1965

Water Resources Data for Minnesota

Part 1. Surface Water Records

Part 2. Water Quality Records

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Prepared in cooperation with the Minnesota Department of Conservation, Division of Waters; the Minnesota Department of Highways; and with other State, municipal, and Federal agencies

United States Department of the Interior
Geological Survey - Water Resources Division

WATER RESOURCES DATA FOR MINNESOTA

1965

Part 1: Surface Water Records

Prepared in cooperation with

Minnesota Department of Conservation Division of Waters
Minnesota Department of Highways
City of Austin, through the Minnesota Division of Waters
City of Rochester, through the Minnesota Division of Waters
Pickands Mather and Company, through the Minnesota Division of Waters
Hanna Mining Company, through the Minnesota Division of Waters
Corps of Engineers, U. S. Army
U. S. Department of State

Copies of this report may be obtained from
District Engineer, Surface Water Branch
U. S. Geological Survey
1610 Post Office Building
St. Paul, Minnesota 55101

1966

CALENDAR FOR WATER YEAR 1965

OCTOBER 1964

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NOVEMBER 1964

S	M	T	W	T	F	S
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DECEMBER 1964

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JANUARY 1965

S	M	T	W	T	F	S
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31						

FEBRUARY 1965

S	M	T	W	T	F	S
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28						

MARCH 1965

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APRIL 1965

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MAY 1965

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30	31					

JUNE 1965

S	M	T	W	T	F	S
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JULY 1965

S	M	T	W	T	F	S
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18	19	20	21	22	23	24
25	26	27	28	29	30	31

AUGUST 1965

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

SEPTEMBER 1965

S	M	T	W	T	F	S
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5	6	7	8	9	10	11
12	13	14	15	16	17	18
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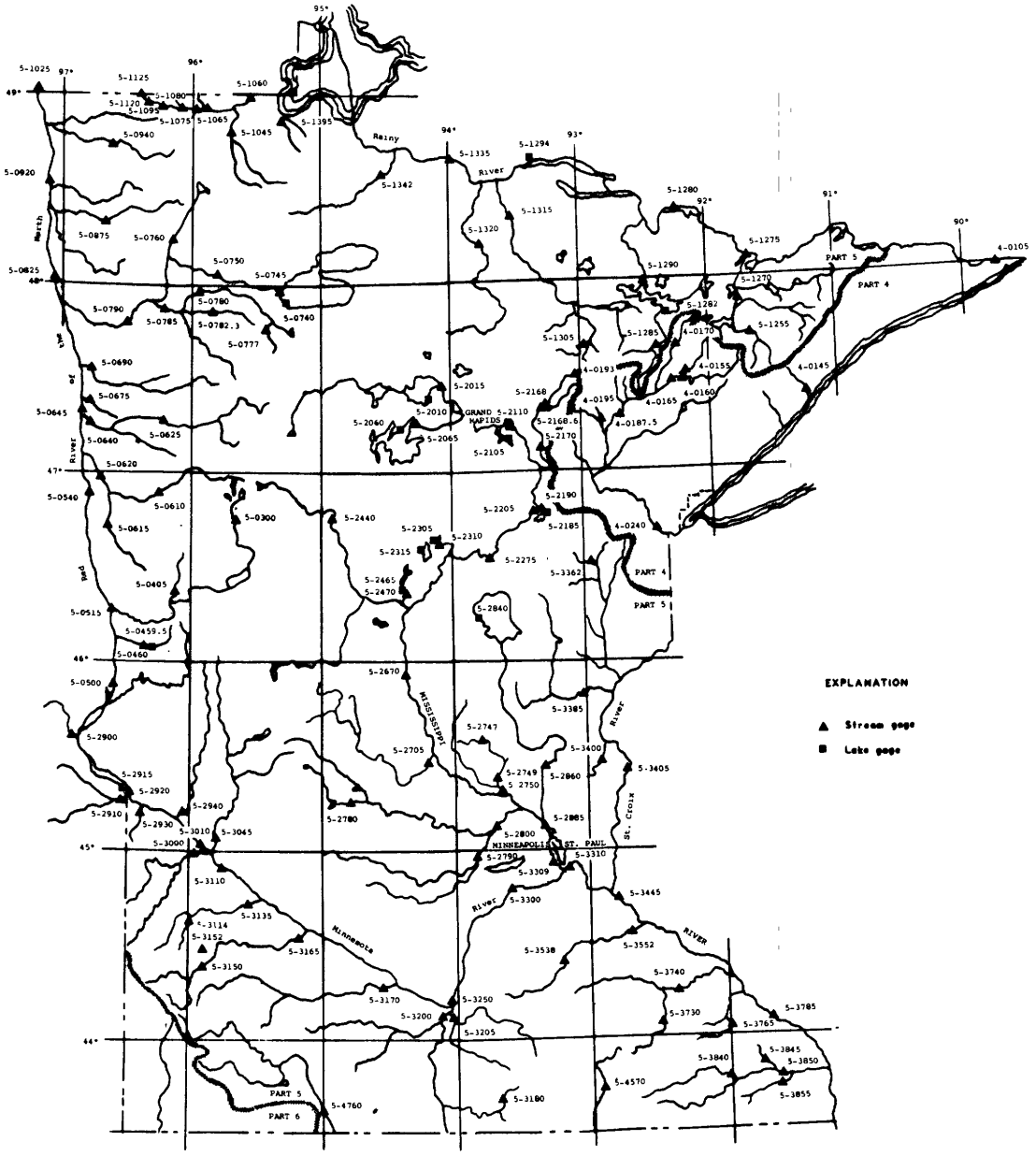

Figure 1.--Map of Minnesota showing location of lake and stream gaging stations.

WATER RESOURCES DATA FOR MINNESOTA, 1965

Part 1. Surface Water Records

INTRODUCTION

The surface-water records for the 1965 water year for gaging stations, partial-record stations, and miscellaneous sites within the State of Minnesota are given in this report. For convenience there are also included records for a few pertinent gaging stations in bordering states. The records were collected and computed by the Water Resources Division of the U. S. Geological Survey under the direction of D. B. Anderson, district engineer, Surface Water Branch.

Through September 30, 1960, the records of discharge and stage of streams and contents and stage of lakes or reservoirs were published in an annual series of U. S. Geological Survey water-supply papers entitled "Surface Water Supply of the United States". Since 1951 there have been 20 volumes in the series; each volume covered an area whose boundaries coincided with those of certain natural drainage areas. The records in Minnesota were contained in Parts 4, 5 and 6 of that series.

Beginning with the 1961 water year, streamflow records and related data will be released by the Geological Survey in annual reports on a State-boundary basis. Distribution of these basic-data reports will be limited and primarily for local needs. The records later will be published in Geological Survey water-supply papers at 5-year intervals.

COOPERATION

Cooperative agreements between the U. S. Geological Survey and organizations of the State of Minnesota for the systematic collection of streamflow records began in 1909. Organizations that supplied data are acknowledged in station descriptions. Organizations that assisted in collecting data through cooperative agreements with the Survey are:

Minnesota Department of Conservation, Division of Waters, Sidney A. Frellsen, director.

Minnesota Department of Highways, John R. Jamieson, Commissioner.

Assistance in the form of funds or services was given by Corps of Engineers, U. S. Army, in collecting records for 30 gaging stations published in this report.

Several gaging stations in the Hudson Bay and St. Lawrence River basins were maintained by funds appropriated to the United States Department of State.

On waters adjacent to the international boundary, certain gaging stations are maintained by the United States (or Canada) under agreement with Canada (or the United States), and the records are obtained and compiled in a manner equally acceptable in both countries. These stations are designated herein as "International gaging stations."

DEFINITION OF TERMS AND ABBREVIATIONS

The terms of streamflow and other hydrologic data, as used in this report, are defined as follows:

Gaging station is a particular site on a stream, canal, lake or reservoir where systematic observations of gage height or discharge are obtained. When used in connection with a discharge record, the term is applied only to those gaging stations where a continuous record of discharge is obtained.

Partial-record station is a particular site where limited streamflow data are collected systematically over a period of years for use in hydrologic analyses.

Cubic foot per second (cfs) is the rate of discharge of a stream whose channel is 1 square foot in cross-sectional area and whose average velocity is 1 foot per second.

Cubic feet per second per square mile (cfsm) is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area.

Runoff in inches (in.) shows the depth to which the drainage area would be covered if all the runoff for a given time period were uniformly distributed on it.

Acre-foot (ac-ft) is the quantity of water required to cover an acre to the depth of 1 foot and is equivalent to 43,560 cubic feet.

Cfs-day is the volume of water represented by a flow of 1 cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons, and represents a runoff of 0.0372 inch from 1 square mile.

Stage-discharge relation is the relation between gage height and the amount of water flowing in a channel, expressed as volume per unit of time.

Control designates a feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, a long reach of the channel, or an artificial structure.

Contents is the volume of water in a reservoir or lake. Unless otherwise indicated, volume is computed on the basis of a level pool and does not include bank storage.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is so enclosed by a topographic divide that direct surface runoff from precipitation normally would drain by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

WSP is used as an abbreviation for "Water-Supply Paper" in references to previously published reports.

DOWNSTREAM ORDER AND STATION NUMBERS

Stations are listed in the same downstream order used in the water-supply papers. Records are listed in a downstream direction along the main stem with all stations on a tributary entering above a main-stem station listed before that station. If a tributary enters between two main-stem stations, it is listed between them. A similar order is followed listing stations on first rank, second rank, and other ranks of tributaries. To indicate the rank of any tributary on which a gaging station is situated and the stream to which it is immediately tributary, each indention in the listing of gaging stations in the table of contents of this report represents one rank. This downstream order and system of indention shows which gaging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gaging station is situated.

As an added means of identification, each gaging station and partial-record station has been assigned a station number. The numbers have been assigned in the same downstream order used in the annual series of water-supply papers. In assigning station numbers, no distinction is made between partial-record stations and continuous-record gaging stations, so that the station number for a partial-record station indicates downstream order position in a list made up of both types of stations. Gaps are left in the numbers to allow for new stations that may be established; hence the numbers are not consecutive.

The complete 8-digit number for each station, such as 05-0615.00, includes the part number "05" and a 6-digit station number. In this report, the part number and only the essential digits of the station number are shown. For example, the complete number 05-0615.00 would appear as 5-0615, just to the left of the station name. In this report, the records are listed in downstream order by parts. All records for a drainage basin encompassing more than one State could be arranged in downstream order by assembling pages from the various State reports by station number to include all records in the basin.

The base data collected at gaging stations consist of records of stage and measurements of discharge. In addition, observations of factors affecting the stage-discharge relation, weather records, and other information are used to supplement base data in determining the daily flow. The records of stage are obtained from a water-stage recorder that gives a continuous record of fluctuations or from direct readings on a nonrecording gage. Measurements of discharge are made with a current meter by the general methods adopted by the Geological Survey on the basis of experience in stream gaging since 1888. These methods are described in Water-Supply Paper 888 and are also outlined in standard textbooks on the measurement of stream discharge.

Rating tables giving the discharge for any stage are prepared from stage-discharge relation curves defined by discharge measurements. If extensions to the rating curves are necessary to define the extremes of discharge, they are made on the basis of indirect measurements of peak discharge (such as slope-area or contracted-opening measurements, or computation of flow over dams or weirs), velocity-area studies, and logarithmic plotting. The application of the daily mean gage height to those rating tables gives the daily mean discharge, from which the monthly and the yearly mean discharge are computed. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features that form the control, the daily mean discharge is determined by the shifting-control method, in which correction factors based on individual discharge measurements and notes by engineers and observers are used in applying the gage heights to the rating tables. If the stage-discharge relation for a station is temporarily changed by the presence of aquatic growth or debris on the control, the daily mean discharge is computed by what is in effect the shifting-control method.

At some gaging stations the stage-discharge relation is affected by backwater from reservoirs, tributary streams, or other sources. This necessitates the use of the slope method in which the slope or fall in a reach of the stream is a factor in determining discharge. Information required for determining the slope or fall is obtained by means of an auxiliary gage set at some distance from the base gage. At some stations the stage-discharge relation is affected by changing stage. For such stations, the rate of change in stage is used as a factor in determining discharge.

At some gaging stations the stage-discharge relation is affected by ice during the winter, and it becomes impossible to compute the discharge in the usual manner. Discharge for periods of ice effect is computed on the basis of the gage-height record and occasional winter discharge measurements, consideration being given to the available information on temperature and precipitation, notes by gage observers and engineers, and comparable records of discharge for other stations in the same or nearby basins.

For some gaging stations there are periods when no gage-height record is obtained or the recorded gage height is so faulty that it cannot be used to compute the daily discharge. This happens when the recorder stops or otherwise fails to operate properly, intakes are plugged, float is frozen in the well, or for various other reasons. For such periods the daily discharges are estimated on the basis of recorded range in stage, adjoining good record, discharge measurements, weather records, and comparison with other station records from the same or nearby basins.

The data in this report generally comprise a description of the station, and a table showing the daily discharge and monthly and yearly discharge of the stream. Tables of mean daily gage height are included for some stations. Records are published for the water year which begins on October 1 and ends on September 30. A calendar for the 1965 water year is shown on page II to facilitate finding the day of the week for any date.

The description of the station gives the location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks. The location of the gaging station and the drainage area are obtained from the most accurate maps available. River mileage given under "Location" for some stations, is that determined and used by the Corps of Engineers unless otherwise noted. Under "Records available" are given periods for which there are published records for the present station or for stations generally equivalent to the present one. Under "gage" are given the type of gage currently in use and the datum of the gage above mean sea level, and a condensed history of the types, locations, and datums of previous gages used during the period of records avail-

able. The references to "datum of 1929" and adjustments of other years are to the datum and adjustments of the U. S. Coast and Geodetic Survey. Under "Average discharge" is given the average discharge for the number of years indicated. It is not given for stations having fewer than five complete years of record or for stations where changes in water development during the period of record cause the figure to have little significance. Under "Extremes" are given the maximum discharge and gage height; the minimum discharge if there is little or no regulation; the minimum daily discharge if there is extensive regulation (also the minimum discharge if useful); and the minimum gage height if it is significant. In the first paragraph, the data given are for the complete current water year unless otherwise specified. In the second paragraph, the data given are for the periods of record within the calendar year dates in the heading (not necessarily those for the complete years indicated by the heading dates). Reliable information concerning major floods that have occurred outside the period of record are given in the third or last paragraph under "Extremes." Unless otherwise qualified, the maximum discharge corresponds to the crest stage obtained by use of a water-stage recorder, a crest-stage indicator, or a nonrecording gage read at the time of the crest. If the maximum gage height did not occur at the same time as the maximum discharge, it is given separately. Information pertaining to the accuracy of the records and to conditions which affect the natural flow at the gaging station is given under "Remarks."

The daily table gives the discharge corresponding to the daily mean gage height unless there are large or rapid changes in discharge during a day. For days having large or rapid changes, discharge for the day is computed by averaging the mean discharges for several parts of a day. For digital recorders, the daily mean discharge is always the average of the discharges at each punched reading. For stations equipped with nonrecording gages, the daily discharge corresponds to once-daily readings of the gage or to the mean of twice-daily readings; but for periods of rapidly changing stage the discharge is determined from a gage-height graph based on gage readings.

In the table of daily discharge, the figures for the maximum day and the minimum day for each month are underlined only on the first day of its occurrence.

In the monthly summary below the daily table, the line headed "Total" gives the sum of the daily figures; it is the total cfs-days for the month. The line headed "Mean" gives the average flow in cubic feet per second during the month. Discharge for the month may be expressed in cubic feet per second per square mile (line headed "Cfsm"), or in inches (line headed "In."), or in acre-feet (line headed "Ac-ft"). Figures for cubic feet per second per square mile and runoff in inches are omitted if the drainage area includes large noncontributing areas, or if the average annual rainfall on the drainage basin is usually less than 20 inches.

In the yearly summary below the monthly summary, the figures of maximum are the maximum daily discharges, not the momentary discharges when the water was at crest stage. Likewise, the minimums in this summary are the minimum daily discharges.

Peak discharges and the times of their occurrence and corresponding gage heights for most stations are listed below the table of daily and monthly discharge. All independent peaks above the selected base are given. The base discharge, which is given in parentheses, is selected so that an average of about three peaks a year can be presented. Peak discharges are not published for any stream for which the peaks are subject to substantial control by man. Time of day is expressed in 24-hour local standard time, for example, 12:30 a.m. is 0030, 1:30 p.m. is 1330.

In a general footnote, introduced by the word "Note", certain periods are indicated for which the discharge is computed or estimated by special methods because of no gage-height record, backwater from various sources, or other unusual conditions. Periods of no gage-height record are indicated if the period is continuous for a month or more or includes the maximum discharge for the year. Periods of backwater from an unusual source, of indefinite stage-discharge relation, or of any other unusual condition at the gage are indicated only if they are a month or more in length and the accuracy of the records is affected. Days on which the stage-discharge relation is affected by ice are not indicated. The methods used in computing discharge for various unusual conditions have been explained in preceding paragraphs.

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For most gaging stations on lakes and reservoirs the data presented comprise a description of the station and a monthly summary table of stage and contents. For some reservoirs a table showing daily contents or stage is given. A skeleton table of capacity at given stages is published each year for all reservoirs for which records are published on a daily basis, but it is not published for reservoirs for which only monthly data are given.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS

The accuracy of streamflow data depends primarily on (1) the stability of the stage-discharge relation or, if the control is unstable, the frequency of discharge measurements, and (2) the accuracy of observations of stage, measurements of discharge, and interpretation of records.

The station description, under "Remarks," states the degree of accuracy of the records. "Excellent" means that about 95 percent of the daily discharges are within 5 percent; "good" within 10 percent; and "fair" within 15 percent. "Poor" means that daily discharges have less than "fair" accuracy.

Discharge at some stations, as indicated by the monthly mean, may vary widely from natural runoff, owing to diversion, consumption, regulation by storage, increase or decrease in evaporation due to artificial causes, or to other factors. For such stations, figures of cubic feet per second per square mile and of runoff in inches are not published unless satisfactory adjustments can be made for diversions, for changes in contents of reservoirs, or for other changes incident to use and control. Evaporation from a reservoir is not included in the adjustments for changes in reservoir contents, unless it is so stated. Even at those stations where adjustments are made, large errors in computed runoff may occur when relatively large negative adjustments are made or when evaporation is large in comparison with the observed discharge.

OTHER DATA AVAILABLE

Data collected at partial-record stations and at miscellaneous sites are given at the end of this report. Data for partial-record stations are presented

in two tables. The first is a table of discharge measurements at low-flow partial-record stations, and the second is a table of annual maximum stage and discharge at crest-stage stations. Discharge measurements at miscellaneous sites are given in a third table.

Information of a more detailed nature than that published for most of the gaging stations is on file in the district office, such as discharge measurements and recorder charts or nonrecording-gage readings. Most gaging-station records in the State through 1962 have been analyzed with an electronic computer to give: (1) the number of days in each year that the daily discharge was between selected limits (duration tables); (2) the lowest mean discharge for selected numbers of consecutive days in each year; and (3) the highest mean discharge for selected numbers of consecutive days in each year.

At or near some gaging stations, water-quality records also are collected. Data are obtained on the chemical quality of the stream water, on water temperature, on suspended-sediment concentration, and on the particle-size distribution of suspended sediment and bed material. These data are given in Part 2 of this report. Under the "Remarks" paragraph of the gaging-station description, reference is made to water-quality records collected on a regular basis.

4-0105. Pigeon River at Middle Falls, below International Bridge, Minn.

(International gaging station)

Location.--Lat 48°00'44", long 89°36'58", in NE¼ sec.24, T.64 N., R.6 E., on right bank 400 ft upstream from Middle Falls, 3½ miles upstream from mouth, and 5¾ miles downstream from International Bridge.

Drainage area.--600 sq mi.

Records available.--June to October 1921, April to November 1922, March 1923 to September 1965. Published as "at International Bridge" April 1924 to September 1940. Monthly discharge only for some periods, published in WSP 1307.

Gage.--Water-stage recorder. Datum of gage is 789.58 ft above mean sea level, datum of 1929. Prior to Sept. 2, 1936, staff gage and Sept. 2, 1936, to Sept. 30, 1940, wire-weight gage at International Bridge, 5¾ miles upstream at datum 100.24 ft higher.

Average discharge.--42 years (1923-65), 481 cfs.

Extremes.--Maximum discharge during year, 4,390 cfs Apr. 30 (gage height, 7.42 ft); minimum daily, 132 cfs Feb. 21-26; minimum gage height, 1.09 ft Nov. 20.
1923-65: Maximum discharge, 11,000 cfs May 5, 1934 (gage height, 7.6 ft, site and datum then in use), from rating curve extended above 7,000 cfs; minimum, 27 cfs Nov. 4, 1945 (gage height, -0.08 ft).

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair.

Cooperation.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.0	172	3.0	817	6.0	2,920
1.5	302	4.0	1,320	7.0	3,920
2.0	452	5.0	2,010	8.0	5,150

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	277	208	185	158	138	138	158	4,170	1,220	590	325	234
2	271	204	182	160	135	138	160	3,880	1,170	1,200	322	234
3	269	201	180	160	135	140	165	3,720	1,100	1,180	308	229
4	263	201	178	160	135	142	170	3,450	1,060	981	299	221
5	255	198	176	*160	135	147	178	2,940	1,040	892	291	218
6	242	196	176	162	135	150	188	2,560	1,110	772	308	216
7	252	201	176	162	135	152	200	2,600	1,200	686	360	218
8	337	196	178	158	137	155	215	2,680	1,150	626	390	214
9	346	198	180	150	140	158	240	2,480	1,080	579	369	211
10	319	221	185	145	140	160	275	2,300	1,040	537	343	206
11	294	260	190	142	140	165	310	2,100	986	500	316	204
12	277	363	183	140	140	168	360	1,830	914	471	305	206
13	269	474	175	140	140	170	400	1,620	856	494	294	208
14	258	452	167	138	138	172	450	1,460	796	504	282	226
15	247	399	160	138	138	175	500	1,920	752	487	274	348
16	237	366	157	138	138	175	550	2,290	713	462	266	449
17	226	346	154	138	*138	172	620	2,160	682	436	260	433
18	218	290	152	138	135	170	680	2,050	655	421	258	412
19	214	235	150	140	135	168	750	1,920	626	399	255	396
20	208	208	150	140	135	165	820	1,690	633	378	250	384
21	216	200	150	140	132	162	900	2,020	626	363	247	369
22	221	210	148	142	132	160	970	2,260	600	360	242	471
23	224	225	148	142	132	160	1,100	1,960	*582	357	237	504
24	218	235	148	145	132	*158	1,250	1,730	568	348	*231	510
25	216	228	148	147	132	155	1,420	1,670	541	343	231	504
26	214	223	148	145	132	152	* 1,890	* 1,600	510	331	229	465
27	211	220	148	142	135	152	* 2,410	1,560	551	319	229	427
28	216	215	150	140	135	152	2,570	1,560	736	*308	229	*402
29	218	202	150	140		152	3,230	1,500	689	296	224	384
30	*214	190	152	140	------	152	4,220	1,590	618	288	224	1,030
31	206	------	155	138	------	155	------	1,490	------	308	229	------
Total	7,653	7,565	5,079	4,528	3,804	4,890	27,349	68,360	24,804	16,216	8,627	10,533
Mean	247	252	164	146	136	158	912	2,205	827	523	278	351
Cfsm	0.412	0.420	0.273	0.243	0.227	0.263	1.52	3.68	1.38	0.872	0.463	0.585
In.	0.47	0.47	0.31	0.28	0.24	0.30	1.70	4.24	1.54	1.01	0.53	0.65

Calendar year 1964: Max 6,770 Min 92 Mean 579 Cfsm 0.965 In. 13.12
Water year 1964-65: Max 4,220 Min 132 Mean 519 Cfsm 0.865 In. 11.74

Peak discharge (base, 3,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-30	2030	7.42	4,390				

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 25 (no gage-height record Jan. 9-21).

4-0145. Baptism River near Beaver Bay, Minn.

Location.--Lat 47°20'15", long 91°12'00", in SE¼NE¼ sec.15, T.56 N., R.7 W., on right bank 260 ft upstream from bridge on U. S. Highway 61, 0.2 mile upstream from mouth, 4 miles northeast of Silver Bay, and 7 miles northeast of village of Beaver Bay.

Drainage area.--140 sq mi.

Records available.--October 1927 to September 1965. Monthly discharge only for some periods, published in WSP 1307.

Gage.--Water-stage recorder. Datum of gage is 609.97 ft above mean sea level (Corps of Engineers bench mark). Prior to Oct. 5, 1934, staff gage at same site and datum.

Average discharge.--38 years, 158 cfs.

Extremes.--Maximum discharge during year, 2,580 cfs Apr. 30 (gage height, 5.06 ft); maximum gage height, 11.06 ft Apr. 12 (floodmark, backwater from ice); minimum discharge, 12 cfs Aug. 25, 29 (gage height, 1.88 ft). 1927-65: Maximum discharge recorded, 9,350 cfs Aug. 9, 1939 (gage height, 8.11 ft), from rating curve extended above 4,000 cfs; maximum gage height, that of Apr. 12, 1965; minimum daily discharge 0.4 cfs Jan. 5, 6, 1940.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair.

Rating table, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.9	12	3.0	146	4.5	1,500
2.1	21	3.3	270	5.0	2,460
2.4	44	3.6	525		
2.7	83	4.0	905		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	227	78	46	31	20	19	21	1,940	188	141	55	20
2	254	78	45	31	20	19	22	1,580	170	270	53	18
3	216	77	44	30	20	19	23	1,520	164	259	44	16
4	196	77	44	30	19	20	24	1,240	176	196	39	15
5	176	76	43	30	19	20	25	1,020	259	152	31	15
6	161	76	43	*29	19	20	30	924	753	119	36	19
7	158	72	42	29	18	20	35	934	715	83	80	29
8	161	70	42	29	18	21	45	867	630	82	82	26
9	146	68	43	28	18	21	70	858	487	76	64	23
10	134	68	43	28	18	21	140	762	376	62	50	20
11	126	88	42	27	18	22	300	620	277	53	41	18
12	121	106	42	27	18	22	360	487	221	45	33	20
13	115	106	40	26	17	22	330	394	180	58	28	30
14	110	98	39	26	17	23	300	333	158	51	24	61
15	104	92	38	26	17	22	340	525	134	46	23	291
16	100	80	38	25	17	22	*360	772	115	44	18	208
17	95	70	37	25	*17	22	430	791	100	62	17	196
18	92	60	37	25	17	22	534	1,090	86	92	16	173
19	86	55	36	24	17	22	668	962	88	92	16	155
20	83	52	36	24	17	22	686	677	161	76	16	136
21	90	51	35	24	17	22	*848	744	152	65	16	134
22	92	50	35	23	17	22	981	668	*126	58	15	167
23	92	50	34	23	17	22	972	506	113	48	*13	146
24	86	*50	34	23	17	*21	943	412	97	40	13	121
25	85	49	33	22	18	21	952	385	83	32	13	104
26	83	48	33	22	18	21	1,100	358	72	27	13	90
27	83	48	32	22	18	21	1,240	*319	244	*22	14	*77
28	83	47	32	21	18	21	1,260	284	385	18	13	74
29	*82	47	32	21		21	1,700	243	232	16	14	87
30	80	46	32	21	- - - - -	21	2,380	216	170	19	17	582
31	78	- - - - -	31	20	- - - - -	21	- - - - -	200	- - - - -	41	26	- - - - -
Total	3,795	2,033	1,183	792	501	655	17,119	22,631	7,112	2,445	933	3,071
Mean	122	67.8	38.2	25.5	17.9	21.1	571	730	237	78.9	30.1	102
Cfsm	0.871	0.484	0.273	0.182	0.128	0.151	4.08	5.21	1.69	0.564	0.215	0.729
In.	1.01	0.54	0.31	0.21	0.13	0.17	4.55	6.01	1.89	0.65	0.25	0.82

Calendar year 1964: Max 2,800 Min 11 Mean 199 Cfsm 1.42 In. 19.29
Water year 1964-65: Max 2,380 Min 13 Mean 171 Cfsm 1.22 In. 16.54

Peak discharge (base, 1,300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-30	0200	5.06	2,580				

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 16 to Apr. 11. No gage-height record Apr. 12-16.

4-0155. Second Creek near Aurora, Minn.

Location.--Lat 47°31'25", long 92°11'35", in SW¼ sec.12, T.58 N., R.15 W., on left bank 0.1 mile downstream from First Creek, 0.4 mile upstream from mouth, and 2.1 miles east of Aurora.

Drainage area.--26.3 sq mi.

Records available.--March 1955 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,410.36 ft above mean sea level, datum of 1929 (levels by Erie Mining Company).

Average discharge.--10 years, 17.3 cfs.

Extremes.--Maximum discharge during year, 84 cfs Apr. 21 (gage height, 4.53 ft); maximum gage height, 5.60 ft Apr. 9 (backwater from ice); minimum daily discharge, 6.7 cfs Jan. 17-19; minimum gage height, 3.39 ft Mar. 25.

1955-65: Maximum discharge, 213 cfs Apr. 22, 1961; maximum gage height, 5.75 ft Mar. 28, 1957 (backwater from ice); minimum daily discharge, 1.5 cfs Jan. 26 to Feb. 4, 1963; minimum gage height, 3.10 ft Feb. 2,3,4, 1963.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.3	5.0	3.8	26
3.4	7.8	4.0	40
3.5	12	4.5	81
3.6	16		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	30	23	12	7.5	7.4	9.1	9.4	45	36	24	19	17
2	32	21	12	7.4	7.5	9.8	9.7	46	32	34	19	17
3	30	20	12	7.4	7.5	11	10	46	31	36	17	16
4	29	19	12	7.4	7.6	12	*12	42	34	33	16	15
5	27	20	11	7.3	7.8	13	15	40	43	29	*16	18
6	*24	20	11	7.3	8.0	13	18	39	57	25	16	17
7	23	17	*11	7.3	8.3	13	21	40	64	23	17	*20
8	24	16	11	7.3	8.6	14	25	38	69	23	17	20
9	23	15	11	7.2	9.1	14	30	36	64	23	16	20
10	20	15	10	7.2	9.6	15	35	36	59	20	15	19
11	20	18	10	7.2	10	14	43	33	51	21	13	18
12	20	20	10	7.2	11	14	50	31	44	20	13	21
13	20	22	9.9	7.1	12	14	56	*27	39	21	12	27
14	19	21	9.6	7.1	12	13	60	26	36	18	12	32
15	20	19	9.3	7.0	12	12	66	41	34	18	12	46
16	23	17	9.1	6.8	13	11	*67	66	32	17	11	43
17	26	16	8.9	6.7	13	9.7	70	62	*27	21	13	42
18	24	15	8.7	*6.7	*13	8.6	72	69	27	22	12	39
19	27	14	8.6	6.7	13	8.1	74	59	25	19	11	36
20	30	13	8.4	6.8	13	8.0	77	53	49	*16	12	31
21	30	13	8.2	6.8	13	7.7	79	71	49	15	11	30
22	29	13	8.1	6.8	13	7.6	76	69	44	14	10	34
23	*30	12	8.0	6.8	12	7.5	*76	61	41	15	10	40
24	26	12	8.0	6.9	12	7.4	67	57	37	16	9.8	43
25	23	12	7.8	7.0	11	7.4	61	55	34	15	10	39
26	20	12	7.8	7.1	9.8	7.4	56	51	30	14	12	31
27	20	12	7.8	7.1	9.0	7.6	55	48	28	14	13	26
28	20	13	7.6	7.2	9.0	7.7	50	47	27	13	13	24
29	20	15	7.6	7.2		7.9	48	44	26	12	12	24
30	23	12	7.6	7.2		8.2	46	40	24	17	13	58
31	25		7.5	7.3		8.6		36		22	15	
Total	757	487	291.5	220.0	292.2	321.3	1,434.1	1,454	1,193	630	417.8	863
Mean	24.4	16.2	9.40	7.10	10.4	10.4	47.8	46.9	39.8	20.3	13.5	28.8
Cfsm	0.928	0.616	0.357	0.270	0.395	0.395	1.82	1.78	1.51	0.772	0.513	1.10
In.	1.07	0.69	0.41	0.31	0.41	0.45	2.03	2.06	1.69	0.89	0.59	1.22

Calendar year 1964: Max 95 Min 4.6 Mean 20.6 Cfsm 0.783 In. 10.64
Water year 1964-65: Max 79 Min 6.7 Mean 22.9 Cfsm 0.871 In. 11.82

Peak discharge (base, 60 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-21	2100	4.53	84	6- 8	1000	4.42	74
5-18	0600	4.40	72	9-30	2100	4.46	77
5-21	1500	4.43	75				

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 20.

4-0160. Partridge River near Aurora, Minn.

Location.--Lat 47°31'02", long 92°11'24", in SE¼SW¼ sec.12, T.58 N., R.15 W., on right bank at upstream side of highway bridge, 1,000 ft downstream from Second Creek, 2½ miles east of Aurora, and 2¾ miles upstream from mouth.

Drainage area.--156 sq mi.

Records available.--August 1942 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,402.30 ft above mean sea level, datum of 1929. Aug. 5, 1942, to Aug. 25, 1944, staff gage and Aug. 26, 1944, to July 1, 1956, water-stage recorder at site 45 ft downstream at same datum.

Average discharge.--23 years, 120 cfs (adjusted for storage and diversion).

