STREAMFLOW AT SELECTED GAGING STATIONS ON THE JAMES RIVER IN NORTH DAKOTA AND SOUTH DAKOTA, 1953-82, WITH A SECTION ON CLIMATOLOGY

By Gregg J. Wiche, Rick D. Benson, and Douglas G. Emerson

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TO METRIC UNITS

For those readers who may prefer to use metric (International System) units rather than inch-pound units, the conversion factors for the terms used in this report are given below.

Multiply inch-pound unit	By	To obtain metric unit
Acre	0.4047	hectare
Acre-foot	1,233	cubic meter
Acre-foot per acre	3,047	cubic meter per hectare
Cubic foot per second	0.02832	cubic meter per second
Foot	0.3048	meter
Foot per mile	0.1894	meter per kilometer
Inch	25.4	millimeter
Mile	1.609	kilometer
Square mile	2.590	square kilometer

To convert degrees Fahrenheit (°F) to degrees Celsius (°C), use the following formula: °C = (°F-32)x5/9.

Sea level: In this report sea level refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level of 1929.

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ABSTRACT

Historic streamflow data were compiled and record extension techniques were used, when necessary, to develop a monthly streamflow record for 1953-82 at streamflow-gaging stations on the James River in North Dakota and South Dakota. The record extension techniques included both Maintenance of Variance Extension Type 1 and Ordinary Least Squares.

In addition to the historic streamflow record, synthesized unregulated streamflow was computed for gaging stations on the James River for 1953-82 by eliminating the effects of Jamestown Reservoir, Pipestem Reservoir, Sand Lake National Wildlife Refuge, and the consumptive surface-water withdrawals. Maintenance of Variance Extension Type 1, Ordinary Least Squares regression, water-balance procedures, and drainage-area ratio methods were used to compute the unregulated streamflows.

Mean annual historic streamflow of the James River at Jamestown is about 7,000 acre-feet less than the mean annual unregulated streamflow. Mean monthly unregulated streamflow is greater than mean monthly historic streamflow during March, April, and May; during all other months, unregulated streamflow is less than historic streamflow.

The climate during 1953-82 was compared to the climate records, which range in length from 53 to 102 years, in the James River basin to determine if the climate during 1953-82 was similar to the climate that has occurred during the last 90 years. On the basis of the climate analysis, the data-development period (1953-82) does not represent an abnormally wet or dry period. Thus, the streamflow during the data-development period represents a range of streamflows that might be expected to occur during the last 90 years.

INTRODUCTION

In September 1983, a technical team consisting of members from the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Geological Survey, North Dakota State Water Commission, South Dakota Department of Water and Natural Resources, and Garrison Conservancy District met to discuss issues related to the hydrology of the James River basin in North Dakota and South Dakota. The discussion focused on how to best analyze the changes in the hydrology of the James River in North Dakota and South Dakota that might result from operation of the Garrison Diversion Unit. Although earlier studies to analyze the effects of the Garrison Diversion Unit on the hydrology of the James River have been completed by the U.S. Bureau of

Reclamation, different results were obtained by using the Hydrologic River Operation Study System and the Return Flow Models (U.S. Department of the Interior, 1983, page III-20). Because of the limitations of existing streamflow models, the technical team concluded that a new model should be developed to analyze a wide range of streamflow conditions and the resulting hydrologic conditions that could be expected to occur in the James River basin.

The new model, Garrison Diversion Unit Monthly Operations Model, developed by the U.S. Bureau of Reclamation requires, as input data, the monthly unregulated streamflows at 13 gaging stations on the James River for 1953-82. Streamflow data of different record lengths are available at all of the 13 gaging stations along the James River in North Dakota and South Dakota.

Historic streamflow, as used in this report, refers to the measured streamflow and, if necessary, the synthesized streamflow for 1953-82. Any values of historic streamflow that are synthesized are based on the water-impounding structures now in place in the James River basin.

This report describes the results of a study to compile and analyze the monthly streamflow data needed as input to the Garrison Diversion Unit Monthly Operations Model developed by the U.S. Bureau of Reclamation. The specific objectives of this study were as follow:

(1) Compile and extend the streamflow record where necessary to develop monthly streamflow for 1953-82 at 13 gaging stations on the James River (pl. 1, in pocket)

Station number	Station name
06468170	James River near Grace City, N.Dak.;
06468500	James River near Pingree, N.Dak.;
06470000	James River at Jamestown, N.Dak.;
06470500	James River at LaMoure, N.Dak.;
06470878	James River at North Dakota-South Dakota State line;
06471000	James River at Columbia, S.Dak.;
06472000	James River near Stratford, S.Dak.;
06473000	James River at Ashton, S.Dak.;
06475000	James River near Redfield, S.Dak.;
06476000	James River at Huron, S.Dak.;
06477000	James River near Forestburg, S.Dak.;
06478000	James River near Mitchell, S.Dak.;
06478500	James River near Scotland, S.Dak.;

(2) estimate an unregulated streamflow for 1953-82 by using water-balance and statistical techniques for all gaging stations identified in item 1; and

(3) characterize the climate for 1953-82 on the basis of recorded climatologic record of about 90 years to determine if 1953-82 was similar to the climate that has occurred during the last 90 years.

In this study, an attempt was made to provide reasonable estimates of streamflow in terms of means and variances of the flow. However, the methods employed do not attempt to preserve the interstation correlation of streamflow values on the James River.

DESCRIPTION OF STUDY AREA

The James River, about 747 miles in total length, drains parts of east-central North Dakota and South Dakota (pl. 1). The James River basin encompasses about 22,000 square miles, of which 8,000 square miles is in North Dakota and 14,000 square miles is in South Dakota. The headwaters of the James River are located in Wells County, N.Dak. From these headwaters, the James River extends about 100 miles to Arrowwood National Wildlife Refuge. Streamflow is low or nonexistent much of the year in this reach of the river. Jamestown Reservoir, located immediately downstream of the refuge in a narrow valley, was created by the completion of the Jamestown Dam during 1953. Pipestem Creek, a major tributary to the James River, enters the James River 1 mile downstream of Jamestown Reservoir. Pipestem Creek has been regulated since the completion of the Pipestem Dam and Reservoir during 1974.

Downstream from Jamestown Dam, the James River meanders for about 135 miles within the confines of a broad valley to near the North Dakota-South Dakota State line. Near the State line, the James River enters the lakebed of glacial Lake Dakota and flows through Dakota Lake National Wildlife Refuge and Sand Lake National Wildlife Refuge. Both refuges were created by construction of low-head dams. The water-surface elevation in Dakota Lake is regulated by a low-head concrete dam control and the total storage capacity is about 3,200 acre-feet. The water-surface elevation in Sand Lake National Wildlife Refuge is regulated by two control structures, and the total storage capacity is about 27,200 acre-feet. After leaving Sand Lake National Wildlife Refuge, the river flows through the Lake Dakota plain for about 150 miles to Redfield, S.Dak. Within parts of the Lake Dakota plain, the slope of the river is less than 0.1 foot per mile and the channel capacity is as little as 200 cubic feet per second. Downstream from Redfield, S.Dak., the channel capacity and slope increase. The elevation of the river decreases about 130 feet in 474 river miles within South Dakota.

Several dams are located on the James River in South Dakota. Two dams near Huron, the James Diversion Dam (capacity 4,980 acre-feet) and the Third Street Dam (capacity 2,700 acre-feet), provide the city of Huron's major water supply. Most of the smaller dams were constructed privately and are used as river crossings or as diversion points for private irrigation. The Tacoma Park and Spink County Dams are used primarily for recreation.

METHODS OF STREAMFLOW RECORD EXTENSION

Record extension can be accomplished by several methods, including use of a drainage-area ratio, regional statistics, regression, and precipitation-runoff modeling. The drainage-area ratio method (Hirsch,

1979) is based on the assumption that the ratio of the flows at two gages is equal to the ratio of their drainage areas using the following equation:

$$\tilde{y}_i = (a_y/a_x)x_i, \tag{1}$$

where

$\tilde{y}_i$ = the estimated flow during month i at the site of interest, in cubic feet per second;

a_y = the drainage area at the site of interest, in square miles;

a_x = the drainage area at the base station, in square miles; and

x_i = the gaged flow during month i at the base station, in cubic feet per second.

If there are no records of streamflow at the site of interest or reliable regional flow statistics, the assumption that the flows are proportional to their drainage areas may be the best assumption to make.

The regional statistics method (Thomas and Benson, 1970) uses regional regression equations developed between streamflow and basin characteristics to estimate mean monthly flows. The equations have not been developed for North Dakota and South Dakota, and their development was not within the scope of this study. Therefore, this method was not used.

Regression techniques can be used to extend streamflow records in time. Regression methods are based on the assumption that streamflow records are available at the site of interest for a period of N_1 years, and records at the base station are available for the same N_1 years, plus an additional N_2 years.

Ordinary Least Squares (OLS) regression can be used to estimate streamflow at the site of interest using the following equation:

$$\tilde{y}_i = a+bx_i, \tag{2}$$

where

$\tilde{y}_i$ and x_i are defined as before.

The parameters a and b are those values that minimize the squared errors. The solution of equation 2 becomes

$$\tilde{y}_i = m(y_1)+r[s(y_1)/s(x_1)][x_i-m(x_1)], \tag{3}$$

where

$m(y_1)$ = the sample mean of N_1 years of gaged flow at the site of interest, in cubic feet per second;

r = the sample product-moment correlation coefficient between the N_1 concurrent measurements of x and y;

$s(y_1)$ = the sample standard deviation of N_1 years of streamflow at the site of interest, in cubic feet per second;

$s(x_1)$ = the sample standard deviation of N_1 years of streamflow at the base station, in cubic feet per second; and

$m(x_1)$ = the sample mean of N_1 years of streamflow at the base station, in cubic feet per second.

Matalas and Jacobs (1964) showed that the sample mean, $m(y_1)$, is an unbiased estimate of the population mean, μ_y, but the sample variance, $s^2(y_1)$, is a biased estimate of the population variance, σ^2_y.

Maintenance of Variance Extension Type 1 (MOVE.1) uses the same equation (equation 2) as OLS, but the parameters a and b are determined so that the mean and variance estimated using equation 2 over the period N would equal the sample mean and variance. The solution of equation 2 becomes

$$\tilde{y}_i = m(y_1)+[s(y_1)/s(x_1)][x_i-m(x_1)]. \tag{4}$$

Equations 3 and 4 differ simply by the r term included in equation 3. Monte Carlo and empirical experiments with actual streamflow records by Hirsch (1982) showed that, even for a relatively small sample size, the MOVE.1 equation tends to produce a less biased estimate of the variance of an extended streamflow record than does OLS regression. Hirsch (1982) and Alley and Burns (1983) present a complete development of the MOVE.1 and OLS equations.

The reason for record extension is to produce a time series that is relatively long and possesses the same statistical characteristics as those of the actual record. Hirsch (1982) demonstrated that the MOVE.1 equation procedure preserves the statistical characteristic of the actual record better than the OLS procedure.

Alley and Burns (1983) developed a means of selecting monthly extension equations either using flow values only from the same month, or developing the extension equation using all flow values. The selection involves a tradeoff between the ability to preserve monthly differences versus greater sample size. The MOVE.1 equation (Alley and Burns, 1983) has an option that allows for both cyclic and noncyclic extension equations to be considered for each individual prediction. If the cyclic option is selected, an extension equation is computed for that month using only streamflow values for the same month; if the noncyclic option is selected, an extension equation is computed using all concurrent streamflow values for the period of record.

For a particular month, the missing value for the dependent station is estimated using both the noncyclic (annual) equation and the cyclic equation (monthly), and a standard error of prediction is computed for both estimates. The equation that provides the smallest standard error of prediction is used to estimate the missing value.

The use of untransformed data or logarithms to extend records was studied by Hirsch (1979) and Stedinger (1980). The conclusion reached by both Hirsch and Stedinger was to work with logarithms.

A precipitation-runoff model is another viable method for developing a time series for flows at a site. The method requires development and calibration of a precipitation-runoff model that can simulate snowmelt and rainfall runoff. A calibrated model does not exist for the areas of interest, and the calibration of such a model was not within the scope of this study. In this study, a combination of regression techniques and drainage-area ratio were used to extend the streamflow records. In most cases, hydrologic judgment was used to select the best extension techniques.

HISTORIC STREAMFLOW RECORD EXTENSION

North Dakota Gaging Stations

James River near Grace City.--Streamflow records for the James River near Grace City (station number 1 on pl. 1 and table 1) begin in June 1968. Streamflow for January 1953 through June 1968 was computed using the MOVE.1 record extension technique. The predictor, or base station, used was the Sheyenne River at Cooperstown, which has a drainage area of about 2,670 square miles (of which about 1,400 square miles probably is noncontributing). Concurrent streamflow records for 14 years, 1969-82, or 168 months, for the James River near Grace City and the Sheyenne River at Cooperstown were available. The concurrent streamflow data were log transformed and then used to develop a MOVE.1 equation. The proximity of the Sheyenne River and the James River, plus similar basin characteristics in the two basins, indicated that the Sheyenne River would be a good predictor station. No other stations with concurrent record, similar basin characteristics, and proximity to the Grace City gage exist that could have been used as an alternative base station.

Cyclic (monthly) equations had the lowest correlation coefficients in the winter months December-March and in August and September (table 2). The noncyclic equation, developed using all concurrent monthly streamflows, had a correlation coefficient greater than or equal to the cyclic equation from June through September. When there was no flow on the Sheyenne River at Cooperstown, streamflow values for the site of interest were estimated by reviewing historic streamflows upstream and downstream of the site of interest. Measured and synthesized streamflows for the data-development period (1953-82) are listed in supplement 1.

James River near Pingree.--Streamflow records for the James River near Pingree (station 2 on pl. 1) are available for water years 1953-68. A MOVE.1 equation was used in an attempt to estimate the streamflow at the Pingree gage for October 1968 through December 1982. The Sheyenne River at Cooperstown was chosen as the predictor or independent station. Fifteen years of concurrent monthly streamflow data were used to develop the extension equation. The correlation coefficient for the noncyclic (annual) equation is 0.67; and the correlation coefficients for the cyclic (monthly) equation range from 0.28 to 0.77 (table 3). Moderate correlation coefficients probably are caused by the regulation and natural storage in Arrowwood National Wildlife Refuge located just upstream of the James River near Pingree gage. Therefore, it was concluded that MOVE.1 is unacceptable as a technique to estimate the monthly historic streamflow of the James River near Pingree.

Table 1.--Selected streamflow-gaging stations operated by the U.S. Geological Survey in the James River basin

	Station number	Station name	Drainage area (square miles) Total	Drainage area (square miles) Noncontributing	Period of record
1	06468170	James River near Grace City, N.Dak.	1,060	650	6/68 to present.
2	06468500	James River near Pingree, N.Dak.	1,670	988	10/52 through 9/68.
	06469400	Pipestem Creek near Pingree, N.Dak.	700	440	10/74 to present.
	06469500	Pipestem Creek near Buchanan, N.Dak.	758	460	3/50 through 9/74.
3	06470000	James River at Jamestown, N.Dak.	2,820	1,650	4/43 to present.
4	06470500	James River at LaMoure, N.Dak.	4,390	2,600	4/50 to present.
	06470800	Bear Creek near Oakes, N.Dak.	357	255	10/76 to present.
	06470875	James River at Ludden Dam, N.Dak.	5,480	3,300	10/81 to present.
5	06470878	James River at North Dakota-South Dakota State line	5,480	3,300	10/81 to present.
	06470980	James River near Hecla, S.Dak.	5,520	3,310	2/82 to present.
6	06471000	James River at Columbia, S.Dak.	5,860	3,380	10/45 to present.
	06471200	Maple River at the North Dakota-South Dakota State line	750	270	6/56 to present.
7	06472000	James River near Stratford, S.Dak.	8,860	4,010	3/50 through 9/72.
8	06473000	James River at Ashton, S.Dak.	9,740	4,070	10/45 to present.
9	06475000	James River near Redfield, S.Dak.	13,900	4,120	3/50 to present.
10	06476000	James River at Huron, S.Dak.	15,900	4,150	8/28 to 9/32, 8/43 to present.
11	06477000	James River near Forestburg, S.Dak.	17,600	4,150	3/50 to present.
12	06478000	James River near Mitchell, S.Dak.	19,100	4,150	7/53 through 9/58, 8/65 through 9/72.
13	06478500	James River near Scotland, S.Dak.	20,700	4,150	9/28 to present.

Table 2.--Monthly and annual correlation coefficients between the James River near Grace City, North Dakota, and the Sheyenne River at Cooperstown, North Dakota

Month											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.64	([1])	0.69	0.94	0.93	0.83	0.86	0.65	0.33	0.90	0.90	0.62

Annual (noncyclic) correlation coefficient = 0.86.

[1]Less than five nonzero concurrent monthly discharges.

Historic streamflow of the James River at the Pingree gage from October 1968 through December 1982 was computed as follows:

(1) Unregulated streamflow of Pipestem Creek at its junction with the James River was subtracted from the unregulated streamflow of the James River at Jamestown, and

(2) the result from (1) was multiplied by 0.90 to account for the intervening drainage area of the James River between Pingree and Jamestown.

Methods used to estimate the unregulated streamflow of the James River at Jamestown are discussed in the following section.

Synthesized unregulated streamflow for Pipestem Creek at its junction with the James River for 1953 through 1974 (necessary for completion of item number 1) was computed by using the following equation:

$$Q_{u\text{-}mouth} = (Q_{h\text{-}b})(1.39), \tag{5}$$

where

$Q_{u\text{-}mouth}$ = unregulated streamflow of Pipestem Creek at its junction with the James River, and

$Q_{h\text{-}b}$ = historic streamflow of Pipestem Creek near Buchanan, N.Dak.

The factor of 1.39 accounts for the intervening contributing drainage area between Pipestem Creek near Buchanan and Pipestem Creek at its junction with the James River. The Pipestem Creek near Buchanan gage was discontinued in 1974 and a new gage was established approximately 7 miles upstream (Pipestem Creek near Pingree). Synthesized unregulated streamflow of Pipestem Creek at its junction with the James River for 1975 through 1982 was computed by using equation 5, but the historic streamflow of Pipestem Creek near Pingree was adjusted for the 13-percent increase in intervening contributing drainage area between Pingree and Buchanan and used in place of the historic streamflow near Buchanan ($Q_{h\text{-}b}$).

Table 3.--Monthly and annual correlation coefficients between the James River near Pingree, North Dakota, and the Sheyenne River at Cooperstown, North Dakota

Month											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
([1])	([1])	0.64	0.65	0.77	0.45	0.28	0.73	0.62	0.70	0.48	0.69

Annual (noncyclic) correlation coefficient = 0.67.

[1]Less than five nonzero concurrent monthly discharges.

James River at Jamestown and at LaMoure.--Historic streamflows are available for the James River at Jamestown and at LaMoure gages for 1953 through 1982 (supplement 1). Thus, no synthesized streamflows were required for these locations.

James River at the North Dakota-South Dakota State line.--Only 2 years (1982-83) of streamflow data are available for the James River at the North Dakota-South Dakota State line. Thus, the relatively short period of concurrent streamflow record between the State line and LaMoure gages precluded the use of regression techniques (MOVE.1 or OLS) to extend the historic record. The drainage-area ratio method, as outlined by Hirsch (1979) and discussed in the Methods of Streamflow Record Extension section, was first considered as a method to compute the historic streamflow at the State line.

Based on the drainage-area ratio method, the annual streamflow at the State line should be 22 percent greater than the streamflow at LaMoure. However, annual streamflow of the James River at the State line in 1982 was 3.5 percent greater than the annual streamflow of the James River at LaMoure and in 1983 was 2.6 percent less than the streamflow of the James River at LaMoure (table 4). One possible explanation for this overestimate of streamflow using the drainage-area ratio method is that the flat slope prevents rapid drainage of water from the basin. From Jamestown to the northern half of LaMoure County, the gradient is 1.5 feet per mile; whereas downstream of LaMoure, the gradient is 0.5 foot per mile. Another possible explanation for this overestimate of streamflow is that the drainage network is not well defined downstream from LaMoure. The flat slope and the poorly defined drainage network tend to increase the amount of runoff entering depressional storage and allow a greater proportion of the runoff to evaporate and infiltrate.

Table 4.--Monthly streamflows for the James River at LaMoure, North Dakota, and at the State line for water years 1982 and 1983

Station name	Streamflow (acre-feet) Month												
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual
							1982						
LaMoure	1,480	1,440	1,010	691	601	5,230	41,470	19,950	14,180	13,350	8,840	3,530	111,800
State line	2,130	1,690	366	209	153	3,400	48,530	17,760	14,370	12,950	8,750	5,400	115,700
							1983						
LaMoure	5,790	4,020	1,330	761	772	32,620	32,030	21,420	20,670	23,900	13,270	9,090	165,700
State line	8,200	5,490	2,520	1,470	845	41,290	30,730	19,440	12,120	13,900	12,720	12,720	161,400

Two tributaries account for 65 percent of the increase in intervening drainage area between LaMoure and the State line. Cottonwood Creek accounts for 36 percent of the intervening contributing drainage area. A small reservoir is located on Cottonwood Creek (pl. 1), and it generally retains most of the runoff from the basin, except in the wetter years. Bear Creek accounts for 29 percent of the intervening contributing drainage area. Daily streamflow record has been collected on Bear Creek near Oakes, N.Dak., since 1976.

Because the drainage-area ratio technique overestimates the streamflow of the James River at the State line, streamflow at the State line was computed by using the gaged record at Bear Creek near Oakes and a linear function based on the streamflow at LaMoure to account for the remaining intervening contributing drainage area. Thus, historic monthly streamflow of the James River at the State line from October 1976 through 1982 was computed as follows:

$$
\begin{aligned}
Q_{h\text{-}stl} &= Q_{h\text{-}la}+Q_{h\text{-}br}, \text{ if } Q_{h\text{-}la} < 100 \text{ cubic feet per second;} \qquad (6)\\
&= Q_{h\text{-}la}+Q_{h\text{-}br}+Q_{h\text{-}la}(-0.057+(5.70)(10^{-4})(Q_{h\text{-}la})),\\
&\quad \text{if 100 cubic feet per second} \leq Q_{h\text{-}la} \leq 400 \text{ cubic feet per second; and}\\
&= Q_{h\text{-}la}(1.17)+Q_{h\text{-}br}, \text{ if } Q_{h\text{-}la} > 400 \text{ cubic feet per second;}
\end{aligned}
$$

where

$Q_{h\text{-}stl}$ = historic streamflow of the James River at the State line,

$Q_{h\text{-}la}$ = historic streamflow of the James River at LaMoure, and

$Q_{h\text{-}br}$ = historic streamflow of Bear Creek near Oakes.

This equation is based on two concepts. First, in the drier years, the streamflow of the James River at LaMoure plus the streamflow from Bear Creek near Oakes is a reasonable estimate of the flow at the State line because little flow is contributed by Cottonwood Creek. Second, in years of average to greater-than-average streamflow in the James River basin, the State line streamflow is reasonably estimated as the sum of the streamflows of the James River at LaMoure and Bear Creek plus some additional streamflow.

Although many methods could have been selected to estimate the streamflow from the intervening drainage area between LaMoure and the State line, a linear function of the streamflow at LaMoure was used. Analysis of streamflow records indicates that when the streamflow at LaMoure is less than 100 cubic feet per second, the contribution to the James River from tributaries such as Cottonwood Creek and Bear Creek is minimal. When the streamflow at LaMoure is 400 cubic feet per second or greater, the tributaries usually are contributing significant runoff to the James River. The contribution based on the linear function ranges from zero percent when the streamflow at LaMoure is less than 100 cubic feet per second to 17 percent when the streamflow at LaMoure is 400 cubic feet per second or greater. The 17-percent factor is based on the intervening contributing drainage area between LaMoure and the State line minus the contributing drainage area of Bear Creek.

For June 1956 through September 1976, a MOVE.1 equation was used to estimate the streamflow for Bear Creek. The Maple River at the State line was used as the predictor or independent station. The Maple River was chosen as the predictor station because of its similar basin characteristics and proximity to the Bear Creek drainage basin. The noncyclic equation (correlation coefficient = 0.82) was used to estimate the streamflow for all months except April. The cyclic (monthly) equation (correlation coefficient = 0.92) was used to estimate the April streamflows for Bear Creek near Oakes for 18 years, and the noncyclic equation was used for 1 year. Computed streamflow for Bear Creek near Oakes for 1956 through 1976 was used in equation 6 in place of the historic streamflow (Q_{h-br}) to develop the monthly streamflow of the James River at the State line.

Because no streamflow data are available for Bear Creek or the Maple River prior to June 1956, the historic record of the James River at the State line for January 1953 through May 1956 was extended using the following equation:

$$
\begin{aligned}
Q_{h-stl} &= Q_{h-la}(1.05), \text{ if } Q_{h-la} < 100 \text{ cubic feet per second;} \\
&= Q_{h-la}(1.05)+Q_{h-la}(-0.057+(5.70)(10^{-4})(Q_{h-la})), \\
&\quad \text{if } 100 \text{ cubic feet per second} \leq Q_{h-la} \leq 400 \text{ cubic} \\
&\quad \text{feet per second; and} \\
&= Q_{h-la}(1.22), \text{ if } Q_{h-la} > 400 \text{ cubic feet per second;}
\end{aligned}
\qquad (7)
$$

terms are defined in equation 6.

Thus, for June 1956 through December 1982, if the streamflow of the James River at LaMoure is less than 100 cubic feet per second, the streamflow of the James River at the State line is equal to the streamflow of the James River at LaMoure plus the streamflow of Bear Creek. When the streamflow at LaMoure is between 100 cubic feet per second and 400 cubic feet per second, the streamflow at the State line is equal to the streamflow at LaMoure, the streamflow of Bear Creek, and an additional amount that accounts for the intervening contributing drainage area between LaMoure and the State line. This additional contribution ranges from zero to 17 percent of the streamflow at LaMoure and is a linear function of the streamflow at LaMoure between 100 cubic feet per second and 400 cubic feet per second. For streamflows greater than 400 cubic feet per second, the additional contribution is 17 percent of streamflow of the James River at LaMoure. The 17-percent factor is based on the intervening contributing drainage area of the James River between LaMoure and the State line.

For 1953 through May 1956, the streamflow of the James River at LaMoure was multiplied by 1.05 to account for the contributing drainage area of Bear Creek (equation 7). The remaining 17 percent of the contributing drainage area to the James River between LaMoure and the State line was accounted for by using a linear relationship based on the streamflow at LaMoure.

South Dakota Gaging Stations

Relatively long-term streamflow records are available for eight James River main-stem gaging stations in South Dakota listed in table 1 and shown on plate 1. All stations except the James River near Stratford and the James River near Mitchell, S. Dak., were in operation throughout the data-development period (1953-82). Historic streamflow for the data-development period for the eight James River gaging stations in South Dakota is listed in supplement 1.

James River near Stratford.--The Stratford gage was discontinued in September 1972. Therefore, it was necessary to extend the Stratford streamflow record for October 1972 through December 1982. The degree of association between the monthly streamflow of the James River near Stratford and the James River at Ashton, S.Dak., was computed by determining the correlation of streamflow at the two gaging stations. Correlation of the untransformed monthly streamflows resulted in a correlation coefficient of 0.99. Because of the strong linear relation between the recorded streamflows at the two stations, the decision was made to use OLS to extend the streamflow of the James River near Stratford using the streamflow of the James River at Ashton as the independent variable. OLS was used to extend streamflow at all gaging stations in South Dakota.

The streamflow distribution for the James River near Stratford is skewed to the right, as indicated by the fact that the mean of the untransformed monthly values equals 113 cubic feet per second and the median of the untransformed values equals 16 cubic feet per second. The correlation coefficients and regression equations used to extend the monthly streamflow for the James River near Stratford (Q_s) using the monthly streamflow for the James River at Ashton (Q_a) are listed in table 5.

James River near Mitchell.--The James River near Mitchell gage was operated from July 1953 through September 1958 and from August 1965 through September 1972. Thus, it was necessary to extend the streamflow record at Mitchell for January through June 1953, for October 1958 through July 1965, and for October 1972 through December 1982.

Benson (1983) indicated that the traveltime between the James River near Forestburg and Mitchell, S.Dak., gages is about 3 days for a streamflow of approximately 900 cubic feet per second. Because there is a relatively short traveltime and no major tributary inflow between these stations, there is a good correlation coefficient of 0.995 for the untransformed concurrent streamflow values between the Forestburg and Mitchell gages. Based on the correlation of monthly streamflow at the two stations, the James River near Mitchell streamflow was extended using the streamflow of the James River near Forestburg as the independent variable in an OLS regression equation. Although no zero monthly streamflows were recorded at the Mitchell gage during the period of record, skewed flow characteristics do exist (the average streamflow for the period of record is 313 cubic feet per second, and the median streamflow is 71 cubic feet per second). Therefore, the monthly streamflow data were log transformed and then separate OLS regression equations were computed for each month. Correlation coefficients

Table 5.--Monthly regression equations used to compute the synthesized historic streamflow of the James River near Stratford, South Dakota

[Q_s, streamflow of the James River near Stratford, in acre-feet; Q_a, streamflow of the James River at Ashton, in acre-feet]

Month	Correlation coefficient	Regression equation
January	0.986	$\ln Q_s$ = -0.500385+0.941216($\ln Q_a$)
February	.958	$\ln Q_s$ = -0.716670+0.911617($\ln Q_a$)
March	.968	$\ln Q_s$ = -0.641005+0.997692($\ln Q_a$)
April	.990	$\ln Q_s$ = 0.187038+0.975717($\ln Q_a$)
May	.993	$\ln Q_s$ = -0.219997+1.007802($\ln Q_a$)
June	.989	$\ln Q_s$ = -1.098180+1.083781($\ln Q_a$)
July	.982	$\ln Q_s$ = -0.607611+1.052843($\ln Q_a$)
August	.966	$\ln Q_s$ = -0.552746+1.017272($\ln Q_a$)
September	.998	$\ln Q_s$ = -0.184376+0.985384($\ln Q_a$)
October	.988	$\ln Q_s$ = -0.284239+0.984672($\ln Q_a$)
November	.972	$\ln Q_s$ = -0.690318+1.021742($\ln Q_a$)
December	.987	$\ln Q_s$ = -0.679947+1.031471($\ln Q_a$)

and the regression equations for each month are listed in table 6. Synthesized historic streamflow at the Mitchell gage (Q_m) was computed using the streamflow near Forestburg (Q_f) as the independent variable and the respective equation for a particular month.

For record extension at the Stratford and Mitchell gages, the MOVE.1 technique could have been used instead of OLS. In the MOVE.1 equation, the values of the coefficients in the linear regression equation are computed to maintain the sample mean and variance rather than minimize the squared errors as is done using OLS. When the correlation coefficient equals 1, the MOVE.1 and OLS procedures produce identical equations. Because the correlation coefficients nearly equaled 1 for the equations developed to compute the streamflow of the James River near Stratford and near Mitchell, the MOVE.1 equation and regression equation would provide about the same streamflow record.

Table 6.--Monthly regression equations used to compute the synthesized historic streamflow of the James River near Mitchell, South Dakota

[Q_m, streamflow of the James River near Mitchell, in acre-feet; Q_f, streamflow of the James River near Forestburg, in acre-feet]

Month	Correlation coefficient	Regression equation
January	0.995	$\ln Q_m = 0.876942+0.907562(\ln Q_f)$
February	.992	$\ln Q_m = 1.690584+0.806011(\ln Q_f)$
March	.947	$\ln Q_m = 0.533436+0.965964(\ln Q_f)$
April	.999	$\ln Q_m = 0.285914+0.987790(\ln Q_f)$
May	.998	$\ln Q_m = 0.556699+0.954971(\ln Q_f)$
June	.967	$\ln Q_m = 0.228300+0.989671(\ln Q_f)$
July	.979	$\ln Q_m = -0.214500+1.034694(\ln Q_f)$
August	.997	$\ln Q_m = 1.991845+0.793372(\ln Q_f)$
September	.996	$\ln Q_m = 1.702997+0.796279(\ln Q_f)$
October	.991	$\ln Q_m = -0.193822+1.037731(\ln Q_f)$
November	.991	$\ln Q_m = 2.264337+0.712094(\ln Q_f)$
December	.987	$\ln Q_m = 1.938280+0.764022(\ln Q_f)$

COMPUTATION OF SYNTHESIZED UNREGULATED STREAMFLOW

Synthesized unregulated streamflow (supplement 2), as used in this report, is defined as the streamflow that would occur in the absence of the hydrologic effects caused by Jamestown Reservoir, Pipestem Reservoir, Sand Lake National Wildlife Refuge, and the consumptive surface-water withdrawals such as irrigation, municipal use, and industrial use. The estimates of unregulated streamflow do not account for numerous small, low-head dams that have been built on the main stem and tributaries of the James River for water supply, fish and wildlife, and recreational purposes. These low-head dams are expected to have minimal effects on the monthly streamflow values.

Surface-water withdrawal data (supplement 3) were obtained from the North Dakota State Water Commission and the South Dakota Department of Water and Natural Resources. Synthesized unregulated streamflow was computed for the same 13 locations on the James River for which the historic data were developed.

North Dakota Gaging Stations

James River near Grace City.--Synthesized unregulated streamflow of the James River near Grace City is about the same as the historic streamflow. Mean monthly surface-water withdrawals between the headwaters of the James River and the Grace City gage were less than 0.30 cubic foot per second during 1953-82. Unregulated streamflow at the Grace City gage was computed by adding the estimated surface-water withdrawals upstream from the gage to the historic streamflow at the gage. The assumption was made that no part of the surface-water withdrawals returned to the James River.

James River near Pingree.--Synthesized unregulated streamflow of the James River near Pingree was computed in the same manner as the unregulated streamflow of the James River near Grace City. There are no surface-water withdrawals between the Grace City and Pingree gages. Therefore, the unregulated streamflow of the James River near Pingree is set equal to the historic streamflow at Pingree plus the estimated surface-water withdrawals from the Grace City gage to the headwaters.

James River at Jamestown.--Synthesized unregulated streamflow of the James River at Jamestown was computed by removing the effect of Jamestown Reservoir and Pipestem Reservoir. For January 1953 through September 1968, the following equation was used:

$$Q_{u-j} = Q_{u-pi}(1.11)+Q_{u-psm}, \tag{8}$$

where

Q_{u-j} = unregulated streamflow of the James River at Jamestown,

Q_{u-pi} = unregulated streamflow of the James River near Pingree,

Q_{u-psm} = unregulated streamflow of Pipestem Creek at its junction with the James River.

