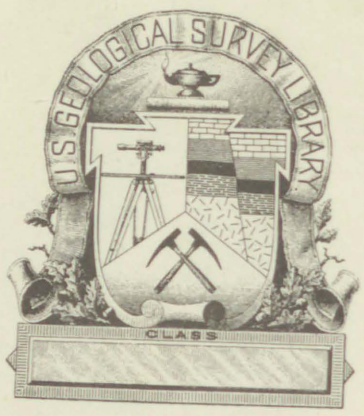
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HISTORY OF IRRIGATION AND CHARACTERISTICS OF STREAMFLOW IN NORTHERN NEBRASKA

by

F.B. Shaffer

OPEN-FILE REPORT 7501

Nebraska District
Lincoln, Nebraska
September 1975

U.S. DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

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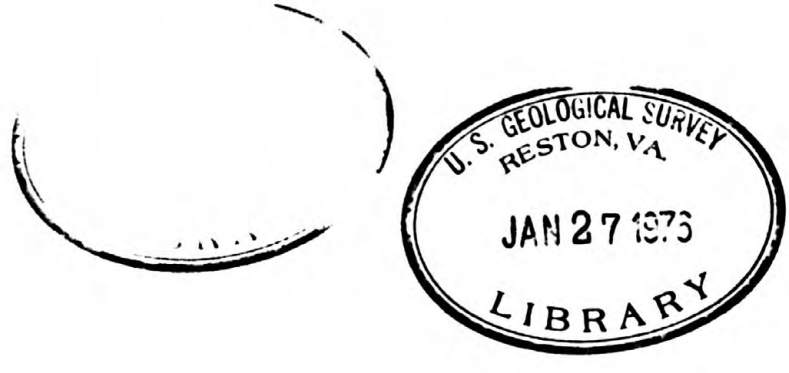
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CONTENTS

ILLUSTRATIONS

HISTORY OF IRRIGATION AND CHARACTERISTICS OF STREAMFLOW IN NORTHERN NEBRASKA

By

F. B. Shaffer

ABSTRACT

Five streams drain the northern part of Nebraska and are tributaries to the Missouri River above Yankton, S. Dak. This report presents statistical data at 29 gaging sites on four of the streams, namely, White River, Ponca Creek, Niobrara River, and Bazile Creek. The fifth stream, Hat Creek, drains a small area in the extreme northwest corner of the State. Because there are no gaging stations on Hat Creek in Nebraska, only the description of the basin is included. The only station on Hat Creek is near Edgemont, S. Dak., and it does not reflect streamflow characteristics in Nebraska.

Two major irrigation projects have been constructed in the Niobrara River basin since gaging of streamflow began, therefore the complete record of water discharge at some gaging stations includes periods before and after streamflow was affected by diversions to upstream projects. The Whitney Irrigation Project was in operation on the White River before streamflow records were obtained. Streamflow records presented in this report have been computed from data that represent 1974 conditions of development and water use.

INTRODUCTION

Topographic setting

This report pertains to the streams of northern Nebraska. The streams drain several major topographic regions as shown in figure 1. Principal topographic regions are sandhills, plains, bluffs, and escarpments. The sandhills are a part of the Sand Hills Region of Nebraska that mantles about one-fifth of the State. The plains border the sandhills and the bluffs and escarpments occupy the northwest corner of the State and border the Niobrara River valley downstream from the sandhills. Parts of the plains have been dissected by erosion. These include a large area bordering the upper reaches of the Niobrara River valley. Only a very small part of the study area is flat bottom land. It borders the lower reaches of the White River in Nebraska and a narrow strip along the Niobrara River, except where it transects sandhills. Although

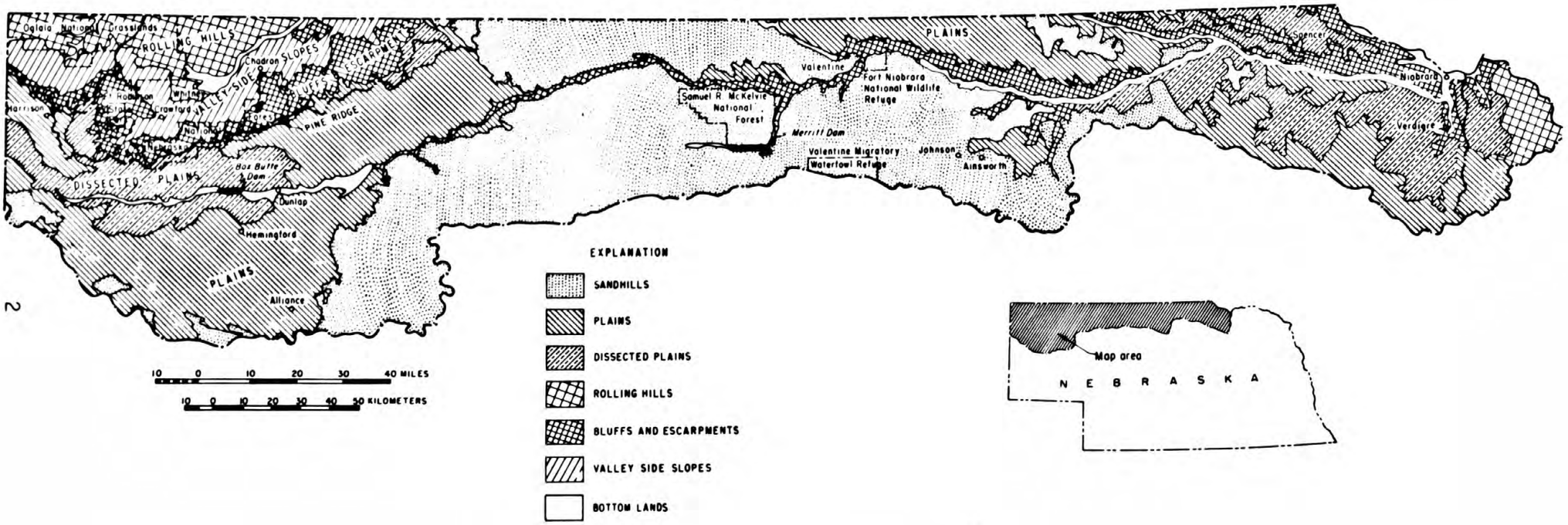

Figure 1.--Topographic regions map.

the bluffs, escarpments, dissected plains, and valleys were shaped by erosional forces of water, much of the area is almost solely the product of wind erosion and deposition. Having been shaped by wind, the dune sand is not subject to erosion by water because precipitation is absorbed by the sand, and surface runoff of water does not occur.

Purpose and scope of study

The purpose of the report is to summarize those streamflow data that are representative of 1974 hydrologic conditions and present historical and geographic data pertinent to streamflow in the basins.

Nebraska's streams were gaged sporadically under a variety of State, Federal, and State-Federal cooperative programs from 1894 to 1931, and many have been gaged continuously since 1931. As the accumulated mass of data obtained under those programs grew, the difficulty in analyzing them increased. Before electronic digital computers were developed, statistical analysis of stream-discharge records was exceedingly time consuming. Now, large amounts of data can be evaluated speedily once the data are prepared in suitable form and appropriate computer programs have been written.

This report presents a statistical analysis of streamflow data at 4 sites on White River, 3 on Ponca Creek, 19 on the Niobrara River and its tributaries, and 1 on Bazile Creek (fig. 2). The statistical analysis includes tables of monthly and annual discharges, duration of daily discharges, probability of annual high and low flows, and an exceedence-probability graph. It also presents exceedence-probability graphs for the Mirage Flats Canal, which diverts water from the Niobrara River, and the Ainsworth Canal, which diverts from the Snake River, a tributary to the Niobrara. (See fig. 2.)

The period of record used in the statistical analyses is designed to show the characteristics of streamflow under present or partially controlled conditions. The probability graph shows the longest record backing up from the latest record which would fall within the 9, 19, or 29-year duration category. Because of this, the two records do not always agree, especially on the tributaries. Since both records are within the controlled period, it is believed to be more significant to use the longer record where possible in the statistics rather than to limit it to the same record as the probability graph which is restricted to the 9, 19, or 29-year periods.

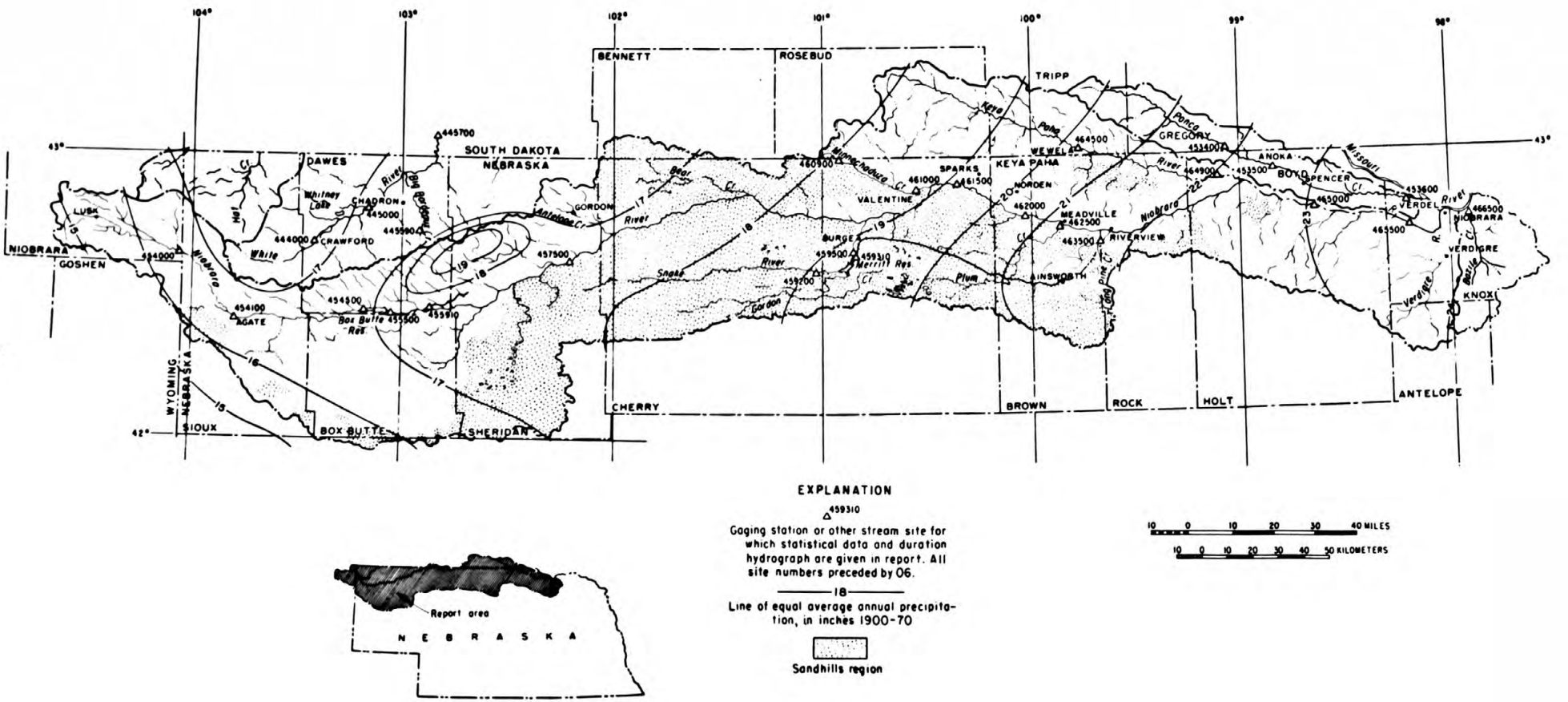

Figure 2.--Hat Creek, White River, Niobrara River, Ponca Creek, and Bazile Creek drainage basins, showing locations of stream and canal gaging sites and average annual precipitation.

SOURCES OF DATA

U.S. Geological Survey publications containing records of daily discharges at gaging stations in the five basins in this report during all or part of the period 1928 through 1973 are as follows:

Water year	Water-Supply Paper	Water year	Water-Supply Paper	Water year	Water-Supply Paper	Water year	Water-Supply Paper
1928	666	1941	926	1954	1339	1966	
1929	686	1942	956	1955	1389	1977	
1930	701	1943	976	1956	1439	1968	2117
1931	716	1944	1006	1957	1509	1969	
1932	731	1945	1036	1958	1559	1970	
1933	746	1946	1056	1959	1629		
1934	761	1947	1086	1960	1709	1971	
1935	786	1948	1116			1972	Annual reports[1/]
1936	806	1949	1146	1961		1973	
1937	826	1950	1176	1962			
1938	856	1951	1209	1963	1917		
1939	876	1952	1239	1964			
1940	896	1953	1279	1965			

[1/] Entitled "Water Resources Data for Nebraska, Part 1." Prepared in cooperation with State and Federal agencies.

Records of monthly and annual mean discharges through September 1950 at all stream-gaging stations are reproduced in Water-Supply Paper 1309, and those for the period October 1950 to September 1960 are reproduced in Water-Supply Paper 1729.

Sources of other information used in preparing this report are:

Water rights and diversions--Hydrographic and Biennial Reports of Nebraska Department of Water Resources

Irrigation well registrations--Files of Nebraska Department of Water Resources

Irrigation well locations--Files of Conservation and Survey Division of University of Nebraska

Climatological Data—Climatological Summaries and Annual Reports of U.S. Weather Bureau and National Oceanic and Atmospheric Administration

Names of tributaries not shown—U.S. Geological Survey 1:250,000 topographic map prepared by Army Map Service.

DEFINITION OF TERMS

Acre-foot is amount of water necessary to cover 1 acre to a depth of 1 foot, and equal to 43,560 cubic feet.

Acre-feet delivered to farms is total water diverted less main canal and lateral wastes and losses.

Climatic year is a continuous 12-month period beginning April 1. It is used in the low-flow probability analyses and is designated by the calendar year in which it ends. (See water year.)

Cubic foot per second (cfs) is the unit of measurement used in reporting stream discharge, also is referred to as second-foot (sec-ft). It is a volume of 1 cubic foot passing a given point during 1 second of time and is equivalent to 7.48 gallons per second or 448.8 gallons per minute.

Evapotranspiration is the loss of water from a land area by evaporation from moist soil and by plant transpiration.

Exceedence probability is the percent chance that the discharge will exceed that indicated in a given unit of time. (See recurrence interval.)

Exceedence-probability hydrograph is a plot of selected exceedence probabilities of stream discharges for each day of the year. In this report, the selected exceedence probabilities are 20, 50, and 80 percent and were obtained from records of 9, 19, or 29 years' duration. They were determined by ranking from highest to lowest the values of mean daily discharge for each January 1, each January 2, etc., in the period of record used and then selecting those discharges for which 20, 50, and 80 percent of the values were greater. The graph shows, for each day, the discharge that has been exceeded the indicated percentage of days during the period of record. Daily extremes for the period of record are also shown. The dot pattern between the 20 percent and the 80 percent lines helps the reader to distinguish these lines from those representing the highest and lowest discharges. The highest and lowest discharge lines can also be called the 0 and 100 percent lines, respectively.

Flow-duration table shows the percentage of time that specified discharges are equaled or exceeded.

Net diversion is the arithmetic difference between the measured quantity of water diverted from a stream into the upper end of a canal and the quantity of unused water returned to that stream.

Nonexceedence probability is the percent chance that the discharge will be less than that indicated in any climatic year. (See recurrence interval.) The mean 7-day flow having a 10-percent nonexceedence probability (10-year recurrence interval) is used in applying Nebraska water-quality criteria (Nebr. Dept. of Health, 1969, p. 18).

Recurrence interval is the average interval of time within which the given event will be equaled or exceeded only once.

Water year is the 12-month period October 1 through September 30, and is designated by the calendar year in which it ends.

Factors to convert English units published herein to International System of Units (SI) are given below:

Multiply English unit	By	To obtain metric unit
acres	4.047×10^{-3}	square kilometres (km^2)
acre-feet (acre-ft)	1.233×10^{-3}	cubic hectometres (hm^3)
cubic feet (ft^3)	2.832×10^{-2}	cubic metres (m^3)
cubic feet per second (ft^3/s)	2.832×10^{-1}	cubic metres per second (m^3/s)
feet (ft)	3.048×10^{-1}	metres (m)
miles (mi)	1.609	kilometres (km)
square miles (mi^2)	2.590	square kilometres (km^2)

HAT CREEK

Hat Creek rises in the bluffs and escarpments region along the Pine Ridge in central Sioux County, at an altitude of about 4,860 feet, near the town of Harrison, Nebr. It flows northward to join the Cheyenne River, at altitude 3,295 feet, in the northern part of Fall River County, S. Dak., about 20 miles north of the Nebraska-South Dakota line.

The drainage area of Hat Creek is approximately 1,050 square miles, 46 percent of which lies in Nebraska, 22 percent in Wyoming, and 32 percent in South Dakota. The part that lies in Nebraska is in the extreme northwest corner of the State in northern Sioux County and in a small area in the northwestern corner of Dawes County. The basin has rough topography characterized by bluffs and escarpments in the upper reaches and valley-side slopes and rolling hills in the lower part of the basin. The timbered Pine Ridge borders the southern boundary of the basin in Nebraska. Much of the Oglala National Grassland Reserve in Nebraska is in the basin.

Tributaries to Hat Creek in Nebraska, as shown on the U.S. Geological Survey Alliance 1:250,000 topographic map, are Antelope, Boggy, Cedar, Cherry, Geike, Horre, Indian, Jim, Jordon, Lickett, Little Red, Long Branch, Monroe, Prairie Dog, Sow Belly, Spring, Squaw, Warbonnet, and Whitehead Creeks. Only small parts of the tributaries are perennial. The clayey soils of the basin inhibit infiltration to the ground-water reservoirs and cause direct runoff of precipitation. Ground-water seepage to the stream is small and occurs mostly in the upper reaches of Hat Creek and those tributaries that head in the Pine Ridge.

Reservoirs have been built on all tributaries in the basin to capture early spring runoff. These are used for recreation, fishing, stock watering, and irrigation. No gaging stations have been installed on Hat Creek in Nebraska. The only gaging station on the stream is 2 miles above its mouth near Edgemont, S. Dak., 18 miles north of the State line. Hat Creek has a mean discharge of 23 cfs at this station for the period 1950 to 1974.

Records of the Nebraska Department of Water Resources show there are 104 active irrigation appropriations in the Hat Creek basin in Nebraska totaling 100.45 cfs to serve an estimated 5,200 acres (fig. 3). There are 72 active storage appropriations in Nebraska totaling 5,556 acre-feet per year. This is equivalent to an average flow of 7.7 cfs.

Because adequate ground-water reservoirs containing suitable quality water have not been discovered in the Nebraska part of the basin, no irrigation wells have been drilled in that area.

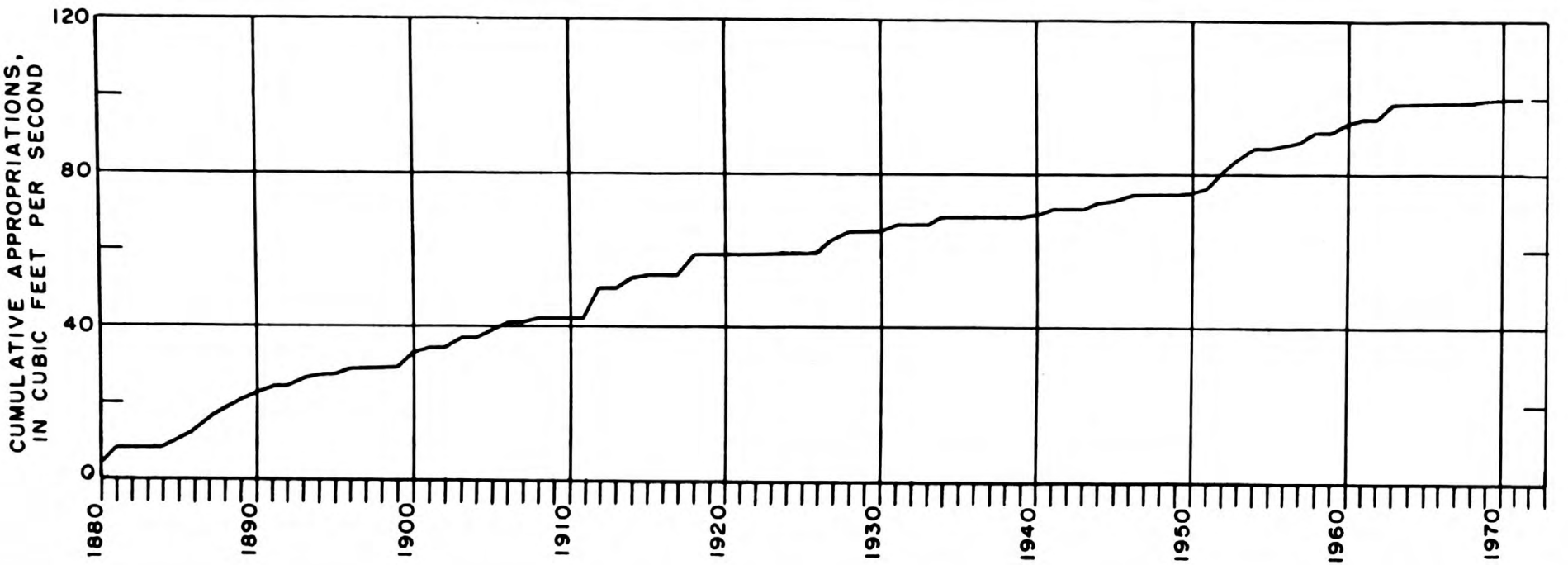

Figure 3.--Active appropriations for the use of surface water in Hat Creek basin.

WHITE RIVER

White River rises in Sioux County, near the town of Harrison, Nebr., at an altitude of about 4,860 feet. It flows northeastward into South Dakota to a point near the 103rd meridian where it joins the Missouri River near the town of Oacoma, S. Dak., at an altitude of 1,375 feet. At the junction, the mean discharge for the period of record is 545 cfs. The stream's gradient is about 15.5 feet per mile.

The White River basin comprises parts of Sioux, Dawes, and Sheridan Counties in the Pine Ridge region of Nebraska, and extends northeast into South Dakota. It includes most of the Pine Ridge Division of the Nebraska National Forest, a part of the Oglala National Grassland Reserve, and Fort Robinson State Park, all in Dawes County.

The basin is a topographically rough area of approximately 10,200 square miles of which 1,677 square miles, or 16 percent, are in Nebraska. In Nebraska the basin consists of bluffs and escarpments, valley-side slopes, and rolling hills. White River valley averages about 1 mile in width and, in many places, the stream has entrenched itself deeply into the flood plain.

Named tributaries to the White River in Nebraska are Ash, Beaver, Big Bordeaux, Chadron, Charcoal, Cottonwood, Dead Horse, Dead Man, Deep, Dry, English, Hooker, Indian, Larabee, Lone Tree, Messenger, Minnepazuta, Patton, Pine, Rush, Sand, Soldier, Squaw, Trunk Butte, White Clay, and Willow Creeks.

Throughout most of the Nebraska part of the basin the soils generally are heavy silty clays and there is very little infiltration of precipitation. Because of the tight soils and steep slopes, runoff from early spring snowmelt and rainfall is usually rapid and results in extensive erosion of sparsely vegetated soils. Seepage of ground water into most tributaries of the White River is minor.

Numerous small dams have been constructed on the tributaries to store the spring streamflow. Reservoirs are used for recreation, fishing, stock watering, and irrigation.

There are two active gaging stations in the White River basin in Nebraska -- one, on Big Bordeaux Creek near Chadron, has 5 years of record; the other, on White River at Crawford, has 38 years of record.

The gaging station on Big Bordeaux Creek is in the upper part of the basin and monitors the streamflow for a drainage area of 9.42 square miles hich is 8 percent of the total area of the basin. The station was established at a possible reservoir site of the U.S. Forest Service.

The next downstream station (inactive) is White River at Slim Butte, S. Dak., 11 miles downstream from the Nebraska-South Dakota line. The mean flow at this station for the period of record (1963-70) is 43 cfs.

Records of the Nebraska Department of Water Resources show there are 188 active irrigation appropriations in the White River basin of which 86 are for 1 cfs or less. The appropriations total 300 cfs to serve 21,050 acres (fig. 4). There are 56 active storage appropriations totaling 6,258 acre-feet per year exclusive of the Whitney Reservoir. The Whitney Irrigation District serves 6,750 acres from both storage and direct flow.

There are 22 active stream appropriations in the Big Bordeaux Creek basin to serve 1,600 acres. Thirteen of the appropriations are for less than 1 cfs. No records of diversions from streams within the basin are available.

Aquifers throughout most of the basin have adequate yield for domestic and stock needs, but supplies adequate for irrigation can be obtained in only a few localities. As a result, there were only 12 registered irrigation wells in the basin in 1974.

Whitney Irrigation District

The Whitney Irrigation District was organized in 1922 to irrigate 9,792 acres near the confluence of Big Cottonwood Creek and White River. The District has a storage appropriation with a priority date of April 28, 1921, to store 10,000 acre-feet and three direct-flow appropriations with priority dates in 1921 for 30.28 cfs. The Whitney Reservoir is in a natural depression and has four dikes to limit its area—two on the north side and one each on the east and south sides. The dikes range in height from 11 to 19 feet and total 8,100 feet in length. A dam on the White River about 3 miles downstream from Crawford diverts water into a 48-inch wooden-stave pipeline that extends 6.25 miles to the Whitney Reservoir. There are two main distribution canals; one is 16 miles long, the other is 7 miles.

The White River flows through the Pine Ridge Indian Reservation in South Dakota and, under Indian treaties, superior water rights are given to the Indians. The Irrigation District has not been able to obtain permission from the Indians to make needed repairs. Because of deteriorated irrigation structures and inadequate water supply in some years, only about 6,750 acres are now being served (1974). The quantity of water diverted from Whitney Reservoir and minor tributaries has not been recorded.

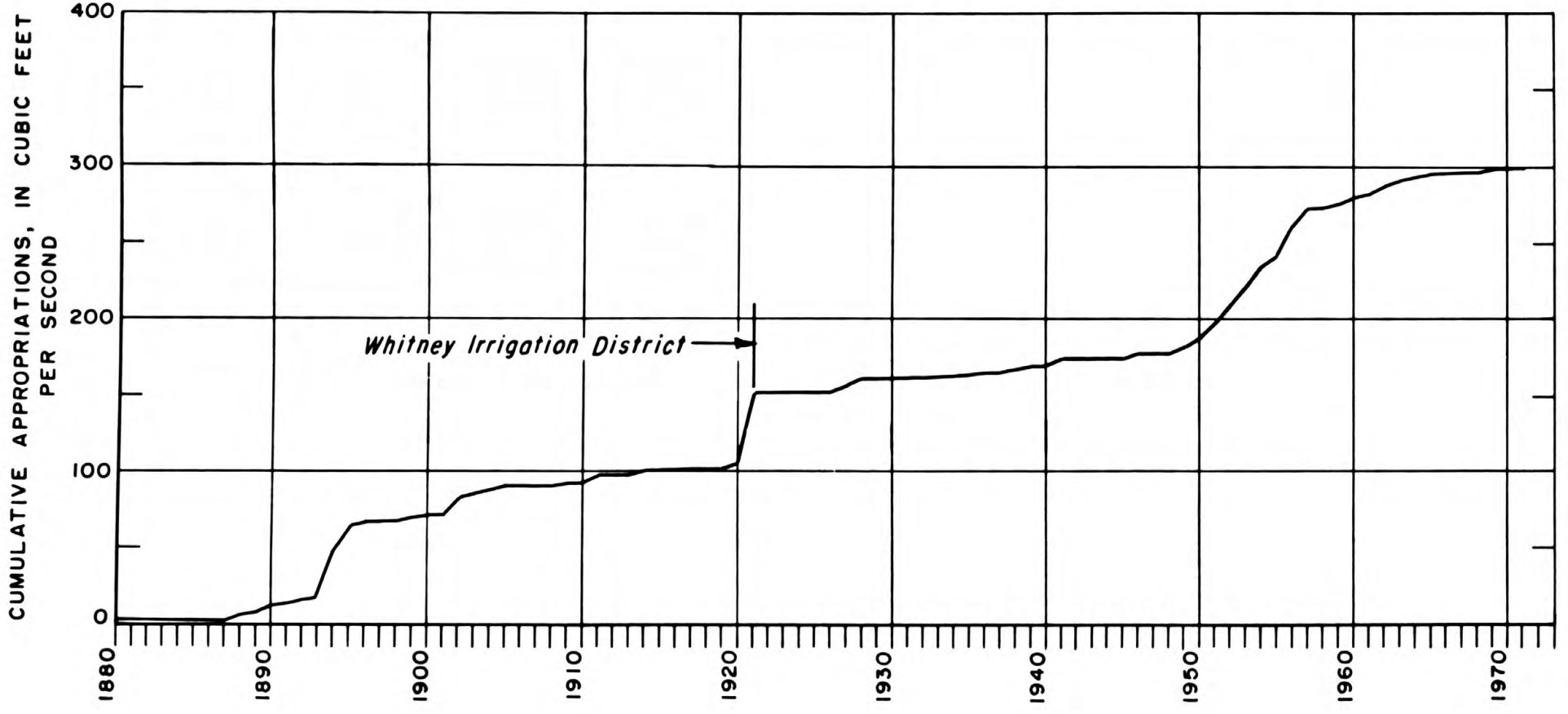

Figure 4.--Active appropriations for the use of surface water in White River basin.

PONCA CREEK

Ponca Creek rises near Colome, in Tripp County, S. Dak., at an altitude of about 2,255 feet and flows southeastward into Gregory County in South Dakota, thence to Boyd and Knox Counties in Nebraska, finally to join the Missouri River at altitude 1,216 feet, 6 miles above the mouth of the Niobrara. Ponca Creek is 155 miles long with an average gradient of 6.7 feet per mile. Active gaging stations are near Naper, Nebr., 74 miles above the mouth of the creek and 6 river miles above the Nebraska-South Dakota line; at Anoka, 62 miles above the mouth; and at Verdel, 3 miles above the mouth.