Extremes.--Maximum discharge during year, 675 cfs May 21 (gage height, 4.59 ft); minimum daily, 13 cfs Jan. 28; minimum gage height, 1.59 ft (from range-in-stage for the period of no gage-height record, Feb. 24 to Apr. 4).
1942-65: Maximum discharge, 3,230 cfs May 10, 1950 (gage height, 7.86 ft); minimum, 2.2 cfs Jan. 30, 31, 1961; minimum gage height, 0.88 ft Mar. 2, 1963.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Flow regulated at times by storage in off-channel Partridge Reservoir, formerly known as Whitewater Lake. Reservoir formed from lake by levees around marsh areas and natural outlet. Available capacity, 20,000 acre-ft between elevations 1,410 ft (natural lake level) and 1,440 ft. Storage began Apr. 9, 1955. Storage in reservoir obtained from Colby Lake during periods of high flow; release from storage returned to Colby Lake to maintain lake elevation during diversion for iron-ore processing. Diversion began Feb. 7, 1956. Some seepage losses from reservoir bypass station.

Rating table, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Apr. 26 to May 5, June 29 to July 30)

1.6	16	2.4	52	3.5	230
1.8	22	2.7	85	4.0	382
2.1	33	2.0	128	5.0	930

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	139	59	32	23	15	17	16	530	250	92	38	20
2	144	54	31	23	15	17	17	530	215	96	36	20
3	144	50	31	22	15	18	17	535	194	97	36	20
4	142	47	30	22	16	18	*17	520	201	94	35	20
5	141	48	30	21	16	18	18	392	220	94	*34	23
6	*135	50	29	20	17	18	18	289	278	93	35	22
7	132	48	*28	20	17	19	19	353	344	87	37	*26
8	120	46	28	19	18	19	21	366	425	82	37	26
9	114	45	28	19	18	19	25	363	460	77	35	26
10	104	46	29	18	18	19	30	344	470	71	33	25
11	98	52	29	17	18	19	40	328	445	68	31	24
12	94	52	29	17	19	20	50	302	332	61	30	28
13	85	54	29	17	19	20	60	272	334	58	29	33
14	78	55	28	16	20	20	78	244	269	54	27	42
15	74	55	27	16	20	19	87	264	215	55	26	65
16	76	50	26	15	20	18	91	331	172	55	25	78
17	77	46	26	15	20	18	96	401	*150	58	27	106
18	73	42	26	*15	*20	17	100	535	132	56	24	133
19	73	42	25	15	20	16	105	600	122	53	22	146
20	76	43	25	14	19	16	110	630	144	*54	20	132
21	72	42	25	14	19	16	118	665	142	53	20	109
22	70	42	25	14	18	15	130	645	144	52	19	88
23	* 71	41	24	14	18	15	*175	625	146	52	18	76
24	63	39	24	14	17	15	233	605	139	51	17	89
25	60	37	24	14	17	15	420	565	128	48	17	88
26	55	36	24	14	17	15	585	500	120	45	18	70
27	55	35	23	14	17	15	580	430	112	42	19	68
28	52	35	23	13	17	15	565	376	104	39	19	66
29	51	34	23	14		16	540	337	98	37	17	64
30	55	33	23	14	----------	16	*540	308	93	44	19	104
31	59	----------	23	14	----------	16	----------	272	----------	42	20	----------
Total	2,782	1,358	827	517	500	534	4,901	13,457	5,598	1,960	820	1,837
Mean	89.7	45.3	26.7	16.7	17.9	17.2	163	434	220	63.2	26.5	61.2
(≠)	+18.9	+2.5	+0.06	+0.02	-0.04	-0.05	+86.8	+23.2	+11.5	+5.0	-0.13	+24.3
Mean	109	47.8	26.8	16.7	17.9	17.2	250	457	232	68.2	26.4	85.5
Cfsm	0.699	0.306	0.172	0.107	0.115	0.110	1.60	2.93	1.49	0.437	0.169	0.548
In.	0.81	0.34	0.20	0.12	0.12	0.13	1.78	3.38	1.66	0.50	0.19	0.61

* Discharge measurement made on this day.
≠ Change in contents in Partridge Reservoir and diversion to iron-ore processing plant, equivalent in cubic feet per second; furnished by Erie Mining Co.
≠ Adjusted for change in contents and diversion
Note.--Stage-discharge relation affected by ice Nov. 25 to Dec. 8, Dec. 15 to Apr. 22 (no gage-height record Jan. 14-17, 29-31, Feb. 8-12, Feb. 24 to Apr. 4).

4-0165. St. Louis River near Aurora, Minn.

Location.--Lat 47°29'30", long 92°14'20", in SW¼ sec.22, T.58 N., R.15 W., on left bank at upstream side of highway bridge, three-quarters of a mile downstream from Partridge River and 1½ miles south of Aurora.

Drainage area.--312 sq mi.

Records available.--August 1942 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,371.24 ft above mean sea level, datum of 1929. Prior to Aug. 26, 1944, chain gage at same site and datum.

Average discharge.--23 years, 231 cfs (adjusted for storage and diversion).

Extremes.--Maximum discharge during year, 1,180 cfs May 21 (gage height, 3.92 ft); minimum daily, 32 cfs Feb. 27; minimum gage height, 0.96 ft Aug. 29, 30.
1942-65: Maximum discharge, 5,380 cfs May 14, 1950 (gage height, 8.37 ft); minimum, 4.0 cfs Oct. 2, 3, 1948 (gage height, 0.30 ft).

Remarks.--Records good except those for period of ice effect, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Flow regulated at times by storage in off-channel Partridge Reservoir, formerly known as Whitewater Lake. Reservoir formed from lake by levees around marsh areas and natural outlet. Available capacity 20,000 acre-ft between elevations 1,410 ft (natural lake level) and 1,440 ft. Storage began Apr. 9, 1955. Storage in reservoir obtained from Colby Lake during periods of high flow: release from storage returned to Colby Lake to maintain lake elevation during diversion for iron-ore processing. Diversion began Feb. 7, 1956. Some seepage losses from reservoir enter above station.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

0.9	42	2.5	432
1.3	91	3.0	661
1.6	143	4.0	1,240
2.0	248		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	325	132	65	52	38	33	58	898	575	181	82	59
2	336	128	63	51	38	34	60	944	518	188	80	58
3	329	122	61	51	38	34	64	980	482	186	82	57
4	318	119	*59	50	38	35	68	992	491	181	79	57
5	307	119	58	49	38	36	74	898	551	174	76	60
6	*296	121	58	49	38	37	80	789	675	169	77	60
7	282	114	58	*48	38	39	85	843	748	158	82	62
8	268	110	58	48	38	40	95	865	838	149	90	62
9	258	109	58	47	38	42	110	848	843	145	96	62
10	238	107	59	46	38	44	130	826	810	134	97	60
11	232	117	59	46	37	46	150	794	742	124	93	60
12	219	121	60	45	36	48	180	738	680	119	82	66
13	205	122	59	44	35	50	220	*695	608	117	74	*76
14	194	124	59	43	35	52	280	642	532	109	69	88
15	183	121	58	43	35	53	350	680	457	102	64	134
16	178	116	57	43	35	53	400	832	397	107	63	143
17	176	112	56	43	35	52	450	950	*355	132	66	202
18	171	104	56	43	35	51	500	1,080	322	156	64	255
19	169	100	55	43	35	51	550	1,120	300	176	63	275
20	169	96	55	43	35	50	603	1,100	336	151	60	265
21	164	92	54	43	35	49	641	1,160	322	*134	58	242
22	*158	90	53	43	34	48	656	1,160	318	119	56	219
23	156	88	53	43	34	48	*651	1,120	307	112	53	210
24	151	84	52	43	33	48	642	1,060	289	105	51	222
25	143	80	51	43	*33	47	719	1,020	262	97	52	219
26	137	78	50	42	33	48	870	920	235	91	54	199
27	134	76	51	41	32	49	892	838	219	84	52	188
28	134	74	51	41	33	50	892	774	213	76	51	188
29	128	70	52	40		52	887	714	199	72	49	188
30	130	68	52	40		54	882	656	181	82	53	296
31	134		52	39		56		618		94	58	
Total	6,422	3,114	1,742	1,385	1,000	1,429	12,239	27,554	13,805	4,024	2,126	4,332
Mean	207	104	56.2	44.7	35.7	46.1	408	889	460	130	68.6	144
(≠) Mean	+18.9	+2.5	+0.06	+0.02	-0.04	-0.05	+86.8	+23.2	+11.5	+5	-0.13	+24.3
≠ Cfsm	226	106	56.3	44.7	35.7	46.0	495	912	472	135	68.5	168
≠ In.	0.724	0.340	0.180	0.143	0.114	0.147	1.59	2.92	1.51	0.433	0.220	0.538
	0.83	0.38	0.21	0.16	0.12	0.17	1.77	3.37	1.68	0.50	0.25	0.60

Calendar year 1964: Max 2,020 Min 21 Mean 199 Mean ≠ 208 Cfsm ≠ 0.667 In. ≠ 9.76
Water year 1964-65: Max 1,160 Min 32 Mean 217 Mean ≠ 230 Cfsm ≠ 0.737 In. ≠ 10.04

* Discharge measurement made on this day.
≠ Change in contents in Partridge Reservoir and diversion to iron-ore processing plant, equivalent in cubic feet per second, furnished by Erie Mining Company.
≠ Adjusted for change in contents and diversion.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 20 (no gage-height record Nov. 30 to Dec. 3, Dec. 5 to Jan. 6).

4-0170. Embarrass River at Embarrass, Minn.

Location.--Lat 47°39'24", long 92°11'51", in NW¼ sec.25, T.60 N., R.15 W., on left bank at Embarrass, 30 ft upstream from highway bridge and 100 ft upstream from railroad bridge.

Drainage area.--93.8 sq mi.

Records available.--August 1942 to December 1964 (discontinued).

Gage.--Water-stage recorder. Datum of gage is 1,410.36 ft above mean sea level, datum of 1929. Prior to Aug. 28, 1944, chain gage at same site and datum.

Average discharge.--22 years, 64.4 cfs.

Extremes.--Maximum discharge during period, 116 cfs Oct. 1 (gage height, 2.55 ft); minimum daily, 8.0 cfs Dec. 5-13; minimum gage height, 1.04 ft Dec. 6, 7, 8, 9.
1942-65: Maximum discharge, 1,740 cfs May 8, 9, 1950; maximum gage height, 10.92 ft May 9, 1950; minimum daily discharge, 0.9 cfs Jan. 28 to Feb. 5, 1963; minimum gage height, 0.63 ft Mar. 7, 1963.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, October to December 1964, except period of ice effect (gage height, in feet and discharge, in cubic feet per second)

1.0	8.3	1.6	49
1.2	18	2.0	82
1.4	32	3.0	142

Discharge, in cubic feet per second, October to December 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	107	27	10									
2	118	28	9.5									
3	118	28	9.0									
4	107	27	8.5									
5	*96	27	8.0									
6	83	26	8.0									
7	74	26	8.0	(*)								
8	70	25	8.0									
9	66	24	8.0									
10	59	25	8.0									
11	56	31	8.0									
12	59	39	8.0									
13	56	36	8.0									
14	52	36	8.5									
15	49	35	8.5									
16	47	34	9.0									
17	44	32	9.0									
18	41	28	9.0									
19	39	28	9.0									
20	38	23	9.0									
21	39	18	9.0									
22	40	17	9.0									
23	39	17	9.0									
24	36	16	9.0									
25	35	15	9.0									
26	34	14	9.0									
27	32	13	9.0									
28	31	12	9.0									
29	30	11	9.0									
30	28	10	9.0		---							
31	*27	---	9.0		---		---		---			---
Total	1,750	728	270.0									
Mean	56.5	24.3	8.71									
Cfsm	0.602	0.259	0.093									
In.	0.69	0.29	0.11									

Calendar year 1964: Max 462 Min 2.5 Mean 55.6 Cfsm 0.593 In. 7.21
Water year 1964-65: Max - Min - Mean - Cfsm - In. -

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 25 to Dec. 31.

4-0187.50 St. Louis River at Forbes, Minn.

Location.--Lat 47°21'48", long 92°35'56" in NE¼SE¼ sec.3, T.56 N., R.18 W., on right bank at downstream side of highway bridge, 0.5 mile downstream from Eveleth Taconite Company dam, 0.6 mile south of Forbes, 1.8 miles upstream from Elbow Creek.

Records available.--August 1964 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,293.11 ft above mean sea level, datum of 1929. Prior to Oct. 28, 1964, wire-weight gage at same site and datum.

Extremes.--1964: Maximum discharge during period August 19 to September 30, 614 cfs Sept. 30 (gage height, 7.50 ft); minimum, 78 cfs Aug. 20 (gage height, 5.82 ft).

1964-65: Maximum discharge during year, 2,560 cfs Apr. 23 (gage height, 11.89 ft); maximum gage height, 14.21 ft Apr. 19 (backwater from ice); minimum discharge, 45 cfs July 6 (gage height, 5.55 ft), result of regulation.

Flood of June 1964 reached a stage of about 12.3 ft, from information furnished by Eveleth Taconite Company (discharge, 2,780 cfs).

Remarks.--Records good except those for period of ice effect or no gage-height record, which are fair. There is some regulation from the Eveleth Taconite Company dam ½ mile upstream at medium and low flow.

Rating table, August 1964 to September 1965, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

5.8	74	8.0	798
6.0	123	10.0	1,600
6.5	272	12.0	2,620
7.0	438		

Discharge, in cubic feet per second, August to September 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1												175
2												181
3											*153	198
4												187
5												196
6												210
7												270
8												311
9												337
10										* 721		347
11												367
12												397
13												370
14												350
15												363
16												*357
17												330
18												285
19											91	337
20											78	350
21											155	327
22											115	311
23											116	334
24											117	445
25											138	438
26											109	520
27											93	560
28											120	582
29											170	592
30					------						190	614
31		------			-----		-----		-----		181	-------
Total												10,641
Mean												355
Ac-ft												-

* Discharge measurement made on this day.

Note.--No gage-height record Aug. 23, 29, 30, Sept. 6, 7, 13, 20, 26, 27.

4-0187.50 St. Louis River at Forbes, Minn.--Continued

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	*614	234	140	64	66	76	80	2,140	1,300	394	181	103
2	657	234	135	64	66	76	82	2,090	1,220	411	166	101
3	672	231	130	64	64	76	86	2,050	1,140	411	164	101
4	650	225	125	64	64	76	92	2,000	1,060	390	161	98
5	621	307	120	64	66	78	100	1,920	1,140	370	161	95
6	592	357	120	65	68	80	105	* 1,820	1,360	231	161	101
7	571	327	115	66	72	80	110	1,710	1,550	337	193	112
8	554	282	112	* 66	74	82	120	1,700	1,800	320	190	120
9	515	253	110	66	77	82	140	1,670	1,700	307	181	158
10	494	234	105	65	81	84	170	1,630	1,500	291	172	109
11	470	237	105	64	* 82	86	210	1,560	1,360	272	166	106
12	*445	250	100	60	82	* 86	260	1,490	1,220	216	161	112
13	418	246	98	62	83	86	430	1,390	1,120	250	149	132
14	397	240	95	62	84	86	600	1,300	1,040	246	138	158
15	377	240	* 93	60	84	86	900	1,140	950	196	126	216
16	357	237	90	60	84	86	1,100	1,430	870	187	115	269
17	330	228	86	60	86	86	1,300	1,660	790	210	115	288
18	330	*219	84	62	86	86	1,700	1,860	*720	250	129	350
19	324	205	82	62	86	86	2,200	1,970	661	266	126	411
20	317	180	80	62	88	86	2,400	1,960	706	288	112	448
21	311	195	76	64	88	84	2,470	2,120	713	266	106	452
22	301	200	74	66	88	84	*2,540	2,250	654	246	98	462
23	291	200	72	68	86	82	2,530	2,210	614	228	95	487
24	282	190	70	70	82	82	2,470	2,160	589	216	95	442
25	270	185	70	70	80	80	2,410	2,150	560	204	98	515
26	259	175	68	72	78	80	2,440	2,080	526	190	103	473
27	250	165	68	72	76	80	2,490	1,910	494	178	106	445
28	253	160	66	70	76	78	2,430	1,780	490	169	95	424
29	246	150	66	70		78	2,330	1,660	456	158	93	421
30	237	145	64	68	------	78	2,240	1,530	421	164	93	628
31	231	------	64	68	------	78	------	1,420	------	169	*95	------
Total	12,636	6,731	2,883	2,024	2,197	2,534	36,535	55,760	28,724	8,031	4,144	8,337
Mean	408	224	93.0	65.3	78.5	81.7	1,218	1,799	957	259	134	278
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max - Min - Mean - Ac-ft -
Water year 1964-65: Max 2,540 Min 60 Mean 467 Ac-ft -

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 19. No gage-height record Oct. 4, 11, 18, 25, June 9-17.

4-0193. West Swan River near Silica, Minn.

Location.--Lat 47°17'36", long 93°02'30", in SW¼NW¼ sec.32, T.56 N., R.21 W., on right bank 10 ft upstream from pilings of dismantled bridge and railroad bed of Great Northern Railroad, 2 miles northwest of Silica, 9 miles southwest of Hibbing and 20 miles above confluence of East Swan and West Swan.

Records available.--April 1963 to September 1965.

Gage.--Water-stage recorder. Altitude of gage is 1,360 ft (from topographic map). Prior to Aug. 2, 1963 reference point at same site and datum.

Extremes.--Maximum discharge during year, 340 cfs Sept. 30 (gage height, 4.81 ft); minimum daily discharge, 1.0 cfs Nov. 28-30.
1963-65: Maximum discharge, that of Sept. 30, 1965; maximum gage height, that of Sept. 30, 1965; minimum discharge, 0.3 cfs Aug. 8, 1963.

Remarks.--Records good. One hundred thirty-five discharge measurements were made during the year.

Cooperation.--An additional one hundred and twenty-five discharge measurements furnished by M. A. Hanna Mining Co.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 2, Apr. 16-19, June 4-6, Aug. 15, 16, 19, 26, 27)

1.2	1.7	1.8	12
1.3	2.4	2.0	22
1.4	3.1	2.5	52
1.5	4.0	3.0	94
1.6	5.4	3.5	150
1.7	8.2	4.0	215

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	5.3	4.4	1.1	7.6	7.5	6.9	8.6	20	9.0	3.5	7.1	3.9
2	12	3.7	1.2	7.7	7.6	6.8	8.7	20	18	3.7	5.4	3.7
3	9.0	3.7	1.6	7.7	7.5	7.3	8.8	22	26	3.9	5.0	3.5
4	7.6	3.3	2.1	7.8	7.3	8.0	8.9	18	28	3.5	4.7	3.3
5	7.6	3.2	2.1	7.9	7.1	8.7	9.0	16	46	3.1	4.1	3.9
6	6.5	3.2	2.1	7.9	7.3	8.4	9.2	24	56	3.0	5.1	3.9
7	5.4	3.1	2.1	8.0	7.5	8.0	10	35	57	3.1	15	5.3
8	5.0	2.9	2.2	8.1	7.7	7.6	11	26	47	3.1	7.6	4.1
9	6.2	2.9	2.3	8.1	7.7	8.0	12	20	31	3.4	4.8	3.7
10	4.7	3.1	2.6	8.2	7.8	8.4	15	18	19	2.9	4.1	3.4
11	6.2	6.2	3.0	8.2	7.8	9.0	37	14	12	2.8	3.7	3.1
12	5.1	8.6	4.4	8.3	7.5	9.5	74	11	86	3.1	3.6	7.2
13	4.7	7.1	5.8	8.4	7.4	9.2	160	9.0	6.2	4.6	2.9	13
14	4.6	5.3	7.6	8.6	7.7	9.0	210	7.1	5.4	3.6	2.8	10
15	4.4	4.7	6.6	8.7	8.3	8.2	192	25	4.8	3.1	2.2	21
16	4.3	4.3	6.2	8.6	8.6	7.6	187	58	4.0	3.3	1.8	15
17	3.9	4.0	6.1	8.3	9.1	8.5	186	50	3.7	3.3	2.4	12
18	3.8	3.8	6.0	7.7	8.8	9.9	191	34	3.2	3.5	2.8	12
19	3.7	3.0	6.1	7.2	8.6	9.6	186	25	3.4	3.7	3.3	9.5
20	3.9	2.5	6.1	7.0	8.8	9.2	163	18	10	3.8	2.8	7.9
21	4.3	2.2	6.2	6.6	8.9	8.6	125	51	6.5	3.9	2.4	7.7
22	4.4	1.9	6.7	6.8	8.6	8.2	114	65	4.8	4.3	2.2	15
23	4.3	1.6	7.2	6.8	8.4	8.1	93	38	4.1	3.6	1.9	14
24	4.4	1.4	7.2	6.7	8.0	8.0	67	30	3.4	3.3	1.8	11
25	4.3	1.2	7.0	6.7	7.6	8.2	52	26	3.1	2.8	2.0	8.6
26	3.9	1.2	6.8	6.7	7.3	8.4	40	18	3.0	2.7	2.2	6.5
27	3.7	1.1	7.2	6.6	7.2	8.6	33	15	3.1	2.7	2.4	5.3
28	3.8	1.0	7.9	6.8	7.0	8.6	28	16	3.4	2.5	2.4	5.0
29	4.4	1.0	7.8	7.0		8.4	23	14	3.0	2.8	2.7	5.3
30	4.4	1.0	7.7	7.1	----------	8.1	24	12	3.0	4.3	4.1	138
31	3.8	----------	7.6	7.3	----------	8.4	----------	9.5	----------	9.0	4.4	----------
Total	159.6	96.6	156.6	235.1	220.6	259.4	2,286.2	764.6	435.7	109.9	119.7	365.8
Mean	5.15	3.22	5.05	7.58	7.88	8.37	76.2	24.7	14.5	3.55	3.86	12.2
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max 162 Min 0.9 Mean 11.1 Ac-ft -
Water year 1964-65: Max 210 Min 1.0 Mean 14.3 Ac-ft -

Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 15 (no gage-height record Jan. 9, 10).

4-0195. East Swan River near Toivola, Minn.

Location.--Lat 47°16'55", long 92°50'05", in NE¼NE¼ sec.2, T.55 N., R.20 W., on left bank 350 ft downstream from bridge on St. Louis County Road 442, 4.8 miles upstream from confluence with West Swan River, 8 miles northwest of Toivola, and 8¾ miles upstream from St. Louis River.

Drainage area.--112 sq mi.

Records available.--September 1953 to September 1962, October 1964 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,260.46 ft above mean sea level, datum of 1929.

Average discharge.--10 years (1953-62, 1965), 86.6 cfs.

Extremes.--Maximum discharge during year, 1,370 cfs Apr. 17 (gage height, 16.77 ft); maximum gage height, 18.08 ft Apr. 15 (backwater from ice); minimum daily discharge, 12 cfs Feb. 22-26.
1953-62, 1965: Maximum discharge, 1,690 cfs Apr. 15, 1956 (gage height, 17.94 ft); maximum gage height, 18.45 ft Apr. 12, 1954 (backwater from ice); minimum daily discharge, that of Feb. 22-26, 1965; minimum gage height, 3.15 ft Aug. 24, 1961.
Flood in May 1950 reached a stage of about 20.0 ft, from information by local residents.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are poor.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Aug. 31)

3.2	14	5.0	80	11.0	580
3.5	23	6.0	132	14.0	914
4.0	40	8.0	286	16.0	1,370
4.5	59				

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	80	35	18	17	14	13	14	233	117	35	50	23
2	90	35	17	17	14	13	14	226	172	37	42	20
3	94	39	17	18	14	13	15	230	214	36	34	18
4	90	42	16	18	14	13	16	203	278	32	28	16
5	85	42	16	18	14	13	18	*177	393	29	29	18
6	78	39	16	19	14	14	22	182	501	*26	32	19
7	72	36	16	*19	14	14	28	246	470	26	43	26
8	66	32	*16	19	15	14	38	264	342	26	44	21
9	62	29	16	19	15	14	64	219	243	28	37	19
10	58	27	16	19	15	14	110	197	172	26	*31	17
11	57	45	16	18	*15	14	170	176	135	24	28	16
12	59	74	16	18	14	14	300	150	108	23	25	26
13	60	71	16	17	14	14	500	129	88	28	23	42
14	58	66	16	17	14	14	820	113	74	29	21	68
15	57	60	16	16	14	15	*1,330	133	65	25	20	110
16	55	55	16	16	13	*15	1,350	282	58	23	19	125
17	54	*50	16	16	13	15	1,360	323	51	33	19	130
18	52	42	16	16	13	14	1,300	312	50	31	20	123
19	50	37	16	16	13	14	1,260	245	90	26	19	121
20	48	34	15	16	13	14	1,140	186	85	24	18	103
21	47	32	15	16	13	13	879	362	67	24	17	94
22	46	30	15	16	12	13	*747	503	56	24	17	150
23	44	29	15	16	12	13	668	386	46	24	16	144
24	43	28	15	16	12	13	578	315	62	24	16	135
25	42	27	15	16	12	13	502	296	39	23	16	118
26	40	27	15	16	12	13	434	271	37	22	17	93
27	39	25	16	15	13	13	378	214	38	21	20	75
28	38	23	16	15	13	13	325	196	36	22	24	60
29	37	21	16	15		13	290	174	32	20	30	140
30	36	19	17	14	----------	14	263	148	32	20	39	300
31	35	---------	17	14	----------	14	----------	129	---------	31	*29	---------
Total	1,772	1,151	495	518	378	423	14,933	7,220	4,131	822	823	2,370
Mean	57.2	38.4	16.0	16.7	13.5	13.6	498	233	138	26.5	26.5	79.0
Cfsm	0.511	0.343	0.143	0.149	0.121	0.121	4.45	2.08	1.23	0.237	0.237	0.705
In.	0.59	0.38	0.16	0.17	0.13	0.14	4.96	2.40	1.37	0.27	0.27	0.79

Calendar year 1964: Max - Min - Mean - Cfsm - In. -
Water year 1964-65: Max 1,360 Min 12 Mean 96.0 Cfsm 0.857 In. 11.63

Peak discharge (base, 400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-17	1800	16.77	1,370	6- 6	1330	10.27	507
5-22	0830	10.35	515				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 17 (no gage-height record Nov. 19 to Dec. 7, Dec. 9-20). No gage-height record Oct. 1 to Nov. 1, Nov. 5-16, Aug. 1-4, 11-30, Sept. 1-30.

4-0240. St. Louis River at Scanlon, Minn.

Location.--Lat 46°42'12", long 92°25'07", in NW¼ sec.30, T.49 N., R.16 W., on right bank 25 ft downstream from lower bridge on U. S. Highway 61 at Scanlon, 0.6 mile downstream from Minnesota Power & Light Co. powerplant, 3 miles upstream from Thomson Reservoir, and 3.2 miles upstream from Midway River.

Drainage area.--3,430 sq mi, approximately.

Records available.--January 1908 to September 1965. Monthly discharge only for some periods, published in WSP 1307. Published as "near Thomson" 1908-50.

Gage.--Water-stage recorder. Datum of gage is 1,101.23 ft above mean sea level, datum of 1929. Oct. 5, 1909, to Sept. 5, 1914, chain gage 3 miles downstream and 50 ft below powerplant at datum about 420 ft lower. Sept. 6, 1914, to Aug. 4, 1953, powerplant record at Thomson hydroelectric plant.

Average discharge.--57 years, 2,172 cfs (unadjusted).

Extremes.--Maximum discharge during year, 24,300 cfs Apr. 20 (gage height, 11.57 ft); minimum, 432 cfs Aug. 28 (gage height, 2.43 ft); minimum gage height, 2.41 ft Nov. 22.
1908-65: Maximum daily discharge, 37,900 cfs May 9, 1950; maximum gage height, 15.8 ft, May 9, 1950, from Minnesota Highway Department (discharge uncertain); minimum discharge, 80 cfs Aug. 29, 1963; minimum daily, 109 cfs Feb. 7, 1924.

Remarks.--Records good. Diurnal fluctuation caused by powerplant upstream. Flow regulated by Whiteface Reservoir and Boulder, Island, Rice and Fish Lakes (combined capacity, 332,160 acre-ft). Records of chemical analyses for the water year 1965 are published in Part 2 of this report.

Rating table, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 18-30, July 9-24)

2.5	515	5.0	3,940
3.0	950	6.0	5,960
3.5	1,540	8.0	11,800
4.0	2,200	11.1	22,600

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,330	1,150	774	1,510	1,550	1,420	800	3,110	4,000	2,010	1,090	755
2	2,360	1,050	1,130	1,460	1,650	1,400	700	7,390	3,460	2,160	1,150	641
3	2,370	1,020	1,210	1,430	1,650	1,500	780	6,960	3,700	2,190	1,220	764
4	2,380	1,000	1,090	*1,520	1,600	1,450	700	6,520	3,940	2,040	1,070	683
5	2,270	1,020	1,030	1,480	1,600	1,450	670	6,010	4,860	1,940	1,030	755
6	2,080	1,000	1,000	1,400	1,620	1,500	750	5,830	7,050	1,770	1,000	633
7	1,940	1,060	940	1,450	1,550	1,500	770	5,830	9,280	1,760	920	737
8	1,880	1,070	960	1,450	1,500	1,400	820	5,760	10,500	1,430	860	692
9	1,720	1,280	960	1,450	1,500	1,420	*860	5,720	11,100	1,520	1,160	710
10	1,560	1,110	1,150	1,400	1,500	1,350	1,200	5,540	9,940	1,540	983	774
11	1,420	1,110	1,100	1,350	1,450	1,450	1,280	5,160	*7,750	1,420	920	674
12	1,430	1,540	1,200	1,350	1,450	1,400	1,770	4,780	6,460	1,360	822	802
13	1,540	1,530	1,200	1,320	1,450	1,500	3,300	4,340	5,420	1,420	774	972
14	1,520	1,360	1,150	1,350	1,450	1,480	5,200	3,860	4,700	*1,370	719	1,090
15	1,670	1,270	1,130	1,450	1,380	1,380	*9,000	3,760	4,000	1,270	683	1,360
16	1,540	1,280	1,130	1,450	1,700	1,130	11,700	3,800	3,260	1,300	633	1,830
17	1,740	1,300	1,050	1,450	1,370	1,020	13,200	4,500	2,520	1,380	578	2,040
18	1,600	1,270	1,100	1,400	1,380	1,050	16,100	5,600	2,360	1,320	683	2,120
19	1,500	1,110	1,200	1,400	1,400	950	21,400	6,590	1,900	1,200	617	2,200
20	1,500	910	1,200	1,450	1,420	1,000	*22,600	6,220	2,160	1,220	683	2,270
21	1,580	822	1,180	1,500	1,400	1,030	22,200	6,140	2,800	1,260	657	2,170
22	1,460	719	1,300	1,500	1,370	1,000	20,500	7,240	3,030	1,280	683	2,150
23	1,300	1,220	1,300	1,500	1,400	950	18,900	7,930	2,550	1,280	674	2,240
24	1,420	1,340	1,200	1,500	1,370	940	17,100	7,540	2,170	1,220	625	2,270
25	1,400	*1,270	1,300	1,450	1,400	930	15,200	7,510	1,970	1,160	683	2,170
26	1,280	1,250	1,300	1,450	*1,370	920	13,400	7,660	1,840	1,140	*719	1,900
27	1,320	1,190	1,320	1,450	1,400	950	11,800	6,910	1,930	1,080	728	2,040
28	*1,320	900	1,320	1,450	1,450	983	11,000	5,100	2,080	1,070	641	1,740
29	1,300	1,130	1,410	1,400		860	9,850	5,420	2,160	1,070	665	1,580
30	1,270	870	1,410	1,420	----------	840	8,950	5,160	2,150	1,180	665	*2,460
31	1,210	----------	1,350	1,420	----------	860	----------	4,600	----------	1,190	737	----------
Total	51,210	34,151	36,094	44,560	41,330	37,013	262,500	184,490	131,040	44,550	25,072	43,222
Mean	1,652	11,138	1,164	1,437	1,476	1,194	8,750	5,951	4,368	1,437	809	1,441
(≠)	-91	-134	-789	-1,012	-1,375	-796	+2,134	+1,981	+246	-650	-323	+370
Mean	1,561	1,004	375	425	101	398	10,884	7,932	4,614	787	486	1,811
Cfsm	0.455	0.293	0.109	0.124	0.029	0.116	3.17	2.31	1.35	0.229	0.141	0.528
In.	0.52	0.33	0.13	0.14	0.03	0.13	3.54	2.66	1.51	0.26	0.16	0.59

Calendar year 1964:	Max	17,600	Min	600	Mean	2,231	Mean≠	3,541	Cfsm≠	1.03	In.≠	9.27
Water year 1964-65:	Max	22,600	Min	578	Mean	2,562	Mean≠	2,123	Cfsm≠	0.619	In.≠	10.00

* Discharge measurement made on this day.
≠ Change in contents, equivalent in cubic feet per second, in Whiteface Reservoir and Boulder, Island, Rice and Fish Lakes; records furnished by Minnesota Power and Light Co.
≠ Adjusted for change in contents.
Note.--Stage-discharge relation affected by ice Dec. 7-15, 17-28, 31, Jan. 6 to Mar. 13, Mar. 17-27, Mar. 29 to Apr. 10 (no gage-height record Feb. 13-26, Mar. 31 to Apr. 9).

5-0300. Otter Tail River near Detroit Lakes, Minn.

Location.--Lat 46°50', long 95°42', in sec.23, T.139 N., R.40 W., on right bank 10 ft upstream from highway bridge, 5 miles downstream from Height of Land Lake, and 7½ miles east of city of Detroit Lakes.

Drainage area.--270 sq mi.

Records available.--March 1937 to September 1965.

Gage.--Water-stage recorder and concrete control. Datum of gage is 1,409.49 ft above mean sea level, datum of 1929.

Average discharge.--28 years, 52.6 cfs (38,100 acre-ft per year).