Synthesized unregulated streamflow of the James River near Pingree was multiplied by 1.11 to account for an 11-percent increase in contributing drainage area between the James River near Pingree gage and the James River at Jamestown gage.

Synthesized unregulated streamflow for Pipestem Creek at its junction with the James River for 1953 through 1982 was computed as follows:

$$Q_{u-psm} = Q_{u-psb}(1.39)+Q_w, \tag{9}$$

where

Q_{u-psm} = unregulated streamflow of Pipestem Creek at its junction with the James River,

Q_{u-psb} = unregulated streamflow of Pipestem Creek near Buchanan, and

Q_w = surface-water withdrawals from Pipestem Creek.

Synthesized unregulated streamflow of Pipestem Creek at its confluence with the James River for October 1974 through December 1982 was computed using equation 9, but the streamflow of Pipestem Creek near Pingree was adjusted for a 13-percent increase in intervening drainage area between the Pingree gage and the Buchanan gage before using equation 9.

A MOVE.1 equation was used to compute synthesized unregulated streamflow for the James River at Jamestown for October 1968 through December 1982 (subsequent to when the James River near Pingree gage was discontinued). The Sheyenne River at Cooperstown was used as the predictor station. Concurrent unregulated streamflow record is available from October 1944 until the construction of the Jamestown Dam in 1953. This relatively short concurrent streamflow record was first extended using the drainage-area ratio method (equation 8) to compute the unregulated streamflow of the James River at Jamestown for January 1953 through September 1968. These streamflows were combined with the historic streamflow prior to reservoir construction (1944 through 1952) to provide an unregulated streamflow of the James River at Jamestown for October 1944 through September 1968. This unregulated streamflow was used to develop a MOVE.1 equation with the Sheyenne River at Cooperstown. The noncyclic (annual) regression equation (r = 0.84) was used to compute the unregulated streamflow of the James River at Jamestown for October 1968 through December 1982.

Water-balance procedures were used as an alternative method to compute the synthesized unregulated streamflow of the James River at Jamestown for October 1968 through December 1982. The following equation was used to compute the unregulated streamflow at Jamestown:

$$Q_{u-j} = Q_{h-j}+S+EA-PA, \tag{10}$$

where

Q_{u-j} = synthesized unregulated streamflow of the James River at Jamestown,
Q_{h-j} = historic streamflow of the James River at Jamestown,
S = change in reservoir storage,
E = reservoir evaporation,
A = reservoir surface area, and
P = precipitation falling on the reservoir.

All terms (that is, Q_{u-j}, Q_{h-j}, S, EA, and PA) are in acre-feet and are based on monthly values. The change in reservoir storage was obtained from the U.S. Geological Survey annual data reports (U.S. Geological Survey, 1959-82).

The National Oceanic and Atmospheric Administration (NOAA) has maintained a pan-evaporation station at Edgeley, N.Dak., from 1950 through 1969 and at Carrington, N.Dak., from 1967 through 1982 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1951-83). Monthly pan-evaporation data were multiplied by 0.74 to obtain the equivalent lake evaporation. The coefficient of 0.74 (U.S. Department of Agriculture, no date) was intended for use in converting annual values of pan evaporation to gross reservoir evaporation and should be used with caution when converting monthly values (Winter, 1981). However, due to a lack of better data, this value was used. When pan-evaporation data were unavailable (usually November through March), the average annual evaporation from shallow lakes and reservoirs was multiplied by the percentage of the mean annual evaporation that normally occurs in a given month (U.S. Department of Agriculture, no date). Monthly lake-evaporation estimates were multiplied by the month-end reservoir surface area to obtain the monthly evaporation from the surface of Jamestown Reservoir.

Monthly precipitation data at Jamestown (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1953-83) were multiplied by reservoir surface area (U.S. Geological Survey, 1964, 1969, 1971-83, and 1973) to obtain the volume of precipitation falling on the reservoir surface.

Unregulated streamflow computed using water-balance procedures was compared to the unregulated streamflow computed using the MOVE.1 equation (table 7). Considerable differences in the estimates of streamflow were found between the two methods. An extreme example occurred in 1974 when the annual streamflow computed using the MOVE.1 equation (164,200 acre-feet) was about 2.5 times greater than the annual streamflow computed using the water-balance procedures (60,300 acre-feet). Analysis of the streamflow record indicated there was relatively large runoff from the headwaters of the Sheyenne River upstream of Cooperstown, N.Dak., from March through June. The relatively large runoff was caused by snowmelt in March and April and greater-than-normal rainfall in May. The large streamflows (May-June) of the Sheyenne River at Cooperstown were used as the independent variable in the MOVE.1 equation to predict the unregulated streamflow of the James River at Jamestown. Although a snowmelt-runoff peak on the James River occurred, there was no secondary peak caused by rainfall in May or June. Thus, the MOVE.1 equation provides a much greater streamflow than is expected for this period.

As a result, unregulated streamflow of the James River at Jamestown for October 1968 through December 1982 was computed using a MOVE.1 equation, but adjustments were made to monthly streamflows in years when there was a large difference between the streamflow computed using the MOVE.1 equation and the streamflow computed using water-balance procedures. The adjustments were made by comparing the monthly streamflow computed using the MOVE.1 equation, water-balance procedures, and measured discharges upstream and downstream from the James River at Jamestown. Unregulated streamflows of the James River are listed in supplement 2.

James River at LaMoure.--Synthesized unregulated streamflow of the James River at LaMoure was computed using the following equation:

$$Q_{u-la} = Q_{u-j}+(Q_{h-la}-Q_{h-j})+Q_w, \tag{11}$$

where

Q_{u-la} = unregulated streamflow of the James River at LaMoure,

Q_{u-j} = unregulated streamflow of the James River at Jamestown,

Q_{h-la} = historic streamflow of the James River at LaMoure,

Q_{h-j} = historic streamflow of the James River at Jamestown, and

Q_w = surface-water withdrawals between Jamestown and LaMoure.

The term $(Q_{h-la}-Q_{h-j})$ represents the historic increase or decrease in streamflow between the Jamestown and LaMoure gages.

Table 7.--Synthesized unregulated streamflow of the James River near Jamestown, North Dakota, 1969-82

Calendar year	Discharge (acre-feet per year) Water balance	MOVE.1 equation
1969	181,100	113,600
1970	14,900	28,400
1971	46,000	59,100
1972	46,100	40,900
1973	2,060	5,970
1974	60,300	164,200
1975	141,200	52,900
1976	33,000	8,740
1977	319	1,330
1978	58,400	8,390
1979	136,700	174,000
1980	19,900	1,550
1981	26,800	18,900
1982	114,900	22,700

James River at the North Dakota-South Dakota State line.--Synthesized unregulated streamflow of the James River at the State line for June 1956 through December 1982 was computed using the following equation:

$$Q_{u\text{-}stl} = Q_{u\text{-}la}+Q_{u\text{-}br}+Q_w, \text{ if } Q_{u\text{-}la} < 100 \text{ cubic feet per second;} \qquad (12)$$

$$= Q_{u\text{-}la}+Q_{u\text{-}br}+Q_w+Q_{u\text{-}la}(-0.057+(5.70)(10^{-4})(Q_{u\text{-}la})), \text{ if } 100 \text{ cubic feet per second} \leq Q_{u\text{-}la} \leq 400 \text{ cubic feet per second; and}$$

$$= (Q_{u\text{-}la})(1.17)+Q_{u\text{-}br}+Q_w, \text{ if } Q_{u\text{-}la} > 400 \text{ cubic feet per second;}$$

where

$Q_{u\text{-}stl}$ = unregulated streamflow of the James River at the State line,

$Q_{u\text{-}la}$ = unregulated streamflow of the James River at LaMoure,

$Q_{u\text{-}br}$ = unregulated streamflow of Bear Creek near Oakes, and

Q_w = surface-water withdrawals between LaMoure and the State line.

Synthesized unregulated streamflow of Bear Creek for October 1976 through December 1982 is equal to the historic streamflow from Bear Creek plus the surface-water withdrawals, which were less than 1 cubic foot per second from January 1953 through December 1982. Unregulated streamflow of Bear Creek for June 1956 through September 1976 was computed using a MOVE.1 regression equation, which was discussed previously.

Synthesized unregulated streamflow of the James River at the State line for January 1953 through May 1956 was computed using the following equation:

$$
\begin{aligned}
Q_{u-stl} &= Q_{u-la}(1.05)+Q_w, \text{ if } Q_{u-la} < 100 \text{ cubic feet per second;} \qquad (13)\\
&= Q_{u-la}(1.05)+Q_{u-la}(-0.057+(5.70)(10^{-4})(Q_{u-la}))+Q_w, \text{ if}\\
&\quad 100 \text{ cubic feet per second} \leq Q_{u-la} \leq 400 \text{ cubic feet}\\
&\quad \text{per second; and}\\
&= Q_{u-la}(1.22)+Q_w, \text{ if } Q_{u-la} > 400 \text{ cubic feet per second;}
\end{aligned}
$$

where

Q_{u-la} = unregulated streamflow of the James River at LaMoure.

Equation 13, used to compute the unregulated streamflow of the James River at the State line, was based on the same hydrologic assumptions used to develop the historic streamflow at the State line (equation 7).

South Dakota Gaging Stations

James River at Columbia.--In theory, the synthesized unregulated streamflow of the James River at Columbia, S.Dak., can be computed by eliminating the regulation effects of Sand Lake National Wildlife Refuge (pl. 1). The unregulated streamflow was computed using the following water-balance equation:

$$Q_{u-c} = Q_{u-stl}+(Q_{h-c}-Q_{h-stl})+S-PA+EA+U+Q_w, \qquad (14)$$

where

Q_{u-c} = unregulated streamflow at the Columbia gage,

Q_{u-stl} = unregulated streamflow at the State line gage,

Q_{h-c} = historic streamflow at the Columbia gage,

Q_{h-stl} = historic streamflow at the State line gage,

S = the net change in storage in Sand Lake and Mud Lake (+ = gain and - = loss),

P = precipitation gain to Sand Lake and Mud Lake,

A = reservoir-surface area,

E = evaporation loss from Sand Lake and Mud Lake,

U = unaccounted-for gain or loss in Sand Lake and Mud Lake (+ = gain and - = loss), and

Q_w = surface-water withdrawals between the State line and the Columbia gage.

A discussion of the sources of precipitation and evaporation data and how the change in storage was computed is included in supplement 4. The unaccounted-for gains or losses were generated in a mass-balance computation, which also is discussed in supplement 4.

Computation of synthesized unregulated streamflow of the James River at the Columbia gage using equation 14 resulted in several occurrences of negative streamflows. Negative streamflows were not surprising considering the unaccounted-for gains and losses that were computed. Although the total mass balance was 13,600 acre-feet for the 30-year period 1953-82, errors ranged from an unaccounted gain of 48,747 acre-feet in 1962 to an unaccounted loss of 59,854 acre-feet in 1966. Numerous sources of error could contribute to the large unaccounted-for gains or losses. Sources of error include, but are not limited to: (1) The use of synthetic streamflow data at the State line due to the absence of historic (regulated) streamflow data; (2) errors associated with the area-capacity curves for Sand Lake and Mud Lake; (3) errors associated with historic lake-level data that would affect all estimates that are a function of lake-surface area; and (4) errors associated with historic streamflow of the James River at Columbia, especially when the river was in a reverse flow condition and when the river was at high stages.

Due to the problems associated with computing the unregulated streamflow of the James River at Columbia using equation 14, an alternate approach was selected. Synthesized unregulated streamflow of the James River at Columbia was computed by applying the drainage-area ratio method to the unregulated streamflow of the James River at the State line. The drainage-area ratio between the State line and Columbia is 1.15. However, this ratio probably does not apply for the entire range of flows that occur on the James River. Assuming the basin characteristics between the State line and Columbia prior to development of Sand Lake National Wildlife Refuge were similar to basin characteristics of the James River downstream of Columbia, the river probably gains little water and the river may even lose water during low-flow conditions (Benson, 1983). Contributing drainage area of the James River between the State line and Columbia probably increases at the time of large runoff because depressional storage has been filled as a result of excess runoff. Because of the hydrologic characteristics, a variable drainage-area ratio was developed to compute synthesized unregulated streamflow of the James River at Columbia.

The 25-percent quartile (8.5 cubic feet per second) and the 75-percent quartile (67.7 cubic feet per second) statistics were computed for the unregulated streamflow of the James River at the State line. Analysis of streamflow records indicates that when streamflow at Columbia is less than 8.5 cubic feet per second the contribution from the intervening drainage area between the State line and Columbia is minimal. When the streamflow is greater than 67.7 cubic feet per second, the intervening drainage area is contributing runoff to the James River. Synthesized unregulated streamflows of the James River at Columbia were computed by using the following equation:

$$
\begin{aligned}
Q_{u\text{-}c} &= Q_{u\text{-}stl}, \text{ if } Q_{u\text{-}stl} < 8.5 \text{ cubic feet per second;} \\
&= Q_{u\text{-}stl} + Q_{u\text{-}stl}(-0.0215+(2.53)(10^{-3})(Q_{u\text{-}stl})), \text{ if} \\
&\quad 8.5 \text{ cubic feet per second} \leq Q_{u\text{-}stl} \leq 67.7 \text{ cubic feet per second; and} \\
&= Q_{u\text{-}stl}(1.15), \text{ if } Q_{u\text{-}stl} > 67.7 \text{ cubic feet per second.}
\end{aligned}
\tag{15}
$$

In March 1960, June 1964, and March 1978 the streamflow of the James River at Columbia was negative (reverse flow; supplement 1). Unregulated streamflow was set at zero in these months.

James River near Stratford.--Synthesized unregulated streamflow for the James River near Stratford was computed by using the following equation:

$$Q_{u-str} = Q_{u-c}+(Q_{h-str}-Q_{h-c})+M_a+Q_w, \tag{16}$$

where

Q_{u-str} = unregulated streamflow near Stratford,

Q_{u-c} = unregulated streamflow at Columbia,

Q_{h-str} = historic streamflow near Stratford,

Q_{h-c} = historic streamflow at Columbia,

M_a = municipal withdrawals by the city of Aberdeen, and

Q_w = surface-water withdrawals between Columbia and Stratford.

Use of equation 16 resulted in negative unregulated streamflows for 21 months of the 30-year study. However, inspection of the streamflow data revealed that, in all instances, the historic stream loss in the reach (Columbia to Stratford) exceeded the unregulated streamflow at Columbia. Reach losses ($Q_{h-st}-Q_{h-c}$) occur primarily in the spring when the main channel does not have the capacity to convey the snowmelt runoff. At this time, flow overtops the natural levee ridge and enters the overbanks. Much of the flow becomes trapped on the overbanks and is lost to evapotranspiration. Unregulated flow was set at zero for the 21 months that had a negative unregulated streamflow.

James River at Ashton.--Synthesized unregulated streamflow of the James River at Ashton was computed by using the following equation:

$$Q_{u-a} = Q_{u-str}+(Q_{h-a}-Q_{h-str})+Q_w, \tag{17}$$

where

Q_{u-a} = unregulated streamflow at Ashton,

Q_{u-str} = unregulated streamflow near Stratford,

Q_{h-a} = historic streamflow at Ashton,

Q_{h-str} = historic streamflow near Stratford, and

Q_w = surface-water withdrawals between Stratford and Ashton.

There were 4 months when the unregulated streamflow at Ashton was negative. Streamflow during these 4 months was set at zero.

James River near Redfield.--Synthesized unregulated streamflow of the James River near Redfield was computed by using the following equation:

$$Q_{u-r} = Q_{u-a}+(Q_{h-r}-Q_{h-a})+Q_w, \tag{18}$$

where

Q_{u-r} = unregulated streamflow near Redfield,

Q_{u-a} = unregulated streamflow at Ashton,

Q_{h-r} = historic streamflow near Redfield,

Q_{h-a} = historic streamflow at Ashton, and

Q_w = irrigation withdrawals between Redfield and Ashton.

There were 4 months when the unregulated streamflow near Redfield was negative. Streamflow during these 4 months was set at zero.

James River at Huron.--Synthesized unregulated monthly streamflow of the James River at Huron was computed by using the following equation:

$$Q_{u-h} = Q_{u-r}+(Q_{h-h}-Q_{h-r})+M+Q_w, \tag{19}$$

where

Q_{u-h} = unregulated streamflow at Huron,

Q_{u-r} = unregulated streamflow near Redfield,

Q_{h-h} = historic streamflow at Huron,

Q_{h-r} = historic streamflow near Redfield,

M = municipal withdrawals by the city of Huron, and

Q_w = irrigation withdrawals.

A negative unregulated streamflow at Huron occurred during 3 months. Streamflow during these 3 months was set at zero.

James River near Forestburg.--Synthesized unregulated monthly streamflow of the James River near Forestburg was computed by using the following equation:

$$Q_{u-f} = Q_{u-h}+(Q_{h-f}-Q_{h-h})+Q_w, \tag{20}$$

where

Q_{u-f} = unregulated streamflow near Forestburg,

Q_{u-h} = unregulated streamflow at Huron,

Q_{h-f} = historic streamflow near Forestburg,

Q_{h-h} = historic streamflow at Huron, and

Q_w = surface-water withdrawals between Huron and Forestburg.

A negative unregulated streamflow occurred during 5 months. Streamflow during these 5 months was set at zero.

James River near Mitchell.--Synthesized unregulated streamflow of the James River near Mitchell was computed by using the following equation:

$$Q_{u-m} = Q_{u-f}+(Q_{h-m}-Q_{h-f})+M+Q_w-W, \tag{21}$$

where

Q_{u-m} = unregulated monthly streamflow near Mitchell,

Q_{u-f} = unregulated monthly streamflow near Forestburg,

Q_{h-m} = historic monthly streamflow near Mitchell,

Q_{h-f} = historic monthly streamflow near Forestburg,

M = municipal withdrawals from the James River via Lake Mitchell,

Q_w = irrigation withdrawals between Forestburg and Mitchell, and

W = wastewater returns from city of Mitchell.

A negative unregulated streamflow at Mitchell occurred during 4 months. Streamflow was set at zero during these 4 months.

James River near Scotland.--Synthesized unregulated monthly streamflow of the James River near Scotland was computed by using the following equation:

$$Q_{u-sc} = Q_{u-m}+(Q_{h-sc}-Q_{h-m})+Q_w, \tag{22}$$

where

Q_{u-sc} = unregulated streamflow near Scotland,

Q_{u-m} = unregulated streamflow near Mitchell,

Q_{h-sc} = historic streamflow near Scotland,

Q_{h-m} = historic streamflow near Mitchell,

Q_w = irrigation withdrawals between Mitchell and Scotland.

A negative unregulated streamflow occurred during 1 month, and this value was set at zero.

COMPARISON OF HISTORIC AND SYNTHESIZED UNREGULATED STREAMFLOWS

Mean annual historic (regulated) streamflow of the James River at Jamestown is about 7,000 acre-feet less than the synthesized mean annual unregulated streamflow. Year-to-year variability of the annual historic streamflow and the annual unregulated streamflow is shown in figure 1. Annual unregulated streamflow ranged from 35,900 acre-feet greater than the annual historic streamflow to 9,700 acre-feet less than the annual historic streamflow. The difference between the annual historic streamflow and the annual unregulated streamflow can be attributed to four factors: (1) Actual difference between the historic and unregulated streamflow, (2) random variability associated with the MOVE.1 equation used to compute the synthesized unregulated streamflow, (3) errors associated with the input data used in the water-balance model, and (4) errors in computation of the historic streamflow of the James River.

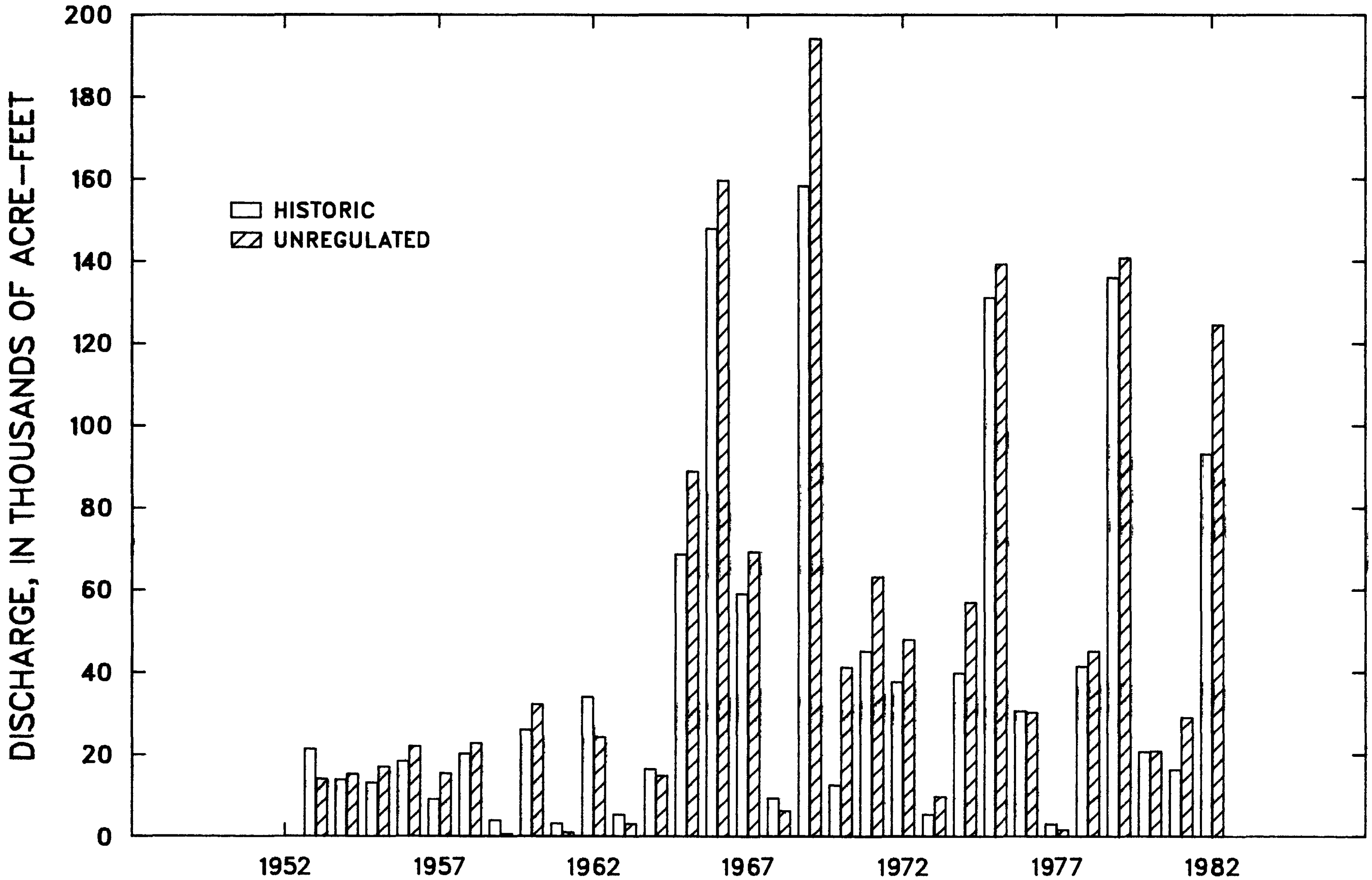

Figure 1.—Annual historic and synthesized unregulated streamflow of the James River at Jamestown, North Dakota, 1953-82.

Monthly variability of streamflow on the James River at Jamestown is shown in figure 2. Historic streamflow is less than unregulated streamflow in March, April, and May, when water from spring runoff typically is being stored in Jamestown Reservoir. Historic streamflow is greater than unregulated streamflow from June through February, when water stored during spring runoff is released gradually throughout the summer, fall, and winter. Comparison of unregulated and historic streamflow at gaging stations downstream of the James River at Jamestown would exhibit the same hydrologic regimen. As previously mentioned, no traveltime was used in the development of unregulated streamflows; thus, the difference between the historic and unregulated streamflows would be almost identical to the difference at the James River at Jamestown gage.

CLIMATOLOGY OF THE JAMES RIVER BASIN

Annual Statistics

The Garrison Diversion Unit Monthly Operations Model was used to simulate a range of hydrologic conditions expected to occur during the operation of the Garrison Diversion Unit. In order to ensure that simulations represent a range of hydrologic conditions that might occur, the streamflow selected for input to the model must be selected for a period that represents a wide range of climatic conditions. Thus, the climate of the 30-year data-development period was compared to the period of record, which ranges from 53 to 102 years, at six meteorologic stations in the James River basin.

The climate of the James River basin can be defined by mean values of meteorologic variables, but the means are only one indicator of climate as a dynamic entity. Longley (1972) defined climate as "***the long-term manifestation of weather in all forms." Stockton and Boggess (1979) defined climate state as "***the average of a complete set of atmospheric, hydrospheric, and cryospheric variables over a specified period of time--of considerable longer life span than individual synoptic weather systems--in a specified domain of the earth-atmosphere system." Stockton and Boggess (1979) defined climatic variation as "***the difference between climatic states of the same kind, for example, between two winters or two decades."

On the basis of these climate definitions, data collected at six meteorologic stations were used to describe the climate and climate variability in the James River basin. The period of record for each meteorologic station is listed in table 8. The yearly ranges in temperature and precipitation depict the truly continental climate of the James River basin. The difference between the maximum and minimum annual mean temperatures for the period of record at each station ranges from 8.0 °F at Menno to 11.4 °F at Aberdeen. Also, there is about a 9 °F difference in the normal annual temperature between Carrington, in the northern part of the basin, and Menno, in the southern part of the basin (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1982).

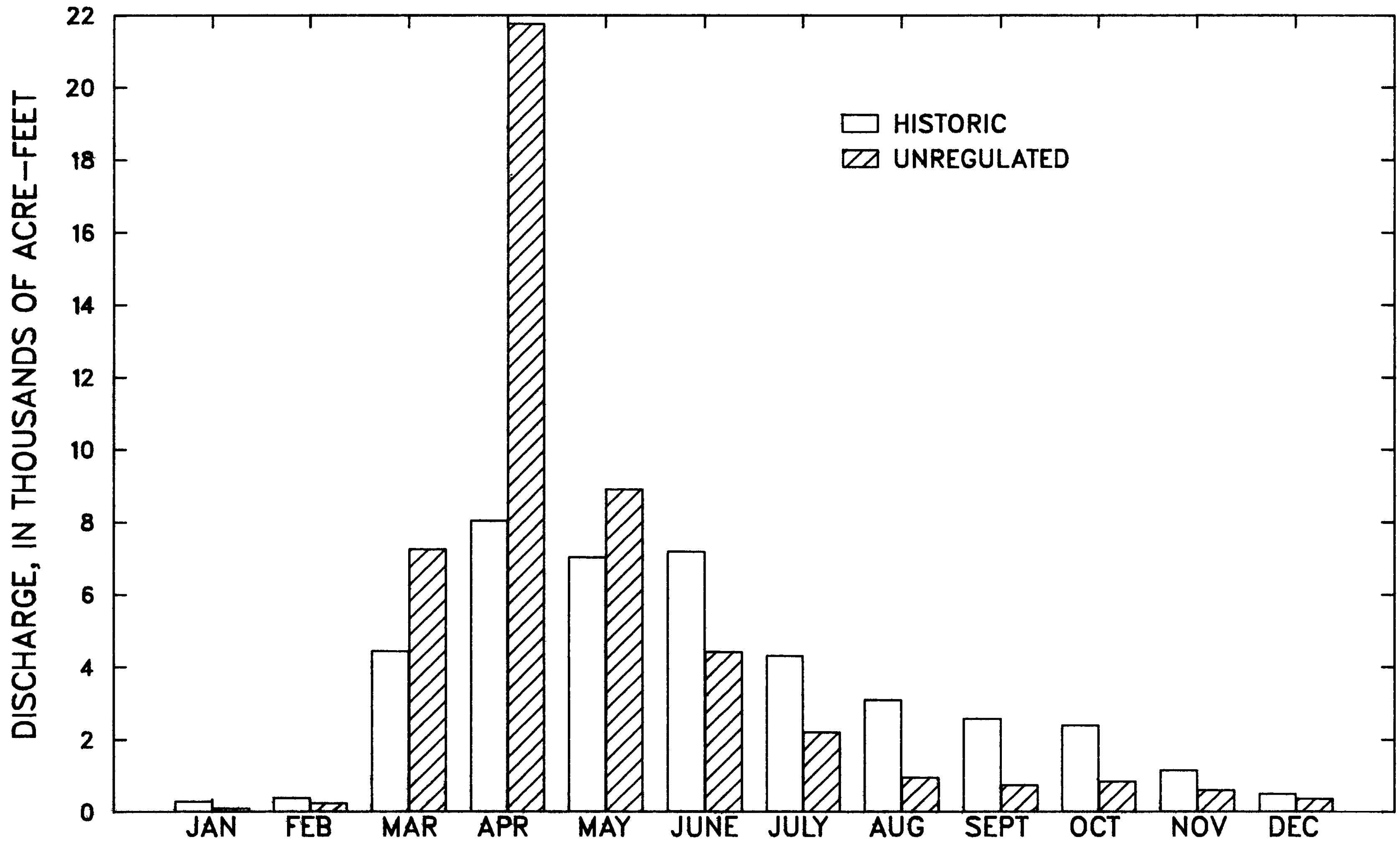

Figure 2.—Average monthly historic and synthesized unregulated streamflow of the James River at Jamestown, North Dakota, 1953-82.

Table 8.--Climatologic data for six meteorologic stations in the James River basin

Station name	Period of record	Year	Maximum	Year	Minimum	Normal[1]
		Annual mean temperature, in degrees Fahrenheit				
Carrington, N.Dak.	1930-82	1931	43.1	1950	34.4	38.7
Jamestown, N.Dak.	1893-1982	1981	44.9	1916	36.0	40.4
Oakes, N.Dak.	1930-82	1931	46.3	1950	37.1	40.9
Aberdeen, S.Dak.	1896-1982	1931	49.7	1916	38.3	43.0
Huron, S.Dak.	1881-1982	1931	50.0	1916	41.2	44.7
Menno, S.Dak.	1896-1982	1931	51.8	1961	43.8	47.6
		Annual precipitation, in inches				
Carrington, N.Dak.	1930-82	1964	26.3	1936	6.52	18.18
Jamestown, N.Dak.	1892-1982	1962	29.8	1936	6.91	18.12
Oakes, N.Dak.	1930-82	1960	29.6	1971	7.73	19.74
Aberdeen, S.Dak.	1890-1982	1896	38.4	1976	7.88	17.79
Huron, S.Dak.	1881-1982	1962	31.7	1952	9.72	18.66
Menno, S.Dak.	1896-1982	1944	38.9	1980	11.40	23.40

[1]U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1982.

Annual precipitation in the James River basin varies greatly from year to year. The difference between maximum annual precipitation and minimum annual precipitation for the period of record ranges from 19.8 inches at Carrington to 30.5 inches at Aberdeen (table 8). Minimum annual precipitation for the period of record ranges from 36 percent of the normal at Carrington to 52 percent at Huron. Maximum annual precipitation for the period of record ranges from 145 percent of the normal at Carrington to 216 percent at Aberdeen. The large difference between maximum and minimum annual precipitation is characteristic of a dry continental climate.

Mean annual runoff of the James River at Jamestown is equal to a depth of only 0.72 inch for the entire 1,170-square-mile contributing drainage area upstream of Jamestown. Mean annual runoff is equal to about 4 percent of the mean annual precipitation; therefore, relatively small variations in the timing and quantity of precipitation throughout the year can result in relatively large changes in annual runoff.

Monthly Climate Statistics

A 58 °F to 64 °F range in mean monthly temperature occurs at all six meteorologic stations in the James River basin for the period of record (table 9); January is the coldest month, and July is the warmest. As expected, mean monthly temperatures increase from north to south in the basin. Year-to-year variation for a given month is greatest in the winter months. The standard deviation of mean monthly temperatures during December through February ranges from 5 °F to 7.8 °F. The large variation in mean monthly temperatures is caused by the large variation in temperatures of the different air masses that dominate from year to year during the winter months. As an example, in a cold winter, the source region for the dominant arctic air mass would be the Mackenzie valley in northern Canada; but in a mild winter, the dominant air mass would be cool marine air from the North Pacific.

Mean monthly temperatures in the summer have much less change from year to year than in the winter. The standard deviation of the mean July and August temperatures ranges from 2.6 °F to 3.4 °F at the six meteorologic stations (table 9). Therefore, about 66 percent of the time, the mean temperature during July and August will be within ±3 °F of the mean temperature for the respective month.

Monthly precipitation characteristics are typical of the relatively dry continental climate of the James River basin. Winter months receive little precipitation; and, in an absolute sense, little year-to-year variability. Precipitation increases markedly in April and May. About 70 percent of the precipitation occurs during the months April through August, and great variability can occur during these months (table 10).

Growing-Season Climate Statistics

Monthly temperature and precipitation data were summed by growing season (April through August) for the period of record. These data provide an indication of the demand for irrigation water and the availability of water to sustain streamflow during the summer. Box plots, as outlined by Tukey (1977), were selected as the graphical technique to present the growing-season temperature and precipitation data (figs. 3-8). The graph depicts a six-number summary for each variable, by decade, that consists of the minimum and maximum values, the median, the mean, and the 25- and 75-percent quartiles.

Figures 3-8 depict the box plots of average growing-season temperature by decade. The upper end of the box represents the 75-percent quartile and the lower end of the box represents the 25-percent quartile. The box covers the middle 50 percent of the data. The solid line represents the median, and the dashed line is the mean. Maximum and minimum values for a particular decade are the end points of the vertical lines attached to the box.

