 1.64	-1.00 – -0.39

Appendix 7. Lower and upper quartile values of monthly coefficients of variation of streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.

[Tabled values are coefficient of variation, in percent; NC, not computed]

Station name	Period of water years	January	February	March	April	May	June
Duncan	1895–1905	NC	NC	20 – 49	29 – 85	37 – 46	20 – 37
	1934–1944	40 – 120	28 – 86	38 – 94	42 – 64	44 – 85	58 – 102
	1951–1961	29 – 49	31 – 72	26 – 43	23 – 36	36 – 78	50 – 75
	1966–1976	24 – 42	21 – 33	11 – 32	12 – 21	29 – 49	45 – 80
	1985–1995	18 – 28	23 – 41	16 – 58	13 – 24	26 – 49	32 – 81
	1996–2006	18 – 31	14 – 32	12 – 42	16 – 41	26 – 66	34 – 60
North Bend	1895–1905	NC	NC	20 – 49	29 – 89	37 – 51	20 – 40
	1934–1944	18 – 55	35 – 47	23 – 55	22 – 34	29 – 47	35 – 53
	1951–1961	25 – 40	21 – 45	21 – 45	17 – 30	28 – 46	34 – 81
	1966–1976	33 – 44	18 – 49	13 – 41	13 – 25	21 – 33	29 – 79
	1985–1995	18 – 28	18 – 50	24 – 74	16 – 29	19 – 49	30 – 66
	1996–2006	15 – 34	11 – 51	13 – 44	16 – 31	22 – 59	30 – 44
Leshara	1934–1944	12 – 44	25 – 49	17 – 47	14 – 38	18 – 54	30 – 53
	1951–1961	25 – 39	20 – 45	20 – 53	17 – 28	27 – 43	33 – 79
	1966–1976	32 – 42	18 – 50	14 – 39	12 – 24	17 – 31	30 – 73
	1985–1995	15 – 23	17 – 37	22 – 59	16 – 26	18 – 47	29 – 63
	1996–2006	13 – 29	14 – 41	13 – 34	13 – 26	17 – 56	32 – 44
Ashland	1895–1905	NC	NC	NC	25 – 68	30 – 47	23 – 39
	1934–1944	33 – 68	29 – 62	10 – 42	13 – 48	20 – 65	37 – 59
	1951–1961	22 – 41	21 – 46	21 – 55	18 – 28	33 – 40	45 – 77
	1966–1976	27 – 53	25 – 50	20 – 33	14 – 25	19 – 41	34 – 87
	1985–1995	18 – 37	24 – 45	18 – 57	16 – 39	20 – 56	30 – 65
	1996–2006	13 – 34	15 – 44	15 – 51	13 – 36	21 – 69	31 – 47
Louisville	1934–1944	31 – 49	40 – 72	35 – 52	19 – 44	34 – 49	42 – 95
	1951–1961	23 – 39	21 – 45	21 – 57	18 – 29	32 – 42	43 – 75
	1966–1976	27 – 52	23 – 49	19 – 32	14 – 25	18 – 44	34 – 85
	1985–1995	29 – 40	26 – 47	25 – 76	16 – 40	19 – 54	29 – 73
	1996–2006	13 – 30	11 – 44	14 – 43	10 – 35	22 – 58	33 – 46

Appendix 7. Lower and upper quartile values of monthly coefficients of variation of streamflow, by station and 11-water-year period, for the Platte River gaging stations from Duncan through Louisville, Nebraska, 1895–2006.—Continued

[Tabled values are coefficient of variation, in percent; NC, not computed]

Station name	Period of water years	July	August	September	October	November	December
Duncan	1895–1905	52 – 88	46 – 92	83 – 102	63 – 118	7 – 28	NC
	1934–1944	105 – 183	123 – 282	61 – 123	44 – 258	33 – 373	41 – 130
	1951–1961	75 – 125	97 – 196	81 – 196	19 – 86	15 – 39	29 – 50
	1966–1976	83 – 155	66 – 97	46 – 88	17 – 31	10 – 19	20 – 29
	1985–1995	49 – 84	54 – 104	29 – 76	15 – 30	17 – 36	18 – 37
	1996–2006	59 – 154	49 – 158	27 – 65	14 – 29	8 – 51	14 – 46
North Bend	1895–1905	49 – 66	46 – 98	83 – 102	63 – 118	7 – 28	NC
	1934–1944	29 – 65	17 – 57	17 – 53	11 – 22	10 – 31	26 – 43
	1951–1961	33 – 71	33 – 72	17 – 51	14 – 26	12 – 29	23 – 50
	1966–1976	58 – 83	37 – 63	21 – 53	20 – 34	12 – 25	24 – 38
	1985–1995	47 – 60	24 – 44	31 – 45	14 – 22	12 – 39	18 – 36
	1996–2006	25 – 60	29 – 46	16 – 44	12 – 24	11 – 24	27 – 48
Leshara	1934–1944	15 – 49	25 – 47	21 – 49	28 – 64	32 – 55	25 – 44
	1951–1961	33 – 69	31 – 69	18 – 43	13 – 25	10 – 27	20 – 47
	1966–1976	50 – 80	32 – 54	18 – 52	18 – 29	9 – 21	24 – 37
	1985–1995	51 – 66	26 – 45	33 – 47	14 – 23	12 – 37	16 – 33
	1996–2006	27 – 65	24 – 49	17 – 51	9 – 21	12 – 22	27 – 42
Ashland	1895–1905	42 – 53	44 – 47	51 – 73	21 – 49	8 – 29	NC
	1934–1944	20 – 45	30 – 55	33 – 59	26 – 68	24 – 66	35 – 61
	1951–1961	41 – 67	31 – 66	20 – 36	15 – 24	10 – 27	23 – 52
	1966–1976	47 – 71	29 – 58	16 – 59	17 – 30	9 – 20	22 – 44
	1985–1995	40 – 56	27 – 57	32 – 51	11 – 21	10 – 24	19 – 38
	1996–2006	30 – 55	29 – 46	13 – 60	12 – 16	11 – 25	24 – 33
Louisville	1934–1944	44 – 69	36 – 60	25 – 49	12 – 31	11 – 34	36 – 47
	1951–1961	38 – 63	33 – 65	19 – 35	15 – 24	12 – 26	22 – 50
	1966–1976	43 – 65	27 – 52	17 – 58	17 – 53	10 – 22	21 – 43
	1985–1995	42 – 66	28 – 71	26 – 52	10 – 29	10 – 20	15 – 38
	1996–2006	31 – 55	29 – 46	15 – 55	13 – 20	9 – 21	19 – 32