Extremes.--Maximum discharge during year, 264 cfs June 13 (gage height, 4.45 ft); minimum, 16 cfs Sept. 10, 11; minimum gage height, 3.10 ft Dec. 12.
1937-65: Maximum discharge, 371 cfs June 26, 1943 (gage height, 4.78 ft, from graph based on partial record); maximum gage height, 6.96 ft Jan. 27, 1950 (backwater from ice); minimum daily discharge, 0.1 cfs Mar. 23, 1940.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Flow partly regulated by dams of Minnesota Department of Conservation on several lakes above station.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.1	17	3.9	117
3.3	30	4.1	164
3.5	50	4.5	280
3.7	78		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	25	22	23	29	25	26	34	180	182	*180	90	28
2	24	22	24	28	25	*26	*35	182	182	180	87	26
3	23	22	25	28	25	26	42	182	187	167	81	24
4	24	22	25	27	26	27	51	182	193	164	76	23
5	24	23	25	27	26	27	56	190	196	154	76	21
6	25	23	24	26	27	28	170	196	233	150	85	21
7	24	22	24	26	28	30	150	193	236	145	81	20
8	24	22	23	25	29	31	140	193	239	135	76	19
9	24	23	23	25	29	31	105	196	*242	135	73	19
10	24	23	22	25	28	31	*115	196	251	126	70	17
11	24	28	22	24	27	32	154	193	254	122	67	17
12	24	28	22	24	26	32	113	190	258	119	61	23
13	24	28	21	24	26	33	109	190	261	128	59	24
14	24	28	21	24	26	35	119	190	261	119	54	28
15	24	28	22	23	26	36	*131	196	258	115	50	30
16	24	25	22	24	26	36	133	198	258	111	48	29
17	23	24	23	24	26	36	135	196	254	104	45	31
18	23	23	24	24	27	36	145	187	251	102	33	31
19	23	22	25	24	27	35	154	187	245	100	24	30
20	23	21	28	25	27	34	164	185	239	98	25	30
21	23	21	29	25	26	33	177	185	233	96	26	29
22	22	20	30	26	26	33	182	182	230	92	26	30
23	22	20	30	26	25	32	187	180	221	92	24	32
24	22	20	30	26	24	32	190	182	212	89	27	35
25	22	*20	31	26	24	32	196	*182	207	85	29	38
26	22	20	31	26	24	32	198	182	201	83	28	40
27	21	20	30	26	24	32	187	187	201	79	*28	39
28	21	21	30	*26	25	32	172	193	193	*85	32	37
29	*21	22	30	25		32	177	187	185	87	36	40
30	21	22	*30	25	----------	33	*180	182	177	89	34	*49
31	22	----------	30	25	----------	33	----------	182	----------	94	30	----------
Total	716	685	799	788	730	984	4,101	5,826	6,740	3,625	1,581	860
Mean	23.1	22.8	25.8	25.4	26.1	31.7	137	188	225	117	51.0	28.6
Ac-ft	1,420	1,360	1,580	1,560	1,450	1,950	8,130	11,560	13,370	7,190	3,140	1,710

Calendar year 1964: Max 162 Min 13 Mean 47.4 Ac-ft 34,410
Water year 1964-65: Max 261 Min 17 Mean 75.2 Ac-ft 54,420

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 10 (no gage-height record Jan. 14 to Mar. 2). No gage-height record Sept. 20-29.

5-0405. Pelican River near Fergus Falls, Minn.

Location.--Lat 46°20'10", long 96°07'00", in NE¼ sec.17, T.133 N., R.43 W., on left bank 990 ft downstream from bridge on U. S. Highway 52, 3 miles northwest of Fergus Falls and 7½ miles upstream from mouth.

Drainage area.--482 sq mi.

Records available.--June 1909 to December 1912, July 1942 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,176.98 ft above mean sea level, datum of 1929 (levels by Minnesota Highway Department). June 19, 1909, to Dec. 31, 1912, staff gage at site 1 mile downstream at different datum. July 1, 1942, to Nov. 6, 1955, staff gage and Nov. 7, 1955 to Sept. 30, 1963, water-stage recorder at site 900 ft upstream at datum 3.00 ft higher.

Average discharge.--25 years (1910-12, 1942-65), 71.9 cfs (52,050 acre-ft per year).

Extremes.--Maximum discharge during year, 551 cfs Apr. 9; maximum gage height, 6.73 ft Apr. 6 (backwater from ice); minimum discharge, 21 cfs Oct. 26-30.
1909-12, 1942-65: Maximum discharge, 756 cfs Mar. 29, 1943 (gage height, 8.53 ft present datum); maximum gage height observed, 8.60 ft Mar. 28, 1950 (backwater from ice, present datum); no flow on many days in 1946, 1949-50.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Flow affected by storage in lakes above station.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.0	18	4.0	151
3.2	27	4.5	282
3.4	43	5.0	431
3.7	86		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	35	22	22	25	29	37	*58	205	254	192	113	77
2	33	24	22	26	29	*37	62	208	265	185	110	75
3	33	24	22	26	29	36	79	211	276	175	106	70
4	32	24	23	26	30	36	110	216	282	168	102	70
5	32	24	23	27	31	37	230	222	290	163	102	68
6	32	24	24	28	32	38	470	232	325	161	106	67
7	31	25	25	28	34	39	450	235	334	158	108	65
8	29	26	26	29	35	40	480	238	361	188	104	63
9	27	26	26	28	36	42	535	240	361	175	100	61
10	27	26	26	28	36	44	510	240	355	165	96	60
11	27	29	27	27	36	46	485	240	337	163	94	60
12	27	31	27	27	35	49	455	240	316	158	92	75
13	26	32	27	27	35	54	430	243	302	158	90	72
14	25	32	26	27	35	55	406	246	293	151	88	77
15	24	33	25	27	35	56	*358	260	285	146	84	84
16	24	33	25	27	36	56	313	265	276	142	80	94
17	24	33	25	27	38	55	276	262	265	140	78	104
18	24	32	24	27	39	54	254	268	260	138	80	104
19	24	30	24	28	40	53	240	260	249	135	78	104
20	24	28	24	29	41	53	232	257	243	130	78	100
21	24	25	24	30	41	53	232	260	235	128	75	104
22	22	24	23	30	42	52	230	257	230	125	73	106
23	22	23	23	30	41	52	227	268	222	122	70	108
24	22	*23	23	31	40	52	224	276	211	122	70	102
25	22	22	23	31	39	52	222	*279	203	122	72	100
26	21	22	23	30	38	51	216	276	203	121	*73	98
27	21	22	24	30	38	51	*211	274	211	*121	75	96
28	*21	22	24	30	37	51	205	268	205	119	75	*92
29	21	22	24	*29		52	208	260	*200	119	75	98
30	22	22	*24	29	----------	53	205	251	192	117	77	113
31	22	----------	25	29	----------	54	----------	251	----------	115	77	----------
Total	800	785	753	873	1,007	1,490	8,613	7,708	8,041	4,522	2,701	2,567
Mean	25.8	26.2	24.3	28.2	36.0	48.1	287	249	268	146	87.1	85.6
Ac-ft	1,590	1,560	1,490	1,730	2,000	2,960	17,080	15,290	15,950	8,970	5,360	5,090

Calendar year 1964: Max 265 Min 15 Mean 68.5 Ac-ft 49,730
Water year 1964-65: Max 535 Min 21 Mean 109 Ac-ft 79,070

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 13 (no gage-height record Jan. 16-28, Feb. 24-Mar. 1, Mar. 30, 31). No gage-height record July 16-26.

5-549.5 Orwell Reservoir near Fergus Falls, Minn.

Location.--Lat 46°12'55", long 96°10'40", in SW¼ sec.26, T.132 N., R.44 W., at dam on Otter Tail River at outlet of Orwell Reservoir, 7 miles southwest of Fergus Falls, Minn.

Drainage area.--1,830 sq mi, approximately.

Records available.--March 1953 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,000.00 ft above mean sea level, adjustment of 1912. Gage readings reduced to elevations above mean sea level.

Extremes.--Maximum contents during year, 15,650 acre-ft Oct. 3 (elevation, 1,071.33 ft); minimum, 910 acre-ft Mar. 29 (elevation, 1,047.39 ft).
1953-65: Maximum contents, 16,920 acre-ft June 17, 1962 (elevation, 1,072.38 ft); minimum (after initial filling), 844 acre-ft Aug. 26, 27, 1953 (elevation, 1,046.96 ft).

Remarks.--Reservoir is formed by earth dam with concrete spillway with one taintor gate; storage began in March 1953. Capacity to elevation, 1,070 ft (maximum operating stage) is 14,100 acre-ft of which 13,100 acre-ft is controlled storage above elevation 1,048 ft (minimum operating stage). Dead storage, 210 acre-ft. Figures given herein represent total contents. Reservoir is used for flood control and to increase low flow for water supply and pollution abatement.

Cooperation.--Records furnished by Corps of Engineers.

Month-end elevation and contents, water year October 1964 to September 1965

Date	Elevation (feet)✓	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	1,071.30	15,610	-
Oct. 31	1,070.00	14,100	-1,510
Nov. 30	1,068.80	12,800	-1,300
Dec. 31	1,063.12	7,900	-4,900
Calendar year 1964	-	-	+900
Jan. 31	1,058.68	4,970	-2,930
Feb. 28	1,055.15	3,270	-1,700
Mar. 31	1,049.56	1,340	-1,930
Apr. 30	1,064.49	8,990	+7,650
May 31	1,063.42	8,140	-850
June 30	1,060.90	6,340	-1,800
July 31	1,063.61	8,290	+1,950
Aug. 31	1,067.22	11,300	+3,010
Sept.30	1,070.28	14,420	+3,120
Water year 1964-65	-	-	-1,190

✓ Elevation at 2400

GPO 826-476-3

5-0460. Otter Tail River below Orwell Dam, near Fergus Falls, Minn.

Location.--Lat 46°12'35", long 96°11'05", in NE¼ sec.34, T.132 N., R.44 W., on left bank 0.7 mile downstream from Orwell Dam, 6.1 miles downstream from Dayton Hollow Dam, 8 miles southwest of Fergus Falls, and 11.1 miles downstream from Pelican River.

Drainage area.--1,830 sq mi, approximately.

Records available.--October 1930 to September 1965. Prior to October 1952, published as Otter Tail River below Pelican River, near Fergus Falls. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,029.65 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Oct. 11, 1930 to Nov. 17, 1933, at same site at datum 2.00 ft higher; Nov. 18, 1933, to Mar. 21, 1953, at site 6.1 miles upstream at datum 40.30 ft higher.

Average discharge.--35 years, 263 cfs (190,400 acre-ft per year).

Extremes.--Maximum discharge during year, 1,330 cfs June 14 (gage height, 4.74 ft); minimum, 30 cfs Oct. 14 (gage height, 2.00 ft).
1930-65: Maximum discharge, 1,710 cfs June 17, 1953 (gage height, 5.60 ft, backwater from aquatic vegetation); minimum, 1.0 cfs May 2, 1934, Sept. 30, 1935; minimum daily, 1.6 cfs Feb. 7, 1937.

Remarks.--Records good. Flow regulated by Orwell Reservoir beginning Mar. 21, 1953 (see preceding page) and powerplants upstream.

Rating tables, water year 1964-65 (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used May 16-28, June 12 to July 4)

Oct. 1 to Mar. 30		Mar. 31 to Sept. 30			
2.4	133	2.4	168	3.5	712
2.6	219	2.6	247	4.0	997
2.9	384	3.0	444	4.5	1,330

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	165	201	230	235	196	224	*260	822	1,100	1,040	550	307
2	237	201	230	235	196	*230	260	816	1,110	931	524	312
3	362	201	230	235	191	218	270	844	1,120	816	481	312
4	356	201	230	230	187	201	274	866	1,140	811	486	316
5	328	201	235	230	182	196	288	866	1,180	816	486	316
6	223	196	230	230	178	191	418	860	1,230	811	492	316
7	235	196	224	230	178	191	545	850	1,160	816	492	316
8	226	196	224	230	173	196	593	855	*1,080	833	492	292
9	188	196	224	230	173	196	336	850	1,040	844	486	283
10	256	196	224	230	173	191	172	850	1,040	850	434	270
11	256	191	224	230	173	191	176	855	1,120	855	418	256
12	256	210	230	224	173	191	172	850	1,260	855	428	260
13	210	224	230	224	173	191	172	850	1,280	850	428	274
14	157	224	230	224	173	191	360	901	1,280	855	428	346
15	172	224	230	219	174	201	*740	1,030	1,280	855	428	428
16	194	224	230	214	176	240	740	1,060	*1,230	680	408	481
17	246	224	235	214	178	256	734	1,060	1,220	620	372	481
18	246	224	240	214	178	261	734	1,060	1,190	674	372	497
19	155	224	230	210	178	246	762	1,050	1,180	680	372	513
20	192	224	230	210	176	246	806	1,040	1,180	653	372	534
21	251	224	235	210	174	230	806	1,030	1,180	631	366	545
22	251	224	235	205	171	224	800	1,030	1,170	642	366	492
23	256	224	235	205	168	219	789	1,030	1,160	653	377	476
24	235	*224	235	205	165	219	800	1,030	1,150	663	377	508
25	214	230	235	201	161	214	794	*1,030	1,140	663	366	524
26	205	230	235	201	161	214	816	1,040	1,120	669	372	497
27	196	235	235	201	161	210	850	1,050	1,110	588	*377	449
28	*201	235	235	201	201	208	844	1,060	1,100	*455	377	439
29	201	230	230	*196		205	*833	1,080	1,080	460	377	439
30	201	230	*230	201	----------	208	822	1,090	*1,060	518	377	*470
31	201	----------	235	201	----------	222	----------	1,090	----------	561	326	----------
Total	7,072	6,464	7,165	6,725	4,941	6,621	16,966	29,795	34,690	22,648	13,007	11,949
Mean	228	215	231	217	176	214	566	961	1,156	731	420	398
Ac-ft	14,040	12,820	14,210	13,340	9,800	13,130	33,650	59,100	68,810	44,920	25,800	23,700

Calendar year 1964: Max 855 Min 51 Mean 292 Ac-ft 211,700
Water year 1964-65: Max 1,280 Min 155 Mean 460 Ac-ft 333,300

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Feb. 15, 16, 20-23, Mar. 2, 3, 28-30.

5-0500. Bois de Sioux River near White Rock, S. Dak.

Location.--Lat 45°51'45", long 96°34'25", in SW¼SW¼ sec.27, T.128 N., R.47 W., on left bank just downstream from Big Slough Outlet, 300 ft downstream from White Rock Dam, 4 miles south of White Rock, and 5 miles northwest of Wheaton, Minn.

Drainage area.--1,160 sq mi, approximately.

Records available.--October 1941 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 960.00 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Jan. 14, 1943, staff gage at same site at datum 0.11 ft lower. Jan. 15, 1943, to Sept. 30, 1963, water stage recorder at same site at datum 0.11 ft lower.

Average discharge.--24 years, 83.8 cfs (60,670 acre-ft per year).

Extremes.--Maximum discharge during year, 1,320 cfs June 9 (gage height, 11.05 ft); minimum, no flow for many days.
1941-65: Maximum discharge, 1,620 cfs Aug. 6, 1962 (gage height, 11.41 ft, present datum); no flow at times in most years.

Remarks.--Records good except those for period of ice effect, which are fair. Flow regulated by Lake Traverse-Bois de Sioux Flood Control and Water Conservation project (available capacity for flood control, 137,000 acre-ft).

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 13

2.7	0
2.8	.2
2.9	.7
3.0	1.7

Apr. 14 to Sept. 30

2.9	.6	4.5	88
3.0	2.1	5.0	131
3.1	4.4	6.0	270
3.2	7.5	8.0	590
3.4	16	10.0	1,020
3.6	26	11.0	1,310
4.0	53		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.3	1.0	.8				0	724	755	729	12	*3.3
2	1.0	1.0	.8				*0	701	878	701	15	3.8
3	1.1	1.0	*.8				*0	667	942	673	14	2.5
4	1.0	1.1	.8	(*)			*73	642	990	644	15	6.2
5	1.2	1.1	.8				80	615	1.040	617	17	2.0
6	1.2	1.1	.8				90	601	1.180	599	14	2.0
7	1.3	1.1	.8				102	446	1.240	572	8.6	1.6
8	1.2	1.1	.8				* 117	146	*1.300	* 546	12	2.8
9	*1.2	1.1	.8				140	148	1.300	516	*11	2.0
10	1.3	1.0	.7				180	146	1.300	486	13	1.5
11	1.2	1.0	.7				220	143	1.300	282	14	2.0
12	1.2	1.0	.7		(*)		270	130	1.300	198	11	2.1
13	1.2	1.0	.6				290	127	1.290	274	16	2.5
14	1.1	1.0	.6				310	124	1.260	262	7.5	4.7
15	1.1	1.0	.5				340	130	1.240	256	8.3	3.1
16	1.1	1.0	.5				369	138	1.220	244	11	4.4
17	1.1	*1.0	.4				399	139	1.200	234	6.3	5.3
18	1.2	1.0	.4				428	*141	1.180	225	6.3	6.3
19	1.2	1.0	.4				444	131	1.160	216	6.6	6.6
20	1.2	1.0	.3				654	132	1.140	212	6.3	6.9
21	1.2	1.0	.3				885	261	1.120	202	4.7	6.0
22	1.2	1.0	.2				883	507	1.090	192	6.0	14
23	1.2	.9	.2				* 876	541	1.050	194	8.3	11
24	1.2	.9	.2				851	610	1.020	188	5.6	11
25	1.2	.9	.2				842	749	979	183	7.5	5.4
26	1.2	.8	.1				834	765	912	75	6.0	6.6
27	1.2	.8	.1				815	773	864	7.2	3.8	7.2
28	1.2	.8	.1				798	769	834	8.6	5.6	5.6
29	1.2	.8	.1				777	767	785	12	6.9	8.3
30	1.0	.8	0		----------		749	765	757	11	3.5	11
31	1.0	----------	0		----------		----------	753	----------	7.2	5.6	----------
Total	36.2	29.3	14.5	0	0	0	12.816	13.431	32.626	9.566.0	288.4	157.7
Mean	1.17	0.98	0.47	0	0	0	427	433	1,088	309	9.30	5.26
Ac-ft	72	58	29	0	0	0	25,420	26,640	64,710	18,970	572	313

Calendar year 1964: Max 206 Min 0 Mean 17.0 Ac-ft 14,180
Water year 1964-65: Max 1,300 Min 0 Mean 189 Ac-ft 136,800

* Discharge measurement or observation of no flow made on this day.
Note.--Stage-discharge relation affected by ice Dec. 1 to Apr. 13 (no gage-height record Dec. 18, 19, Apr. 1).

5-0515. Red River of the North at Wahpeton, N. Dak.

Location.--Lat 46°15'55", long 96°35'40", in NE¼ sec.8, T.132 N., R.47 W., on left bank in Wahpeton, 800 ft downstream from confluence of Bois de Sioux and Otter Tail Rivers and at mile 548.6.

Drainage area.--4,010 sq mi, approximately.

Records available.--April 1942 to September 1965. Gage-height records collected in this vicinity since 1917 are contained in reports of U. S. Weather Bureau.

Gage.--Water-stage recorder and concrete and wooden dam. Datum of gage is 943 ft above mean sea level, datum of 1929. Prior to Aug. 6, 1943, U. S. Weather Bureau staff gage 800 ft upstream, converted to present datum. Aug. 6, 1943, to Oct. 27, 1950, chain gage at present site and datum.

Average discharge.--22 years (1943-65), 516 cfs (373,600 acre-ft per year).

Extremes.--Maximum discharge during year, 5,690 cfs Apr. 11 (gage height, 14.34 ft); minimum, 101 cfs Mar. 19 (gage height, 3.73 ft, backwater from ice); minimum gage height, 2.98 ft Nov. 20.
1942-65: Maximum discharge, 7,130 cfs Apr. 12, 1952 (gage height, 14.99 ft); minimum, 8 cfs Aug. 25, 1961 (gage height, 2.26 ft).
Maximum stage known, 17.0 ft in spring of 1897.

Remarks.--Records good, except those for period of ice effect, which are fair. Flow regulated by Orwell Reservoir (capacity, 14,100 acre-ft at elevation 1,070 ft above mean sea level, adjustment of 1912); Lake Traverse (capacity, 137,000 acre-ft), available for flood control, numerous other controlled lakes and ponds, and several powerplants.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 26 to Nov. 18)

Oct. 1 to May 14		May 15 to Sept. 30	
3.1	152	3.5	236
4.0	370	5.0	700
6.0	1,080	11.0	3,650
11.0	3,600		
14.5	5,800		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	156	199	250	225	180	190	*200	1,620	2,000	2,020	567	331
2	154	196	240	205	165	220	240	1,580	2,040	1,980	536	292
3	196	192	210	200	185	*230	320	1,550	2,180	1,900	514	288
4	310	194	210	220	*195	220	315	1,540	2,260	1,740	478	285
5	334	196	215	215	185	230	345	1,550	2,390	1,660	463	285
6	328	196	220	*205	205	215	430	1,540	2,640	1,650	490	292
7	238	199	225	220	205	210	*670	1,510	3,040	1,620	511	295
8	218	199	225	200	185	215	1,700	1,370	3,210	1,680	497	295
9	210	196	*225	160	205	220	3,100	1,120	*3,190	1,640	481	272
10	201	*201	225	215	200	230	4,300	1,050	3,070	1,580	494	253
11	232	199	225	230	180	230	*5,560	*1,050	2,900	1,580	463	241
12	253	196	215	225	190	*225	4,990	1,080	2,770	1,430	424	262
13	255	216	205	210	165	220	3,910	1,090	2,740	1,260	415	258
14	*232	229	185	215	190	225	2,460	1,090	2,730	1,280	400	250
15	176	227	205	200	185	230	*1,690	1,150	*2,680	1,270	397	*316
16	182	232	275	185	200	*235	1,610	1,200	2,660	1,250	397	403
17	203	227	245	205	195	245	1,460	1,250	2,640	1,110	385	490
18	234	232	260	205	205	210	1,340	1,280	2,590	946	*352	494
19	248	235	310	200	205	115	1,260	1,280	2,550	968	343	511
20	199	145	280	190	200	195	*1,270	1,270	2,510	*968	334	546
21	194	160	260	185	185	260	1,460	1,250	2,480	946	334	592
22	241	200	250	185	160	280	1,670	1,340	*2,450	896	334	634
23	250	270	265	185	165	280	1,700	1,660	2,410	924	334	588
24	253	280	240	200	155	260	1,690	1,780	2,360	942	385	592
25	236	250	205	195	155	240	1,670	1,860	2,320	973	412	626
26	216	235	235	170	170	245	1,660	*2,000	2,300	973	364	651
27	205	220	230	160	175	245	1,650	2,030	2,280	856	349	620
28	201	245	235	170	170	250	*1,680	2,040	2,200	668	352	553
29	203	220	255	170		230	1,670	2,020	2,120	487	352	560
30	199	225	255	165	----------	210	1,660	2,010	2,060	445	352	595
31	199	----------	235	220	----------	195	----------	2,040	----------	475	355	----------
Total	6,956	6,411	7,315	6,135	5,160	7,005	53,680	46,200	75,770	38,117	12,864	12,670
Mean	224	214	236	198	184	226	1,789	1,490	2,526	1,230	415	422
Ac-ft	13,800	12,720	14,510	12,170	10,230	13,890	106,500	91,640	150,300	75,600	25,520	25,130

Calendar year 1964: Max 1,560 Min 37 Mean 335 Ac-ft 243,200
Water year 1964-65: Max 5,560 Min 115 Mean 762 Ac-ft 552,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 10.

5-0540. Red River of the North at Fargo, N. Dak.

Location.--Lat 46°51'40", long 96°47'00", in NW¼NE¼ sec.18, T.139 N., R.48 W., at city water plant on 4th St. S. in Fargo, 25 miles upstream from mouth of Sheyenne River and at mile 453.

Drainage area.--6,800 sq mi, approximately.

Records available.--May 1901 to September 1965. Published as "at Moorhead, Minn." 1901. Monthly discharge for some periods, published in WSP 1308.

Gage.--Water-stage recorder and concrete control. Datum of gage is 861.8 ft above mean sea level, datum of 1929. Prior to Sept. 1, 1914, staff gage at site 1½ miles downstream at datum 1.0 ft lower. Sept. 1, 1914, to July 31, 1928, staff gage at site 1 mile downstream at datum 9.3 ft higher. Aug. 1, 1928, to Apr. 12, 1959, staff gage at site 1 mile downstream at datum 5.6 ft higher. Aug. 13, 1959, to June 21, 1960, water-stage recorder at site 2 miles upstream at datum 5.6 ft higher. June 22, 1960, to Sept. 30, 1962, water-stage recorder at present site at datum 5.6 ft higher. Since June 22, 1960, auxiliary water-stage recorder 2 miles upstream.

Average discharge.--64 years, 511 cfs (369,900 acre-ft per year, unadjusted); median of yearly mean discharges, 420 cfs (304,000 acre-ft per year, unadjusted).

Extremes.--Maximum discharge during year, 11,400 cfs Apr. 15 (gage height, 30.5 ft); minimum, 107 cfs Nov. 22 (gage height, 13.56 ft).
1901-65: Maximum discharge, 16,300 cfs Apr. 15, 16, 1952; maximum gage height, 28.79 ft Apr. 16, 1952, datum then in use; no flow for many days in each year for period 1932-41.
Maximum stage known, 40.1 ft Apr. 7, 1897, site and datum in use prior to 1914.

Remarks.--Records good except those for period Apr. 11-15, which are fair. Records of chemical analyses and water temperatures for the water year 1965 are published in Part 2 of this report. Flow regulated by Orwell Reservoir (capacity, 14,100 acre-ft at elevation 1,070 ft above mean sea level, adjustment of 1912), Lake Traverse (capacity, 137,000 acre-ft, available for flood control), other controlled lakes and ponds and several powerplants. Some small diversions for municipal supply. Figures of daily discharge do not include diversion by City of Fargo.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	193	230	209	214	183	198	224	2,190	2,180	2,190	698	432
2	188	230	204	214	188	204	214	2,100	2,220	2,110	657	426
3	183	230	209	209	188	*198	263	2,030	2,180	2,040	657	414
4	179	230	224	204	204	198	257	1,960	2,160	2,000	651	401
5	174	224	224	198	*183	198	286	1,870	2,280	1,930	670	383
6	246	219	209	193	188	214	*395	1,810	2,420	1,820	698	358
7	334	224	209	*219	193	230	613	1,790	2,560	1,720	626	346
8	358	224	214	204	179	224	991	1,760	2,890	1,740	626	334
9	328	214	209	204	179	214	1,490	1,740	3,340	1,760	651	334
10	252	224	*219	204	204	204	*3,500	1,610	*3,580	1,790	632	340
11	235	224	224	198	193	204	5,700	1,390	3,700	1,830	626	346
12	219	*198	230	165	174	209	7,400	*1,270	3,720	1,810	*601	328
13	230	198	235	188	188	214	8,400	1,220	3,680	1,800	569	334
14	*246	193	224	198	188	214	*10,000	1,230	*3,540	1,720	550	*364
15	252	193	209	193	183	204	11,300	1,280	3,360	1,600	513	328
16	269	214	198	188	170	*209	10,700	1,290	3,180	*1,610	488	340
17	219	219	174	179	170	198	8,850	1,290	3,040	1,570	470	389
18	179	230	165	179	179	198	6,800	1,310	2,940	1,490	470	476
19	174	230	183	179	193	193	*5,100	1,360	2,870	1,330	476	576
20	198	170	183	193	198	198	3,950	1,380	2,790	1,170	445	626
21	230	126	193	193	179	179	*3,150	1,380	2,730	1,170	420	657
22	240	111	214	188	188	130	2,800	1,380	2,670	1,150	408	677
23	198	138	230	188	174	142	2,750	1,400	2,610	1,170	408	684
24	198	170	230	188	174	188	2,650	1,450	*2,560	1,090	432	740
25	246	209	219	193	179	230	2,550	*1,640	2,500	1,090	432	756
26	286	246	219	193	179	235	2,500	1,770	2,450	1,100	463	764
27	292	257	209	188	179	240	*2,450	1,880	2,440	1,140	501	764
28	281	235	204	193	193	240	2,380	1,990	2,400	1,130	482	756
29	252	209	209	193		240	2,300	2,050	2,360	1,090	432	780
30	230	198	214	183		*240	2,240	2,090	2,270	1,000	432	772
31	224		209	183		235		2,170		796	432	
Total	7,333	6,217	6,505	6,006	5,170	6,422	112,203	51,080	83,620	46,956	16,616	15,225
Mean	237	207	210	194	185	207	3,740	1,648	2,787	1,515	536	508
Ac-ft	14,540	12,330	12,900	11,910	10,250	12,740	222,600	101,300	165,900	93,140	32,960	30,200
(ƒ)	573	547	559	555	531	580	563	594	606	662	681	524
Mean ≠	246	216	219	203	194	217	3,750	1,657	2,798	1,525	547	516
Ac-ft≠	15,120	12,880	13,460	12,470	10,790	13,320	223,100	101,900	166,500	93,800	33,640	30,720

Calendar year 1964:	Max	2,330	Min	31	Mean	400	Ac-ft	290,700	Mean≠	410	Ac-ft≠	297,900
Water year 1964-65:	Max	11,300	Min	111	Mean	995	Ac-ft	720,800	Mean≠	1,005	Ac-ft≠	727,700

* Discharge measurement made on this day.
ƒ Diversion in acre-ft, by City of Fargo.
≠ Adjusted for diversion.

5-0610. Buffalo River near Hawley, Minn.

Location.--Lat 46°51'00", long 96°19'45", near center of SE¼ sec.14, T.139 N., R.45 W., near left downstream end of bridge on farm lane, 2 miles southwest of Hawley.

Drainage area.--322 sq mi.

Records available.--March 1945 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,111.91 ft above mean sea level, datum of 1929. Prior to Jan. 29, 1953, chain gage at bridge 1,800 ft upstream at datum 3.17 ft lower.

Average discharge.--20 years, 71.7 cfs (51,910 acre-ft per year).

Extremes.--Maximum discharge during year, 1,250 cfs Apr. 11 (gage height, 8.87 ft); maximum gage height, 9.36 ft Apr. 9 (backwater from ice); minimum daily discharge, 13 cfs Dec. 17-27.
1945-65: Maximum discharge, 1,590 cfs Aug. 5, 1955 (gage height, 9.31 ft); minimum observed, 6.8 cfs July 28, 1945; minimum gage height, 2.55 ft Sept. 5, 1961.
Maximum stage known, about 11.3 ft, present datum, in spring of 1921, from information by local resident.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

2.8	14	6.0	348
3.1	26	7.0	522
3.5	50	8.0	810
4.0	93	9.0	1,340
5.0	206		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	33	26	14	15	16	*16	19	196	124	75	29	26
2	32	28	14	15	16	16	*24	190	122	70	27	25
3	31	28	14	15	16	16	34	186	135	64	27	22
4	30	26	14	16	16	16	58	174	137	59	26	22
5	31	26	14	16	17	16	96	166	145	56	28	21
6	31	26	14	16	17	17	160	169	177	53	37	21
7	31	25	15	16	18	17	*300	165	213	51	43	21
8	30	24	15	16	18	17	560	160	202	53	46	21
9	30	24	15	16	18	18	750	162	200	56	39	20
10	29	25	15	16	17	18	*920	174	198	53	36	19
11	28	31	15	16	17	18	1,210	168	195	48	33	20
12	29	33	15	15	17	18	1,210	153	190	49	29	24
13	28	34	15	15	17	19	1,190	143	180	52	27	29
14	28	33	15	15	16	19	1,140	135	165	59	25	36
15	27	31	14	15	16	19	1,110	150	151	56	25	39
16	27	29	14	15	16	19	1,040	177	136	53	23	43
17	26	28	13	16	16	19	950	175	124	48	22	45
18	26	23	13	16	16	19	833	171	115	44	20	45
19	26	20	13	16	16	19	740	160	106	41	20	43
20	26	18	13	17	16	18	657	144	100	41	19	39
21	26	18	13	17	16	18	*599	132	100	41	17	38
22	26	18	13	18	15	18	550	122	101	42	18	41
23	26	17	13	18	15	17	498	118	102	43	17	48
24	25	*17	13	18	14	17	453	*122	96	37	18	55
25	25	17	13	18	14	17	406	124	86	35	21	56
26	25	16	13	18	14	17	359	126	81	*33	*25	53
27	*25	16	13	17	15	17	318	131	86	31	27	49
28	24	15	14	*17	15	17	284	132	91	28	25	*48
29	25	15	*14	16		17	252	130	*82	28	25	52
30	24	14	14	16	----------	18	*216	126	77	29	26	62
31	24	----------	15	16	----------	19	----------	127	----------	29	28	----------
Total	854	701	432	502	450	546	16,936	4,708	4,017	1,457	828	1,083
Mean	27.5	23.4	13.9	16.2	16.1	17.6	565	152	134	47.0	26.7	36.1
Ac-ft	1,690	1,390	857	996	893	1,080	33,590	9,340	7,970	2,890	1,640	2,150

Calendar year 1964: Max 958 Min 13 Mean 75.6 Ac-ft 54,880
Water year 1964-65: Max 1,210 Min 13 Mean 89.1 Ac-ft 64,490

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 10 (no gage-height record Jan. 26, 27, Feb. 2-28, Mar. 3-30, Apr. 1).

5-0612. Whisky Creek at Barnesville, Minn.

Location.--Lat 46°39'33", long 96°23'54", in NE¼NW¼ sec.29, T.137 N., R.45 W., on right bank 18 ft upstream from culvert on State Highway 34, 0.7 mile upstream from Blue Eagle Lake, and 1.0 mile northeast of Barnesville.

Drainage area.--62.5 sq mi, of which 25.3 sq mi contribute directly to surface runoff.

Records available.--Water years 1961-64 (annual maximum), October 1964 to September 1965.

Gage.--Water-stage recorder and crest-stage gage. Altitude of gage is 1,030 ft (from topographic map). Prior to Oct. 6, 1964, crest-stage gage at present site and datum.