At the four stations where data were recorded for 1900-29, the mean growing-season temperatures were relatively cool during the three decades, except at Aberdeen during 1920-29 (figs. 4, 6, 7, and 8). Relatively warm

Table 9.--Mean monthly temperature and standard deviation for the period of record for six meteorologic stations in the James River basin

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Carrington, N.Dak. (period of record 1930-82)												
Mean temperature, in degrees Fahrenheit	5.0	10.1	22.8	39.9	53.0	62.6	69.0	66.7	55.8	44.4	26.3	12.8
Standard deviation	7.8	7.5	6.1	4.3	3.9	3.0	2.8	2.6	3.2	3.8	4.9	5.8
Jamestown, N.Dak. (period of record 1893-1982)												
Mean temperature, in degrees Fahrenheit	7.1	11.6	25.3	42.4	54.8	64.2	70.2	68.2	57.6	45.6	27.8	14.4
Standard deviation	7.6	7.2	5.9	4.5	3.8	3.1	3.0	3.3	3.5	4.2	5.9	6.3
Oakes, N.Dak. (period of record 1930-82)												
Mean temperature, in degrees Fahrenheit	6.7	12.3	25.9	42.4	55.4	65.1	71.4	69.5	58.5	46.5	28.7	14.9
Standard deviation	7.6	7.3	5.8	4.0	4.1	3.2	3.2	2.6	3.3	3.5	4.2	5.7
Aberdeen, S.Dak. (period of record 1896-1982)												
Mean temperature, in degrees Fahrenheit	10.0	14.8	28.6	45.0	56.8	66.2	72.5	70.4	60.1	47.4	30.4	16.7
Standard deviation	7.2	7.3	6.2	3.8	3.8	3.4	3.3	3.2	3.4	3.9	5.0	5.8
Huron, S.Dak. (period of record 1881-1982)												
Mean temperature, in degrees Fahrenheit	12.2	16.7	30.0	46.0	57.1	67.2	73.4	71.3	61.3	48.7	32.0	19.4
Standard deviation	7.5	7.1	5.8	3.8	3.7	3.2	3.4	2.9	3.3	3.8	4.5	5.6
Menno, S.Dak. (period of record 1896-1982)												
Mean temperature, in degrees Fahrenheit	16.6	21.2	33.4	48.4	59.6	69.2	75.0	72.9	63.7	51.6	35.0	22.2
Standard deviation	6.9	6.7	6.0	3.8	3.4	3.4	3.4	3.0	3.3	3.8	4.2	5.0

Table 10.--Mean monthly precipitation and standard deviation for the period of record for six meteorologic stations in the James River basin

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Carrington, N.Dak. (period of record 1930-82)							
Mean precipitation, in inches	0.54	0.49	0.75	1.48	2.36	3.62	2.67	1.99	1.58	1.20	0.63	0.46
Standard deviation	.50	.40	.56	1.13	1.34	1.85	1.68	1.37	1.23	1.12	.58	.34
					Jamestown, N.Dak. (period of record 1892-1982)							
Mean precipitation, in inches	.48	.51	.81	1.63	2.46	3.56	2.89	2.34	1.62	1.14	.61	.53
Standard deviation	.39	.43	.63	1.17	1.60	1.92	1.68	1.61	1.36	.97	.61	.39
					Oakes, N.Dak. (period of record 1930-82)							
Mean precipitation, in inches	.55	.60	.90	1.96	2.50	3.55	2.44	2.26	1.64	1.24	.71	.51
Standard deviation	.45	.49	.71	1.18	1.41	2.11	1.51	1.93	1.32	1.00	.62	.35
					Aberdeen, S.Dak. (period of record 1890-1982)							
Mean precipitation, in inches	.67	.72	1.34	2.41	2.86	3.72	2.83	2.43	1.75	1.41	.79	.63
Standard deviation	.73	.65	1.15	1.66	1.99	2.23	1.58	1.73	1.27	1.07	.78	.70
					Huron, S.Dak. (period of record 1881-1982)							
Mean precipitation, in inches	.52	.59	1.07	2.09	2.71	3.41	2.55	2.22	1.57	1.35	.64	.52
Standard deviation	.54	.52	.82	1.42	1.66	2.06	1.52	1.52	1.12	1.11	.63	.47
					Menno, S.Dak. (period of record 1896-1982)							
Mean precipitation, in inches	.55	.78	1.33	2.17	3.45	3.99	3.07	2.87	2.36	1.56	.93	.67
Standard deviation	.49	.61	.91	1.17	2.01	1.97	1.91	1.78	1.51	1.25	.81	.54

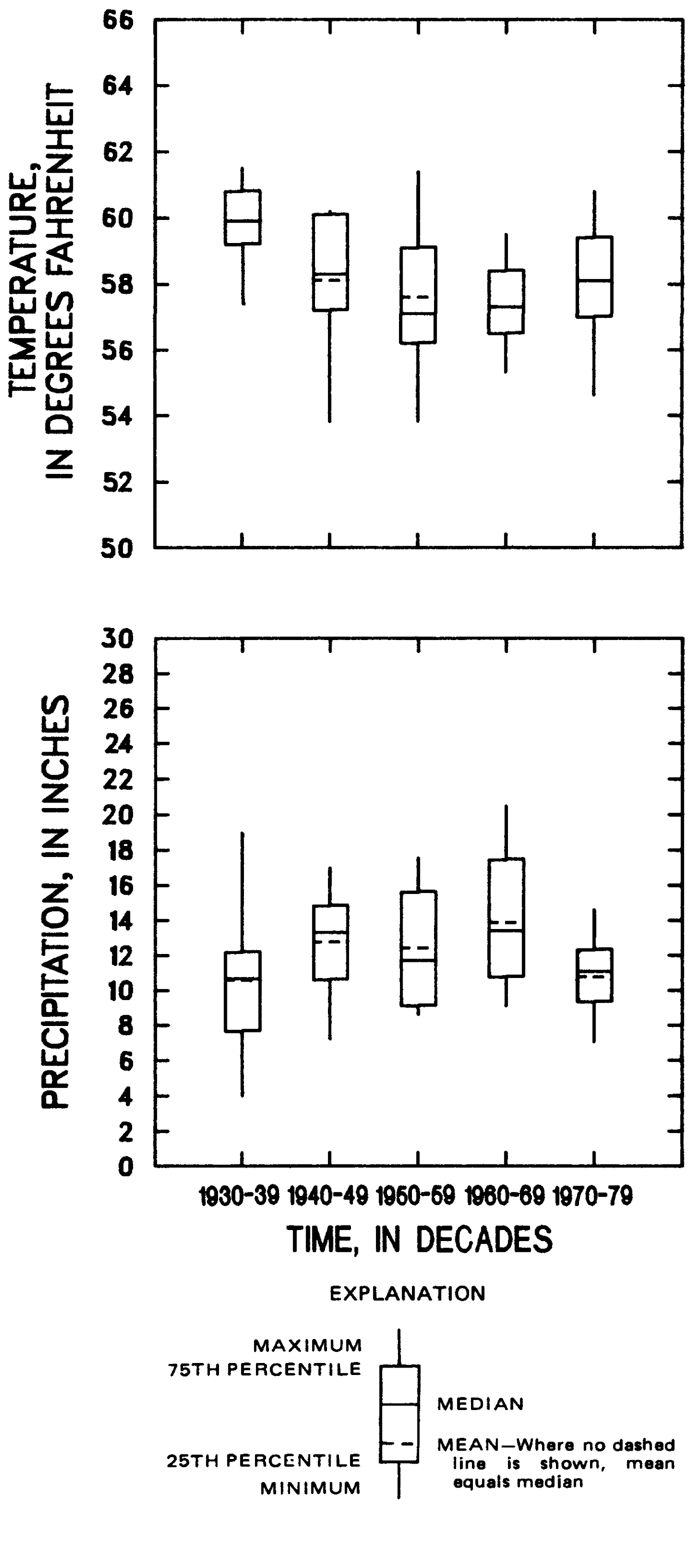

Figure 3.—Growing-season (April-August) temperature and precipitation for 10-year periods at Carringtion, North Dakota.

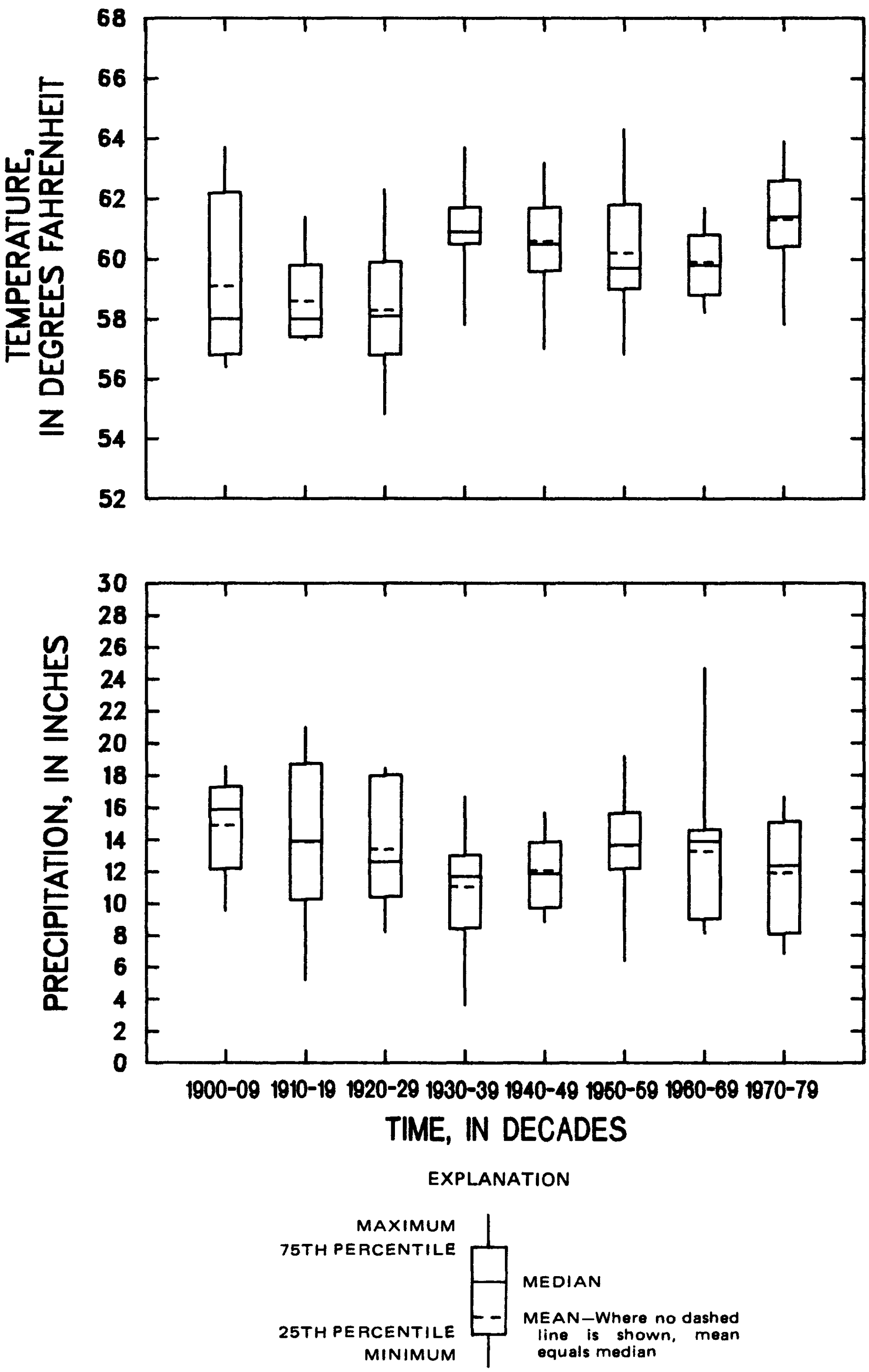

Figure 4.—Growing-season (April-August) temperature and precipitation for 10-year periods at Jamestown, North Dakota.

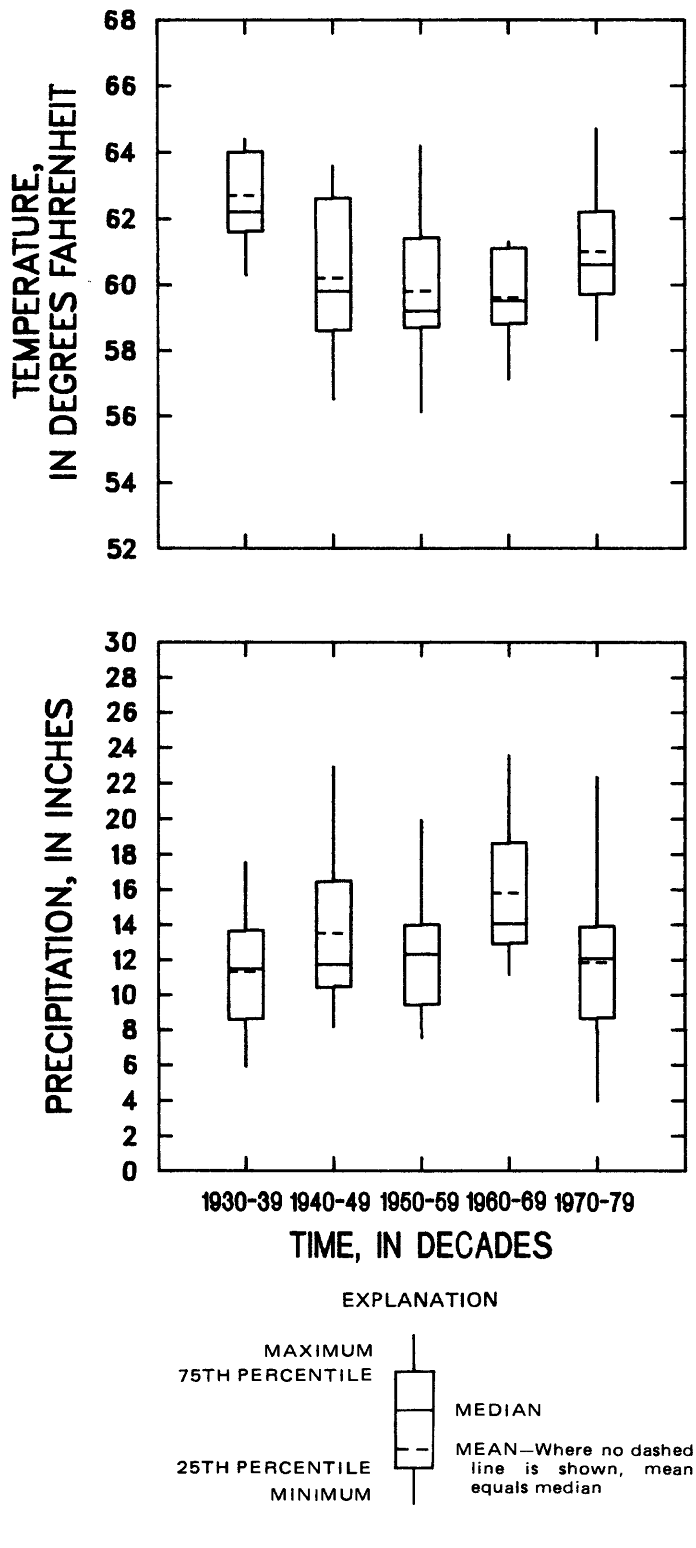

Figure 5.—Growing-season (April-August) temperature and precipitation for 10-year periods at Oakes, North Dakota.

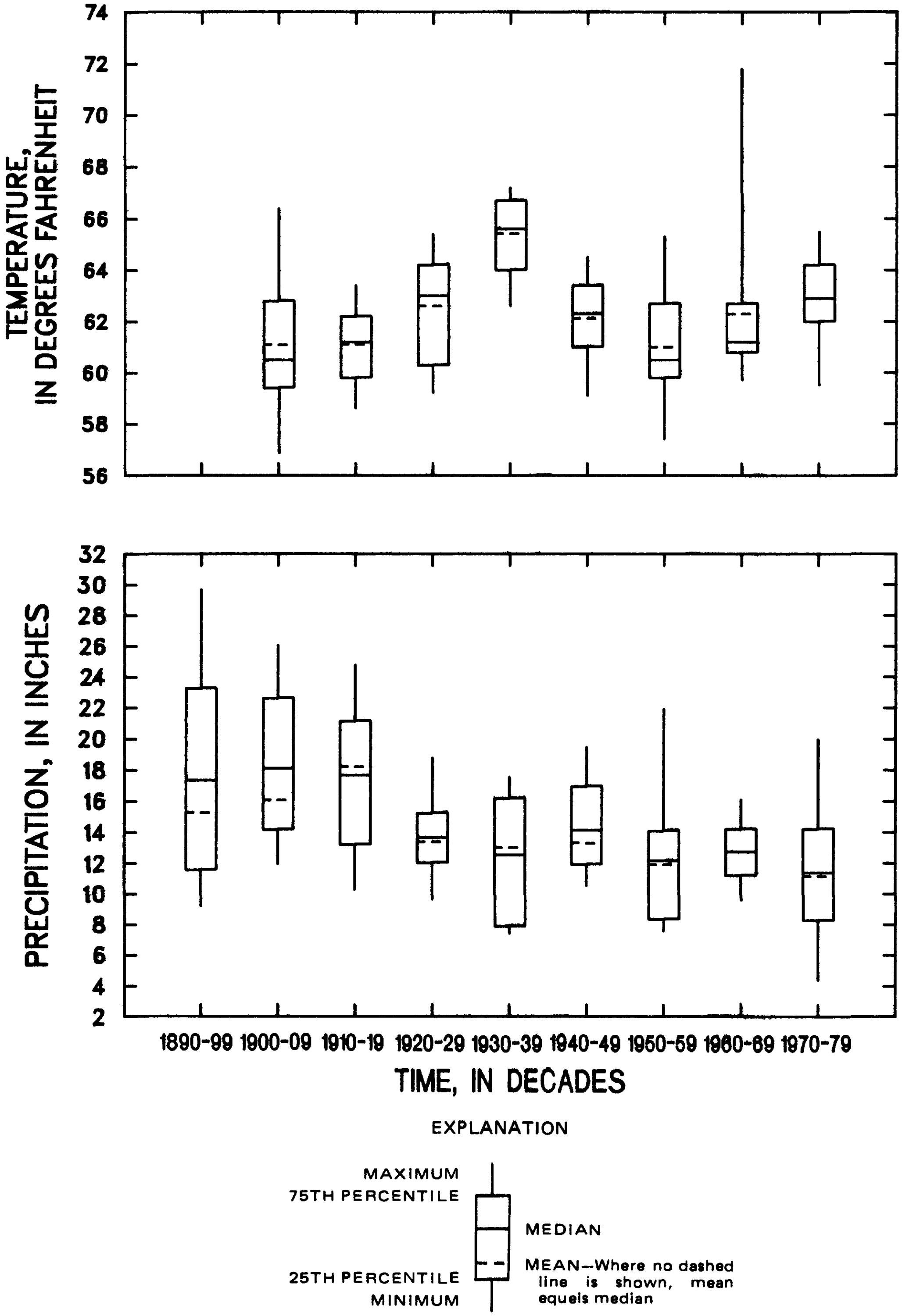

Figure 6.—Growing-season (April-August) temperature and precipitation for 10-year periods at Aberdeen, South Dakota.

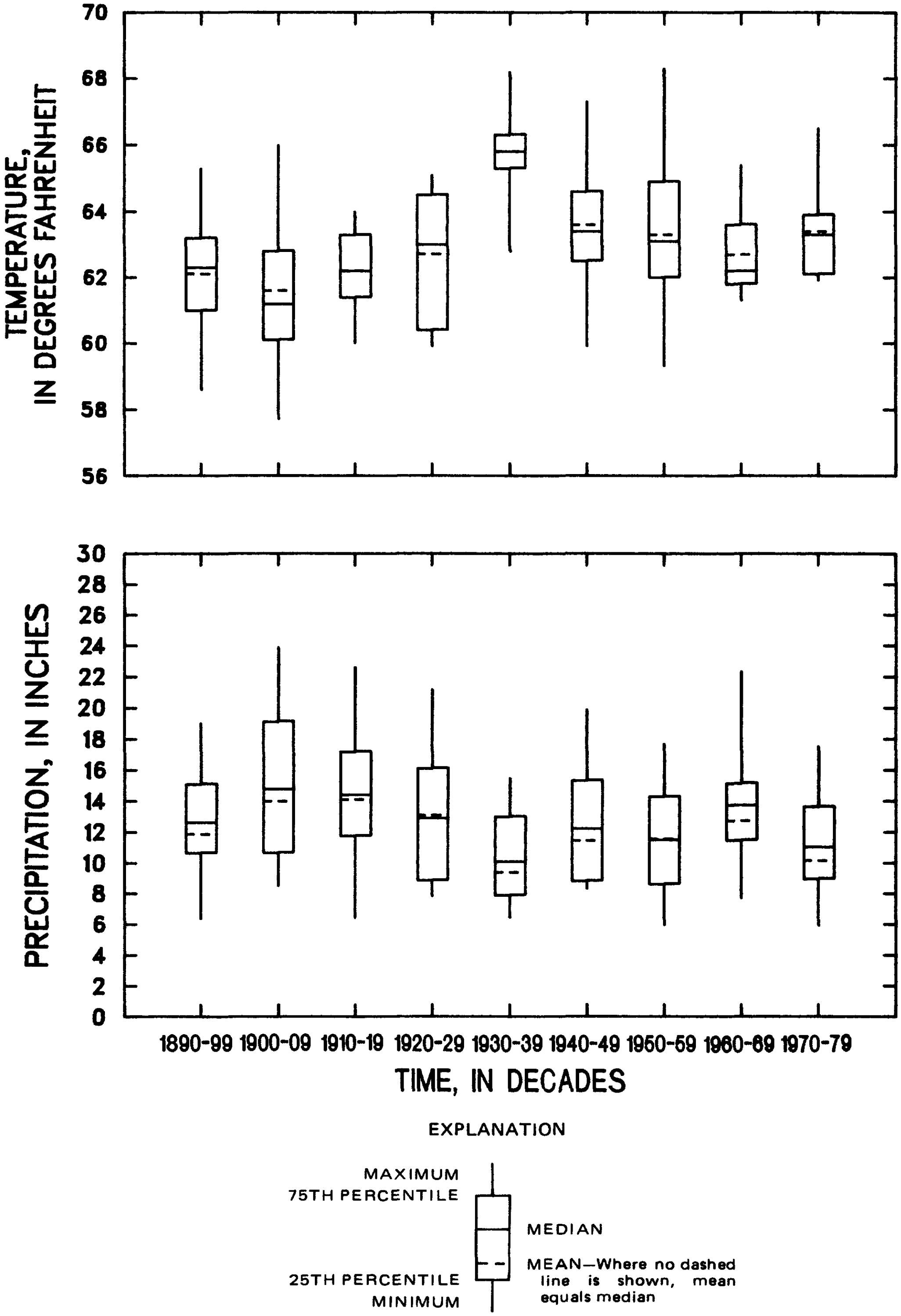

Figure 7.—Growing-season (April-August) temperature and precipitation for 10-year periods at Huron, South Dakota.

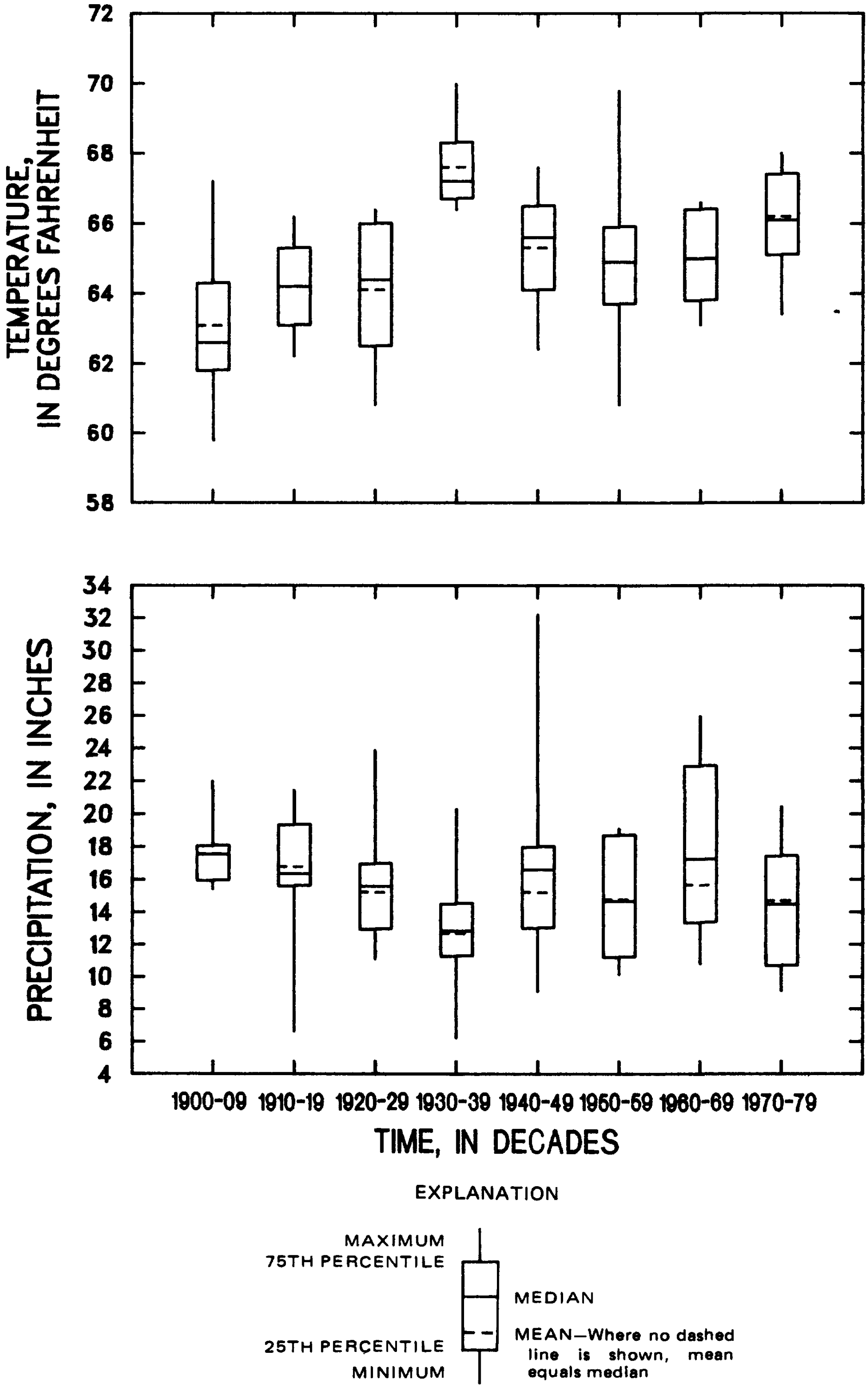

Figure 8.—Growing-season (April-August) temperature and precipitation for 10-year periods at Menno, South Dakota.

growing-season temperatures occurred during 1930-39 (figs. 3-8). The decade 1930-39 can be characterized as having minimal variability in mean growing-season temperature, especially at Carrington and Jamestown, which are located in the northern part of the James River basin. Following 1930-39, growing-season temperatures decreased in 1940-49 at all stations in the James River basin. Mean growing-season temperatures remained about average during 1950-59 and 1960-69; but in general more variability occurred during 1960-69. Mean growing-season temperatures increased at all stations during 1970-79, and at Jamestown they exceeded those of 1930-39.

The decade 1890-99 may have been a relatively wet decade, but precipitation data are available only for Aberdeen (fig. 6). Relatively abundant rainfall occurred in the James River basin during 1900-29 and especially in 1900-09 (figs. 4, 6, 7, and 8). During 1900-09, the wettest decade from 1900 through 1980, the mean growing-season precipitation was at least 3.8 inches greater than during 1930-39 at four stations in the James River basin. The decade 1910-19 is characterized by a large range in growing-season precipitation. At Jamestown, the second largest (20.99 inches) and the second smallest (5.17 inches) growing-season precipitation totals were recorded. Although the annual growing-season precipitation decreased during 1920-29, it is still equal to or greater than any decade since 1930-39, except at Aberdeen and Menno during 1940-49 and Menno during 1960-69.

The minimum mean growing-season precipitation at five of the six meteorologic stations in the James River basin occurred during 1930-39. The minimum mean growing-season precipitation at Aberdeen occurred during 1970-79. The driest year on record at Carrington and Jamestown was 1936, when less than 4 inches of precipitation was recorded during the growing season. At all other locations except Menno, the growing-season precipitation was less than 8.5 inches in 1936.

The annual mean growing-season precipitation was about average during the decades 1940-49 and 1950-59. The annual growing-season variability was not abnormally large during 1940-49 and 1950-59, except at Menno. At Menno the growing-season precipitation ranged from 9.0 to 32.2 inches during 1940-49. The decade 1960-69 was relatively wet, as the annual growing-season precipitation was greater than 7.5 inches in all years. Following the moist growing seasons of 1960-69, 1970-79 indicated a return to drier years (figs. 3-8). The 1970-79 decade ranks as the second driest for the period of record at five of the six stations. At Aberdeen, the minimum mean growing-season precipitation was recorded during 1970-79 (fig. 6). The 1970-79 decade was not without variability, the third greatest annual growing-season precipitation (22.4 inches) and the minimum annual growing-season precipitation (3.93 inches) for 1930-82 were recorded at Oakes.

No discharge data are available in the James River basin prior to September 1928, but Hoyt and Langbein (1944) and Julian (1970) indicated that greater-than-normal precipitation and runoff occurred throughout most of the United States in the early 1900's. Stockton and Boggess (1979) pointed out that greater-than-normal precipitation resulted in an increase in discharge on the Colorado River and the Rio Grande River during the early 1900's. Thus, indirect evidence suggests that discharge of the James River in North Dakota and South Dakota probably was greater than normal during the early 1900's.

Test for Trends in Temperature and Precipitation Data

Statistical analyses were used to determine if there are any trends in the climatologic data with time. If changes in climatic variables have occurred, then corresponding changes in runoff and the demand for irrigation water also may have occurred. Of course, the possibility exists that runoff characteristics may have changed regardless of climatic variables.

The Kendall's Tau (Kendall, 1975), as modified by Hirsch and others (1982), was used to test for trends in the climatic record. The null hypothesis for Kendall's Tau is that the data are random samples independent of time. Smith and others (1982) have outlined the procedure as follows:

> The only necessary background assumption is that the random variable is independent and identically distributed (with any distribution). In this test, all possible pairs of data values are compared; if the later value (in time) is higher, a plus is scored; if the later value is lower, a minus is scored. If there is no trend in the data, the odds are 50-50 that a value is higher (or lower) than one of its predecessors. In the absence of a trend, the number of pluses should be about the same as the number of minuses. If, however, there are many more pluses than minuses, the values later in the series are more frequently higher than those earlier in the series, and so an uptrend is likely. Similarly, if there are many more minuses than pluses, a downtrend is likely.

A trend from one month to the next may not be detected when variables such as temperature and precipitation have a seasonal cycle. Seasonal cycles can confound the detection of trends. Hirsch (1982) provides a derivation of the Kendall Tau test called the Seasonal Kendall Tau that can be used to compare the corresponding months of a year for a series of years. As a result, this test avoids problems associated with seasonality in the data.

The Seasonal Kendall Tau test was chosen to aid in answering two questions: (1) Has there been a change in either growing-season temperature or precipitation during the period of record; and (2) has there been a change in either variable during the data-development period (1953-82)?

The trend test for the period of record for the two climatic variables, temperature and precipitation, is shown in table 11. The value of tau for growing-season temperature is negative at Carrington and Oakes and positive at the other four locations. The upward trend at Jamestown, Huron, and Menno is significant at the 10-percent (two-sided) significance level. The upward trend at Aberdeen is not significant. The downward trend is significant at Carrington. The magnitude of the small upward trend in growing-season temperature at Huron and Menno is 0.027 °F per month. At Jamestown, the small upward trend in growing-season temperature is 0.035 °F per month.

Table 11.--Trend analysis for growing-season temperature and precipitation data for the period of record at six meteorologic stations in the James River basin

[The p-level value associated with an observed value of a test statistic is the smallest level of significance that would have allowed the null hypothesis to be rejected]

	Temperature				Precipitation			
Location	Period of record	Kendal's Tau	p-level	Slope (°F per month)	Period of record	Kendal's Tau	p-level	Slope (inches per month)
Carrington, N.Dak.	1930-82	-0.10	0.035	-0.029	1930-82	0.016	0.706	0.002
Jamestown, N.Dak.	1893-1982	.18	.000	.035	1892-1982	-.027	.407	-.002
Oakes, N.Dak.	1930-82	-.047	.324	-.0149	1930-82	-.045	.292	-.005
Aberdeen, S.Dak.	1896-1982	.054	.139	.010	1890-1982	-.153	.000	-.014
Huron, S.Dak.	1881-1982	.164	.000	.027	1881-1982	-.089	.003	-.014
Menno, S.Dak.	1896-1982	.140	.000	.027	1896-1982	-.044	.178	-.004

At all stations except Carrington, the value of tau for growing-season precipitation is negative (suggesting a downward trend). The downward trend is significant at the 10-percent (two-sided) significance level at Aberdeen and Huron. Although a significant downward trend in growing-season precipitation exists at Aberdeen and Huron, the magnitude of the trend is relatively small (0.014 inch per month).

Trend analysis of growing-season temperature and precipitation data for the data-development period (1953-82) is summarized in table 12. At all stations except Huron, the value of tau for growing-season temperature is positive (suggesting a slight upward trend). The value of tau is not significant at the 10-percent (two-sided) significance level at any of the stations. The magnitude of the upward trend in growing-season temperature ranges from 0.014 °F per month at Menno to 0.049 °F per month at Oakes. The upward trend in temperature probably was caused by the warm growing seasons in 1970-79.

At all six stations, the value of tau for growing-season precipitation is negative (suggesting a slight downward trend). The value of tau is significant at the 10-percent (two-sided) significance level at Carrington, Oakes, and Aberdeen. The magnitude of the downward trend ranged from -0.004 inch per month at Huron to -0.033 inch per month at Oakes.

Table 12.--Trend analysis for growing-season temperature and precipitation data for the data-development period at six meteorologic stations in the James River basin

[The p-level value associated with an observed value of a test statistic is the smallest level of significance that would have allowed the null hypothesis to be rejected]

		Temperature			Precipitation		
Location	Period of record	Kendal's Tau	p-level	Slope (°F per month)	Kendal's Tau	p-level	Slope (inches per month)
Carrington, N.Dak.	1953-82	0.029	0.662	0.018	-0.096	0.097	-0.022
Jamestown, N.Dak.	1953-82	.073	.261	.045	-.095	.102	-.024
Oakes, N.Dak.	1953-82	.101	.120	.049	-.147	.011	-.033
Aberdeen, S.Dak.	1953-82	.086	.184	.045	-.095	.100	-.017
Huron, S.Dak.	1953-82	-.042	.520	-.022	-.023	.690	-.004
Menno, S.Dak.	1953-82	.028	.675	.014	-.048	.411	-.013

SUMMARY AND CONCLUSIONS

Historic streamflow data were compiled and record extension techniques were used, where necessary, to develop monthly streamflows for 1953 through 1982 (data-development period) for 13 gaging stations on the James River in North Dakota and South Dakota. Four gaging stations on the James River were not in operation at times during 1953-82. Record extension techniques were used to compute the synthesized historic streamflow for these four stations. The Maintenance of Variance Extension Type 1 (MOVE.1) technique was used to compute the synthesized historic streamflow of the James River near Grace City for January 1953 through May 1968. The drainage-area ratio technique was used to compute the historic streamflow of the James River near Pingree for October 1968 through December 1982. Ordinary Least Squares (OLS) regression was used to compute the historic streamflow record of the James River at Stratford for October 1972 through December 1982, and OLS regression was used to compute the historic streamflow of the James River at Mitchell for January 1953 through June 1953, October 1958 through July 1965, and for October 1972 through December 1982.