The basin, in general, is characterized by hilly land with moderate to steep slopes. It has an area of 820 square miles (52 percent) in South Dakota and 390 square miles (48 percent) in Nebraska.

Streamflow fluctuates rapidly because overland runoff from the clay soils is rapid. During late summer, autumn, and winter the stream generally has little or no flow. Ground-water seepage to the stream is very small. Rainfall, which averages 22 inches per year is heaviest in spring and early summer.

The flat narrow flood plains along Ponca Creek are suitable for irrigation; however, because water supplies are inadequate, irrigation is not extensive. Records of the Nebraska Department of Water Resources show there are 113 active irrigation appropriations of which 6 are for 1.0 cfs or less. These appropriations total 16 cfs to serve an estimated 760 acres (fig. 5). There are also three active storage appropriations totaling 76.5 acre-feet. There are no irrigation wells in the Ponca Creek basin in Nebraska because there are no aquifers capable of yielding an adequate amount of water.

NIOBRARA RIVER

The Niobrara River rises near the town of Lusk in Niobrara County, Wyo., about 35 miles west of the Wyoming-Nebraska line and enters Nebraska in Sioux County, 25 miles south of the northwest corner of the State. It is the largest stream in northern Nebraska and is perennial throughout its entire 537-mile meandering length in Nebraska. It traverses about two-thirds of the length of the State, terminating near the town of Niobrara where it enters the Missouri River. The river's headwaters are at an altitude of 5,675 feet; it enters Nebraska at an altitude of 4,685 feet; and its confluence with the Missouri River is at an altitude of 1,210 feet. The average gradient is 8.3 feet per mile. In Wyoming, the gradient averages 12.8 feet per mile and, in Nebraska, it is 7.6 feet per mile. In many places the Niobrara River flows in a deeply incised U-shaped valley.

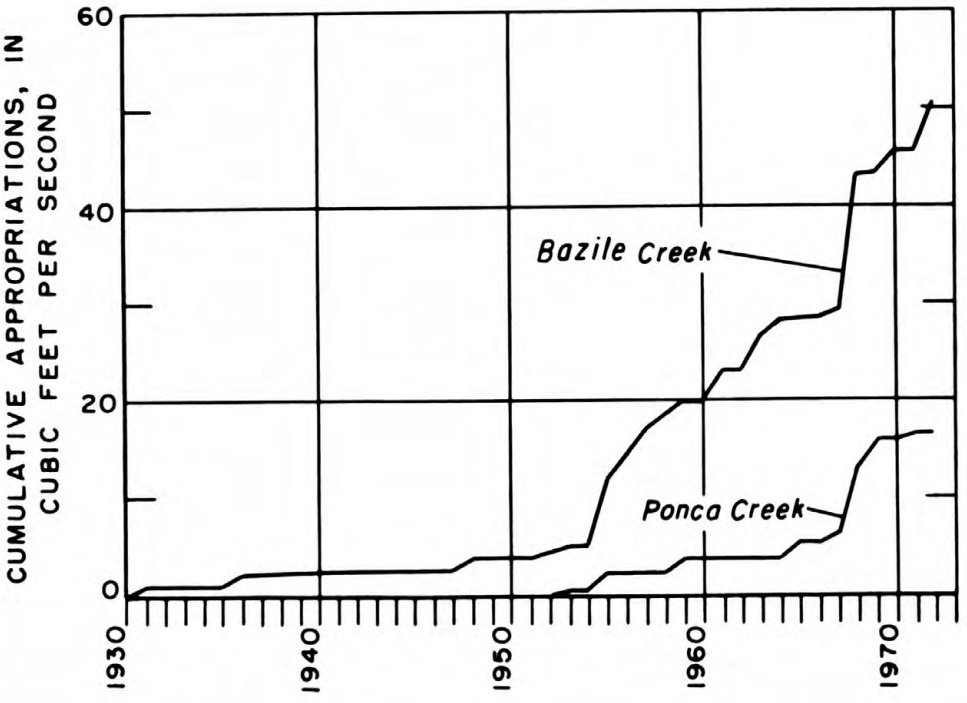

Figure 5.--Active appropriations for the use of surface water in Ponca and Bazile Creek basins.

The Niobrara River basin is part of the Great Plains region and includes parts of Wyoming, Nebraska, and South Dakota. The basin includes 535 square miles in Wyoming; 1,263 in South Dakota; and 11,382 in Nebraska.

The basin is about 350 miles long and 60 miles wide at its widest point, with an average width of about 30 miles.

Topographic features (fig. 1) include a Dissected Plains and Plains Region in the western part of the basin, the Sand Hills Region in the central part, and the Dissected Plains and Plains Region in the eastern part of the basin.

The part of the basin east of the sandhills consists of tablelands in the outer margins of the basin and of moderately to steeply sloping loess-mantled plains, stream terraces, and bottom lands progressing closer to the river. The area west of the sandhills constitutes about 28 percent, the sandhills about 42 percent, and the area east of the sandhills about 30 percent of the basin.

Topography in the rolling Sand Hills Region consists of dunes of different heights that have been stabilized by grass cover. The sandhills are used principally for ranching. Non-ranch lands include Samuel R. McKelvie National Forest, a manmade forest; Fort Niobrara National Wildlife Refuge; and the north part of Valentine Migratory Waterfowl Refuge, all in Cherry County.

The area adjacent to the Niobrara from Valentine to the Keya Paha-Boyd County line is heavily timbered. Other timbered areas are along the minor tributaries entering the Niobrara from the south.

There is no overland runoff in the Sand Hills Region except in small areas adjacent to streams during unusually heavy rains. Therefore, there is little flooding, although occasionally ice jams cause local flooding on low benches that border the main stem of the river. Most of the approximately 3,200 farm ponds in the Niobrara Basin are west of the sandhills.

Flow of the Niobrara River at the Wyoming-Nebraska State line is more uniform throughout the year than most Nebraska streams; however, occasional high flows do occur. The maximum flow recorded was 800 cfs on July 17, 1969; the minimum recorded was 1.4 cfs in 1959, 1961, 1964, and 1968. The mean discharge for the period 1956-73 was 4 cfs. The flow near the mouth of the Niobrara River at the Verdel gaging station during the period 1964-73 averaged 1,500 cfs, a net increase in flow of 1,496 cfs as the river traversed the State.

Streamflow east of the Wyoming-Nebraska line fluctuates considerably because of rapid runoff from the Dissected Plains Region. The recorded maximum discharge above Box Butte reservoir ~~near the mouth of the river~~ was 4,950 cfs on July 28, 1951, and the minimum was 1.6 cfs on September 26, 1953.

The duration hydrograph of daily discharge at the Spencer gaging station about 40 miles upstream from the mouth of the Niobrara River (fig. 6) shows the effects of irrigation diversion, principally for the Ainsworth Project that began in 1963.

Surface-water irrigation was introduced in the Niobrara River basin October 1, 1883, when the Lakotah Project in Sioux County was granted an appropriative right to 7.14 cfs from the Niobrara River. (The amount was later reduced to 5.85 cfs.) All appropriations in Nebraska prior to 1934 were from the main stem of the Niobrara River between the Wyoming-Nebraska line and the west edge of the sandhills (fig. 7).

In 1974, approximately one-third of the irrigation appropriations in the Niobrara basin were west of the sandhills (fig. 8).

The two major irrigation projects in the Niobrara Basin are Mirage Flats and Ainsworth, both built by the U.S. Bureau of Reclamation. These two projects account for about 54 percent of the total of 85,200 acres in the basin irrigated by surface water.

Ground-water irrigation began in 1938 and has steadily increased (fig. 9). There are now (1974) 1,845 wells serving an estimated 180,000 acres in the basin (fig. 10). The wells are distributed within the basin as follows: west of the sandhills, 712; in the sandhills, 225; and east of the sandhills, 848.

Mirage Flats Project

In 1895, following the dry years of 1893 and 1894, farmers organized a mutual company to construct a system to irrigate approximately the same area as the present Mirage Flats Project. Construction was by the farmers. Because no storage was provided, flows were inadequate to meet peak irrigation requirements during dry years. Above-normal precipitation followed the drought years, and the project was abandoned in 1903, after wind and fire destroyed two of the project's wooden flumes.

Mirage Flats Project was authorized on April 26, 1940, under terms of the Water Conservation and Utilization Act. Construction by the U.S. Bureau of Reclamation began January 20, 1941, and the first delivery of water was made July 17, 1946. The project has a direct-flow appropriation for 158.38 second-feet, dated January 25, 1937, and two storage appropriations, one for 15,000 acre-feet dated March 6, 1937, and the other for 32,670 acre-feet dated June 24, 1941.

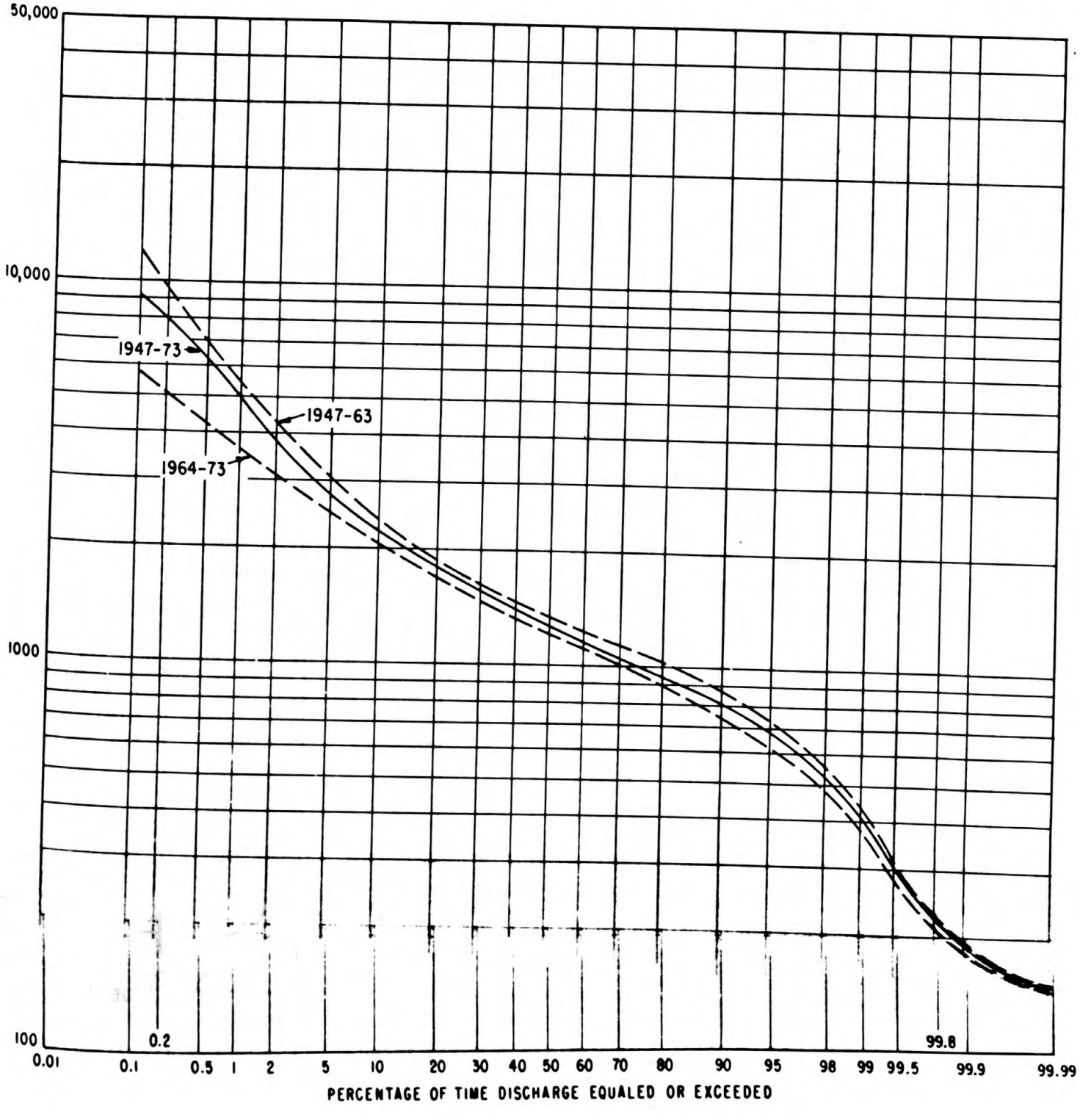

Figure 6.--Duration hydrograph of daily discharges, Niobrara River near Spencer, Nebr., for periods 1947-73, 1947-63, and 1964-73.

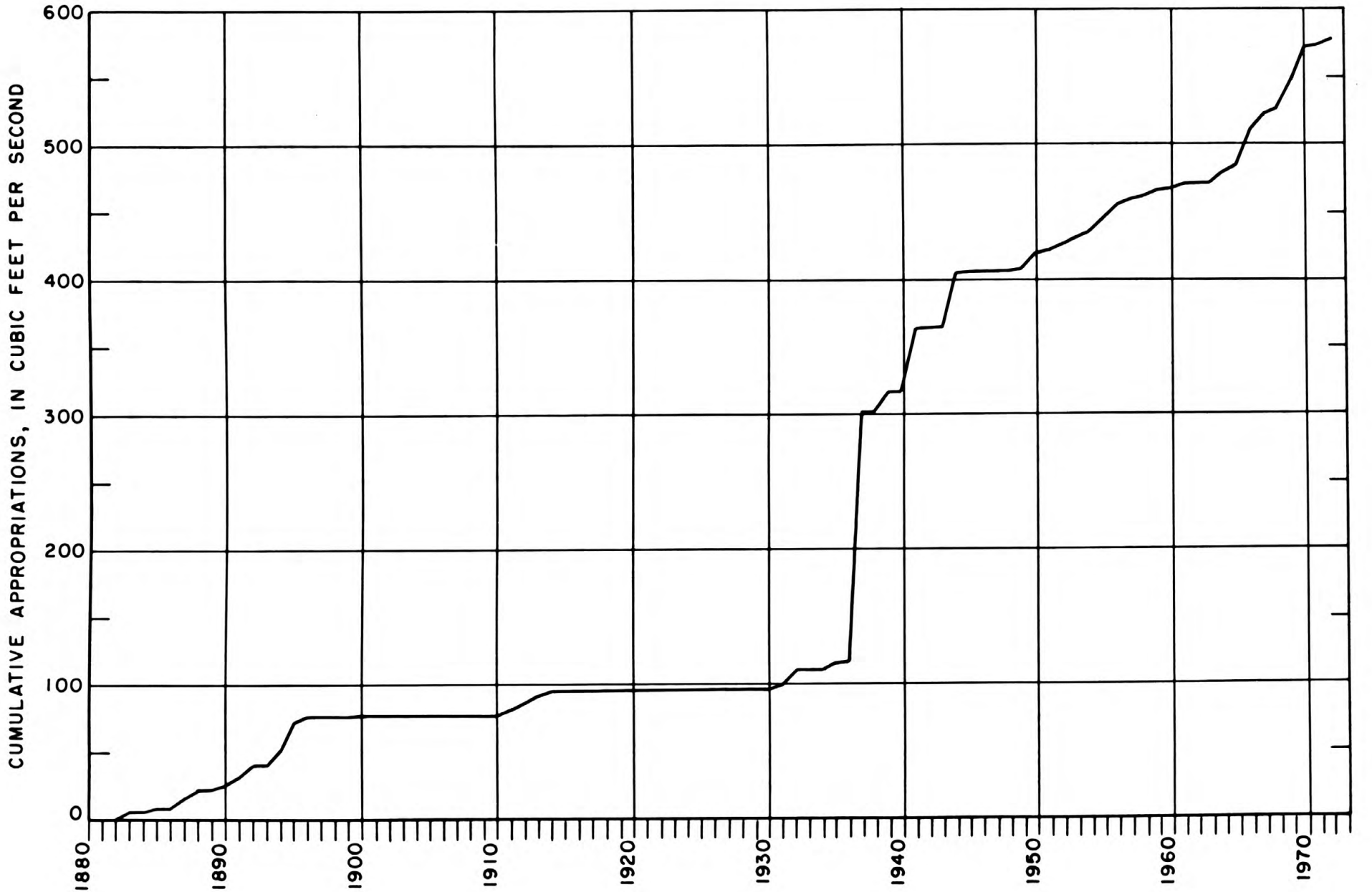

Figure 7.--Active appropriations for the use of surface water from main stem of Niobrara River.

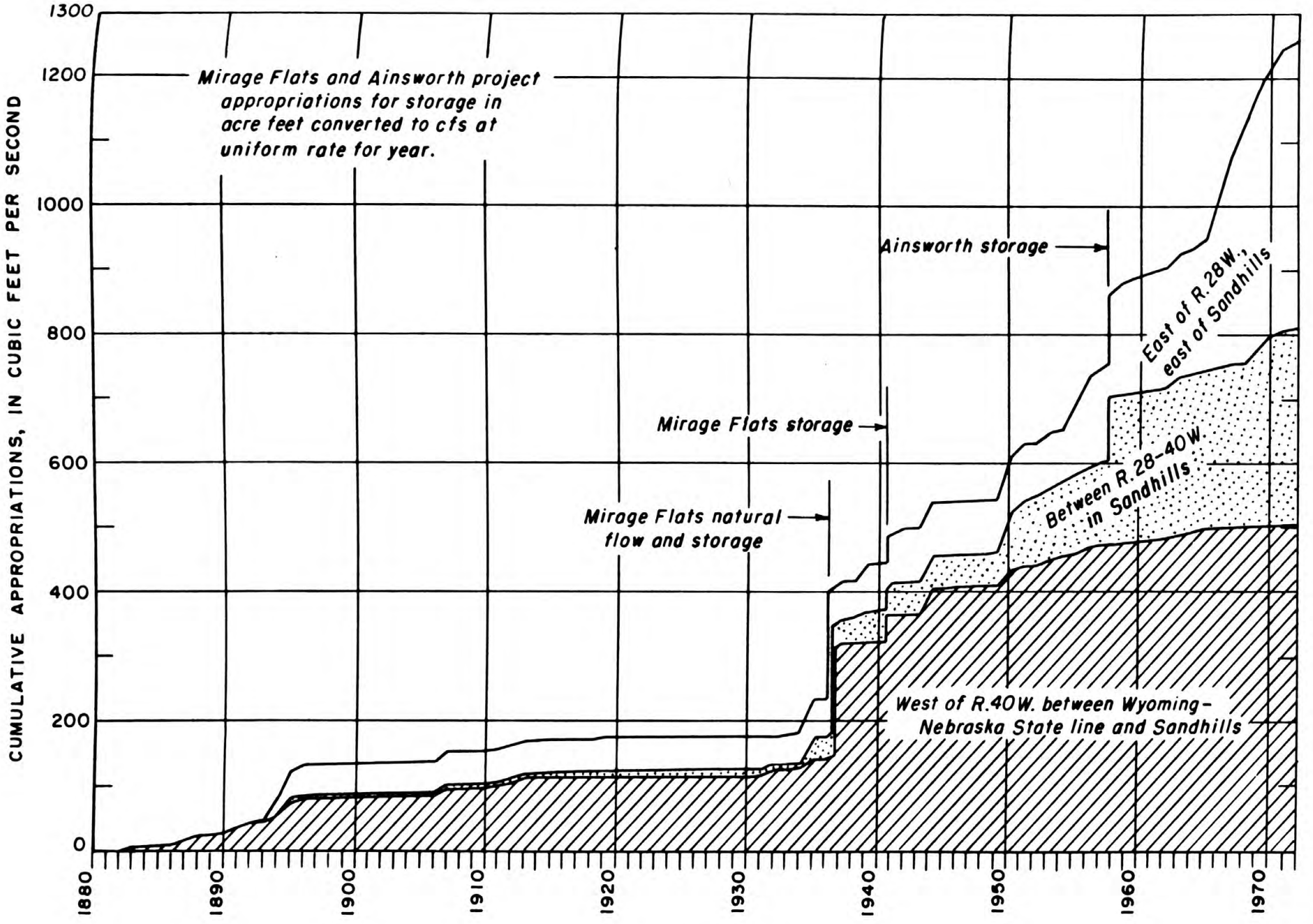

Figure 8.-- Active appropriations for the use of surface water in Niobrara River basin.

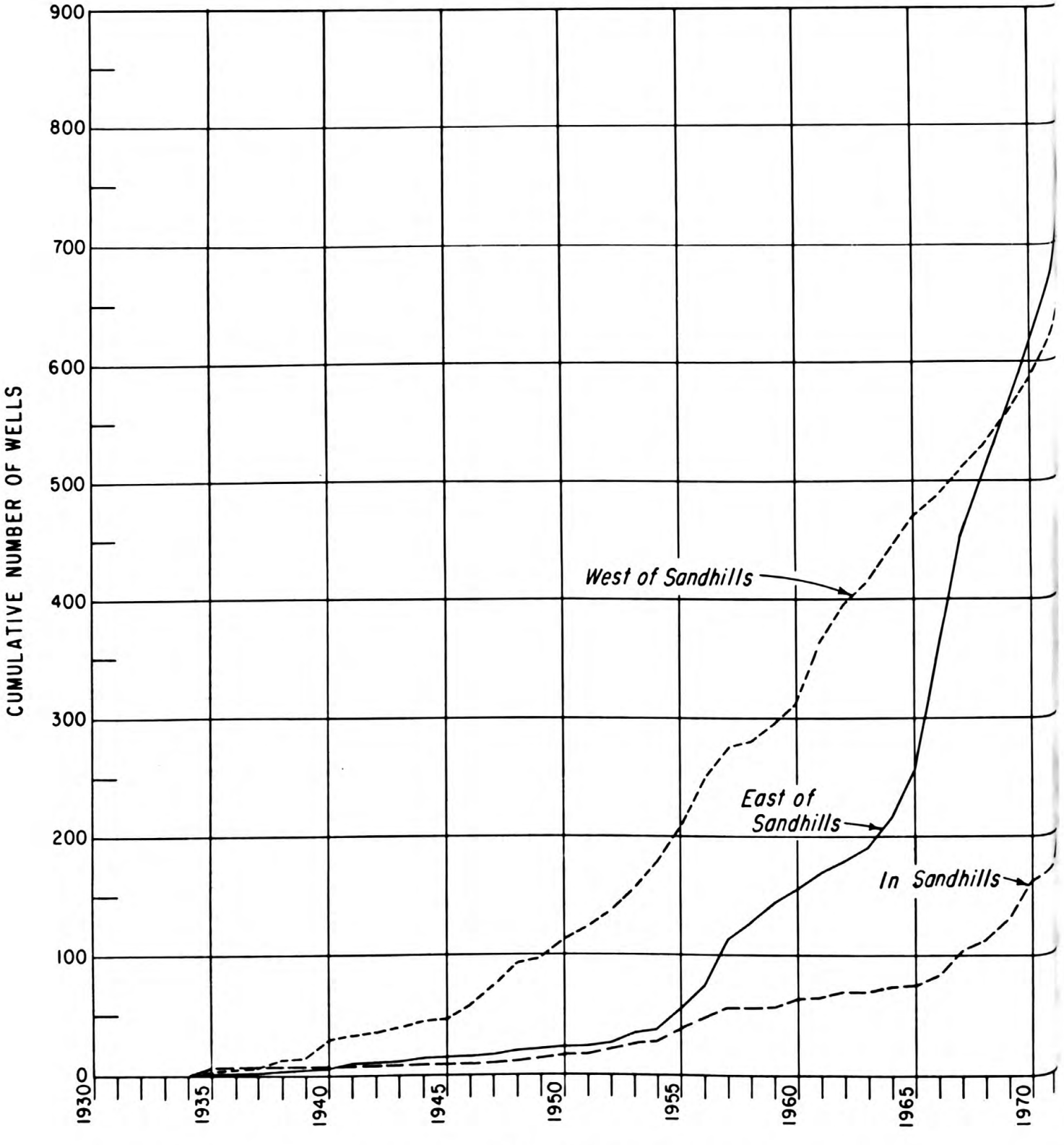

Figure 9.--Cumulative totals of registered irrigation wells in Niobrara River basin w of sandhills, in sandhills, and east of sandhills.

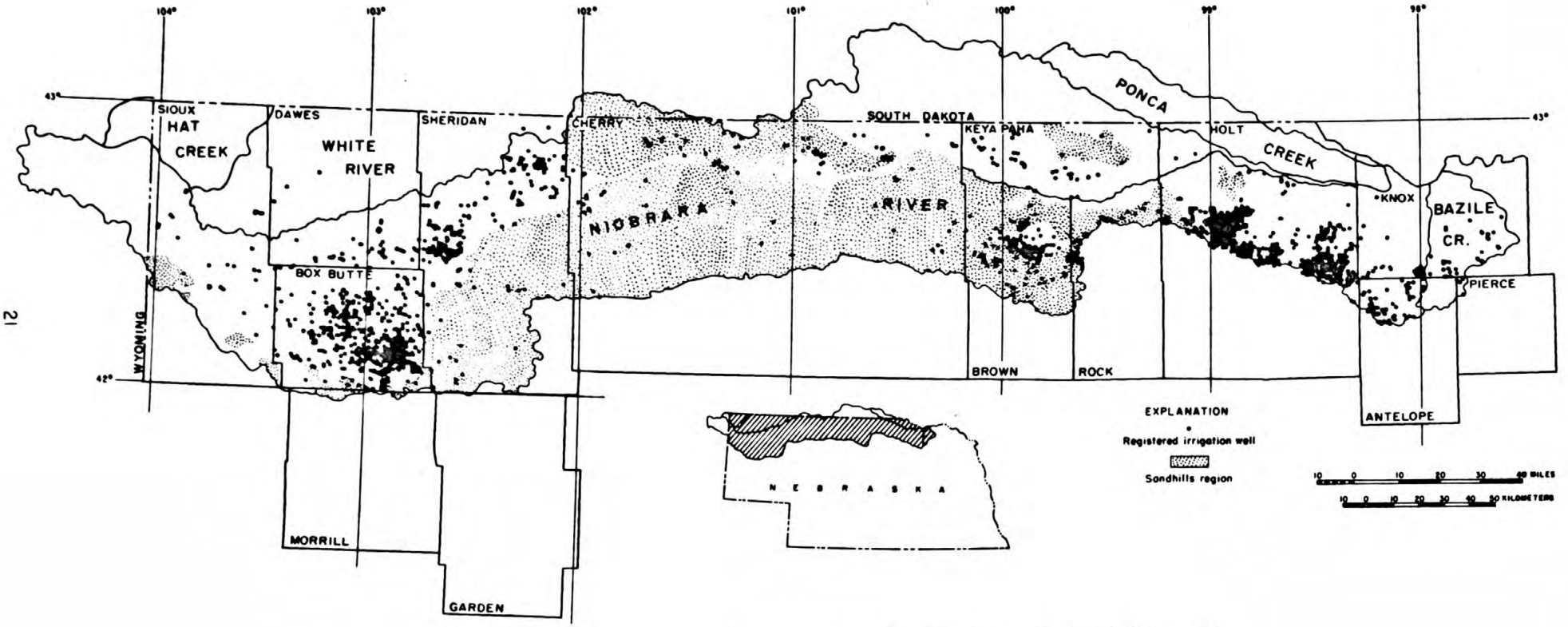

Figure 10.--Location of irrigation wells in the Nebraska part of the five basins described in this report.

Box Butte Dam and Reservoir on the Niobrara River in Box Butte County, about 10 miles north of the town of Hemingford, are part of the Mirage Flats Project. Storage began October 3, 1945. The reservoir has a capacity of 31,300 acre-feet with a surface area of 1,600 acres. Spring flows are stored and released as needed for irrigation, usually during the period from about May 15 to September 15. Storage of peak flows serves to reduce downstream flooding.

Regulation of the Box Butte Reservoir has resulted in uniform, though greatly reduced, average flow in the Niobrara River below the Mirage Flats Diversion Dam (fig. 11). Above Box Butte Reservoir the flow of the river averages 28.9 cfs, whereas below the diversion dam the flow averages only 2.7 cfs. This reduction in flow amounts to 19,000 acre-feet per year.

The Dunlap Diversion Dam is located 8 miles downstream from the Reservoir and 1 mile downstream from the town of Dunlap. It diverts water from the left bank of the stream into the Mirage Flats Canal, which is 14 miles long and has a carrying capacity of 220 cfs. Some years, the water supply is inadequate for all the 12,000 acres served by the Project (fig. 12); however, about 90 percent of the acreage in the District has been irrigated each year for the past 25 years.

Below the Mirage Flats Diversion Dam the flow of the Niobrara River increases, partly because of return flow from the project, but mostly because of increased ground-water discharge from the sandhills. Discharge from the sandhills causes flow in the central and lower portions of the Niobrara River to be much more uniform than flow in most rivers in Nebraska.

Because the Mirage Flats Canal has a priority date of January 25, 1937, its water right is senior over some of the upstream appropriators. During periods of low flow, the water supply is administered according to the doctrine of priority, therefore periods have occurred when the upstream junior appropriators were denied the right to divert water from the stream. As a result, the Nebraska Department of Water Resources, in 1955, required all appropriators upstream from Box Butte Reservoir to install automatic recorders to measure diversions so that water supply would be administered in an orderly manner. Records of diversions upstream from Box Butte are therefore available from 1956 to date (1974).

Except for the Ainsworth Project, no records were kept of diversions below Mirage Flats Project because the water supply is adequate to satisfy all irrigation requirements. The ratio of water diverted in the Niobrara River basin above Mirage Flats in 1973 to the total appropriated in that part of the basin was applied to the active appropriations listed in the 39th Biennial Report to estimate the water diverted annually in the remaining portion of the basin.