Extremes.--Maximum discharge during year, 175 cfs Apr. 9 (gage height, about 5.45 ft); maximum gage height, 7.67 ft Apr. 6 (from highwater mark, backwater from ice); minimum discharge, 0.1 cfs Aug. 24 (gage height, 2.24 ft).
1961-65: Maximum discharge, 292 cfs June 8, 1962 (gage height, 6.52 ft); maximum gage height, 8.29 ft Mar. 28, 1962 (backwater from ice).

Remarks.--Records fair except those for periods of no gage-height record, which are poor.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to May 23				May 24 to Sept. 30			
2.4	1.6	3.0	15	2.3	0.2	2.7	4.5
2.5	2.8	3.5	37	2.4	.3	3.0	14
2.7	6.7	4.0	62	2.5	.8	4.0	62
				2.6	2.2	5.0	130

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2.5	4.6	1.0	0.8	1.2	*1.7	*2.7	5.6	17	3.0	1.0	2.0
2	2.4	4.6	.9	.8	1.2	1.7	3.0	5.3	22	2.8	1.2	1.5
3	2.4	4.2	.9	.9	1.2	1.8	5.3	5.1	24	1.8	1.4	1.1
4	2.3	4.0	.9	.9	1.2	1.8	20	5.0	24	1.5	1.2	.9
5	2.3	4.0	.9	.9	1.3	1.9	73	5.0	21	1.1	1.1	.8
6	2.3	4.0	.9	.9	1.4	1.9	115	5.0	51	1.1	1.0	.9
7	2.3	3.8	.9	.9	1.4	2.0	*155	5.0	64	1.5	1.1	.9
8	2.3	3.8	.9	.9	1.4	2.0	165	5.1	*52	3.0	1.0	.8
9	2.4	4.2	.9	1.0	1.4	2.0	170	5.2	27	5.4	.9	.8
10	2.4	4.2	.9	1.0	1.4	2.0	150	5.3	15	4.5	1.2	.8
11	2.5	9.6	.9	1.0	1.4	2.1	130	5.4	11	4.0	.5	1.2
12	2.5	9.1	.9	1.0	1.4	2.1	100	5.4	9.1	5.7	.4	6.6
13	2.8	11	.9	1.1	1.4	2.1	80	5.4	9.4	10	.3	8.8
14	2.8	8.4	.9	1.1	1.4	2.1	70	5.2	11	7.2	.2	10
15	3.1	7.7	.8	1.1	1.4	2.1	60	5.1	7.8	5.1	.2	12
16	3.1	5.6	.8	1.1	1.4	2.1	50	5.0	5.7	6.0	.3	12
17	2.9	5.0	.8	1.1	1.4	2.1	40	5.2	4.5	4.5	.2	16
18	2.7	4.3	.8	1.1	1.5	2.0	36	5.6	3.3	3.3	.3	14
19	2.7	3.6	.8	1.1	1.5	2.0	32	6.2	2.6	2.0	.2	11
20	2.7	2.7	.8	1.1	1.5	2.0	28	7.8	2.4	1.5	.2	8.1
21	2.7	2.2	.8	1.1	1.5	2.0	*24	10	2.4	5.7	.2	7.2
22	2.5	1.5	.8	1.1	1.5	2.0	13	12	1.8	9.7	.2	11
23	2.5	*1.2	.8	1.1	1.5	2.0	13	14	1.6	8.8	.2	13
24	2.5	1.1	.8	1.1	1.6	2.0	14	*16	1.2	5.7	.2	13
25	2.5	1.1	.8	1.1	1.6	2.0	15	18	1.6	3.8	.8	10
26	2.5	1.1	.8	1.2	1.6	2.1	15	16	2.0	2.2	*1.1	7.8
27	*2.7	1.0	.8	1.2	1.7	2.1	15	14	9.4	*1.5	1.2	6.0
28	2.7	1.0	.8	*1.2	1.7	2.2	10	12	8.5	1.2	1.0	*5.4
29	3.1	1.0	*.8	1.2		2.3	6.7	10	*5.4	1.1	1.2	8.5
30	4.0	1.0	.8	1.2		2.4	6.0	8.8	3.8	1.0	1.8	19
31	4.4		.8	1.2		2.5		13		1.0	1.8	
Total	83.5	120.6	26.3	32.5	40.1	63.1	1,616.7	251.7	421.5	116.7	23.6	211.1
Mean	2.69	4.02	0.85	1.05	1.43	2.04	53.9	8.12	14.0	3.76	0.76	7.04
Cfsm	0.043	0.064	0.014	0.017	0.022	0.033	0.862	0.130	0.224	0.060	0.2	0.113
In.	-	-	-	-	-	-	-	-	-	-	-	-
Ac-ft	166	239	52	64	80	125	3,210	499	836	231	47	419

Calendar year 1964: Max - Min - Mean - Cfsm - In. - Ac-ft -
Water year 1964-65: Max 170 Min 0.2 Mean 8.24 Cfsm 0.132 In. - Ac-ft 5,970

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 7 (no gage-height record Dec. 24-28, Jan. 14-27, Jan. 29 to Feb. 28, Mar. 2-31, Apr. 2-6). No gage-height record Oct. 1-6, Apr. 8-14, 16-20, 23-26, 28, Apr. 30 to May 23.

5-0615. South Branch Buffalo River at Sabin, Minn.

Location.--Lat 46°46'20", long 96°37'40", in SW¼SW¼ sec.9, T.138 N., R.47 W., near center of span on downstream side of highway bridge, a quarter of a mile downstream from Whiskey Creek and 1 mile east of Sabin.

Drainage area.--522 sq mi.

Records available.--March 1945 to September 1965.

Gage.--Wire-weight gage read once or twice daily. Datum of gage is 902.39 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service). Prior to Aug. 17, 1948, at site 1 mile downstream at different datum. Aug. 17, 1948, to July 26, 1965, chain gage at same site and datum.

Average discharge.--20 years, 55.6 cfs (40,250 acre-ft per year).

Extremes.--Maximum discharge during year, 4,130 cfs Apr. 11 (gage height, 15.96 ft); maximum stage, 16.29 ft Apr. 8 (from floodmark, backwater from ice); no flow Dec. 12 to Mar. 27.
1945-65: Maximum discharge, 6,340 cfs June 9, 1962 (gage height, 17.04 ft); no flow for many days in most years.

Remarks.--Records good except those for periods of ice effect, which are fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	8.1	8.0	1.2			*0	1.0	67	67	25	33	4.9
2	5.7	10	.8			0	1.1	60	75	22	29	4.6
3	5.2	10	.5			0	1.3	58	76	18	25	3.5
4	5.7	11	.3			0	2.5	56	83	16	21	4.7
5	6.0	10	.3			0	15	55	94	14	40	4.2
6	4.7	11	.3			0	80	51	113	13	40	3.6
7	4.9	11	.2			0	500	54	146	12	36	3.1
8	2.9	11	.2			0	*2,750	63	312	13	35	2.4
9	4.7	12	.2			0	3,100	60	363	12	41	1.6
10	4.1	12	.1			0	3,350	55	384	13	34	1.4
11	5.7	13	.1			0	3,850	55	310	16	13	1.4
12	6.7	16	0			0	3,150	49	197	19	9.8	1.8
13	7.0	17	0			0	1,910	45	123	20	7.2	2.6
14	7.4	19	0			0	1,150	44	94	20	6.2	4.3
15	7.6	21	0			0	*887	44	77	23	5.0	12
16	7.9	20	0			0	733	49	70	24	3.7	12
17	7.7	19	0			0	580	65	56	23	2.7	18
18	7.6	15	0			0	443	77	46	23	2.2	20
19	7.7	11	0			0	350	82	38	22	1.8	27
20	7.4	9.0	0			0	285	75	34	21	2.0	27
21	7.4	7.5	0			0	239	62	29	28	5.0	28
22	6.9	6.4	0			0	208	50	25	38	8.4	31
23	6.7	*5.6	0			0	181	46	21	72	8.6	33
24	5.7	5.2	0			0	156	*45	18	67	7.0	36
25	6.2	4.7	0			0	135	54	16	45	6.4	38
26	*6.2	4.2	0			0	114	73	14	*34	*4.4	41
27	5.7	3.5	0			0	97	92	17	29	3.4	45
28	5.3	3.0	0	(*)		.1	88	98	18	27	3.0	*44
29	6.4	2.2	0			.4	78	92	*29	27	3.1	43
30	6.2	1.6	*0		----------	.7	*72	84	27	32	4.9	48
31	6.0	----------	0		----------	.9	----------	74	----------	32	4.9	----------
Total	193.4	309.9	4.2	0	0	2.1	24,506.9	1,934	2,972	800	446.7	547.1
Mean	6.24	10.3	0.14	0	0	0.07	817	62.4	99.1	25.8	14.4	18.2
Ac-ft	384	615	8.3	0	0	4.2	48,610	3,840	5,890	1,590	886	1,090

Calendar year 1964: Max 780 Min 0 Mean 40.8 Ac-ft 29,610
Water year 1964-65: Max 3,850 Min 0 Mean 86.9 Ac-ft 62,920

* Discharge measurement or observation of no flow made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Dec. 11, Mar. 28 to Apr. 10 (no gage-height record Nov. 26, Mar. 28 to Apr. 5).

5-0620. Buffalo River near Dilworth, Minn.

Location.--Lat 46°57'40", long 96°39'40", in SW¼SE¼ sec.6, T.140 N., R.47 W., on left bank 4½ miles southeast of Kragnes, 6½ miles northeast of Dilworth, and 9 miles downstream from South Branch.

Drainage area.--1,040 sq mi, approximately.

Records available.--March 1931 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Altitude of gage is 870 ft (from topographic map). Prior to Apr. 5, 1937, chain gage at same site and datum.

Average discharge.--34 years, 119 cfs (86,150 acre-ft per year).

Extremes.--Maximum discharge during year, 5,960 cfs Apr. 11 (gage height, 23.37 ft, from floodmark); minimum daily, 14 cfs Dec. 1-5, 20-30.
1931-65: Maximum discharge, 6,140 cfs June 11, 1962 (gage height, 23.56 ft); no flow at times in 1936.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	50	31	14	15	16	*16	20	374	234	117	57	37
2	46	33	14	15	16	16	22	341	232	116	59	35
3	43	34	14	15	16	16	24	*322	234	108	59	32
4	39	37	14	15	17	16	26	306	244	99	58	31
5	36	38	14	15	17	16	29	294	247	90	53	29
6	34	39	15	16	17	16	34	286	261	83	56	28
7	33	38	15	16	17	17	42	281	326	76	60	27
8	34	38	15	16	17	17	53	274	362	73	60	26
9	35	38	15	16	17	17	180	271	424	72	60	25
10	36	37	15	16	17	17	700	282	496	71	60	24
11	37	38	16	15	17	17	*5,900	301	537	69	55	25
12	37	*41	16	15	17	17	5,650	306	524	69	50	27
13	36	45	16	15	17	17	5,000	303	461	67	46	34
14	34	47	15	15	17	18	*3,900	311	387	69	42	40
15	34	48	15	15	17	18	2,950	341	329	74	36	47
16	34	52	15	15	17	18	*2,480	380	290	77	34	55
17	34	51	15	15	17	18	2,190	400	261	68	30	66
18	35	48	15	15	17	17	1,920	400	235	59	27	74
19	34	39	15	16	16	17	1,650	388	208	63	25	78
20	33	34	14	16	16	17	1,420	367	186	63	24	77
21	32	31	14	16	16	17	*1,220	350	170	62	22	73
22	32	30	14	17	16	17	1,080	326	159	62	21	72
23	32	*29	14	17	16	17	952	306	148	70	20	76
24	32	27	14	17	15	17	850	288	139	86	21	81
25	31	25	14	17	15	16	760	272	133	104	24	84
26	*31	22	14	17	15	*17	678	*256	124	102	*27	84
27	31	20	14	17	15	17	603	247	117	*86	29	89
28	31	18	14	*16	15	17	539	253	*120	73	31	*96
29	31	16	*14	16		18	474	260	120	63	33	98
30	32	15	14	16	----------	18	419	256	116	58	35	104
31	31	----------	15	16	----------	19	----------	242	----------	56	36	----------
Total	1,080	1,039	452	489	458	528	41,765	9,584	7,824	2,405	1,250	1,674
Mean	34.8	34.6	14.6	15.8	16.4	17.0	1,392	309	261	77.6	40.3	55.8
Ac-ft	2,140	2,060	897	970	908	1,050	82,840	19,010	15,520	4,770	2,480	3,320

Calendar year 1964: Max 1,670 Min 11 Mean 131 Ac-ft 94,810
Water year 1964-65: Max 5,900 Min 14 Mean 188 Ac-ft 136,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 10. No gage-height record May 9-25, Aug. 28 to Sept. 27.

5-0625. Wild Rice River at Twin Valley, Minn.

Location.--Lat 47°16'00", long 96°14'40", in NE¼ sec.27, T.144 N., R.44 W., on left bank 100 ft upstream from highway bridge, three-quarters of a mile northeast of village of Twin Valley, and 2 miles upstream from small tributary.

Drainage area.--888 sq mi.

Records available.--June 1909 to September 1917, July 1930 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,008.16 ft above mean sea level, datum of 1929 (Corps of Engineers bench mark). June 1909 to September 1917 staff gage at site a quarter of a mile downstream at different datum. July 23, 1930, to Nov. 24, 1934, chain gage at highway bridge 100 ft downstream from present site at present datum. Nov. 25, 1934, to Aug. 2, 1950, water-stage recorder 80 ft upstream from present site at present datum.

Average discharge.--43 years, 161 cfs (116,600 acre-ft per year).

Extremes.--Maximum discharge during year, 3,160 cfs Apr. 12 (gage height, 10.48 ft, from floodmark); minimum, 18 cfs Aug. 22 (gage height, 0.99 ft).
1909-17, 1930-65: Maximum discharge, 9,200 cfs July 22, 1909 (gage height, 20.0 ft, site and datum then in use), from rating curve extended above 3,300 cfs; minimum, 0.5 cfs Nov. 4, 1939.

Remarks.--Records good except those for period of ice effect or no gage-height record, which are poor. Flow slightly regulated by Rice Lake and many other small lakes above station. Diurnal fluctuation caused by operation of mill at Faith, 17 miles above station.

Rating table, water year, 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Apr. 18-28, July 12 to Aug. 13)

1.0	21	4.0	496
1.2	32	5.0	744
1.5	54	7.0	1,300
2.0	105	9.0	2,180
2.5	176	10.5	3,180
3.0	268		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	74	49	38	28	37	*30	43	741	592	323	79	42
2	74	54	37	28	37	30	56	713	582	297	82	36
3	71	51	36	28	37	29	72	*682	582	279	74	35
4	74	54	36	28	37	29	100	674	598	253	67	33
5	79	54	35	29	38	29	156	638	640	230	61	31
6	75	53	35	29	38	30	310	594	656	213	75	30
7	76	50	35	29	38	30	640	558	726	202	70	29
8	72	49	34	29	38	31	*1,380	524	827	190	68	32
9	75	52	34	30	38	32	1,800	510	848	178	70	30
10	72	49	34	30	37	32	2,050	552	866	170	61	30
11	68	59	34	30	36	33	2,500	592	858	160	51	29
12	67	59	33	30	35	34	3,080	576	825	173	51	27
13	66	62	33	30	35	35	*2,840	550	775	215	43	33
14	67	63	33	31	34	36	2,280	528	728	255	41	40
15	64	63	32	31	34	36	2,050	530	682	253	33	47
16	61	63	32	32	34	36	1,930	626	633	217	37	48
17	60	59	32	32	33	36	1,790	734	588	187	33	59
18	60	50	31	33	33	35	1,500	760	556	176	31	61
19	60	43	31	34	33	35	1,360	744	580	163	28	62
20	57	46	30	35	33	34	1,300	718	705	152	26	66
21	56	50	30	36	32	33	1,220	726	710	145	25	64
22	52	51	30	37	32	33	*1,170	718	594	138	23	67
23	55	51	30	39	31	33	1,130	708	498	142	22	71
24	54	50	29	40	31	33	1,080	684	370	128	23	81
25	49	*49	29	40	31	33	1,020	669	330	121	25	92
26	53	47	29	39	30	33	973	*650	344	*114	*28	94
27	52	45	29	39	30	34	921	640	405	104	28	98
28	51	43	29	*38	30	34	871	630	*391	93	32	*97
29	49	42	*29	38		35	827	621	378	83	41	101
30	*49	40	29	37		36	778	616	354	77	48	112
31	50		28	37		*37		606		76	42	
Total	1,942	1,550	996	1,026	962	1,026	37,227	19,812	18,221	5,507	1,418	1,677
Mean	62.6	51.7	32.1	33.1	34.4	33.1	1,242	639	607	178	45.7	55.9
Ac-ft	3,850	3,070	1,980	2,040	1,910	2,040	73,840	39,300	36,140	10,930	2,810	3,330

Calendar year 1964: Max 1,580 Min 19 Mean 178 Ac-ft 129,000
Water year 1964-65: Max 3,080 Min 22 Mean 250 Ac-ft 181,200

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 10 (no gage-height record Nov. 30, Dec. 27, Jan. 15-17, Jan. 29 to Feb. 28). No gage-height record Apr. 11, May 6-15, May 30 to June 5, June 17-19, 22-27, Sept. 30.

5-0640. Wild Rice River at Hendrum, Minn.

Location.--Lat 47°16'05", long 96°47'50", in SE¼ sec.19, T.144 N., R.48 W., near center of span on downstream side of highway bridge, half a mile east of Hendrum and 4 miles upstream from mouth.

Drainage area.--1,600 sq mi, approximately.

Records available.--March 1944 to September 1965.

Gage.--Wire-weight gage read once or twice daily. Datum of gage is 836.75 ft above mean sea level, datum of 1929 (levels by Corps of Engineers). Prior to Aug. 2, 1949, chain gage at same site and datum.

Average discharge.--21 years, 216 cfs (156,400 acre-ft per year).

Extremes.--Maximum discharge during year, 6,800 cfs Apr. 14 (gage height, 29.44 ft); maximum gage height, 29.52 ft Apr. 15 (from floodmark, backwater from Red River of the North); minimum daily, 18 cfs Mar. 26-31. 1944-65: Maximum discharge, that of Apr. 14, 1965; maximum gage height, that of Apr. 15, 1965 (backwater from Red River of the North); no flow for some days in 1948-49.

Remarks.--Records good except those for periods of ice effect, backwater from Red River of the North, or no gage-height record, which are fair. Large part of high flow diverted into Marsh River basin at overflow section 3½ miles east of Ada. Another diversion into Marsh River basin, formed 1½ miles southeast of Ada, diverted water at all stages 1947-51, after which it was closed except for small regulated flow diverted at same point. Amount of diversion not known.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	90	54	34	26	32	29	19	903	644	394	114	61
2	90	54	33	26	32	28	22	839	660	*363	108	56
3	89	52	32	25	32	28	28	813	664	332	108	50
4	90	54	32	25	31	*28	36	774	697	305	103	48
5	90	55	31	25	31	28	50	716	727	280	97	46
6	92	56	31	26	31	27	150	684	734	255	94	61
7	94	60	31	26	31	27	400	646	814	239	109	48
8	95	62	31	27	32	27	800	623	926	230	108	51
9	92	66	31	27	32	27	*1,910	610	1,000	214	94	47
10	89	78	30	27	32	27	3,200	603	1,020	198	93	42
11	88	82	30	27	33	26	4,900	610	1,020	188	87	37
12	87	*90	30	27	33	26	*5,840	598	1,020	188	80	41
13	87	90	30	28	33	26	5,780	568	989	205	69	40
14	88	92	29	28	33	26	*6,660	543	930	303	65	43
15	87	97	29	28	33	25	6,400	522	850	349	61	55
16	92	98	29	28	33	25	5,420	706	774	330	57	63
17	95	100	28	29	32	24	*4,340	930	698	296	52	74
18	100	99	28	30	32	23	3,300	962	644	257	51	86
19	107	95	28	31	32	22	2,510	936	580	230	47	97
20	111	86	27	32	31	21	*2,070	888	664	211	43	97
21	110	60	27	33	31	21	1,900	852	941	196	42	91
22	109	44	27	34	30	20	1,780	859	918	186	40	91
23	108	*42	26	35	30	19	*1,660	848	711	316	38	92
24	106	44	26	35	29	19	1,540	816	581	346	40	100
25	98	45	26	*35	30	18	1,430	818	509	239	45	105
26	86	45	26	35	30	*18	1,320	834	470	192	*45	119
27	80	43	26	34	30	18	*1,210	*816	453	166	42	127
28	70	40	26	34	29	18	1,110	767	457	147	43	125
29	70	38	26	33		18	1,020	762	439	*129	44	*132
30	*61	36	26	33	----------	18	*951	738	412	126	52	152
31	61	----------	*26	32	----------	18	----------	684	----------	117	59	----------
Total	2,812	1,957	892	921	880	725	67,756	23,268	21,946	7,527	2,130	2,277
Mean	90.7	65.2	28.8	29.7	31.4	23.4	2,259	751	732	243	68.7	75.9
Ac-ft	5,580	3,880	1,770	1,830	1,750	1,440	134,400	46,150	43,530	14,930	4,220	4,520

Calendar year 1964: Max 2,570 Min 16 Mean 234 Ac-ft 169,900
Water year 1964-65: Max 6,660 Min 18 Mean 365 Ac-ft 264,000

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 11 (no gage-height record Nov. 22, Dec. 20, Jan. 10, 31, Mar. 6, 17, 18, 21). No gage-height record Oct. 11, July 9, Aug. 28, Sept. 10. Backwater from the Red River of the North Apr. 15 to May 1.

5-0645. Red River of the North at Halstad, Minn.

Location.--Lat 47°21'10", long 96°50'50", on line between secs.24 and 25, T.145 N., R.49 W., on left bank on upstream side of highway bridge, half a mile west of Halstad, 2½ miles downstream from Wild Rice River, and at mile 375.2.

Drainage area.--21,800 sq mi, approximately, (includes 3,800 sq mi in closed basins).

Records available.--April 1936 to June 1937 (no winter records), April 1942 to September 1960 (spring and summer months only), May 1961 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 826.65 ft above mean sea level, datum of 1929. Prior to July 17, 1961, wire-weight gage at same site and datum.

Extremes.--Maximum discharge during year, 25,600 cfs Apr. 17; maximum gage height, 35.22 ft Apr. 17; minimum daily, 225 cfs Mar. 25; minimum gage height, 2.92 ft Oct. 7.
1936-37, 1942-65: Maximum discharge, that of Apr. 17, 1965; maximum gage height, that of Apr. 17, 1965; minimum discharge observed, 5.4 cfs Oct. 8, 9, 12-14, 1936.
Flood in 1897 reached a stage of about 38.5 ft.

Remarks.--Records good except those for period of ice effect or no gage-height record, which are fair. Some regulation by many controlled lakes and reservoirs on tributaries.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Loop curves used Apr. 9 to May 3)

2.1	158	5.0	1,020
2.6	246	8.0	2,460
3.0	344	13.0	5,750

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	336	381	*330	255	290	275	450	6,110	3,480	3,100	1,560	640
2	347	378	295	255	280	280	470	5,600	3,540	*2,990	1,460	633
3	361	375	290	260	275	285	500	5,190	3,750	2,870	1,390	626
4	350	372	285	270	265	*295	520	*4,840	3,880	2,770	1,390	630
5	339	372	285	270	265	295	590	4,460	3,830	2,710	1,390	592
6	333	364	280	270	265	300	880	4,160	3,880	2,660	1,390	558
7	328	364	280	275	265	305	1,750	3,960	4,020	2,540	1,390	525
8	352	358	280	275	265	310	3,300	3,760	4,230	2,390	1,380	507
9	432	361	280	280	270	315	4,800	3,620	4,470	2,280	1,330	513
10	471	366	280	285	270	320	8,100	3,590	4,770	2,260	1,310	516
11	477	396	275	290	260	320	12,500	3,470	5,080	2,280	1,280	510
12	444	*426	270	*290	265	315	*16,900	3,230	5,310	2,330	1,240	510
13	405	456	260	295	265	310	21,900	2,950	5,420	2,370	1,170	510
14	390	441	255	290	255	310	*24,500	2,750	5,410	2,430	1,090	516
15	378	432	255	290	260	310	25,400	2,710	5,200	2,440	1,010	513
16	384	435	250	295	265	305	25,600	2,820	4,880	2,340	929	543
17	405	432	250	300	265	300	25,600	3,120	4,560	2,230	864	570
18	408	430	245	305	265	280	24,700	3,230	4,300	2,120	a 845	619
19	393	420	240	300	265	260	23,500	3,230	4,120	2,020	a 830	697
20	355	405	230	300	265	255	21,700	3,220	4,010	1,910	a 810	790
21	328	390	230	295	265	260	19,800	3,160	4,140	1,810	a 800	902
22	336	370	230	295	270	265	*17,900	3,100	4,120	1,720	a 790	982
23	358	365	235	290	265	260	16,000	3,030	3,910	1,930	a 770	1,050
24	378	360	240	290	265	240	14,200	2,960	3,700	2,010	a 760	1,090
25	369	340	250	*290	265	225	12,400	2,930	3,530	1,770	a 755	1,110
26	347	340	250	285	265	*230	10,700	3,040	3,410	1,640	* 740	1,140
27	361	350	250	290	265	290	*9,200	*3,190	3,340	1,600	a 720	1,160
28	387	350	250	290	270	340	8,100	3,290	3,350	1,590	a 700	1,160
29	399	340	255	290		380	7,250	3,380	3,290	*1,620	a 680	*1,180
30	*396	340	255	290	----------	400	*6,700	3,450	3,190	1,640	a 665	1,230
31	387	----------	*255	290	----------	420	----------	3,470	----------	1,660	661	----------
Total	11,734	11,509	8,115	8,845	7,470	9,255	365,910	111,020	124,120	68,030	32,099	22,522
Mean	379	384	262	285	267	299	12,200	3,581	4,137	2,195	1,035	751
Ac-ft	23,270	22,830	16,100	17,540	14,820	18,360	725,800	220,200	246,200	134,900	63,670	44,670

Calendar year 1964: Max 7,750 Min 164 Mean 944 Ac-ft 685,400
Water year 1964-65: Max 25,600 Min 225 Mean 2,119 Ac-ft 1,548,000

* Discharge measurement made on this day.
a No gage-height record.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 12.

5-0675. Marsh River near Shelly, Minn.

Location.--Lat 47°24'45", long 96°45'50", in NE¼NW¼ sec.3, T.145 N., R.48 W., near center of span on downstream truss of bridge, 3¾ miles southeast of Shelly and 10 miles upstream from mouth.

Drainage area.--151 sq mi.

Records available.--March 1944 to September 1965. Monthly discharge only for March 1944, published in WSP 1308.

Gage.--Chain gage read once or twice daily. Datum of gage is 844.14 ft above mean sea level, datum of 1929 (levels by Corps of Engineers).

Average discharge.--21 years, 87.5 cfs (63,350 acre-ft per year).

Extremes.--Maximum discharge during year, 3,120 cfs Apr. 13 (gage height, 16.87 ft, from floodmark, backwater from Red River of the North); no flow for many days.
1944-65: Maximum discharge, 4,660 cfs May 11, 1950 (gage height, 18.96 ft, from floodmark); no flow for many days most years.

Remarks.--Records fair. Large part of high flow of Wild Rice River diverted into Marsh River basin at overflow section 3½ miles east of Ada. Another diversion from Wild Rice River formed 1 mile southeast of Ada supplemented flow at all stages 1947-51, after which it was closed except for small regulated flow diverted at same point for abatement of pollution from Ada sewage plant effluent.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0	a 0.1					0	25	23	23	a 2.2	0.8
2	0	.3					*0	a 25	39	*19	1.4	.8
3	.3	.2					.2	25	58	16	1.2	.6
4	.5	.1				(*)	.5	a 26	65	11	1.1	a .6
5	.6	0					2.0	26	70	9.5	.7	a .4
6	.7	0					9.0	22	79	8.2	3.7	.2
7	.3	0					68	16	67	7.0	25	.1
8	0	0					*315	19	60	6.4	20	.7
9	0	0					*920	a 19	66	5.6	14	a .7
10	0	a 0					1,350	21	57	4.9	10	.7
11	0	a .2					1,890	27	47	a 4.6	7.2	.7
12	0	* .4					* 2,460	a 27	39	5.6	5.3	.6
13	0	.3					2,950	a 26	34	56	4.0	.3
14	0	a .4					2,350	24	28	105	3.3	a 1.2
15	0	.6					1,720	29	22	82	a 2.8	1.7
16	0	.3					1,110	50	21	48	2.0	2.5
17	0	a .3					*480	43	14	31	a 1.0	3.0
18	0	a .2					350	*31	10	38	.7	3.3
19	0	.2					265	27	9.3	35	a .6	4.7
20	0	a .1					*215	29	a 86	28	.5	3.7
21	0	0					170	26	8.0	22	.2	a 4.0
22	0	0					140	24	7.0	17	0	4.7
23	0	* 0					*107	24	6.0	14	0	a 5.8
24	0	0					78	22	5.3	12	.2	6.7
25	0	0		(*)			62	24	a 5.0	10	a .7	8.4
26	0	0					50	24	4.7	8.4	* .9	8.0
27	0	0					42	24	a 5.0	6.4	.9	a 7.8
28	0	0					36	25	a 6.5	5.3	.6	* 8.7
29	0	0					31	a 25	a 11	* 4.7	.7	8.4
30	* 0	0			----------		*27	26	15	3.7	1.1	23
31	0	----------	(*)		----------		----------	22	----------	3.3	.6	----------
Total	2.4	3.7	0	0	0	0	17,197.7	803	890.4	650.6	112.6	112.8
Mean	0.08	0.12	0	0	0	0	573	25.9	29.7	21.0	3.63	3.76
Ac-ft	4.8	7.3	0	0	0	0	34,110	1,590	1,770	1,290	223	224

Calendar year 1964: Max 393 Min 0 Mean 12.3 Ac-ft 8,907
Water year 1964-65: Max 2,950 Min 0 Mean 54.2 Ac-ft 39,220

* Discharge measurement or observation of no flow made on this day.
a No gage-height record.
Note.--Stage-discharge relation affected by ice Nov. 19, 20, Mar. 31 to Apr. 11 (no gage-height record Nov. 20). Backwater from Red River of the North Apr. 12-22.

5-0690. Sandhill River at Climax, Minn.

Location.--Lat 47°36'10", long 96°47'40", in SE¼SE¼ sec.29, T.148 N., R.48 W., near center of span on upstream side of highway bridge, 1 mile southeast of Climax and 4 miles upstream from mouth.

Drainage area.--405 sq mi, approximately.

Records available.--March 1943 to September 1965 (winter records incomplete in some years). Monthly discharge only for some periods, published in WSP 1308.

Gage.--Chain gage read once daily. Datum of gage is 833.69 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Average discharge.--19 years (1946-65), 59.9 cfs (43,370 acre-ft per year).

Extremes.--Maximum discharge during year, 4,560 cfs Apr. 14 (gage height, 17.81 ft, from floodmark); minimum daily, 8.0 cfs Feb. 22-26; minimum gage height, 1.31 ft Sept. 3.
1943-65: Maximum discharge, that of Apr. 14, 1965; minimum not determined.

Remarks.--Records good except those for periods of ice effect, no gage-height record, or backwater from Red River of the North, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1 to Nov. 17)

1.3	19	8.0	487
1.6	28	10.0	979
2.0	42	12.0	1,620
3.0	86	14.0	2,450
5.0	196	16.0	3,420
7.0	364	17.9	4,620

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	35	19	13	12	8.8	8.2	22	181	122	81	34	21
2	32	20	13	12	8.6	8.3	*29	172	136	77	32	20
3	34	19	12	12	8.5	8.4	52	174	276	70	29	19
4	38	19	12	12	8.6	8.4	90	163	223	64	27	20
5	36	18	12	12	8.8	8.6	140	156	150	60	29	24
6	34	18	12	12	8.8	9.2	200	160	134	54	38	26
7	32	18	12	12	8.7	9.8	* 316	139	153	52	38	22
8	30	18	12	11	8.5	10	* 436	132	215	50	29	22
9	30	18	12	11	8.4	10	475	128	201	43	25	*22
10	28	19	12	11	8.4	10	620	132	163	41	22	21
11	27	24	12	11	8.3	10	1,200	132	138	40	22	20
12	*26	*33	12	11	8.2	10	*2,590	121	124	38	22	21
13	26	30	12	11	8.2	11	*3,200	118	120	90	21	23
14	23	27	12	11	8.2	11	4,360	116	120	106	20	24
15	22	25	11	11	8.2	*12	3,700	134	119	85	20	26
16	23	23	11	11	8.2	12	2,290	160	117	67	23	27
17	24	24	11	11	8.3	11	*1,370	154	106	58	28	30
18	22	22	*11	11	8.4	11	1,050	*153	100	50	30	34
19	22	19	11	*11	* 8.5	11	882	143	89	*45	*29	32
20	20	14	11	11	8.4	11	*771	134	89	44	26	29
21	19	16	11	11	8.2	10	676	131	84	45	25	27
22	20	18	11	11	8.0	10	600	132	81	46	22	30
23	19	18	11	10	8.0	10	*462	124	*75	51	21	40
24	20	18	11	10	8.0	10	442	123	72	53	22	46
25	19	17	11	10	8.0	10	392	120	67	51	23	44
26	18	17	11	9.8	8.0	10	276	115	63	48	22	44
27	18	16	11	9.5	8.2	11	242	115	92	43	22	43
28	19	15	11	9.3	8.2	12	220	114	144	39	20	43
29	18	14	11	9.1		13	205	110	116	36	21	49
30	18	13	11	9.0	----------	14	194	108	92	38	24	71
31	18	----------	11	8.8	----------	17	----------	108	----------	37	22	----------
Total	770	589	357	334.5	233.6	327.9	27,502	4,202	3,781	1,702	788	920
Mean	24.8	19.6	11.5	10.8	8.34	10.6	917	136	126	54.9	25.4	30.7
Ac-ft	1,530	1,170	708	663	463	650	54,550	8,330	7,500	3,380	1,560	1,820

Calendar year 1964: Max 573 Min 6.0 Mean 47.1 Ac-ft 34,200
Water year 1964-65: Max 4,360 Min 8.0 Mean 114 Ac-ft 82,320

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 10. No gage-height record Apr. 11, 27-29. Backwater from the Red River of the North Apr. 15-22 (no gage-height record, Apr. 18, 19).