Only 2 years (1982-83) of historic streamflow data were available for the James River at the North Dakota-South Dakota State line; therefore, regression techniques could not be used with any degree of confidence to compute the historic streamflow for January 1953 through December 1982. On the basis of hydrologic basin characteristics downstream of LaMoure, the historic streamflow of the James River at the State line was computed by summing the streamflow of the James River at LaMoure, Bear Creek near Oakes, and the streamflow from the intervening contributing drainage area between LaMoure and the State line. The streamflow from the intervening contributing drainage area is based on a linear function of the streamflow at LaMoure.

Synthesized unregulated streamflow for the gaging stations was computed by removing the effects of Jamestown Reservoir, Pipestem Reservoir, Sand Lake National Wildlife Refuge, and the consumptive surface-water withdrawals such as irrigation, municipal use, and industrial use. The unregulated streamflow of the James River near Pingree and near Grace City, upstream of Jamestown Reservoir, is equal to the historic streamflow plus minor surface-water withdrawals from the James River.

Synthesized unregulated streamflow of the James River at Jamestown for January 1953 through September 1968 was computed using the drainage-area ratio technique. Synthesized unregulated streamflow of the James River for October 1968 through December 1982 was computed using a MOVE.1 equation, but adjustments were made to monthly streamflows in years when large differences between estimates computed by the MOVE.1 equation and the water-balance procedures occurred.

Synthesized unregulated streamflow of the James River at LaMoure was computed by subtracting the historic streamflow of the James River at Jamestown from the historic streamflow at LaMoure, and adding the surface-water withdrawals between Jamestown and LaMoure to the unregulated streamflow of the James River at Jamestown.

Synthesized unregulated streamflow of the James River at the State line for June 1956 through December 1982 was computed by summing the unregulated discharge of Bear Creek near Oakes, the unregulated discharge of the James River at LaMoure, the streamflow from the intervening contributing drainage area between LaMoure and the State line, and the surface-water withdrawals from the James River between LaMoure and the State line. The streamflow from the intervening drainage area was computed as a function of the streamflow at LaMoure.

Water-balance procedures were used to compute the unregulated streamflow of the James River at Columbia. Although the water balance was within 13,600 acre-feet of balancing during the data-development period (1953-82), individual year water-balance estimates ranged from an unaccounted-for gain of about 48,700 acre-feet to an unaccounted-for loss of about 59,900 acre-feet. Because of the large year-to-year variations in the unaccounted-for gains and unaccounted-for losses, unregulated streamflow of the James River at Columbia was computed by multiplying the unregulated streamflow at the State line by the drainage-area ratio between the State line and Columbia gages.

Synthesized unregulated streamflow of the James River at all locations downstream of Columbia was computed by: (1) Subtracting the historic streamflow at the nearest upstream station from the historic streamflow at the station of interest (this difference equals the reach gain or loss), (2) adding the value obtained in step 1 to the unregulated streamflow at the nearest upstream station, and (3) adding the surface-water withdrawals between the nearest upstream station and the station of interest to the value obtained in step 2.

Mean annual historic streamflow of the James River at Jamestown is about 7,000 acre-feet less than the synthesized mean annual unregulated streamflow. Differences between the annual historic streamflow and annual unregulated streamflow can be attributed to four factors: (1) Actual difference between the historic and unregulated streamflow, (2) random variability associated with the MOVE.1 equation used to compute the synthesized unregulated streamflow at Jamestown, (3) errors associated with the input data used in the water-balance procedure, and (4) errors in computation of the historic streamflow of the James River at Jamestown. A comparison of the monthly variability between historic and unregulated streamflow of the James River at Jamestown indicates that historic streamflow is less than unregulated streamflow during March, April, and May. During all other months, historic streamflow is greater than unregulated streamflow because of the regulation of Jamestown and Pipestem Reservoirs.

The climate during the data-development period (1953-82) was compared to the 90-year climate record available at four of the six meteorologic stations in the James River basin to determine if the climate during 1953-82 was similar to the climate that has occurred during the last 90 years. The difference between the maximum and minimum annual mean temperatures for the period of record at each station ranges from 8.0 °F at Menno to 11.4 °F at Aberdeen. About a 9 °F difference in the normal annual temperature exists between Carrington in the northern part of the basin and Menno in the southern part of the basin.

Annual precipitation varies greatly from year to year. Mean precipitation in the James River basin has ranged from a minimum of 6.52 inches at Carrington in 1936 to a maximum of 38.9 inches at Menno in 1944. Minimum annual precipitation has ranged from 36 percent of normal at Carrington to 52 percent of normal at Huron. Maximum annual precipitation has ranged from 145 percent of normal at Carrington to 216 percent of normal at Aberdeen. Mean annual runoff in the basin is equal to about 4 percent of the mean annual precipitation (18 inches).

Summary statistics were computed for the growing-season temperature and precipitation data collected at six meteorologic stations in the James River basin. Growing-season temperatures were relatively cool during 1900-29. Although large fluctuations of growing-season precipitation occurred during 1910-19, relatively abundant rainfall occurred in the James River basin during 1900-29.

Growing-season temperatures for 1930-39 can be characterized as being warm with little year-to-year variability. The minimum mean growing-season precipitation at five of the six meteorologic stations in the James River basin occurred during 1930-39. Growing-season precipitation at Carrington and Jamestown was less than 4 inches in 1936, and was less than 8.5 inches at the other four stations.

Although still relatively dry, the mean annual growing-season temperatures increased and the precipitation increased during 1940-49. Mean growing-season temperatures remained about average during 1950-59. The mean annual growing-season precipitation during 1940-49 was slightly less than during 1950-59. The mean annual growing-season temperatures were about average during 1960-69. The decade 1960-69 was relatively wet and 1970-79 was relatively dry, although not as dry as 1930-39.

The Kendall's Tau was used to test for trends in the climatic record. At five of the six meteorologic stations a small downward trend (negative value of tau) in growing-season precipitation for the period of record occurs. The downward trend is significant at the 10-percent (two-sided) significance level at Aberdeen and Huron, but the magnitude of the trend is only 0.014 inch per month. A significant (10-percent, two-sided) upward trend in growing-season temperature occurred at Jamestown, Huron, and Menno; the upward trend in growing-season temperature at Aberdeen is not significant. A small downward trend in growing-season temperature occurred at Oakes and Carrington, and the trend is significant at Carrington.

Trend analysis of the climate variables for the data-development period (1953-82) indicates a slight upward trend in growing-season temperature at all stations except Huron. The upward trend in growing-season temperature ranges from 0.014 °F per month at Menno to 0.049 °F per month at Oakes. At all six stations, a slight downward trend in growing-season precipitation occurred. The magnitude of the downward trend ranged from -0.004 inch per month at Huron to -0.033 inch per month at Oakes.

On the basis of the box plots and the trend tests of growing-season temperature and precipitation, the climate of the James River basin was rather cool and wet during 1900-29. In general, 1930-39 had hot and dry growing seasons. The data-development period had several cool and wet growing seasons during 1960-69 and several hot and dry growing seasons during 1970-79. Thus, the data-development period included a wide range of climatic conditions; and, based on the analysis completed for this study, the data-development period was not selected from an abnormally wet or abnormally dry period. Therefore, based on the assumption that there is a positive correlation between runoff and precipitation, the streamflow compiled and synthesized for the data-development period represents a range of streamflows that might be expected to occur during relatively wet and dry periods in the James River basin.

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Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized (January 1953 through June 1968) and measured (July 1968 through December 1982) streamflow, in cubic feet per second, of the James River near Grace City, N.Dak.												
1953	0.05	0.08	0.42	0.62	2.90	17.42	18.16	0.10	0.01	0.02	0.04	0.03
1954	.08	2.66	15.63	2.52	1.34	6.00	4.00	4.78	2.57	2.72	1.81	.33
1955	.10	.08	.92	49.14	5.26	37.98	4.51	.06	0	.01	.02	.01
1956	.03	.02	.03	130.42	38.63	76.15	5.76	.22	.42	.19	2.34	.19
1957	.13	.08	6.25	2.15	3.06	1.64	4.82	1.58	24.67	10.49	9.48	2.35
1958	.40	.32	2.65	3.03	1.06	1.69	29.51	.21	.01	.01	.05	.01
1959	.02	0	1.60	3.20	.88	.72	.14	0	0	.07	.03	.01
1960	.04	.02	3.17	105.15	5.80	16.76	2.02	.09	.03	.01	.04	.01
1961	.02	0	3.00	1.04	.67	.06	.02	0	0	.01	0	.03
1962	.02	.01	.74	31.67	6.70	.25	5.23	.85	.19	.08	.36	.08
1963	.02	0	1.28	1.57	.74	1.08	1.54	.01	.01	0	0	.02
1964	.01	0	.01	5.24	2.05	0	25.48	.93	1.95	2.46	.75	.06
1965	.11	.08	.13	262.63	12.85	10.57	20.31	24.07	3.42	12.97	3.12	.68
1966	.25	.08	423.36	511.60	36.27	30.10	35.64	12.39	.93	.97	.29	.26
1967	.16	.18	27.70	268.56	67.21	9.52	3.16	.09	.04	.18	.16	.04
1968	.10	.08	29.09	2.98	3.40	6.54	1.40	.32	.47	.23	.48	.18
1969	0	0	0	775.00	52.00	13.80	8.85	4.75	.48	.70	1.18	.69
1970	.16	.06	4.42	20.50	39.70	31.70	4.72	.86	.43	.25	.51	.13
1971	0	0	.81	288.00	25.90	54.30	22.40	3.75	.40	1.29	1.22	.39
1972	.01	0	84.20	71.20	28.80	13.10	1.01	.35	.15	.23	.33	.13
1973	0	0	1.72	.57	.18	.11	.02	.03	.14	1.60	.47	.22
1974	.01	.05	.14	200.00	264.00	75.30	5.51	.77	.18	.13	.80	.30
1975	.04	0	1.76	280.00	262.00	32.00	25.40	1.16	.55	.33	.36	.03
1976	0	1.83	50.80	87.80	17.40	2.06	.33	.01	0	0	0	0
1977	0	0	.73	.29	.67	.16	.24	.05	.40	.11	.12	.14
1978	.09	0	35.50	171.00	8.73	.63	.22	.01	.02	.05	.05	0
1979	0	0	0	361.00	263.00	24.50	112.00	14.40	1.02	.26	.46	.28
1980	.04	0	5.15	21.70	2.25	99.90	21.20	25.60	44.00	13.10	19.00	6.65
1981	2.28	49.90	54.20	30.30	9.59	17.50	19.10	8.69	3.47	3.87	2.22	1.59
1982	.12	0	146.00	477.00	69.20	48.60	35.90	19.50	9.09	14.00	18.20	5.60
Mean	.14	1.85	30.05	138.86	41.07	21.00	13.95	4.19	3.17	2.21	2.13	.68

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through September 1968) and synthesized (October 1968 through December 1982) streamflow, in cubic feet per second, of the James River near Pingree, N.Dak.												
1953	0	0	0	0	0.15	9.85	5.60	0.39	0.10	0	0	0
1954	0	0	0	0	.09	34.40	7.35	.23	.21	.15	.12	.10
1955	0.05	0	0	55.70	8.96	23.90	.78	.14	.03	0	0	0
1956	0	0	0	6.12	63.90	43.40	5.32	.19	.12	.09	.12	.10
1957	.10	.10	.22	1.18	2.35	.36	.23	.19	9.61	37.40	27.50	17.40
1958	6.49	6.07	21.00	45.70	14.10	2.60	.50	.20	.20	.20	.20	.08
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	79.70	12.80	36.30	1.50	.05	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	.21	18.80	1.47	.01	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	229.00	100.00	13.80	13.50	99.90	62.10	90.70	46.60	30.10
1966	7.61	0	441.00	512.00	226.00	111.00	47.40	39.20	22.60	14.80	4.07	.10
1967	0	0	4.16	247.00	146.00	97.00	41.20	1.02	2.13	9.59	2.70	0
1968	0	0	1.63	.01	0	.22	0	1.67	4.37	2.95	1.74	2.38
1969	.64	.70	1.84	1,688.83	157.92	17.80	14.43	0	7.61	5.81	4.10	8.83
1970	5.36	1.56	12.80	187.17	114.96	86.09	0	11.51	4.98	3.04	3.07	2.33
1971	.87	.79	5.47	366.68	71.97	66.62	72.62	6.37	9.85	14.98	19.79	11.10
1972	.94	.45	126.16	104.04	117.02	43.64	1.39	2.41	1.92	2.23	2.52	4.50
1973	2.00	.61	83.12	0	7.25	3.67	0	0	5.14	11.88	1.96	1.61
1974	.41	.28	0	146.48	314.95	76.64	7.91	3.97	1.24	2.71	9.87	3.01
1975	2.33	2.45	59.89	323.00	521.00	200.00	58.00	2.06	3.10	5.11	3.49	3.13
1976	1.93	.33	70.24	116.09	37.18	6.87	1.96	.73	0	0	0	0
1977	.02	.06	7.38	3.73	6.45	.49	.13	0	.72	2.08	1.09	.53
1978	.59	.18	57.25	199.97	20.52	9.49	2.31	5.92	10.03	.48	.57	.36
1979	.26	.36	.15	362.07	754.29	24.92	54.65	15.24	6.02	1.94	4.21	2.77
1980	1.61	1.21	0	54.13	8.29	2.97	20.43	22.50	30.50	2.43	2.48	3.04
1981	2.18	17.21	45.39	66.46	13.13	75.09	26.11	0	6.21	9.18	7.95	8.07
1982	.66	.14	170.55	529.25	83.99	53.98	119.81	20.79	5.39	43.19	31.10	15.97
Mean	1.14	1.08	36.94	177.48	93.44	34.71	17.40	7.87	6.47	8.70	5.84	3.85

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through September 1974) and synthesized (October 1974 through December 1982) streamflow, in cubic feet per second, of the Pipestem Creek near Buchanan, N.Dak.												
1953	0.29	0.51	10.00	12.90	42.50	62.80	20.60	1.65	0.24	0.23	0.50	0.24
1954	.03	3.63	2.80	8.97	4.78	110.00	13.60	.96	.55	.38	.99	1.14
1955	.57	.07	24.90	80.80	6.45	15.50	2.96	.26	.06	.11	.12	.03
1956	0	0	4.26	34.80	41.60	63.50	8.40	2.05	2.29	.91	4.69	2.47
1957	1.19	1.13	14.80	12.60	10.10	3.33	.83	1.32	23.60	17.00	12.10	6.61
1958	1.90	17.20	80.20	67.20	12.80	6.19	6.09	.47	.23	.13	.42	.05
1959	0	.03	1.79	.74	1.24	.70	.44	.02	0	.30	.36	.31
1960	.01	0	87.80	167.00	13.50	9.04	1.87	.46	.15	.12	0	0
1961	0	0	4.42	3.82	2.08	.06	.12	.01	.25	.15	.18	.03
1962	0	0	44.50	33.70	17.60	26.30	92.80	28.80	12.30	5.81	4.25	3.12
1963	.31	0	3.50	12.60	9.62	6.01	1.51	1.24	.48	.23	.27	.08
1964	0	.01	.19	17.40	7.57	106.00	27.20	6.02	2.21	6.23	3.12	.39
1965	0	0	.28	331.00	36.60	12.60	7.08	47.20	32.80	28.20	12.00	4.59
1966	.61	0	493.00	107.00	67.90	40.50	22.90	11.10	1.60	1.48	1.89	1.12
1967	.18	0	192.00	82.80	86.30	17.30	1.98	.15	.26	.33	.42	.13
1968	0	0	15.30	19.50	13.90	8.31	2.91	.41	.76	.26	.54	.14
1969	0	0	0	736.00	30.40	16.70	14.60	13.90	2.31	1.14	1.26	1.12
1970	.21	.02	.01	42.10	65.80	26.90	8.12	.72	.89	.38	.79	.32
1971	0	0	11.10	119.00	14.50	75.60	12.40	.92	.61	1.63	2.24	1.07
1972	.13	0	125.00	86.50	19.20	5.63	1.02	1.25	.27	.64	.80	.08
1973	0	.14	10.30	5.27	1.81	.97	.05	.01	.24	.89	.38	.18
1974	0	0	48.90	82.10	65.30	29.10	.97	.30	.11	.31	.02	.02
1975	0	0	2.02	509.63	133.34	32.09	37.18	2.16	.16	.10	.05	.03
1976	.01	1.11	89.84	72.55	6.93	.46	.09	0	0	0	0	0
1977	0	0	.14	.18	.05	.02	.08	0	0	0	0	0
1978	0	0	164.98	114.13	8.73	1.97	.23	.03	0	0	0	0
1979	0	0	.90	496.07	106.90	30.06	48.70	6.87	.68	.20	.18	.21
1980	.03	0	17.63	18.31	3.83	17.85	4.09	5.93	21.92	10.48	22.71	7.38
1981	2.67	44.86	33.67	17.40	5.86	5.33	4.75	20.91	1.77	2.54	.49	.18
1982	0	0	183.04	348.04	41.02	35.93	3.32	.00	0	4.94	4.84	3.32
Mean	.27	2.29	55.58	121.34	29.27	25.56	11.56	5.17	3.56	2.84	2.52	1.15

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River at Jamestown, N.Dak.												
1953	2.13	2.34	22.10	22.40	70.30	160.00	54.90	6.99	4.25	2.44	2.74	2.87
1954	2.78	15.00	7.44	14.40	8.46	148.00	20.90	5.35	4.14	2.87	1.56	2.39
1955	1.97	2.04	15.90	114.00	12.90	34.30	22.80	3.95	3.43	3.42	2.60	2.10
1956	1.96	2.07	18.90	44.30	49.70	126.00	17.10	5.37	5.40	8.12	19.40	7.14
1957	4.85	4.49	18.90	20.00	18.10	5.27	5.69	3.16	18.80	23.50	18.00	11.40
1958	6.38	35.30	113.00	97.30	25.60	19.50	18.80	5.65	3.75	3.16	4.78	3.82
1959	3.50	3.22	9.71	5.25	6.55	7.29	10.80	6.61	2.20	3.73	3.63	3.12
1960	3.01	2.79	120.00	242.00	23.10	18.40	7.20	4.50	3.79	2.27	2.74	2.89
1961	2.40	2.46	14.30	10.90	7.39	1.59	1.64	1.69	4.04	2.29	2.26	2.65
1962	2.35	2.85	66.40	58.80	26.50	38.50	254.00	46.10	26.80	16.30	11.50	8.81
1963	2.76	3.47	9.10	22.00	18.00	12.10	6.80	3.03	3.82	2.98	3.19	3.33
1964	2.86	2.93	3.55	31.00	17.00	143.00	36.50	11.20	8.94	8.57	5.10	3.54
1965	2.81	2.83	3.35	417.00	138.00	33.50	65.00	172.00	119.00	124.00	20.70	38.60
1966	35.70	25.40	731.00	512.00	439.00	378.00	148.00	33.30	78.40	42.30	8.30	8.30
1967	4.54	3.30	248.00	143.00	176.00	233.00	116.00	28.90	5.73	5.50	5.22	4.23
1968	3.29	2.68	30.80	30.50	26.50	28.00	12.30	4.16	6.03	3.45	3.95	3.53
1969	3.53	3.06	16.30	949.00	425.00	430.00	367.00	272.00	73.20	70.10	8.09	5.38
1970	4.01	4.79	9.79	48.50	85.20	29.90	12.10	3.11	1.26	2.05	4.26	3.52
1971	2.50	4.93	32.70	153.00	161.00	167.00	42.50	11.60	27.30	87.10	44.40	13.70
1972	3.94	3.40	190.00	150.00	64.60	65.20	19.10	50.20	47.40	23.50	4.34	1.06
1973	1.74	2.23	39.10	8.21	6.45	5.94	6.89	9.34	2.01	2.65	2.34	2.00
1974	1.93	2.35	8.76	10.20	108.00	333.00	76.20	36.60	46.80	29.50	4.09	3.47
1975	2.76	2.71	6.40	174.00	523.00	360.00	124.00	294.00	296.00	291.00	76.90	12.00
1976	6.52	12.50	68.70	262.00	81.00	17.60	17.90	17.30	15.90	3.01	2.59	3.89
1977	2.83	3.71	5.25	5.42	3.22	2.38	6.55	3.48	6.00	4.34	4.22	3.52
1978	2.30	2.07	67.60	84.80	156.00	153.00	106.00	47.90	50.60	6.45	4.14	3.46
1979	3.67	3.35	22.50	141.00	482.00	405.00	267.00	240.00	245.00	248.00	166.00	19.80
1980	5.61	4.21	47.10	32.90	6.95	23.00	9.56	10.90	71.50	47.40	50.80	32.70
1981	9.61	29.10	51.10	24.20	10.80	13.30	10.90	14.70	53.30	18.10	26.00	10.20
1982	5.43	17.30	172.00	227.00	257.00	232.00	242.00	155.00	62.10	76.70	68.10	20.80
Mean	4.66	6.96	72.33	135.17	114.44	120.79	70.20	50.27	43.23	38.83	19.40	8.14

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River at LaMoure, N.Dak.												
1953	12.20	16.40	84.40	41.90	63.30	418.00	130.00	27.20	17.40	15.20	15.80	12.60
1954	11.10	44.40	27.60	31.90	22.00	278.00	142.00	19.30	16.00	13.00	11.80	11.30
1955	8.65	7.04	42.10	147.00	26.30	72.00	86.20	20.70	13.70	12.70	11.90	8.06
1956	6.29	6.55	41.20	99.00	54.50	279.00	41.80	17.50	14.00	16.00	35.10	19.00
1957	7.52	4.79	21.10	49.60	36.00	20.90	14.40	12.10	22.60	37.30	34.10	24.80
1958	15.90	19.40	223.00	140.00	44.50	47.90	28.70	10.40	10.90	9.70	15.20	7.74
1959	3.69	1.90	17.60	24.30	19.70	26.40	26.90	6.03	5.39	11.60	11.20	10.50
1960	8.08	6.36	97.20	461.00	45.10	36.40	13.20	7.34	5.14	6.03	11.90	7.61
1961	7.55	6.11	43.60	28.50	22.30	8.63	4.89	3.20	10.30	7.54	8.42	8.67
1962	7.47	8.97	123.00	158.00	56.90	85.60	825.00	182.00	72.30	39.50	34.90	23.90
1963	11.80	7.29	32.80	66.10	52.00	34.70	21.20	16.70	14.40	8.75	11.70	7.85
1964	7.07	8.71	11.80	70.10	38.70	186.00	69.50	19.00	13.00	13.60	12.90	9.61
1965	8.34	7.55	9.88	565.00	177.00	66.90	86.30	169.00	155.00	158.00	44.00	52.20
1966	39.40	42.10	1,202.00	661.00	519.00	408.00	215.00	67.50	83.90	73.70	21.10	14.60
1967	11.70	9.74	226.00	280.00	247.00	266.00	155.00	32.50	16.30	13.70	14.60	10.20
1968	8.93	10.50	52.60	50.60	50.70	168.00	31.10	12.50	14.00	13.20	15.40	8.77
1969	3.96	2.47	4.57	1,697.00	461.00	455.00	405.00	292.00	93.20	84.80	24.90	22.00
1970	18.90	17.40	34.80	107.00	112.00	44.10	14.60	5.10	4.27	6.72	11.70	8.85
1971	7.43	8.87	84.70	167.00	164.00	179.00	66.70	10.20	17.50	92.00	62.40	22.90
1972	13.90	12.20	391.00	194.00	104.00	81.00	32.50	47.60	47.10	38.70	13.60	12.50
1973	13.60	13.30	92.80	30.30	14.70	8.10	1.93	9.26	19.50	26.70	10.90	8.25
1974	7.24	8.80	114.00	132.00	134.00	396.00	89.70	33.40	46.80	41.80	16.70	11.50
1975	9.88	9.82	20.20	615.00	610.00	552.00	387.00	290.00	291.00	351.00	162.00	36.20
1976	23.90	39.80	168.00	314.00	150.00	40.70	25.40	13.90	12.80	15.40	12.30	10.50
1977	8.10	11.20	31.90	22.60	12.40	23.40	34.90	10.40	16.20	27.50	10.00	8.43
1978	5.39	5.26	430.00	246.00	214.00	225.00	145.00	63.80	70.10	13.30	11.70	8.44
1979	8.43	10.80	58.90	1,165.00	591.00	488.00	309.00	257.00	269.00	243.00	192.00	48.50
1980	21.80	17.40	114.00	83.90	23.80	31.50	16.50	15.90	77.30	56.20	62.10	30.00
1981	15.00	18.20	65.20	48.00	24.80	25.90	24.00	11.80	38.70	24.10	24.20	16.50
1982	11.20	10.80	85.10	697.00	324.00	238.00	217.00	144.00	59.40	81.50	64.20	21.50
Mean	11.48	13.14	131.70	279.76	147.16	173.00	122.01	60.91	51.57	51.74	32.96	16.78

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River at the North Dakota-South Dakota State line												
1953	12.81	17.22	88.62	43.99	66.46	509.79	136.41	26.53	17.49	15.96	16.59	13.23
1954	11.65	46.62	28.98	33.49	23.10	319.80	150.69	18.68	16.19	13.65	12.39	11.86
1955	9.08	7.39	44.14	158.20	27.58	75.43	88.72	19.99	13.77	12.70	11.90	8.06
1956	6.29	6.55	41.20	99.00	54.50	307.96	40.31	16.02	13.39	16.00	35.10	19.00
1957	7.52	4.79	21.10	49.70	37.80	21.98	14.75	11.01	22.59	37.30	34.20	24.80
1958	15.90	19.50	274.64	146.77	54.80	52.49	28.90	9.24	10.44	9.70	15.20	7.74
1959	3.69	1.90	17.60	24.30	19.70	26.29	25.48	4.75	4.89	11.60	11.20	10.50
1960	8.08	6.36	117.70	577.77	55.60	45.31	14.92	6.48	6.03	6.13	11.90	7.61
1961	7.55	6.11	47.70	29.50	24.00	8.90	3.60	1.96	9.82	7.54	8.42	8.67
1962	7.47	8.97	150.20	196.29	61.00	110.49	1,089.41	200.47	75.74	41.60	36.30	24.90
1963	12.00	7.29	36.10	71.40	57.20	47.17	21.28	15.84	14.30	8.75	11.70	7.85
1964	7.07	8.71	11.90	73.80	48.60	236.55	86.69	19.02	12.75	13.70	12.90	9.61
1965	8.34	7.55	9.88	697.85	190.22	71.22	88.02	176.16	159.93	163.59	44.90	53.00
1966	39.50	42.10	1,524.83	802.65	613.93	479.34	228.09	110.84	86.90	75.40	22.40	15.30
1967	12.10	10.04	250.83	332.04	290.58	296.38	160.07	31.11	15.87	13.70	14.60	10.20
1968	8.93	10.50	52.51	53.00	61.52	180.62	33.15	11.43	13.46	13.20	15.40	8.77
1969	3.96	2.47	4.38	2,372.39	552.89	537.27	479.30	323.06	92.80	84.80	24.90	22.00
1970	18.90	17.40	34.57	116.19	119.86	46.70	13.58	4.05	3.87	6.72	11.70	8.85
1971	7.43	8.87	94.37	174.91	170.05	192.31	72.55	9.19	17.04	92.00	62.40	22.90
1972	13.90	12.30	525.27	215.22	115.71	86.76	31.81	46.52	46.49	38.70	13.60	12.50
1973	13.60	13.40	93.66	30.55	14.67	6.48	1.00	7.26	22.14	31.00	11.20	8.25
1974	7.24	9.30	129.92	138.59	147.49	469.30	87.84	31.05	45.90	41.80	16.70	11.50
1975	9.88	9.82	19.83	770.16	743.64	682.08	492.51	320.88	321.70	400.92	167.69	36.20
1976	23.90	41.00	26.48	359.55	156.23	39.52	15.72	5.28	9.50	15.40	12.30	10.50
1977	8.10	11.20	31.80	22.48	12.27	22.47	20.55	1.00	11.92	27.50	10.10	8.43
1978	5.39	5.26	620.78	300.81	233.07	240.90	144.50	55.63	88.78	14.30	11.90	8.64
1979	8.43	10.80	78.57	1,685.60	728.18	575.92	337.33	271.95	291.42	262.69	202.21	48.50
1980	21.80	17.40	17.94	100.18	24.74	33.86	3.91	4.70	73.01	56.20	62.10	30.00
1981	15.00	18.20	65.17	48.17	24.78	26.12	11.85	1.00	32.65	24.10	24.20	16.50
1982	11.20	10.80	91.56	885.22	375.28	260.46	221.37	136.97	54.43	81.50	64.20	21.50
Mean	11.56	13.33	151.74	353.66	170.18	200.33	138.14	63.27	53.51	54.61	33.68	16.91

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
				Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River at Columbia, S.Dak.								
1953	0	0	4.54	3.53	38.41	114.87	484.41	52.87	2.57	0.91	0	0
1954	0	1.78	13.42	27.73	29.70	33.21	132.90	4.33	2.45	2.59	43.56	.59
1955	0	0	10.42	85.90	14.30	22.84	80.06	.96	0	0	0	0
1956	0	0	.42	10.39	97.74	131.93	112.69	.59	0	0	0	0
1957	0	0	.02	35.07	77.07	50.12	17.40	.37	14.84	11.64	37.49	52.94
1958	30.96	37.69	94.16	189.13	85.35	38.60	.03	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	-6.28	222.97	186.39	64.67	75.70	1.09	1.13	0	4.10	.86
1961	.11	0	4.03	1.39	3.38	.71	0	0	0	.02	1.95	.07
1962	0	0	2.75	395.28	135.29	327.58	346.22	862.56	226.01	82.68	46.94	29.22
1963	12.26	5.71	15.19	125.68	125.88	210.41	4.99	1.30	1.36	0	50.54	34.51
1964	15.91	4.68	6.55	13.85	63.83	-93.84	192.90	50.85	0	.03	2.57	.03
1965	0	0	0	238.11	538.83	25.09	34.51	52.90	82.23	149.90	57.34	31.32
1966	26.35	25.35	250.35	1,565.71	769.76	479.48	333.41	78.44	51.91	.29	7.34	16.33
1967	9.76	5.10	115.48	389.21	380.93	199.10	212.64	52.81	4.25	5.63	3.56	2.31
1968	0	0	12.54	46.00	119.78	71.07	143.36	6.00	.02	25.29	110.97	40.90
1969	0	0	0	1,407.70	1,325.32	665.08	496.15	214.57	30.25	60.35	50.57	190.63
1970	16.80	0	6.55	216.83	201.55	81.51	7.32	0	0	0	0	0
1971	0	0	.67	3.46	55.77	102.03	121.48	85.51	46.43	28.23	89.24	88.00
1972	14.75	0	63.57	600.14	309.09	68.05	33.92	42.95	32.47	28.77	62.90	7.20
1973	.11	0	6.02	1.18	1.48	4.32	1.38	.20	0	3.29	6.10	.16
1974	0	0	15.19	48.18	92.93	108.47	116.10	77.96	18.71	.26	5.98	5.89
1975	5.84	4.39	.59	49.14	646.73	448.38	1,172.68	660.34	381.92	304.51	284.81	93.02
1976	19.39	30.21	127.23	181.30	283.61	104.60	17.99	2.07	0	0	0	0
1977	0	0	.72	.02	0	0	0	0	0	0	0	0
1978	0	0	-117.57	821.76	348.26	146.26	319.73	57.41	44.60	53.00	43.04	10.67
1979	0	0	20.96	330.04	1,500.70	666.22	363.22	255.93	132.60	185.54	261.11	128.27
1980	1.98	6.07	23.26	140.77	16.15	6.37	0	0	0	17.89	47.83	30.80
1981	21.91	3.75	10.67	28.07	.03	.08	3.64	3.22	.05	.55	8.87	40.01
1982	11.84	4.79	67.30	424.08	613.78	182.48	60.87	115.45	105.88	96.80	146.01	79.40
Mean	6.27	4.32	24.96	253.42	268.73	141.99	162.86	89.36	39.32	35.27	45.76	29.44

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through September 1972) and synthesized (October 1972 through December 1982) streamflow, in cubic feet per second, of the James River near Stratford, S.Dak.												
1953	0	0	73.54	138.77	140.45	204.87	642.27	312.09	24.97	2.21	1.58	4.41
1954	.76	6.37	20.54	33.86	51.10	119.91	184.44	19.52	.35	0	18.84	16.64
1955	.02	0	49.55	124.01	42.22	21.19	89.22	35.96	.29	0	0	0
1956	0	0	0	19.16	97.64	66.70	133.36	16.20	.13	0	0	0
1957	0	0	.18	15.98	95.64	113.27	41.84	4.78	6.47	5.29	23.43	42.87
1958	21.19	23.71	124.51	229.47	168.13	88.60	15.25	.02	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	2.72	185.00	291.55	94.80	60.84	16.39	1.66	0	0	0
1961	0	0	1.46	9.53	8.34	5.70	.33	0	0	0	0	0
1962	0	0	8.75	413.01	331.31	300.31	504.45	814.24	592.55	154.22	57.49	57.26
1963	19.29	8.35	15.19	122.94	160.13	243.03	108.17	9.01	1.58	0	18.52	31.00
1964	14.73	3.49	5.48	40.17	291.42	91.11	589.31	231.70	10.20	.33	0	0
1965	0	0	0	278.71	700.89	224.38	44.93	43.32	51.31	139.00	78.90	32.20
1966	25.48	20.53	297.79	1,758.38	981.26	598.58	466.57	311.27	115.24	9.71	12.02	14.26
1967	11.69	8.14	114.67	352.94	594.12	343.38	253.18	91.69	3.87	6.34	3.55	2.63
1968	.91	.14	14.18	89.14	215.83	113.51	149.67	31.47	.37	.02	73.53	57.07
1969	.29	0	0	2,036.05	1,924.47	828.69	692.56	526.11	97.54	50.22	89.51	191.97
1970	50.09	8.53	17.09	234.21	331.11	150.87	11.69	.23	0	0	0	0
1971	0	0	9.63	31.76	40.45	80.47	152.61	71.83	66.50	26.93	63.44	94.52
1972	23.11	5.26	143.75	824.45	605.89	296.04	78.19	70.32	34.69	2.11	37.02	15.38
1973	2.33	1.04	33.44	42.00	10.90	2.27	.07	0	0	0	0	0
1974	0	.63	116.46	57.93	81.43	76.69	76.16	49.67	18.62	.08	0	0
1975	0	0	.11	73.58	414.15	540.77	825.04	712.79	400.67	214.41	180.65	92.63
1976	15.08	8.80	57.20	281.80	241.05	98.01	9.24	3.32	.03	0	0	0
1977	0	0	2.62	19.61	1.27	.02	0	.00	0	0	.05	.02
1978	0	0	4.36	1,299.24	881.98	323.87	443.17	251.05	49.46	32.31	26.99	20.74
1979	.99	.34	17.47	465.16	1,461.72	854.18	765.50	296.70	127.71	100.47	155.51	127.26
1980	11.04	1.76	10.96	174.36	35.53	17.61	4.07	1.95	.03	0	7.68	14.90
1981	5.61	1.39	5.56	28.87	2.73	.08	0	0	0	0	0	0
1982	0	1.93	6.91	565.52	805.96	388.17	98.78	45.89	57.53	56.58	84.11	72.11
Mean	6.75	3.35	38.47	331.52	366.96	209.57	214.70	132.25	55.39	26.67	31.09	29.60