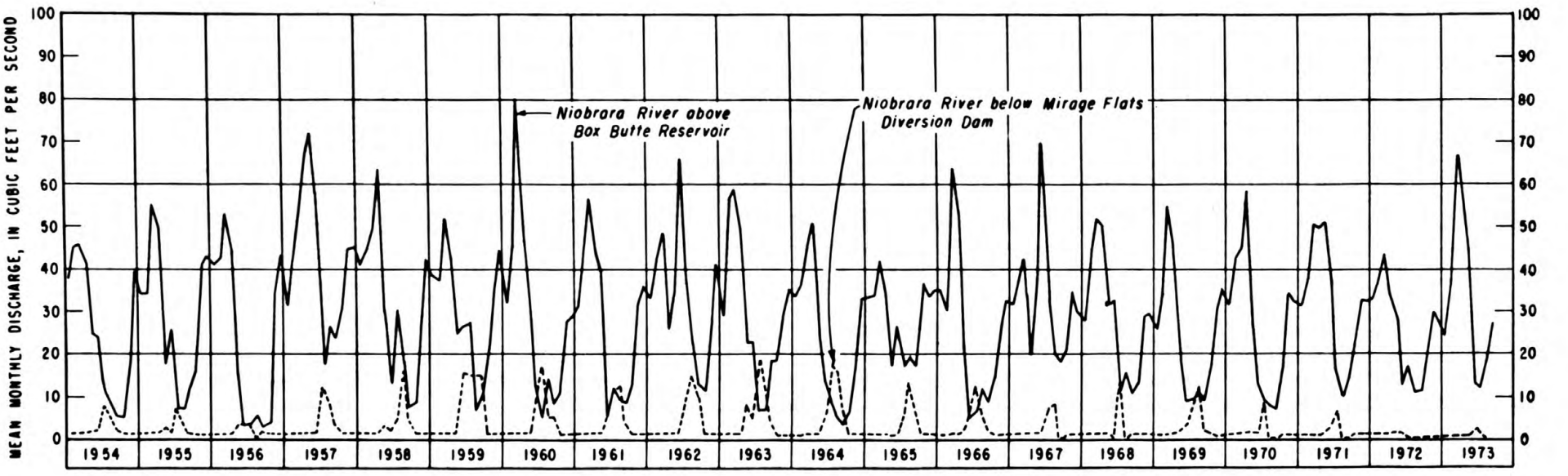

Figure 11.--Niobrara River above Box Butte Reservoir and below Mirage Flats Diversion Dam, 1954-73.

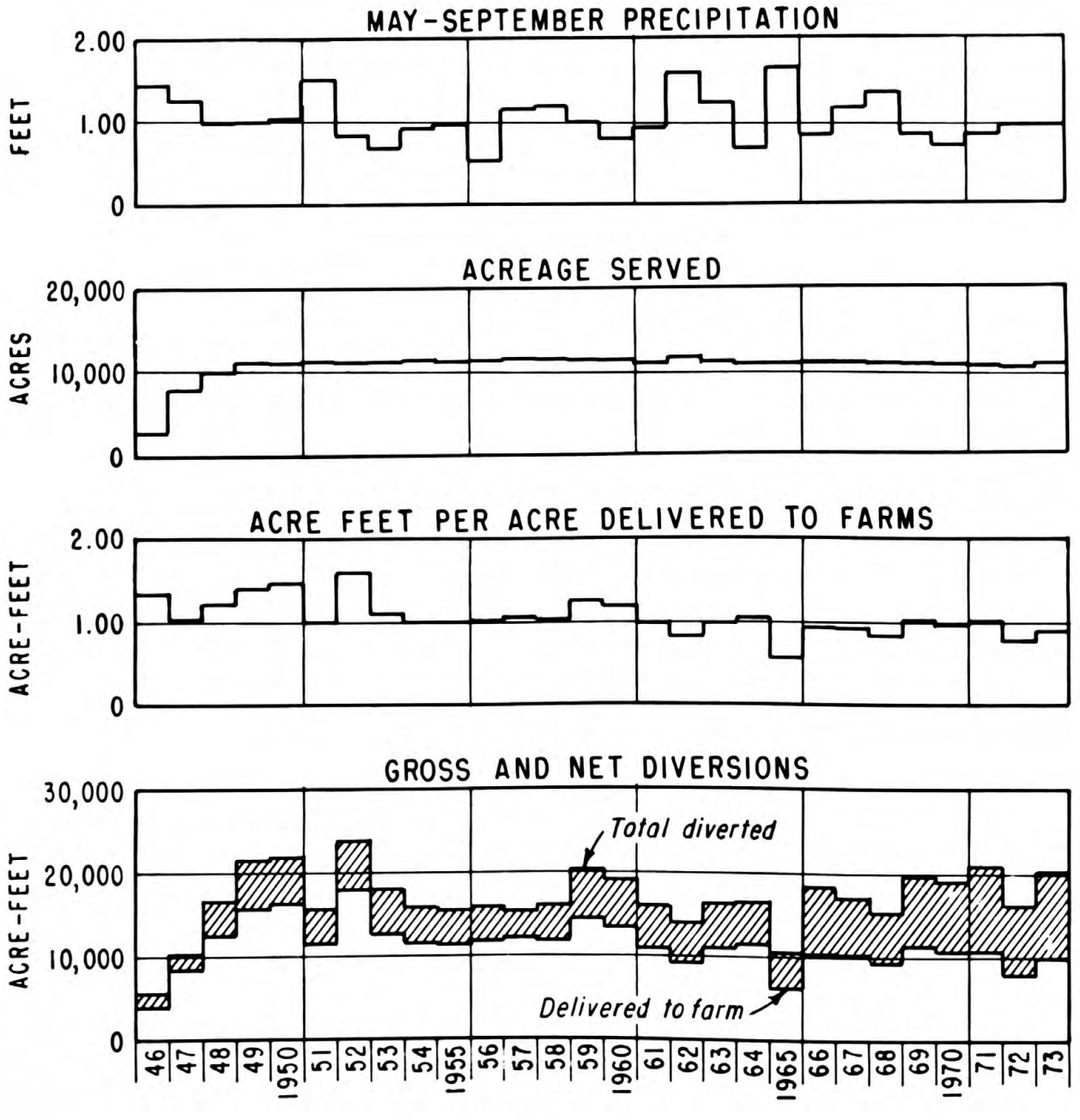

Figure 12.--Total and net amounts of water diverted for irrigation, acreage served, amount of water diverted per acres served, and total May-September precipitation, Mirage Flats Irrigation Project, 1947-73.

An estimated 39,200 acres, exclusive of the Mirage Flats and Ainsworth Projects, are now being irrigated by surface water. In the upper reaches of the basin some of the acreage is irrigated by a combination of surface and ground water. Acreage reports must be filed prior to April 15 of each year, specifying the acreage to be irrigated that year.

Ainsworth Irrigation Project

The Ainsworth Irrigation Project, an integral part of the Missouri River Basin Development Program, was authorized August 21, 1954, and built by the U.S. Bureau of Reclamation during 1961-64. Principal features of the project are Merritt Dam and Reservoir on the Snake River about 26 miles southwest of Valentine, Nebr., and the 53 miles of concrete-lined canal leading from the reservoir to a point near Johnston, Nebr. The reservoir has a total capacity of 74,000 acre-feet, an active capacity of 68,000 acre-feet, and a surface area of 2,900 acres. Storage in the reservoir began February 19, 1964, and the maximum content that year was 43,490 acre-feet. The following year, the capacity of the reservoir was reached. Capacity of the reservoir is less than half the annual flow of Snake River at this location. Storage is not necessarily seasonal; that is, if there is space available in the reservoir, streamflow above that needed to satisfy all existing downstream appropriators can be stored during the irrigation season. (See fig. 13.) Natural flow of Snake River supplemented by water stored from the nonirrigation season fulfills the need of the Ainsworth Project.

The irrigation canal, with a capacity of 580 cfs, diverts from the right bank at Merritt Dam and extends eastward for 53 miles. The canal is concrete lined to prevent leakage into the sandy soils which it traverses for most of its course. There are 185 miles of laterals which serve 33,900 acres scattered across a small plains region in Brown and Rock Counties (fig. 14). Water was first turned into the canal June 1, 1965. Flow of Niobrara River is reduced by the operation of Ainsworth Project. Duration curves of daily discharges at Niobrara River near Spencer, Nebr., (fig. 6) show the difference in flow for the periods 1947-63 and 1964-73 as compared to 1947-73. The earlier period presents the record prior to the operation of the Ainsworth Project, a period which was drier than 1964-73.

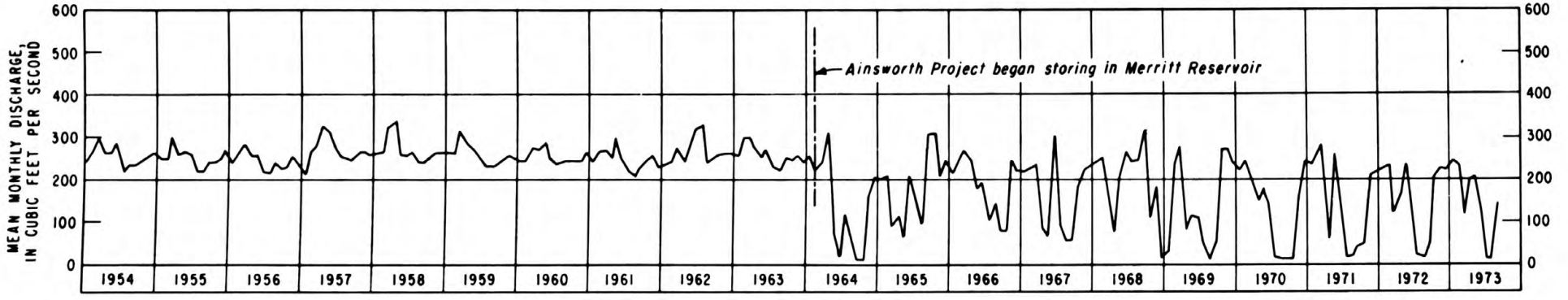

Figure 13.--Snake River near Burge, Nebr., before and after operation of Ainsworth Irrigation Project.

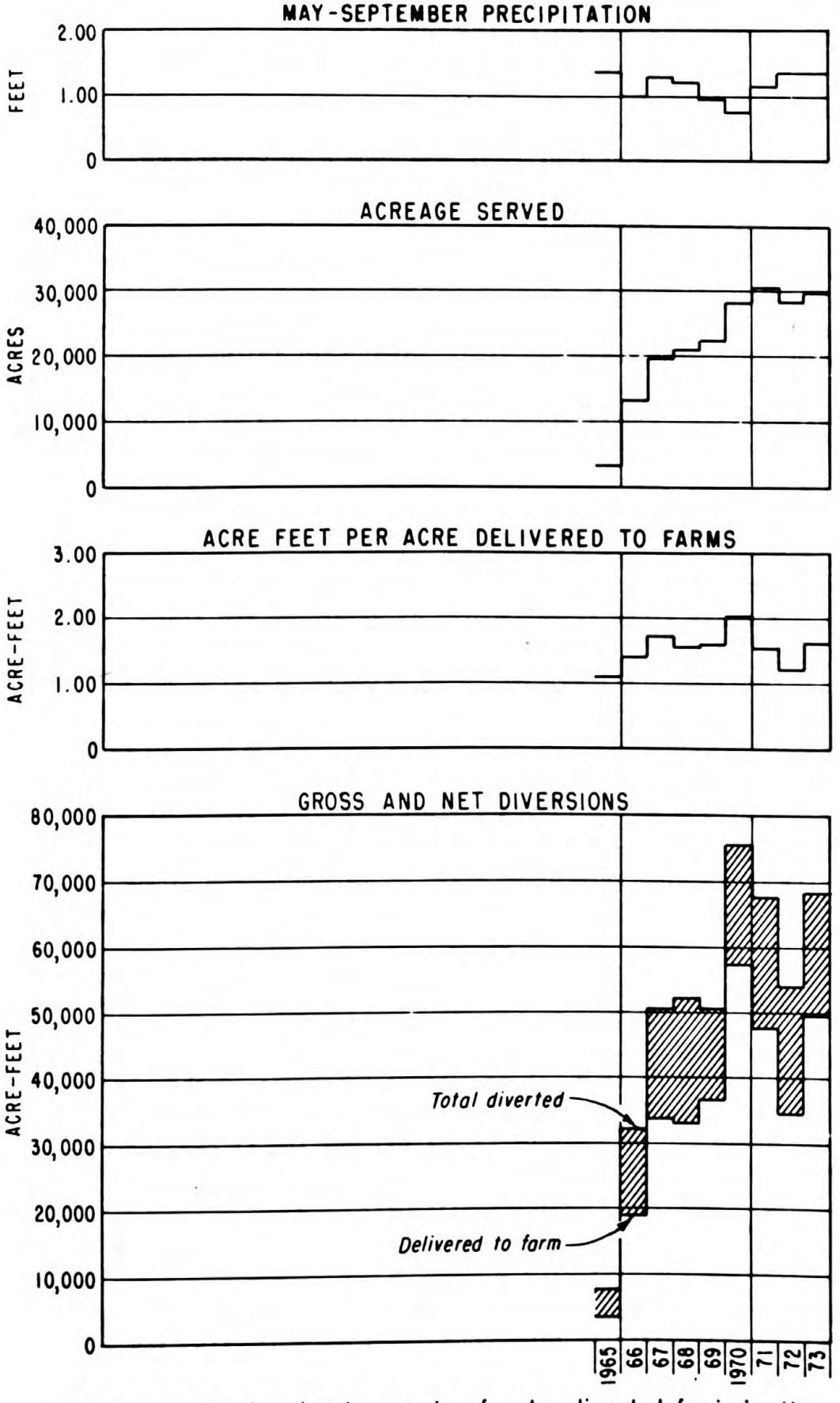

Figure 14.--Total and net amounts of water diverted for irrigation, acreage served, amount of water diverted per acre served, and total May-September precipitation, Ainsworth Irrigation Project, 1964-73.

Principal tributaries of the Niobrara River

Principal tributaries to the Niobrara, in downstream order, are the Snake River; Minnechaduza, Plum, and Long Pine Creeks; Keya Paha River; and Verdigree Creek.

Snake River.—Snake River rises in the Sandhill Region in the east-central part of Sheridan County about 30 miles south of the South Dakota-Nebraska line. The stream meanders eastward to the point where it is joined by Boardman's Creek, its principal tributary in central Cherry County. From the junction with Boardman's Creek, the Snake River flows northeastward to its confluence with the Niobrara near Burge in north-central Cherry County, 173 miles above the mouth of the Niobrara. The Snake River is 120 miles long, drains an area of 880 square miles, and has a gradient of 11.6 feet per mile. Floods do not occur in the basin because sandy soils absorb the average annual precipitation of 18 inches. The rainfall then percolates through the aquifer to streams to sustain their flow during dry periods.

The Snake River is the source of water for the Ainsworth Irrigation Project. (See Ainsworth Irrigation Project.) Prior to the development of the Ainsworth Project, the Snake River contributed 300 cfs or about 30 percent of the flow of the Niobrara just below its confluence with the Snake; however, since the completion of the Ainsworth Project, it contributes only about 22 percent (fig. 13).

Duration hydrograph of daily discharges of the Snake River near Burge, Nebr., for the periods 1948-63 and 1964-73 (fig. 15) show the difference in flow before and after operation of the Ainsworth Project. Low flows especially have been greatly reduced due to the regulation of Merritt Reservoir and diversions from Ainsworth Canal.

Minnechaduza Creek.—The source of Minnechaduza Creek is in Todd County in south-central South Dakota, about 5 miles north of the State line. The stream meanders south-westward to enter the Niobrara 149 miles above its mouth or about 4 miles northeast of the city of Valentine. The Minnechaduza drains 419 square miles of which 118 square miles are in South Dakota. Its valley is narrow, and the stream gradient is 15 feet per mile. The mean annual discharge at Valentine, which is near the mouth of Minnechaduza Creek, was 35 cfs (1947-72). The mean annual precipitation in the basin is 18 inches.

Plum Creek.—The source of Plum Creek is in the Sandhills Lake Region in east-central Cherry County. The stream flows northeastward to its confluence with the Niobrara River near Meadville, 108 miles above the mouth of the Niobrara. The drainage area is 600 square miles and the stream gradient is 6.7 feet per mile. Plum Creek maintains an unusually uniform flow, averaging 107 cfs near its mouth during the period 1949-73. The mean annual precipitation in the basin is 21 inches.

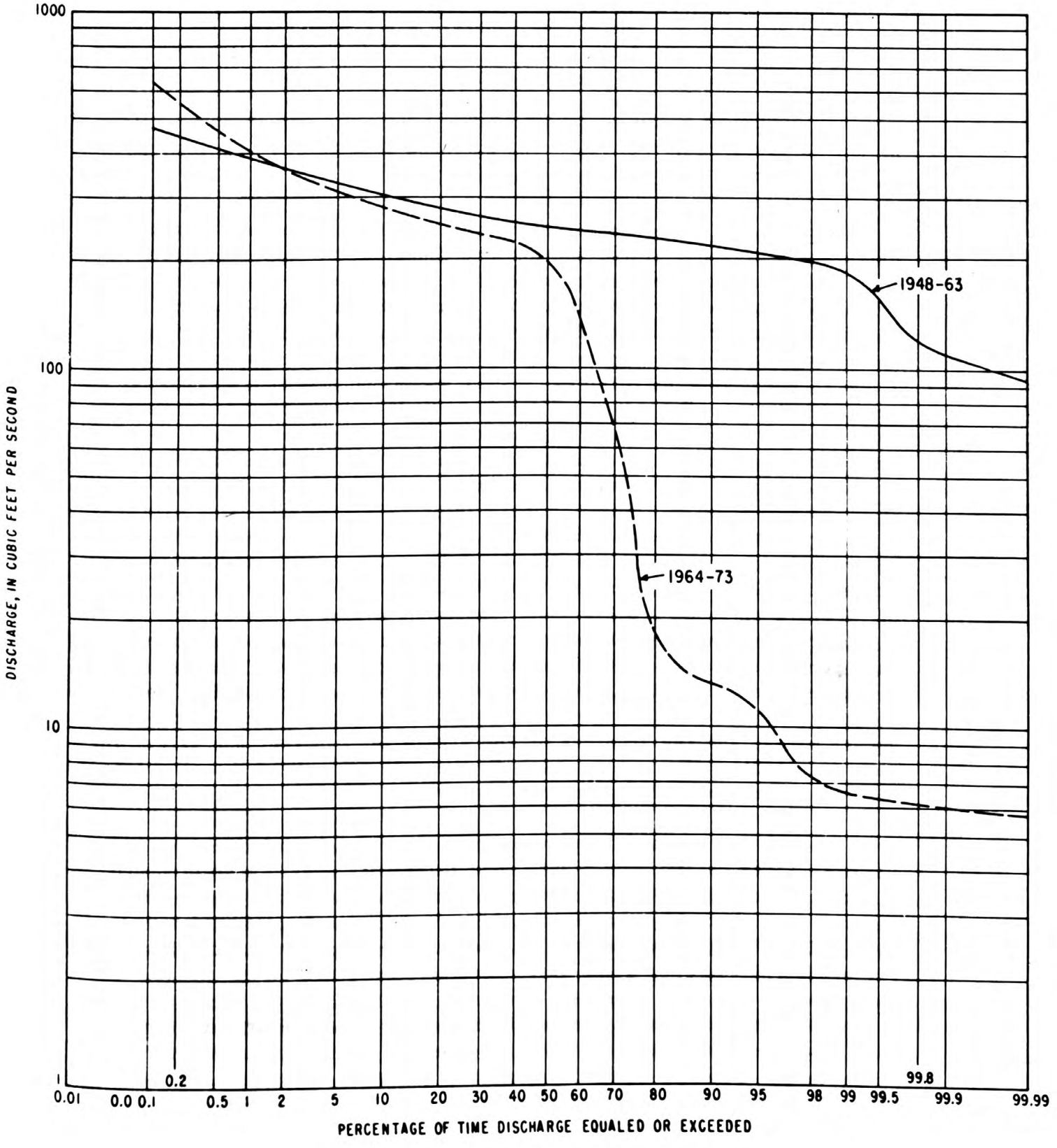

Figure 15.--Duration hydrograph of daily discharges, Snake River near Burge, Nebr., for periods 1948-63 and 1964-73.

Long Pine Creek.—Long Pine Creek originates in the Sand Hills Region of Brown County where the altitude at the basin divide is approximately 2,900 feet and enters the Niobrara River near Riverview, 96 miles above the mouth of the Niobrara at altitude 1,925 feet. The gradient is about 20 feet per mile. The tributaries, of which Bone Creek is the principal one, are fed by springs; therefore, the flow is relatively uniform throughout the year. The mean discharge at the mouth of the creek is about 150 cfs. The drainage area is 423 square miles. Mean annual precipitation is 21 inches.

Keya Paha River.—Headwaters of the Keya Paha River are in the hilly areas of Todd, Tripp, and Gregory Counties, S. Dak. The stream's sources are springs in the upper reaches of the basin. The stream follows a southeastward course to its confluence with the Niobrara River about 8 miles north-west of Burton in Keya Paha County, Nebr., 59 miles above the mouth of the Niobrara. The drainage area is approximately 1,660 square miles, of which 64 percent is in South Dakota and the remainder in Nebraska. Most of the principal tributaries of the Keya Paha are in South Dakota. The gradient of the stream averages 9 feet per mile. The mean annual discharge is 140 cfs. The mean annual precipitation in the basin is 19 inches.

Verdigre Creek.—The principal source of Verdigre Creek is in northern Antelope County. The stream follows a general northern course and empties into the Niobrara River about 4 miles southeast of the town of Niobrara or about 5 miles above the mouth of the Niobrara. The main tributaries to the Verdigre—namely, the North, Middle, and South branches—have perennial flow. Streamflow is variable in the lower reaches of the creek because the soil is clayey and slopes are steep. Flooding inundated about half the town of Verdigre in 1935. The drainage area is 551 square miles, and the gradient of the stream is 16.6 feet per mile. The mean annual flow of Verdigre Creek is about 75 cfs. Mean annual precipitation in the basin is 23 inches.

Through the years, 45 water-power plants have been built in the Niobrara River basin. The plants were relatively small; most produced electric energy for a town or for grist mills. According to the Nebraska Department of Water Resources records, only 19 plants were active in 1930. In 1950, five hydroelectric plants were operating in the basin. Presently (1974), only three hydroelectric plants are in operation.

The operating plants are on the Minnechaduza Creek at Valentine, with a water-right priority date of September 12, 1896, for 35 cfs and an installed capacity of 0.25 megawatts; the Niobrara River near Valentine, with a priority date of January 29, 1902, for 1,600 cfs and an installed capacity of 1.85 megawatts; and the Niobrara River near Spencer with a priority date of October 30, 1923, for 1,450 cfs with an installed capacity of 3.9 megawatts. The two installations near Valentine are considered to be run-of-the-river plants, but they hold for short

periods the low flows of summer to build up sufficient head to generate power. A small amount of storage is provided above the Spencer plant.

No electric-generating plants in the basin require cooling water from streams, and the regulation necessary to build up sufficient head for power has only a minimal effect on the streamflow. All three hydroplants are now owned and operated by the Nebraska Public Power District (NPPD).

BAZILE CREEK

Bazile Creek basin includes an area of 440 square miles mostly in Knox County, Nebr., east of the Niobrara River basin. The topography of the basin is characterized by moderate to steep slopes, sharp ridges, and remnants of a nearly level upland till plain. Mean annual precipitation in the basin is 24 inches. Bazile Creek rises in the plains area of northeastern Antelope County, Nebr., and flows northward through Knox County to join the Missouri River about 4.5 miles east of the town of Niobrara. Bazile Creek enters Lewis and Clark Lake, created by Gavins Point Dam on the Missouri River. Streamflow is variable ranging from 68,600 cfs in 1957 to 0.6 cfs in 1970, with a mean discharge of about 90 cfs.

There are 53 active appropriations totaling 53.13 second-feet in Bazile Creek basin; 28 of these are for less than 1 cfs. All surface water used for irrigation in the basin is pumped directly from Bazile Creek. Irrigation with ground water is small as there are only 33 registered irrigation wells in the basin.

STREAMFLOW STATISTICS

Characteristics of streamflow at gaging stations in White River, Ponca Creek, Niobrara River, and Bazile Creek basins are described by statistical data that are arranged in tables or figures. All statistics derived from discharge records for a given gaging station are grouped together after the gaging-station description, and the several groups are arranged according to gaging-station number in increasing order. Because the gaging-station numbers are assigned to reflect downstream order, the first group of statistics is for gaging station 06444000 White River at Crawford, Nebr., and the last is for 06466500 Bazile Creek near Niobrara, Nebr.

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06444000 White River at Crawford, Nebr.

LOCATION.—Lat 42°41'33", long 103°25'03", in W½ sec.3, T.31 N., R.52 W., Dawes County, on right bank 15 ft downstream from bridge in city park at Crawford.

DRAINAGE AREA.—313 sq mi.

PERIOD OF RECORD.—February 1931 to September 1943; October 1947 to September 1973.

DIVERSIONS.—Some pumping directly from stream; streamflow not appreciably affected.

Monthly and annual mean discharges, water years 1932-43; 1948-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	23	13	16	2.2	14	6.80
November....	27	16	19	2.8	14	8.01
December....	27	16	20	2.6	13	8.34
January.....	28	15	21	2.5	12	8.58
February....	34	18	24	4.0	17	9.71
March.....	60	20	27	9.3	34	11.28
April.....	47	19	25	5.9	23	10.35
May.....	106	17	26	14	55	10.60
June.....	55	14	23	8.7	38	9.31
July.....	36	8.3	16	5.8	37	6.42
August.....	33	6.3	12	4.8	39	5.06
September...	37	8.2	13	5.0	38	5.54
Annual.....	30	16	20	3.2	16	100

Duration of daily mean discharge, water years 1932-43; 1948-73

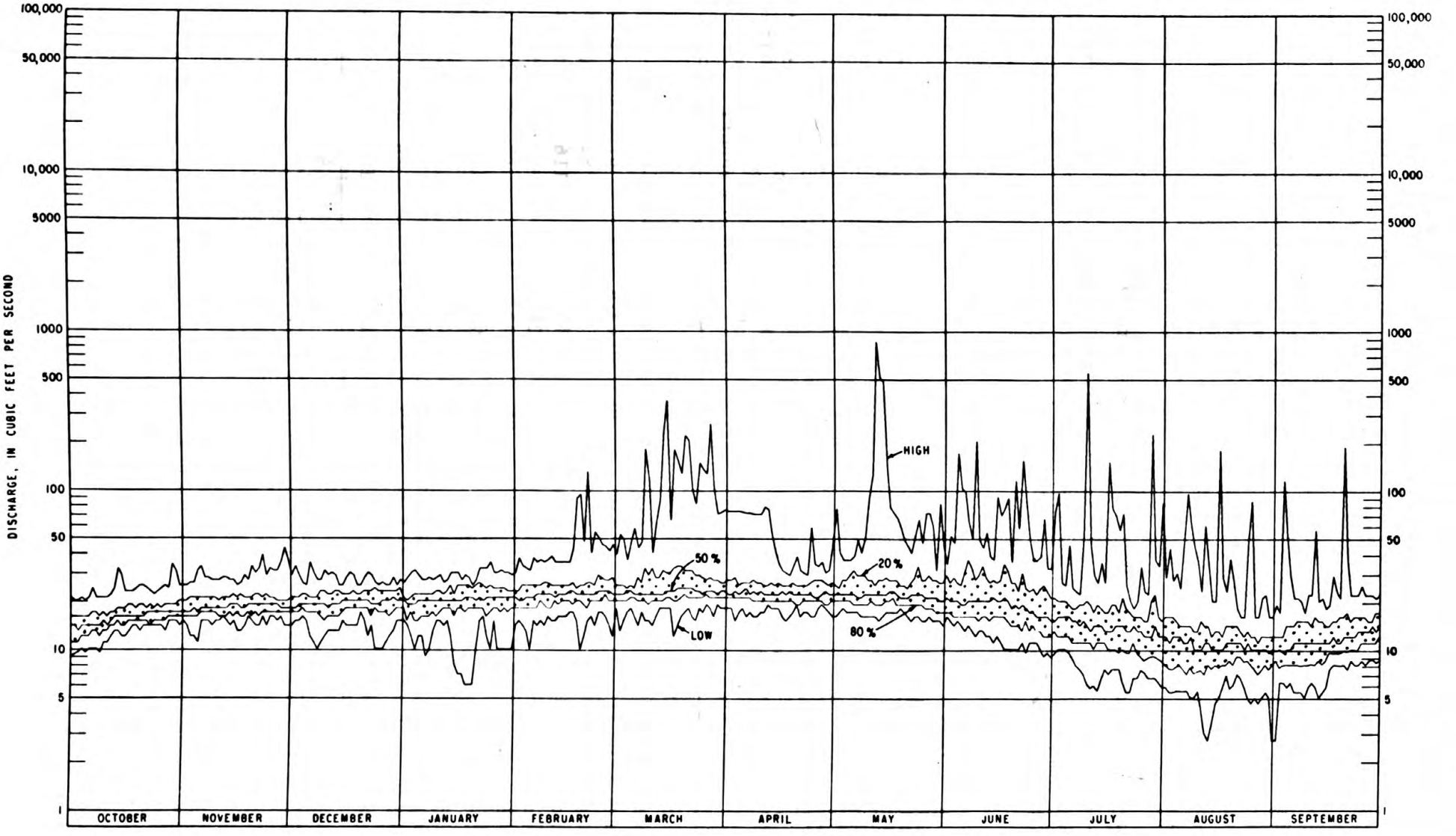
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
3.9	100	16	72.4	59	1.0
4.6	99.9	19	54.3	69	.8
6.3	99.3	23	26.0	81	.6
7.4	98.2	27	11.4	95	.4
8.7	95.4	31	5.4	110	.3
10	92.4	36	2.8	130	.2
12	87.2	43	1.7	180	.1
14	81.1	50	1.2		

Probability of annual high flows, water years 1932-43; 1948-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	24	22	22	21	21	21
50	2	113	67	46	36	30	27
10	10	370	198	114	73	54	41
4	25	611	323	175	105	72	53
2	50	862	457	238	136	90	63
1	100	1,190	635	321	176	112	75

Probability of annual low flows, climatic years 1933-43; 1949-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
1	100	1.9	2.1	2.8	3.9	4.5	5.6
2	50	2.6	2.9	3.6	4.8	5.4	6.5
5	20	3.8	4.2	4.8	6.0	6.4	7.7
10	10	4.6	5.1	5.8	6.5	7.3	8.4
20	5	5.4	6.0	6.5	7.2	8.0	9.1
50	2	7.2	7.8	8.1	8.7	9.6	11



Exceedence probability graph of daily discharge, White River at Crawford, Nebr., 1941-43, 1948-73.