5-0740. Lower Red Lake near Red Lake, Minn.

Location.--Lat 47°57', long 95°17', in NW¼ sec.28, T.152 N., R.36 W., on left bank just upstream from dam at outlet, 13 miles northwest of village of Red Lake.

Drainage area.--1,950 sq mi, approximately.

Records available.--June 1930 to November 1932 (published as Red Lake at Redby), May 1933 to September 1965 (published as Red Lake near Red Lake 1933-40); records on Upper Red Lake published as Red Lake at Waskish, April 1930 to September 1933, all in reports of Geological Survey. October 1921 to September 1929 gage heights at Redby and on Upper Red Lake at Waskish in files of Minnesota Department of Conservation (fragmentary).

Gage.--Water-stage recorder. Datum of gage is 1,169.00 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). May 1933 to Sept. 6, 1934, staff gage at same site and datum. Staff gages at Waskish and Redby at datum 69.00 ft lower.

Extremes.--Maximum gage height during year, 6.73 ft June 27 (affected by wind action); maximum daily, 6.49 ft June 12; minimum, 3.04 ft Nov. 22 (affected by wind action).
1930-65: Maximum gage height, 9.53 ft June 25, 1950; minimum recorded, 0.80 ft Nov. 20, 1936.

Remarks.--Water level subject to fluctuation caused by change in direction and velocity of wind and by seiches.

Month-end gage height, in feet, October 1964 to September 1965

Oct. 31.....5.14	Feb. 28.....4.71	June 30.....6.28
Nov. 30.....4.99	Mar. 31.....4.71	July 31.....5.82
Dec. 31.....4.90	Apr. 30.....5.39	Aug. 31.....5.24
Jan. 31.....4.78	May 31.....6.05	Sept.30.....5.39

Note.--Mean daily gage heights are available.

5-0745. Red Lake River near Red Lake, Minn.

Location.--Lat 47°57', long 95°17', in NW¼ sec.28, T.152 N., R.36 W., on left bank 50 ft downstream from dam at outlet of Lower Red Lake and 13 miles northwest of village of Red Lake.

Drainage area.--1,950 sq mi, approximately.

Records available.--May 1933 to September 1965. Monthly discharge only for May 1933, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,167.00 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Sept. 7, 1934, staff gage at site 50 ft upstream at datum 2.00 ft higher. Sept. 7, 1934, to Nov. 26, 1951, water-stage recorder at present site at datum 2.00 ft higher.

Average discharge.--32 years, 404 cfs (292,500 acre-ft per year).

Extremes.--Maximum daily discharge during year, 848 cfs July 21-24; maximum gage height, 6.81 ft Aug. 6 (affected by backwater from aquatic vegetation); minimum daily discharge, 9 cfs Apr. 11-21.
1933-65: Maximum discharge, 3,600 cfs June 25, 1950 (gage height, 11.19 ft, affected by seiches and backwater from aquatic vegetation, present datum), from rating curve extended above 1,400 cfs; no flow at times.

Remarks.--Records fair. Flow completely regulated by outlet dam on Lower Red Lake.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	60	519	565	540	615	625	635	360	314	662	815	770
2	62	519	565	540	615	625	635	372	325	*655	811	778
3	60	522	565	540	620	625	625	*372	360	662	811	778
4	56	522	560	545	620	625	620	369	375	673	811	782
5	*55	519	560	545	620	630	620	337	381	673	808	796
6	53	519	560	545	620	630	620	337	416	684	815	804
7	51	519	560	550	620	630	620	345	*432	687	811	796
8	53	515	560	550	620	630	610	348	461	698	785	789
9	53	515	555	555	620	630	420	348	458	734	793	808
10	51	*508	555	555	620	635	170	354	441	759	*789	830
11	53	512	550	560	620	635	9	357	438	767	789	830
12	55	512	550	565	620	635	9	351	409	793	793	830
13	55	512	545	570	625	635	9	351	406	808	785	826
14	53	498	545	580	625	635	* 9	357	403	811	756	844
15	53	508	545	590	625	635	9	375	403	819	763	*830
16	53	491	540	595	625	640	9	378	406	826	759	830
17	53	502	540	600	*625	640	9	372	416	830	767	830
18	53	488	535	600	625	640	9	384	432	837	756	837
19	121	*478	535	605	625	640	9	*378	454	837	756	837
20	*298	490	535	605	625	640	9	366	464	841	745	837
21	478	490	530	610	625	640	9	375	454	848	752	837
22	546	540	530	*610	625	640	150	372	448	848	734	837
23	539	580	*530	610	625	640	357	372	464	*848	720	837
24	542	580	530	610	625	*640	366	372	546	848	720	826
25	546	580	530	610	625	640	366	372	*684	844	720	833
26	539	580	535	610	625	640	375	372	680	837	723	826
27	542	575	535	610	625	640	372	394	676	837	*741	826
28	546	575	540	610	625	640	375	397	673	833	752	830
29	532	570	540	610		640	384	384	669	833	752	833
30	525	570	540	615	----------	635	366	372	666	826	763	833
31	525	----------	540	615	----------	635	----------	345	----------	819	770	----------
Total	7,261	15,808	16,905	18,055	17,430	19,690	8,785	11,338	14,154	24,277	23,865	24,580
Mean	234	527	545	582	622	635	293	366	472	783	770	819
Ac-ft	14,400	31,350	33,530	35,810	34,570	39,050	17,420	22,490	28,070	48,150	47,340	48,750

Calendar year 1964: Max 580 Min 6.5 Mean 243 Ac-ft 176,700
Water year 1964-65: Max 848 Min 9 Mean 554 Ac-ft 400,900

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 9 (no gage-height record Jan. 6-12). Stage-discharge relation indefinite Apr. 10-22.

5-0750. Red Lake River at High Landing, near Goodridge, Minn.

Location.--Lat 48°03', long 95°48', on line between secs. 28 and 29, T.153 N., R.40 W., on left bank at upstream side of highway bridge at High Landing, 7 miles south of Goodridge and 33 miles upstream from Thief River.

Drainage area.--2,300 sq mi, approximately.

Records available.--September 1929 to September 1965. Prior to October 1930, published as "at Kratka."

Gage.--Water-stage recorder. Datum of gage is 1,141.57 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Oct. 1, 1930, staff gage at site 10 miles downstream at different datum. Oct. 1, 1930, to Sept. 30, 1932, staff gage at datum 5.00 ft higher and Oct. 1, 1932, to Dec. 8, 1938, staff gage at datum 4.00 ft higher at site 50 ft downstream. Dec. 9, 1938, to Sept. 30, 1949, water-stage recorder at present site at datum 4.00 ft higher.

Average discharge.--36 years, 425 cfs (307,700 acre-ft per year).

Extremes.--Maximum discharge during year, 2,740 cfs Apr. 13 (gage height, 11.42 ft); maximum gage height, 12.15 ft Apr. 12 (backwater from ice); minimum discharge, 91 cfs Oct. 20 (gage height, 1.75 ft).
1929-65: Maximum discharge, 3,720 cfs May 11, 1950 (gage height, 13.42 ft); no flow during infrequent periods in 1931-34, 1936-37.

Remarks.--Records good except those for period of ice effect, which are fair. Flow regulated by outlet dam on Lower Red Lake.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	163	553	580	590	590	595	630	562	553	778	683	716
2	168	549	580	595	590	600	640	545	595	757	674	709
3	169	543	590	595	585	600	650	583	972	750	667	702
4	177	521	590	595	585	600	670	579	954	741	661	716
5	180	532	600	595	585	600	710	575	867	732	657	711
6	172	528	600	595	590	605	780	589	1,030	723	663	711
7	168	524	600	590	595	605	850	560	1,310	709	685	720
8	160	521	605	590	595	610	950	534	1,270	698	691	718
9	153	524	610	585	595	610	1,150	526	1,170	694	694	723
10	150	526	610	585	600	615	1,400	575	1,070	700	691	723
11	141	537	610	585	600	615	1,800	595	991	748	689	727
12	132	543	605	585	600	620	2,370	575	919	826	*687	748
13	127	536	600	585	600	625	2,680	562	852	886	687	762
14	124	537	600	585	595	625	2,340	539	783	906	683	785
15	116	539	600	585	595	630	*1,670	646	716	904	667	*826
16	112	519	595	585	595	620	1,140	807	667	892	667	838
17	107	504	590	590	595	630	942	773	625	876	669	857
18	103	510	590	590	*595	615	852	*725	589	862	667	852
19	98	515	590	595	595	630	788	705	568	855	665	840
20	118	520	590	600	595	635	730	702	585	855	663	824
21	*283	530	590	*600	590	630	*648	659	579	845	665	819
22	438	540	585	600	590	620	597	654	566	*828	665	840
23	530	570	*585	600	590	615	689	638	549	804	663	876
24	558	600	585	595	585	*615	814	640	*532	778	665	889
25	566	*615	585	595	585	610	804	623	558	755	663	879
26	566	610	585	595	585	610	757	587	663	739	696	867
27	566	600	590	595	585	615	709	568	757	725	711	867
28	556	590	590	590	590	615	657	589	785	709	709	876
29	556	580	590	590		620	617	589	788	694	720	902
30	553	580	590	590	----------	620	595	564	792	687	732	970
31	554	----------	590	590	----------	625	----------	558	----------	687	727	----------
Total	8,564	16,396	18,400	18,340	16,575	19,080	30,629	18,926	23,655	24,143	21,126	23,993
Mean	276	547	594	592	592	615	1,021	611	788	779	681	800
Ac-ft	16,990	32,520	36,500	36,380	32,880	37,840	60,750	37,540	46,920	47,890	41,900	47,590

Calendar year 1964: Max 710 Min 34 Mean 306 Ac-ft 221,800
Water year 1964-65: Max 2,680 Min 98 Mean 657 Ac-ft 475,700

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 13.

GPO 826-476-4

5-0760. Thief River near Thief River Falls, Minn.

Location.--Lat 48°11', long 96°10', in sec.3, T.154 N., R.43 W., on right bank a quarter of a mile upstream from highway bridge, 5 miles north of city of Thief River Falls, 7 miles upstream from mouth, and 9 miles downstream from Mud Lake National Wild Life Refuge.

Drainage area.--959 sq mi.

Records available.--July 1909 to September 1917, April 1920 to September 1921, October 1922 to September 1924, October 1928 to September 1965. Monthly discharge only for some periods, annual maximums for water years 1919, 1922, 1925, 1926, published in WSP 1308.

Gage.--Water-stage recorder and control of grouted boulders. Datum of gage is 1,112.33 ft above mean sea level, datum of 1929 (levels by Minnesota Highway Department). Prior to May 4, 1939, staff or chain gage at same site and datum.

Average discharge.--48 years, 132 cfs (95,560 acre-ft per year).

Extremes.--Maximum discharge during year, 4,110 cfs Apr. 12 (gage height, 14.99 ft); maximum gage height, 15.70 ft Apr. 12 (backwater from ice); minimum daily discharge, 0.1 cfs Jan. 22 to Feb. 8.
1909-17, 1919-26, 1928-65: Maximum discharge, 5,610 cfs May 13, 1950 (gage height, 17.38 ft); no flow at times in some years.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are poor. Some regulation by Thief and Mud Lakes.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

4.3	1.2	4.8	29	9.0	1,240
4.4	2.9	5.0	59	11.0	1,970
4.5	5.6	5.5	175	13.0	2,960
4.6	17	6.0	304	15.0	4,120
		7.0	588		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	481	475	18	6.2	0.1	0.2	1.6	1,630	885	657	124	4.4
2	564	472	17	5.8	.1	.3	1.8	1,590	971	660	119	3.6
3	648	463	17	5.4	.1	.3	2.2	1,640	1,630	657	114	2.4
4	618	454	17	5.0	.1	.3	4.0	1,630	1,650	627	79	7.2
5	579	446	17	4.5	.1	.4	9.0	1,680	1,370	594	59	14
6	549	412	16	3.9	.1	.4	23	2,050	1,460	561	57	14
7	531	270	16	3.3	.1	.5	50	1,930	1,890	481	52	11
8	516	260	16	2.8	.1	.5	115	1,700	1,840	446	49	8.3
9	522	255	16	2.4	.2	.6	320	1,570	1,640	296	46	7.9
10	519	239	16	2.1	.2	.7	*1,100	1,600	1,420	229	42	7.9
11	510	239	16	1.7	.2	.7	2,400	1,620	1,300	216	38	9.1
12	507	242	16	1.2	.2	.9	3,600	1,530	1,200	803	36	9.5
13	507	239	16	.9	.2	1.0	3,840	1,470	1,120	935	33	*9.5
14	501	239	15	.7	.2	1.1	*3,620	1,400	1,060	809	31	14
15	489	239	15	.5	.2	1.2	3,450	1,430	994	657	30	37
16	478	208	14	.3	.2	1.3	3,360	1,600	941	588	28	81
17	472	120	14	.3	*.2	1.3	3,200	1,550	892	561	26	119
18	463	66	14	.2	.2	1.4	2,950	*1,460	836	525	*25	124
19	457	* 47	13	.2	.2	1.4	2,720	1,390	796	495	24	116
20	449	36	13	.2	.2	1.4	2,600	1,320	761	352	20	104
21	*446	32	13	*.2	.2	1.4	*2,520	1,280	732	301	20	95
22	478	30	*13	.1	.2	1.4	2,440	1,250	710	291	19	95
23	537	28	13	.1	.2	1.3	2,330	1,190	694	*278	18	140
24	540	26	12	.1	.2	*1.3	2,240	1,150	* 676	270	19	188
25	537	24	11	.1	.2	1.3	2,160	1,110	667	257	13	262
26	525	23	10	.1	.2	1.3	2,070	1,050	654	247	5.3	260
27	513	21	9.0	.1	.2	1.4	2,000	1,010	682	229	4.2	249
28	501	20	8.3	.1	.2	1.4	1,910	978	745	79	2.9	239
29	492	19	7.6	.1		1.4	1,800	948	739	51	4.7	247
30	486	18	7.1	.1	----------	1.4	1,710	908	691	81	56	426
31	478	----------	6.6	.1	----------	1.5	----------	892	----------	124	5.0	----------
Total	15,893	5,662	422.6	48.8	4.8	31.0	54,546.6	43,556	31,646	13,357	1,148.7	2,904.8
Mean	513	189	13.6	1.57	0.17	1.00	1,818	1,405	1,055	431	37.1	96.8
Ac-ft	31,520	11,230	838	97	9.5	61	108,200	86,390	62,770	26,490	2,280	5,760

Calendar year 1964: Max 2,480 Min 0 Mean 323 Ac-ft 234,300
Water year 1964-65: Max 3,840 Min 0.1 Mean 464 Ac-ft 335,600

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 16 to Apr. 12 (no gage-height record Mar. 25 to Apr. 10). No gage-height record July 9-11, Aug. 8-17.

5-0777. Ruffy Brook near Gonvick, Minn.

Location.--Lat 47°44'50", long 95°24'45", on line between secs. 5 and 8, T.149 N., R.37 W., on downstream side of bridge on County Highway 17, 4 miles upstream from mouth, and 4¾ miles east of Gonvick.

Drainage area.--45.2 sq mi.

Records available.--July 1960 to September 1965.

Gage.--Wire-weight gage read once daily. Datum of gage is 1,227.93 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Sept. 9, 1960, reference point at same site and datum.

Average discharge.--5 years, 14.7 cfs.

Extremes.--Maximum discharge during year, 412 cfs Apr. 13 (gage height, 6.38 ft); minimum daily, 1.5 cfs Feb. 24 - Mar. 1.
1960-65: Maximum discharge, that of Apr. 13, 1965; minimum discharge, 0.6 cfs Sept. 5, 1961; minimum gage height, 1.09 ft Aug. 20, 1964.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair.

Rating table, water year 1964-65, except period of ice effect
(gage height, in feet, and discharge, in cubic feet per second)

1.1	1.4	2.5	58
1.2	2.4	3.0	90
1.3	4.0	4.0	157
1.4	6.5	5.0	250
1.7	15	6.5	429
2.0	30		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	14	3.2	3.1	2.6	1.9	1.5	3.0	21	10	3.8	1.8	3.0
2	13	6.5	3.1	2.6	1.9	1.6	3.1	27	41	3.8	2.1	2.5
3	12	3.8	3.1	2.6	1.8	1.6	3.3	*34	93	3.4	1.9	2.2
4	11	2.9	3.0	2.6	1.8	1.7	3.6	29	139	3.2	2.0	2.5
5	10	2.9	3.0	2.6	1.8	1.7	7.0	27	163	2.9	2.0	2.2
6	9.7	2.5	3.0	2.5	1.8	1.8	17	27	200	2.6	7.3	2.4
7	8.9	2.6	3.0	2.5	1.8	2.0	26	28	187	2.6	3.8	2.7
8	7.8	2.6	3.0	2.5	1.8	2.1	20	28	147	2.6	2.7	2.5
9	7.3	3.0	3.1	2.5	1.9	2.2	*22	28	108	2.5	2.4	2.5
10	6.5	3.0	3.1	2.5	1.9	2.2	55	48	83	2.5	2.2	2.5
11	5.5	5.2	3.2	2.5	1.9	2.3	150	47	64	2.4	*1.9	2.6
12	5.0	6.0	3.2	2.6	1.9	2.5	270	38	49	44	1.8	2.5
13	4.3	5.2	3.1	2.7	1.8	2.7	398	36	36	23	1.8	3.0
14	4.3	4.3	3.1	2.8	1.8	3.0	*359	30	23	7.8	1.8	*5.0
15	3.6	4.3	3.1	2.8	1.8	3.2	313	102	18	6.5	1.6	6.2
16	3.8	4.0	3.0	2.8	1.7	3.2	248	167	14	4.5	1.6	4.8
17	4.0	3.6	3.0	2.8	*1.7	3.2	177	139	12	4.5	2.6	6.5
18	4.5	3.4	3.0	2.7	1.7	3.1	131	127	11	5.8	2.1	5.8
19	4.5	3.3	2.9	2.7	1.7	3.1	101	*110	10	3.6	2.0	4.8
20	*4.5	*3.3	2.8	2.6	1.6	3.0	*77	99	10	3.2	1.8	4.0
21	4.3	3.2	2.8	*2.6	1.6	3.0	59	83	8.1	3.4	1.8	4.0
22	4.0	3.2	2.7	2.5	1.6	2.9	56	54	7.8	*3.2	1.7	6.0
23	4.0	3.2	*2.7	2.4	1.6	2.9	52	43	6.5	2.9	1.7	9.5
24	3.8	3.3	2.7	2.4	1.5	2.9	47	39	5.2	2.6	1.8	8.7
25	3.8	3.4	2.7	2.4	1.5	*2.9	44	36	*4.5	2.4	2.1	7.8
26	3.6	3.4	2.6	2.3	1.5	2.9	*38	28	4.5	2.4	4.0	7.0
27	3.4	3.3	2.6	2.2	1.5	2.8	31	27	3.8	2.2	3.4	6.2
28	3.2	3.3	2.6	2.2	1.5	2.8	29	30	7.0	2.2	2.9	6.2
29	3.2	3.2	2.6	2.1		2.8	26	25	6.2	2.2	2.9	5.8
30	3.0	3.2	2.6	2.0	------	2.8	21	22	4.8	2.2	3.4	11
31	3.0	------	2.6	2.0	------	2.9	------	20	------	2.2	3.0	------
Total	183.5	108.3	90.1	77.6	48.3	79.3	2,787.0	1,599	1,476.4	163.1	75.9	142.4
Mean	5.92	3.61	2.91	2.50	1.72	2.56	92.9	51.6	49.2	5.26	2.45	4.75
Ac-ft	364	215	179	154	96	157	5,530	3,170	2,930	324	151	282

Calendar year 1964: Max 131 Min 0.9 Mean 9.47 Ac-ft 6,880
Water year 1964-65: Max 398 Min 1.5 Mean 18.7 Ac-ft 13,550

Peak discharge (base, 65 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-13	0400	6.38	412	6-6	2000	4.83	233
5-16	0300	4.38	188				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 12 (no gage-height record Dec. 12-22, Jan. 1-20, Jan. 22 to Feb. 16, Feb. 18 to Mar. 24, Mar. 26-31).

5-0780. Clearwater River at Plummer, Minn.

Location.--Lat 47°55', long 96°03', in SE¼SW¼ sec.4, T.151 N., R.42 W., on right bank 200 ft downstream from Soo Line Railroad bridge, 300 ft downstream from bridge on U. S. Highway 59, 0.9 mile northwest of railroad depot in Plummer, and 8 miles upstream from Hill River.

Drainage area.--512 sq mi.

Records available.--April 1939 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,099.12 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Nov. 10, 1939, staff gage at site 100 ft upstream at same datum.

Average discharge.--26 years, 169 cfs (122,400 acre-ft per year).

Extremes.--Maximum discharge during year, 3,620 cfs Apr. 12 (gage height, 11.88 ft); maximum gage height, 11.97 ft Apr. 11 (backwater from ice); minimum discharge, 30 cfs Aug. 21, 22 (gage height, 2.46 ft).
1939-65: Maximum discharge, 3,640 cfs June 9, 1962 (gage height, 11.90 ft); maximum gage height, that of Apr. 11, 1965; minimum discharge, 7.9 cfs July 8, 1940.

Remarks.--Records good except those for period of ice effect, which are fair. Slight regulation by Clearwater Lake.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

2.4	26	5.0	472
2.6	42	7.0	1,030
3.0	89	9.0	1,840
3.5	166	12.0	3,710
4.0	257		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	174	70	57	46	39	39	48	390	311	150	56	61
2	185	69	56	45	39	40	50	372	587	142	54	62
3	176	70	56	45	39	40	51	414	1,010	123	52	60
4	188	71	56	45	39	41	53	426	1,090	108	49	69
5	160	70	56	44	40	41	57	412	906	96	48	69
6	153	68	56	44	40	42	90	477	835	89	48	66
7	144	66	56	44	40	43	210	433	1,080	88	48	62
8	131	65	56	43	40	44	370	381	1,370	82	51	60
9	123	65	56	43	41	44	*520	344	1,340	79	60	57
10	115	66	56	42	41	45	1,000	414	1,290	74	42	55
11	108	71	55	42	41	45	2,250	494	1,170	69	38	55
12	104	76	54	42	41	45	3,480	444	1,050	92	37	54
13	97	84	53	41	42	45	*3,040	392	988	187	46	*53
14	93	85	52	42	42	44	2,760	348	906	271	41	65
15	90	84	52	42	41	44	2,750	525	789	228	41	93
16	86	84	52	42	41	44	2,370	760	662	174	35	103
17	85	74	51	43	40	44	2,000	830	550	150	37	132
18	85	60	50	42	*40	44	1,840	*835	449	129	*34	140
19	84	*44	50	*42	40	44	*1,740	856	377	114	49	116
20	82	52	50	42	40	43	1,600	809	325	109	46	102
21	81	59	50	41	39	43	1,430	752	277	100	32	90
22	*81	62	*49	41	39	43	1,250	698	223	*96	32	90
23	79	64	49	41	39	43	1,080	622	190	90	32	136
24	76	64	49	41	38	44	954	560	*163	85	31	167
25	75	64	49	41	38	*44	832	513	147	82	33	164
26	74	64	48	41	38	45	715	460	136	74	44	144
27	74	62	48	40	38	45	601	412	144	69	68	129
28	71	60	47	40	39	46	518	396	178	62	76	121
29	71	59	47	40		46	463	374	188	60	69	142
30	71	58	46	40	-------	47	424	346	158	60	64	295
31	70	------	46	40	------	47	------	321	------	64	64	------
Total	3,286	2,010	1,608	1,307	1,114	1,354	34,546	15,810	18,889	3,396	1,457	3,012
Mean	106	67.0	51.9	42.2	39.8	43.7	1,152	510	630	110	47.0	100
Ac-ft	6,520	3,990	3,190	2,590	2,210	2,690	68,520	31,360	37,470	6,740	2,890	5,970

Calendar year 1964: Max 1,490 Min 22 Mean 137 Ac-ft 99,210
Water year 1964-65: Max 3,480 Min 31 Mean 241 Ac-ft 174,100

Peak discharge (base, 500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-12	0630	11.90	3,640	6-8	1200	8.00	1,390
5-19	1300	6.43	856				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 17 to Apr. 11.

5-0782.3 Lost River at Oklee, Minn.

Location.--Lat 47°50'35", long 95°51'30", on west edge of sec.1, T.150 N., R.41 W., on upstream side of bridge on State Highway 222 at northwest edge of Oklee, 12 miles upstream from mouth.

Drainage area.--266 sq mi.

Records available.--July 1960 to September 1965.

Gage.--Wire-weight gage read once daily. Datum of gage is 1,126.94 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Sept. 9, 1960, reference points at same site at datum 8.00 ft higher. Sept. 9, 1960 to Sept. 30, 1964, wire-weight gage at same site at datum 8.00 ft higher.

Average discharge.--5 years, 76.2 cfs (55,170 acre-ft per year).

Extremes.--Maximum discharge during year, 1,780 cfs Apr. 12 (gage height, 11.12 ft); maximum gage height, 11.53 ft Apr. 11 (from floodmark, backwater from ice); minimum discharge, 1.4 cfs Aug. 22 (gage height, 1.94 ft).

1960-65: Maximum discharge, that of Apr. 12, 1965; maximum gage height, that of Apr. 11, 1965; no flow Feb. 16 to Mar. 21, 1963, Feb. 15 to Mar. 2, 1964.

Maximum stage known since at least 1897, 18.39 ft Apr. 21, 1950 (present datum), from floodmarks (discharge, 2,790 cfs).

Remarks.--Records good except those for period Oct. 1 to Apr. 11, which are poor.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	*76	20	6.7	4.8	4.3	2.7	2.6	209	102	62	16	8.6
2	68	19	6.5	4.9	4.2	2.7	2.8	229	165	55	13	7.0
3	62	21	6.2	5.0	4.1	2.8	3.2	242	443	50	9.8	7.0
4	46	27	6.0	5.1	3.9	2.8	4.0	224	426	41	8.6	8.0
5	*33	20	5.9	5.2	3.8	2.9	8.0	233	483	38	8.0	8.0
6	41	19	5.7	5.4	3.7	3.0	20	300	495	38	13	8.0
7	34	19	5.6	5.4	3.7	3.1	38	244	513	35	12	6.0
8	25	19	5.5	5.4	3.7	3.2	76	197	542	29	12	4.2
9	26	19	5.5	5.3	3.6	3.3	*160	231	507	26	10	5.6
10	22	20	5.5	5.3	3.6	3.4	325	263	487	24	9.2	6.5
11	22	17	5.5	5.2	3.6	3.5	700	264	478	22	8.0	6.5
12	20	19	5.5	5.1	3.6	3.6	1,530	234	437	32	*7.0	4.6
13	22	22	5.5	5.1	3.5	3.7	1,430	191	379	62	6.0	6.0
14	22	33	5.4	5.0	3.5	3.7	1,600	179	327	115	6.5	*17
15	24	33	5.3	4.9	3.4	3.7	1,490	327	290	117	6.5	13
16	26	32	5.2	4.9	3.4	3.6	1,360	390	220	74	27	16
17	28	33	5.1	4.9	3.3	3.5	1,190	367	142	56	29	18
18	25	24	5.1	5.0	*3.3	3.2	1,010	*344	123	41	9.2	21
19	26	18	5.0	5.1	3.2	3.0	*804	314	111	33	5.6	19
20	25	*15	4.9	5.2	3.1	2.8	666	292	109	31	3.8	17
21	*27	13	4.8	*5.4	2.9	2.6	571	277	98	30	2.9	23
22	27	12	*4.8	5.4	2.8	2.4	499	267	84	*30	1.4	28
23	26	12	4.8	5.4	2.6	2.3	446	248	78	32	1.7	38
24	26	11	4.7	5.4	2.5	2.2	408	236	*64	32	2.9	39
25	26	10	4.7	5.3	2.5	*2.2	375	233	56	27	3.8	32
26	25	9.8	4.7	5.2	2.5	2.2	*343	210	53	21	3.8	33
27	21	9.1	4.7	5.1	2.6	2.2	310	166	62	21	4.6	28
28	20	8.4	4.7	4.9	2.6	2.2	272	115	81	18	2.9	26
29	21	7.6	4.7	4.8		2.2	258	111	72	16	4.2	31
30	20	7.0	4.7	4.7	----------	2.3	234	104	71	16	6.0	60
31	21	----------	4.7	4.5	----------	2.4	----------	109	----------	18	7.0	----------
Total	933	548.9	163.6	158.3	93.5	89.4	16,135.6	7,350	7,498	1,242	261.4	545
Mean	30.1	18.3	5.28	5.11	3.34	2.88	538	237	250	40.1	8.43	18.2
Ac-ft	1,850	1,090	324	314	185	177	32,000	14,580	14,870	2,460	518	1,080

Calendar year 1964: Max 460 Min 0 Mean 46.9 Ac-ft 34,060
Water year 1964-65: Max 1,600 Min 1.4 Mean 95.9 Ac-ft 69,450

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 11.

5-0785. Clearwater River at Red Lake Falls, Minn.

Location.--Lat 47°53'15", long 96°16'25", in NW¼NE¼ sec.22, T.151 N., R.44 W., on left bank 40 ft downstream from Great Northern Railroad bridge in Red Lake Falls, 1.4 miles upstream from mouth, and 3 miles downstream from Badger Creek.

Drainage area.--1,370 sq mi, approximately.

Records available.--June 1909 to September 1917, October 1934 to September 1965. Monthly discharge only for October, November 1934, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 949.49 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Sept. 12, 1911, staff gage at site half a mile upstream and Sept. 12, 1911, to Sept. 30, 1917, staff gage at site 40 ft upstream at different datum.

Average discharge.--39 years, 290 cfs (210,000 acre-ft per year).

Extremes.--Maximum discharge during year, 8,680 cfs Apr. 13 (gage height, 10.86 ft, from floodmark); minimum daily, 45 cfs Feb. 23-26.
1909-17, 1934-65: Maximum discharge, 9,310 cfs May 6, 1950 (gage height, 11.28 ft); maximum gage height observed, 17.5 ft Apr. 5, 1913, site and datum then in use (backwater from ice); no flow Sept. 15, 1936, Sept. 14, 1939, Aug. 19-22, 1940.

Remarks.--Records good except those for period of ice effect, which are fair. Slight regulation by Clearwater Lake and several smaller lakes.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.8	44	5.0	1,500
2.0	78	7.0	3,520
2.5	188	9.0	5,980
3.0	351	11.0	8,890
4.0	826		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	351	126	80	58	50	46	68	1,070	713	359	169	106
2	351	123	78	58	49	47	74	1,120	1,690	339	150	104
3	332	123	78	59	49	47	81	1,170	2,760	301	134	100
4	312	121	77	60	48	48	95	1,180	2,620	270	123	111
5	294	119	76	60	48	48	170	1,130	2,080	236	117	152
6	273	128	75	60	49	49	350	1,260	2,010	222	119	141
7	254	126	75	60	49	50	*975	1,220	2,670	205	113	126
8	242	121	74	60	50	51	1,300	1,070	2,990	199	111	113
9	233	119	72	59	50	52	1,600	956	2,890	188	108	106
10	210	117	70	59	50	53	2,750	1,070	2,650	176	113	*100
11	196	126	68	58	49	54	5,800	1,270	2,460	171	98	96
12	*181	*130	66	58	49	55	7,500	1,160	2,220	378	94	96
13	178	146	65	58	48	55	*7,860	1,020	1,990	803	90	98
14	171	157	64	57	48	55	6,650	1,230	1,790	719	86	106
15	166	157	62	57	48	*55	6,000	1,380	1,580	611	82	157
16	159	155	61	57	48	55	5,590	2,110	1,370	476	80	213
17	159	146	60	56	48	54	*4,920	2,020	1,180	396	108	236
18	169	95	*59	56	47	54	4,380	*1,810	993	359	113	294
19	159	80	58	*56	*47	54	3,920	1,690	843	*339	*73	260
20	157	90	58	56	47	54	3,480	1,600	741	324	74	216
21	152	98	58	56	46	54	3,190	1,510	660	270	80	191
22	148	98	58	56	46	54	2,840	1,400	588	245	65	178
23	146	97	57	55	45	54	2,470	1,290	*516	222	57	225
24	139	96	57	55	45	54	2,180	1,190	442	208	55	355
25	134	94	57	54	45	55	1,950	1,100	400	196	55	347
26	134	92	57	53	45	55	*1,760	993	359	186	55	312
27	132	90	57	52	46	56	1,620	896	392	171	57	264
28	130	86	58	52	46	57	1,450	849	611	159	117	239
29	128	84	58	52		59	1,220	872	480	152	123	242
30	126	81	58	51	----------	61	1,110	815	434	146	111	564
31	126	----------	58	51	----------	65	----------	724	----------	152	106	----------
Total	6,042	3,421	2,009	1,749	1,335	1,660	83,353	38,175	43,122	9,178	3,036	5,848
Mean	195	114	64.8	56.4	47.7	53.5	2,778	1,231	1,437	296	97.9	195
Ac-ft	11,980	6,790	3,980	3,470	2,650	3,290	165,300	75,720	85,530	18,200	6,020	11,600

Calendar year 1964: Max 2,690 Min 29 Mean 271 Ac-ft 196,800
Water year 1964-65: Max 7,860 Min 45 Mean 545 Ac-ft 394,500

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 12 (no gage-height record Feb. 9-18, Feb. 20 to Mar. 14, Mar. 16 to Apr. 6). No gage-height record Apr. 14-25.