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River at Ashton, S.Dak.												
1953	0.08	1.93	129.68	178.11	154.38	234.95	617.60	476.21	36.37	7.48	2.05	6.15
1954	1.85	9.67	34.25	28.33	55.49	99.00	194.51	28.79	.27	0	8.17	23.45
1955	1.61	.34	52.42	134.36	60.45	25.43	65.80	57.00	1.41	0	0	0
1956	0	0	0	10.69	91.19	61.51	158.26	24.62	.72	0	0	0
1957	0	0	.55	30.60	101.68	136.11	55.39	7.22	3.95	4.62	18.22	31.36
1958	25.55	19.21	134.61	255.64	181.67	97.93	26.48	.57	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	11.90	272.78	346.22	120.84	56.29	20.67	1.87	.02	0	0
1961	0	0	.55	5.70	7.79	8.07	.15	0	0	0	0	0
1962	0	0	46.94	516.15	446.05	373.48	456.27	695.44	690.32	208.64	75.17	67.77
1963	21.52	9.99	14.75	111.21	169.09	235.10	143.73	12.70	1.26	0	10.39	28.80
1964	15.50	3.13	5.77	43.24	274.93	88.40	526.30	286.51	16.29	.86	.24	.03
1965	0	0	0	252.95	730.44	393.51	61.26	38.84	43.04	143.70	102.80	34.01
1966	26.30	20.99	261.67	1,587.55	1,041.78	722.49	599.47	385.38	148.14	21.45	19.90	17.35
1967	14.52	8.62	129.65	407.95	686.53	455.48	286.21	101.29	4.57	3.25	4.20	4.37
1968	1.33	1.15	11.69	83.79	236.32	130.83	153.03	45.24	1.09	.02	63.09	66.87
1969	3.56	.05	.62	2,320.71	2,582.52	966.19	830.62	657.24	148.60	52.51	107.44	159.57
1970	75.57	15.18	55.16	250.24	373.58	186.41	22.38	.88	0	0	.02	.02
1971	0	0	12.12	50.37	39.91	84.97	156.39	77.93	61.07	25.29	54.03	96.46
1972	32.72	6.19	153.47	747.58	701.21	397.48	95.55	161.25	40.54	8.75	61.76	24.13
1973	5.42	3.39	64.71	42.13	12.90	4.27	.11	0	0	0	0	0
1974	0	1.94	31.81	58.57	94.83	110.13	88.75	74.61	24.91	.11	0	0
1975	0	0	.21	74.84	476.28	667.75	853.01	1,023.59	561.02	331.70	291.38	137.55
1976	39.29	35.26	110.83	296.37	278.37	138.11	11.97	5.22	.05	0	0	0
1977	0	0	19.11	11.93	4.67	3.75	.02	0	0	0	.10	.03
1978	0	0	8.39	1,419.37	1,008.35	416.08	472.70	366.96	67.14	48.55	45.34	32.22
1979	2.18	1.03	33.76	495.34	1,664.63	1,018.16	794.43	432.47	175.81	153.60	251.64	187.15
1980	28.22	6.05	21.16	181.20	41.65	28.33	5.48	3.09	.03	0	13.24	23.39
1981	13.74	4.65	10.73	28.69	3.27	.22	0	0	0	0	0	0
1982	0	6.64	13.34	605.15	922.08	491.78	113.61	69.04	78.27	85.74	137.91	107.91
Mean	10.30	5.18	45.66	350.05	426.28	256.56	228.19	168.43	70.22	36.54	42.24	34.95

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River near Redfield, S.Dak.							
1953	0.98	6.66	487.43	294.54	382.44	308.24	728.97	804.53	75.11	19.21	9.38	13.61
1954	3.56	18.29	73.67	72.64	83.80	130.46	198.60	41.68	.62	0	.64	27.11
1955	1.66	.70	194.18	165.84	65.30	46.47	65.13	64.03	1.80	0	0	0
1956	0	0	2.78	20.57	90.03	80.00	145.00	25.61	.12	0	0	0
1957	0	0	2.72	101.27	143.07	196.18	139.73	9.92	2.66	14.52	22.07	34.84
1958	29.19	21.57	181.61	409.01	222.15	98.57	28.93	1.35	0	0	0	0
1959	0	0	3.42	1.36	.47	.15	0	0	0	0	0	0
1960	0	0	81.71	1,497.50	441.18	152.97	74.13	22.96	2.03	1.82	2.32	.63
1961	.10	.09	6.70	4.49	17.58	10.40	2.85	1.17	0	0	0	0
1962	0	0	128.77	890.52	560.02	617.35	610.69	724.99	730.56	232.19	84.84	72.71
1963	26.67	12.35	18.04	108.26	167.67	241.23	161.87	14.00	4.29	.18	7.24	33.29
1964	18.87	6.39	7.03	51.56	333.34	104.67	473.82	315.10	26.89	1.54	.29	.07
1965	0	.04	1.15	241.07	767.73	452.87	72.61	26.87	35.28	125.16	82.37	34.64
1966	27.19	21.90	827.79	1,624.38	1,114.55	750.59	648.21	436.86	156.33	33.26	23.36	18.33
1967	14.80	9.47	186.63	483.61	675.57	525.05	327.60	127.62	12.94	3.42	4.27	2.57
1968	.50	1.01	8.39	150.01	251.15	145.00	137.32	53.29	4.57	.15	47.90	70.78
1969	7.12	2.45	8.78	4,812.31	2,977.33	1,050.19	974.30	724.76	130.08	44.35	107.27	132.58
1970	97.16	18.01	95.97	348.30	415.76	223.44	41.80	1.56	0	.26	.67	.13
1971	.03	.49	17.78	67.73	60.03	82.43	141.16	C6.29	77.17	39.84	51.34	94.20
1972	39.58	5.80	569.29	907.76	965.39	512.38	138.58	160.29	31.80	9.35	45.28	29.84
1973	6.20	10.77	287.22	78.10	20.18	9.06	.10	0	0	0	0	0
1974	0	.92	27.94	70.74	95.38	104.97	85.22	57.13	17.55	0	0	0
1975	0	0	0	83.86	396.05	631.69	800.11	959.11	576.18	300.77	287.94	144.90
1976	44.35	37.43	99.71	299.08	292.38	185.74	17.76	0	0	0	0	0
1977	0	0	95.48	24.44	2.46	.08	0	0	0	0	0	0
1978	0	0	782.07	2,083.73	1,140.30	480.55	479.82	381.22	61.27	46.58	49.66	36.97
1979	5.48	2.18	45.72	536.41	1,676.41	1,024.36	770.85	446.76	181.30	116.15	237.64	197.06
1980	31.39	7.18	23.70	258.91	51.65	29.90	7.35	4.41	.13	.33	4.22	26.80
1981	20.90	7.29	15.16	36.00	5.29	.32	.02	0	0	0	0	0
1982	0	9.96	66.74	812.65	934.68	490.28	116.44	69.54	84.20	97.25	143.02	112.87
Mean	12.52	6.70	144.92	551.22	478.31	289.52	246.30	184.70	73.76	36.21	40.39	36.13

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River at Huron, S.Dak.												
1953	0	12.96	717.52	354.64	444.92	346.14	910.61	1,333.52	105.54	25.71	18.02	26.20
1954	12.93	68.60	93.74	76.16	94.00	120.20	188.07	37.34	11.29	1.20	.81	5.12
1955	6.00	2.05	348.73	186.73	59.49	61.69	28.51	87.12	.15	0	0	0
1956	0	0	6.96	48.35	78.06	90.74	145.54	202.47	5.75	.46	5.51	.98
1957	1.90	5.78	36.04	169.94	256.22	312.81	183.93	11.45	6.02	8.99	20.28	47.96
1958	43.26	34.68	212.70	477.48	226.90	124.43	80.39	.89	0	0	0	0
1959	0	0	4.63	1.38	0	0	0	0	0	0	0	0
1960	0	0	301.60	2,633.97	483.30	166.11	71.54	32.70	7.75	0	0	0
1961	0	.07	76.29	9.26	23.29	20.82	0	0	0	13.01	1.08	0
1962	0	3.75	508.25	2,198.16	1,000.17	1,380.31	855.87	727.62	746.35	271.28	109.31	83.54
1963	49.49	33.78	48.94	80.74	183.64	200.45	161.72	6.16	0	.21	6.17	36.51
1964	27.81	15.36	12.25	46.00	243.34	93.66	402.54	319.21	24.79	.47	6.07	0
1965	0	0	3.29	214.18	735.56	515.44	69.04	11.76	33.01	94.07	95.04	53.99
1966	35.23	41.94	1,224.96	1,661.71	1,164.01	751.03	691.57	425.34	195.17	57.26	32.67	35.29
1967	32.67	29.15	544.08	525.88	715.85	777.45	397.89	99.45	13.08	3.45	7.45	13.47
1968	12.47	8.59	6.44	76.57	217.73	123.17	78.49	50.79	21.75	5.03	35.90	82.68
1969	23.68	8.50	67.83	5,509.95	3,378.95	1,102.39	954.07	742.31	198.48	71.64	132.53	140.41
1970	158.78	47.57	494.79	478.97	499.57	311.87	36.10	0	0	0	1.63	1.87
1971	0	3.93	110.75	58.17	31.19	56.37	96.52	49.29	53.11	36.77	49.73	78.81
1972	52.61	20.44	911.69	1,032.26	1,520.96	886.58	164.48	159.44	56.10	20.02	50.94	49.86
1973	36.97	66.03	512.25	113.47	27.18	2.91	0	0	0	0	.66	.03
1974	0	14.40	32.09	64.40	75.15	84.33	45.59	35.91	22.87	.21	1.85	.02
1975	0	0	11.73	97.89	371.45	601.08	713.02	987.16	565.12	313.47	275.18	182.16
1976	81.22	84.68	121.52	250.04	232.54	98.63	6.68	0	0	0	0	.24
1977	0	0	409.66	41.95	.99	0	0	0	0	0	0	1.63
1978	1.17	0	1,246.88	2,883.41	1,214.85	555.35	431.90	391.03	112.20	49.55	52.00	40.58
1979	18.20	9.71	74.06	632.51	1,682.54	1,088.36	779.40	456.93	205.77	119.48	249.50	211.19
1980	68.91	20.33	57.46	226.88	70.78	61.24	16.34	1.06	0	0	0	7.01
1981	24.80	14.46	12.56	24.39	3.77	0	0	11.27	0	.07	0	0
1982	0	19.57	64.22	780.99	968.97	471.85	108.23	43.71	103.47	128.80	148.90	128.97
Mean	22.94	18.88	275.80	698.55	533.51	346.85	253.93	207.46	82.93	40.71	43.37	40.95

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River near Forestburg, S.Dak.											
1953	6.55	7.13	871.58	443.31	585.47	396.25	855.43	1,374.89	121.61	27.39	23.93	35.39
1954	15.19	83.28	119.00	96.37	104.64	162.60	193.06	40.45	17.86	10.28	14.87	10.68
1955	10.96	8.25	481.76	206.28	66.32	58.06	26.87	83.19	3.03	2.86	.99	2.31
1956	2.80	2.97	20.93	99.24	63.07	89.00	138.12	277.87	11.39	4.10	14.03	7.19
1957	5.84	6.25	85.87	184.35	318.77	413.14	239.77	18.20	8.64	15.06	33.43	48.71
1958	44.77	33.04	218.87	613.55	260.52	120.90	79.01	4.00	1.26	2.03	6.87	4.90
1959	1.89	.97	16.08	4.77	5.61	12.27	.31	.15	.97	3.37	4.96	6.90
1960	3.84	5.46	262.01	4,264.12	501.76	171.67	69.35	36.35	16.00	4.60	3.48	4.33
1961	2.78	15.90	264.06	28.84	55.26	74.90	11.17	1.25	.59	19.43	8.71	5.94
1962	2.39	6.18	691.18	3,550.62	2,119.56	2,919.74	1,413.78	829.72	747.38	290.93	110.30	85.58
1963	49.68	34.10	71.04	113.14	244.61	272.95	210.12	14.90	4.69	8.31	8.71	30.90
1964	32.20	20.51	22.44	70.67	284.18	156.25	339.18	345.31	37.83	3.58	5.90	6.51
1965	8.34	7.20	12.47	192.18	709.02	576.14	73.74	8.05	36.81	98.39	106.50	55.96
1966	31.94	41.58	1,456.74	1,649.71	1,254.80	746.15	650.83	424.95	223.44	70.03	34.81	36.15
1967	31.39	27.78	499.89	520.45	705.18	996.66	477.56	115.97	15.53	15.61	10.49	10.78
1968	6.65	8.64	16.00	91.81	281.94	168.77	116.25	68.27	9.75	8.67	26.60	81.09
1969	26.38	8.64	63.57	6,283.83	3,880.55	1,150.79	933.01	711.08	233.70	60.22	122.43	118.70
1970	172.86	54.61	598.79	516.62	561.69	422.91	75.00	4.52	.34	3.82	9.06	9.81
1971	2.02	7.36	314.02	107.51	58.22	69.01	102.39	46.41	53.70	39.91	65.14	98.83
1972	60.32	20.26	1,063.97	1,026.29	2,027.69	1,274.40	276.18	234.87	67.21	39.78	57.11	57.86
1973	45.49	64.61	1,182.87	224.28	67.77	16.65	7.43	3.58	2.52	11.04	14.91	7.27
1974	3.22	37.60	108.54	84.97	87.87	114.50	49.52	31.45	24.74	11.16	4.55	3.04
1975	2.37	3.75	11.63	135.64	389.66	590.95	631.36	940.00	579.29	325.05	282.17	195.97
1976	87.84	99.29	138.80	244.51	228.22	110.20	13.71	0	0	0	0	0
1977	0	0	947.04	116.16	12.34	3.11	.94	.10	.15	1.72	9.02	2.46
1978	.59	.54	1,106.73	3,057.41	1,349.32	654.39	404.48	414.32	114.70	41.75	52.13	39.91
1979	15.38	10.52	102.91	546.48	1,565.44	1,141.50	772.79	434.56	207.71	124.54	246.81	193.45
1980	72.13	24.79	33.10	218.68	91.28	56.84	15.68	2.23	.62	2.28	6.13	1.56
1981	21.16	16.35	12.16	31.86	10.29	.39	0	15.42	.03	0	2.54	6.98
1982	.08	7.98	101.77	683.82	963.84	546.45	146.12	33.83	93.54	144.90	173.61	162.14
Mean	25.57	22.18	363.19	846.92	628.50	449.58	277.44	217.20	87.83	46.36	48.67	44.38

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Synthesized (January through June 1953, October 1958 through July 1965, and October 1972 through December 1982) and measured (July 1953 through September 1958 and August 1965 through September 1972) streamflow, in cubic feet per second, of the James River near Mitchell, S.Dak.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1953	9.04	12.12	1,025.69	521.07	636.96	448.70	904.97	1,372.35	155.71	39.36	28.00	45.78
1954	20.61	92.28	152.19	120.40	131.39	417.44	222.51	60.81	31.80	12.18	15.26	16.60
1955	17.48	17.50	879.45	343.75	102.51	76.87	28.00	60.81	4.15	3.09	5.24	5.98
1956	3.64	4.68	30.83	120.63	60.94	93.83	138.02	266.10	15.53	2.15	17.66	10.65
1957	7.94	10.93	94.59	193.97	373.58	500.48	420.59	43.23	17.53	20.26	44.47	52.29
1958	51.72	35.51	297.09	749.85	279.22	123.04	86.36	17.82	2.27	2.02	11.71	8.85
1959	2.93	2.43	21.68	5.93	7.53	14.40	.28	.68	2.34	3.40	9.28	11.50
1960	5.56	9.76	321.21	4,875.42	549.69	196.08	74.78	54.14	21.71	4.68	7.21	8.05
1961	4.16	23.12	323.65	35.04	66.86	86.30	11.30	3.74	1.56	20.91	13.86	10.25
1962	3.63	10.79	819.83	4,068.73	2,176.17	3,238.70	1,692.72	647.48	463.69	346.79	84.52	78.71
1963	56.87	42.78	91.04	135.22	276.80	310.27	235.47	26.67	8.17	8.67	13.86	36.14
1964	38.36	28.40	29.91	84.95	319.41	178.63	386.47	322.98	43.11	3.61	10.50	10.99
1965	11.27	12.21	16.96	228.21	764.75	649.89	79.69	2.41	34.10	103.35	111.41	63.26
1966	30.83	49.57	1,340.38	1,700.72	1,383.12	770.29	654.81	444.63	220.24	75.77	39.96	36.87
1967	30.07	30.75	522.03	556.11	725.69	1,168.92	598.46	117.52	19.80	12.49	12.07	12.86
1968	8.51	11.79	19.32	75.69	265.25	164.14	124.64	81.48	5.61	15.63	13.61	70.91
1969	40.02	16.28	66.55	7,344.19	4,263.75	1,243.46	935.14	724.73	257.33	65.60	127.61	98.83
1970	177.97	68.24	645.66	602.31	434.92	259.90	72.39	6.13	2.05	4.10	11.53	14.54
1971	3.43	16.64	625.08	158.28	83.15	64.43	98.80	54.87	47.21	36.15	71.11	95.02
1972	73.90	26.58	1,028.72	1,236.54	2,450.90	1,833.99	347.77	267.74	68.53	8.00	52.89	58.37
1973	52.50	71.59	1,377.62	265.82	81.25	19.49	7.42	8.60	4.99	11.63	20.32	11.97
1974	4.75	46.28	137.11	101.91	104.12	131.32	52.79	48.27	30.74	11.76	8.74	6.15
1975	3.59	7.20	15.86	161.76	431.77	666.41	735.09	714.87	378.56	389.09	165.00	148.24
1976	95.38	101.23	173.88	289.50	259.05	126.45	13.97	0	0	0	0	0
1977	0	0	1,111.35	138.78	15.97	3.70	.88	.49	.54	1.69	14.22	5.22
1978	1.01	1.51	1,291.87	3,509.95	1,413.82	737.18	463.71	373.20	104.25	46.25	49.58	43.94
1979	19.63	16.57	130.25	640.70	1,629.32	1,278.53	906.06	387.61	167.27	143.78	149.99	146.77
1980	79.77	33.08	43.54	259.27	107.99	65.66	16.05	5.90	1.63	2.26	10.81	3.69
1981	26.22	23.66	16.56	38.67	13.43	.47	0	27.42	.17	0	5.76	11.60
1982	.16	13.27	128.85	799.53	1,025.33	616.73	161.70	51.13	88.63	168.24	116.75	128.25
Mean	29.37	27.89	425.96	978.76	681.15	516.19	315.69	206.46	73.31	52.10	41.43	41.74

Supplement 1.--Measured and synthesized historic streamflow for the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Measured (January 1953 through December 1982) streamflow, in cubic feet per second, of the James River near Scotland, S.Dak.												
1953	27.58	42.24	1,079.81	752.02	899.65	684.19	986.71	1,435.73	203.13	48.58	46.03	63.96
1954	38.09	163.24	277.45	187.00	192.51	682.29	261.51	104.00	57.53	33.23	47.14	38.97
1955	37.06	48.29	1,174.64	450.87	134.77	88.74	39.55	65.70	10.07	9.12	11.29	15.97
1956	16.56	19.72	77.77	187.13	80.52	96.00	138.67	314.05	24.07	4.62	24.94	21.48
1957	17.68	18.38	90.13	184.18	324.71	624.41	439.28	63.54	26.47	20.10	53.63	57.07
1958	56.51	42.89	270.67	858.69	334.35	142.67	116.74	29.32	5.36	2.55	26.81	18.57
1959	14.03	13.47	50.02	33.21	32.10	16.44	5.51	.02	4.64	4.36	16.94	24.51
1960	19.84	18.38	928.10	7,218.85	898.66	297.38	108.10	57.26	34.57	16.52	19.07	25.22
1961	20.39	167.96	365.90	76.90	124.38	337.04	45.16	23.94	7.80	22.43	32.74	20.77
1962	13.61	34.75	791.75	7,334.52	2,200.55	7,101.53	3,844.41	1,387.32	887.12	529.31	195.27	117.13
1963	69.93	106.69	237.18	206.41	351.61	273.05	284.47	80.75	29.73	26.90	30.64	31.32
1964	52.35	56.75	95.12	145.81	266.76	211.20	245.64	398.74	86.80	22.36	21.93	15.45
1965	17.58	23.71	30.23	158.28	579.56	704.63	223.86	31.65	31.56	97.71	165.61	108.07
1966	50.77	66.17	1,366.81	1,907.38	1,668.67	852.42	700.76	510.89	299.45	103.94	58.87	49.49
1967	44.77	46.74	441.74	621.28	754.85	1,141.19	766.85	143.07	30.64	23.74	21.07	25.81
1968	20.26	26.76	39.84	85.14	220.25	220.48	126.61	90.68	78.00	43.81	32.10	80.81
1969	55.55	30.97	191.29	8,188.56	4,704.38	1,640.05	1,117.48	776.36	311.11	94.42	147.34	112.10
1970	171.48	155.36	969.97	702.76	702.46	481.48	123.06	16.17	8.34	12.49	27.56	26.61
1971	14.56	43.45	1,297.97	260.11	121.94	275.67	158.32	67.83	42.44	50.97	80.10	100.10
1972	83.71	47.79	1,313.68	1,277.51	2,574.12	2,660.51	354.16	283.87	102.67	62.65	104.16	79.61
1973	131.76	265.57	2,490.26	451.64	170.39	67.73	18.70	8.96	15.73	41.55	38.97	35.81
1974	40.15	67.65	230.54	127.14	117.48	197.54	49.10	29.06	20.20	20.96	20.94	15.71
1975	15.84	15.94	41.03	142.08	338.22	602.92	561.50	868.23	612.24	344.39	323.65	228.51
1976	107.48	202.64	232.93	257.50	239.64	137.34	22.28	4.07	3.38	4.98	5.60	6.96
1977	3.77	11.78	1,004.42	224.71	41.78	20.60	11.58	5.69	39.28	40.67	70.77	33.23
1978	17.58	18.78	1,851.05	4,224.10	1,973.82	885.26	576.02	527.38	166.56	63.26	67.86	62.81
1979	38.09	32.97	851.97	671.18	1,499.71	1,395.70	804.01	519.73	254.64	126.28	249.17	211.16
1980	122.80	54.40	81.87	202.04	137.16	53.83	21.03	9.92	6.34	5.24	6.81	12.05
1981	17.09	27.96	24.48	19.90	18.67	5.14	7.24	14.10	10.00	11.17	10.12	16.46
1982	11.06	103.35	119.84	581.32	1,040.39	875.49	190.31	43.32	84.94	193.69	253.77	203.61
Mean	44.93	65.83	600.62	1,257.94	758.14	759.10	411.62	263.71	116.49	69.40	73.70	61.98

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River near Grace City, N.Dak.												
1953	0.05	0.08	0.42	0.64	2.93	17.45	18.21	0.15	0.04	0.04	0.04	0.03
1954	.08	2.66	15.63	2.54	1.37	6.03	4.05	4.83	2.60	2.74	1.81	.33
1955	.10	.08	.92	49.16	5.29	38.01	4.56	.11	.03	.03	.02	.01
1956	.03	.02	.03	130.44	38.66	76.18	5.81	.27	.45	.21	2.34	.19
1957	.13	.08	6.25	2.17	3.09	1.67	4.87	1.63	24.70	10.51	9.48	2.35
1958	.40	.32	2.65	3.05	1.09	1.72	29.56	.26	.04	.03	.05	.01
1959	.02	0	1.60	3.22	.91	.75	.19	.05	.03	.09	.03	.01
1960	.04	.02	3.17	105.17	5.83	16.79	2.07	.14	.06	.03	.04	.01
1961	.02	0	3.00	1.06	.70	.09	.07	.05	.03	.03	0	.03
1962	.02	.01	.74	31.69	6.73	.28	5.28	.90	.22	.10	.36	.08
1963	.02	0	1.28	1.62	.82	1.18	1.64	.11	.11	.08	.03	.02
1964	.01	0	.01	5.29	2.13	.10	25.58	1.03	2.05	2.54	.78	.06
1965	.11	.08	.13	262.76	13.11	10.85	20.60	24.36	3.70	13.23	3.25	.68
1966	.25	.08	423.36	511.67	36.40	30.25	35.79	12.54	1.08	1.10	.36	.26
1967	.16	.18	27.70	268.63	67.34	9.67	3.31	.24	.19	.31	.23	.04
1968	.10	.08	29.09	3.05	3.55	6.69	1.56	.48	.62	.36	.55	.18
1969	0	0	0	775.07	52.15	13.95	9.01	4.91	.63	.83	1.25	.69
1970	.16	.06	4.42	20.58	39.85	31.87	4.90	1.04	.60	.40	.58	.13
1971	0	0	.81	288.02	25.93	54.33	22.45	3.80	.43	1.31	1.24	.39
1972	.01	0	84.20	71.23	28.86	13.18	1.11	.45	.23	.29	.36	.13
1973	0	0	1.72	.60	.23	.18	.08	.09	.21	1.63	.49	.22
1974	.01	.05	.14	200.03	264.05	75.37	5.57	.83	.25	.16	.82	.30
1975	.04	0	1.76	280.03	262.05	32.05	25.46	1.22	.60	.38	.38	.03
1976	0	1.83	50.80	87.83	17.45	2.11	.39	.07	.05	.05	.02	0
1977	0	0	.73	.31	.83	.21	.42	.11	.57	.26	.14	.14
1978	.09	0	35.50	171.02	8.76	.66	.27	.06	.05	.07	.05	0
1979	0	0	0	361.02	263.03	24.53	112.05	14.45	1.05	.28	.46	.28
1980	.04	0	5.15	21.72	2.28	99.93	21.25	25.65	44.03	13.12	19.02	6.65
1981	2.28	49.90	54.20	30.32	9.62	17.53	19.15	8.74	3.50	3.89	2.24	1.59
1982	.12	0	146.00	477.02	69.23	48.63	35.97	19.55	9.12	14.02	18.20	5.60
Mean	.14	1.85	30.05	138.90	41.14	21.07	14.04	4.27	3.24	2.27	2.15	.68

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River near Pingree, N.Dak.												
1953	0	0	0	0	0.15	9.85	5.60	0.39	0.10	0	0	0
1954	0	0	0	0	.09	34.40	7.35	.23	.21	.15	.12	.10
1955	.05	0	0	55.70	8.96	23.90	.78	.14	.03	0	0	0
1956	0	0	0	6.12	63.90	43.40	5.32	.19	.12	.09	.12	.10
1957	.10	.10	.22	1.18	2.35	.36	.23	.19	9.61	37.40	27.50	17.40
1958	6.49	6.07	21.00	45.70	14.10	2.60	.50	.20	.20	.20	.20	.08
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	79.70	12.80	36.30	1.50	.05	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	.21	18.80	1.47	.01	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	229.00	100.00	13.80	13.50	99.90	62.10	90.70	46.60	30.10
1966	7.61	0	441.00	512.00	226.00	111.00	47.40	39.20	22.60	14.80	4.07	.10
1967	0	0	4.16	247.00	146.00	97.00	41.20	1.02	2.13	9.59	2.70	0
1968	0	0	1.63	.01	0	.22	0	1.67	4.37	2.95	1.74	2.38
1969	.64	.70	1.84	1,688.83	157.92	17.80	14.43	0	7.61	5.81	4.10	8.83
1970	5.36	1.56	12.80	187.17	114.96	86.09	0	11.51	4.98	3.04	3.07	2.33
1971	.87	.79	5.47	366.68	71.97	66.62	72.62	6.37	9.85	14.98	19.79	11.10
1972	.94	.45	126.16	104.04	117.02	43.64	1.39	2.41	1.92	2.23	2.52	4.50
1973	2.00	.61	83.12	0	7.25	3.67	0	0	5.14	11.88	1.96	1.61
1974	.41	.28	0	146.48	314.95	76.64	7.91	3.97	1.24	2.71	9.87	3.01
1975	2.33	2.45	59.89	323.00	521.00	200.00	58.00	2.06	3.10	5.11	3.49	3.13
1976	1.93	.33	70.24	116.09	37.18	6.87	1.96	.73	0	0	0	0
1977	.02	.06	7.38	3.73	6.45	.49	.13	0	.72	2.08	1.09	.53
1978	.59	.18	57.25	199.97	20.52	9.49	2.31	5.92	10.03	.48	.57	.36
1979	.26	.36	.15	362.07	754.29	24.92	54.65	15.24	6.02	1.94	4.21	2.77
1980	1.61	1.21	0	54.13	8.29	2.97	20.43	22.50	30.50	2.43	2.48	3.04
1981	2.18	17.21	45.39	66.46	13.13	75.09	26.11	0	6.21	9.18	7.95	8.07
1982	.66	.14	170.55	529.25	83.99	53.98	119.81	20.79	5.39	43.19	31.10	15.97
Mean	1.14	1.08	36.94	177.48	93.44	34.71	17.40	7.87	6.47	8.70	5.84	3.85

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
				Synthesized unregulated streamflow, in cubic feet per second, of Pipestem Creek at mouth								
1953	0.43	0.74	13.97	18.10	59.37	87.68	29.15	2.85	0.78	0.57	0.79	0.36
1954	.07	5.07	3.96	12.64	6.94	153.29	19.42	1.89	1.21	.78	1.47	1.61
1955	.82	.13	34.68	112.48	9.26	21.93	4.63	.92	.53	.40	.26	.07
1956	.03	.03	5.99	48.54	58.12	88.65	12.19	3.41	3.63	1.52	6.62	3.46
1957	1.68	1.60	20.64	17.68	14.33	5.02	1.67	2.39	33.25	23.88	16.92	9.22
1958	2.67	23.94	111.55	93.57	18.08	8.99	8.98	1.21	.76	.43	.68	.10
1959	.03	.07	2.56	1.20	2.02	1.36	1.13	.58	.44	.67	.60	.46
1960	.04	.03	122.11	232.30	19.06	12.95	3.11	1.20	.65	.42	.10	.03
1961	.03	.03	6.21	5.48	3.18	.47	.68	.57	.79	.46	.35	.07
1962	.03	.03	61.92	47.01	24.76	36.95	129.51	40.59	17.54	8.33	6.00	4.36
1963	.46	.03	4.93	17.68	13.66	8.74	2.61	2.28	1.11	.57	.47	.14
1964	.03	.04	.33	24.35	10.81	147.73	38.32	8.92	3.52	8.91	4.43	.57
1965	.03	.03	.46	460.26	51.17	17.90	10.36	66.16	46.04	39.45	16.78	6.41
1966	.88	.03	685.34	148.90	94.67	56.71	32.35	15.99	2.67	2.31	2.72	1.58
1967	.28	.03	266.95	115.26	120.25	24.44	3.27	.76	.81	.71	.68	.21
1968	.03	.03	21.34	27.27	19.61	11.94	4.56	1.13	1.50	.61	.85	.22
1969	.03	.03	.07	1,023.21	42.55	23.60	20.81	19.88	3.66	1.83	1.85	1.58
1970	.32	.06	.08	58.69	91.75	37.78	11.80	1.56	1.68	.78	1.20	.47
1971	.03	.03	15.50	165.58	20.45	105.47	17.75	1.89	1.29	2.52	3.21	1.52
1972	.21	.03	173.82	120.40	26.98	8.21	1.93	2.35	.79	1.11	1.21	.14
1973	0	.22	14.39	7.49	2.81	1.74	.58	.64	.78	1.46	.63	.28
1974	0	.03	68.04	114.29	91.06	40.84	1.86	1.07	.60	.65	.13	.06
1975	0	.03	2.88	708.55	185.63	44.99	52.26	3.63	.67	.36	.17	.07
1976	.01	1.57	124.95	101.01	9.92	1.03	.12	0	.44	.22	.10	.03
1977	0	.03	.26	.42	.38	.42	.72	.65	.44	.24	.10	.03
1978	0	.03	229.39	158.81	12.44	3.13	.93	.70	.44	.24	.10	.03
1979	0	.03	1.32	689.70	148.90	42.17	68.30	10.20	1.39	.51	.35	.32
1980	.04	.03	24.58	25.62	5.63	25.20	6.30	8.90	30.91	14.80	31.66	10.29
1981	3.71	62.38	46.87	24.35	8.45	7.80	7.21	29.72	2.91	3.77	.78	.28
1982	.03	.03	254.50	483.94	57.30	50.32	5.23	.65	.39	7.10	6.82	4.64
Mean	.40	3.21	77.32	168.83	40.98	35.92	16.59	7.76	5.39	4.19	3.60	1.62

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River at Jamestown, N.Dak.												
1953	0.43	0.74	13.97	18.10	59.54	98.61	35.37	3.28	0.89	0.57	0.79	0.36
1954	.07	5.07	3.96	12.64	7.04	191.47	27.58	2.15	1.44	.95	1.60	1.72
1955	.88	.13	34.68	174.31	19.21	48.46	5.50	1.08	.56	.40	.26	.07
1956	.03	.03	5.99	55.33	129.05	136.82	18.10	3.62	3.76	1.62	6.75	3.57
1957	1.79	1.71	20.88	18.99	16.94	5.42	1.93	2.60	43.92	65.39	47.44	28.53
1958	9.87	30.68	134.86	144.30	33.73	11.88	9.53	1.43	.98	.65	.90	.19
1959	.03	.07	2.56	1.20	2.02	1.36	1.13	.58	.44	.67	.60	.46
1960	.04	.03	122.11	320.77	33.27	53.24	4.77	1.26	.65	.42	.10	.03
1961	.03	.03	6.21	5.48	3.18	.47	.68	.57	.79	.46	.35	.07
1962	.03	.03	61.92	47.01	24.76	37.18	150.38	42.22	17.55	8.33	6.00	4.36
1963	.46	.03	4.93	17.68	13.66	8.74	2.61	2.28	1.11	.57	.47	.14
1964	.03	.04	.33	24.35	10.81	147.73	38.32	8.92	3.52	8.91	4.43	.57
1965	.03	.03	.46	714.45	162.17	33.22	25.34	177.05	114.97	140.13	68.51	39.82
1966	9.33	.03	1,174.85	717.22	345.53	179.92	84.96	59.50	27.76	18.74	7.24	1.69
1967	.28	.03	271.57	389.43	282.31	132.11	49.00	1.89	3.17	11.35	3.68	.21
1968	.03	.03	23.15	27.28	19.61	12.18	4.56	2.98	6.35	3.89	2.78	2.87
1969	.74	.81	2.11	2,899.69	218.02	43.38	36.84	14.18	12.12	8.29	6.41	11.39
1970	6.28	1.79	14.30	266.66	219.48	133.44	9.45	14.35	7.21	4.16	4.61	3.06
1971	1.00	.91	21.58	[1]573.00	100.42	[1]179.49	98.44	8.97	12.23	19.17	25.20	13.85
1972	1.25	.53	[1]314.00	[1]236.00	[1]157.00	[1]56.70	3.47	5.03	2.92	3.59	4.01	5.14
1973	2.22	.90	106.75	6.85	10.87	5.82	.46	.46	6.49	14.66	2.81	2.07
1974	.46	.34	60.00	[1]277.05	[1]441.00	[1]126.00	10.65	5.48	1.98	3.66	11.10	3.40
1975	2.59	2.75	69.43	[1]1,064.00	[1]764.00	[1]267.00	116.60	5.92	4.12	6.04	4.05	3.55
1976	2.15	1.94	[1]203.00	[1]230.00	51.23	8.66	2.30	.81	.32	.16	.07	.02
1977	.02	.10	8.46	4.57	7.55	.97	.86	.17	1.24	2.55	1.31	.62
1978	.66	.23	[1]293.00	[1]381.00	35.24	13.68	3.50	7.28	11.59	.77	.73	.43
1979	.29	.43	1.49	[1]1,092.00	[1]987.00	69.86	[1]29.02	27.13	8.08	2.67	5.03	3.40
1980	1.83	1.38	21.25	85.76	14.84	[1]28.50	[1]29.00	[1]33.90	[1]64.80	17.50	34.42	13.67
1981	6.13	[1]81.50	[1]97.30	[1]98.20	23.04	91.23	36.22	10.47	9.81	13.97	9.61	9.25
1982	.76	.19	[1]444.00	1,072.00	150.62	110.30	138.35	23.75	6.38	55.09	41.38	22.39
Mean	1.66	4.42	117.97	365.84	144.77	74.46	35.83	15.64	12.57	13.84	10.09	5.90

[1]Discharge adjusted based on a comparison of the Maintenance of Variance Extension Type 1 regression equation and water-balance procedures.