06445000 White River below Cottonwood Creek near Whitney, Nebr.

LOCATION.--Lat 42°48'35", long 103°10'05", in NE¼NE¼ sec.26, T.33 N., R.50 W., on left bank 0.5 mile downstream from Cottonwood Creek and 4.5 miles northeast of Whitney.

DRAINAGE AREA.—676 sq mi.

PERIOD OF RECORD.—October 1948 to September 1961.

DIVERSIONS.--Streamflow affected appreciably by irrigation and storage in Whitney Reservoir.

Monthly and annual mean discharges, water years 1952-61

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	11	2.5	5.8	3.5	61	2.80
November....	20	2.1	6.9	5.7	83	3.32
December....	21	2.8	8.1	5.4	67	3.90
January.....	25	2.2	8.4	7.8	92	4.04
February....	42	1.8	10	12	116	4.99
March.....	78	3.0	26	24	91	12.47
April.....	46	8.1	21	12	57	9.91
May.....	238	17	56	66	118	26.82
June.....	70	5.5	26	21	79	12.75
July.....	62	6.0	20	17	88	9.47
August.....	23	3.4	10	7.2	69	5.02
September...	42	2.8	9.4	12	126	4.51
Annual.....	37	9.0	17	8.6	49	100

Duration of daily mean discharge, water years 1952-61

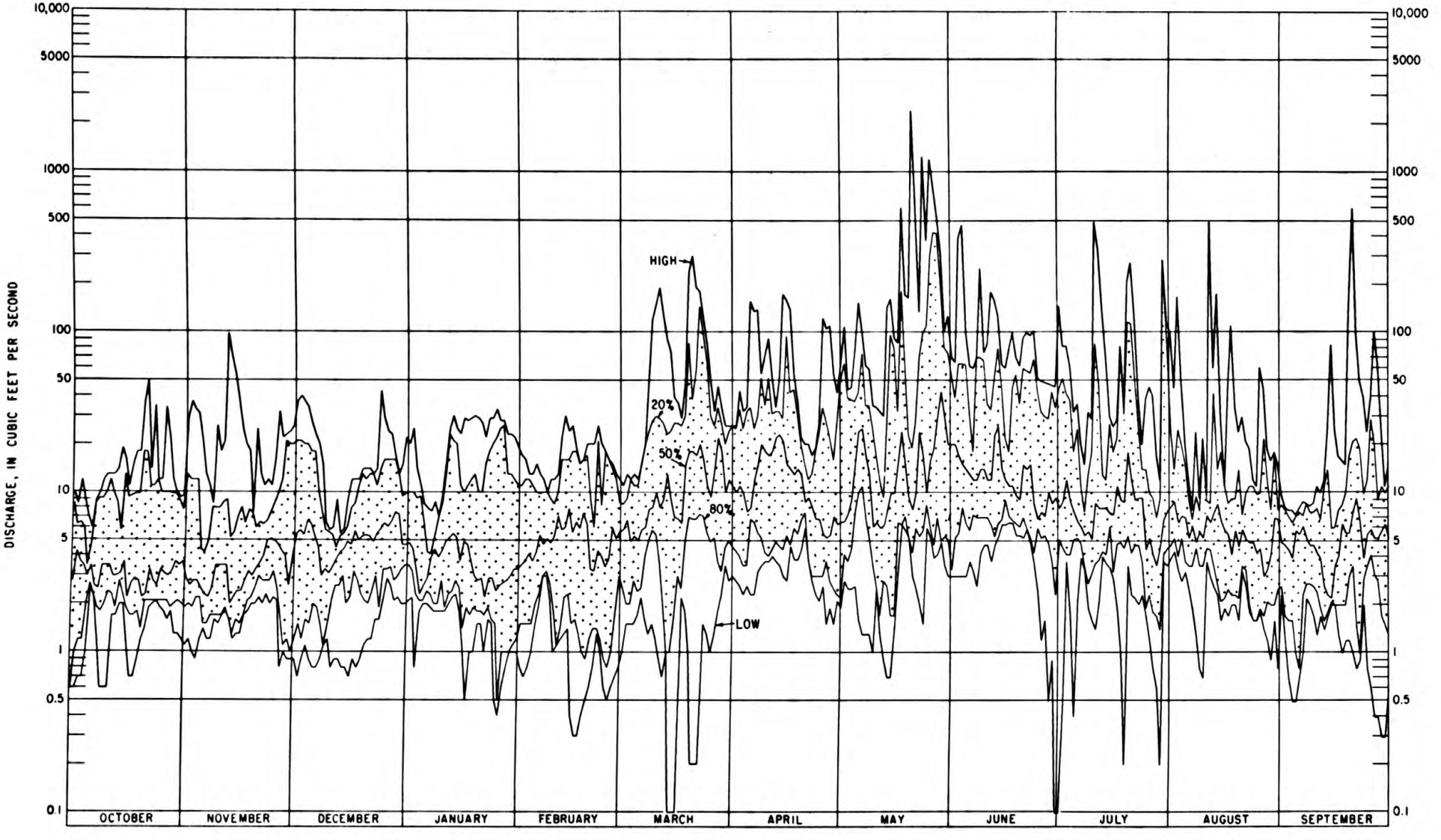
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	3.1	75.8	54	5.3
.10	99.9	4.1	67.3	72	3.6
.30	99.7	5.5	56.9	95	2.7
.40	99.6	7.3	45.7	130	1.7
.60	99.2	9.7	35.4	170	1.0
.70	98.8	13	27.5	220	.7
1.0	97.2	17	21.7	300	.5
1.3	95.2	23	15.6	400	.3
1.7	92.3	30	11.0	530	.2
2.3	84.9	40	7.6	710	.1

Probability of annual high flows, water years 1952-61

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	124	74	49	33	24	20
50	2	392	234	131	86	55	37
10	10	1,350	661	394	247	148	90

Probability of annual low flows, climatic years 1953-61

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	0	0.10	0.40	0.90	1.4	1.8
20	5	.10	.20	.50	1.0	1.6	2.0
50	2	.40	.50	.80	1.3	2.2	2.8



Exceedence probability graph of daily discharge, White River below Cottonwood Creek near Whitney, Nebr., 1953-61.

06445590 Big Bordeaux Creek near Chadron, Nebr.

LOCATION.—Lat 42°43'30", long 102°55'44", in NW¼NW¼ sec.26, T.32 N., R.48 W., Dawes County, Nebraska National Forest-Pine Ridge Division, on right bank 4.2 miles northeast of Chadron State Park headquarters and 8 miles southeast of Chadron.

DRAINAGE AREA.—9.42 sq mi.

PERIOD OF RECORD.—June 1968 to September 1973.

DIVERSIONS.—Streamflow not affected by pumping.

Monthly and annual mean discharges, water years 1969-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	0.35	0.19	0.27	0.06	22	4.62
November....	.50	.38	.44	.05	10	7.58
December....	.56	.14	.44	.17	39	7.60
January.....	.66	.26	.49	.16	32	8.44
February....	.58	.38	.51	.08	15	8.88
March.....	1.3	.57	.80	.30	37	13.92
April.....	.85	.60	.74	.10	13	12.81
May.....	.88	.70	.78	.06	8	13.44
June.....	.59	.47	.52	.04	8	9.08
July.....	1.3	.20	.52	.43	82	9.07
August.....	.20	.05	.12	.06	49	2.16
September...	.28	.04	.14	.09	65	2.40
Annual.....	0.60	0.44	0.48	0.07	14	100

Duration of daily mean discharge, water years 1969-73

Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	0.20	81.7	1.3	0.9
.01	99.2	.30	72.6	1.5	.8
.02	98.3	.40	60.1	1.9	.5
.03	96.9	.50	46.2	2.3	.4
.04	96.1	.60	30.7	2.8	.3
.05	95.7	.70	19.1	3.4	.2
.06	95.0	.90	6.1	4.9	.1
.08	93.4	1.0	3.6		

Probability of annual high flows, water years 1969-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	1.1	0.92	0.82	0.74	0.66	0.62
50	2	1.8	1.5	1.1	1.0	.86	.76

Probability of annual low flows, climatic years 1970-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
20	5	0	0	0	0	0.02	0.04
50	2	.01	.02	.04	.06	.07	.11

It has been determined that a minimum of 9 years of record is needed for an exceedence-probability graph (see last paragraph of page 3). Because only 5 years of record for Big Bordeaux Creek near Chadron, Nebr., and 8 years of record for White River at Slim Butte, S. Dak., are available, graphs for these stations were not prepared.

06445700 White River at Slim Butte, S. Dak.

LOCATION.--Lat 43°04', long 102°49', in SE¼ sec.23, T.36 N., R.47 W., on left bank 300 feet downstream from highway bridge, 0.25 mile downstream from Janis Creek, 0.5 mile east of village of Slim Butte, 8.75 miles southwest of Oglala, and 11 miles downstream from Nebraska-South Dakota State line.

DRAINAGE AREA.—1,500 sq mi, approximately.

RECORDS AVAILABLE.—July 1962 to September 1970.

DIVERSIONS.--Streamflow affected appreciably by upstream irrigation and storage.

Monthly and annual mean discharges, water years 1963-70

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	26	12	13	8.9	71	2.45
November....	16	4.8	11	4.6	42	2.13
December....	16	2.8	10	4.4	42	2.01
January.....	26	4.6	12	6.4	54	2.28
February....	58	9.8	28	19	69	5.35
March.....	263	19	72	84	116	14.07
April.....	124	16	53	33	62	10.33
May.....	66	16	35	17	48	6.90
June.....	1,010	10	195	337	173	37.90
July.....	185	7.2	54	62	114	10.51
August.....	87	1.8	23	29	128	4.45
September...	18	.10	8.3	7.5	90	1.62
Annual.....	115	13.1	43	32	74	100

Duration of daily mean discharge, water years 1963-70

Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	2.0	92.8	93	6.2
.01	97.1	3.0	90.8	140	4.4
.09	97.0	4.4	85.4	200	3.0
.10	96.9	6.4	78.9	290	1.9
.20	96.4	9.4	68.7	430	1.4
.30	96.3	14	54.3	630	.8
.40	96.0	20	40.6	920	.5
.70	95.3	30	27.2	1,300	.3
1.0	95.0	43	16.8	2,000	.1
1.4	94.1	63	9.8		

Probability of annual high flows, water years 1963-70

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	20	17	15	12	10	9
50	2	840	640	480	310	175	110
10	10	6,020	3,350	2,030	1,600	920	550

Probability of annual low flows, climatic years 1964-70

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	0	0	0	0	0	0.17
20	5	0	0	.14	.26	.78	1.2
50	2	1.3	2.3	2.7	3.7	5.7	6.8

06453400 Ponca Creek near Naper, Nebr.

LOCATION.—Lat 43°01'45", long 99°05'59", in SE¼SE¼ sec.22, T.95 N., R.70 W., Gregory County, S. Dak., on right bank 70 ft upstream from highway bridge, 2.2 miles north of and 6.0 miles upstream from South Dakota-Nebraska State line, 4.2 miles south of St. Charles, S. Dak., and 5 miles north of Naper, Nebr.

DRAINAGE AREA.—373 sq mi.

PERIOD OF RECORD.—October 1960 to September 1973.

DIVERSIONS.—Streamflow not affected by pumping.

Monthly and annual mean discharges, water years 1961-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	18	0	1.8	4.8	273	0.49
November....	17	0	3.0	5.7	188	.83
December....	15	0	1.8	4.1	228	.50
January.....	29	0	4.3	8.2	190	1.18
February....	122	.10	19	33	176	5.19
March.....	237	5.0	75	77	102	20.71
April.....	259	4.9	62	78	126	17.18
May.....	296	3.7	56	84	151	15.36
June.....	522	2.8	68	140	207	18.68
July.....	505	.10	50	138	273	13.92
August.....	159	0	15	44	287	4.21
September...	54	0	6.3	15	232	1.75
Annual.....	154	7.0	30	39	128	100

Duration of daily mean discharge, water years 1961-73

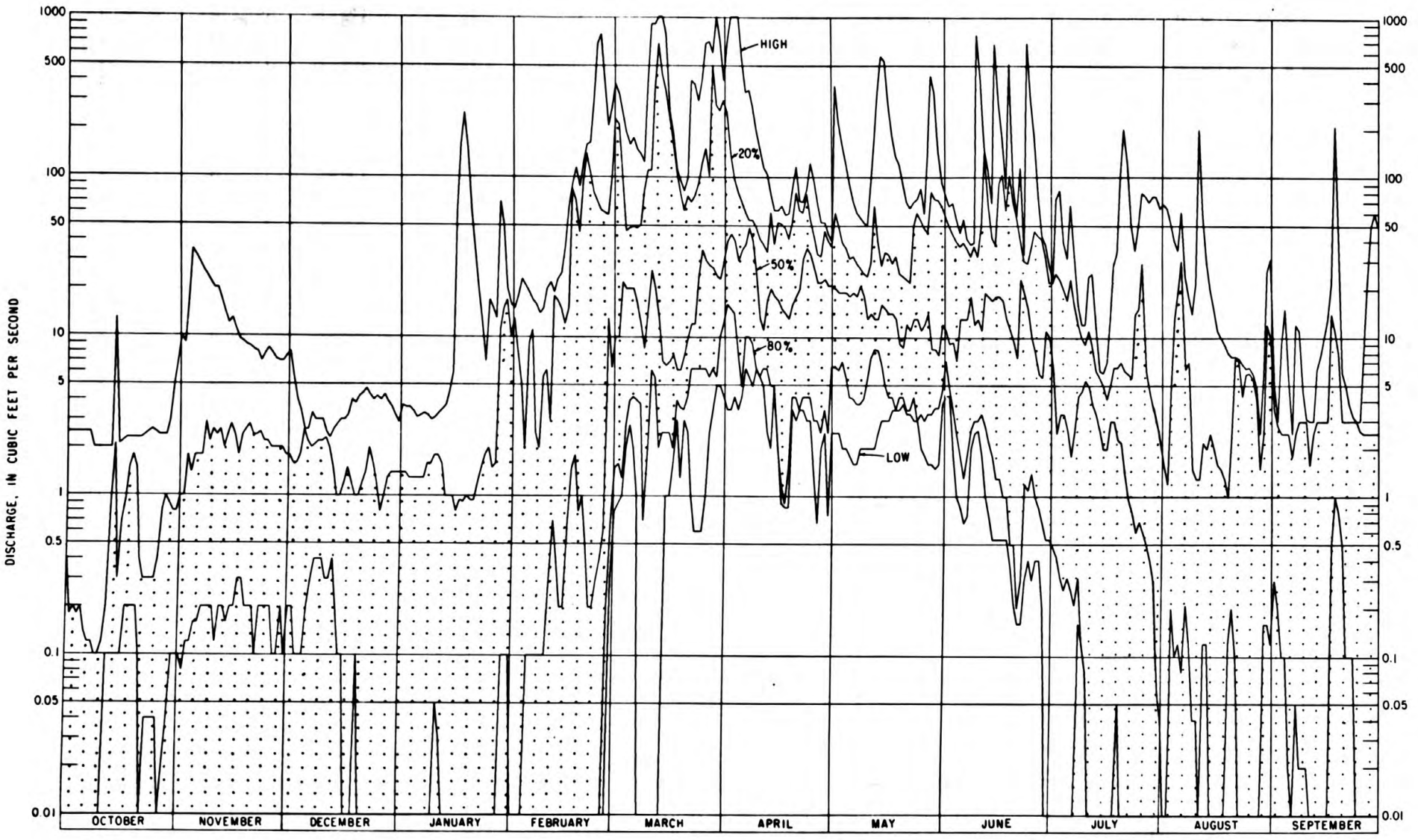
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	1.2	55.9	68	7.4
.01	77.8	1.7	52.4	99	5.3
.02	77.0	2.5	49.2	140	4.0
.03	76.6	3.6	44.6	210	3.1
.16	75.9	5.2	40.8	300	2.4
.19	75.2	7.5	36.4	430	1.5
.20	69.5	11	31.4	630	.9
.30	66.3	16	25.7	900	.5
.40	64.7	23	18.6	1,300	.2
.60	61.3	33	13.5		
.80	59.4	47	10.1		

Probability of annual high flows, water years 1963-70

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	22	18	17	16	14	13
50	2	635	476	306	187	119	71
10	10	1,860	1,470	980	780	550	273

Probability of annual low flows, climatic years 1962-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	0	0	0	0	0	0
20	5	0	0	0	0	0	.01
50	2	0	0	0	0	0	.03



Exceedence probability graph of daily discharge, Ponca Creek near Naper, Nebr., 1965-73.

06453500 Ponca Creek at Anoka, Nebr.

LOCATION.—Lat 42°56'25", long 98°50'39", in NE¼ sec.9, T.34 N., R.13 W., Boyd County, on downstream side of left pier of bridge on State Highway 11, 0.5 mile southwest of Anoka and 0.5 mile upstream from Dry Creek.

DRAINAGE AREA.—505 sq mi.

PERIOD OF RECORD.—March 1949 to September 1973.

DIVERSIONS.—Streamflow not affected by pumping.

Monthly and annual mean discharges, water years 1950-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	40	0	5.6	11	193	0.90
November....	39	.01	6.4	10	157	1.02
December....	32	0	4.6	8	172	.73
January.....	38	0	4.6	8.7	191	.73
February....	192	0	25	50	197	4.07
March.....	762	2.8	169	182	107	27.13
April.....	753	13	134	175	130	21.55
May.....	530	4.3	90	116	129	14.47
June.....	958	4.3	98	195	199	15.69
July.....	654	0	48	132	274	7.68
August.....	234	0	26	58	221	4.23
September...	80	0	11	23	202	1.80
Annual.....	258	7.2	52	53	102	100

Duration of daily mean discharge, water years 1950-73

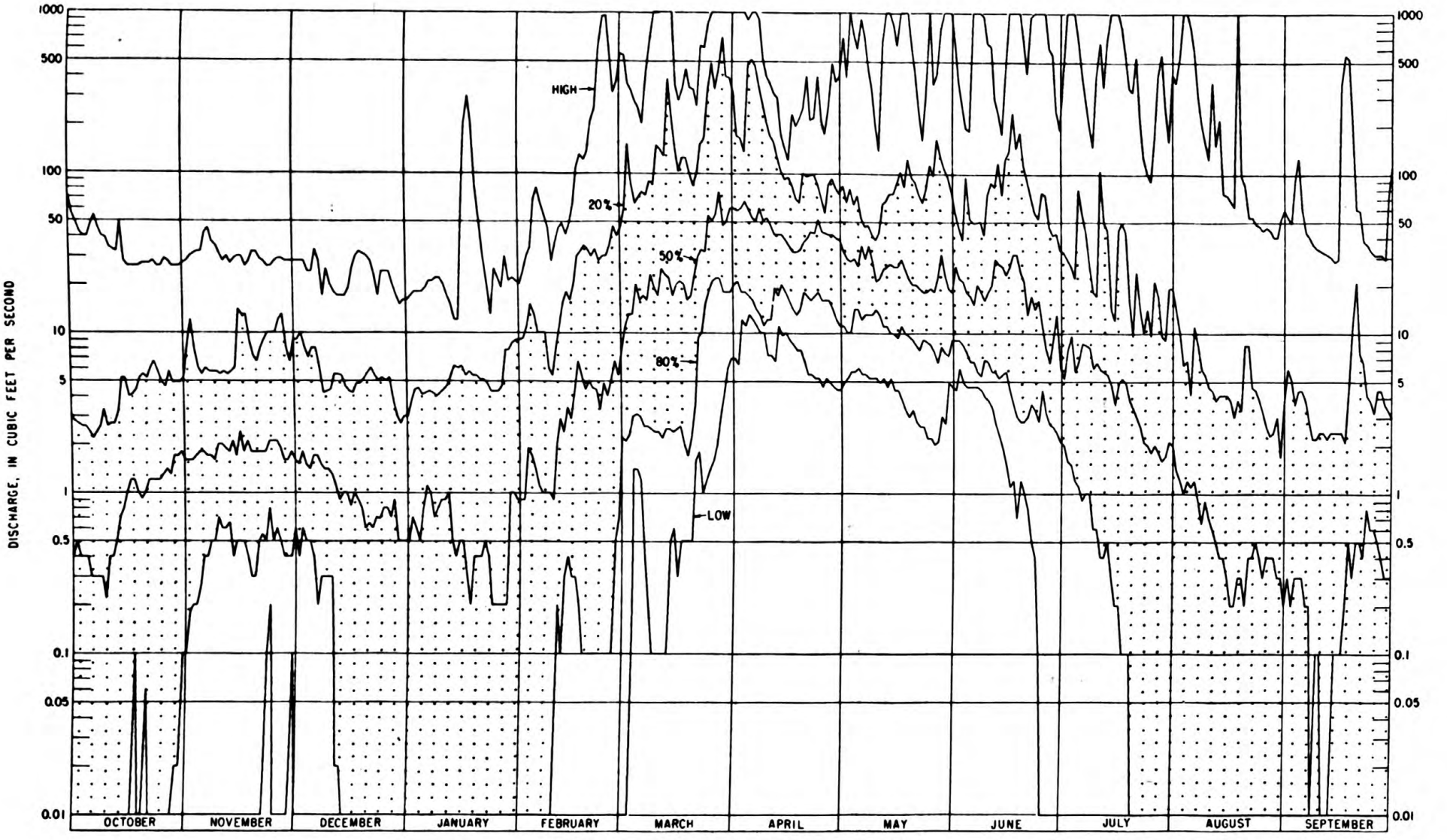
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	1.3	68.6	78	11.4
.01	86.2	2.0	62.5	120	7.9
.03	86.0	3.0	56.7	180	5.4
.05	85.9	4.5	51.2	270	3.8
.07	85.7	6.7	45.4	400	2.8
.20	83.5	10	39.8	600	1.6
.30	81.6	15	34.8	910	.9
.40	79.9	23	28.2	1,400	.5
.60	76.6	35	21.3	2,100	.2
.90	73.2	52	15.8		

Probability of annual high flows, water years 1950-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	310	187	89	42	22	17
50	2	1,130	779	523	339	225	144
10	10	3,700	2,910	1,950	1,150	765	500
4	25	6,600	5,280	3,400	2,000	1,300	900
2	50	9,800	8,000	5,000	2,900	1,880	1,390

Probability of annual low flows, climatic years 1951-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
2	50	0	0	0	0	0	0
5	20	0	0	0	0	0	0
10	10	0	0	0	0	0	0
20	5	0	0	0	0	0	.20
50	2	0	0	0	0	.10	.60



Exceedence probability graph of daily discharge, Ponca Creek at Anoka, Nebr., 1955-73.

06453600 Ponca Creek at Verdel, Nebr.

LOCATION.—Lat 42°48'40", long 98°10'35", in NE¼NE¼ sec.30, T.33 N., R. 7 W., Knox County, near left bank at left downstream end of bridge on State Highway 12, 0.6 mile east of Verdel and 3.1 miles upstream from mouth.

DRAINAGE AREA.—812 sq mi.

PERIOD OF RECORD.—October 1957 to September 1973.

DIVERSIONS.—Streamflow not affected appreciably by pumping.

Monthly and annual mean discharges, water years 1958-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	69	0	9.4	17	179	0.91
November....	51	.80	12	13	114	1.13
December....	85	.30	12	22	189	1.13
January.....	63	0	8.0	16	205	.77
February....	445	0	55	108	197	5.30
March.....	1,330	6.5	291	378	130	28.07
April.....	662	23	179	199	111	17.31
May.....	562	8.6	136	159	117	13.16
June.....	1,240	16	182	305	167	17.62
July.....	729	5.4	91	179	197	8.78
August.....	327	.42	43	83	193	4.13
September...	114	0	18	30	172	1.69
Annual.....	343	14	86	86	100	100

Duration of daily mean discharge, water years 1958-73

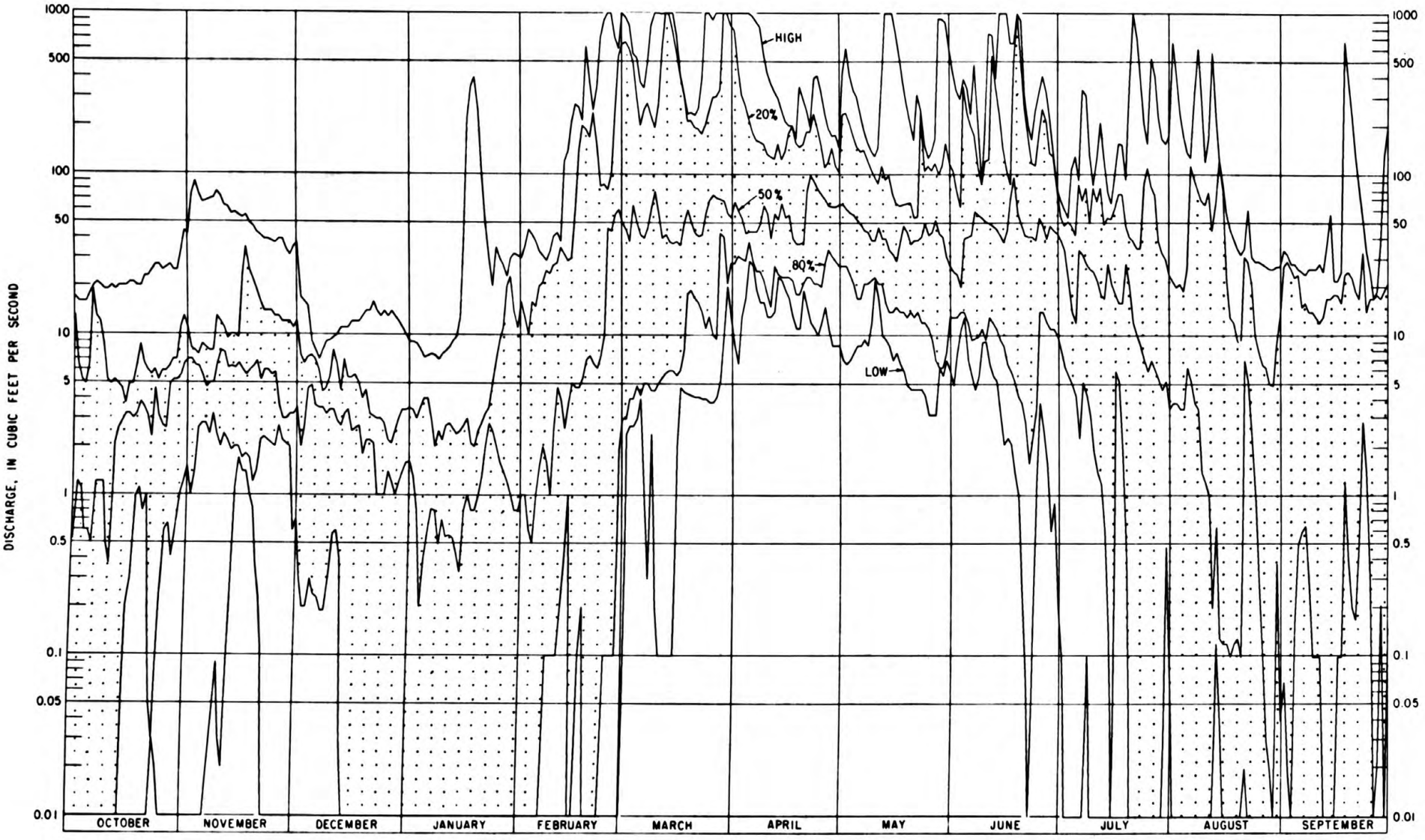
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	1.0	79.0	100	12.8
.01	86.2	1.5	76.4	160	8.8
.02	86.0	2.3	72.9	240	6.4
.03	85.7	3.5	68.3	360	4.4
.05	85.3	5.3	61.9	550	2.8
.07	85.2	8.1	54.8	840	1.9
.10	85.0	12	48.8	1,300	1.0
.20	83.0	19	39.3	2,000	.5
.30	82.4	29	32.4	3,000	.2
.40	81.9	44	26.0		
.60	80.8	67	18.7		

Probability of annual high flows, water years 1958-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	231	180	102	56	32	23
50	2	1,260	936	621	415	292	192
10	10	5,550	4,270	2,670	1,730	1,150	732
4	25	10,700	8,410	4,970	3,100	1,960	1,230

Probability of annual low flows, climatic years 1959-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
5	20	0	0	0	0	0	0
10	10	0	0	0	0	0	0
20	5	0	0	0	0	0	0
50	2	0	0	0	.10	.30	.70



Exceedence probability graph of daily discharge, Ponca Creek at Verdel, Nebr., 1965-73.