5-0790. Red Lake River at Crookston, Minn.

Location.--Lat 47°46'32", long 96°36'33", in SW¼SW¼ sec.30, T.150 N., R.46 W., on right bank at downstream side of highway bridge in Crookston, 0.3 mile downstream from Interstate Power Co.'s dam, 0.6 mile downstream from bridge on State Highway 81, and 53 miles above mouth.

Drainage area.--5,280 sq mi, approximately.

Records available.--May 1901 to September 1965. Monthly discharge only for some periods, published in WSP 1308. Figures of daily discharge for Apr. 3-30, 1904, published in WSP 130, have been found unreliable and should not be used.

Gage.--Water-stage recorder (digital after June 10). Datum of gage is 832.72 ft above mean sea level, datum of 1929. May 18, 1901, to June 30, 1909, chain gage at bridge 300 ft upstream at same datum. July 1, 1909, to Sept. 25, 1911, chain gage, Sept. 26, 1911, to Sept. 30, 1919, water-stage recorder, and Oct. 1, 1919, to Sept. 30, 1930, chain gage, at present site and datum.

Average discharge.--64 years, 1,001 cfs (724,700 acre-ft per year).

Extremes.--Maximum discharge during year, 19,400 cfs Apr. 14 (gage height, 23.51 ft); maximum gage height, 25.82 ft Apr. 12 (backwater from ice); minimum discharge, 50 cfs Nov. 21 (gage height, 2.65 ft).
1901-65: Maximum discharge, 27,400 cfs May 7, 1950 (gage height, 25.70 ft); maximum gage height, that of Apr. 12, 1965; no flow for part of July 13, 1960 (caused by regulation of powerplant upstream).

Remarks.--Records good except those for period of ice effect, which are fair. Diurnal fluctuation caused by powerplant upstream.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Sept. 7-14)

4.0	530	13.0	6,600
5.0	970	16.0	9,540
7.0	2,160	20.0	14,100
10.0	4,260	24.0	20,500

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,290	1,160	610	600	610	630	710	3,900	2,570	2,120	1,000	848
2	1,130	1,180	610	600	610	620	730	3,740	3,130	1,980	966	839
3	1,180	1,170	620	600	620	620	770	3,740	5,590	1,880	923	821
4	1,250	1,160	630	600	620	620	850	3,990	7,370	1,820	915	866
5	1,200	1,140	640	610	630	630	1,200	3,990	6,410	1,720	861	960
6	1,140	1,130	640	610	640	630	2,000	4,530	5,350	1,630	816	930
7	1,060	1,120	650	620	640	640	3,300	5,110	6,030	1,570	689	906
8	1,020	960	650	620	640	640	*4,000	4,480	7,290	1,480	800	888
9	950	906	650	630	650	640	4,700	3,910	7,560	1,400	815	888
10	916	898	640	630	660	640	*5,900	3,660	6,560	1,220	827	*880
11	898	935	640	620	660	640	10,000	3,960	5,700	1,120	811	848
12	*857	*920	630	620	650	640	17,000	4,070	5,130	1,240	796	884
13	844	945	620	620	650	640	*18,400	3,640	4,640	3,560	788	893
14	821	965	620	620	640	640	18,700	3,460	4,250	4,390	764	920
15	798	965	610	620	640	640	*18,600	3,520	3,910	3,550	760	*1,000
16	880	960	610	620	640	*630	15,700	4,580	3,540	2,910	752	1,100
17	772	945	610	620	640	630	12,900	5,100	3,210	2,460	752	1,200
18	668	884	*610	620	640	620	10,800	4,880	2,860	2,260	763	1,340
19	740	510	610	620	*640	620	9,340	4,480	2,570	*2,070	*763	1,380
20	718	280	600	630	640	620	*8,240	*4,190	2,370	1,890	731	1,300
21	704	185	600	630	640	620	7,540	4,010	2,180	1,720	736	1,230
22	686	270	600	*640	630	620	7,000	3,840	2,080	1,560	740	1,180
23	821	575	590	640	620	620	6,290	3,660	*1,980	1,500	708	1,200
24	1,100	620	590	640	620	630	5,810	3,490	1,840	1,390	708	1,370
25	1,210	660	590	640	620	630	5,600	3,340	1,730	1,320	731	1,590
26	1,230	670	590	640	620	640	*5,310	3,180	1,650	1,260	722	1,650
27	1,230	650	590	630	630	640	5,030	3,010	1,720	1,190	749	1,600
28	1,220	620	590	630	630	650	4,700	2,850	2,050	1,150	749	1,530
29	1,190	610	600	630		660	4,390	2,770	2,420	1,010	808	1,500
30	1,180	610	600	620	----------	670	4,110	2,730	2,280	903	857	1,650
31	1,180	----------	600	620	----------	690	----------	2,620	----------	915	848	----------
Total	30,883	24,603	19,040	19,290	17,770	19,700	219,620	118,430	115,970	56,188	24,648	34,191
Mean	996	820	614	622	635	635	7,321	3,820	3,866	1,813	795	1,140
Ac-ft	61,260	48,790	37,770	38,260	35,250	39,070	435,600	234,900	230,000	111,400	48,890	67,820

Calendar year 1964: Max 5,240 Min 131 Mean 988 Ac-ft 717,200
Water year 1964-65: Max 18,700 Min 185 Mean 1,919 Ac-ft 1,389,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 14.

5-0825. Red River of the North at Grand Forks, N. Dak.

Location.--Lat 47°56'34", long 97°03'10", in SW¼NE¼ sec.33, T.152 N., R.50 W., on left bank on second floor of old sewage plant in Grand Forks, 2.3 miles downstream from Red Lake River, and at mile 296.

Drainage area.--30,100 sq mi, approximately (includes 3,800 sq mi in closed basins).

Records available.--April 1882 to September 1965. Monthly discharge only prior to May 1901, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 778.35 ft above mean sea level, datum of 1929. 1882-92, gages near site of Northern Pacific Railway bridge, 1½ miles upstream (history not available, datum apparently the same as following gage). 1892 to Oct. 15, 1926, staff and chain gages on Northern Pacific Railway bridge, at datum about 5½ ft higher, but published referred to datum only half a foot higher than present datum. Oct. 16, 1926, to Nov. 2, 1933, staff gages near present site, at datum 5 ft higher than present datum but published at present datum. Nov. 3, 1933 to Apr. 13, 1965, water-stage recorder 0.3 mile upstream at present datum.

Average discharge.--83 years, 2,333 cfs (1,689,000 acre-ft per year).

Extremes.--Maximum discharge during year, 52,000 cfs Apr. 17 (gage height, 44.92 ft); minimum daily, 590 cfs Nov. 22.

1882-1965: Maximum discharge, about 80,000 cfs Apr. 10, 1897 (gage height, 50.2 ft, site and datum then in use), from rating curve extended above 54,000 cfs; minimum, 2.4 cfs Feb.3-5, 12, 14, 16-19, 1937 (caused by unusual regulation during repair of dam at Grand Forks).

Remarks.--Records good except those for period of ice effect, which are fair. Records of chemical analyses and water temperatures for the water year 1965 are published in Part 2 of this report. Flow regulated by many lakes and reservoirs on tributaries.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,260	1,660	935	950	1,010	855	990	13,900	*6,170	5,730	2,730	1,610
2	2,010	1,660	935	940	1,000	865	1,040	12,200	6,300	5,490	2,710	1,590
3	1,800	1,630	935	930	1,000	875	*1,130	*11,200	6,930	5,200	2,610	1,570
4	1,750	1,630	935	930	1,000	885	1,240	10,200	9,020	4,980	2,510	1,610
5	1,780	1,620	935	930	1,000	900	1,350	9,670	10,600	4,750	2,420	1,600
6	1,760	1,600	930	930	990	910	1,700	9,350	11,000	4,590	2,400	1,620
7	1,670	1,590	930	930	960	920	2,500	*9,050	*10,000	4,450	2,360	1,630
8	1,620	1,580	930	925	950	920	5,400	9,000	9,950	4,320	2,260	1,560
9	1,540	1,540	930	920	940	920	8,800	8,720	11,400	*4,130	2,220	1,510
10	1,500	1,460	930	920	935	925	11,300	8,200	12,100	3,880	2,230	1,490
11	1,490	1,430	930	*920	935	930	*16,000	*7,730	12,000	3,680	2,190	1,510
12	1,500	1,440	930	925	930	940	25,300	7,560	11,600	3,710	2,160	1,520
13	1,500	*1,460	930	930	930	955	*37,700	7,420	11,100	3,760	2,120	1,520
14	1,450	1,480	935	960	925	960	*44,700	*7,100	10,600	5,120	2,030	1,570
15	1,380	1,530	935	975	925	950	48,800	6,860	10,000	6,800	1,940	1,590
16	1,340	1,540	940	980	925	945	51,500	6,800	*9,460	6,320	1,850	1,610
17	1,340	1,520	945	990	920	960	*50,300	7,420	8,770	5,680	1,760	1,690
18	1,340	1,520	940	1,000	910	990	48,200	8,300	8,100	5,110	1,700	1,780
19	1,280	1,400	940	1,010	910	980	45,800	*8,560	7,480	4,730	1,660	1,900
20	1,220	1,000	935	1,020	905	970	45,600	8,270	6,940	4,460	1,630	2,000
21	1,220	655	940	1,030	900	935	*41,200	7,900	6,540	4,170	1,620	2,050
22	1,210	590	940	1,030	895	930	38,800	7,530	6,310	3,900	1,620	2,110
23	1,160	600	940	1,020	890	920	36,200	7,250	6,200	3,610	1,580	2,200
24	1,170	620	945	1,020	880	925	33,300	6,950	5,990	3,510	1,530	2,220
25	1,380	740	950	1,020	880	930	29,600	6,690	*5,650	3,560	1,500	2,320
26	1,580	840	950	1,020	*865	935	*26,700	6,430	5,380	3,400	1,500	2,480
27	1,630	870	955	*1,020	860	930	23,800	6,310	5,300	3,150	1,540	2,600
28	1,660	890	960	1,020	855	930	21,000	6,250	5,430	3,000	1,550	2,630
29	1,660	945	970	1,020		*935	*18,400	6,190	5,660	*2,930	1,540	2,620
30	*1,660	*945	*975	1,010	----------	950	16,000	6,180	*5,860	2,880	*1,550	*2,670
31	1,650	----------	970	1,010	----------	960	----------	6,210	----------	2,780	1,590	----------
Total	47,510	37,985	29,180	30,235	26,025	28,835	734,350	251,400	247,840	133,780	60,610	56,380
Mean	1,533	1,266	941	975	929	930	24,480	8,110	8,261	4,315	1,955	1,879
Ac-ft	94,230	75,340	57,880	59,970	51,620	57,190	1,457,000	498,600	491,600	265,300	120,200	111,800

Calendar year 1964: Max 13,200 Min 380 Mean 2,065 Ac-ft 1,499,000
Water year 1964-65: Max 51,500 Min 590 Mean 4,614 Ac-ft 3,341,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 11.

5-0875. Middle River at Argyle, Minn.

Location.--Lat 48°20'27", long 96°49'02", in SE¼SW¼ sec.10, T.156 N., R.48 W., on left bank 20 ft upstream from bridge on U. S. Highway 75 in Argyle and 14 miles upstream from mouth.

Drainage area.--265 sq mi.

Records available.--March to September 1945, November 1950 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 828.53 ft above mean sea level, datum of 1929. Prior to Nov. 8, 1951, chain or wire-weight gage at bridge 20 ft upstream at datum 1.0 ft higher. Nov. 8, 1951, to Sept. 18, 1952, water-stage recorder at present site at datum 1.0 ft higher.

Average discharge.--15 years (1950-65), 34.9 cfs (25,270 acre-ft per year).

Extremes.--Maximum discharge during year, 2,590 cfs Apr. 12 (gage height, 15.29 ft); minimum daily, 1.0 cfs Feb. 22 to Mar. 3; minimum gage height, 1.21 ft Aug. 24.
1945, 1950-65: Maximum discharge, that of Apr. 12, 1965; no flow at times most years.
Flood of April 1950 reached a stage of 15.25 ft, present datum, from floodmarks (discharge, 2,790 cfs).

Remarks.--Records good except those for period of ice effect, which are fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	88	7.6	5.6	2.9	1.7	1.0	1.4	120	64	221	14	1.9
2	70	7.6	5.2	2.9	1.6	1.0	1.6	112	63	199	13	1.4
3	57	7.4	5.0	2.9	1.5	1.0	2.1	106	67	176	12	1.3
4	52	7.2	4.8	2.8	1.4	1.1	4.0	121	89	206	11	3.1
5	52	11	4.7	2.8	1.4	1.1	9.0	159	161	225	9.4	2.6
6	52	22	4.6	2.8	1.3	1.1	16	176	229	183	8.8	2.4
7	50	21	4.5	2.8	1.3	1.1	25	229	224	138	7.8	3.0
8	46	19	4.5	2.8	1.2	1.2	40	376	239	105	7.1	2.8
9	42	16	4.5	2.8	1.2	1.3	92	423	301	82	6.4	2.8
10	36	14	4.4	2.7	1.1	1.4	190	362	317	62	5.5	2.6
11	31	15	4.4	2.6	1.1	1.5	*466	306	266	50	5.5	2.6
12	27	*14	4.3	2.6	1.1	1.6	1,500	310	196	49	4.7	2.4
13	24	14	4.2	2.5	1.1	1.6	2,410	297	141	42	5.5	2.3
14	20	15	4.1	2.5	1.1	1.7	* 2,160	233	104	57	4.4	3.3
15	18	20	4.0	2.5	1.1	1.7	1,940	180	78	118	3.7	3.4
16	17	23	4.0	2.5	1.1	1.7	1,670	144	61	127	3.2	3.7
17	15	23	3.9	2.5	1.1	1.6	1,350	126	50	108	3.7	4.0
18	14	17	3.7	2.5	1.1	1.6	1,070	112	41	106	3.2	3.6
19	12	14	3.5	2.5	1.1	1.6	855	100	35	89	2.6	4.7
20	12	12	3.4	2.5	1.1	1.5	694	96	32	*72	2.3	7.8
21	11	11	3.4	2.5	1.1	1.5	*557	93	27	61	1.9	11
22	11	10	3.3	2.5	1.0	1.5	446	87	24	64	1.8	11
23	10	10	3.3	2.6	1.0	1.4	363	83	20	67	1.7	11
24	9.6	*9.8	3.3	2.6	*1.0	1.4	305	81	18	56	1.4	11
25	9.2	9.3	3.2	*2.6	1.0	1.3	262	76	16	46	*1.6	14
26	9.0	8.6	3.2	2.5	1.0	*1.3	229	*72	16	38	2.0	18
27	*8.8	8.0	3.1	2.4	1.0	1.3	196	69	20	31	2.7	21
28	9.4	7.3	*3.1	2.3	1.0	1.3	*176	68	*17	25	1.9	* 25
29	10	6.6	3.0	2.2		1.3	155	68	17	22	2.6	27
30	8.0	6.0	3.0	2.0	----------	1.3	135	70	130	18	2.0	28
31	7.4	----------	2.9	1.8	----------	1.4	----------	68	----------	16	2.2	----------
Total	838.4	386.4	122.1	79.4	32.8	42.4	17,320.1	4,923	3,063	2,859	155.6	238.7
Mean	27.0	12.9	3.94	2.56	1.17	1.37	577	159	102	92.2	5.01	7.95
Ac-ft	1,663	766	242	157	65	84	34,350	9,770	6,080	5,670	309	473

Calendar year 1964: Max 878 Min 0 Mean 45.2 Ac-ft 32,730
Water year 1964-65: Max 2,410 Min 1.0 Mean 82.4 Ac-ft 59,630

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 12 (no gage-height record Apr. 7-10).

5-0920. Red River of the North at Drayton, N. Dak.

Location.--Lat 48°34'20", long 97°08'50", on line between secs.24 and 25, T.159 N., R.51 W., on downstream end of east pier of interstate highway bridge, 1½ miles northeast of Drayton and at mile 207.

Drainage area.--34,800 sq mi, approximately (includes 3,800 sq mi in closed basins).

Records available.--April 1936 to June 1937, April 1941 to September 1965 (fragmentary prior to April 1949).

Gage.--Water-stage recorder and concrete control. Datum of gage is 755.00 ft above mean sea level, datum of 1929 (Minnesota Highway bench mark). Prior to Nov. 30, 1954, wire-weight gage at site 1½ miles upstream at datum 1.59 ft higher.

Average discharge.--16 years (1949-65), 3,307 cfs (2,394,000 acre-ft per year); median of yearly mean discharges, 2,570 cfs (1,860,000 acre-ft per year).

Extremes.--Maximum discharge during year, 47,200 cfs Apr. 22 (gage height, 40.43 ft); minimum daily, 718 cfs, Nov. 27, 28.

1936-37, 1941-65: Maximum discharge, 86,500 cfs May 12, 1950 (gage height, 41.58 ft, former site and datum); minimum observed, 7.7 cfs Oct. 16, 1936 (gage height, 1.75 ft, former site and datum).

Maximum discharge known since 1860, that of May 12, 1950. Flood of April 1897 reached a stage of about 41 ft, at site and datum in use prior to Nov. 30, 1954.

Remarks.--Records good except those for period of ice effect, which are fair. Some regulation by reservoirs on tributaries.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,820	1,810	796	990	950	900	1,150	29,500	* 6,680	6,210	2,970	1,470
2	3,000	1,780	832	990	940	900	1,200	27,400	6,850	6,380	2,910	1,500
3	2,880	1,770	860	980	945	900	1,250	*25,300	7,420	6,340	2,870	1,500
4	2,570	1,750	880	980	940	900	1,300	23,300	8,000	6,110	2,760	1,600
5	2,290	1,740	900	970	940	910	1,350	21,600	9,470	5,840	2,660	1,600
6	2,140	1,720	910	960	940	920	1,400	20,200	11,200	5,590	2,570	1,600
7	2,050	1,700	920	950	940	920	1,500	*18,800	*12,200	* 5,360	2,500	1,600
8	1,970	1,690	920	940	940	930	2,000	17,400	12,300	5,100	2,450	1,610
9	* 1,860	1,670	930	930	935	920	3,200	16,300	12,400	*4,860	*2,360	*1,590
10	1,780	1,660	940	920	930	920	6,800	15,200	12,500	4,640	2,310	1,550
11	1,690	1,610	950	920	920	930	11,500	*14,100	*12,600	4,320	2,250	1,500
12	1,630	1,540	950	*920	920	940	21,400	12,800	12,700	4,240	2,250	1,470
13	1,620	*1,490	950	920	920	950	22,900	11,800	12,600	4,520	2,230	1,470
14	1,610	1,470	961	920	920	970	28,300	* 11,100	12,300	4,580	2,180	1,500
15	1,600	1,460	*961	920	*910	980	* 32,700	10,300	11,800	5,280	2,120	1,560
16	1,580	1,460	972	935	910	990	36,600	9,700	*11,000	6,510	2,020	1,590
17	1,500	1,480	972	940	910	1,010	39,200	9,200	10,500	6,980	1,940	1,700
18	1,450	1,040	972	940	910	1,020	41,700	9,050	9,850	6,880	1,840	1,760
19	1,420	850	983	945	910	1,020	*43,900	*9,040	9,240	6,410	1,740	1,850
20	1,390	1,300	983	950	910	1,020	46,300	9,160	8,570	*5,900	1,660	2,000
21	1,330	1,190	983	960	900	1,030	46,800	9,140	*7,920	5,420	1,620	2,140
22	1,280	1,040	994	960	900	* 1,040	47,100	8,730	7,370	5,010	1,590	2,250
23	1,260	910	994	960	900	1,050	45,800	8,250	6,980	4,610	1,580	2,340
24	1,230	832	994	970	900	1,050	45,300	* 7,820	6,760	4,210	1,560	2,400
25	1,210	778	994	970	910	1,050	43,700	7,520	* 6,480	3,960	1,530	2,420
26	1,240	734	994	*975	910	1,060	42,000	7,250	6,170	3,910	1,490	2,500
27	1,440	718	994	975	910	1,060	*39,600	7,020	5,940	3,790	1,470	2,660
28	1,660	718	994	975	920	1,060	37,200	6,850	5,790	3,540	1,460	2,770
29	1,760	726	1,000	965		1,080	34,500	6,780	5,790	3,330	1,470	2,900
30	1,800	752	1,000	960	----------	1,080	31,700	6,740	*5,970	3,160	1,480	3,040
31	1,810	----------	1,000	950	----------	1,100	----------	6,710	----------	3,070	1,470	----------
Total	54,870	39,388	29,483	29,540	25,790	30,610	759,350	404,060	275,350	156,060	63,310	57,440
Mean	1,770	1,313	951	953	921	987	25,310	13,030	9,178	5,034	2,042	1,915
Ac-ft	108,800	78,120	58,480	58,590	51,150	60,710	1,506,000	801,400	546,100	309,500	125,600	113,900

Calendar year 1964: Max 15,600 Min 460 Mean 2,595 Ac-ft 1,884,000
Water year 1964-65: Max 47,100 Min 718 Mean 5,275 Ac-ft 3,818,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Jan. 1 to Apr. 14.

5-0940. South Branch Two Rivers at Lake Bronson, Minn.

Location.--Lat 48°43'50", long 96°39'50", in SW¼SW¼ sec.30, T.161 N., R.46 W., on left bank 100 ft upstream from bridge on U. S. Highway 59 at town of Lake Bronson and 2 miles downstream from dam at outlet of Bronson Lake.

Drainage area.--444 sq mi.

Records available.--September 1928 to November 1936, April to September 1937, April 1941 to October 1943, April to December 1944, April 1945 to September 1947, October 1953 to September 1965. Monthly discharge only for some periods, published in WSP 1308. Published as South Fork Two Rivers at Bronson prior to 1941.

Gage.--Water-stage recorder. Datum of gage is 928.46 ft above mean sea level, adjustment of 1928 (levels by Geodetic Survey of Canada). Prior to Nov. 23, 1953, chain gage at bridge 100 ft downstream at datum 2.00 ft higher. Nov. 23, 1953, to Oct. 5, 1963, water-stage recorder at same site at datum 2.00 ft higher.

Average discharge.--24 years (1928-36, 1941-43, 1945-47, 1953-65), 71.1 cfs (51,470 acre-ft per year).

Extremes.--Maximum discharge during year, 2,780 cfs Apr. 15 (gage height, 12.30 ft); minimum daily, 4.0 cfs Mar. 24-27; minimum gage height, 3.24 ft Aug. 21.
1928-37, 1941-47, 1953-65: Maximum discharge, 2,960 cfs June 13, 1962 (gage height, 12.82 ft, present datum); no flow at times in 1937, 1941, 1960.

Remarks.--Records good except those for periods of ice effect or no gage height record, which are fair. Flow partly regulated since 1937 by Bronson Lake (usable capacity, 3,700 acre-ft).

Rating table, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.2	3.4	5.0	265
3.3	6.6	6.0	500
3.5	21	8.0	1,140
3.7	40	10.0	1,870
4.0	80	12.3	3,780
4.5	167		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.4	5.4	4.9	4.8	4.6	4.5	4.7	150	255	34	5.8	6.2
2	4.8	5.1	4.9	4.7	4.5	4.5	5.0	190	255	207	5.8	5.4
3	4.8	5.1	4.8	4.7	4.5	4.6	5.8	197	259	263	6.0	5.4
4	4.8	5.1	4.8	4.7	4.5	4.7	8.0	194	265	143	7.6	9.2
5	4.8	5.1	4.8	4.7	4.5	4.7	18	316	298	116	8.1	5.4
6	4.8	5.1	4.8	4.7	4.5	4.8	50	861	327	115	8.1	5.4
7	4.8	5.1	4.8	4.7	4.5	4.8	120	943	351	110	7.0	5.8
8	4.8	5.1	4.8	4.7	4.5	4.8	220	694	516	106	7.0	6.6
9	4.4	5.1	4.8	4.6	4.5	4.8	400	617	438	53	6.6	11
10	4.4	5.1	4.9	4.6	4.6	4.9	800	629	275	14	6.6	15
11	4.4	8.1	4.9	4.6	4.6	4.9	*1,550	687	347	30	6.6	19
12	4.4	7.6	4.9	4.6	4.6	4.9	2,150	531	283	33	6.6	21
13	5.1	7.6	4.9	4.5	4.6	4.9	2,420	539	188	33	6.6	22
14	5.1	7.6	4.8	4.5	4.6	4.9	*2,560	480	186	36	5.4	57
15	4.8	7.6	4.8	4.5	4.6	4.8	2,760	331	137	62	5.4	137
16	4.8	7.6	4.7	4.5	4.6	4.8	2,680	392	99	58	5.1	47
17	4.8	7.0	4.7	4.6	4.6	4.7	2,430	425	104	57	4.8	10
18	4.8	7.0	4.7	4.6	4.6	4.6	2,030	388	130	56	5.1	9.3
19	5.1	7.0	4.7	4.6	4.6	4.5	*1,520	273	127	56	5.4	20
20	4.8	6.6	4.7	4.6	4.6	4.4	1,040	333	101	*33	5.1	128
21	5.1	6.4	4.6	4.7	4.6	4.3	725	340	36	12	5.1	108
22	5.1	6.1	4.6	4.7	4.5	4.2	*678	365	13	17	4.8	8.7
23	5.1	5.9	4.6	4.7	4.5	4.1	684	314	19	26	5.1	10
24	5.1	*5.8	4.7	4.8	*4.4	4.0	635	*311	48	26	5.1	11
25	5.4	5.7	4.7	*4.8	4.4	*4.0	496	309	68	26	*5.1	39
26	6.2	5.6	4.7	4.8	4.4	4.0	277	307	66	26	5.4	83
27	*5.1	5.5	4.7	4.7	4.4	4.0	285	307	68	18	5.8	107
28	5.1	5.4	*4.8	4.7	4.4	4.1	*283	259	*130	5.8	5.8	*101
29	5.1	5.2	4.8	4.7		4.2	239	215	199	5.8	6.6	7.6
30	5.1	5.0	4.8	4.6	----------	4.3	137	298	63	6.6	6.2	9.3
31	5.1	----------	4.8	4.6	----------	4.5	----------	325	----------	6.2	6.2	----------
Total	152.4	181.6	147.9	144.3	126.8	140.2	27,210.5	12,520	5,651	1,790.4	185.9	1,030.3
Mean	4.92	6.05	4.77	4.65	4.53	4.52	907	404	188	57.8	6.00	34.3
Ac-ft	302	360	293	286	252	278	53,970	24,830	11,210	3,550	369	2,040

Calendar year 1964: Max 1,960 Min 0.6 Mean 93.1 Ac-ft 67,570
Water year 1964-65: Max 2,760 Min 4.0 Mean 135 Ac-ft 97,740

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 13 (no gage-height record Jan. 29 to Feb. 23, Feb. 27 to Mar. 24, Mar. 26 to Apr. 1, Apr. 3-10, 12, 13).

5-1025. Red River of the North at Emerson, Manitoba

(International gaging station)

Location.--Lat 49°00'30", long 97°13'00", in sec.2, T.1, R.2 E., on right bank 1,500 ft downstream from Canadian National Railway bridge in Emerson, three-quarters of a mile downstream from International Boundary, 3.6 miles downstream from Pembina River, and at mile 154.3.

Drainage area.--40,200 sq mi, approximately (includes 3,800 sq mi in closed basins).

Records available.--March to November 1902 (gage heights only), May 1912 to September 1929 (monthly discharge only, published in WSP 1308), October 1929 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 700.00 ft above mean sea level, datum of 1929, by Geodetic Survey of Canada. Prior to 1912, staff gage at different datum. May 3, 1912, to Apr. 10, 1953, chain gage and/or staff gage on Canadian National Railway bridge, 1,500 ft upstream. May 3, 1912, to September 30, 1923, at datum 2.55 ft lower than present datum; Oct. 1, 1923, to Sept. 30, 1925, at datum 1.14 ft lower than present datum; Oct. 1, 1925, to Sept. 30, 1947, at datum 0.57 ft higher than present datum; and Oct. 1, 1947, to Sept. 30, 1948, at datum 0.21 ft higher than present datum.

Average discharge.--53 years (1912-65), 2,818 cfs (2,040,000 acre-ft per year); median of yearly mean discharges, 2,400 cfs (1,740,000 acre-ft per year).

Extremes.--Maximum discharge during year, 46,200 cfs Apr. 26 (gage height, 85.19 ft); minimum daily, 875 cfs Feb. 4-7, 20-22; minimum gage height, 47.70 ft Nov. 20, 27.
1912-65: Maximum discharge, 95,500 cfs May 13, 1950 (gage height, 90.89 ft); minimum observed, 0.9 cfs Feb. 6-8, 1937 (gage height, 44.00 ft).

Remarks.--Records good except those for period of ice effect, which are fair.

Cooperation.--This station is one of the international gaging stations maintained by Canada under agreement with the United States.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,340	1,700	920	945	890	905	940	39,700	8,680	6,480	3,520	1,720
2	2,220	1,700	920	950	880	905	*955	38,200	8,740	*6,940	3,380	1,710
3	2,550	1,700	920	930	880	905	1,020	*36,500	8,910	7,000	3,270	1,720
4	2,580	1,690	920	925	875	910	1,090	34,300	9,210	6,960	*3,180	*1,800
5	*2,430	1,690	920	905	875	915	1,180	*32,000	9,920	6,900	3,080	1,860
6	2,290	1,660	920	*905	875	920	1,390	30,300	11,000	6,710	2,960	1,870
7	2,140	1,650	915	900	875	925	1,670	28,800	*12,300	6,440	2,840	1,860
8	2,080	1,640	*900	900	*880	925	2,470	27,300	12,600	6,170	2,750	1,840
9	2,030	1,640	900	905	900	930	3,750	*25,700	12,700	5,880	2,680	1,840
10	1,950	1,640	890	905	900	930	6,340	24,100	12,800	5,590	2,620	1,820
11	1,850	1,630	890	905	900	935	11,100	*22,300	12,900	5,320	2,530	1,800
12	1,780	1,600	890	905	900	940	16,000	20,400	12,900	5,070	2,470	1,770
13	1,720	*1,550	890	900	900	950	20,900	18,400	12,900	4,920	2,440	1,720
14	1,670	1,510	890	900	900	960	25,000	*16,700	12,800	4,950	2,410	1,720
15	1,640	1,460	890	905	910	980	28,000	15,400	12,600	*5,000	2,370	1,760
16	1,620	1,500	890	905	910	990	*33,300	13,900	12,300	5,420	2,300	1,810
17	1,580	1,470	890	905	910	1,000	*36,200	12,500	11,800	6,360	2,250	1,880
18	1,510	1,460	900	910	910	995	33,200	11,400	11,200	6,840	2,160	1,990
19	1,450	1,200	905	910	880	990	*40,100	10,800	10,600	6,890	*2,060	2,030
20	*1,410	1,000	900	910	875	985	*41,700	10,600	9,970	6,660	1,970	*2,080
21	1,360	1,120	*900	*915	875	980	*43,200	*10,600	*9,270	6,250	1,920	2,170
22	1,320	1,350	900	910	875	985	*44,500	10,500	8,640	*5,870	1,840	2,280
23	1,330	1,320	900	910	*880	985	*45,400	10,300	8,090	5,510	1,800	2,450
24	1,240	1,200	905	910	890	985	*45,800	10,200	7,640	5,140	1,780	2,570
25	1,220	1,060	910	905	895	980	46,100	9,920	7,300	4,790	1,780	2,610
26	1,200	940	925	905	895	945	*44,100	9,680	7,010	4,520	1,750	2,630
27	1,200	900	935	905	895	940	*43,100	9,420	6,770	4,340	1,720	2,680
28	1,300	900	945	905	900	940	*42,800	9,260	6,530	4,190	1,710	2,770
29	1,470	900	940	905		*940	42,100	9,090	6,360	3,990	1,700	2,920
30	1,590	910	940	905	----------	940	*41,100	8,920	6,320	3,800	1,720	3,190
31	1,660	----------	950	905	----------	940	----------	8,830	----------	3,680	1,720	----------
Total	52,730	41,690	28,210	28,205	24,930	29,455	749,505	576,020	300,760	174,580	72,680	62,870
Mean	1,701	1,390	910	910	890	950	24,980	18,580	10,020	5,632	2,344	2,096
Ac-ft	104,600	82,690	55,950	55,940	49,450	58,420	1486,000	1,143,000	596,500	346,300	144,200	124,700

Calendar year 1964: Max 17,500 Min 362 Mean 2,928 Ac-ft 2,126,000
Water year 1964-65: Max 46,100 Min 875 Mean 5,867 Ac-ft 4,248,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 16. Discharge computed from manually read gage Oct. 1 to Feb. 23.

5-1045. Roseau River below South Fork near Malung, Minn.

Location.--Lat 48°47'30", long 95°44'40", in SW¼ sec.6, T.161 N., R.39 W., on left bank a quarter of a mile downstream from South Fork and 1½ miles northwest of Malung.

Drainage area.--573 sq mi.

Records available.--October 1946 to September 1965.

Gage.--Water-stage recorder and concrete control. Datum of gage is 1,029.67 ft above mean sea level, adjustment of 1912.

Average discharge.--19 years, 135 cfs (97,740 acre-ft per year).