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River at LaMoure, N.Dak.												
1953	10.50	14.80	76.29	37.62	52.54	356.69	111.60	24.49	14.42	13.33	13.85	10.09
1954	8.39	34.47	24.14	30.16	20.58	321.55	149.81	17.10	13.68	11.08	11.84	10.63
1955	7.56	5.13	60.90	207.33	32.61	86.24	70.03	18.83	11.21	9.68	9.56	6.03
1956	4.36	4.51	28.31	110.05	133.85	289.90	43.93	16.75	12.74	9.50	22.45	15.43
1957	4.46	2.01	23.18	48.69	34.87	21.13	11.21	12.04	47.92	79.19	63.54	41.93
1958	19.39	14.78	244.96	187.10	52.66	40.36	20.00	6.68	8.33	7.19	11.32	4.11
1959	.22	0	10.55	20.35	15.20	20.55	17.80	.50	3.83	8.54	8.17	7.84
1960	5.11	3.60	99.41	539.87	55.30	71.32	11.40	4.67	2.22	4.18	9.26	4.75
1961	5.18	3.68	35.61	23.18	18.12	7.61	4.67	2.74	7.32	5.71	6.51	6.09
1962	5.15	6.15	118.55	146.24	55.18	84.35	722.09	178.75	63.28	31.53	29.40	19.45
1963	9.50	3.85	28.73	61.88	47.69	31.44	17.72	16.60	11.92	6.34	8.98	4.66
1964	4.24	5.82	8.68	63.55	32.54	190.83	72.03	17.37	7.81	13.94	12.23	6.64
1965	5.56	4.75	7.09	862.55	201.20	66.69	46.91	174.29	151.07	174.13	91.81	53.42
1966	13.03	16.73	1,645.95	866.32	425.56	210.00	152.53	94.20	33.46	50.14	20.04	7.99
1967	7.44	6.47	249.67	526.53	353.34	165.18	88.21	5.68	13.81	19.55	13.06	6.18
1968	5.67	7.85	45.05	47.48	43.84	152.25	23.65	11.58	14.42	13.64	14.23	8.11
1969	1.17	.22	1.00	3,637.27	254.05	68.45	75.34	34.63	32.29	22.99	23.22	28.01
1970	21.17	14.40	39.41	325.26	246.31	147.71	12.48	16.81	10.40	8.83	12.05	8.39
1971	5.93	4.85	73.68	587.10	103.45	191.56	122.85	7.76	2.50	24.07	43.20	23.05
1972	11.21	9.33	515.10	280.10	196.43	72.57	17.23	2.75	2.74	18.79	13.27	16.58
1973	14.08	11.97	160.55	29.04	19.15	8.11	0	1.46	24.40	38.71	11.37	8.32
1974	5.77	6.79	165.34	398.95	467.03	189.22	26.48	4.35	2.78	15.96	23.71	11.43
1975	9.71	9.86	83.33	1,505.10	851.03	459.20	381.60	3.70	0	66.04	89.15	27.75
1976	19.53	29.24	302.40	282.10	120.26	32.09	13.74	.92	0	12.55	9.78	6.63
1977	5.29	7.59	35.11	21.75	16.73	22.14	31.12	8.79	12.09	25.71	7.09	5.53
1978	3.75	3.42	655.40	542.20	93.24	85.83	44.55	25.01	31.79	7.62	8.29	5.41
1979	5.05	7.88	37.89	2,116.00	1,096.00	153.06	173.67	46.49	32.98	0	31.03	32.10
1980	18.02	14.57	88.15	136.76	31.69	37.23	38.99	41.62	71.64	26.30	45.72	10.97
1981	11.52	70.60	111.40	122.00	37.04	104.01	51.71	9.70	0	19.97	7.81	15.55
1982	6.53	0	357.10	1,542.00	217.62	116.50	115.97	15.07	4.57	59.89	37.48	23.09
Mean	8.48	10.84	177.76	510.15	177.50	126.79	88.98	27.38	21.52	26.84	23.65	14.54

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River at the North Dakota-South Dakota State line												
1953	11.02	15.54	80.10	39.50	55.17	426.58	120.21	27.74	15.92	14.00	14.54	10.59
1954	8.81	36.19	25.35	31.67	21.61	378.14	163.32	19.53	14.97	11.63	12.43	11.16
1955	7.94	5.39	64.00	230.38	34.27	90.72	75.32	21.51	12.38	9.68	9.56	6.03
1956	4.36	4.51	28.31	110.68	136.42	322.04	46.02	18.43	13.35	9.50	22.45	15.43
1957	4.46	2.01	23.18	48.79	36.67	22.45	14.46	13.53	48.93	79.19	63.64	41.93
1958	19.39	14.88	301.18	199.93	62.96	45.17	22.80	7.84	8.79	7.19	11.32	4.11
1959	.22	0	10.55	20.35	15.20	20.66	19.22	1.78	4.33	8.54	8.17	7.84
1960	5.11	3.60	119.91	670.05	65.80	80.41	15.48	5.93	3.93	4.28	9.26	4.75
1961	5.18	3.68	39.71	24.18	19.82	8.14	6.16	3.98	7.80	5.71	6.51	6.09
1962	5.15	6.15	145.40	183.17	59.28	109.46	971.69	199.12	67.64	33.63	30.80	20.45
1963	9.70	3.85	32.03	67.18	52.89	44.17	20.64	18.26	12.82	6.34	8.98	4.66
1964	4.24	5.82	8.78	67.25	42.44	242.36	91.84	19.75	8.46	14.04	12.23	6.64
1965	5.56	4.75	7.09	1,045.98	218.24	71.17	50.99	184.28	156.34	181.84	92.71	54.22
1966	13.13	16.73	2,044.47	1,043.11	504.81	225.51	159.19	140.26	37.46	51.84	21.34	8.69
1967	7.84	6.77	279.76	639.76	427.27	177.12	91.57	7.07	14.24	19.55	13.06	6.18
1968	5.67	7.85	45.34	50.28	54.82	163.21	28.80	13.26	14.96	13.64	14.23	8.11
1969	1.17	.22	1.19	4,642.91	289.91	73.73	83.09	35.94	32.69	22.99	23.22	28.01
1970	21.17	14.40	39.64	376.01	274.03	154.70	13.70	17.86	10.80	8.83	12.05	8.39
1971	5.93	4.85	83.81	688.94	103.95	207.20	132.99	9.17	2.96	24.07	43.20	23.05
1972	11.21	9.43	673.08	320.20	218.89	78.81	20.12	4.83	3.35	18.79	13.27	16.58
1973	14.08	12.07	168.00	30.39	19.58	8.50	2.36	3.46	28.56	43.01	11.67	8.32
1974	5.77	7.29	187.84	472.13	557.92	206.71	28.54	6.70	3.68	15.96	23.71	11.43
1975	9.71	9.86	83.70	1,812.36	1,025.96	574.42	468.00	10.64	1.80	66.04	89.15	27.75
1976	19.53	30.44	363.88	320.74	124.46	33.27	23.42	9.54	3.30	12.55	9.78	6.63
1977	5.29	7.59	35.61	22.27	16.86	23.07	43.69	19.97	16.37	25.71	7.19	5.53
1978	3.75	3.42	885.14	669.51	98.79	87.47	59.15	33.58	56.91	8.62	8.49	5.61
1979	5.05	7.88	58.42	2,799.17	1,319.41	164.50	192.19	56.00	36.32	0	31.23	32.10
1980	18.02	14.57	106.15	157.13	33.15	42.07	51.58	52.82	75.93	26.30	45.72	10.97
1981	11.52	70.60	112.15	123.75	37.06	106.63	67.46	22.41	4.74	19.97	7.81	15.55
1982	6.53	0	416.27	1,874.61	242.57	123.94	136.04	30.29	9.54	59.89	37.48	23.09
Mean	8.55	11.01	215.67	626.08	205.67	143.74	107.33	33.85	24.31	27.44	23.84	14.66

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River at Columbia S.Dak.												
1953	11.08	15.74	92.03	42.40	61.56	489.96	137.57	28.51	15.71	13.92	14.67	10.62
1954	8.80	38.50	26.39	33.33	22.02	434.25	187.12	19.48	14.72	11.47	12.45	11.21
1955	7.90	5.35	73.26	264.69	36.27	103.86	86.00	21.61	12.02	9.47	9.50	6.00
1956	4.33	4.48	29.71	127.07	156.50	369.78	49.94	18.33	13.04	9.25	23.14	15.69
1957	4.42	1.98	24.00	53.56	39.06	22.82	14.15	13.12	53.39	90.78	72.42	45.59
1958	19.92	15.05	346.26	229.72	71.59	48.91	23.11	7.29	8.35	6.94	11.31	4.08
1959	.20	0	10.54	20.77	15.16	20.87	19.21	1.28	3.88	8.29	8.07	7.81
1960	5.07	3.57	0	770.35	75.31	92.03	15.22	5.37	3.50	4.03	9.18	4.72
1961	5.16	3.66	42.89	24.96	20.10	7.75	5.64	3.42	7.36	5.46	6.40	6.07
1962	5.12	6.12	167.12	210.43	66.82	125.42	1,116.70	228.25	77.21	35.57	32.44	21.08
1963	9.71	3.82	33.94	76.94	58.71	47.70	20.77	18.13	12.50	6.08	8.89	4.63
1964	4.21	5.80	8.73	77.06	45.89	0	105.03	19.76	8.02	13.99	12.25	6.60
1965	5.53	4.72	7.03	589.81	250.58	81.41	56.04	211.19	179.22	208.80	106.52	60.00
1966	13.25	17.00	2,351.00	1,199.39	580.13	258.76	182.41	160.65	39.68	57.44	21.93	8.68
1967	7.81	6.73	321.60	735.50	490.90	203.18	104.70	6.52	13.98	19.86	13.11	6.15
1968	5.64	7.81	49.67	55.39	61.15	187.19	29.76	12.85	14.74	13.19	14.47	8.07
1969	1.51	.43	1.19	5,053.73	335.16	82.67	96.47	40.56	29.93	23.42	23.97	29.34
1970	17.92	14.48	35.49	409.48	316.92	201.15	12.29	20.28	7.18	8.21	12.12	8.34
1971	6.16	5.04	86.16	1,139.38	118.80	283.87	144.14	8.25	.45	21.87	45.14	23.81
1972	11.40	9.71	980.64	338.12	344.11	112.08	21.56	3.20	2.57	18.65	13.41	16.88
1973	13.76	12.35	156.09	31.81	19.69	6.79	2.36	3.11	26.18	47.68	11.80	8.29
1974	6.21	7.53	142.02	1,550.30	1,566.65	1,243.85	28.28	5.07	2.20	15.65	24.20	11.48
1975	8.96	9.33	70.68	1,261.32	1,711.68	451.86	454.62	9.06	1.80	75.27	102.52	29.11
1976	19.60	31.78	308.20	509.02	142.09	32.89	25.01	8.96	3.29	12.59	9.83	6.64
1977	5.50	7.74	33.45	22.89	16.88	23.43	48.14	20.43	15.65	26.30	7.23	5.51
1978	4.13	3.66	0	855.02	112.72	97.51	68.03	34.20	58.64	8.34	8.54	5.59
1979	5.50	8.14	64.97	3,655.47	3,096.05	191.77	205.89	61.44	34.49	0	32.96	34.05
1980	18.20	14.82	111.97	175.29	34.71	26.96	26.17	20.67	28.22	28.96	47.09	10.93
1981	7.99	18.20	326.80	46.27	39.10	130.62	78.36	22.85	4.74	21.09	7.51	15.76
1982	6.86	0	8.15	1,548.49	278.96	156.67	139.88	29.31	6.13	67.74	36.52	23.37
Mean	8.40	9.45	197.00	703.60	339.51	184.53	116.82	35.44	23.29	29.68	25.32	15.20

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Synthesized unregulated streamflow, in cubic feet per second, of the James River near Stratford S.Dak.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1953	13.29	17.92	163.18	179.89	167.09	584.13	300.96	292.91	41.86	18.05	18.64	17.50
1954	12.38	45.86	36.02	42.12	47.50	525.62	245.78	39.89	15.41	11.42	0	29.63
1955	10.33	7.80	115.06	305.45	69.04	107.42	101.69	61.83	16.17	12.38	12.20	8.88
1956	7.51	8.28	32.97	138.60	160.84	310.22	76.65	39.10	16.45	12.70	25.38	18.21
1957	7.04	4.61	26.92	37.12	61.34	90.23	45.13	22.59	47.73	86.94	60.57	37.83
1958	12.62	3.46	378.91	272.39	158.61	103.42	44.40	12.80	12.10	10.02	13.51	6.72
1959	2.81	3.13	13.64	24.13	18.59	25.28	24.15	6.10	7.98	11.29	10.91	10.55
1960	7.89	6.61	11.77	735.16	185.14	128.18	9.19	26.49	8.42	6.65	7.21	6.00
1961	7.22	5.94	42.58	35.68	28.12	17.60	10.18	8.96	10.32	8.42	6.57	8.00
1962	7.11	8.77	175.67	230.66	266.63	102.84	1,279.87	186.63	446.79	109.68	45.34	51.59
1963	19.16	9.53	37.10	77.46	97.61	86.42	130.80	31.32	16.47	9.50	0	3.66
1964	5.43	7.09	10.07	105.78	278.99	192.14	510.43	206.46	21.71	16.86	12.07	8.88
1965	7.95	7.20	9.66	632.91	417.47	287.40	74.16	207.32	151.64	200.56	130.52	64.14
1966	14.83	14.66	2,401.04	1,394.65	797.29	385.38	323.72	400.15	106.58	69.69	29.29	9.50
1967	12.65	12.66	323.88	702.26	709.80	354.15	153.51	52.98	17.44	23.35	15.50	8.77
1968	8.94	10.80	53.70	100.89	160.09	232.80	42.53	45.26	18.18	0	0	26.96
1969	4.00	3.08	4.00	5,684.97	936.94	250.07	295.81	357.53	101.34	16.44	65.39	33.00
1970	53.54	25.42	48.46	429.36	449.17	275.65	25.63	25.22	10.72	10.81	14.94	11.14
1971	8.91	7.47	97.38	1,170.37	107.03	265.94	181.40	1.95	23.39	23.84	22.39	33.32
1972	23.22	18.94	1,063.93	565.44	644.29	344.57	71.93	36.93	9.55	0	0	27.74
1973	18.59	16.01	186.11	75.37	33.83	11.21	9.60	10.29	30.05	47.89	8.76	11.11
1974	9.50	11.00	146.12	1,562.89	1,558.35	1,218.96	0	0	7.41	18.67	21.07	8.36
1975	5.59	7.45	72.96	1,288.82	1,482.14	548.08	118.41	70.91	26.34	0	1.55	31.84
1976	18.43	13.43	241.23	612.60	106.46	33.91	30.61	16.90	8.60	15.94	12.81	9.68
1977	8.54	10.44	37.91	46.65	22.49	28.23	54.86	26.30	19.97	29.65	11.34	9.74
1978	6.90	6.82	124.28	1,335.71	649.43	284.09	204.10	244.17	69.80	0	0	17.99
1979	8.77	10.97	65.05	3,800.07	3,065.27	389.08	624.94	118.67	45.48	0	0	35.83
1980	30.15	13.49	102.39	224.26	77.07	53.86	58.55	39.60	40.62	14.30	9.56	0
1981	0	18.76	324.32	58.84	58.08	143.14	92.89	34.59	21.44	23.50	1.33	0
1982	0	.22	0	1,693.96	475.99	370.77	197.90	0	0	30.49	0	18.64
Mean	11.78	11.26	211.54	785.48	443.02	258.36	177.99	87.46	45.67	27.97	18.56	18.84

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River at Ashton, S.Dak.												
1953	13.37	19.84	219.32	219.23	181.02	614.21	276.29	457.04	53.26	23.32	19.11	19.24
1954	13.47	49.16	49.73	36.59	51.90	504.72	255.85	49.16	15.33	11.42	0	36.45
1955	11.92	8.14	117.92	315.80	87.27	111.66	78.27	82.88	17.29	12.38	12.20	8.88
1956	7.51	8.28	32.97	130.13	154.38	305.03	101.55	47.52	17.04	12.70	25.38	18.21
1957	7.04	4.61	27.29	51.75	67.38	113.07	58.68	25.03	45.21	86.28	55.36	26.31
1958	16.98	0	389.01	298.56	172.16	112.75	55.62	13.35	12.10	10.02	13.51	6.72
1959	2.81	3.13	13.64	24.13	18.59	25.28	24.15	6.10	7.98	11.29	10.91	10.55
1960	7.89	6.61	20.96	822.94	239.81	154.21	4.63	30.77	8.62	6.67	7.21	6.00
1961	7.22	5.94	41.67	31.85	27.57	19.97	10.00	8.96	10.32	8.42	6.57	8.00
1962	7.11	8.77	213.86	333.80	381.37	176.01	1,231.69	67.83	544.56	164.09	63.02	62.09
1963	21.39	11.16	36.66	65.73	106.57	78.48	166.37	35.01	16.15	9.50	0	1.46
1964	6.20	6.73	10.36	108.85	262.50	189.44	447.43	261.27	27.80	17.40	12.30	8.91
1965	7.95	7.20	9.66	607.15	447.02	456.53	90.49	202.83	143.37	205.26	154.41	65.95
1966	15.65	15.13	2,364.92	1,223.81	857.81	509.29	456.62	474.26	139.49	81.43	37.17	12.59
1967	15.48	13.14	338.86	757.26	802.21	466.25	186.54	62.58	18.15	20.26	16.15	10.51
1968	9.37	11.81	51.21	95.54	180.58	250.12	45.89	59.03	18.91	0	0	36.77
1969	7.27	3.13	4.62	5,969.63	1,594.99	387.58	433.86	488.65	152.40	18.73	83.32	.60
1970	79.02	32.07	86.54	445.39	491.63	311.20	36.32	25.87	10.72	10.81	14.96	11.16
1971	8.91	7.47	99.87	1,188.97	106.49	270.44	185.17	8.05	17.97	22.20	12.97	35.26
1972	32.83	19.88	1,073.65	488.57	739.61	446.01	89.28	127.86	15.39	6.64	24.74	36.49
1973	21.68	18.35	217.39	75.51	35.83	13.21	9.64	10.29	30.05	47.89	8.76	11.11
1974	9.50	12.32	161.48	1,563.53	1,571.75	1,252.40	12.59	24.95	13.70	18.70	21.07	8.36
1975	5.59	7.45	73.05	1,290.08	1,544.27	675.06	146.38	381.71	186.68	117.29	112.28	76.76
1976	42.64	39.88	294.86	627.17	144.07	74.59	33.45	18.80	8.62	15.94	12.81	9.68
1977	8.54	10.44	54.40	38.97	25.94	32.65	55.54	26.30	19.97	29.65	11.39	9.76
1978	6.90	6.82	128.32	1,455.84	775.81	377.28	235.15	361.36	87.48	16.23	18.35	29.47
1979	9.95	11.65	81.35	3,830.26	3,268.18	553.30	655.25	255.82	93.58	53.13	96.13	95.72
1980	47.33	17.77	112.59	231.10	83.19	65.16	61.07	41.52	40.62	14.30	15.13	8.49
1981	8.13	22.02	329.49	58.65	58.61	143.84	93.45	34.59	21.44	23.50	1.33	0
1982	0	4.93	6.42	1,733.59	592.10	475.12	214.04	23.94	20.74	59.65	53.80	54.43
Mean	15.32	13.13	222.07	804.01	502.35	305.50	191.71	123.78	60.50	37.84	30.68	24.20

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River near Redfield, S.Dak.												
1953	14.26	24.58	577.08	335.67	417.15	689.92	390.86	788.02	92.00	35.05	26.44	26.70
1954	15.17	57.78	89.15	80.89	88.28	538.60	260.71	62.65	15.68	11.42	0	40.10
1955	11.97	8.50	259.69	347.28	92.52	135.12	78.37	90.49	17.68	12.38	12.20	8.88
1956	7.51	8.28	35.75	140.01	153.64	325.94	89.06	49.10	16.44	12.70	25.38	18.21
1957	7.04	4.61	29.45	122.41	117.55	176.40	148.69	28.31	43.91	96.18	59.21	29.79
1958	20.62	2.36	436.01	451.93	221.42	114.01	58.84	14.13	12.10	10.02	13.51	6.72
1959	2.81	3.13	17.06	25.49	19.06	25.43	24.15	6.10	7.98	11.29	10.91	10.55
1960	7.89	6.61	90.76	2,047.66	344.03	190.11	23.24	33.65	8.79	8.47	9.53	6.64
1961	7.32	6.03	47.81	30.64	37.36	22.30	12.70	10.13	10.32	8.42	6.57	8.00
1962	7.11	8.77	295.69	708.17	504.59	423.65	1,390.88	97.97	584.80	187.64	72.69	67.04
1963	26.54	13.52	39.94	62.79	105.56	85.24	185.27	36.90	19.18	9.68	0	5.95
1964	9.56	9.99	11.61	117.17	322.46	208.04	397.83	292.03	38.40	18.08	12.35	8.94
1965	7.95	7.24	10.81	595.27	487.89	521.31	108.52	190.86	135.61	186.72	133.98	66.58
1966	16.54	16.03	2,931.03	1,260.65	934.16	542.80	512.04	530.79	147.67	93.24	40.64	13.56
1967	15.76	13.99	395.84	832.92	807.08	545.74	240.04	94.96	26.52	20.43	16.22	8.70
1968	8.54	11.67	47.91	161.76	196.51	267.20	39.65	73.88	22.64	.13	0	40.67
1969	10.83	5.53	12.78	8,465.32	1,992.07	476.05	587.87	563.07	135.05	10.57	83.16	0
1970	100.60	34.90	127.34	546.90	535.64	353.30	67.07	32.87	11.78	11.08	15.61	11.27
1971	8.94	7.96	105.53	1,211.38	128.23	272.95	180.52	2.91	35.24	36.75	10.29	33.00
1972	39.70	19.48	1,489.46	648.75	1,039.51	561.07	132.97	128.51	6.99	7.24	8.25	42.20
1973	22.46	25.73	439.90	122.94	43.81	19.43	11.92	12.59	30.05	47.89	8.76	11.11
1974	9.50	11.29	157.60	1,577.95	1,572.37	1,248.00	11.14	8.80	7.48	18.59	21.07	8.36
1975	5.59	7.45	72.84	1,309.42	1,464.84	639.92	100.78	321.23	202.76	86.36	108.84	84.11
1976	47.70	42.06	283.74	629.87	160.60	127.86	44.09	14.62	9.04	15.94	12.81	9.68
1977	8.54	10.44	130.77	51.58	24.07	32.45	61.46	29.63	21.49	29.65	11.29	9.73
1978	6.90	6.82	901.99	2,163.44	908.08	444.49	247.64	379.30	82.75	14.26	22.67	34.22
1979	13.25	12.80	93.30	3,871.43	3,282.33	562.01	635.95	271.67	99.61	15.68	82.13	105.63
1980	50.50	18.91	115.13	308.86	93.27	68.03	64.63	43.62	40.79	14.62	6.10	11.90
1981	15.29	24.67	333.91	65.96	61.44	145.22	95.59	35.79	21.81	23.50	1.33	0
1982	0	8.25	59.83	1,944.67	605.36	476.38	221.37	29.14	27.49	71.17	58.91	59.39
Mean	17.55	14.65	321.32	1,007.97	558.70	341.30	214.13	142.46	64.40	37.51	29.70	26.25

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River at Huron, S.Dak.												
1953	14.44	32.07	808.32	397.13	483.24	732.62	578.43	1,321.91	124.35	42.80	36.18	40.40
1954	25.78	109.37	110.46	85.88	102.42	533.59	254.87	62.30	28.42	13.97	1.36	19.32
1955	17.86	11.45	415.78	370.00	91.15	156.16	47.13	118.22	18.62	14.08	13.70	10.38
1956	9.27	10.10	41.68	169.88	145.44	342.86	95.42	231.02	24.99	15.09	32.59	20.90
1957	10.51	12.01	64.34	192.93	236.95	301.58	203.45	37.03	49.86	92.36	58.94	44.43
1958	36.49	17.32	468.91	522.53	232.79	148.85	119.57	17.30	15.09	11.99	15.24	8.46
1959	4.18	4.56	19.65	27.12	20.70	27.70	27.13	8.86	10.27	12.78	12.23	11.89
1960	9.37	8.14	312.14	3,185.88	392.26	211.65	29.21	50.42	16.96	8.26	8.64	7.43
1961	9.06	7.92	119.24	37.60	45.91	35.98	13.87	12.67	13.39	23.45	9.43	9.79
1962	8.72	14.19	676.78	2,017.73	951.97	1,196.60	1,648.40	108.86	603.28	228.51	98.72	79.43
1963	51.21	36.86	72.70	37.44	127.94	53.07	195.77	37.80	17.97	11.74	.71	10.96
1964	20.77	21.30	19.09	114.28	242.55	210.98	343.78	310.01	40.07	19.48	20.32	11.06
1965	10.49	9.83	15.48	571.39	469.40	603.12	128.72	180.88	137.57	158.42	149.10	88.39
1966	26.83	38.41	3,330.47	1,300.65	1,000.30	567.20	585.01	542.48	190.28	119.73	52.13	32.72
1967	35.86	35.98	755.51	877.83	869.58	830.47	350.29	93.07	30.37	22.90	21.55	21.74
1968	22.51	21.32	47.96	90.69	170.57	258.90	0	81.92	43.14	7.20	0	54.51
1969	29.47	13.72	73.92	9,165.40	2,399.20	538.90	583.78	592.09	207.44	40.14	110.42	9.84
1970	164.40	66.71	528.34	680.14	625.05	449.07	83.48	41.96	15.75	13.21	18.67	15.12
1971	11.11	13.67	200.70	1,204.40	105.22	255.28	156.91	.08	15.50	36.09	10.79	19.73
1972	54.79	36.26	1,833.93	775.70	1,598.30	941.51	177.95	140.58	35.46	20.18	15.92	64.22
1973	55.51	83.35	667.21	161.02	57.95	21.85	18.26	17.35	34.23	50.40	11.61	13.35
1974	11.84	27.19	164.09	1,574.37	1,557.08	1,248.48	20.44	32.88	30.96	21.35	25.18	10.64
1975	7.82	9.78	86.80	1,326.09	1,444.54	614.88	40.77	369.35	197.89	101.51	98.25	123.53
1976	86.78	91.60	307.76	588.85	122.09	84.13	70.73	26.48	14.92	18.36	14.94	12.07
1977	10.34	12.32	446.76	76.45	27.99	39.12	69.52	36.45	25.88	31.63	13.04	13.11
1978	10.29	9.13	1,369.04	2,967.72	996.04	535.12	236.35	411.84	141.41	19.69	27.16	39.99
1979	27.81	22.38	123.62	3,969.44	3,293.21	633.87	670.93	299.29	130.50	21.22	95.74	121.52
1980	89.79	33.80	150.53	279.28	123.62	115.09	87.97	54.38	44.05	16.62	3.61	0
1981	20.87	33.55	333.07	56.87	64.03	150.87	103.58	51.00	25.14	25.68	3.26	1.90
1982	1.97	19.82	59.21	1,914.89	648.75	473.21	244.42	28.96	52.43	104.44	66.55	77.23
Mean	29.87	28.80	454.12	1,157.99	621.54	410.42	239.54	177.25	77.87	44.11	34.87	33.14

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River near Forestburg, S.Dak.												
1953	21.00	26.23	962.38	485.79	623.78	782.74	523.25	1,363.28	140.41	44.48	42.10	49.59
1954	28.04	124.04	135.71	106.08	113.06	575.99	259.87	65.41	34.99	23.04	15.43	24.88
1955	22.82	17.65	548.81	389.55	98.36	153.09	45.49	114.28	21.49	16.95	14.69	12.69
1956	12.07	13.07	55.65	220.76	130.87	341.77	88.80	307.53	30.64	18.73	41.11	27.11
1957	14.44	12.48	114.17	207.34	300.30	403.11	260.78	44.38	52.49	98.42	72.08	45.18
1958	38.01	15.68	475.07	658.61	267.92	147.05	120.31	22.02	16.35	14.02	22.12	13.35
1959	6.07	5.53	31.09	30.52	26.31	39.96	27.44	9.01	11.24	16.15	17.19	18.78
1960	13.21	13.59	272.55	4,816.03	413.58	221.54	31.66	57.57	25.21	12.86	12.12	11.76
1961	11.84	23.75	307.01	57.17	80.21	93.59	29.40	16.69	13.98	29.88	17.06	15.73
1962	11.11	16.62	859.71	3,370.19	2,073.68	2,739.56	2,210.66	214.25	604.31	248.16	99.71	81.46
1963	51.41	37.18	94.80	69.85	191.24	129.41	248.21	49.59	22.65	19.84	3.24	5.35
1964	25.16	26.45	29.29	138.95	286.46	277.67	285.48	339.93	53.11	22.59	20.15	17.56
1965	18.83	17.03	24.67	549.39	445.56	667.92	138.48	180.99	141.37	162.74	160.56	90.36
1966	23.55	38.05	3,562.25	1,288.65	1,094.30	567.17	550.26	546.62	218.55	132.49	54.27	33.58
1967	34.58	34.61	711.33	872.40	862.15	1,055.15	436.73	114.18	32.82	35.06	24.59	19.06
1968	16.69	21.37	57.52	105.93	236.30	306.15	44.12	102.31	31.14	10.85	0	52.92
1969	32.17	13.86	69.65	9,939.29	2,900.80	588.60	564.54	561.53	242.71	28.72	100.32	0
1970	178.49	73.75	632.34	717.78	687.18	560.11	127.45	49.31	16.08	17.03	26.10	23.06
1971	13.12	17.11	403.97	1,253.74	132.25	268.93	167.66	0	16.08	39.23	26.20	39.75
1972	62.50	36.08	1,986.22	769.73	2,105.02	1,329.32	289.86	216.12	46.64	39.94	22.08	72.22
1973	64.03	81.93	1,337.83	271.82	98.54	35.66	27.97	21.35	36.75	61.44	25.86	20.59
1974	15.06	50.38	240.55	1,594.94	1,569.80	1,278.65	32.98	31.63	32.82	32.30	27.88	13.66
1975	10.20	13.52	86.70	1,363.84	1,462.76	605.03	0	327.41	212.06	113.09	105.24	137.34
1976	93.40	106.20	325.05	583.42	117.76	99.84	83.15	26.75	14.92	18.36	14.94	11.82
1977	10.34	12.32	984.14	150.88	39.58	42.77	71.00	36.87	26.03	33.36	22.07	13.94
1978	9.71	9.67	1,228.88	3,141.73	1,130.52	634.76	209.84	436.04	144.53	11.89	27.29	39.32
1979	25.00	23.19	152.47	3,883.41	3,176.13	687.84	667.14	278.98	132.97	26.28	93.05	103.77
1980	93.01	38.26	126.17	271.08	145.65	112.06	87.30	55.55	44.67	18.90	9.75	0
1981	17.22	35.44	332.68	64.48	70.55	151.25	103.58	55.15	25.18	25.61	5.80	8.88
1982	2.05	8.23	96.76	1,817.72	643.62	548.28	282.80	21.21	42.50	120.54	91.26	110.41
Mean	32.50	32.11	541.51	1,306.37	717.47	514.83	267.21	188.86	82.82	49.77	40.48	37.14