06454000 Niobrara River at Wyoming-Nebraska State line

LOCATION.—Lat 42°39'33", long 104°03'54", in SW¼ sec.15, T.31 N., R.60 W., Niobrara County, Wyo., on left bank 0.2 mile downstream from Van Tassel Creek, 0.3 mile upstream from Wyoming-Nebraska State line, and 3 miles east of Van Tassel, Wyo.

DRAINAGE AREA.—450 sq mi, approximately.

PERIOD OF RECORD.—October 1955 to September 1973.

DIVERSIONS.—Streamflow affected by upstream irrigation.

Monthly and annual mean discharges, water years 1956-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	4.1	2.4	3.1	0.48	15	5.96
November....	5.0	2.8	3.5	.58	17	6.69
December....	4.7	2.6	3.5	.51	15	6.69
January.....	4.6	2.6	3.5	.59	17	6.69
February....	18	3.2	6.1	.46	76	11.61
March.....	19	3.3	6.3	.36	57	12.06
April.....	10	3.6	6.2	.19	30	11.79
May.....	10	3.2	5.3	.18	33	10.18
June.....	13	2.6	4.8	.23	48	9.25
July.....	22	2.1	4.7	.47	10	8.99
August.....	4.4	1.8	2.6	.67	26	4.97
September...	3.7	1.8	2.7	.57	21	5.12
Annual.....	5.5	3.2	4.4	0.69	16	100

Duration of daily mean discharge, water years 1956-73

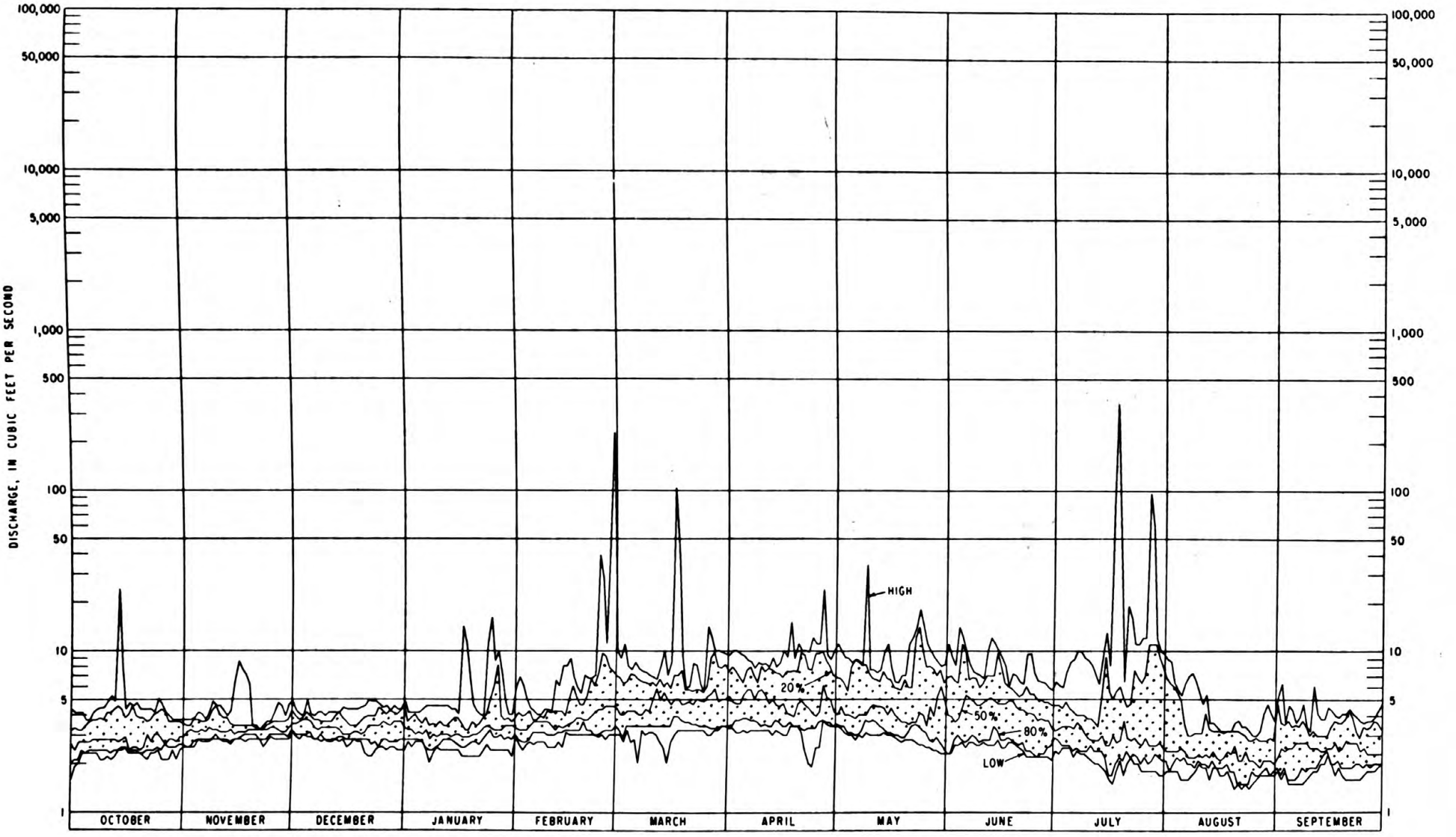
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
1.4	100	4.8	21.1	17	0.7
1.6	99.5	5.6	14.6	19	.6
1.9	97.9	6.5	9.9	22	.5
2.2	94.9	7.6	6.1	26	.4
2.6	85.8	8.9	3.7	36	.3
3.0	72.6	10	2.3	66	.2
3.5	50.9	12	1.4	77	.1
4.1	32.0	14	.9		

Probability of annual high flows, water years 1956-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	3	3	4	4	4	4
50	2	31	21	14	11	9	8
10	10	182	98	48	28	18	12
4	25	387	190	81	43	23	15
2	50	650	302	117	57	28	17

Probability of annual low flows, climatic years 1957-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
2	50	1.2	1.2	1.3	1.4	1.5	1.7
5	20	1.3	1.3	1.4	1.5	1.7	1.8
10	10	1.3	1.4	1.5	1.6	1.8	2.0
20	5	1.5	1.6	1.6	1.8	1.9	2.1
50	2	1.8	1.9	2.0	2.1	2.3	2.4



Exceedence probability graph of daily discharge, Niobrara River at Wyoming-Nebraska State line 1965-73.

06454100 Niobrara River at Agate, Nebr.

LOCATION.—Lat 42°25'22", long 103°47'23", in SW¼ sec.6, T.28 N., R.55 W., Sioux County, on right bank 10 ft upstream from timber farm-vehicle bridge, 300 ft upstream from bridge on State Highway 29, 0.2 mile northwest of Agate, and 14.5 miles upstream from Whistle Creek.

DRAINAGE AREA.—840 sq mi, approximately.

PERIOD OF RECORD.—October 1957 to September 1973.

DIVERSIONS.—Streamflow affected by upstream diversions.

Monthly and annual mean discharges, water years 1958-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	16	5.3	10	3.5	35	5.60
November....	22	12	15	2.4	16	8.60
December....	22	14	17	2.3	13	9.59
January.....	21	14	16	1.8	11	8.98
February....	36	16	21	4.6	22	11.81
March.....	37	18	25	5.3	21	14.05
April.....	30	11	21	5.3	26	11.57
May.....	20	8.0	14	3.5	24	8.16
June.....	28	6.6	11	5.8	52	6.33
July.....	17	4.6	9.9	3.8	38	5.59
August.....	12	3.7	8.2	2.2	27	4.62
September...	13	4.0	9.1	3.0	34	5.10
Annual.....	17	12	15	1.4	10	100

Duration of daily mean discharge, water years 1958-73

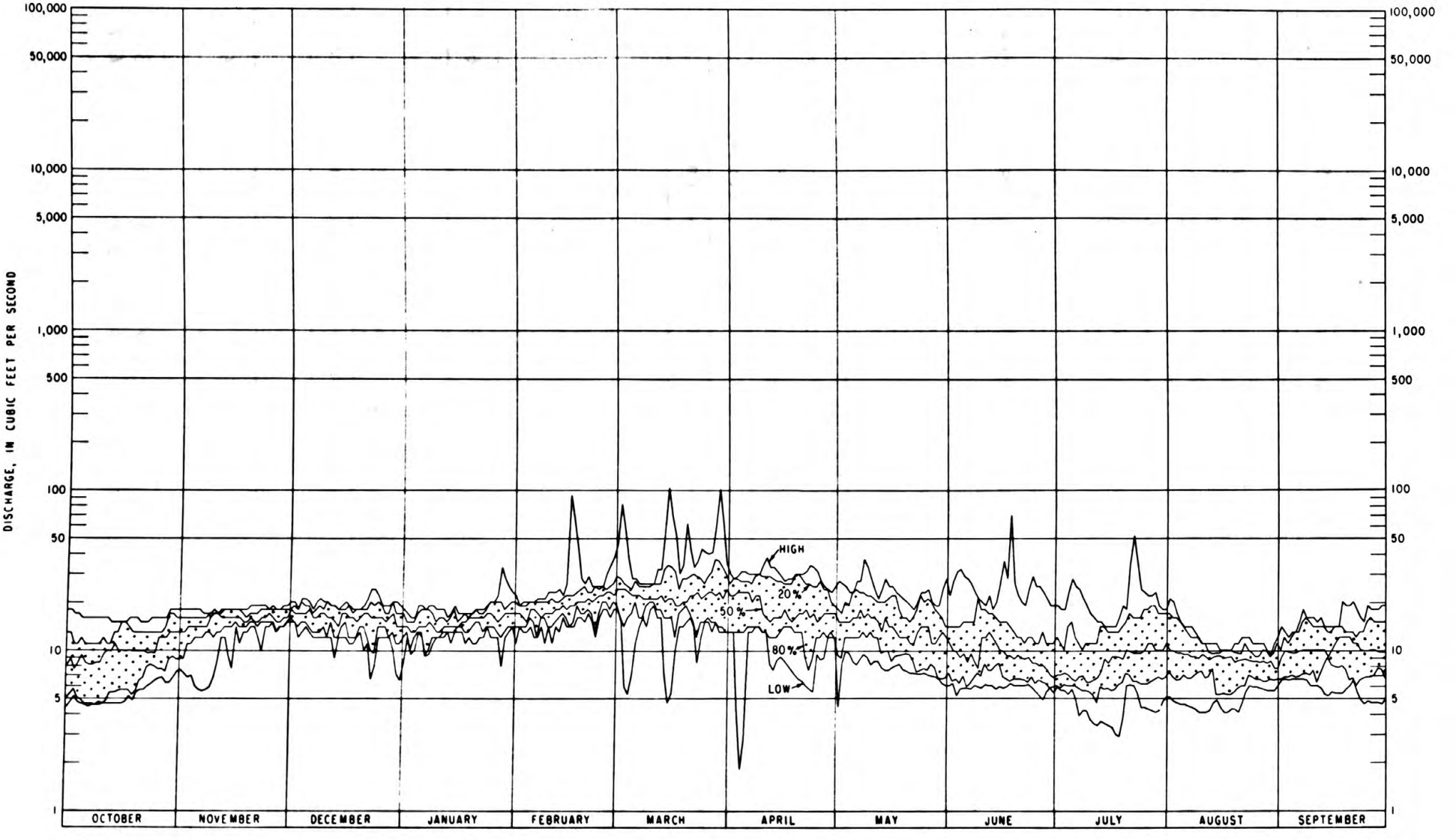
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
2.6	100	8.9	76.6	30	3.3
2.9	99.9	10	70.2	34	1.7
3.3	99.6	11	67.4	39	1.0
3.8	99.1	13	58.7	44	.7
4.3	98.2	15	47.9	50	.5
4.8	96.5	16	42.3	56	.4
5.4	94.7	19	25.2	64	.2
6.2	90.8	21	17.5	72	.1
7.0	85.7	24	10.2		
7.9	81.4	27	5.3		

Probability of annual high flows, water years 1958-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	21	21	21	21	19	18
50	2	49	41	35	31	27	24
10	19	94	70	52	43	35	30
4	25	122	87	61	51	40	34
2	50	146	101	69	56	43	36

Probability of annual low flows, climatic years 1959-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
2	50	1.4	1.8	2.0	2.1	2.2	2.9
5	20	2.0	2.5	2.6	2.8	3.2	3.7
10	10	2.5	3.2	3.3	3.5	4.0	4.7
20	5	3.2	3.7	4.1	4.4	4.9	5.4
50	2	4.4	4.9	5.5	5.8	6.6	7.4



Exceedence probability graph of daily discharge, Niobrara River at Agate, Nebr., 1965-73.

06454500 Niobrara River above Box Butte Reservoir, Nebr.

LOCATION.—Lat 42°27'35", long 103°10'15", in NE¼ sec.27, T.29 N., R.50 W., Dawes County, on right bank 1 mile upstream from high-water line of Box Butte Reservoir and 6 miles east of Marsland.

DRAINAGE AREA.—1,400 sq mi, approximately.

PERIOD OF RECORD.—October 1946 to September 1973.

DIVERSIONS.—Streamflow affected appreciably by upstream diversions.

Monthly and annual mean discharges, water years 1947-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	42	3.9	18	9.5	53	4.83
November....	45	15	32	7.6	24	8.57
December....	50	27	38	6.6	17	10.31
January.....	43	10	34	7.0	21	9.03
February....	57	26	41	6.7	16	10.96
March.....	106	42	58	15	27	15.39
April.....	67	20	48	11	24	12.79
May.....	72	16	31	12	40	8.24
June.....	70	3.1	27	19	73	7.12
July.....	56	3.5	18	13	70	4.84
August.....	30	5.4	15	7.5	49	4.13
September...	56	2.8	14	10	73	3.79
Annual.....	43	24	31	5.5	18	100

Duration of daily mean discharge, water years 1947-73

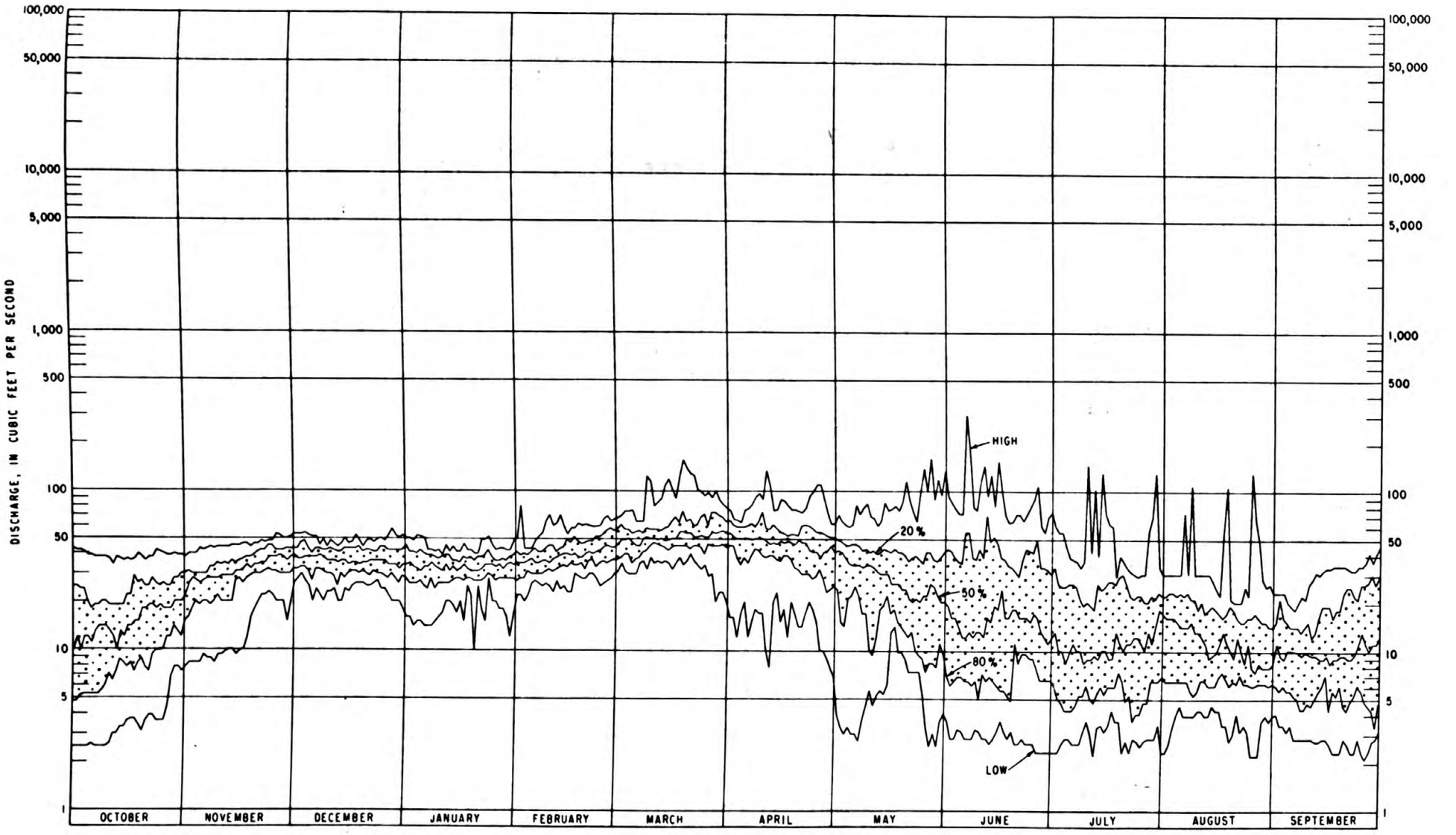
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
2.2	100	11	82.3	53	11.2
2.6	99.6	13	79.1	62	5.1
3.0	98.8	15	75.9	72	2.8
3.5	97.5	17	72.9	85	1.5
4.1	96.4	20	67.7	99	.8
4.9	95.2	24	61.7	120	.5
5.7	94.0	28	55.7	140	.2
6.7	92.1	33	45.4	160	.1
7.8	89.8	38	35.3		
9.2	86.2	45	20.9		

Probability of annual high flows, water years 1947-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	49	48	47	46	43	41
50	2	118	96	82	71	62	55
10	10	243	157	124	105	86	71
4	25	331	193	147	125	99	79
2	50	409	221	164	141	110	85
1	100	499	251	182	159	121	91

Probability of annual low flows, climatic years 1948-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
1	100	1.0	1.2	1.4	1.5	1.7	1.9
2	50	1.4	1.5	1.7	2.0	2.2	3.1
5	20	1.6	1.8	2.1	2.4	2.8	3.8
10	10	2.2	2.2	2.4	2.7	3.5	4.6
20	5	2.5	2.7	3.0	3.3	4.5	5.9
50	2	3.8	4.3	4.7	5.2	7.4	9.3



Exceedence probability graph of daily discharge, Niobrara River above Box Butte Reservoir, Nebr., 1955-73.

06455500 Niobrara River below Box Butte Reservoir, Nebr.

LOCATION.--Lat 42°27'25", long 103°04'05", in SE¼ sec.28, T.29 N., R.49 W., Dawes County, on left bank 0.2 mile downstream from Box Butte Reservoir and 9 miles north of Hemingford.

DRAINAGE AREA.--1,460 sq mi, approximately.

PERIOD OF RECORD.—October 1946 to September 1973.

DIVERSIONS.—Flow regulated by Box Butte Reservoir.

Monthly and annual mean discharges, water years 1947-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	1.7	0.41	1.0	0.20	29	0.31
November....	2.5	.35	.93	.37	40	.29
December....	1.4	.23	.89	.25	28	.28
January.....	1.2	.34	.90	.25	27	.28
February....	1.3	.31	1.0	.25	25	.32
March.....	39	.80	3.8	9.5	252	1.19
April.....	43	.84	4.2	9.7	227	1.34
May.....	32	1.0	8.4	11	128	2.66
June.....	90	1.0	26	26	99	8.20
July.....	170	21	111	40	36	34.89
August.....	187	76	122	28	23	38.37
September...	80	11	38	20	53	11.87
Annual.....	38	14	27	5.2	19	100

Duration of daily mean discharge, water years 1947-73

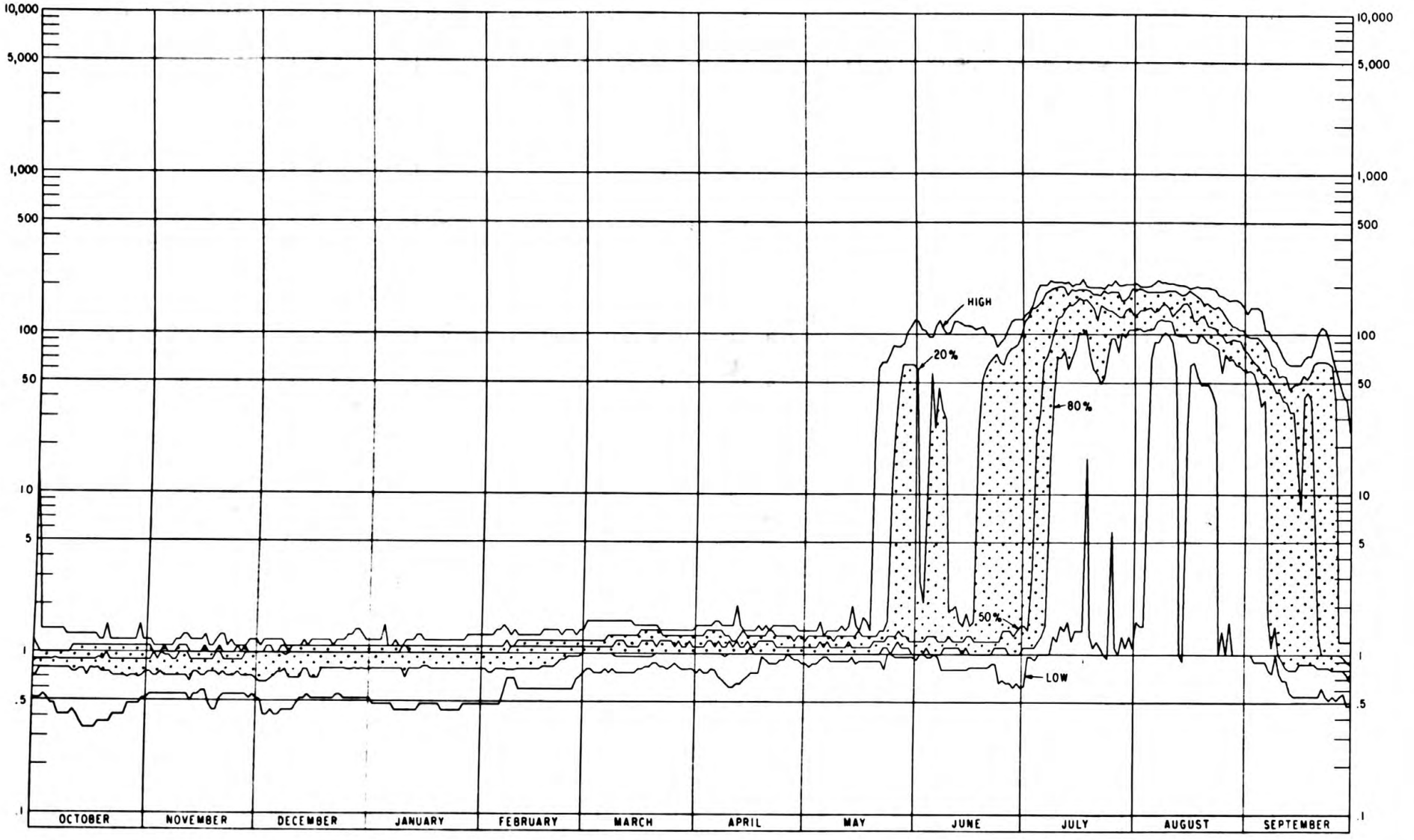
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0.10	100	2.1	27.3	22	25.2
.20	99.8	2.6	27.1	27	24.6
.30	99.3	3.3	26.9	35	23.4
.40	98.4	4.2	26.8	44	21.5
.50	96.8	5.3	26.6	55	19.7
.60	94.0	6.7	26.5	70	16.9
.80	87.9	8.5	26.4	88	14.0
1.0	74.5	11	26.3	110	10.8
1.3	39.1	14	26.0	140	6.6
1.7	27.9	17	25.7	180	2.4

Probability of annual high flows, water years 1947-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	125	122	117	109	97	72
50	2	197	193	186	171	152	126
10	10	219	216	213	200	182	151
4	25	224	221	220	209	192	158
2	50	226	223	222	215	198	163
1	100	228	224	223	219	203	166

Probability of annual low flows, climatic years 1948-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
1	100	0.07	0.08	0.09	0.11	0.17	0.23
2	50	.11	.12	.13	.16	.22	.29
5	20	.19	.20	.22	.24	.32	.39
10	10	.27	.28	.32	.35	.42	.49
20	5	.39	.41	.45	.49	.56	.62
50	2	.64	.67	.71	.75	.80	.85



Exceedence probability graph of daily discharge, Niobrara River below Box Butte Reservoir Nebr., 1955-73.

06455900 Niobrara River near Dunlap, Nebr.

LOCATION.—Lat 42°27'45", long 102°55'25", on river and two diversion canals in SE¼NW¼ sec.26, T.29 N., R.48 W., Dawes County, at diversion dam 1,000 ft upstream from Cottonwood Creek and 2.5 miles east of Dunlap.

DRAINAGE AREA.—1,580 sq mi, approximately.

PERIOD OF RECORD.--October 1930 to September 1942; September 1961 to September 1971 (discontinued).

DIVERSIONS.--Streamflow affected by upstream diversions and regulation of Box Butte Reservoir.

Monthly and annual mean discharges, water years 1962-71

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	15	8.7	12	1.8	15	2.96
November....	12	7.1	10	1.8	17	2.41
December....	13	8.2	11	1.4	12	2.69
January.....	13	9.3	11	1.3	12	2.71
February....	16	10	13	2.0	16	3.04
March.....	16	11	14	1.9	14	3.28
April.....	16	10	14	2.1	15	3.30
May.....	34	9.8	17	8.0	48	3.98
June.....	49	13	24	14	60	5.60
July.....	170	52	121	44	36	28.78
August.....	182	98	135	29	21	32.21
September...	71	22	38	14	38	9.04
Annual.....	40	28	35	3.6	10	100

Duration of daily mean discharge, water years 1962-71

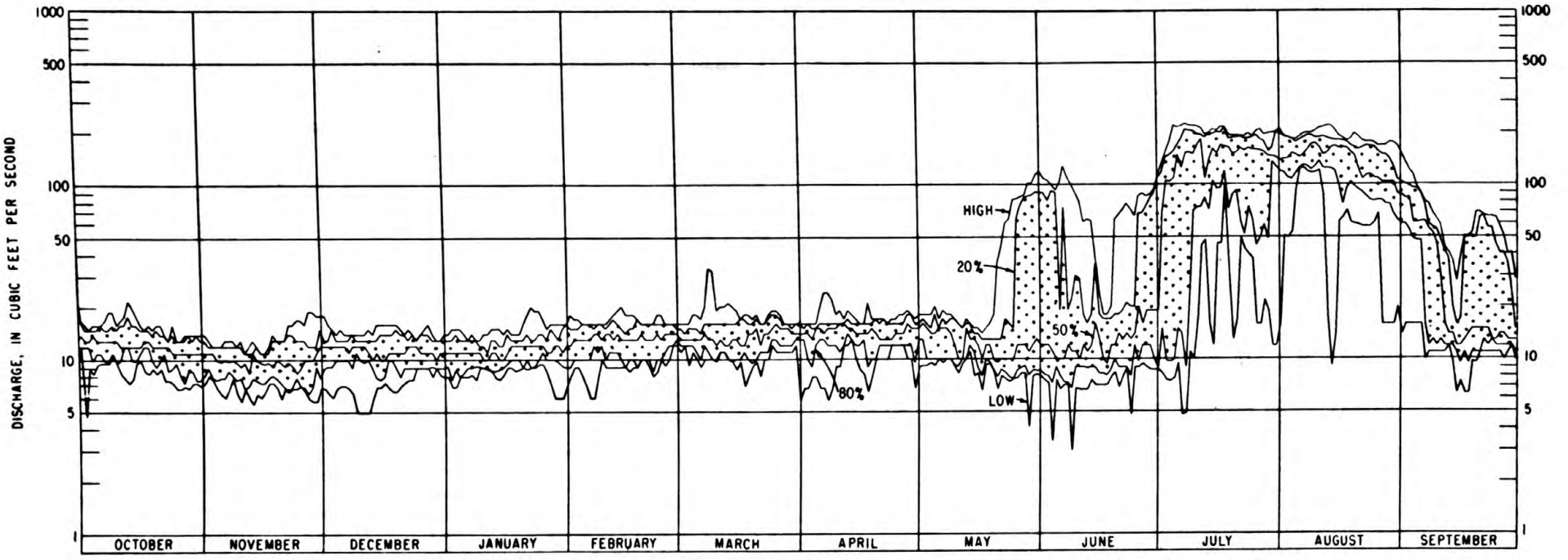
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
3.4	100	16	33.4	60	18.3
3.9	99.9	19	22.7	69	16.9
5.1	99.6	21	21.4	78	15.7
6.0	98.8	24	21.1	89	14.2
7.5	96.5	28	20.9	100	13.1
8.5	92.7	31	20.8	120	10.7
9.7	85.9	36	20.6	130	9.3
11	77.4	41	20.3	150	7.6
13	57.5	47	19.8	170	4.6
14	46.8	53	19.1	200	.8

Probability of annual high flows, water years 1962-71

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	193	177	172	153	126	93
50	2	207	202	194	179	162	137
10	10	251	218	210	196	184	160

Probability of annual low flows, climatic years 1963-71

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	3.8	5.0	5.4	6.2	6.9	8.0
20	5	4.2	5.4	6.0	6.7	7.4	8.5
50	2	5.3	6.7	7.0	7.9	8.6	9.8



Exceedence probability graph of daily discharge, Niobrara River near Dunlap, Nebr., 1963-71.