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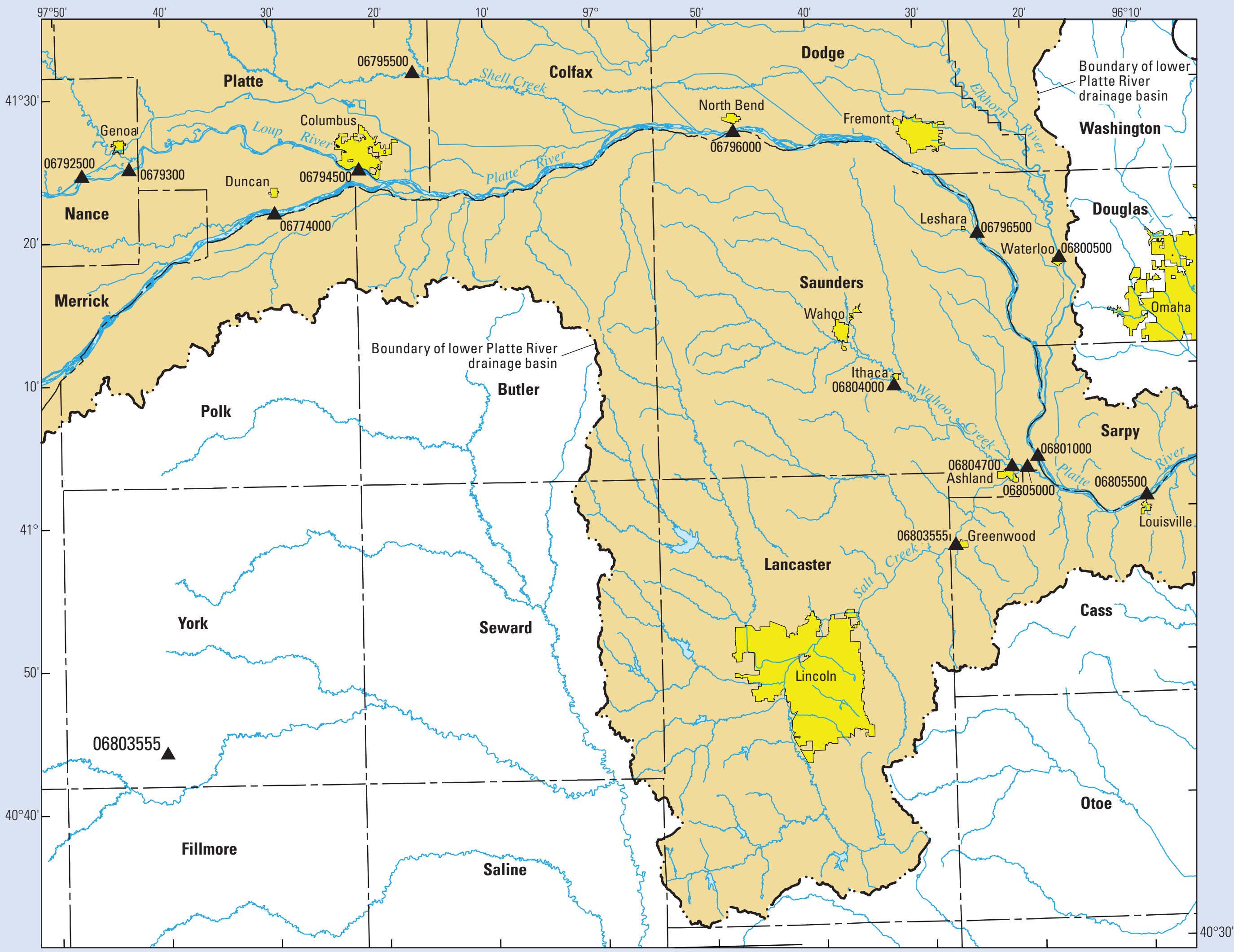
Back cover.—Map of study area and gaging stations on the Platte River and contributing tributaries, Nebraska.



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