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River near Mitchell, S.Dak.												
1953	22.15	29.82	1,115.15	561.86	674.95	835.64	573.34	1,359.97	172.19	54.84	44.89	58.68
1954	32.40	131.93	167.81	128.76	140.94	833.30	291.39	86.93	47.07	23.66	14.79	29.76
1955	28.01	25.50	945.15	525.31	135.23	173.92	48.12	92.52	20.28	15.55	17.65	15.04
1956	11.35	13.14	63.95	240.17	129.62	349.07	91.73	298.17	32.05	14.90	43.22	29.05
1957	15.21	15.76	121.50	215.26	358.22	496.13	448.61	74.18	59.04	102.00	81.83	47.44
1958	43.33	16.44	551.64	792.82	289.26	153.62	133.10	39.34	14.52	12.03	25.39	15.71
1959	5.38	5.19	34.92	29.49	25.47	39.19	23.74	6.15	9.61	14.10	19.85	21.70
1960	13.37	16.26	330.15	5,425.20	465.13	252.57	44.30	80.21	28.20	11.06	14.34	13.95
1961	11.56	29.22	364.90	61.27	95.25	111.45	37.47	23.83	12.07	29.34	20.62	18.41
1962	10.75	19.55	986.75	3,886.18	2,133.91	3,065.03	2,497.76	37.50	317.84	302.09	72.40	73.04
1963	56.76	43.93	112.90	89.59	226.58	172.90	280.17	65.66	22.92	17.97	6.62	8.78
1964	29.27	32.18	34.64	150.63	324.52	305.07	338.95	321.48	54.80	20.13	22.77	20.04
1965	19.91	20.09	27.26	583.05	505.66	749.65	154.24	182.05	135.44	165.48	163.69	95.84
1966	20.44	43.93	3,443.91	1,337.08	1,226.77	599.02	563.74	572.72	211.85	135.82	57.49	32.33
1967	31.32	35.54	731.48	905.58	892.00	1,244.20	578.36	129.46	33.71	29.58	24.30	19.24
1968	16.57	22.45	58.82	87.32	218.79	303.42	60.74	116.46	24.42	15.43	0	40.80
1969	44.04	19.70	70.81	10,997.10	3,281.25	679.70	574.72	578.70	267.14	31.96	103.77	0
1970	181.50	85.17	677.06	800.78	557.43	401.23	134.99	53.17	14.86	14.77	26.54	25.73
1971	12.60	24.34	713.05	1,302.01	154.39	264.42	171.32	10.29	8.74	33.11	30.30	34.04
1972	74.15	40.37	1,949.01	977.50	2,525.21	1,885.60	357.71	245.46	44.60	5.82	16.00	70.83
1973	68.84	86.55	1,530.34	310.57	108.72	36.74	27.14	23.79	35.59	59.36	29.16	23.13
1974	14.46	56.83	266.93	1,609.33	1,583.23	1,292.50	39.81	48.24	35.29	30.32	30.01	14.67
1975	9.45	14.91	88.90	1,387.43	1,502.25	678.19	110.88	104.48	8.30	174.77	0	87.68
1976	99.26	106.36	358.40	627.57	150.81	124.23	95.71	25.78	12.03	16.31	13.31	10.16
1977	8.51	10.39	1,146.57	172.78	45.24	45.24	67.44	34.07	23.39	31.10	25.48	14.90
1978	8.25	8.66	1,412.12	3,591.78	1,196.50	726.55	282.50	405.58	135.89	14.12	22.92	41.50
1979	27.44	27.33	199.16	3,997.30	3,237.37	823.10	799.92	253.92	89.49	43.33	0	55.33
1980	98.77	44.56	157.61	334.80	162.05	120.14	84.59	55.51	42.40	16.60	12.60	.28
1981	20.48	58.81	351.44	68.99	71.19	148.80	99.74	63.57	22.15	23.42	7.28	11.73
1982	.20	11.49	139.31	1,930.91	704.17	615.49	297.41	35.88	34.33	141.52	32.52	74.62
Mean	34.52	36.55	605.05	1,930.91	770.74	584.20	310.32	180.84	65.67	53.35	32.66	33.48

Supplement 2.--Synthesized unregulated streamflow for gaging stations on the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Synthesized unregulated streamflow, in cubic feet per second, of the James River near Scotland, S.Dak.												
1953	40.69	59.94	1,169.29	792.80	937.65	1,071.12	655.08	1,423.34	219.62	64.06	62.92	76.86
1954	49.88	202.89	293.07	195.36	202.06	1,098.14	330.39	130.12	72.80	44.71	46.67	52.12
1955	47.59	56.29	1,240.35	632.43	167.50	185.79	59.67	97.42	26.20	21.58	23.70	25.03
1956	24.27	28.18	110.88	306.67	149.20	351.24	92.38	346.13	40.59	17.37	50.50	39.88
1957	24.95	23.21	117.05	205.46	310.44	621.70	469.33	96.04	67.98	101.84	90.99	52.22
1958	48.12	23.32	525.21	901.65	345.48	174.90	165.51	52.38	17.61	12.57	40.48	25.44
1959	16.49	16.22	63.26	56.77	50.04	41.22	28.98	5.48	11.92	15.06	27.51	34.71
1960	27.65	24.88	937.05	7,768.57	816.31	357.20	81.72	86.44	41.06	22.90	26.20	31.13
1961	27.79	174.06	407.16	103.14	154.97	365.52	75.43	47.13	18.30	30.85	39.49	28.93
1962	20.74	43.52	958.66	7,151.89	2,160.48	6,931.08	4,653.60	780.47	741.26	484.62	183.15	111.45
1963	69.82	107.84	259.04	160.78	303.59	139.00	333.27	122.84	44.48	36.20	23.39	3.97
1964	43.26	60.54	99.86	211.48	274.19	341.12	202.40	400.49	98.50	38.89	34.20	24.49
1965	26.22	31.60	40.53	513.12	323.11	808.35	303.31	215.00	132.90	159.82	217.88	140.65
1966	40.38	60.54	3,470.34	1,543.74	1,514.96	685.11	614.58	642.68	291.06	163.98	76.40	44.95
1967	46.03	51.53	651.19	970.76	923.80	1,220.44	751.65	158.71	44.55	40.84	33.31	32.19
1968	28.33	37.42	79.35	98.25	175.58	361.27	64.89	126.50	97.27	43.62	18.49	50.71
1969	59.57	34.39	195.55	11,841.87	3,721.89	1,076.28	757.21	630.47	320.92	60.78	123.50	13.27
1970	175.01	172.28	1,001.39	901.23	826.07	625.70	190.05	64.42	21.21	23.16	42.57	37.80
1971	23.73	51.15	1,385.95	1,403.84	193.99	478.17	237.02	24.88	4.81	47.93	39.29	39.11
1972	83.95	61.58	2,233.98	1,018.47	2,648.44	2,712.10	364.28	262.09	78.82	60.47	67.27	92.07
1973	148.11	280.57	2,643.00	496.39	198.50	85.94	39.15	25.01	46.59	89.29	47.81	46.97
1974	49.86	78.20	360.37	1,634.56	1,596.74	1,362.01	41.44	31.80	26.23	39.52	42.22	24.23
1975	21.70	23.64	114.07	1,367.75	1,408.84	617.54	0	262.70	243.33	130.06	158.64	167.95
1976	111.36	207.77	417.45	595.57	132.87	142.46	120.66	36.17	15.41	21.29	18.91	17.13
1977	12.28	22.17	1,039.64	253.94	73.67	73.00	98.49	45.75	62.13	70.08	82.03	42.90
1978	24.82	25.93	1,971.32	4,305.92	1,757.20	878.12	405.40	570.55	198.46	31.13	41.21	60.37
1979	45.90	43.74	920.90	4,027.79	3,107.75	942.83	704.63	394.32	178.90	25.83	99.17	119.72
1980	141.80	65.88	195.94	277.96	197.83	126.63	123.75	71.41	47.11	19.58	8.60	8.64
1981	11.35	63.11	359.36	50.42	82.52	158.51	113.78	53.12	31.98	34.59	11.63	16.59
1982	11.09	101.57	130.30	1,713.61	720.75	886.12	350.15	47.52	31.29	166.98	169.53	149.98
Mean	50.09	74.47	779.72	1,716.89	849.21	830.62	414.27	241.71	109.11	70.65	64.92	53.72

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between the headwaters and Grace City gage												
1953	0	0	0	0.02	0.03	0.03	0.05	0.05	0.03	0	0	0
1954	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1955	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1956	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1957	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1958	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1959	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1960	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1961	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1962	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1963	0	0	0	.05	.08	.10	.10	.10	.10	.02	0	0
1964	0	0	0	.05	.08	.10	.10	.10	.10	.08	.03	0
1965	0	0	0	.13	.26	.28	.29	.29	.28	.08	.03	0
1966	0	0	0	.07	.13	.15	.15	.15	.15	.26	.13	0
1967	0	0	0	.07	.13	.15	.15	.15	.15	.13	.07	0
1968	0	0	0	.07	.15	.15	.16	.16	.15	.13	.07	0
1969	0	0	0	.07	.15	.15	.16	.16	.15	.13	.07	0
1970	0	0	0	.08	.15	.17	.18	.18	.17	.13	.07	0
1971	0	0	0	.02	.03	.03	.05	.05	.03	.15	.07	0
1972	0	0	0	.03	.06	.08	.10	.10	.08	.02	.02	0
1973	0	0	0	.03	.05	.07	.06	.06	.07	.06	.03	0
1974	0	0	0	.03	.05	.07	.06	.06	.07	.03	.02	0
1975	0	0	0	.03	.05	.05	.06	.06	.05	.03	.02	0
1976	0	0	0	.03	.05	.05	.06	.06	.05	.05	.02	0
1977	0	0	0	.02	.16	.05	.18	.06	.17	.05	.02	0
1978	0	0	0	.02	.03	.03	.05	.05	.03	.15	.02	0
1979	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1980	0	0	0	.02	.03	.03	.05	.05	.03	.02	0	0
1981	0	0	0	.02	.03	.03	.05	.05	.03	.02	.02	0
1982	0	0	0	.02	.03	.03	.07	.05	.03	.02	.02	0
Mean	0	0	0	.03	.07	.07	.08	.08	.07	.06	.02	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between the Pingree gage and Jamestown gage												
1953	0	0	0.31	0.32	0.13	0.13	0.03	0.02	0.02	0	0	0
1954	0	0	.31	.32	.13	.15	.03	.02	.02	0	0	0
1955	0	0	.31	.30	.13	.13	.03	.02	.02	0	0	0
1956	0	0	0	0	0	.03	.42	.36	.15	0	0	0
1957	0	0	0	0	0	.03	.32	.29	.12	0	0	0
1958	0	0	0	0	0	.03	.34	.31	.12	0	0	0
1959	0	0	0	0	0	.03	.34	.31	.12	0	0	0
1960	0	0	0	0	0	.03	.36	.31	.12	0	0	0
1961	0	0	0	0	0	.03	.34	.31	.12	0	0	0
1962	0	0	0	0	0	.03	.31	.27	.10	0	0	0
1963	0	0	0	0	0	.03	.27	.24	.10	0	0	0
1964	0	0	0	0	0	.02	.23	.21	.08	0	0	0
1965	0	0	0	0	0	.02	.16	.15	.05	0	0	0
1966	0	0	0	0	0	.02	.19	.16	.07	0	0	0
1967	0	0	0	0	0	.02	.08	.06	.03	0	0	0
1968	0	0	0	0	0	.02	.06	.05	.02	0	0	0
1969	0	0	0	0	0	.02	.08	.06	.03	0	0	0
1970	0	0	0	0	0	.02	.08	.06	.03	0	0	0
1971	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1972	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1973	0	0	0	0	0	.03	.31	.27	.12	0	0	0
1974	0	0	0	0	0	.03	.32	.27	.12	0	0	0
1975	0	0	0	0	0	.03	.34	.29	.12	0	0	0
1976	0	0	0	0	0	.07	.87	.76	.30	0	0	0
1977	0	0	0	0	0	.08	1.07	.94	.37	0	0	0
1978	0	0	0	0	0	.05	2.20	.50	.20	0	0	0
1979	0	0	0	0	0	.05	2.18	.50	.20	0	0	0
1980	0	0	0	0	0	.13	1.58	1.41	.55	0	0	0
1981	0	0	0	0	0	.08	1.08	.95	.37	0	0	0
1982	0	0	0	0	0	.17	2.26	2.02	.77	0	0	0
Mean	0	0	.03	.03	.01	.05	.53	.38	.15	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from Pipestem Creek												
1953	0.02	0.02	0.05	0.12	0.21	0.28	0.37	0.40	0.32	0.18	0.07	0.02
1954	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1955	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1956	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1957	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1958	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1959	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1960	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1961	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1962	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1963	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1964	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1965	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1966	.02	.02	.05	.12	.21	.30	.37	.40	.32	.18	.07	.02
1967	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1968	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1969	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1970	.02	.02	.05	.12	.21	.28	.37	.40	.32	.18	.07	.02
1971	.02	.02	.05	.12	.21	.28	.37	.44	.32	.18	.07	.02
1972	.02	.02	.05	.12	.21	.28	.37	.44	.30	.18	.07	.02
1973	0	.02	.05	.12	.21	.28	.37	.45	.32	.16	.07	.02
1974	0	.02	.05	.12	.21	.28	.37	.47	.32	.16	.07	.02
1975	0	.02	.05	.12	.21	.28	.42	.45	.32	.16	.07	.02
1976	0	.02	.05	.12	.21	.28	.42	.45	.32	.16	.07	.02
1977	0	.02	.05	.12	.22	.28	.44	.47	.32	.16	.07	.02
1978	0	.02	.05	.12	.22	.28	.44	.47	.32	.17	.07	.02
1979	0	.02	.05	.12	.22	.28	.44	.47	.32	.17	.07	.02
1980	0	.02	.05	.12	.22	.28	.44	.47	.32	.17	.07	.02
1981	0	.02	.05	.12	.22	.28	.44	.47	.32	.17	.07	.02
1982	.02	.02	.05	.12	.20	.27	.44	.47	.28	.17	.07	.02
Mean	.01	.02	.05	.12	.20	.27	.37	.41	.31	.17	.07	.02

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between the Jamestown gage and the LaMoure gage												
1953	0	0	0.02	0.02	0	0.08	1.13	1.00	0.38	0	0	0
1954	0	0	.02	.02	0	.08	1.13	1.00	.38	0	0	0
1955	0	0	.02	.02	0	.08	1.13	1.00	.38	0	0	0
1956	0	0	.02	.02	0	.08	1.13	1.00	.38	0	0	0
1957	0	0	.10	.10	.03	.08	.57	.50	.20	0	0	0
1958	0	0	.10	.10	.03	.08	.57	.50	.20	0	0	0
1959	0	0	.10	.10	.03	.08	.57	.50	.20	0	0	0
1960	0	0	.10	.10	.03	.08	.63	.57	.22	0	0	0
1961	0	0	.10	.10	.03	.10	.74	.66	.27	0	0	0
1962	0	0	.03	.03	.02	.07	.71	.63	.23	0	0	0
1963	0	0	.10	.10	.03	.10	.71	.65	.23	0	0	0
1964	0	0	.10	.10	.03	.10	.71	.65	.23	0	0	0
1965	0	0	.10	.10	.03	.07	.27	.24	.10	0	0	0
1966	0	0	.10	.10	.03	.08	.57	.50	.20	0	0	0
1967	0	0	.10	.10	.03	.07	.21	.19	.07	0	0	0
1968	0	0	.10	.10	.03	.07	.29	.26	.10	0	0	0
1969	0	0	.10	.10	.03	.07	.50	.45	.17	0	0	0
1970	0	0	.10	.10	.03	.07	.53	.47	.18	0	0	0
1971	0	0	.10	.10	.03	.07	.21	.19	.07	0	0	0
1972	0	0	.10	.10	.03	.07	.36	.32	.12	0	0	0
1973	0	0	.10	.10	.03	.13	1.21	1.08	.42	0	0	0
1974	0	0	.10	.10	.03	.22	2.33	2.07	.80	0	0	0
1975	0	0	.10	.10	.03	.20	2.00	1.78	.67	0	0	0
1976	0	0	.10	.10	.03	.33	3.94	3.51	1.34	0	0	0
1977	0	0	0	0	0	.15	1.91	1.70	.65	0	0	0
1978	0	0	0	0	0	.15	2.05	1.83	.70	0	0	0
1979	0	0	0	0	0	.20	2.65	2.36	.90	0	0	0
1980	0	0	0	0	0	.23	3.05	2.72	1.04	0	0	0
1981	0	0	0	0	0	.18	2.39	2.13	.82	0	0	0
1982	0	0	0	0	0	.20	2.62	2.32	.89	0	0	0
Mean	0	0	.06	.06	.02	.12	1.19	1.06	.40	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
			Surface-water withdrawals, in cubic feet per second, from Bear Creek									
1953	0	0	0	0	0	0.05	0.57	0.50	0.20	0	0	0
1954	0	0	0	0	0	.05	.57	.50	.20	0	0	0
1955	0	0	0	0	0	.05	.57	.50	.20	0	0	0
1956	0	0	0	0	0	.05	.57	.50	.20	0	0	0
1957	0	0	0	0	0	.05	.57	.50	.20	0	0	0
1958	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1959	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1960	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1961	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1962	0	0	0	0	0	.03	.29	.26	.10	0	0	0
1963	0	0	0	0	0	.03	.32	.26	.10	0	0	0
1964	0	0	0	0	0	.03	.34	.31	.12	0	0	0
1965	0	0	0	0	0	.05	.52	.45	.17	0	0	0
1966	0	0	0	0	0	.05	.52	.45	.17	0	0	0
1967	0	0	0	0	0	.05	.52	.45	.17	0	0	0
1968	0	0	0	0	0	.03	.58	.52	.20	0	0	0
1969	0	0	0	0	0	.03	.52	.45	.17	0	0	0
1970	0	0	0	0	0	.03	.19	.19	.07	0	0	0
1971	0	0	0	0	0	.05	.69	.61	.23	0	0	0
1972	0	0	0	0	0	.03	.58	.52	.20	0	0	0
1973	0	0	0	0	0	.03	.60	.53	.20	0	0	0
1974	0	0	0	0	0	.03	.45	.42	.17	0	0	0
1975	0	0	0	0	0	.03	.36	.31	.12	0	0	0
1976	0	0	0	0	0	.03	.36	.31	.12	0	0	0
1977	0	0	0	0	0	.03	.36	.31	.12	0	0	0
1978	0	0	0	0	0	.02	.32	.29	.12	0	0	0
1979	0	0	0	0	0	.03	.34	.31	.12	0	0	0
1980	0	0	0	0	0	.03	.39	.34	.13	0	0	0
1981	0	0	0	0	0	.03	.42	.37	.13	0	0	0
1982	0	0	0	0	0	.02	.32	.29	.12	0	0	0
Mean	0	0	0	0	0	.03	.42	.37	.14	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between the junction of Bear Creek and the James River and the LaMoure gage												
1953	0	0	0	0	0	0.05	0.74	0.66	0.25	0	0	0
1954	0	0	0	0	0	.02	.23	.21	.08	0	0	0
1955	0	0	.06	.07	.03	.05	.23	.21	.08	0	0	0
1956	0	0	0	0	0	.02	.23	.21	.08	0	0	0
1957	0	0	0	0	0	.02	.23	.21	.08	0	0	0
1958	0	0	0	0	0	.03	.36	.32	.13	0	0	0
1959	0	0	0	0	0	.03	.48	.44	.17	0	0	0
1960	0	0	0	0	0	.03	.36	.32	.13	0	0	0
1961	0	0	0	0	0	.03	.36	.32	.13	0	0	0
1962	0	0	0	0	0	.03	.36	.32	.13	0	0	0
1963	0	0	0	0	0	.03	.36	.32	.13	0	0	0
1964	0	0	0	0	0	.03	.36	.32	.13	0	0	0
1965	0	0	0	0	0	0	.08	.08	.03	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	.02	.13	.13	.03	0	0	0
1968	0	0	0	0	0	.02	.16	.15	.07	0	0	0
1969	0	0	0	0	0	.02	.06	.06	.03	0	0	0
1970	0	0	0	0	0	.02	.27	.26	.10	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	.08	.08	.03	.03	.08	.06	.03	0	0	0
1973	0	0	.31	.32	.13	.13	.08	.06	.03	0	0	0
1974	0	0	.45	.47	.19	.22	.10	.10	.03	0	0	0
1975	0	0	.11	.12	.05	.15	1.29	1.15	.43	0	0	0
1976	0	0	.42	.43	.18	.32	1.66	1.49	.57	0	0	0
1977	0	0	.11	.12	.05	.07	2.21	1.97	.75	0	0	0
1978	0	0	.11	.12	.05	.22	2.29	2.04	.78	0	0	0
1979	0	0	.06	.07	.03	.23	2.63	2.36	.90	0	0	0
1980	0	0	.02	.02	0	.12	1.39	1.23	.47	0	0	0
1981	0	0	.03	.03	.02	.13	1.49	1.33	.50	0	0	0
1982	0	0	.34	.37	.15	.29	1.76	1.56	.60	0	0	0
Mean	0	0	.07	.07	.03	.08	.64	.58	.22	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between the junction of Bear Creek and the James River and the State line												
1953	0	0	0	0	0	0.07	0.99	0.87	0.33	0	0	0
1954	0	0	0	0	0	.07	.99	.87	.33	0	0	0
1955	0	0	0	0	0	.07	.99	1.03	.33	0	0	0
1956	0	0	0	0	0	.07	.99	.87	.33	0	0	0
1957	0	0	0	0	0	.05	.65	.58	.23	0	0	0
1958	0	0	0	0	0	.05	.65	.58	.23	0	0	0
1959	0	0	0	0	0	.05	.65	.58	.23	0	0	0
1960	0	0	0	0	0	.03	.53	.48	.18	0	0	0
1961	0	0	0	0	0	.07	.74	.66	.25	0	0	0
1962	0	0	0	0	0	.05	.69	.61	.23	0	0	0
1963	0	0	0	0	0	.07	.74	.68	.27	0	0	0
1964	0	0	0	0	0	.05	.61	.55	.20	0	0	0
1965	0	0	0	0	0	.03	.58	.52	.20	0	0	0
1966	0	0	.11	.12	.10	.17	1.00	.91	.33	0	0	0
1967	0	0	.11	.12	.10	.17	.91	.81	.23	0	0	0
1968	0	0	.19	.20	.08	.10	.81	.71	.27	0	0	0
1969	0	0	.19	.20	.08	.13	.57	.50	.20	0	0	0
1970	0	0	.23	.23	.10	.15	.66	.60	.23	0	0	0
1971	0	0	.23	.23	.10	.15	.66	.60	.23	0	0	0
1972	0	0	.23	.23	.10	.18	1.13	1.00	.38	0	0	0
1973	0	0	.23	.23	.10	.23	1.58	1.41	.53	0	0	0
1974	0	0	.23	.23	.10	.27	1.41	1.83	.70	0	0	0
1975	0	0	.26	.27	.11	.28	2.18	2.18	.75	0	0	0
1976	0	0	.58	.60	.24	.83	7.66	6.82	2.61	0	0	0
1977	0	0	.19	.20	.08	.83	10.00	8.90	3.41	0	0	0
1978	0	0	.21	.22	.10	.60	6.79	6.04	2.32	0	0	0
1979	0	0	.37	.38	.16	.68	6.80	6.04	2.32	0	0	0
1980	0	0	.58	.60	.26	1.09	10.81	9.63	3.69	0	0	0
1981	0	0	0	0	0	.92	12.04	10.71	4.11	0	0	0
1982	0	0	0	0	0	.94	12.44	11.07	4.25	0	0	0
Mean	0	0	.13	.13	.06	.27	2.81	2.54	.96	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between the North Dakota-South Dakota State line and Columbia, S.Dak.												
1953	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	.42	.42	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0
Mean	0	0	0	0	0	0	.01	.01	0	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between Columbia, S.Dak., and Stratford, S.Dak.												
1953	0	0	0	0	1.04	1.60	1.97	1.48	0	0	0	0
1954	0	0	0	0	1.04	1.60	1.97	1.48	0	0	0	0
1955	0	0	0	0	1.04	1.60	1.97	1.48	0	0	0	0
1956	0	0	0	0	1.04	1.41	1.97	1.48	0	0	0	0
1957	0	0	0	0	1.04	1.60	1.97	1.48	0	0	0	0
1958	0	0	0	0	1.04	1.60	1.97	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	1.04	1.60	1.97	1.32	0	0	0	0
1961	0	0	0	0	.11	.18	0	0	0	0	0	0
1962	0	0	0	0	1.04	1.60	1.97	1.48	0	0	0	0
1963	0	0	0	0	1.25	1.90	2.34	1.48	0	0	0	0
1964	0	0	0	0	2.05	3.13	3.84	2.24	0	0	0	0
1965	0	0	0	0	2.05	3.13	2.98	.16	0	0	0	0
1966	0	0	0	0	2.05	3.13	2.98	2.89	0	0	0	0
1967	0	0	0	0	2.05	3.13	2.98	2.08	0	0	0	0
1968	0	0	0	0	0	0	2.11	1.66	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	.24	2.63	1.32	0	0	0	0
1971	0	0	0	0	0	.24	2.44	1.22	0	0	0	0
1972	0	0	0	0	0	0	1.92	1.22	0	0	0	0
1973	0	0	0	0	0	.15	2.46	1.01	0	0	0	0
1974	0	0	0	0	0	.34	3.53	3.42	.54	0	0	0
1975	0	0	0	0	0	0	3.69	3.69	1.41	0	0	0
1976	0	0	0	0	.85	1.24	5.32	.02	0	0	0	0
1977	0	0	0	.54	.15	.10	.11	.15	0	0	0	0
1978	0	0	0	0	.33	4.05	8.25	11.06	1.95	0	0	0
1979	0	0	0	5.98	5.17	6.44	11.89	11.71	10.17	0	0	0
1980	0	0	0	11.14	16.34	10.62	19.40	11.71	8.39	0	0	0
1981	0	0	0	7.85	10.67	7.90	11.43	9.43	10.45	0	0	0
1982	0	0	0	.42	1.51	3.85	12.07	11.56	3.24	0	0	0
Mean	0	0	0	.86	1.76	2.08	3.94	2.94	1.21	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between Stratford, S.Dak., and Ashton, S.Dak.												
1953	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	.29	.57	.11	0	0	0	0	0
1977	0	0	0	0	.05	.69	.67	0	0	0	0	0
1978	0	0	0	0	0	.97	1.51	1.28	0	0	0	0
1979	0	0	0	0	0	.25	1.38	1.38	0	0	0	0
1980	0	0	0	0	0	.57	1.11	.78	0	0	0	0
1981	0	0	0	0	0	.57	.55	0	0	0	0	0
1982	0	0	0	0	0	.74	1.30	.80	0	0	0	0
Mean	0	0	0	0	.01	.15	.22	.14	0	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
				Surface-water withdrawals, in cubic feet per second, from the James River between Ashton, S.Dak., and Redfield, S.Dak.								
1953	0	0	0	0	8.07	2.42	3.20	2.67	0	0	0	0
1954	0	0	0	0	8.07	2.42	.76	.59	0	0	0	0
1955	0	0	0	0	.41	2.42	.76	.59	0	0	0	0
1956	0	0	0	0	.41	2.42	.76	.59	0	0	0	0
1957	0	0	0	0	8.78	3.26	5.68	.59	0	0	0	0
1958	0	0	0	0	8.78	.62	.76	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	9.25	3.76	.76	.59	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	9.25	3.76	4.77	.59	0	0	0	0
1963	0	0	0	0	.41	.62	.76	.59	0	0	0	0
1964	0	0	0	0	1.55	2.34	2.88	2.18	0	0	0	0
1965	0	0	0	0	3.58	5.41	6.68	0	0	0	0	0
1966	0	0	0	0	3.58	5.41	6.68	5.06	0	0	0	0
1967	0	0	0	0	15.84	9.92	12.12	6.05	0	0	0	0
1968	0	0	0	0	1.09	2.91	9.47	6.80	.25	0	0	0
1969	0	0	0	4.08	2.26	4.47	10.33	6.90	1.18	0	0	0
1970	0	0	0	3.45	1.82	5.08	11.34	6.31	1.06	0	0	0
1971	0	0	0	5.04	1.63	5.04	10.57	6.51	1.18	0	0	0
1972	0	0	0	0	35.73	.15	.65	1.61	.34	0	0	0
1973	0	0	0	11.46	.70	1.43	2.29	2.29	0	0	0	0
1974	0	0	0	2.25	.07	.76	2.08	1.33	1.14	0	0	0
1975	0	0	0	10.32	.80	.92	7.30	4.00	.92	0	0	0
1976	0	0	0	0	2.52	5.65	4.85	1.04	.47	0	0	0
1977	0	0	0	.10	.34	3.46	5.94	3.33	1.53	0	0	0
1978	0	0	0	43.24	.33	2.74	5.37	3.68	1.14	0	0	0
1979	0	0	0	.10	2.37	2.50	4.28	1.56	.54	0	0	0
1980	0	0	0	.05	.08	1.31	1.69	.78	.07	0	0	0
1981	0	0	0	0	.81	1.28	2.13	1.20	.37	0	0	0
1982	0	0	0	3.58	.65	2.76	4.50	4.70	.82	0	0	0
Mean	0	0	0	2.79	4.31	2.84	4.31	2.40	.37	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
			Surface-water withdrawals, in cubic feet per second, from the James River between Redfield, S.Dak., and Huron, S.Dak.									
1953	0	0	0	0	1.84	2.77	3.42	2.59	0	0	0	0
1954	0	0	0	0	2.03	3.08	2.00	1.51	0	0	0	0
1955	0	0	0	0	2.03	3.08	2.00	1.51	0	0	0	0
1956	0	0	0	0	1.06	3.08	2.00	1.51	0	0	0	0
1957	0	0	0	0	3.84	5.80	7.16	4.05	0	0	0	0
1958	0	0	0	0	3.84	5.80	5.35	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	3.84	5.80	5.35	4.05	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	4.72	7.14	8.83	5.01	0	0	0	0
1963	0	0	0	0	3.55	5.36	6.64	5.01	0	0	0	0
1964	0	0	0	0	6.59	9.97	12.33	9.30	0	0	0	0
1965	0	0	0	0	9.74	14.76	18.23	0	0	0	0	0
1966	0	0	0	0	13.19	19.96	24.69	18.64	0	0	0	0
1967	0	0	0	0	18.77	28.40	35.11	21.79	0	0	0	0
1968	0	0	0	0	4.37	10.00	11.86	6.51	0	0	0	0
1969	0	0	0	0	2.29	6.99	11.61	7.29	.52	0	0	0
1970	0	0	0	0	2.23	3.50	17.35	6.26	.34	0	0	0
1971	0	0	0	0	2.44	4.54	16.26	9.76	.67	0	0	0
1972	0	0	0	0	0	2.57	14.56	8.73	.71	0	0	0
1973	0	0	0	0	3.61	4.54	1.48	.16	.39	0	0	0
1974	0	0	0	0	1.33	17.01	43.86	40.61	14.27	0	0	0
1975	0	0	0	0	.85	1.61	22.22	15.56	2.45	0	0	0
1976	0	0	0	5.39	17.89	39.46	32.90	7.38	2.18	0	0	0
1977	0	0	0	5.33	2.57	3.55	4.11	3.16	1.36	0	0	0
1978	0	0	0	1.97	9.97	11.88	31.78	18.23	4.02	0	0	0
1979	0	0	0	0	2.03	4.32	22.77	13.69	2.54	0	0	0
1980	0	0	0	0	7.59	12.82	10.44	10.77	.20	0	0	0
1981	0	0	0	0	.86	1.98	3.27	.70	.10	0	0	0
1982	0	0	0	0	7.06	12.54	27.53	21.84	3.23	0	0	0
Mean	0	0	0	.42	4.67	8.41	13.50	8.19	1.10	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between Huron, S.Dak., and Forestburg, S.Dak.												
1953	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	.37	.55	0	0	0	0	0	0
1956	0	0	0	0	.42	.64	.80	1.12	0	0	0	0
1957	0	0	0	0	.80	1.19	1.50	.60	0	0	0	0
1958	0	0	0	0	1.51	1.73	2.13	1.61	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	2.86	4.32	4.65	3.51	0	0	0	0
1961	0	0	0	0	2.33	3.53	4.36	2.76	0	0	0	0
1962	0	0	0	0	2.33	3.53	4.36	3.29	0	0	0	0
1963	0	0	0	0	2.33	3.83	4.03	3.06	0	0	0	0
1964	0	0	0	0	3.07	4.10	5.06	3.82	0	0	0	0
1965	0	0	0	0	2.70	4.10	5.06	3.82	0	0	0	0
1966	0	0	0	0	3.20	4.84	5.98	4.52	0	0	0	0
1967	0	0	0	0	3.24	5.46	6.77	4.59	0	0	0	0
1968	0	0	0	0	1.53	1.66	6.36	2.91	0	0	0	0
1969	0	0	0	0	0	1.29	1.82	.67	.05	0	0	0
1970	0	0	0	0	0	0	5.07	2.83	0	0	0	0
1971	0	0	0	0	0	1.01	4.88	2.44	0	0	0	0
1972	0	0	0	0	0	0	.21	.11	.07	0	0	0
1973	0	0	0	0	0	.07	2.28	.42	0	0	0	0
1974	0	0	0	0	0	0	8.60	3.20	0	0	0	0
1975	0	0	0	0	0	.29	9.29	5.22	0	0	0	0
1976	0	0	0	.10	0	4.15	5.40	.28	0	0	0	0
1977	0	0	0	.22	.24	.54	.54	.33	0	0	0	0
1978	0	0	0	0	0	.60	.91	.91	.62	0	0	0
1979	0	0	0	0	.02	.82	2.83	2.05	.54	0	0	0
1980	0	0	0	0	1.53	1.38	0	0	0	0	0	0
1981	0	0	0	.13	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	.47	.49	2.13	0	0	0	0
Mean	0	0	0	.02	.95	1.67	3.11	1.87	.04	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between Forestburg, S.Dak., and Mitchell, S.Dak.												
1953	0	0	0	0	1.79	2.72	3.37	1.82	0	0	0	0
1954	0	0	0	0	2.83	4.29	4.34	3.27	0	0	0	0
1955	0	0	0	0	2.83	4.29	4.34	3.27	0	0	0	0
1956	0	0	0	0	3.38	5.13	6.34	5.50	0	0	0	0
1957	0	0	0	0	5.25	7.97	9.86	7.43	0	0	0	0
1958	0	0	0	0	5.25	7.19	8.90	6.72	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	6.11	9.28	10.52	7.94	0	0	0	0
1961	0	0	0	0	6.11	9.28	11.47	7.94	0	0	0	0
1962	0	0	0	0	6.11	9.28	11.47	8.65	0	0	0	0
1963	0	0	0	0	6.11	9.28	10.52	7.94	0	0	0	0
1964	0	0	0	0	6.11	8.50	10.52	7.94	0	0	0	0
1965	0	0	0	0	7.33	11.13	13.74	10.38	0	0	0	0
1966	0	0	0	0	7.33	11.13	13.74	10.38	0	0	0	0
1967	0	0	0	0	12.43	20.10	24.85	17.56	0	0	0	0
1968	0	0	0	0	2.33	5.23	12.41	4.83	.84	0	0	0
1969	0	0	0	0	0	1.45	11.81	7.03	3.90	0	0	0
1970	0	0	0	0	.37	7.68	14.62	6.41	.72	0	0	0
1971	0	0	0	0	.33	3.36	11.38	5.69	2.52	0	0	0
1972	0	0	0	0	.02	.02	.39	.31	.02	0	0	0
1973	0	0	0	0	.23	1.97	3.87	1.77	.20	0	0	0
1974	0	0	0	.20	.55	.66	8.10	4.00	.18	0	0	0
1975	0	0	0	0	.50	1.04	11.34	6.08	.40	0	0	0
1976	0	0	0	1.33	4.93	11.01	15.91	2.37	.07	0	0	0
1977	0	0	0	1.61	4.98	4.99	.42	.46	.18	0	0	0
1978	0	0	0	0	4.47	12.22	17.42	14.36	5.09	0	0	0
1979	0	0	0	.15	.16	1.31	3.33	3.01	.12	0	0	0
1980	0	0	0	1.83	2.72	2.45	.91	0	0	0	0	0
1981	0	0	0	0	.39	.52	.02	0	0	0	0	0
1982	0	0	0	0	2.16	.24	3.16	1.22	.13	0	0	0
Mean	0	0	0	.17	3.44	5.79	8.64	5.48	.48	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River between Mitchell, S.Dak., and Scotland, S.Dak.												
1953	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	1.09	1.65	2.03	1.55	0	0	0	0
1958	0	0	0	0	1.09	1.65	2.03	1.55	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	2.20	3.33	4.10	3.11	0	0	0	0
1961	0	0	0	0	2.20	3.33	4.10	3.11	0	0	0	0
1962	0	0	0	0	2.20	3.33	4.10	3.11	0	0	0	0
1963	0	0	0	0	2.20	3.33	4.10	3.11	0	0	0	0
1964	0	0	0	0	2.31	3.48	4.29	3.25	0	0	0	0
1965	0	0	0	0	2.63	3.97	4.90	3.71	0	0	0	0
1966	0	0	0	0	2.63	3.97	4.90	3.71	0	0	0	0
1967	0	0	0	0	2.63	3.97	4.90	3.71	0	0	0	0
1968	0	0	0	1.48	1.79	1.51	2.18	.83	.47	0	0	0
1969	0	0	0	0	0	0	.15	.13	0	0	0	0
1970	0	0	0	0	1.09	2.91	4.39	1.22	.07	0	0	0
1971	0	0	0	0	.81	2.52	6.18	1.63	.84	0	0	0
1972	0	0	0	0	0	0	.18	.49	.08	0	0	0
1973	0	0	0	0	.63	.97	.72	.86	.25	0	0	0
1974	0	0	0	0	.15	3.29	5.32	2.76	1.48	0	0	0
1975	0	0	0	0	.13	2.84	5.63	4.86	1.34	0	0	0
1976	0	0	0	0	1.48	7.34	16.64	6.33	0	0	0	0
1977	0	0	0	.24	2.62	10.86	20.35	6.47	0	0	0	0
1978	0	0	0	0	.68	3.50	10.59	10.80	.25	0	0	0
1979	0	0	0	0	0	2.55	6.77	8.28	2.03	0	0	0
1980	0	0	0	.39	6.60	18.32	34.19	11.89	0	0	0	0
1981	0	0	0	.20	6.10	5.04	6.80	2.86	0	0	0	0
1982	0	0	0	.91	1.51	11.88	24.13	19.45	.66	0	0	0
Mean	0	0	0	.11	1.49	3.52	6.12	3.63	.25	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River for city of Aberdeen, S.Dak.												
1953	2.60	2.55	2.52	2.64	2.90	3.02	4.18	4.36	4.41	3.33	2.80	2.91
1954	3.30	3.27	2.94	3.13	3.58	3.62	6.07	4.39	3.29	2.99	2.78	2.79
1955	2.83	2.87	3.14	3.10	4.48	4.25	5.38	4.41	4.55	3.43	3.18	3.38
1956	3.76	4.46	4.33	3.24	4.00	5.01	4.78	4.32	3.86	4.05	2.63	2.97
1957	3.08	3.09	3.23	3.11	3.14	3.13	5.37	4.22	3.19	2.96	2.60	2.72
1958	2.91	2.80	2.73	2.74	3.76	3.44	4.82	6.47	4.40	3.62	2.59	3.11
1959	3.09	3.69	3.66	3.95	4.04	5.19	5.82	5.67	4.82	3.51	3.33	3.24
1960	3.31	3.59	3.28	3.27	4.27	5.21	8.07	5.29	5.16	3.08	2.50	2.52
1961	2.57	2.69	2.66	3.04	3.46	5.51	4.96	6.52	3.47	3.50	2.50	2.35
1962	2.34	3.12	3.01	2.94	3.23	3.64	3.50	6.14	3.57	3.01	2.77	2.90
1963	2.86	3.59	3.72	3.83	3.99	4.95	5.31	4.70	4.40	4.02	2.91	2.99
1964	2.82	2.93	2.83	2.82	4.07	4.78	6.07	4.24	4.12	3.04	2.81	2.72
1965	2.84	2.93	3.10	2.94	3.28	4.20	5.54	6.53	3.93	3.11	2.88	3.01
1966	2.86	2.93	3.06	3.04	4.25	5.16	6.08	4.44	4.22	3.34	3.16	3.39
1967	3.42	3.39	3.64	3.56	4.30	4.20	6.23	6.46	4.53	3.27	2.83	2.70
1968	2.81	3.35	2.80	2.76	3.40	3.73	5.12	6.22	3.64	4.38	3.00	3.22
1969	2.59	3.12	3.32	3.40	3.11	4.47	3.45	6.38	4.83	3.72	2.93	2.74
1970	2.73	2.85	2.87	2.94	3.16	5.77	7.44	3.99	4.18	3.06	3.32	3.29
1971	3.24	2.87	2.65	3.16	4.18	4.00	4.34	7.24	3.37	3.85	3.58	3.52
1972	4.07	4.69	3.66	3.53	3.98	5.29	4.92	6.05	5.60	3.95	3.05	3.16
1973	3.07	3.08	3.06	3.23	5.55	7.43	7.18	7.50	4.55	4.11	3.59	3.50
1974	3.87	3.34	3.33	3.35	3.77	7.70	7.78	6.71	5.59	3.76	3.37	3.25
1975	2.92	2.96	3.24	3.61	3.57	4.52	9.10	6.72	5.13	4.09	3.76	3.67
1976	3.69	3.60	3.61	3.61	7.15	7.50	10.62	7.84	6.22	3.94	3.50	3.58
1977	3.58	3.18	3.00	4.27	4.94	5.52	7.78	6.73	5.08	3.94	4.79	4.96
1978	3.24	3.72	2.78	3.78	3.14	5.79	5.16	6.21	5.13	3.98	2.99	2.73
1979	2.68	2.92	4.20	4.11	3.56	3.41	5.75	5.59	6.72	4.86	3.68	3.27
1980	3.40	3.49	3.19	4.97	7.80	5.94	10.49	6.20	4.69	3.78	3.08	2.80
1981	3.06	3.44	3.09	4.61	6.60	5.43	7.94	6.51	7.41	3.47	3.16	2.98
1982	3.14	3.63	3.53	4.25	3.93	5.37	9.48	8.16	3.26	3.51	3.14	3.01
Mean	3.09	3.27	3.21	3.43	4.15	4.91	6.29	5.87	4.58	3.62	3.11	3.11