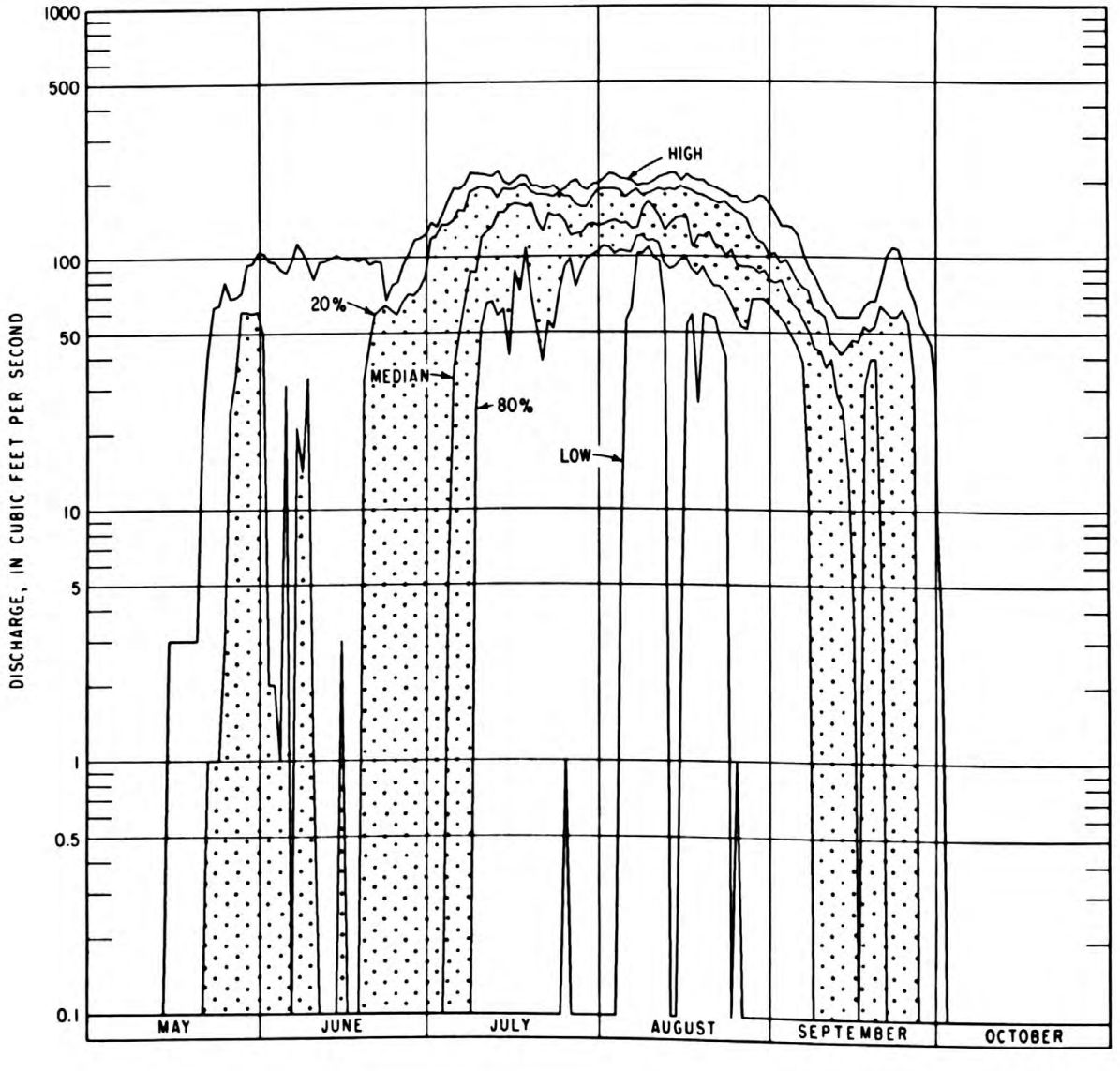
06455910 Mirage Flats Canal near Dunlap, Nebr.

POINT OF DIVERSION.—Lat 42°27'50", long 102°55'45", SE¼NW¼ sec.26, T.29 N., R.48 W., Dawes County, on left bank of Niobrara River 8 miles downstream from Box Butte Dam.

PERIOD OF RECORD.—July 17, 1946, to September 30, 1973.

REMARKS.—Mirage Flats Canal supplied by releases from Box Butte Reservior; storage began October 3, 1945.

AVERAGE ANNUAL DIVERSION.—1946-73, 17,000 acre-feet.



Exceedence probability graph of daily discharge, Mirage Flats Canal near Dunlap, Nebr., 1955-73.

06456500 Niobrara River near Hay Springs, Nebr.

LOCATION.--Lat 42°29'00", long 102°41'40", in NW¼ sec.23, T.29 N., R.46 W., on left bank 20 ft downstream from bridge on State Highway 87, 4 miles upstream from Box Butte Creek, and 14 miles south of Hay Springs.

DRAINAGE AREA.--1,790 sq mi, approximately.

PERIOD OF RECORD.--June 1950 to September 1964 (discontinued).

DIVERSIONS.--Streamflow affected by upstream diversions and regulation of Box Butte Reservoir.

Monthly and annual mean discharges, water years 1951-64

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	31	16	24	3.8	16	7.11
November....	34	20	25	4.5	18	7.36
December....	30	19	25	3.7	15	7.28
January.....	32	19	25	4.0	16	7.53
February....	42	24	29	4.9	17	8.46
March.....	78	24	35	13	38	10.45
April.....	57	22	32	8.6	27	9.44
May.....	100	16	34	21	61	10.00
June.....	59	14	28	13	45	8.31
July.....	114	11	32	30	94	9.50
August.....	57	11	25	16	62	7.42
September...	71	11	24	16	64	7.14
Annual.....	37	20	28	5.7	20	100

Duration of daily mean discharge, water years 1951-64

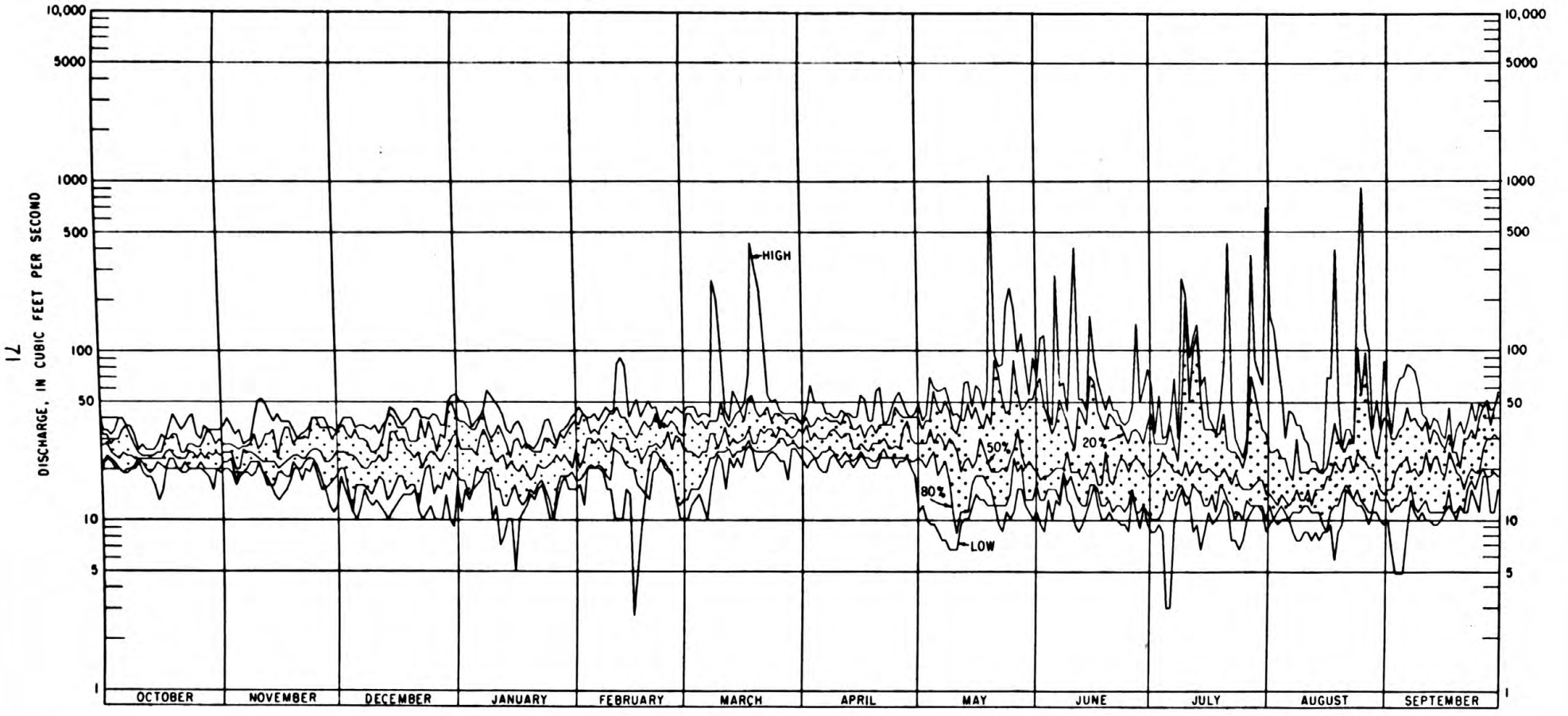
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
2.7	100	20	68.7	100	1.1
3.2	99.9	24	51.1	120	.9
5.6	99.8	29	31.9	150	.7
6.7	99.6	34	19.5	180	.6
8.0	99.4	41	8.9	210	.4
9.6	97.5	50	5.0	310	.2
12	92.3	59	3.0	370	.1
14	86.0	71	1.9		
17	77.1	85	1.4		

Probability of annual high flows, water years 1951-64

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	28	27	27	25	24	23
50	2	225	131	85	61	49	42
10	10	1,120	488	263	152	108	79

Probability of annual low flows, climatic years 1952-64

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	3.9	5.9	7.8	9.1	11	12
20	5	5.0	6.6	8.3	9.7	12	13
50	2	7.5	8.3	9.5	11	14	16



Exceedence probability graph of daily discharge, Niobrara River near Hay Springs, Nebr., 1956-64.

06457500 Niobrara River near Gordon, Nebr.

LOCATION.—Lat 42°38'00", long 102°12'40", in NE¼ sec.26, T.31 N., R.42 W., Sheridan County, on left bank 250 ft upstream from bridge on State Highway 27, 4 miles downstream from Rush Creek, and 11 miles south of Gordon.

DRAINAGE AREA.—4,290 sq mi, approximately.

PERIOD OF RECORD.—August 1928 to September 1932; October 1945 to September 1973.

DIVERSIONS.—Streamflow affected appreciably by reservoir regulation and diversions from streams.

Monthly and annual mean discharges, water years 1946-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	137	87	105	11	11	7.28
November....	142	85	115	14	12	7.99
December....	144	71	110	20	18	7.61
January.....	140	81	111	15	13	7.70
February....	288	72	138	37	27	9.58
March.....	351	103	159	48	30	11.04
April.....	203	102	145	28	19	10.09
May.....	283	94	131	39	30	9.11
June.....	305	77	133	58	43	9.28
July.....	243	68	106	43	41	7.35
August.....	149	60	89	24	27	6.17
September...	212	63	98	31	32	6.80
Annual.....	152	97	120	14	11	100

Duration of daily mean discharge, water years 1946–73

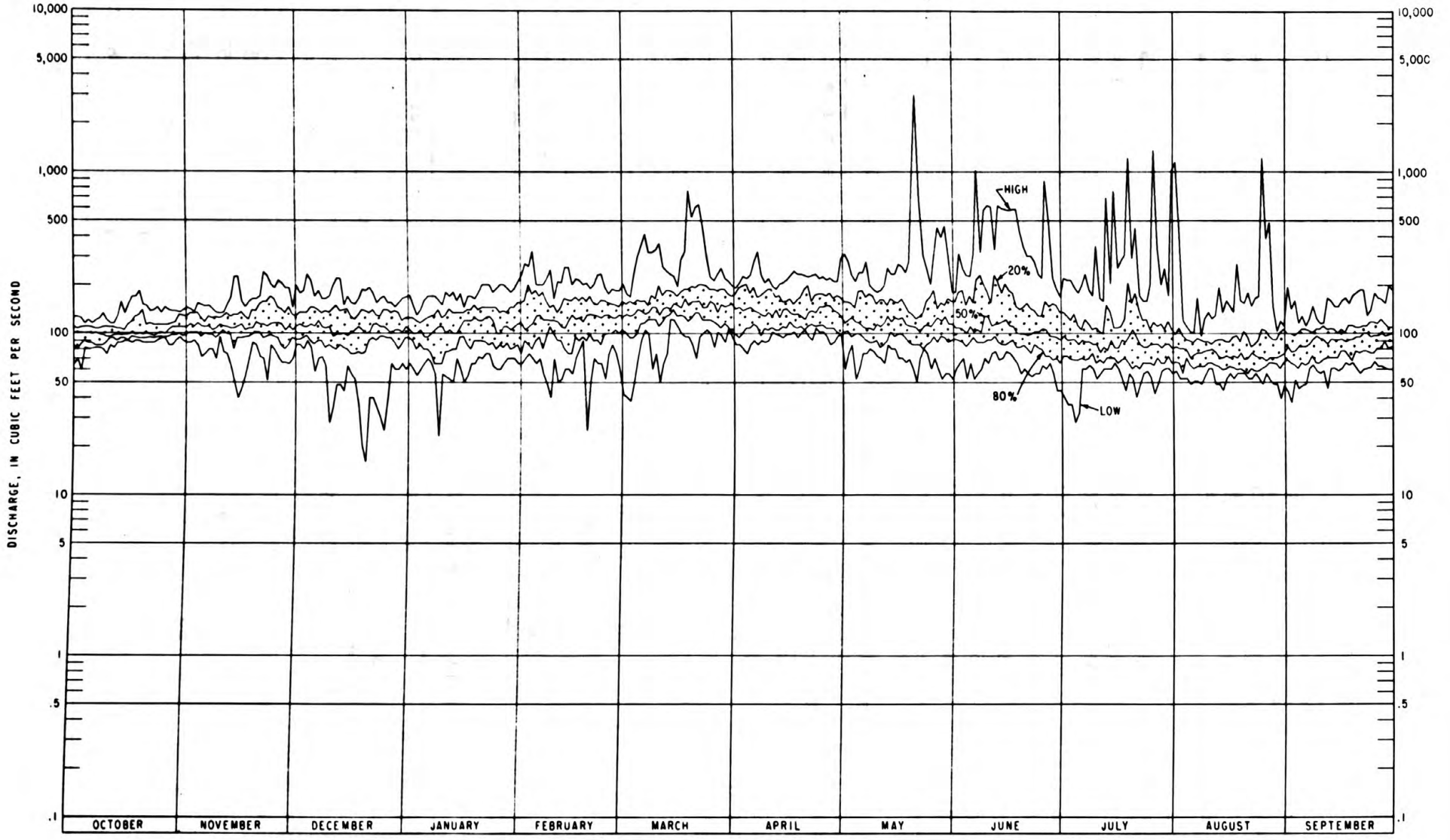
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
24	100	86	77.2	260	1.5
32	99.9	98	64.2	300	1.0
37	99.8	110	49.5	350	.7
43	99.6	130	29.7	400	.6
49	99.3	150	16.9	460	.5
56	98.6	170	9.7	610	.3
65	95.4	200	4.4	700	.2
74	88.7	230	2.4	800	.1

Probability of annual high flows, water years 1946–73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	140	138	135	132	130	128
50	2	508	353	273	222	190	165
10	10	1,590	840	560	389	301	237
4	25	2,540	1,230	779	507	379	287
2	50	3,480	1,600	983	612	449	330
1	100	4,680	2,060	1,230	934	529	379

Probability of annual low flows, climatic years 1947–73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
1	100	9	15	19	30	35	38
2	50	17	26	32	45	51	57
5	20	22	31	37	50	57	63
10	10	27	35	42	53	60	67
20	5	33	41	48	57	64	71
50	2	48	54	60	66	73	80



Exceedence probability graph of daily discharge, Niobrara River near Gordon, Nebr., 1955-73.

06459200 Snake River above Merritt Reservoir, Nebr.

LOCATION.—Lat 42°35'40", long 101°02'20", in NE¼ sec.11, T.30 N., R.32 W., Cherry County, on left bank 5 ft upstream from steel piling control, 1,200 ft upstream from Shelbourn Bridge, 0.7 mile northwest of Swanson Camp, 8.5 miles southeast of headquarters for Nebraska National Forest (Niobrara Division), 10 miles upstream from Boardman Creek, and 14.5 miles upstream from Merritt Dam.

DRAINAGE AREA.—440 sq mi, approximately, of which about 28 sq mi contributes directly to surface runoff.

PERIOD OF RECORD.—October 1962 to September 1973.

DIVERSIONS.—Streamflow not affected appreciably by irrigation.

Monthly and annual mean discharges, water years 1963-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	209	187	197	7.0	4	8.04
November....	215	184	202	9.6	5	8.25
December....	217	183	200	8.9	4	8.16
January.....	218	181	202	11	5	8.24
February....	243	199	218	13	6	8.89
March.....	252	205	223	18	8	9.09
April.....	243	200	221	12	5	9.01
May.....	225	181	207	13	6	8.44
June.....	251	183	205	21	10	8.37
July.....	202	172	191	9.1	5	7.78
August.....	213	179	191	11	6	7.80
September...	214	180	195	11	6	7.93
Annual.....	212	194	204	6.1	3	100

Duration of daily mean discharge, water years 1963-73

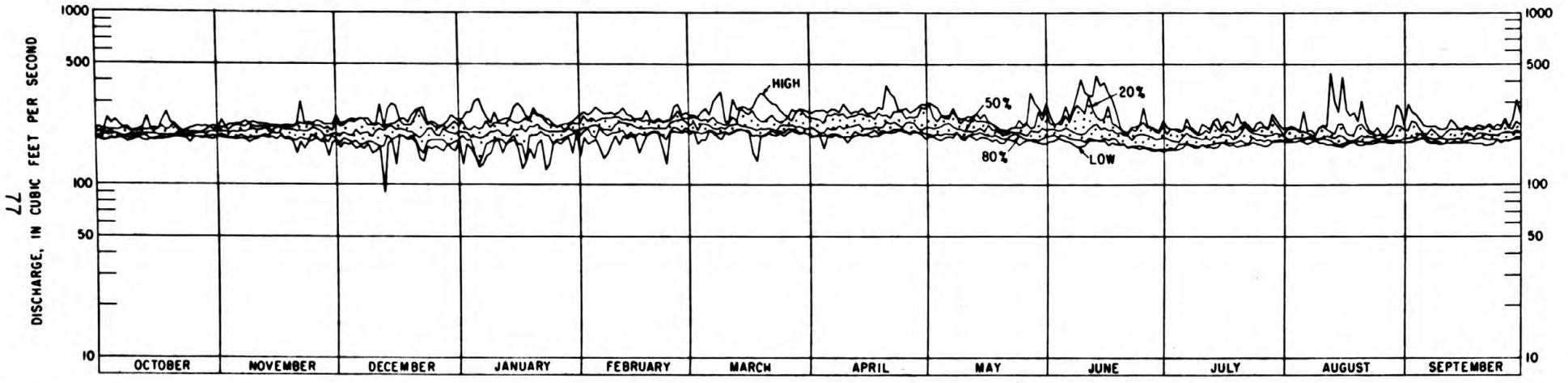
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
100	100	190	73.1	260	3.9
110	99.9	200	52.3	280	1.5
140	99.6	210	34.3	290	1.1
150	99.4	220	21.0	310	.6
160	98.6	230	12.7	320	.5
170	96.3	240	8.1	340	.2
180	89.2	250	5.4	370	.1

Probability of annual high flows, water years 1963-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	248	240	231	216	208	203
50	2	338	309	276	253	240	229
10	10	425	369	324	283	260	247

Probability of annual low flows, climatic years 1964-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
5	20	96	136	153	157	167	174
10	10	105	139	155	160	170	177
20	5	118	143	158	164	173	180



Exceedence probability graph of daily discharge, Snake River above Merritt Reservoir, 1965-73.

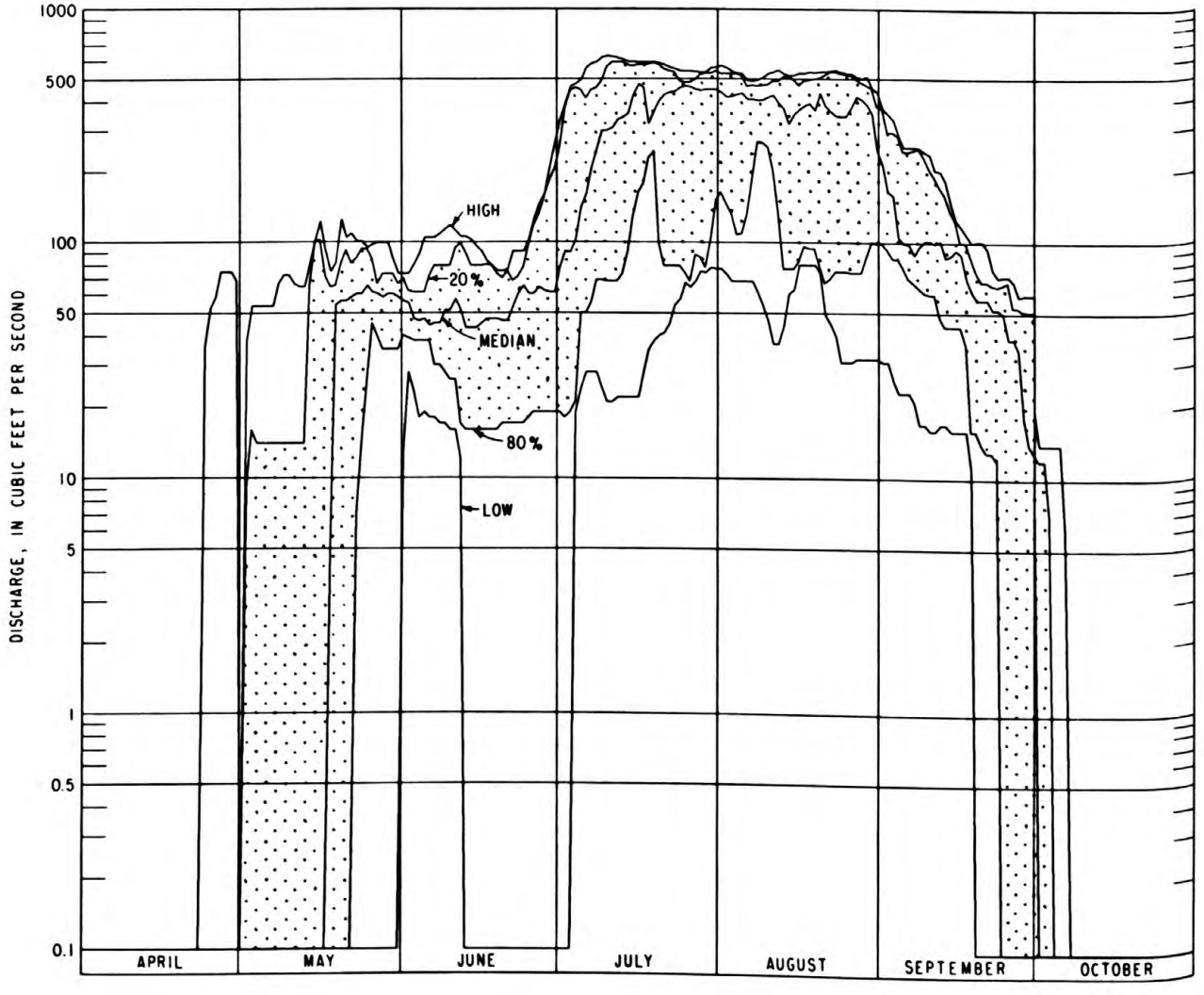
06459310 Ainsworth Canal near Valentine, Nebr.

POINT OF DIVERSION.—Lat 42°38'10", long 100°52'15", in SW¼NW¼ sec.29 T.31 N., R.30 W., Cherry County, on right bank of Snake River 2.1 miles upstream from Burge gaging station.

PERIOD OF RECORD.--June 1, 1965, to September 1973.

REMARKS.—Diversion facilities only at Merritt Dam. Storage in Merritt Reservoir began February 19, 1964.

AVERAGE ANNUAL DIVERSIONS.--1965-73, 51,000 acre-feet.



Exceedence probability graph of daily discharge, Ainsworth Canal near Valentine, Nebr., 1965-73.

06459500 Snake River near Burge, Nebr.

LOCATION.—Lat 42°39'20", long 100°51'00", in NE¼ sec.20, T.31 N., R.30 W., Cherry County, on right bank 150 ft downstream from Nebraska National Forest boundary, 4 miles downstream from Merritt Dam, 6.5 miles southwest of Burge, and 22 miles southwest of Valentine.

DRAINAGE AREA.—660 sq mi, approximately, of which about 44 sq mi contributes directly to surface runoff.

PERIOD OF RECORD.—June 1947 to September 1973.

DIVERSIONS.—Streamflow affected by storage in Merritt Reservoir and diversions to Ainsworth Project.

Monthly and annual mean discharges, water years 1964-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	309	13	148	110	74	7.63
November....	270	161	216	38	18	11.08
December....	250	12	209	71	34	10.76
January.....	258	29	210	66	31	10.82
February....	256	207	236	16	7	12.16
March.....	280	92	200	72	36	10.27
April.....	311	58	148	83	56	7.61
May.....	260	63	158	75	48	8.13
June.....	294	11	165	80	49	8.47
July.....	243	13	81	74	91	4.18
August.....	246	12	67	76	114	3.43
September...	311	7.4	106	114	107	5.46
Annual.....	222	104	162	33	20	100

Duration of daily mean discharge, water years 1964-73

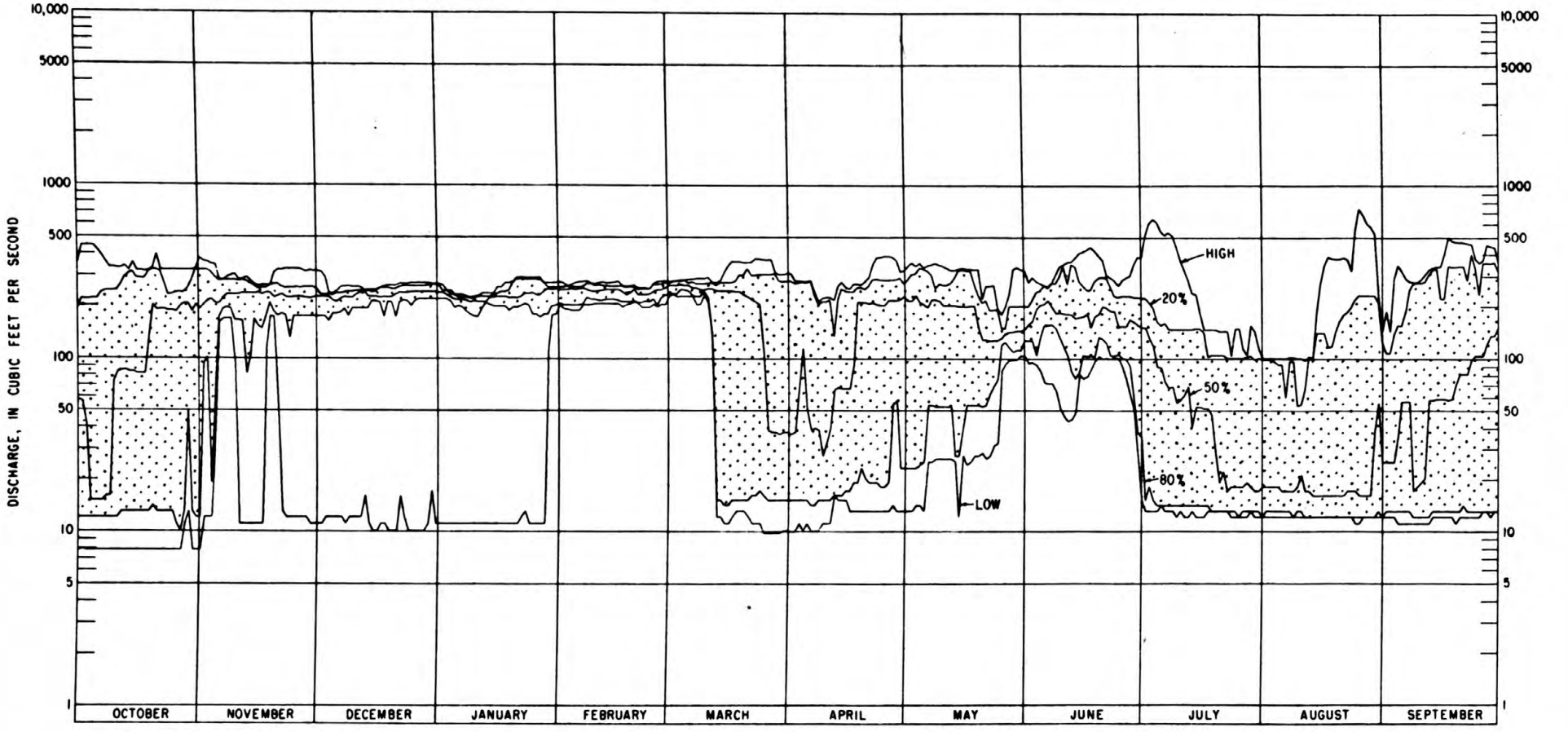
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
5.8	100	29	75.8	150	58.1
6.7	98.7	34	75.7	170	55.7
7.8	97.1	39	74.8	200	50.2
9.0	96.3	45	74.2	230	34.4
10	96.1	52	73.8	260	16.2
12	93.8	61	70.5	300	6.3
14	86.2	70	69.5	350	2.6
16	82.8	81	68.6	410	1.0
19	77.9	94	66.5	470	.4
22	77.2	110	63.2	550	.2
25	76.5	130	61.2		

Probability of annual high flows, water years 1964-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	334	323	308	272	259	189
50	2	385	380	364	330	295	260
10	10	552	528	476	410	343	286

Probability of annual low flows, climatic years 1965-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	5.6	5.9	6.2	7.3	7.7	8.1
20	5	7.6	8.1	8.6	10	10	11
50	2	10	11	12	14	14	15



Exceedence probability graph of daily discharge, Snake River near Burge, Nebr., 1965-73.