Extremes.--Maximum discharge during year, 4,660 cfs Apr. 13 (gage-height, 21.90 ft); minimum daily, 2.5 cfs Feb. 23 to Mar. 2.
1946-65: Maximum discharge, that of Apr. 13, 1965; no flow for part of Jan. 15, 1952 (caused by construction of concrete control) and July 23 to Sept. 8, 1961.

Remarks.--Records good except those for periods of ice effect or no gage height record, which are fair.

Rating table, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Apr. 26 to May 5)

4.6	3.1	5.7	69	10.0	1,080
4.7	4.7	6.0	124	14.0	1,970
4.9	9.0	6.5	263	18.0	2,920
5.2	20	7.0	453	21.9	4,660
5.5	42	8.0	684		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	872	70	22	7.5	3.9	2.5	2.6	218	274	198	40	3.8
2	860	207	20	7.3	3.9	2.5	2.7	215	274	278	36	3.8
3	776	297	19	7.1	3.8	2.6	2.8	218	290	320	32	3.4
4	706	263	18	7.0	3.8	2.6	3.0	238	442	286	28	8.9
5	668	238	17	6.8	3.7	2.6	3.2	533	520	218	27	16
6	642	204	17	6.6	3.7	2.7	3.6	1,380	560	174	24	18
7	604	179	16	6.4	3.6	2.7	4.5	1,320	692	139	20	20
8	552	171	16	6.3	3.6	2.7	5.0	1,240	858	118	18	18
9	487	146	15	6.2	3.5	2.8	6.0	1,090	928	100	15	20
10	410	128	15	6.0	3.5	2.8	200	944	908	83	14	18
11	356	122	15	5.9	3.5	2.9	1,500	846	830	69	12	17
12	317	139	14	5.8	3.4	3.0	*3,740	810	680	66	11	14
13	286	182	14	5.7	3.3	3.0	*4,600	758	504	137	9.0	13
14	249	204	13	5.6	3.3	3.0	4,150	676	360	218	12	14
15	221	193	13	5.5	3.3	3.0	3,590	577	278	204	19	22
16	212	174	12	5.4	3.2	3.0	3,250	533	226	190	13	51
17	215	156	12	5.4	3.1	2.9	2,810	533	180	224	10	78
18	184	90	11	5.3	3.0	2.9	2,330	543	152	187	8.3	89
19	166	50	11	5.2	2.8	2.9	1,920	552	125	182	6.8	101
20	151	54	10	5.2	2.7	2.8	*1,640	540	105	198	5.3	96
21	139	59	10	5.1	2.6	2.8	1,420	520	104	*234	4.7	81
22	131	56	9.6	5.0	2.6	2.8	1,220	484	108	193	4.3	67
23	122	52	9.4	5.0	2.5	2.7	*1,040	442	104	156	3.2	58
24	114	43	9.1	5.0	2.5	2.7	874	407	78	137	3.2	89
25	105	*39	8.9	4.9	*2.5	2.7	736	384	56	107	4.6	124
26	101	34	8.6	4.8	2.5	*2.6	624	*356	46	89	*4.5	148
27	94	30	8.4	4.6	2.5	2.6	530	328	58	76	3.2	158
28	96	29	8.2	4.5	2.5	2.6	428	309	236	61	3.4	146
29	*109	25	*8.1	4.3		2.6	* 324	297	*290	51	3.8	*154
30	92	23	7.9	4.1	----------	2.6	259	282	241	44	4.3	215
31	74	----------	7.7	4.0	----------	2.6	----------	274	----------	41	4.2	----------
Total	10,111	3,657	395.9	173.5	88.8	85.2	37,218.4	17,847	10,507	4,778	403.8	1,864.9
Mean	326	122	12.8	5.60	3.17	2.75	1,241	576	350	154	13.0	62.2
Ac-ft	20,050	7,250	785	344	176	169	73,820	35,400	20,840	9,480	801	3,700

Calendar year 1964: Max 1,850 Min 2.4 Mean 199 Ac-ft 144,700
Water year 1964-65: Max 4,600 Min 2.5 Mean 239 Ac-ft 172,800

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18-22, Nov. 29 to Apr. 10 (no gage-height record Jan. 1-25). No gage-height record Apr. 11, June 16-25.

5-1060. Sprague Creek near Sprague, Manitoba

(International gaging station)

Location.--Lat 48°59'33", long 95°39'43", in NE¼ sec.34, T.164 N., R.39 W., on left bank half a mile south of international boundary, 3½ miles south of Sprague, Manitoba, 8 miles upstream from mouth, and 14 miles northeast of Roseau, Minn.

Drainage area.--169 sq mi. Prior to October 1958, 151 sq mi; change due to construction of drainage ditch within basin.

Records available.--September 1928 to September 1965 (winter records incomplete prior to 1941). Prior to September 1951, published as Mud Creek near Sprague.

Gage.--Water-stage recorder and concrete control. Datum of gage is 1,038.4 ft above mean sea level, adjustment of 1928 by Geodetic Survey of Canada. Prior to Mar. 15, 1929, staff gage at same site and datum.

Average discharge.--26 years (1928-29, 1940-65), 58.7 cfs (42,500 acre-ft per year).

Extremes.--Maximum discharge during year, 1,250 cfs May 7 (gage height, 13.02 ft); minimum daily, 1.0 cfs Feb. 2.
1928-65: Maximum discharge, 2,070 cfs Sept. 1, 1942 (gage height, 15.31 ft), from rating curve extended above 960 cfs; no flow at times in some years.

Remarks.--Records good except those for period of ice effect, which are poor.

Cooperation.--This station is maintained by the United States under agreement with Canada.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Aug. 21-26, Sept. 21-30)

Oct. 1 to Nov. 20		Nov. 21 to Sept. 30			
3.3	32	2.6	3.6	4.0	86
3.5	48	2.7	5.2	5.0	146
4.0	84	2.8	7.4	7.0	277
5.0	143	3.0	14	9.0	472
7.0	255	3.2	26	11.0	779
8.0	328	3.5	51	13.0	1,240

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	278	39	4.1	1.8	1.1	1.4	3.1	184	153	162	52	14
2	297	41	4.0	1.8	1.0	1.4	4.0	192	158	424	49	12
3	287	41	3.6	1.8	1.1	1.4	6.0	204	281	584	44	10
4	266	43	3.3	1.8	1.1	1.4	10	187	283	610	37	31
5	247	39	3.1	1.9	1.1	1.4	15	320	241	598	30	111
6	220	36	2.9	1.9	1.1	1.5	20	903	299	458	28	101
7	202	37	2.8	1.9	1.2	1.5	30	1,100	444	330	26	97
8	189	33	2.8	1.9	1.2	1.6	50	1,060	406	254	22	81
9	169	33	2.8	1.9	1.2	1.7	80	839	344	192	18	72
10	153	35	2.8	1.8	1.2	1.7	150	768	288	149	15	66
11	141	38	2.8	1.8	1.2	1.8	250	688	245	118	13	59
12	131	44	2.7	1.7	1.3	1.8	450	581	203	134	12	54
13	120	47	2.6	1.7	1.3	1.8	* 830	490	171	187	12	49
14	109	45	2.5	1.6	1.3	1.8	1,090	414	145	162	11	51
15	98	45	2.5	1.6	1.3	1.8	1,200	353	123	132	9.4	83
16	90	45	2.4	1.6	1.3	1.8	1,060	306	104	114	8.2	87
17	83	37	2.3	1.5	1.3	1.8	* 912	276	91	153	11	109
18	74	32	2.2	1.5	1.3	1.8	771	269	78	250	8.8	120
19	67	25	2.1	1.5	1.4	1.8	626	258	68	221	7.7	105
20	64	15	2.0	1.4	1.5	1.8	519	236	66	172	6.2	89
21	61	10	2.0	1.4	1.5	1.8	477	234	66	* 145	4.8	76
22	56	7.0	1.9	1.4	1.4	1.8	428	234	73	128	4.5	73
23	53	5.0	1.8	1.4	1.4	1.8	371	214	70	111	4.0	120
24	50	*3.7	1.8	1.4	* 1.2	1.9	339	213	63	91	3.9	148
25	48	5.0	1.8	* 1.4	1.1	1.9	309	*232	55	77	4.6	148
26	46	4.4	1.8	1.3	1.1	2.0	283	218	50	62	* 4.8	141
27	45	4.1	1.8	1.3	1.2	2.0	256	204	87	53	6.9	120
28	* 46	4.2	1.8	1.2	1.4	2.1	238	199	262	44	12	111
29	42	4.2	* 1.8	1.1		2.2	* 216	190	* 182	39	10	* 110
30	39	4.3	1.8	1.1	----------	2.4	198	182	153	43	12	198
31	38	----------	1.8	1.1	----------	2.7	----------	168	----------	50	13	----------
Total	3,809	801.9	76.4	48.5	34.8	55.6	11,191.1	11,916	5,252	6,247	500.8	2,646
Mean	123	26.7	2.46	1.56	1.24	1.79	373	384	175	202	16.2	88.2
Ac-ft	7,560	1,590	152	96	69	110	22,200	23,640	10,420	12,390	993	5,250

Calendar year 1964: Max 445 Min 0.1 Mean 54.3 Ac-ft 39,400
Water year 1964-65: Max 1,200 Min 1.0 Mean 117 Ac-ft 84,470

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 17 to Apr. 13.

5-1065. Roseau River at Roseau Lake, Minn.

Location.--Lat 48°54'22", long 95°49'55", in SW¼SW¼ sec.28, T.163 N., R.40 W., on upstream bridge piling on left bank at Roseau Lake, 3½ miles upstream from Pine Creek, 3¾ miles downstream from Sprague Creek, and 7 miles northwest of Roseau.

Records available.--November 1939 to September 1965 (incomplete).

Gage.--Staff gage read once daily. Datum of gage is 1,018.59 ft above mean sea level, adjustment of 1928 by Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Extremes.--Maximum elevation during year, 1,035.83 ft Apr. 20, 21; minimum observed, 1,020.95 ft Aug. 23.
1939-65: Maximum elevation observed, 1,036.86 ft May 13, 1950; minimum observed, 1,019.75 ft Aug. 16, 1941.

Elevation, in feet, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	28.30						23.03	33.95	29.45	25.93	22.21	21.47
2	28.64						23.03	33.75	29.19	26.87	22.13	21.47
3	28.68						23.05	33.55	29.13	27.65	22.03	21.41
4	28.62						23.05	33.35	29.09	27.79	21.85	21.53
5	28.62						23.09	33.15	29.09	27.71	21.75	22.63
6	28.60						23.15	33.21	29.11	27.53	22.35	23.05
7	28.58						23.19	33.35	29.49	27.33	22.17	23.03
8	28.50						23.25	33.51	29.77	26.95	21.89	22.85
9	28.40						23.43	33.55	29.93	26.45	21.65	22.63
10	28.22						24.53	33.59	29.99	25.85	21.55	22.55
11	28.00						30.09	33.55	29.99	25.29	21.31	22.41
12	27.78						31.67	33.53	29.93	24.85	21.23	22.29
13	27.52						32.47	33.43	29.75	25.05	21.15	22.27
14	27.16						33.17	33.37	29.53	25.55	21.11	22.25
15	26.80						34.05	33.27	29.23	25.69	21.07	22.83
16	26.44						34.65	33.07	28.93	25.41	21.15	23.25
17	26.12						35.05	32.87	28.53	25.19	21.29	23.73
18	25.84						35.43	32.69	28.09	25.67	21.27	24.27
19	25.44						35.77	32.51	27.57	25.93	21.19	24.41
20	25.12						35.83	32.33	26.97	25.73	21.09	24.23
21	24.82						35.83	32.15	26.35	25.85	21.03	23.97
22	24.56						35.67	31.95	25.77	25.85	21.03	23.71
23	24.34						35.55	31.71	25.33	25.63	20.95	23.91
24	24.16						35.45	31.42	24.81	25.01	21.09	24.33
25	23.94						35.35	31.25	24.35	24.33	21.19	24.71
26	23.64						35.15	31.01	23.87	23.65	21.25	25.01
27	23.34						35.01	30.79	23.77	23.09	21.33	25.05
28	23.02						34.65	30.51	24.69	22.65	21.39	24.95
29	23.02						34.35	30.23	26.37	22.35	21.41	24.85
30	23.00						34.15	29.99	26.31	22.17	21.45	25.75
31	22.82						-----	29.73	-----	22.17	21.47	-----

Note.--Add 1,000.00 ft to obtain elevation above mean sea level.

5-1075. Roseau River at Ross, Minn.

Location.--Lat 48°54'37", long 95°55'18", in SE¼ sec.27, T.163 N., R.41 W., on left bank 300 ft downstream from highway bridge, a quarter of a mile north of Ross, and 2.3 miles downstream from Pine Creek.

Drainage area.--1,220 sq mi, approximately.

Records available.--July 1928 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,018.44 ft above mean sea level, adjustment of 1928 by Geodetic Survey of Canada. Prior to Mar. 13, 1929, staff gage at same site and datum.

Average discharge.--37 years, 238 cfs (172,300 acre-ft per year).

Extremes.--Maximum discharge during year, 3,780 cfs Apr. 20 (gage height, 16.50 ft); minimum daily, 7.5 cfs Mar. 20-22.
1928-65: Maximum discharge, 6,560 cfs May 12, 1950 (gage height, 18.25 ft); no flow Aug. 29, 30, 1961. Maximum stage known, about 19 ft in 1896. Other outstanding floods reached the following stages (from information by local residents); flood of July 1919, 17.5 ft; flood of 1927, about 16 ft.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. High flow regulated by natural storage in Roseau Lake.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Apr. 16-23, June 18 to July 7, Aug. 4 to Sept. 3)

1.0	17	9.0	963
1.5	32	12.0	1,680
2.0	53	14.0	2,250
3.0	111	16.0	3,190
4.0	195	17.0	4,380
6.0	438		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	931	160	47	21	15	9.5	14	2,530	1,220	608	117	28
2	967	173	45	21	14	9.5	15	2,450	1,170	749	103	28
3	979	284	41	21	14	9.0	16	2,370	1,140	852	93	26
4	977	362	37	21	14	9.0	16	2,280	1,120	867	83	38
5	981	358	34	21	13	9.0	17	2,250	1,110	852	79	68
6	987	333	32	20	13	9.0	18	2,210	1,120	823	116	84
7	989	300	31	20	13	9.0	19	2,260	1,170	783	105	100
8	977	270	31	20	13	9.0	21	2,340	1,210	719	87	114
9	959	246	31	20	13	9.0	35	2,400	1,250	629	69	116
10	929	217	31	20	13	9.0	75	2,400	1,280	534	58	116
11	891	202	32	19	12	9.0	350	2,370	1,290	454	48	114
12	850	217	33	19	12	9.0	800	2,370	1,290	406	42	110
13	800	248	33	19	12	9.5	1,150	2,340	1,260	431	38	110
14	741	284	32	18	12	9.5	1,500	2,320	1,220	488	33	128
15	674	291	30	18	12	9.5	2,150	2,280	1,160	498	30	160
16	619	280	29	18	12	9.2	* 2,820	2,210	1,100	455	34	194
17	573	256	28	18	12	8.8	3,210	2,150	1,030	444	42	250
18	523	200	26	18	12	8.4	3,530	2,060	951	508	42	311
19	468	175	25	18	11	8.0	3,620	2,030	861	533	36	315
20	423	165	25	17	11	7.5	* 3,740	1,940	758	503	30	299
21	388	150	24	17	11	7.5	3,730	1,880	659	534	26	268
22	358	120	24	17	11	7.5	* 3,700	1,830	568	* 538	22	240
23	332	95	23	17	10	8.0	3,540	1,780	500	484	18	256
24	305	*78	23	16	10	8.0	3,380	1,720	432	399	16	311
25	279	65	23	16	*10	* 8.2	3,230	* 1,630	369	311	16	355
26	243	58	22	* 16	9.5	8.8	3,070	1,580	310	238	* 17	386
27	214	56	22	16	9.5	9.5	2,920	1,520	304	186	19	393
28	*195	53	* 22	16	9.5	10	* 2,790	1,470	*438	149	22	*382
29	186	52	22	15		12	2,690	1,400	624	121	25	367
30	184	51	22	15	----------	13	2,620	1,340	618	106	26	512
31	172	----------	22	15	----------	14	----------	1,280	----------	108	27	----------
Total	19,094	5,799	902	563	333.5	285.9	54,786	62,990	27,532	15,310	1,519	6,179
Mean	616	193	29.1	18.2	11.9	9.22	1,826	2,032	918	494	49.0	206
Ac-ft	37,870	11,500	1,790	1,120	661	567	108,700	124,900	54,610	30,370	3,010	12,260

Calendar year 1964: Max 1,760 Min 4.2 Mean 322 Ac-ft 234,100
Water year 1964-65: Max 3,740 Min 7.5 Mean 534 Ac-ft 387,400

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 15. No gage-height record Apr. 11, Sept. 4-15.

5-1080. Roseau River near Badger, Minn.

Location.--Lat 48°54'42", long 96°00'24", in SW¼ sec.30, T.163 N., R.41 W., on right bank 100 ft upstream from highway bridge and 9 miles north of Badger.

Records available.--August 1928 to September 1965 (incomplete).

Gage.--Water-stage recorder. Datum of gage is 1,016.90 ft above mean sea level, adjustment of 1928 by Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Extremes.--Maximum elevation during year, 1,031.73 ft Apr. 22; minimum recorded, 1,018.06 ft Aug. 25.
1928-65: Maximum elevation, 1,032.65 ft May 13, 1950; minimum recorded, 1,017.42 ft Aug. 30, 1961.

Mean elevation, in feet, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	25.60	20.76						30.60	26.78	24.03	20.10	18.39
2	25.73	20.83						30.41	26.60	24.68	20.05	18.39
3	25.81	21.77						30.22	26.50	25.16	19.91	18.37
4	25.81							30.02	26.43	25.28	19.75	18.68
5	25.82							29.98	26.38	25.23	19.65	20.21
6	25.83							29.95	26.41	25.12	20.18	20.96
7	25.84							29.90	26.57	25.00	20.25	20.93
8	25.81							30.00	26.67	24.74	19.90	20.78
9	25.74							30.12	26.81	24.34	19.54	20.54
10	25.63							30.15	26.89	23.88	19.28	20.42
11								30.05	26.93	23.40	19.07	20.28
12							28.01	30.07	26.94	23.01	18.92	20.12
13							28.69	29.99	26.85	23.06	18.77	20.06
14							29.32	29.95	26.74	23.39	18.67	20.01
15							30.11	29.88	26.55	23.51	18.56	20.55
16							30.64	29.74	26.33	23.30	18.51	21.08
17							31.07	29.59	26.06	23.16	18.73	21.54
18							31.36	29.39	25.71	23.43	18.79	22.05
19							31.51	29.29	25.33	23.66	18.72	22.15
20							31.64	29.10	24.90	23.55	18.59	22.03
21							31.69	28.94	24.42	23.63	18.45	21.94
22							31.72	28.78	23.92	23.73	18.32	21.56
23							31.67	28.60	23.47	23.50	18.22	21.60
24							31.59	28.41	22.98	22.99	18.10	22.06
25							31.49	28.10	22.49	22.37	18.08	22.40
26							31.36	27.94	22.01	21.86	18.09	22.63
27							31.21	27.77	21.95	21.15	18.11	22.70
28	21.16						31.04	27.57	22.76	20.70	18.17	22.64
29	21.03						30.89	27.36	23.88	20.35	18.27	22.55
30	21.00						30.76	27.17	24.01	20.10	18.33	23.25
31	20.88							26.96		20.08	18.36	

Note.--Add 1,000 ft to obtain elevation above mean sea level.

GPO 826-476-5

5-1095. Roseau River near Haug, Minn.

Location.--Lat 48°55'28", long 96°12'26", in SE¼ sec.21,T.163 N., R.43 W., on left bank 250 ft downstream from abandoned highway bridge, 5 miles south of international boundary, and 8¼ miles northwest of Haug.

Records available.--April 1932 to September 1965 (incomplete).

Gage.--Water-stage recorder. Datum of gage is 1,014.02 ft above mean sea level, adjustment of 1928 by Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Extremes.--Maximum elevation during year, 1,023.96 ft about May 2, from floodmark; minimum recorded, 1,015.35 ft Aug. 26.
1932-65: Maximum elevation, 1,024.64 ft May 15, 1950; minimum recorded, 1,014.74 ft Aug. 8, 1933.

Mean elevation, in feet, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	21.12								23.06	20.91	17.65	15.58
2	21.22								23.02	21.34	17.57	15.57
3	21.32								22.98	21.57	17.44	15.56
4	21.39								22.91	21.69	17.30	15.80
5	21.41								22.84	21.75	17.20	16.62
6	21.44								22.82	21.76	17.13	17.40
7	21.46							23.83	22.78	21.76	17.17	17.52
8	21.47							23.81	22.76	21.69	16.92	17.44
9	21.47							23.81	22.75	21.58	16.60	17.28
10	21.45							23.83	22.75	21.36	16.33	17.11
11	21.40							23.81	22.75	21.01	16.16	16.97
12	21.32						22.10	23.82	22.74	20.69	16.03	16.82
13	21.20						22.53	23.80	22.73	20.45	15.95	16.73
14	21.04						22.97	23.77	22.72	20.38	15.92	16.73
15	20.84						23.17	23.74	22.68	20.42		16.95
16	20.58						23.31	23.71	22.63	20.42		17.42
17	20.37						23.42	23.70	22.57	20.27		
18	20.13						23.50	23.67	22.47	20.22		
19	19.87						23.59	23.65	22.36	20.36		
20	19.57							23.61	22.22	20.43		
21	19.29							23.57	22.02	20.41		
22	19.07							23.54	21.75	20.48		
23	18.86							23.51	21.39	20.45		
24	18.69							23.48	20.91	20.20		
25	18.50							23.43	20.31	19.77		
26	18.31							23.39	19.69	19.22	15.35	
27	18.05							23.34	19.89	18.70	15.39	
28	17.86							23.30	20.03	18.27	15.39	18.95
29	17.69							23.24	20.39	17.95	15.45	
30	17.64							23.19	20.70	17.76	15.55	
31								23.13		17.69	15.58	

Note.--Add 1,000 ft to obtain elevation above mean sea level.

5-1120. Roseau River below State ditch 51, near Caribou, Minn.

(International gaging station)

Location.--Lat 48°58'54", long 96°27'46", in SE¼SW¼ sec.34, T.164 N., R.45 W., on left bank 400 ft downstream from State ditch 51 (known locally as Caribou cutoff ditch) and 0.6 mile west of Caribou.

Drainage area.--1,570 sq mi, approximately.

Records available.--April to October 1917, April 1920 to September 1965 (some winter records incomplete). Published as "at Caribou", prior to April 1929; as "below Cutoff ditch, near Caribou" April 1929 to September 1936. Records published for both sites April 1929 to September 1930. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,002.14 ft above mean sea level, adjustment of 1928, by Geodetic Survey of Canada. Prior to Apr. 1, 1929, chain gage at site at Caribou 0.6 mile upstream at datum 0.95 ft lower.

Average discharge.--15 years (1920-30, 1932-33, 1936-37, 1940-43), 298 cfs (215,700 acre-ft per year).

Extremes.--Maximum discharge during year, 2,690 cfs May 6 (gage height, 9.64 ft); minimum daily discharge recorded, 11 cfs Mar. 25-29.
1917, 1920-65: Maximum discharge, 4,080 cfs May 19, 1950 (gage height, 11.81 ft); no flow Aug. 13, 1936. Flood of 1916 is reported to have reached a stage of about 15.5 ft at former site.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Occasionally, at high stages, there is some natural diversion of flow above station to headwaters of Two Rivers. Station not operated during winter period.

Cooperation.--This station is maintained by the United States under agreement with Canada.

Rating table, water year 1964-65, except period of ice effect
(gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1-6, Sept. 28-30)

2.0	36	6.0	980
2.5	102	7.0	1,350
3.0	192	8.0	1,780
4.0	413	9.7	2,730

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	830						12	2,520	1,880	970	333	90
2	840						12	2,530	1,860	1,130	315	86
3	868						13	2,490	1,860	1,130	293	110
4	886						15	2,450	1,830	1,120	267	150
5	896						16	2,530	1,780	1,110	246	230
6	902						17	2,680	1,750	1,100	244	260
7	912						18	2,660	1,740	1,120	241	250
8	915						20	2,590	1,720	1,100	222	240
9	918						21	2,530	1,660	1,080	179	210
10	915						45	2,510	1,620	1,050	140	200
11	915						140	2,450	1,580	980	118	190
12	902						500	2,410	1,550	918	104	180
13	883						1,120	2,390	1,520	861	91	180
14	855						1,370	2,360	1,500	818	80	180
15	815						1,470	2,340	1,470	809	73	240
16	754						1,480	2,310	1,450	812	70	280
17	705						1,560	2,290	1,420	784	64	330
18	656						1,660	2,290	1,380	757	68	360
19	613						*1,760	2,260	1,350	766	72	370
20	557						1,860	2,240	1,320	793	73	360
21	512						1,990	2,220	1,270	793	72	340
22	486						*2,120	2,190	1,220	*799	66	320
23	456						2,240	2,170	1,130	806	59	330
24	418						2,350	*2,160	1,020	769	56	370
25	394					*11	2,420	2,160	877	705	*54	400
26	360					11	2,470	2,130	736	616	52	410
27	*321					11	2,500	2,100	824	531	56	420
28	280					11	*2,510	2,050	*840	453	60	*430
29	250					11	2,520	2,010	830	394	70	446
30	225				----------	12	2,530	1,970	871	363	90	453
31	210	----------			----------	12	----------	1,920	----------	340	90	----------
Total	20,449						36,759	71,910	41,858	25,777	4,018	8,415
Mean	660						1,225	2,320	1,395	832	130	280
Ac-ft	40,560						72,910	142,600	83,020	51,130	7,970	16,690

Calendar year 1964: Max Min Mean Ac-ft
Water year 1964-65 Max Min Mean Ac-ft

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Mar. 25-Apr. 14. No gage-height record Oct. 28-31, Mar. 31, Apr. 1, Aug. 26 to Sept. 27.

5-1125. Roseau River at international boundary, near Caribou, Minn.

Location.--Lat 48°59'57", long 96°30'20", near center of sec.29, T.164 N., R.45 W., on left bank 400 ft upstream from international boundary crossing and 3 miles northwest of Caribou.

Drainage area.-- 1,590 sq mi, approximately.

Records available.--May 1933 to September 1965 (incomplete).

Gage.--Water-stage recorder. Datum of gage is 1,002.59 ft above mean sea level, adjustment of 1928, by Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Extremes.--Maximum elevation during year, 1,007.09 ft May 6; minimum recorded, 1,002.44 ft Apr. 9.
1933-65: Maximum elevation recorded, 1,007.43 ft Apr. 14, 1960; minimum recorded, 1,001.97 ft Aug. 14, 1933.

Mean elevation, in feet, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	5.41							7.04	6.94	5.60	4.13	3.45
2	5.42						2.48	7.04	6.84	5.94	4.08	3.44
3	5.48						2.48	7.04	6.84	5.94	4.02	3.43
4	5.51						2.48	7.04	6.79	5.92	3.95	3.51
5	5.52						2.47	7.04	6.79	5.89	3.93	3.68
6	5.53						2.47	7.09	6.79	5.89	3.94	3.92
7	5.56						2.47	7.08	6.79	5.90	3.94	4.03
8	5.56						2.46	7.06	6.74	5.89	3.89	3.99
9	5.56						2.45	7.05	6.71	5.84	3.78	3.94
10	5.55						2.51	7.04	6.65	5.78	3.69	3.89
11	5.53						2.96	7.04	6.62	5.64	3.63	3.84
12	5.51						5.68	7.04	6.59	5.49	3.58	3.82
13	5.44						6.67	7.04	6.54	5.35	3.53	3.75
14	5.35						6.82	7.04	6.51	5.25	3.49	3.75
15	5.29						6.59	7.03	6.48	5.23	3.45	3.79
16	5.14						6.53	7.02	6.45	5.24	3.44	3.92
17	5.00						6.59	7.02	6.42	5.19	3.44	4.06
18	4.90						6.68	7.01	6.37	5.12	3.47	4.17
19	4.77						6.76	6.99	6.34	5.14	3.48	4.27
20	4.61						6.83	6.99	6.27	5.20	3.47	4.30
21	4.50						6.87	6.97	6.20	5.21	3.44	4.29
22	4.41						6.94	6.96	6.12	5.22	3.41	4.24
23	4.32						6.97	6.95	5.99	5.23	3.39	4.16
24	4.27						7.01	6.95	5.78	5.17	3.36	4.19
25	4.19						7.03	6.94	5.43	5.02	3.36	4.29
26	4.12						7.04	6.94	5.09	4.79	3.35	4.36
27	4.06						7.04	6.94	5.28	4.55	3.36	4.44
28	3.96						7.04	6.94	5.33	4.39	3.36	4.46
29							7.06	6.94	5.27	4.24	3.41	4.47
30							7.04	6.94	5.36	4.19	3.44	4.49
31								6.94		4.14	3.45	

Note.--Add 1,000.00 ft to obtain elevation above mean sea level.

5-1255. Stony River near Isabella, Minn.

Location.--Lat 47°41'10", long 91°38'20", in NW¼NW¼ sec.17, T.60 N., R.10 W., on left bank 275 ft downstream from Slate Lake and bridge on State Highway 1, 11 miles upstream from Birch Lake, and 12¾ miles northwest of Isabella.

Drainage area.--180 sq mi.

Records available.--October 1952 to December 1964 (discontinued). Prior to October 1958, published as Stoney River near Isabella.

Gage.--Water-stage recorder. Datum of gage is 1,632.45 ft above mean sea level, datum of 1929.

Average discharge.--12 years, (1952-64), 127 cfs.

Extremes.--Maximum discharge during period, 226 cfs Oct. 1 (gage height, 8.22 ft); minimum, 37 cfs Dec. 31 (gage height, 7.59 ft).
1952-65: Maximum discharge, 2,040 cfs Apr. 27, 1957 (gage height, 10.60 ft); minimum, 5.6 cfs Aug. 22, 1961 (gage height, 7.32 ft).

Remarks.--Records good.

Rating table, period October to December 1964 (gage height, in feet, and discharge, in cubic feet per second)

7.6	28
7.7	47
7.9	97
8.1	171
8.5	377

Discharge, in cubic feet per second, October to December 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	*207	78	45									
2	216	75	45									
3	216	75	45									
4	207	72	43									
5	198	70	41									
6	189	67	41	(*)								
7	189	67	39									
8	171	65	39									
9	159	65	39									
10	151	65	39									
11	147	65	41									
12	147	65	41									
13	139	63	41									
14	128	63	41									
15	121	58	43									
16	114	54	43									
17	104	54	43									
18	97	54	43									
19	92	49	41									
20	92	47	41									
21	92	47	41									
22	86	45	41									
23	86	45	41									
24	86	*45	41									
25	83	45	41									
26	83	47	41									
27	83	47	41									
28	86	47	41									
29	83	47	41									
30	80	45	41		---							
31	*78	---	41		---		---		---			---
Total	4,010	1,731	1,285									
Mean	129	57.7	41.5									
Cfsm	0.717	0.321	0.231									
In.	0.83	0.36	0.27									

Calendar year 1964: Max 1,120 Min 12 Mean 150 Cfsm 0.833 In. 11.33
Water year 1964-65: Max - Min - Mean - Cfsm - In. -

* Discharge measurement made on this day.

5-1270. Kawishiwi River near Winton, Minn.

Location.--Lat 47°56'05", long 91°45'50", in NE¼NW¼ sec.20, T.63 N., R.11 W., at powerplant of Minnesota Power & Light Co., just upstream from Fall Lake, and 1.8 miles east of Winton.

Drainage area.--1,200 sq mi, approximately.

Records available.--June 1905 to June 1907, October 1912 to September 1919 (fragmentary), September 1923 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Average discharge.--46 years (1905-6, 1915-17, 1918-19, 1923-65), 956 cfs (unadjusted).

Extremes.--Maximum daily discharge during year, 5,800 cfs May 10; no flow Jan. 31.
1905-07, 1912-19, 1923-65: Maximum daily discharge, 16,000 cfs May 18, 1950; no flow at times.

Remarks.--Records good. Daily discharge computed from powerplant records. Flow regulated by powerplant and by Camp Six, Bald Eagle, Gabbro, Little Gabbro, Birch, White Iron, South Farm, Farm, and Garden Lakes.