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second from the James River for city of Huron, S.Dak.												
1953	1.35	1.40	1.35	1.60	2.09	2.39	2.94	2.72	2.25	1.48	1.31	1.31
1954	1.45	1.51	1.45	1.72	2.25	2.57	3.17	2.93	2.43	1.60	1.41	1.41
1955	1.82	1.89	1.82	2.16	2.82	3.22	3.97	3.68	3.04	2.00	1.76	1.76
1956	2.07	2.14	2.07	2.45	3.20	3.65	4.50	4.17	3.45	2.27	2.00	2.00
1957	1.83	1.90	1.83	2.17	2.84	3.24	3.99	3.69	3.05	2.01	1.77	1.77
1958	2.12	2.19	2.12	2.50	3.28	3.74	4.61	4.26	3.53	2.32	2.04	2.05
1959	1.61	1.67	1.61	1.91	2.50	2.85	3.51	3.25	2.69	1.77	1.56	1.56
1960	1.73	1.80	1.73	2.05	2.68	3.06	3.77	3.49	2.89	1.90	1.68	1.68
1961	2.17	2.25	2.17	2.57	3.36	3.83	4.72	4.37	3.61	2.38	2.10	2.10
1962	1.90	1.97	1.90	2.25	2.94	3.35	4.13	3.83	3.16	2.08	1.84	1.84
1963	2.17	2.25	2.17	2.57	3.36	3.84	4.73	4.38	3.62	2.38	2.10	2.10
1964	2.66	2.75	2.66	3.14	4.12	4.70	5.79	5.36	4.43	2.92	2.57	2.57
1965	2.99	3.10	2.99	3.54	4.63	5.29	6.52	6.03	4.99	3.28	2.89	2.90
1966	2.66	2.76	2.66	3.15	4.12	4.70	5.80	5.37	4.44	2.92	2.57	2.58
1967	2.62	2.71	2.62	3.10	4.05	4.62	5.70	5.28	4.36	2.87	2.53	2.53
1968	2.35	2.44	2.35	2.79	3.65	4.16	5.13	4.75	3.92	2.58	2.28	2.28
1969	2.44	2.53	2.44	2.89	3.78	4.31	5.31	4.92	4.07	2.68	2.35	2.36
1970	2.56	2.66	2.56	3.03	3.97	4.53	5.58	5.17	4.27	2.82	2.48	2.48
1971	2.58	2.67	2.58	3.05	3.99	4.55	5.61	5.19	4.29	2.82	2.49	2.49
1972	2.44	2.53	2.44	2.89	3.78	4.31	5.31	4.92	4.06	2.67	2.36	2.36
1973	2.68	2.78	2.68	3.17	4.15	4.74	5.84	5.41	4.47	2.94	2.59	2.60
1974	2.75	2.84	2.75	3.25	4.25	4.85	5.98	5.54	4.58	3.01	2.65	2.66
1975	2.63	2.72	2.63	3.11	4.07	4.64	5.72	5.30	4.38	2.88	2.54	2.54
1976	2.61	2.70	2.61	3.08	4.03	4.60	5.67	5.25	4.34	2.86	2.52	2.52
1977	2.13	2.21	2.13	2.40	3.30	3.77	4.64	4.30	3.55	2.34	2.06	2.06
1978	2.63	2.72	2.63	3.11	4.07	4.64	5.72	5.29	4.38	2.88	2.54	2.54
1979	2.16	2.42	2.31	2.25	3.19	4.18	4.30	4.42	4.57	2.60	2.06	2.07
1980	2.09	2.06	1.94	2.88	4.26	3.40	4.60	3.94	3.77	2.73	2.04	2.07
1981	1.98	2.01	2.06	2.96	3.81	4.68	5.57	3.80	3.80	2.48	2.27	2.24
1982	2.31	2.30	2.24	2.22	2.41	3.20	4.39	4.48	2.86	2.03	2.08	2.05
Mean	2.25	2.33	2.25	2.67	3.50	3.99	4.91	4.52	3.78	2.48	2.18	2.18

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second, from the James River for city of Mitchell, S.Dak.												
1953	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	21.21	21.92	0	0	0	22.46	0	0	0	0
1980	0	0	22.93	23.70	0	0	0	0	0	0	0	0
1981	0	17.96	16.22	0	0	0	0	0	0	0	0	0
1982	0	0	17.47	0	0	0	0	0	0	0	0	0
Mean	0	.60	2.59	1.52	0	0	0	.75	0	0	0	0

Supplement 3.--Surface-water withdrawals from the James River in North Dakota and South Dakota, 1953-82--Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Surface-water withdrawals, in cubic feet per second from the James River for city of Mitchell, S.Dak.--Wastewater												
1953	1.33	1.40	1.37	1.69	2.13	2.25	2.83	2.64	2.32	1.62	1.28	1.31
1954	1.06	1.12	1.10	1.35	1.71	1.80	2.27	2.11	1.86	1.29	1.03	1.05
1955	1.33	1.40	1.38	1.70	2.14	2.26	2.84	2.65	2.33	1.62	1.29	1.31
1956	1.56	1.64	1.61	1.98	2.50	2.64	3.32	3.09	2.72	1.89	1.50	1.53
1957	1.34	1.41	1.38	1.70	2.15	2.27	2.86	2.66	2.34	1.63	1.29	1.32
1958	1.63	1.71	1.68	2.07	2.61	2.75	3.46	3.22	2.84	1.97	1.57	1.60
1959	1.72	1.81	1.77	2.18	2.76	2.91	3.66	3.41	3.00	2.08	1.66	1.69
1960	1.56	1.64	1.61	1.98	2.50	2.64	3.32	3.09	2.72	1.89	1.50	1.53
1961	1.66	1.75	1.71	2.11	2.66	2.81	3.53	3.29	2.89	2.01	1.60	1.63
1962	1.59	1.67	1.64	2.02	2.55	2.69	3.39	3.15	2.77	1.93	1.53	1.56
1963	1.84	1.94	1.90	2.34	2.95	3.11	3.92	3.65	3.21	2.23	1.78	1.81
1964	2.05	2.16	2.12	2.60	3.29	3.47	4.37	4.06	3.57	2.49	1.98	2.02
1965	1.85	1.95	1.91	2.35	2.97	3.13	3.94	3.67	3.23	2.24	1.79	1.82
1966	2.00	2.11	2.07	2.54	3.22	3.39	4.27	3.97	3.49	2.43	1.93	1.97
1967	1.94	2.04	2.00	2.46	3.11	3.28	4.13	3.84	3.38	2.35	1.87	1.91
1968	1.96	2.06	2.02	2.49	3.15	3.32	4.18	3.89	3.42	2.38	1.89	1.93
1969	1.77	1.81	1.83	2.25	2.84	3.00	3.77	3.51	3.09	2.15	1.71	1.74
1970	2.10	2.21	2.17	2.67	3.37	3.55	4.47	4.16	3.66	2.54	2.03	2.06
1971	1.94	2.04	2.00	2.47	3.12	3.29	4.14	3.85	3.39	2.35	1.87	1.91
1972	1.94	2.04	2.00	2.46	3.11	3.28	4.13	3.84	3.38	2.35	1.87	1.90
1973	2.20	2.31	2.27	2.79	3.53	3.72	4.69	4.36	3.84	2.67	2.12	2.16
1974	2.13	2.24	2.20	2.70	3.42	3.60	4.53	4.22	3.71	2.58	2.05	2.09
1975	1.96	2.07	2.03	2.49	3.15	3.32	4.18	3.89	3.42	2.38	1.89	1.93
1976	1.69	1.78	1.75	2.15	2.72	2.87	3.61	3.36	2.95	2.05	1.63	1.66
1977	1.84	1.93	1.90	2.33	2.95	3.11	3.92	3.64	3.21	2.23	1.77	1.81
1978	1.88	1.98	1.94	2.39	3.02	3.19	4.01	3.73	3.28	2.28	1.82	1.85
1979	1.81	1.90	1.87	2.30	2.90	3.06	3.85	3.58	3.15	2.19	1.74	1.78
1980	1.88	1.98	1.94	2.39	3.02	3.19	4.01	3.73	3.28	2.28	1.82	1.85
1981	1.81	1.90	1.87	2.30	2.90	3.06	3.85	3.58	3.15	2.19	1.74	1.78
1982	1.94	2.04	2.00	2.47	3.12	3.29	4.14	3.85	3.39	2.35	1.87	1.91
Mean	1.78	1.87	1.83	2.26	2.85	3.01	3.79	3.52	3.10	2.15	1.71	1.75

Supplement 4.--Sand Lake mass-balance study

Since 1960, the refuge managers of Sand Lake National Wildlife Refuge have prepared Annual Water Program summaries that include, among other information, tabulations of average monthly lake elevations of Sand and Mud Lakes (Robert Green, written commun., 1985). Annual summaries prior to 1960 do not include tabulations of monthly lake elevations but do include narrative discussions of the operation of Sand and Mud Lakes. Although the narrative discussions do not indicate the elevation of Sand and Mud Lakes on a monthly basis, the discussions usually indicate lake elevations prior to spring breakup, maximum elevations reached during spring and summer, and lake elevations subsequent to winter freezeup. In addition, the Water Management Plan for 1958 contains a compilation of refuge water-management records; and this compilation includes a tabulation of end-of-month lake elevations for May through September of 1939-57.

A reconstruction of the operation of Sand Lake for 1953-59 was accomplished by reviewing the narrative summaries. For some months, it was necessary to interpolate between reported elevations of months preceding and following the month in question. In addition, it was sometimes necessary to assume that lake elevations remained constant, or changed at a uniform rate, from winter freezeup to spring breakup.

The method used to reconstruct the operation of Mud Lake for 1956-59 was similar to the method described for Sand Lake; however, narrative summaries for 1953-55 were not of sufficient detail to reconstruct operation of Mud Lake. In addition, the end-of-month contents for Mud Lake for May through September 1953 were reported as lost in the 1958 Water Management Plan (Robert Green, written commun., 1985). The assumption was made that Mud Lake elevations are directly proportional to inflow; thus, lake elevations for 1953-55 were reconstructed by using associated lake elevations of similar inflows that occurred when more detailed operations record were kept.

Evaporation

Monthly pan-evaporation data have been collected at Redfield since 1949 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1982). The pan-evaporation data normally were collected for April through October, but there are some months with missing data. To complete the Sand Lake mass-balance study, it was necessary to fill in the missing evaporation data for the months of April-October and to estimate evaporation for the months of November-March.

Monthly pan evaporation at Redfield was correlated with average monthly temperature at Redfield from 1953-81 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1954-82). A correlation coefficient of 0.78 was computed. Temperature was used as the independent variable and pan evaporation was used as the dependent variable to develop a regression equation as follows:

$$E = -3.730+0.1734(T) \quad (23)$$

where
T = average monthly temperature, in degrees Fahrenheit, and
E = average monthly pan evaporation, in inches.

Equation 23 was used to compute missing pan-evaporation data during the months of April-October.

Discussions with the South Dakota State Climatologist and the South Dakota State Soil Conservation Service did not reveal the existence of a method to estimate pan evaporation during the winter months of November through March. However, the U.S. Department of Agriculture (no date) indicates that pan evaporation for November through March is 8.0 percent of the annual pan evaporation and is distributed as follows: November, 3 percent; December, 1.0 percent; January, 0.75 percent; February, 0.95 percent; and March, 2.30 percent. This distribution of pan evaporation during the winter was used in the operation study of Sand Lake. The total pan evaporation for April-October was divided by 0.9198 to obtain the total annual pan evaporation, and then the monthly pan evaporation for each month during November-March was estimated by multiplying the appropriate monthly proportion times the estimated annual total. Monthly pan-evaporation values are listed in the following table.

Monthly lake evaporation was estimated by multiplying the monthly pan evaporation by a factor of 0.725 (U.S. Department of Agriculture, no date). The factor to convert pan evaporation to gross reservoir evaporation is intended for use in converting annual values and needs to be used with caution when converting monthly values (Winter, 1981). However, due to lack of better data, this factor was used.

Precipitation

Monthly precipitation data are recorded at the Sand Lake National Wildlife Refuge headquarters and published as Columbia, S. Dak. Monthly precipitation data for 1953-82 are listed in the following table (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1954-83).

Operation study

Annual Water Program summaries prepared by the refuge managers included the surface area as a function of reservoir capacity for each lake based on area-capacity tables developed from surveys completed in the 1940's. As part of the present study, it was determined necessary to use area-capacity tables developed from a U.S. Bureau of Reclamation survey conducted in 1980. Historic lake levels were used in conjunction with the area-capacity tables to generate "adjusted" areas and capacities for each lake.

To obtain the "adjusted" areas and capacities, a computer program was written that computes the area and capacity of each lake based on lake elevations that were read as input. Monthly pan evaporation at Redfield and

Recorded and estimated monthly pan evaporation, in inches, for 1953-82 at Redfield, S.Dak.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1953	0.32	0.41	0.99	3.82	5.85	6.71	6.22	6.04	6.31	4.63	1.29	0.44	43.03
1954	.39	.49	1.19	4.87	7.08	6.75	10.15	8.64	5.58	4.42	1.55	.53	51.64
1955	.49	.62	1.49	8.41	12.35	7.79	9.26	9.13	7.51	5.20	1.95	.66	64.86
1956	.38	.49	1.18	4.36	8.24	8.75	7.98	6.68	5.39	5.72	1.54	.52	51.23
1957	.33	.42	1.02	4.79	5.60	6.09	8.12	6.98	4.47	4.70	1.33	.45	44.30
1958	.38	.48	1.16	4.33	8.49	6.38	6.77	8.91	6.36	5.13	1.51	.51	50.41
1959	.42	.53	1.29	4.26	7.28	9.68	11.28	10.02	6.81	2.26	1.68	.57	56.08
1960	.37	.47	1.14	5.43	7.41	5.77	8.69	8.24	5.18	4.84	1.49	.51	49.54
1961	.35	.45	1.08	4.43	6.19	7.41	8.00	7.50	5.88	3.94	1.41	.48	47.12
1962	.31	.39	.95	5.04	4.23	5.74	6.53	8.15	4.94	3.31	1.24	.42	41.25
1963	.38	.48	1.15	5.12	6.93	8.10	8.94	8.26	4.45	4.36	1.51	.51	50.19
1964	.42	.54	1.30	5.90	7.91	7.95	10.31	8.63	6.03	5.22	1.69	.58	56.48
1965	.36	.46	1.11	4.14	7.27	6.89	8.55	8.41	4.45	4.69	1.45	.49	48.27
1966	.39	.49	1.19	3.54	8.00	9.16	10.76	7.02	5.59	3.62	1.56	.53	51.85
1967	.37	.47	1.14	4.21	6.96	6.67	8.37	8.82	6.53	4.19	1.49	.51	49.73
1968	.37	.47	1.14	4.25	5.66	7.41	9.36	8.61	5.46	4.87	1.49	.51	49.60
1969	.39	.50	1.21	4.72	7.10	7.82	8.28	10.15	6.79	3.48	1.58	.54	52.56
1970	.41	.52	1.27	3.74	6.48	9.28	9.70	8.86	8.02	4.66	1.65	.56	55.15
1971	.40	.51	1.24	4.66	6.74	8.75	9.19	9.26	5.75	5.13	1.61	.55	53.79
1972	.35	.44	1.07	4.00	5.81	7.20	8.23	7.19	6.95	3.61	1.40	.48	46.73
1973	.36	.46	1.11	3.81	5.53	7.96	8.95	8.57	4.08	5.37	1.44	.49	48.13
1974	.41	.52	1.26	4.09	5.62	8.16	10.63	9.24	7.52	5.03	1.64	.56	54.68
1975	.37	.47	1.14	2.83	6.07	7.94	10.89	8.05	4.65	5.01	1.48	.50	49.40
1976	.51	.65	1.58	6.30	8.50	11.61	11.79	12.97	8.28	3.54	2.05	.70	68.48
1977	.43	.54	1.31	5.13	9.22	10.08	11.01	7.48	6.54	2.90	1.71	.58	56.93
1978	.38	.48	1.16	2.87	6.24	7.70	8.62	8.72	7.89	4.33	1.51	.51	50.41
1979	.31	.39	.96	3.61	5.44	7.63	8.89	4.78	6.44	1.41	1.25	.42	41.53
1980	.42	.53	1.28	4.05	10.04	9.66	8.67	7.60	5.51	5.70	1.67	.57	55.70
1981	.45	.57	1.38	7.35	7.55	9.55	11.51	8.64	7.12	3.62	1.80	.61	60.15
1982	.37	.47	1.15	3.71	6.43	7.00	9.12	8.60	6.66	4.39	1.50	.51	49.91

Monthly precipitation, in inches, at Sand Lake National Wildlife Refuge for 1953-82

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1953	0.46	0.90	0.96	5.65	3.18	7.93	0.87	2.03	0.28	0.62	0.30	0.30	23.48
1954	.17	.08	.42	1.61	1.11	2.60	1.34	2.12	2.72	.81	.10	.20	13.28
1955	.25	.32	.15	.96	2.30	4.39	2.55	2.60	.55	0	.07	.10	14.24
1956	.45	.18	.70	.74	2.25	2.47	2.02	1.32	1.32	1.84	1.63	.30	15.22
1957	.16	.29	.10	4.38	4.67	3.84	2.61	5.84	2.19	2.11	1.00	.31	27.50
1958	.22	1.72	0	2.10	1.98	2.70	1.69	.68	.23	.79	1.02	0	13.13
1959	.14	.49	.06	.49	3.19	2.21	2.88	1.28	2.66	1.13	.69	.65	15.87
1960	.81	.38	.56	3.25	2.39	2.95	1.23	4.69	1.21	.71	.50	.83	19.51
1961	0	.30	.10	1.64	3.18	2.24	2.55	.43	3.02	3.20	.04	.43	17.13
1962	.38	.86	.81	1.70	5.23	3.58	4.27	1.86	2.14	1.25	.55	.02	22.65
1963	.15	0	.23	1.44	3.38	4.67	3.97	3.87	1.92	.15	.43	.22	20.43
1964	.21	.07	1.05	5.08	2.06	4.31	3.16	2.14	1.07	.10	.34	.53	20.12
1965	.37	.10	1.00	3.18	3.02	3.35	3.04	2.45	2.60	.56	.88	.50	21.05
1966	.08	.51	4.40	1.40	1.49	3.84	1.68	3.83	2.06	1.56	.65	.01	21.51
1967	.61	.38	.11	4.59	.61	6.01	2.05	.94	3.55	1.82	.45	.86	21.98
1968	.05	0	1.80	4.96	2.24	4.40	2.37	.97	4.06	.48	.78	2.04	24.15
1969	1.54	2.60	.25	.89	2.34	3.34	3.76	.99	.44	.51	.13	1.15	17.94
1970	1.00	.84	2.59	3.66	2.33	1.91	3.11	.25	1.12	1.25	2.39	.59	21.04
1971	.98	.40	.07	1.45	2.62	3.84	1.72	1.27	1.32	3.01	1.57	.97	19.22
1972	1.27	.77	1.40	.89	5.99	1.32	4.16	1.08	0	1.26	.73	1.20	20.07
1973	.30	.07	1.49	.99	1.59	1.91	1.56	1.88	4.45	2.09	.44	.73	17.50
1974	.01	.45	.59	2.67	5.55	.17	1.56	1.53	.37	.50	.02	.02	13.44
1975	.56	.29	2.57	3.28	1.93	6.63	.58	2.74	1.73	1.25	.22	.36	22.14
1976	1.03	.58	.84	1.46	.45	2.95	.25	.99	.80	.21	.02	.22	9.80
1977	.24	.67	3.33	.85	3.14	2.33	2.68	2.72	4.34	1.44	2.03	.86	24.63
1978	.01	.37	.73	2.00	3.44	7.04	1.67	3.29	0	.21	.58	0	19.34
1979	1.22	1.25	1.57	2.49	2.15	4.05	3.11	.61	.41	1.11	.04	.13	18.14
1980	.72	.42	.54	.58	2.52	2.40	1.08	4.71	1.03	1.30	0	.04	15.34
1981	.16	.10	.78	1.21	1.71	3.19	5.69	2.78	1.18	2.51	.46	.75	20.52
1982	1.66	.20	4.19	.62	2.57	1.56	3.41	.72	2.08	4.55	.58	.09	22.23

monthly precipitation at Columbia also were read as input. The program computed the change in storage of the lake, the evaporation loss, the precipitation gain, and net gain or loss for each lake on a monthly basis. These data were used as input to the mass-balance study.

Mass-balance study

A mass-balance study was computed using output data from the operation study in conjuction with inflow of the James River at the North Dakota-South Dakota State line and outflow of the James River at Columbia. The mass-balance study was conducted on an annual basis in the following manner.

Annual streamflow of the James River at the State line was adjusted by a factor of 1.10 to account for the intervening inflow that accrues directly to the refuge downstream from the State line gaging station (refuge inflow). Annual discharge at Columbia was adjusted by a factor of 0.96 to account for the intervening inflow that accrues to the James River between the refuge and the Columbia gage (refuge outflow). The difference of refuge outflow minus refuge inflow plus the refuge change in storage produced the stream gain or loss through the refuge. Evaporation and precipitation data were used to compute the accounted-for loss within the refuge. The difference between the stream loss or gain and the accounted-for loss was termed the unaccounted-for loss within the refuge.

This method is similar to a previous mass-balance study conducted on the refuge (Benson, 1983), except the change in refuge storage was incorporated into the present mass balance and most of the input data (area-capacity, infow, outflow, and evaporation) were refined in greater detail. The results of the mass-balance computation are presented in the following table.

Sand Lake National Wildlife Refuge mass-balance computation

[Synthetic refuge inflow = State line flow multiplied by 1.10 (ratio of contributing drainage area). Synthetic refuge outflow = Columbia flow multipled by 0.96 (ratio of contributing drainage area). Lake evaporation = pan evaporation multiplied by 0.725. Unaccounted-for refuge loss/gain (acre feet per acre) on the total line is not the arithmetic sum of the column]

Year	Synthetic refuge inflow (acre-feet)	Change in refuge storage (acre-feet)	Synthetic refuge outflow (acre-feet)	Stream loss/gain through refuge (acre-feet)	Sand and Mud Lake evaporation loss (acre-feet)	Sand and Mud Lake precipitation gain (acre-feet)	Accounted-for refuge loss/gain (acre-feet)	Unaccounted-for refuge loss/gain (acre-feet)	Refuge surface area, April-November (acres)	Unaccounted-for refuge loss/gain (acre-feet per acre)
1953	63,880	6,312	41,215	-16,353	-30,446	23,558	-6,889	-9,465	11,845	-0.80
1954	45,333	2,515	17,037	-25,781	-35,832	12,591	-23,242	-2,539	11,279	-.23
1955	31,645	-3,939	12,453	-23,130	-46,051	14,233	-31,819	8,689	11,839	.73
1956	43,288	-305	20,610	-22,984	-33,419	13,344	-20,075	-2,908	10,470	-.28
1957	19,134	2,864	17,268	997	-27,304	23,822	-3,482	4,479	10,185	.44
1958	43,028	-12,429	27,444	-28,012	-32,102	11,910	-20,192	-7,820	10,229	-.76
1959	10,792	-5,211	0	-16,004	-20,274	7,726	-12,548	-3,456	5,758	-.60
1960	56,990	15,483	31,945	-9,562	-32,462	17,049	-15,412	5,851	10,990	.53
1961	10,913	-2,759	681	-12,991	-29,389	14,828	-14,560	1,569	10,227	.15
1962	134,491	13,911	142,991	22,411	-76,455	50,119	-26,336	48,747	25,479	1.91
1963	20,665	-15,516	33,926	-2,255	-28,104	15,732	-12,372	10,117	8,967	1.13
1964	35,821	7,160	15,313	-13,348	-58,052	26,869	-31,182	17,834	15,142	1.18
1965	110,823	12,956	70,671	-27,196	-38,029	22,660	-15,369	11,826	13,203	-.90
1966	270,027	-12,209	208,627	-73,608	-62,336	48,582	-13,754	59,854	21,565	-2.78
1967	95,725	-8,738	80,340	-24,123	-31,662	19,957	-11,706	12,417	10,455	-1.19
1968	30,639	-3,429	33,562	-507	-29,346	19,213	-10,133	9,626	9,836	.98
1969	297,757	3,434	258,022	-36,301	-82,381	32,188	-50,193	13,892	27,542	.50
1970	26,712	-10,354	30,750	-6,317	-18,889	10,602	-8,287	1,970	5,820	.34
1971	61,466	5,561	36,187	-19,718	-31,797	15,163	-16,634	-3,084	9,901	-.31
1972	77,506	-1,728	73,147	-6,087	-27,761	16,314	-11,447	5,359	8,985	.60
1973	16,883	6,964	1,408	-8,511	-20,997	9,617	-11,380	2,869	7,286	.39
1974	75,352	11,150	28,559	-35,643	-43,632	14,095	-29,537	-6,106	13,120	-.47
1975	264,574	-13,863	236,963	-41,474	-116,803	53,389	-63,414	21,941	31,354	.70
1976	47,201	-7,249	44,522	-9,928	-31,754	6,986	-24,768	14,840	6,943	2.14
1977	12,483	8,553	43	-3,886	-18,437	10,384	-8,053	4,167	5,576	.75
1978	115,571	5,759	99,941	-9,872	-41,622	23,758	-17,864	7,992	14,696	.59
1979	298,390	3,080	224,294	-71,016	-66,837	42,096	-24,740	46,276	27,123	-1.71
1980	29,452	2,439	16,778	-10,236	-33,605	12,436	-21,169	10,934	9,823	1.11
1981	20,409	-1,355	7,042	-14,723	-43,614	20,585	-23,029	8,306	11,986	.69
1982	146,951	-1,639	111,004	-37,587	-41,118	23,363	-17,755	19,832	14,368	-1.38
Total	2,513,897	7,419	1,922,737	-583,741	-1,230,508	633,167	-597,341	13,600	392,040	.03