06460900 Minnechaduza Creek near Kilgore, Nebr.

LOCATION.—Lat 42°59'10", long 100°33'55", in NE¼NW¼ sec.30, T.35 N., R.30 W., Cherry County, on right bank 800 ft northeast of Paul Zysset ranch buildings, 2.5 miles downstream from South Dakota-Nebraska State line and 4.5 miles northeast of Kilgore.

DRAINAGE AREA.—85 sq mi, approximately.

PERIOD OF RECORD.—March 1958 to September 1973.

DIVERSIONS.—Streamflow not affected appreciably by pumping from stream.

Monthly and annual mean discharges, water years 1959-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	5.6	1.6	2.9	1.2	40	3.30
November....	6.8	2.0	5.2	1.4	27	5.86
December....	7.3	3.0	5.0	1.4	29	5.69
January.....	7.0	2.3	4.6	1.4	29	5.22
February....	16	4.4	8.2	3.0	37	9.29
March.....	28	6.6	17	5.7	34	18.79
April.....	32	6.1	18	8.0	45	19.88
May.....	25	5.2	12	6.2	53	13.08
June.....	47	1.4	11	14	125	12.94
July.....	15	.4	2.5	3.4	138	2.82
August.....	4.9	0	1.4	1.4	104	1.55
September...	3.7	.1	1.4	1.2	88	1.58
Annual.....	12.0	5.0	7.3	1.9	26	100

Duration of daily mean discharge, water years 1959-73

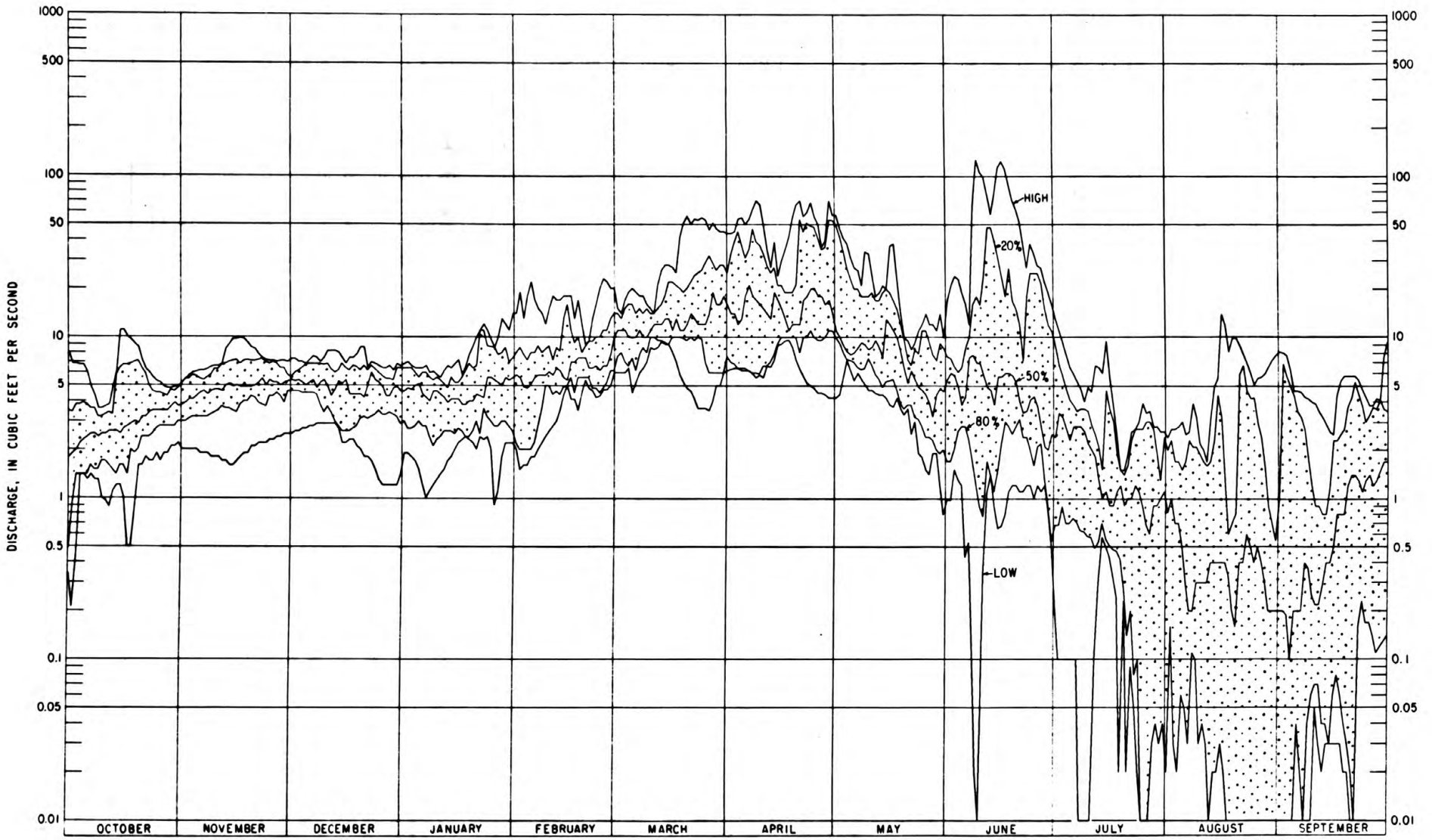
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	0.40	92.1	7.1	28.5
.01	98	.50	90.5	9.4	20.7
.02	97.7	.70	87.7	13	14.2
.03	97.4	1.0	84.7	17	10.0
.04	97.0	1.3	81.9	22	6.5
.05	96.8	1.7	78.3	30	4.0
.07	96.5	2.3	72.5	39	2.6
.09	96.3	3.0	65.6	52	1.4
.20	94.4	4.0	57.0	70	.4
.30	92.8	5.3	44.6	92	.1

Probability of annual high flows, water years 1959-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	28	26	19	14	13	10
50	2	60	55	46	35	26	20
10	10	106	97	79	57	42	31
4	25	134	122	98	68	50	37

Probability of annual low flows, climatic years 1960-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
5	20	0	0	0	0	0	0.01
10	10	0	0	0	0	.01	.04
20	5	0	0	0	.01	.05	.15
50	2	0	0	.10	.21	.42	.67



Exceedence probability graph of daily discharge, Minnechaduza Creek near Kilgore, Nebr., 1964-72.

06461000 Minnechaduza Creek at Valentine, Nebr.

LOCATION.—Lat 42°53'10", long 100°33'10", in SW¼ sec.30, T.34 N., R.27 W., Cherry County, on right bank 500 ft downstream from powerplant in city park at north edge of Valentine and 4 miles upstream from mouth.

DRAINAGE AREA.—390 sq mi, approximately, of which about 200 sq mi contributes directly to surface runoff.

PERIOD OF RECORD.—December 1947 to September 1973.

DIVERSIONS.—Streamflow regulated by powerplant 500 feet above station.

Monthly and annual mean discharges, water years 1949-72

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	34	19	26	4.2	16	6.30
November....	39	26	31	3.0	10	7.35
December....	39	24	29	3.9	13	7.01
January.....	33	15	27	4.5	17	6.43
February....	58	27	35	6.1	17	8.38
March.....	106	34	59	21	36	14.11
April.....	82	32	55	15	27	13.06
May.....	94	29	49	16	32	11.68
June.....	118	21	40	21	53	9.57
July.....	61	14	25	12	47	5.89
August.....	36	12	21	6.4	30	5.07
September...	44	13	22	7.0	33	5.15
Annual.....	44	29	35	4.1	12	100

Duration of daily mean discharge, water years 1949-72

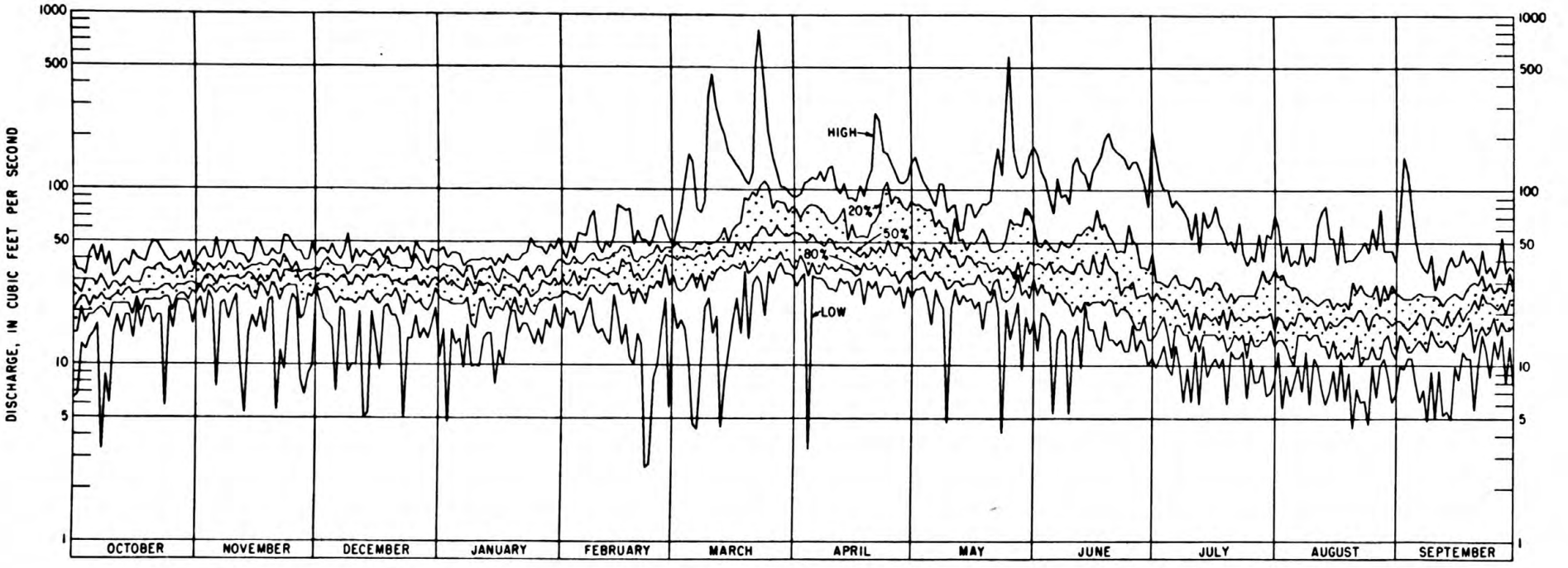
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
3.1	100	17	88.0	79	4.4
3.7	99.9	20	81.6	94	2.5
5.1	99.6	24	70.9	110	1.6
6.1	99.2	28	58.2	130	.9
7.2	98.7	34	39.2	160	.4
8.6	98.3	40	25.5	190	.3
10	97.6	47	15.8	220	.1
12	96.1	56	9.9		
14	93.9	67	6.6		

Probability of annual high flows, water years 1949-72

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	61	54	48	44	43	38
50	2	148	131	114	93	75	62
10	10	397	306	219	153	110	87
4	25	634	449	288	187	129	101
2	50	888	589	347	214	143	111

Probability of annual low flows, climatic years 1950-72

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
2	50	2.5	4.0	6.5	9.4	10	12
5	20	2.9	4.7	7.9	10	11	13
10	10	3.4	5.5	8.8	11	12	14
20	5	4.0	6.7	10	12	13	15
50	2	5.5	9.3	13	14	16	18



Exceedence probability graph of daily discharge, Minnechaduza Creek at Valentine, Nebr., 1955-73.

06461500 Niobrara River near Sparks, Nebr.

LOCATION.—Lat 42°54'10", long 100°21'40", in SE¼ sec.22, T.34 N., R.26 W., Cherry County, on left bank 18 ft downstream from highway bridge, 2.2 miles downstream from Big Beaver Creek, 5.5 miles downstream from Minnechaduza Creek, and 6.5 miles southwest of Sparks.

DRAINAGE AREA.—8,090 sq mi, approximately.

PERIOD OF RECORD.—October 1945 to September 1973.

DIVERSIONS.--Streamflow affected by irrigation and power developments.

Monthly and annual mean discharges, water years 1964-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	879	525	676	112	17	7.69
November....	830	669	764	54	7	8.69
December....	823	448	720	108	15	8.19
January.....	897	525	744	114	15	8.46
February....	967	789	852	48	6	9.70
March.....	1,230	652	874	162	18	9.95
April.....	1,070	615	833	125	15	9.48
May.....	1,060	612	804	136	17	9.15
June.....	1,470	575	799	272	34	9.09
July.....	807	456	604	127	21	6.88
August.....	784	419	524	126	24	5.97
September...	853	460	593	141	24	6.75
Annual.....	818	634	731	52	7	100

Duration of daily mean discharge, water years 1964-73

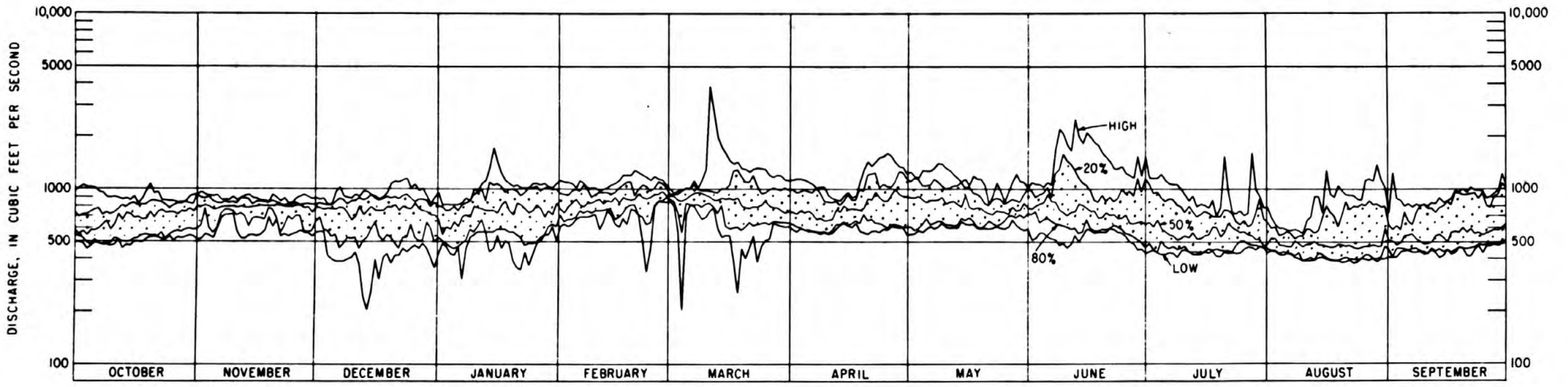
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
190	100	560	76.4	1,200	2.5
210	99.9	620	66.1	1,300	1.4
330	99.8	700	55.5	1,500	.8
360	99.7	770	42.9	1,600	.4
410	97.6	860	23.7	1,800	.3
450	93.6	960	11.1	2,000	.1
500	85.8	1,100	4.3		

Probability of annual high flows, water years 1964-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	1,180	1,090	920	904	824	798
50	2	1,580	1,430	1,350	1,200	1,090	966
10	10	2,700	2,200	1,890	1,590	1,340	1,080

Probability of annual low flows, climatic years 1965-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	203	259	348	373	400	420
20	5	231	282	357	387	412	440
50	2	297	343	395	430	460	500



Exceedence probability graph of daily discharge, Niobrara River near Sparks, Nebr., 1965-73.

06462000 Niobrara River near Norden, Nebr.

LOCATION.—Lat 42°47'13', long 100°02'06", in N½SW¼ sec.33, T.33 N., R.23 W., Keya Paha County, on left bank 60 ft downstream from county road bridge, 1.5 miles downstream from Fairfield Creek and 6 miles south of Norden.

DRAINAGE AREA.—8,390 sq mi, approximately.

PERIOD OF RECORD.—October 1952 to September 1973.

DIVERSIONS.—Streamflow affected by irrigation and power development.

Monthly and annual mean discharges, water years 1964-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	1,020	581	748	146	20	7.64
November....	924	714	853	63	7	8.71
December....	915	563	806	104	13	8.23
January.....	1,030	588	855	143	17	8.74
February....	1,070	853	958	62	6	9.79
March.....	1,460	714	1,000	220	22	10.22
April.....	1,200	704	932	146	16	9.52
May.....	1,090	693	878	142	16	8.97
June.....	1,500	659	884	259	29	9.03
July.....	846	486	649	122	19	6.63
August.....	837	458	566	118	21	5.78
September...	985	495	660	163	25	6.74
Annual.....	905	727	815	58	7	100

Duration of daily mean discharge, water years 1964-73

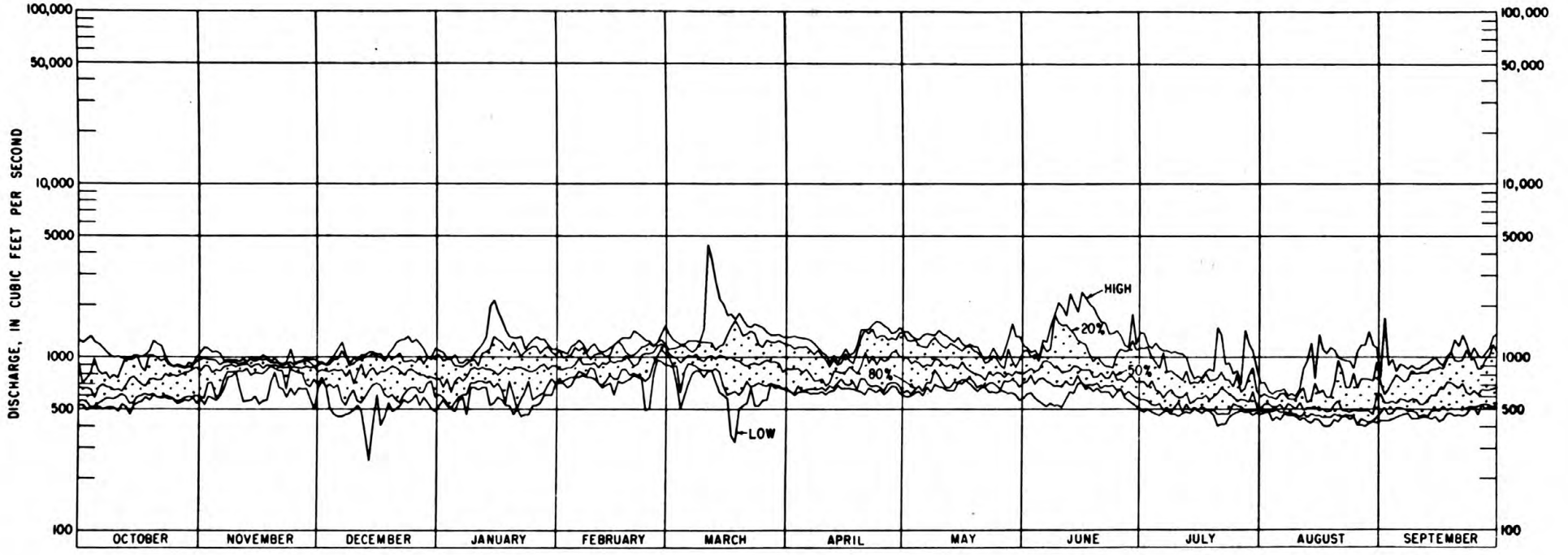
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
300	100	670	68.1	1,400	2.0
330	99.9	740	58.9	1,500	1.3
400	99.8	830	46.2	1,700	.7
450	98.7	910	30.4	1,900	.4
490	93.9	1,000	19.8	2,100	.2
550	85.7	1,100	11.3	2,300	.1
610	77.2	1,200	6.0		

Probability of annual high flows, water years 1964-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	1,380	1,250	1,110	1,080	1,000	906
50	2	1,750	1,630	1,530	1,360	1,220	1,090
10	10	2,970	2,600	2,180	1,770	1,470	1,230

Probability of annual low flows, climatic years 1965-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	260	330	410	430	445	470
20	5	340	380	440	465	430	500
50	2	430	460	490	510	530	570



Exceedence probability graph of daily discharge, Niobrara River near Norden, Nebr., 1965-73.

06462500 Plum Creek at Meadville, Nebr.

LOCATION.--Lat 42°45'05", long 99°52'05", in NE¼NW¼ sec.14, T.32 N., R.22 W., Brown County, on left bank 0.4 mile upstream from county road bridge, 1 mile upstream from mouth, 1 mile southwest of Meadville, and 17 miles north of Ainsworth.

DRAINAGE AREA.--600 sq mi, approximately, of which about 340 sq mi contributes directly to surface runoff.

PERIOD OF RECORD.--December 1947 to September 1973.

DIVERSIONS.—Streamflow affected by storage and pumping from stream.

Monthly and annual mean discharges, water years 1949-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	117	79	94	9.4	10	7.27
November....	123	80	93	8.8	10	7.23
December....	107	78	93	8.0	9	7.22
January.....	110	73	92	9.7	11	7.12
February....	146	80	99	15	15	7.71
March.....	216	90	121	28	23	9.38
April.....	272	92	132	39	30	10.25
May.....	266	89	137	39	28	10.62
June.....	276	86	129	42	33	10.04
July.....	390	78	108	60	56	8.43
August.....	128	74	94	14	14	7.29
September...	144	77	96	17	18	7.44
Annual.....	140	92	107	13	12	100

Duration of daily mean discharge, water years 1949-73

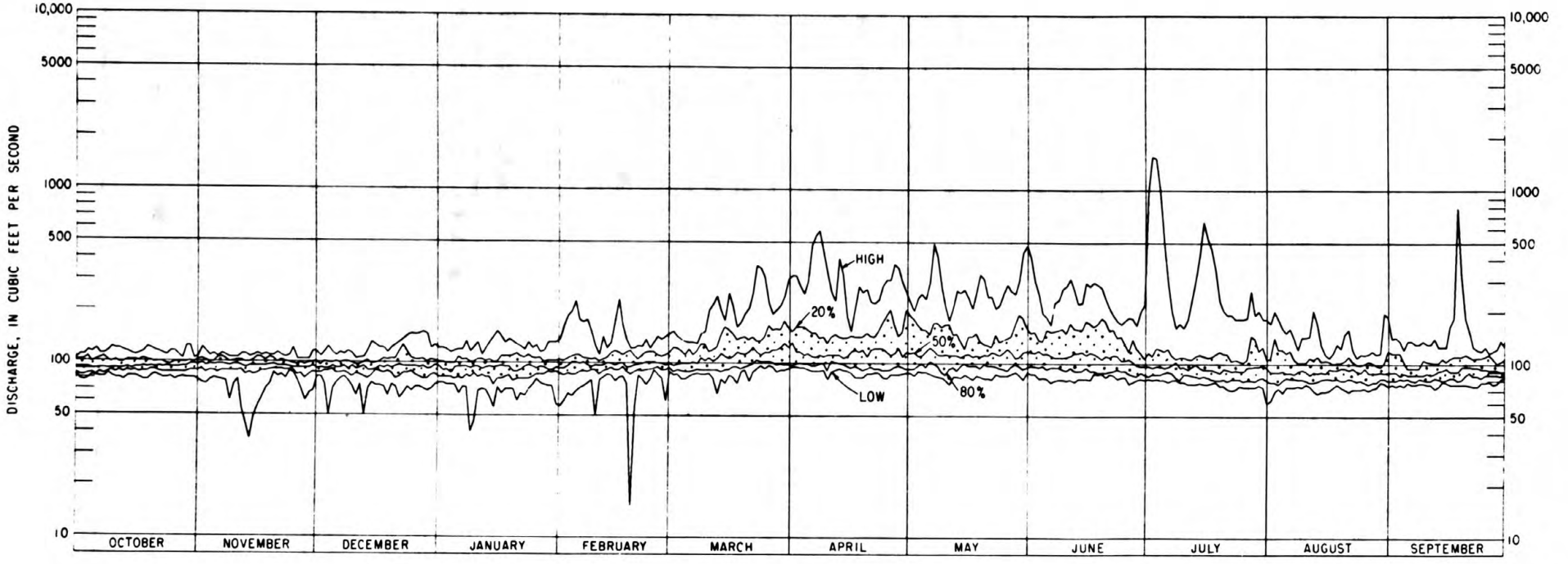
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
40	100	110	26.3	280	1.2
46	99.9	120	18.4	320	.8
53	99.8	140	9.9	370	.5
61	99.7	160	6.6	430	.3
70	99.2	180	4.6	490	.2
80	92.8	210	2.8	560	.1
92	63.9	240	1.9		

Probability of annual high flows, water years 1949-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	123	119	114	107	108	103
50	2	326	290	241	205	169	146
10	10	740	622	455	344	262	212
4	25	1,060	869	601	430	321	253
2	50	1,350	1,100	729	501	370	286
1	100	1,700	1,360	874	579	424	323

Probability of annual low flows, climatic years 1950-73

Non-exceedence probability (percent)	Recurrence interval,	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
1	100	10	19	30	50	56	60
2	50	18	36	49	64	64	70
5	20	20	44	59	69	74	77
10	10	34	53	63	71	76	79
20	5	44	59	68	74	78	81
50	2	63	70	75	79	83	86



Exceedence probability graph of daily discharge, Plum Creek at Meadville, Nebr., 1955-73.

06463500 Long Pine Creek near Riverview, Nebr.

LOCATION.--Lat 42°41'20", long 99°41'20", in N½ sec.5, T.31 N., R.20 W., Brown County, on right bank 7 ft downstream from county road bridge, 1 mile downstream from Bone Creek, and 5.5 miles southwest of Riverview.

DRAINAGE AREA.--390 sq mi, approximately.

PERIOD OF RECORD.--April 1948 to January 1954; September 1954 to September 1973.

DIVERSIONS.--Small amount of storage and irrigation, but flow not appreciably affected.

Monthly and annual mean discharges, water years, 1955-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	127	108	119	5.4	4	7.51
November....	142	107	123	8.1	6	7.79
December....	134	102	120	8.3	7	7.59
January.....	135	103	118	7.4	6	7.46
February....	139	118	125	5.7	5	7.92
March.....	200	113	145	25	17	9.19
April.....	199	120	142	21	15	8.98
May.....	198	117	145	26	18	9.15
June.....	194	110	144	23	16	9.09
July.....	368	106	140	59	42	8.86
August.....	192	103	128	22	18	8.08
September...	187	108	132	23	18	8.38
Annual.....	163	119	132	11	8	100

Duration of daily mean discharge, water years 1955-73

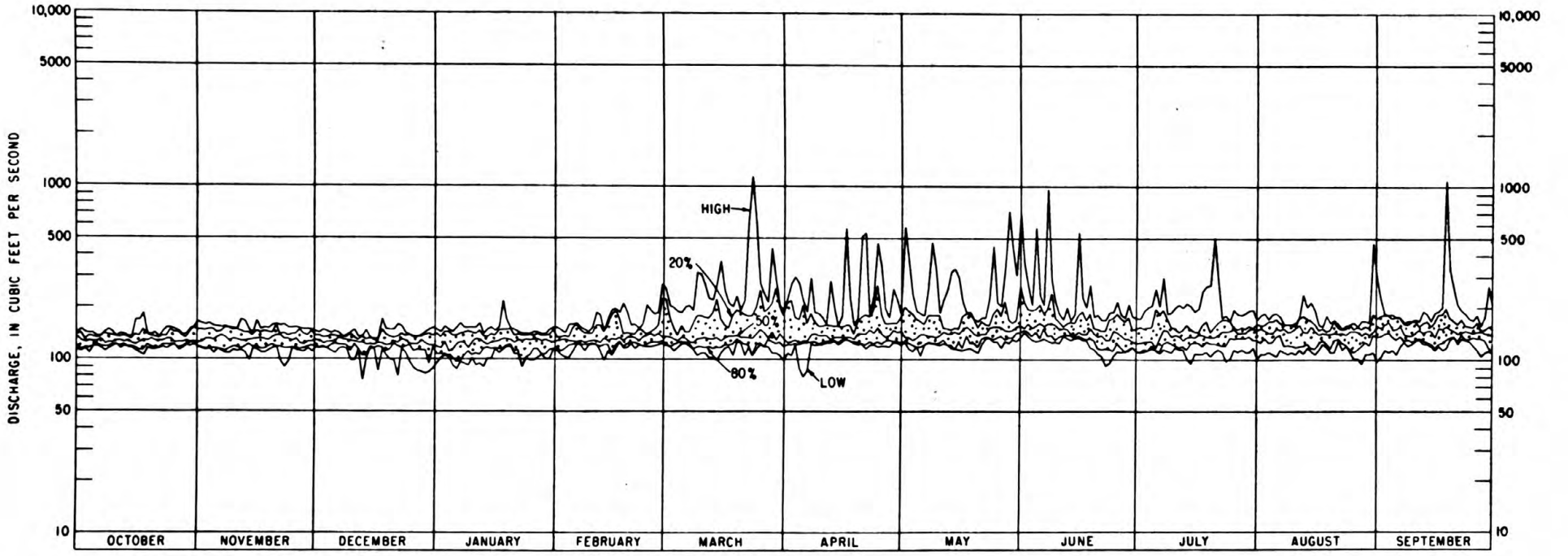
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
67	100	140	19.5	290	0.9
74	99.9	150	12.4	320	.8
83	99.7	170	6.3	360	.6
92	98.9	190	3.6	440	.4
100	97.3	210	2.4	490	.3
110	87.9	240	1.7	610	.2
130	34.8	260	1.3	670	.1

Probability of annual high flows, water years 1955-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	135	130	125	120	115	110
50	2	429	303	230	200	172	154
10	10	1,220	730	439	335	250	208
4	25	1,920	1,100	602	432	304	246
2	50	2,630	1,460	757	520	351	279

Probability of annual low flows, climatic year 1956-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
2	50	47	63	74	83	94	101
5	20	58	71	80	87	98	103
10	10	66	77	84	90	100	105
20	5	77	84	89	94	102	107
50	2	91	94	97	101	107	111



Exceedence probability graph of daily discharge, Long Pine Creek near Riverview, Nebr., 1965-73.

06464500 Keya Paha River at Wewela, S. Dak.

LOCATION.--Lat 43°01'42", long 99°46'45", in SE¼ sec.23, T.95 W., R.76 W., Tripp County, on left bank 13 feet downstream from bridge on U.S. Highway 183, 1.0 mile north of Wewela, 4.5 miles upstream from Holt Creek and 11.5 miles downstream from Lost Creek.

DRAINAGE AREA.—1,070 sq mi, approximately.

PERIOD OF RECORD.—November 1937 to September 1940; October 1947 to September 1973.

DIVERSIONS.—Streamflow not affected appreciably by irrigation.

Monthly and annual mean discharges, water years 1948-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	68	20	35	13	38	3.92
November....	75	15	40	15	37	4.55
December....	62	8.7	31	14	44	3.54
January.....	46	1.6	25	12	48	2.83
February....	129	22	48	26	54	5.43
March.....	598	53	190	150	79	21.43
April.....	605	52	160	112	70	18.03
May.....	358	42	129	84	65	14.53
June.....	512	37	96	93	97	10.78
July.....	607	18	68	113	166	7.67
August.....	143	9.7	36	28	79	4.01
September...	66	11	29	14	49	3.28
Annual.....	175	41	74	34	47	100

Duration of daily mean discharge, water years 1948-73

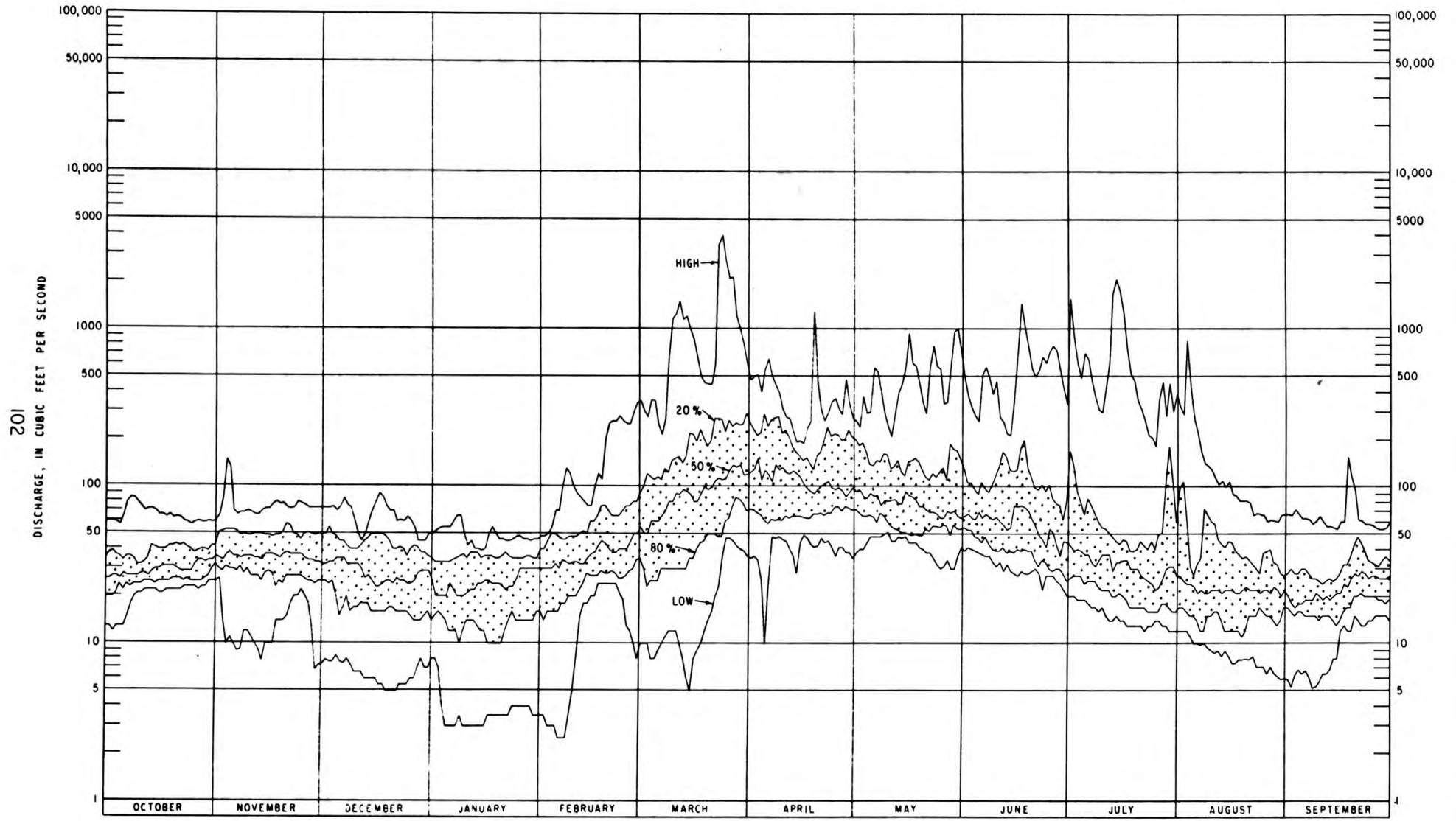
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0	100	18	89.2	240	4.5
1.0	99.6	24	80.0	330	2.5
2.3	99.5	32	62.0	440	1.6
3.1	99.2	42	46.0	580	1.0
4.1	99.0	57	33.9	780	.6
5.5	98.7	76	23.9	1,000	.4
7.4	98.0	100	16.3	1,400	.2
9.9	96.9	140	10.4	1,900	.1
13	94.7	180	7.1		

Probability of annual high flows, water years 1948-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	117	115	104	90	80	69
50	2	589	488	387	293	224	170
10	10	2,220	1,790	1,270	832	568	403
4	25	3,930	3,180	2,170	1,320	861	597
2	50	5,810	4,670	3,140	1,820	1,150	788
1	100	8,420	7,000	4,480	2,470	1,520	1,030

Probability of annual low flows, climatic years 1949-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
1	100	0.30	0.40	0.60	0.80	1.0	1.3
2	50	.60	.70	1.0	1.4	1.7	2.2
5	20	1.4	1.6	2.3	2.8	3.7	4.0
10	10	3.1	3.4	4.0	5.0	6.4	6.7
20	5	5.8	6.6	7.3	8.5	10	12
50	2	12	13	14	16	19	22



Exceedence probability graph of daily discharge, Keya Paha River at Wewela, So. Dak., 1955-73.

06464900 Keya Paha River near Naper, Nebr.

LOCATION.—Lat 42°55'00", long 99°05'50", in SE¼SE¼ sec.17, T.34 N., R.15 W., Boyd County, on left bank 8 ft downstream from highway bridge, 3.3 miles south of Naper, and 8.6 miles upstream from mouth.

DRAINAGE AREA.—1,630 sq mi, approximately.

PERIOD OF RECORD.—October 1957 to September 1973.

DIVERSIONS.—Streamflow not affected appreciably by diversions for irrigation.

Monthly and annual mean discharges, water years 1958-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	149	36	62	26	42	3.71
November....	155	51	76	27	35	4.54
December....	137	31	57	26	47	3.40
January.....	89	18	51	20	39	3.05
February....	232	34	102	49	47	6.15
March.....	1,090	102	334	262	79	19.99
April.....	506	98	279	133	48	16.69
May.....	662	75	229	148	64	13.72
June.....	945	60	193	211	109	11.59
July.....	1,540	6.3	172	368	214	10.33
August.....	420	5.3	65	102	157	3.89
September...	131	11	49	28	58	2.94
Annual.....	389	80	139	76	54	100

Duration of daily mean discharge, water years 1958-73

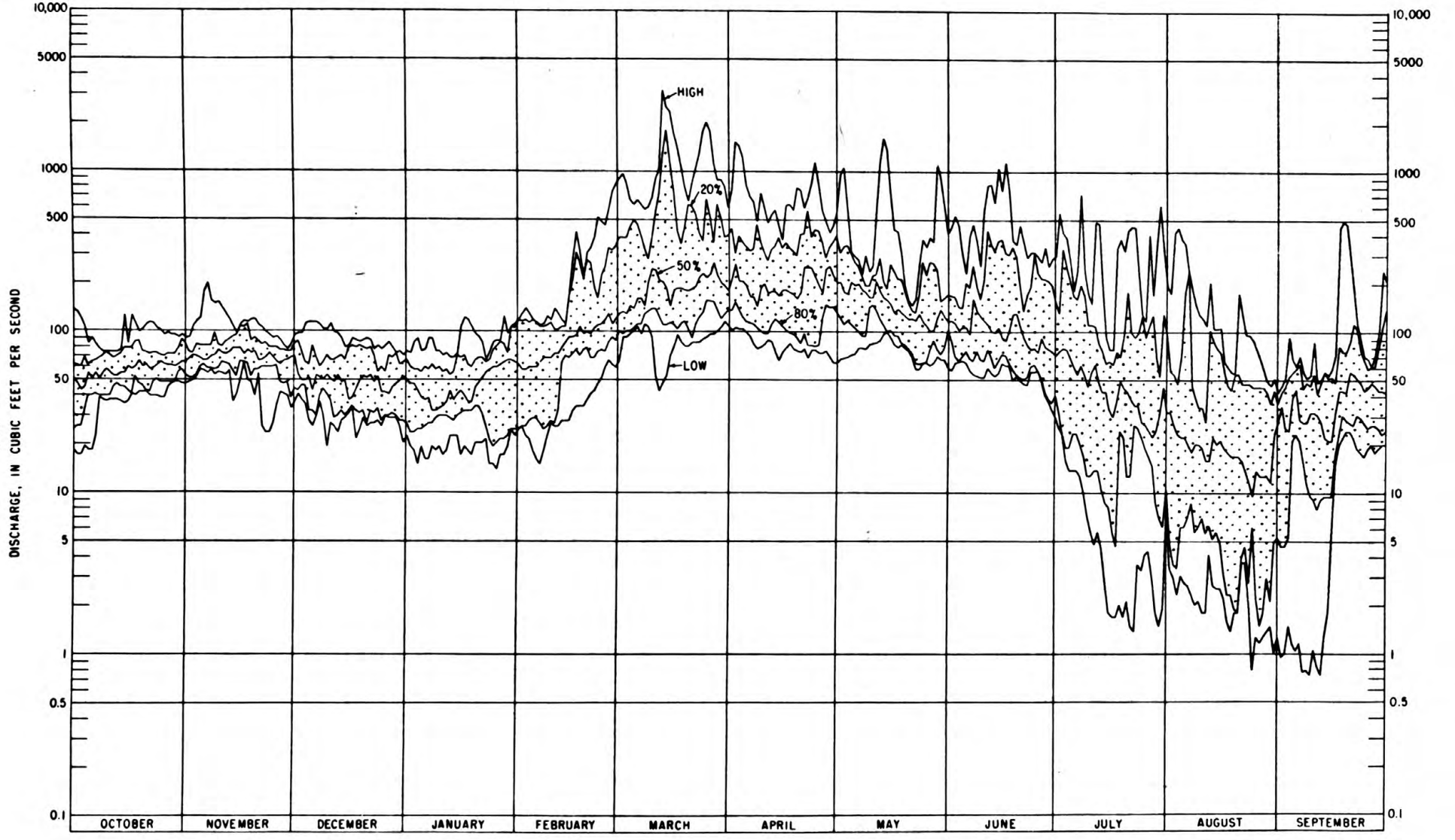
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0.70	100	14	96.2	290	9.4
.90	99.9	19	94.3	390	5.8
1.2	99.8	25	90.5	510	4.0
1.6	99.5	33	84.5	670	2.7
2.1	99.2	43	77.4	880	1.6
2.8	98.8	57	62.1	1,200	.9
3.6	98.6	75	46.2	1,500	.6
4.8	98.2	98	36.2	2,000	.3
6.3	97.8	130	26.5	2,700	.1
8.3	97.3	170	18.6		
11	96.9	220	13.6		

Probability of annual high flows, water years 1958-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	335	299	259	200	176	156
50	2	1,380	1,040	784	596	440	312
10	10	4,500	3,600	2,350	1,500	1,130	770
4	25	7,800	6,500	4,300	2,600	1,850	1,350

Probability of annual low flows, climatic years 1959-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
5	20	0.43	0.50	0.71	0.96	1.9	3.7
10	10	.94	1.0	1.4	2.0	3.9	6.9
20	5	2.1	2.4	3.1	4.4	9.0	13
50	2	8.6	9.5	12	16	23	31



Exceedence probability graph of daily discharge, Keya Paha River near Naper, Nebr., 1965-73.

06465000 Niobrara River near Spencer, Nebr.

LOCATION.--Lat 42°48'33", long 98°30'19", in SE¼NW¼ sec.30, T.33 N., R.11 W., Boyd County, at Spencer Powerplant Dam 5 miles southeast of Spencer.

DRAINAGE AREA.—12,100 sq mi, approximately.

PERIOD OF RECORD.—August 1927 to September 1936; June 1940 to September 1973.

DIVERSIONS.—Streamflow affected considerably by irrigation and power regulation.

Monthly and annual mean discharges, water years 1964-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	1,540	1,000	1,220	166	14	7.43
November....	1,620	1,110	1,350	136	10	8.21
December....	1,210	676	1,010	142	14	6.15
January.....	1,450	983	1,180	170	14	7.20
February....	1,890	1,340	1,550	169	11	9.41
March.....	3,210	1,510	2,120	541	26	12.87
April.....	2,230	1,250	1,860	315	17	11.35
May.....	2,490	1,200	1,660	392	24	10.13
June.....	2,600	1,030	1,510	455	30	9.21
July.....	1,430	631	1,010	251	25	6.14
August.....	1,190	612	868	208	24	5.28
September...	1,480	746	1,090	250	23	6.62
Annual.....	1,510	1,260	1,370	82	6	100

Duration of daily mean discharge, water years 1964-73

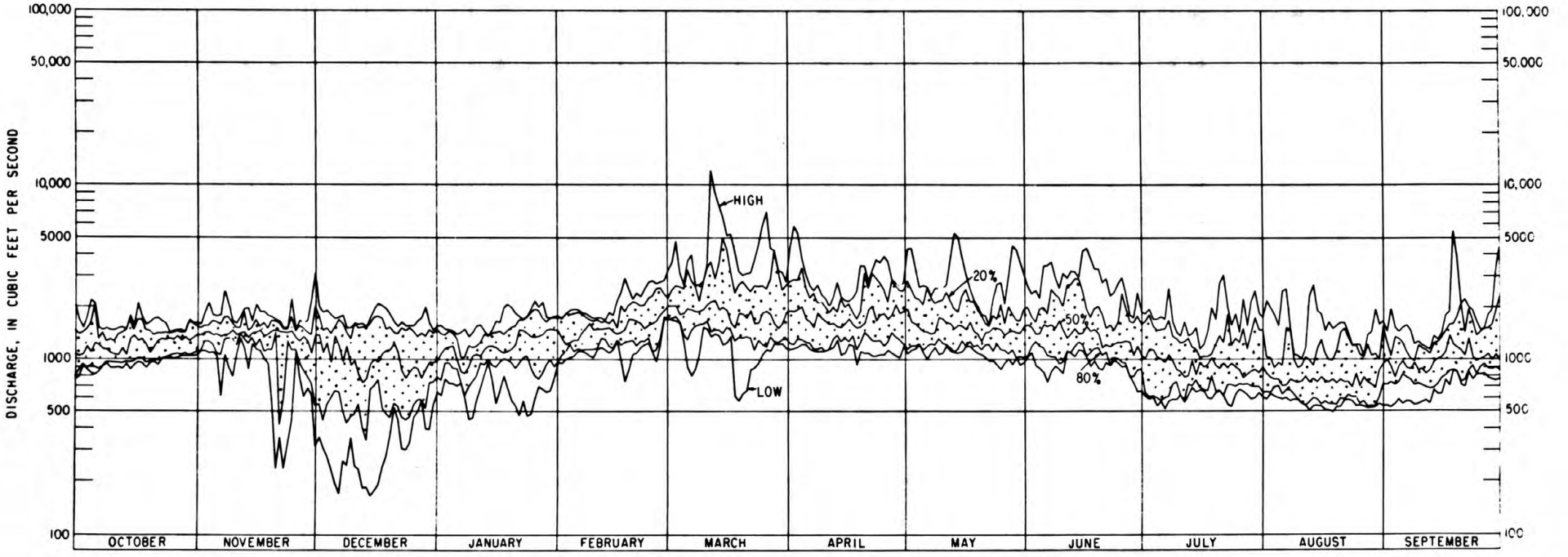
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
150	100	640	94.0	2,700	3.4
190	99.8	820	84.6	3,500	1.3
240	99.7	1,000	71.7	4,500	.4
310	99.4	1,300	48.9	5,700	.1
390	99.2	1,700	19.7		
500	98.5	2,200	7.7		

Probability of annual high flows, water years 1964-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	3,290	3,060	2,540	2,080	1,820	1,600
50	2	4,870	4,050	3,400	2,990	2,510	2,090
10	10	8,480	6,750	5,310	4,180	3,180	2,490

Probability of annual low flows, climatic years 1965-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	148	169	210	410	545	610
20	5	178	209	260	450	595	670
50	2	271	320	390	570	710	800



Exceedence probability graph of daily discharge, Niobrara River near Spencer, Nebr., 1965-73.

06465500 Niobrara River near Verdel, Nebr.

LOCATION.--Lat 42°44'25", long 98°12'45", near center of N½ sec.23, T.32 N., R.8 W., Knox County, on left bank 4 ft downstream from Pishelville Bridge, 6 miles south of Verdel, and 7 miles upstream from Verdigre Creek.

DRAINAGE AREA.—12,600 sq mi, approximately.

PERIOD OF RECORD.—April 1938 to May 1940; June 1958 to September 1973.

DIVERSIONS.—Streamflow affected considerably by irrigattion and power regulation.

Monthly and annual mean discharges, water years 1964-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	1,670	1,040	1,320	217	16	7.21
November....	1,770	1,210	1,420	159	11	7.81
December....	1,400	787	1,140	169	15	6.24
January.....	1,640	1,060	1,300	210	16	7.15
February....	2,060	1,430	1,730	226	13	9.48
March.....	3,380	1,620	2,420	580	24	13.27
April.....	2,760	1,370	2,100	420	20	11.49
May.....	2,590	1,230	1,830	406	22	10.02
June.....	2,710	1,060	1,670	472	28	9.14
July.....	1,450	685	1,120	258	23	6.15
August.....	1,320	644	954	238	25	5.23
September...	1,580	875	1,240	279	22	6.81
Annual.....	1,680	1,400	1,520	92	6	100

Duration of daily mean discharge, water years 1964-73

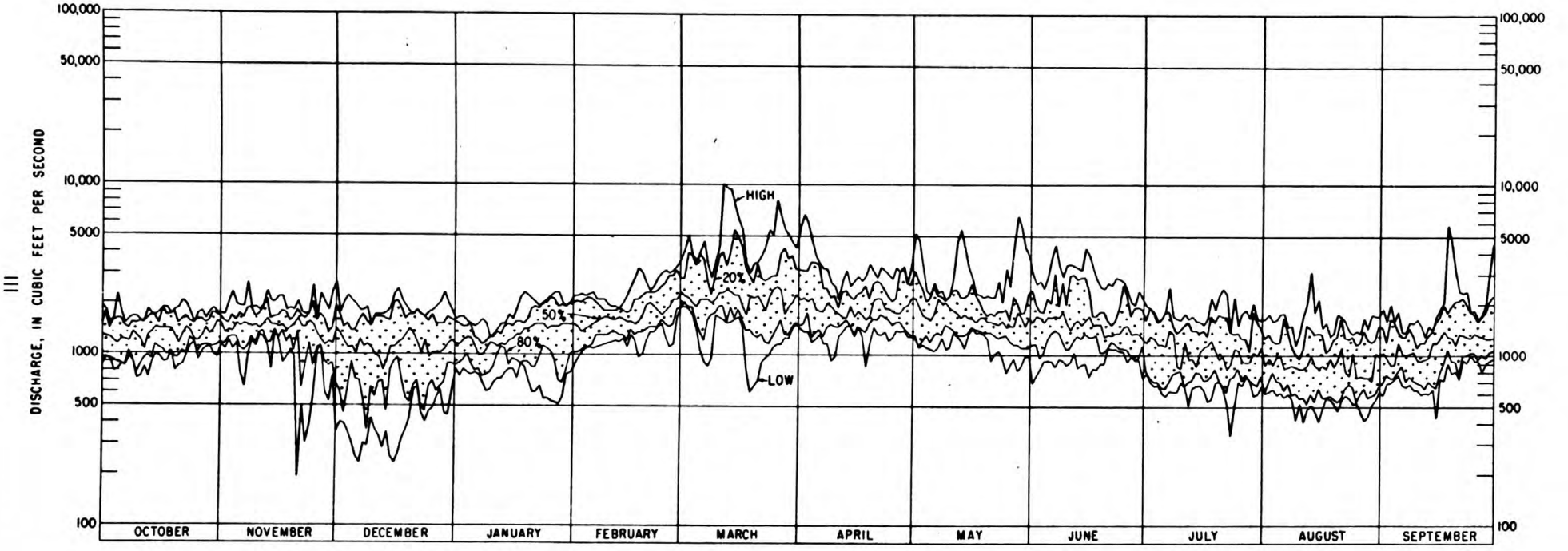
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
220	100	770	91.1	2,600	6.4
260	99.9	890	85.5	3,100	3.4
310	99.7	1,000	79.9	3,600	1.9
360	99.5	1,200	66.7	4,200	1.3
410	99.2	1,400	51.6	4,900	.7
480	98.8	1,700	29.6	5,700	.3
560	97.8	1,900	19.9	6,600	.2
660	95.0	2,300	9.7	7,700	.1

Probability of annual high flows, water years 1964-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	2,980	2,960	2,790	2,260	1,880	1,650
50	2	5,910	4,970	3,920	3,330	2,850	2,410
10	10	10,100	7,860	5,950	4,710	3,650	2,840

Probability of annual low flows, climatic years 1965-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
10	10	192	270	360	505	600	680
20	5	235	318	415	555	660	760
50	2	330	420	530	660	820	950



Exceedence probability graph of daily discharge, Niobrara River near Verdel, Nebr., 1965-73.

06466500 Bazile Creek near Niobrara, Nebr.

LOCATION.—Lat 42°45'00", long 97°56'10", in NE¼ sec.18, T.32 N., R.5 W., Knox County, on downstream side of left pier of bridge on State Highway 12, 2.5 miles upstream from mouth and 4.5 miles east of Niobrara, Nebr.

DRAINAGE AREA.—440 sq mi, approximately.

PERIOD OF RECORD.—May 1952 to September 1973.

DIVERSIONS.—Streamflow affected by upstream irrigation.

Monthly and annual mean discharges, water years 1953-73

Month	Maximum (cfs)	Minimum (cfs)	Mean (cfs)	Standard deviation (cfs)	Coefficient of variation (percent)	Annual runoff (percent)
October.....	67	28	46	11	23	4.28
November....	72	33	51	11	21	4.69
December....	69	26	43	13	31	3.93
January.....	75	24	42	13	30	3.86
February....	213	42	79	45	56	7.30
March.....	621	62	162	127	78	14.90
April.....	587	57	136	117	86	12.57
May.....	469	42	128	108	84	11.81
June.....	933	25	215	221	103	19.80
July.....	275	15	79	57	72	7.32
August.....	326	10	58	67	116	5.34
September...	94	13	46	22	49	4.20
Annual.....	194	43	90	38	42	100

Duration of daily mean discharge, water years 1953-73

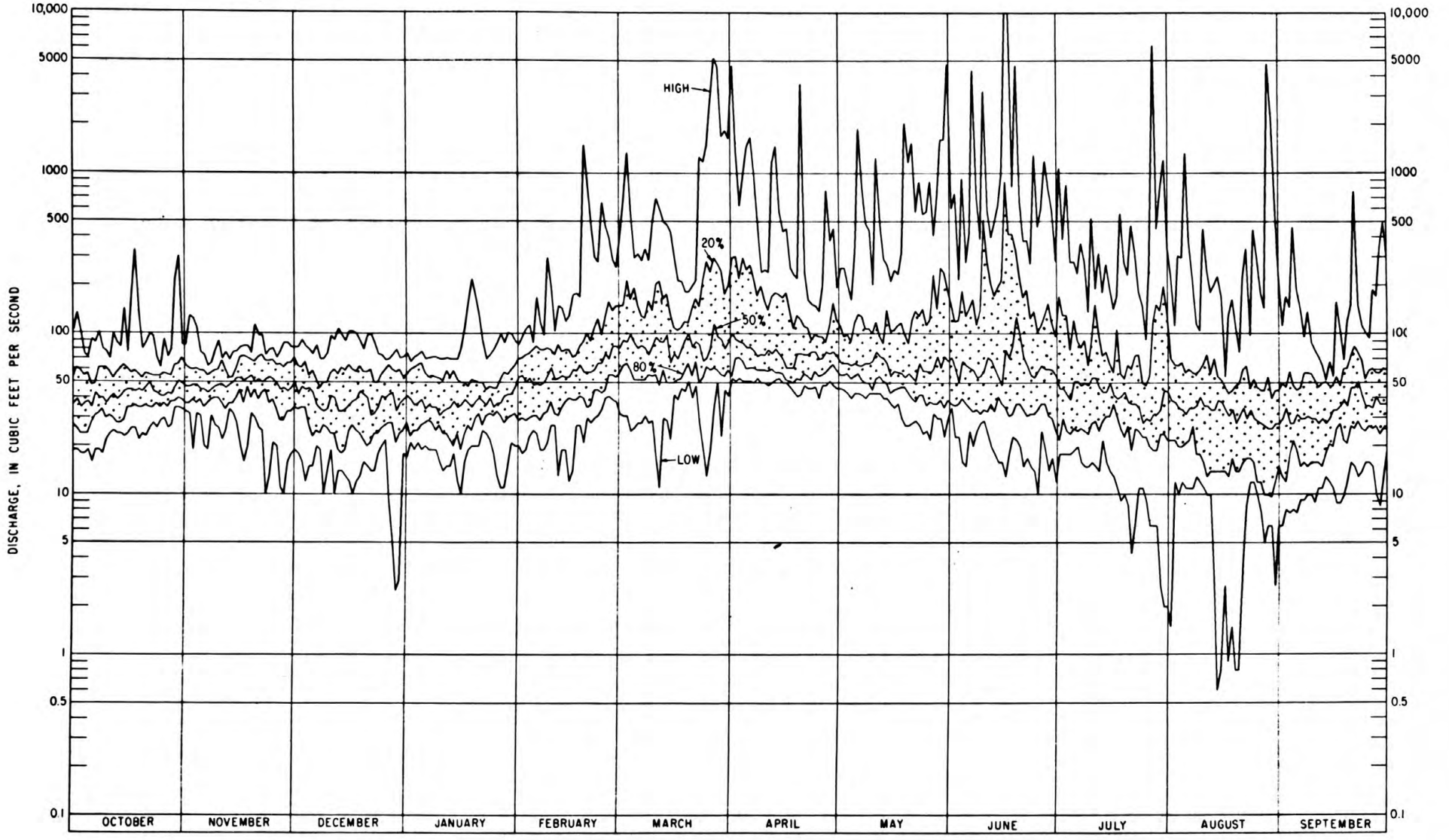
Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)	Mean daily discharge (cfs)	Days discharge was equaled or exceeded (percent)
0.80	100	30	83.9	330	2.7
1.1	99.9	40	68.2	450	1.8
3.6	99.8	54	45.8	600	1.3
6.6	99.7	74	26.0	820	.9
9.0	99.3	99	15.9	1,100	.7
12	98.4	130	10.8	1,500	.4
16	96.7	180	6.6	2,000	.2
22	93.0	240	4.3	3,700	.1

Probability of annual high flows, water years 1953-73

Exceedence probability (percent)	Recurrence interval, in years	Highest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	15	30	60
99	1	204	188	123	87	70	58
50	2	2,000	1,060	614	394	263	187
10	10	6,330	3,540	1,900	1,100	649	418
4	25	9,480	5,750	3,010	1,660	933	578
2	50	12,200	7,970	4,110	2,200	1,190	720

Probability of annual low flows, climatic years 1954-73

Non-exceedence probability (percent)	Recurrence interval, in years	Lowest average flow, in cubic feet per second					
		1 day	Consecutive days				
			3	7	14	30	60
2	50	1.1	1.6	2.3	4.9	6.6	9.8
5	20	1.9	2.9	4.1	7.4	9.5	13
10	10	3.2	4.7	6.5	11	13	16
20	5	6 0	7.6	9.9	14	17	21
50	2	14	16	21	22	27	31



Exceedence probability graph of daily discharge, Bazile Creek near Niobrara, Nebr., 1955-73.