Cooperation.--Records collected by Minnesota Power & Light Co., under general supervision of Geological Survey, in connection with a Federal Power Commission project.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	859	649	377	312	298	297	396	2,980	4,120	1,060	406	282
2	1,020	681	248	172	140	277	396	3,090	3,140	1,680	655	250
3	1,020	681	312	204	237	374	364	3,600	2,740	1,650	558	273
4	1,050	681	249	266	204	374	364	3,870	2,740	1,750	591	282
5	1,050	714	281	266	153	374	364	4,670	2,800	1,680	623	250
6	988	681	175	234	282	374	396	5,030	2,880	1,310	623	282
7	924	679	268	266	218	374	427	5,320	2,820	1,280	591	250
8	891	679	236	266	218	465	363	5,590	2,780	1,250	439	375
9	891	681	203	234	218	488	298	5,760	2,750	1,140	558	343
10	924	656	203	172	315	552	363	5,800	2,810	1,160	558	375
11	956	647	268	266	250	550	492	5,760	2,620	1,160	494	565
12	956	704	203	266	218	531	362	5,720	2,640	1,120	526	628
13	956	712	97	234	250	404	394	5,440	2,550	1,200	480	605
14	924	712	236	266	250	404	394	5,250	2,250	1,000	329	593
15	891	647	261	234	185	476	426	5,280	1,860	988	194	771
16	891	679	332	266	250	431	426	5,140	1,650	988	314	586
17	859	583	203	172	250	464	459	5,050	1,060	1,020	378	617
18	891	712	203	201	250	528	491	5,020	1,140	1,120	346	585
19	827	648	268	266	218	496	603	5,080	1,240	912	314	585
20	794	528	203	248	250	464	811	4,890	2,040	960	314	624
21	811	561	203	234	250	313	889	5,070	1,940	863	249	773
22	*778	528	236	234	185	464	915	5,530	2,190	935	97	1,020
23	778	496	299	107	218	464	1,220	5,500	1,990	799	281	1,120
24	778	496	234	223	249	335	1,380	5,450	1,640	668	317	1,280
25	746	496	299	266	249	464	1,430	5,490	1,500	683	281	1,180
26	746	496	172	234	184	399	1,930	5,460	1,430	603	281	1,180
27	746	501	269	234	249	431	1,910	*5,070	1,490	623	545	1,180
28	746	496	298	266	249	345	2,120	4,900	1,440	526	494	1,150
29	746	496	320	266		367	2,470	4,670	1,500	623	281	992
30	681	484	344	266	----------	367	2,810	4,440	1,280	655	281	1,670
31	746	----------	344	0	----------	364	----------	4,660	----------	526	250	----------
Total	26,864	18,404	7,844	7,141	6,487	13,010	25,663	154,580	65,030	31,932	12,648	20,666
Mean	867	613	253	230	232	420	855	4,986	2,168	1,030	408	689
(≠)	-128	-204	+24	-18	-28	-240	+210	+200	+200	-10	-1	+30
Mean≠	739	409	277	212	204	180	1,065	5,186	2,368	1,020	407	719
Cfsm≠	0.616	0.341	0.231	0.177	0.170	0.150	0.888	4.32	1.97	0.850	0.339	0.599
In.≠	0.71	0.38	0.27	0.20	0.18	0.17	0.99	4.98	2.20	0.98	0.39	0.67

Calendar year 1964: Max 5,330 Min 65 Mean 1,003 Mean≠ 1,005 Cfsm≠ 0.838 In.≠ 11.40
Water year 1964-65: Max 5,800 Min 0 Mean 1,069 Mean≠ 1,072 Cfsm≠ 0.893 In.≠ 12.12

* Discharge measurement made on this day.
≠ Change in contents, equivalent in cubic feet per second, in Camp Six, Bald Eagle, Gabbro, Little Gabbro, Birch, White Iron, South Farm, Farm, and Garden Lakes.
≠ Adjusted for change in reservoir contents.

5-1275. Basswood River near Winton, Minn.

(International gaging station)

Location.--Lat 48°04'55", long 91°39'10", in sec.30, T.65 N., R.10 W., on Jackfish Bay of Basswood Lake, used to determine discharge at outlet (lat 48°06', long 91°39', in sec.19, T.65 N., R.10 W., on international boundary 14 miles northeast of Winton).

Drainage area.--1,740 sq mi, approximately (above outlet of Basswood Lake).

Records available.--March to June 1924, September 1925 to March 1928, January 1930 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,299.80 ft above mean sea level, adjustment of 1928, by Geodetic Survey of Canada. Prior to June 2, 1938, staff gages at several sites on Jackfish Bay, at same datum. June 2 to Oct. 27, 1938, staff gage at Williams Island half a mile northeast of present gage at same datum.

Average discharge.--37 years (1925-27, 1930-65), 1,299 cfs.

Extremes.--Maximum discharge during year, 6,140 cfs May 25 (gage height, 3.53 ft); minimum, 392 cfs Feb. 28 (gage height, -0.28 ft).
1924, 1925-27, 1930-65: Maximum discharge, 15,600 cfs May 24, 1950 (gage height, 6.94 ft); minimum, 73 cfs Dec. 5, 1948.

Remarks.--Records excellent. Flow affected by storage on Kawishiwi River.

Cooperation.--This station is maintained by the United States under agreement with Canada.

Rating table, water year 1964-65 (gage height, in feet, and discharge, in cubic feet per second)

-0.30	380	0.5	1,060
-0.20	442	1.0	1,640
-0.10	507	2.0	3,160
0	580	3.0	5,040
.2	760	4.0	7,190

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	*1,070	960	810	490	417	405	588	2,220	5,730	2,430	1,190	684
2	1,080	950	780	488	411	417	597	2,430	5,520	2,430	1,170	665
3	1,090	950	760	485	411	417	597	2,620	5,300	2,410	1,150	648
4	1,100	930	741	485	405	423	597	2,840	5,040	2,430	1,120	640
5	1,120	930	712	483	411	423	597	3,040	4,880	2,390	1,080	622
6	1,070	920	712	483	411	430	* 597	3,290	4,740	2,360	1,130	614
7	1,090	920	694	480	405	430	665	3,560	4,580	2,280	1,130	622
8	1,070	910	665	478	405	430	675	3,790	4,450	2,240	1,080	640
9	1,060	950	648	473	399	436	675	4,010	4,370	2,160	1,050	665
10	1,060	960	631	467	417	442	675	4,260	4,260	2,100	1,030	675
11	1,060	960	640	464	423	468	732	4,450	4,130	2,030	1,000	684
12	1,060	1,000	622	464	430	474	750	4,640	4,050	2,000	1,010	656
13	1,060	1,010	606	464	430	494	760	4,800	3,920	2,040	990	648
14	1,060	1,030	588	462	430	507	790	4,940	3,810	2,000	960	656
15	1,060	1,010	580	462	430	507	830	5,180	3,650	1,970	940	712
16	1,060	1,010	580	*462	423	522	850	5,380	3,450	1,960	910	741
17	1,050	990	573	455	423	529	870	5,500	3,250	1,930	870	790
18	1,050	980	558	448	423	551	900	5,610	3,060	1,880	850	820
19	1,050	960	544	442	423	565	930	5,650	2,920	1,850	810	840
20	1,050	950	529	442	423	573	960	5,690	2,870	1,810	780	850
21	1,060	940	529	442	417	573	1,020	5,860	2,770	1,750	741	880
22	1,060	930	525	442	411	573	1,100	5,920	2,820	1,710	703	910
23	1,050	910	523	442	411	573	1,200	5,940	2,850	1,640	675	940
24	1,030	910	520	442	411	573	1,280	6,010	2,820	1,590	648	960
25	1,010	880	515	442	411	573	1,380	6,070	2,750	1,560	631	970
26	1,010	860	508	436	405	573	1,480	*6,070	2,630	1,500	640	980
27	1,010	860	500	436	405	573	1,620	6,070	2,570	*1,420	760	990
28	990	840	495	430	399	573	1,760	6,050	2,540	1,360	722	1,000
29	980	810	492	423		580	1,890	6,010	2,520	1,320	712	1,030
30	960	810	490	423	---------	580	2,060	5,920	2,440	1,280	712	1,250
31	960	----------	490	417	---------	588	----------	5,840	----------	1,240	703	----------
Total	32,490	28,030	18,560	14,152	11,620	15,775	29,425	149,660	110,690	59,070	27,897	23,782
Mean	1,048	934	599	457	415	509	981	4,828	3,690	1,905	900	792
Cfsm	0.602	0.537	0.344	0.263	0.238	0.293	0.564	2.77	2.12	1.09	0.517	0.455
In.	0.69	0.60	0.40	0.30	0.25	0.34	0.63	3.20	2.37	1.26	0.60	0.51

Calendar year 1964: Max 4,600 Min 261 Mean 1,248 Cfsm 0.717 In. 9.76
Water year 1964-65: Max 6,070 Min 399 Mean 1,428 Cfsm 0.821 In. 11.15

* Discharge measurement made on this day.
Note.--No gage-height record Dec. 22 to Jan. 15.

5-1280. Namakan River at outlet of Lac la Croix, Ontario

(International gaging station)

Location.--Lat 48°21'20", long 92°12'50", at Campbell's Camp, 2½ miles west of outlet of Lac la Croix.

Drainage area.--5,165 sq mi.

Records available.--September 1921 to January 1922, April 1922 to September 1965, in reports of Geological Survey. Monthly discharge only for some periods, published in WSP 1308. August 1921 to September 1965 in reports of Water Resources Branch, Department of Northern Affairs and National Resources, Canada.

Gage.--Water-stage recorder. Gage readings have been reduced to elevations above mean sea level, United States and Canada Boundary Survey datum. Prior to October 1933, staff gages at various sites on Lac la Croix. October 1933 to March 13, 1963, staff gage at present site and datum.

Average discharge.--43 years (1922-65), 3,558 cfs.

Extremes.--Maximum discharge during year, 14,900 cfs June 2 (elevation, 1,189.11 ft); minimum, 1,730 cfs Mar. 15 (elevation, 1,182.92 ft).
1921-65: Maximum discharge, 28,200 cfs May 31 to June 2, 1950 (elevation, 1,193.30 ft); minimum, 535 cfs at times in February, March and April 1924 (elevation, 1,181.50 ft).

Remarks.--Records good.

Cooperation.--This station is maintained by Canada under agreement with the United States.

Rating table, water year 1964-65 (gage height, in feet, and discharge, in cubic feet per second)

1,182.5	1,280	1,186.0	6,980
1,183.0	1,820	1,188.0	11,900
1,184.0	3,130	1,190.0	17,400

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3,680	3,790	2,990	2,490	1,990	1,820	1,840	4,620	14,800	8,480	4,530	2,530
2	3,680	3,830	2,960	2,480	1,960	1,840	1,840	4,930	14,800	8,360	4,480	2,520
3	3,730	3,780	2,930	2,470	1,950	1,840	1,840	5,250	14,800	8,240	4,420	2,480
4	3,780	3,780	2,920	2,450	1,940	1,840	1,840	5,540	14,700	8,130	4,320	2,470
5	3,790	3,620	2,890	2,430	1,940	1,830	1,840	5,880	14,600	7,990	4,210	2,340
6	3,840	3,580	2,860	2,410	1,930	1,820	1,880	6,190	14,600	7,830	4,240	2,380
7	3,910	3,550	2,850	2,390	1,920	1,820	1,940	6,390	14,400	7,600	4,150	2,320
8	3,910	3,500	2,820	2,380	1,900	1,810	1,940	6,730	14,200	7,490	4,070	2,300
9	3,930	3,470	2,810	2,360	1,890	1,800	1,950	7,100	14,000	7,260	3,960	2,270
10	3,950	3,440	2,790	2,350	1,920	1,790	1,960	7,390	13,900	7,100	3,880	2,220
11	3,960	3,410	2,780	2,340	1,900	1,780	2,050	7,650	13,500	6,960	3,780	2,230
12	3,960	3,410	2,770	2,320	1,900	1,760	2,060	7,900	13,300	6,890	3,740	2,240
13	3,980	3,420	2,740	2,310	1,900	1,760	2,070	8,180	13,100	6,820	3,680	2,230
14	4,000	3,410	2,710	2,300	1,900	1,750	2,110	8,450	12,800	6,730	3,540	2,310
15	4,000	3,410	2,700	2,270	1,890	1,750	2,170	8,950	12,500	6,570	3,470	2,410
16	4,020	3,280	2,700	2,260	1,890	1,760	2,220	9,460	12,100	6,500	3,410	2,450
17	4,000	3,260	2,680	2,240	1,870	1,780	2,240	9,910	11,800	6,390	3,310	2,450
18	3,910	3,250	2,670	2,230	1,870	1,780	2,300	10,300	11,500	6,260	3,280	*2,470
19	3,910	3,240	2,650	2,220	1,880	1,800	2,350	10,800	11,300	6,150	3,220	2,480
20	4,000	3,220	2,640	2,210	1,870	1,790	2,440	11,300	11,000	6,010	3,140	2,490
21	4,030	3,190	2,630	2,190	1,870	1,780	2,560	11,600	10,700	5,860	3,090	2,540
22	4,030	3,160	2,610	2,130	1,840	1,780	2,700	12,100	10,500	5,730	3,020	2,580
23	4,020	3,130	2,600	2,130	1,830	1,780	2,850	12,600	10,200	5,570	2,950	2,650
24	4,000	3,130	2,580	2,110	1,830	1,780	3,030	13,100	9,940	5,380	2,880	2,680
25	3,980	3,120	2,570	2,100	1,820	1,780	3,220	13,400	9,680	5,250	2,850	2,740
26	3,960	3,090	2,560	2,070	1,820	1,770	3,420	13,700	9,460	5,130	2,790	2,790
27	3,930	3,060	2,540	2,070	1,820	1,780	3,650	13,900	9,210	4,990	2,810	2,860
28	3,880	3,030	2,540	2,060	1,810	1,780	3,880	14,200	8,970	4,870	2,740	2,910
29	3,860	3,020	2,530	2,050		1,800	4,100	14,400	8,880	4,810	2,710	3,000
30	3,840	2,990	2,520	2,010	---	1,800	4,370	14,500	8,610	4,740	2,670	3,190
31	3,810	---	2,500	2,000	---	1,820	---	14,700	---	4,620	2,600	---
Total	121,280	100,570	84,040	69,830	52,850	55,570	74,660	301,120	363,850	200,710	107,940	75,530
Mean	3,910	3,350	2,710	2,250	1,890	1,790	2,490	9,710	12,100	6,470	3,480	2,520
Cfsm	0.76	0.65	0.52	0.44	0.37	0.35	0.48	1.88	2.34	1.25	0.67	0.49
In.	0.87	0.72	0.61	0.50	0.38	0.40	0.54	2.17	2.62	1.45	0.78	0.54

Calendar year 1964: Max 12,100 Min 918 Mean 4,128 Cfsm 0.799 In. 10.87
Water year 1964-65: Max 14,800 Min 1,750 Mean 4,410 Cfsm 0.854 In. 11.58

* Discharge measurement made on this day.

5-1282. Vermilion Lake near Soudan, Minn.

Location.--Lat 47°49'52", long 92°16'20", in SW¼SE¼ sec.20, T.62 N., R.15 W., on south shore of Vermilion Lake, at McKinley Park, 2 miles northwest of Soudan.

Records available.--October 1913 to July 1915, July 1941 to November 1942, June 1946 to September 1965 (fragmentary during 1947).

Gage.--Water-stage recorder. Datum of gage is 1,355.10 ft above mean sea level, datum of 1929. October 1913 to July 1915, staff gage 2 miles southwest of present gage at Tower, at datum about 0.5 ft lower. July 1941 to November 1942 and June 1946 to June 1951, staff gage approximately 13 miles northwest at Vermilion Dam near Tower, at same datum. All gage readings have been reduced to elevations above mean sea level, datum of 1929.

Extremes.--Maximum elevation during year, 1,358.78 ft May 21 (affected by wind action); maximum daily, 1,358.71 ft May 27; minimum, 1,356.93 ft Sept. 4 (affected by wind action).
1913-15, 1941-42, 1946-65: Maximum elevation observed, 1,359.52 ft May 16, 1950; minimum observed, 1,356.02 ft Jan. 29, 1942.
Elevation on June 6, 1913, was 1,359.94 ft (determined from reference point set by local observers).

Mean daily elevation, in feet, October 1964 to September 1965

Oct. 31.....1,357.10	Feb. 22.....1,357.02	June 30.....1,358.00
Nov. 30.....1,357.05	Mar. 31.....1,357.06	July 31.....1,357.49
Dec. 31.....1,357.08	Apr. 30.....1,358.18	Aug. 31.....1,357.10
Jan. 31.....1,357.01	May 31.....1,358.58	Sept.30.....1,357.44

Note.--Elevations other than those shown above are available.

5-1285. Pike River near Embarrass, Minn.

Location.--Lat 47°39'36", long 92°18'54", in NE¼NW¼ sec.25, T.60 N., R.16 W., on left bank 75 ft below bridge on County Road 373, 5.4 miles west of Embarrass, and 8.5 miles downstream from Sandy River.

Drainage area.--115 sq mi.

Records available.--October 1953 to December 1964 (discontinued).

Gage.--Water-stage recorder. Datum of gage is 1,410.27 ft above mean sea level, datum of 1929.

Average discharge.--11 years, (1953-64), 74.8 cfs.

Extremes.--Maximum discharge during period, 154 cfs Oct. 4 (gage height, 5.30 ft); minimum daily, 10 cfs Dec. 21-25, 28-31; minimum gage height, 3.57 ft Dec. 10.
1953-65: Maximum discharge, 1,750 cfs Apr. 17, 1954 (gage height, 10.28 ft); minimum daily, 0.4 cfs Jan. 29 to Feb. 3, 1963; minimum gage height, 3.08 ft Aug. 25-28, 1961.
Flood in May 1950 reached a stage of approximately 11.3 ft, from information by local residents (discharge, 2,400 cfs).

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, October to December 1964, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.4	10	4.5	77
3.5	14	5.0	119
4.0	41	6.0	221

Discharge, in cubic feet per second, October to December 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	109	34	15									
2	129	33	15									
3	148	33	15									
4	152	33	14									
5	*141	31	13									
6	128	30	13									
7	115	28	13	(*)								
8	106	28	13									
9	95	27	13									
10	87	28	12									
11	83	31	12									
12	83	41	12									
13	81	46	12									
14	78	48	12									
15	74	48	11									
16	69	48	11									
17	64	44	11									
18	59	36	11									
19	57	34	11									
20	54	30	11									
21	54	27	10									
22	52	24	10									
23	49	21	10									
24	47	20	10									
25	45	19	10									
26	44	19	11									
27	42	19	11									
28	41	19	10									
29	38	17	10									
30	36	16	10		---							
31	*35	---	10		---		---		---			---
Total	2,395	912	362									
Mean	77.3	30.4	11.7									
Cfsm	0.672	0.264	0.102									
In.	0.77	0.29	0.12									

Calendar year 1964: Max 708 Min 3.4 Mean 78.0 Cfsm 0.678 In. 9.23
Water year 1964-65: Max - Min - Mean - Cfsm - In. -

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Dec. 31.

5-1290. Vermilion River below Vermilion Lake, near Tower, Minn.

Location.--Lat 47°57'41", long 92°28'33", in SE¼SW¼ sec.2, T.63 N., R.17 W., on left bank 200 ft downstream from dam at outlet of Vermilion Lake, 4.4 miles upstream from Twomile Creek, and 14.2 miles northwest of Tower.

Drainage area.--483 sq mi.

Records available.--May 1911 to September 1917, June 1928 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,350.36 ft above mean sea level, datum of 1929. May 17, 1911, to Sept. 30, 1917, and July 9, 1931, to Apr. 11, 1939, staff gage at same site and datum. June 26, 1928, to July 8, 1931, staff gage at datum 0.05 ft higher.

Average discharge.--43 years, 299 cfs.

Extremes.--Maximum discharge during year, 1,420 cfs May 25 (gage height, 3.40 ft); minimum, 56 cfs Feb. 28, Sept. 5; minimum gage height, 0.19 ft Feb. 28.
1911-17, 1928-65: Maximum discharge, 2,710 cfs May 23, 1950 (gage height, 4.68 ft); no flow Oct. 25-29, 1955, caused by temporary storage behind new concrete dam at outlet of Vermilion Lake.

Remarks.--Records good.

Rating table, water year 1964-65 (gage height, in feet, and discharge, in cubic feet per second)

0.1	45	2.0	534
.5	88	3.0	1,100
1.0	176	4.0	2,000
1.5	312		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	198	*138	110	118	87	90	117	789	1,120	644	262	113
2	178	*140	108	115	87	105	117	822	1,100	594	268	127
3	186	136	106	117	87	103	115	844	1,080	609	268	106
4	180	129	105	115	87	103	113	880	1,060	594	265	124
5	176	136	105	110	88	102	110	904	1,040	584	255	82
6	184	129	106	110	88	102	117	929	1,060	574	294	105
7	*194	131	103	106	88	102	131	916	1,060	524	277	94
8	172	125	*106	105	88	98	131	910	1,020	524	268	100
9	180	125	106	105	88	97	131	916	985	480	255	91
10	186	134	105	105	97	97	129	923	979	470	255	78
11	186	136	113	103	100	96	144	923	960	466	246	85
12	174	127	112	105	97	96	151	*910	941	484	232	103
13	182	134	110	102	98	96	155	916	935	489	241	97
14	184	144	108	100	97	96	161	910	910	470	212	108
15	180	131	108	*100	94	97	168	979	868	462	205	133
16	176	122	118	102	96	98	178	1,040	838	466	205	148
17	166	102	117	97	94	98	190	1,090	806	480	188	144
18	155	108	118	96	94	113	205	1,080	794	475	186	146
19	157	113	113	94	94	113	224	1,090	778	466	170	146
20	166	108	113	94	94	115	255	1,170	772	439	163	148
21	146	106	113	94	90	113	291	1,150	762	416	153	161
22	153	115	112	90	88	113	335	1,190	767	*385	146	170
23	155	106	113	88	88	113	403	1,220	729	372	140	172
24	153	108	118	91	*88	112	462	1,230	734	343	138	180
25	148	105	118	91	85	110	529	1,270	724	324	142	165
26	149	100	117	91	85	*108	584	1,210	724	312	138	170
27	151	106	115	92	84	108	629	1,160	694	284	125	180
28	134	112	113	91	78	108	674	1,160	654	277	124	*172
29	148	112	120	91		110	719	1,160	639	277	129	186
30	142	110	118	90	---	108	762	1,130	*629	288	131	224
31	138	---	118	90	---	113	---	1,130	---	274	124	---
Total	5,177	3,628	3,465	3,098	2,529	3,233	8,430	31,951	26,162	13,846	6,205	4,058
Mean	167	121	112	99.9	90.3	104	281	1,031	872	447	200	135
Cfsm	0.346	0.251	0.232	0.207	0.187	0.215	0.582	2.13	1.81	0.925	0.414	0.280
In.	0.40	0.28	0.27	0.24	0.19	0.25	0.65	2.46	2.02	1.07	0.48	0.31

Calendar year 1964: Max 960 Min 55 Mean 268 Cfsm 0.555 In. 7.55
Water year 1964-65: Max 1,270 Min 78 Mean 306 Cfsm 0.634 In. 8.62

* Discharge measurement made on this day.

5-1294. Rainy Lake at Fort Frances, Ontario

(International gaging station)

Location.--Lat 48°37'15", long 93°21'20", on Government dock at Pither's Point in town of Fort Frances.

Records available.--January 1910 to September 1917 and October 1934 to September 1965 in reports of Geological Survey. August 1911 to September 1965 in reports of Water Resources Branch, Department of Northern Affairs and National Resources, Canada. Prior to October 1949, published as "at Ranier, Minn."

Gage.--Water-stage recorder. Auxiliary staff gages read once daily. Datum of gage is at mean sea level (United States and Canadian Boundary Survey). Prior to Jan. 1, 1950, staff gage 3 miles northeast of Ranier, Minn., at same datum. Supplementary gage in town pumping station, half a mile south, used during winter months.

Extremes.--Maximum elevation during year, 1,108.47 ft Oct. 1; minimum, 1,104.91 ft Apr. 10.
1910-17, 1934-65: Maximum elevation observed, 1,112.97 ft July 5, 1950; minimum observed, 1,101.26 ft Apr. 17, 1923, Apr. 2, 1930.

Cooperation.--This station is maintained by Canada under agreement with the United States.

Month-end elevation, in feet, water year October 1964 to September 1965

Oct. 31 ..... 8.06	Feb. 28 ..... 5.87	June 30 ..... 8.00
Nov. 30 ..... 8.11	Mar. 31 ..... 5.09	July 31 ..... 8.00
Dec. 31 ..... 7.57	Apr. 30 ..... 5.99	Aug. 31 ..... 7.65
Jan. 31 ..... 6.66	May 31 ..... 8.01	Sept.30 ..... 7.71

Note.--Add 1,100 ft to obtain elevation above mean sea level. Elevations other than those shown are available.

5-1305. Sturgeon River near Chisholm, Minn.

Location.--Lat 47°40'25", long 92°54'00", in NE¼NW¼ sec.20, T.60 N., R.20 W., on left bank 1,000 ft upstream from highway bridge, 0.6 mile downstream from East Branch Sturgeon River, and 11½ miles north of Chisholm.

Drainage area.--187 sq mi.

Records available.--August 1942 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,306.7 ft above mean sea level, datum of 1929. Prior to Aug. 24, 1944, staff gage at site 1,000 ft downstream at different datum.

Average discharge.--23 years, 116 cfs.

Extremes.--Maximum discharge during year, 1,110 cfs April 21 (gage height, 3.98 ft); minimum daily, 12 cfs several days; minimum gage height, 0.42 ft April 4.
1942-65: Maximum discharge, 3,630 cfs May 7, 1950 (gage height, 6.41 ft) from rating curve extended above 1,600 cfs on basis of slope-area measurement of peak flow; minimum dialy, 6.0 cfs Feb. 18-27, 1944; minimum gage height, 0.08 ft Jan. 28 to Feb. 1, 1963.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

0.3	14	2.0	225
.6	26	2.5	383
.9	44	3.0	585
1.2	72	4.0	1,120
1.6	134		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	132	*74	42	30	20	18	12	505	257	67	25	23
2	136	75	40	30	20	18	13	488	246	80	26	22
3	138	75	39	29	20	18	13	473	246	72	35	21
4	138	76	38	29	20	18	14	446	254	67	35	19
5	134	78	37	29	20	18	15	412	268	61	33	21
6	126	78	36	29	19	17	16	397	314	54	50	21
7	119	78	35	29	19	17	17	*376	348	50	52	26
8	*113	76	34	29	19	17	19	362	366	46	47	25
9	107	75	*33	28	18	17	23	348	355	45	41	25
10	103	75	33	27	18	17	27	334	314	41	36	24
11	101	85	33	26	18	17	35	314	268	38	34	22
12	101	92	32	26	18	17	70	283	228	37	31	30
13	103	98	32	26	18	17	115	266	200	44	28	41
14	101	98	31	26	18	16	205	248	176	41	26	52
15	100	98	31	25	18	16	350	297	158	38	22	97
16	97	97	31	26	18	16	*461	423	144	37	24	100
17	94	95	31	26	18	15	585	465	132	40	28	101
18	92	91	30	26	18	15	814	513	119	40	28	104
19	94	79	29	* 26	*18	15	928	496	115	36	25	104
20	92	72	29	26	18	14	1,030	476	126	32	24	103
21	89	66	29	26	18	13	1,080	449	136	31	22	100
22	88	62	29	25	18	13	1,100	423	132	30	21	121
23	85	60	28	25	18	12	1,030	415	121	28	20	124
24	84	58	28	25	18	12	918	408	107	26	20	126
25	81	55	28	24	18	12	819	408	97	22	19	119
26	80	50	28	23	18	*12	718	390	86	*23	19	110
27	79	48	28	22	18	12	653	369	79	22	20	*106
28	78	46	28	21	18	12	604	352	75	20	20	95
29	78	45	29	21		12	567	331	*69	19	19	94
30	76	43	29	21		12	530	304	65	20	21	257
31	75		30	20		12		274		25	*24	
Total	3,114	2,198	990	801	517	467	12,781	12,045	5,601	1,232	875	2,233
Mean	100	73.3	31.9	25.8	18.5	15.1	426	389	187	39.7	28.2	74.4
Cfsm	0.535	0.392	0.171	0.138	0.099	0.081	2.28	2.08	1.00	0.212	0.151	0.398
In.	0.62	0.44	0.20	0.16	0.10	0.09	2.54	2.40	1.11	0.25	0.17	0.44

Calendar year 1964: Max 1,210 Min 14 Mean 114 Cfsm 0.610 In. 8.28
Water year 1964-65: Max 1,100 Min 12 Mean 117 Cfsm 0.626 In. 8.52

Peak discharge (base, 500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-21	2100	3.98	1,110	5-18	1300	3.87	526

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 15 (no gage-height record Jan. 18).

5-1315. Little Fork River at Little Fork, Minn.

Location.--Lat 48°24', long 93°34', in NW¼ sec.9, T.68 N., R.25 W., on left bank 100 ft downstream from bridge on State Highway 65 at town of Little Fork and 1½ miles upstream from Beaver Creek, and 18 miles upstream from mouth.

Drainage area.--1,730 sq mi, approximately.

Records available.--June to November 1909, April to November 1910, April 1911 to June 1917, September 1917, October 1917 to March 1919 (gage heights only), June 1928 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,073.06 ft above mean sea level, datum of 1929. June 23, 1909, to Mar. 4, 1917, staff gage at same site and datum. Mar. 5 to Sept. 30, 1917, June 22, 1928, to June 21, 1936, chain gage and June 22, 1936, to July 20, 1937, wire-weight gage, at site 100 ft upstream at same datum.

Average discharge.--42 years (1911-16, 1928-65), 970 cfs.

Extremes.--Maximum discharge during year, 11,400 cfs Apr. 22 (gage height, 25.05 ft, backwater from ice); maximum gage height, 29.81 ft Apr. 21 (backwater from ice); minimum daily discharge, 68 cfs Feb. 28 to Mar. 5; minimum gage height, 5.64 ft Aug. 26.
1909-17, 1928-65: Maximum discharge, 25,000 cfs Apr. 18, 1916, May 11, 1950 (gage height, 37.00 ft); minimum observed, 21 cfs Aug. 26, 27, 1936.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used June 17 to July 3, Aug. 23 to Sept. 14)

5.5	170	12.0	2,600
6.0	265	16.0	4,820
7.0	528	20.0	7,530
9.0	1,200	24.0	10,800

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,060	369	300	154	80	68	100	5,180	2,650	616	369	185
2	1,060	362	284	152	80	68	110	4,940	2,450	597	466	187
3	1,030	359	272	150	80	68	110	4,900	2,340	1,090	469	192
4	982	*354	264	148	*78	68	120	4,810	2,290	1,140	481	209
5	947	352	258	145	78	68	130	4,540	2,320	1,050	597	203
6	861	342	255	*145	78	70	140	4,320	2,440	904	588	196
7	828	339	252	142	75	70	150	4,050	2,830	743	1,230	189
8	800	334	250	140	75	70	175	3,740	3,390	628	1,830	*187
9	758	334	250	135	75	70	220	3,440	3,480	552	1,940	203
10	718	332	245	130	75	72	300	3,180	3,180	495	1,150	203
11	681	352	242	128	75	75	500	2,990	2,810	443	894	203
12	650	393	240	125	75	75	900	2,890	2,470	412	718	211
13	604	454	235	120	75	80	1,400	2,730	2,160	415	591	216
14	576	516	*230	115	75	80	2,000	2,520	1,910	416	498	250
15	558	552	225	110	75	82	3,000	3,050	1,690	534	423	418
16	540	564	220	110	75	82	4,500	4,600	1,500	576	354	709
17	522	558	215	105	75	82	5,500	5,310	1,330	604	315	1,100
18	510	531	210	105	75	80	6,500	6,230	1,090	693	280	1,310
19	486	465	205	102	75	80	8,000	5,700	920	819	269	1,340
20	472	400	200	100	73	80	*9,100	5,120	868	897	259	1,300
21	466	430	195	98	73	80	10,300	4,740	878	822	267	1,210
22	460	410	194	95	73	80	10,800	4,840	891	734	254	1,240
23	446	400	190	95	73	*80	*9,850	4,480	914	641	224	1,690
24	440	410	184	92	73	80	9,010	4,200	858	558	196	1,940
25	434	420	180	90	70	82	8,350	4,280	*777	486	180	2,030
26	426	400	176	90	70	82	7,570	4,090	715	426	184	1,960
27	415	370	172	85	68	85	6,880	3,720	662	372	267	1,750
28	407	350	168	85	68	85	6,360	3,430	659	334	209	1,540
29	393	330	164	85		90	*5,860	3,210	650	*301	216	1,380
30	380	310	162	80	---	95	5,480	3,050	622	294	203	1,720
31	372	---	158	80	---	98	---	2,870	---	301	189	---
Total	19,282	12,092	6,795	3,536	2,090	2,425	123,415	128,150	51,744	18,893	16,110	25,471
Mean	622	403	219	114	74.6	78.2	4,114	4,134	1,725	609	520	849
Cfsm	0.360	0.233	0.127	0.066	0.043	0.045	2.38	2.39	0.997	0.352	0.301	0.491
In.	0.41	0.26	0.15	0.08	0.04	0.05	2.65	2.75	1.11	0.41	0.35	0.55

Calendar year 1964: Max 11,300 Min 74 Mean 1,095 Cfsm 0.632 In. 8.61
Water year 1964-65: Max 10,800 Min 68 Mean 1,122 Cfsm 0.649 In. 8.81

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 22.

5-1320. Big Fork River at Big Falls, Minn.

Location.--Lat 48°12', long 93°48', in sec.35, T.155 N., R.25 W., on left bank at village of Big Falls, 700 ft downstream from falls, 0.3 mile downstream from bridge on U.S. Highway 71, and 4¾ miles upstream from Sturgeon River.

Drainage area.--1,460 sq mi, approximately.

Records available.--August to November 1909, April to November 1910, April 1911 to September 1912 (gage heights and discharge measurements only), June 1928 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,144.71 ft above mean sea level, datum of 1929. Prior to June 10, 1911, staff gage at railroad bridge about 0.4 mile upstream at different datum. June 10, 1911, to Dec. 17, 1937, staff gage or chain gage at site 200 ft upstream at same datum.

Average discharge.--37 years (1928-1965), 637 cfs.

Extremes.--Maximum discharge during year, 7,510 cfs Apr. 21 (gage height, 10.85 ft); minimum daily, 78 cfs Mar. 23, 24; minimum gage height, 2.85 ft Aug. 16 (result of regulation).
1909-12, 1928-65: Maximum discharge, 14,800 cfs May 8, 9, 1950; maximum gage height, 17.08 ft May 8, 1950; minimum discharge recorded, 7 cfs Aug. 7, 1939.

Remarks.--Records good except those for period of ice effect, which are fair. Some diurnal fluctuation at low flow caused by powerplant a quarter of a mile upstream.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.0	134	6.0	2,190
3.5	349	7.0	3,180
4.0	635	9.0	5,380
5.0	1,340	10.0	6,540

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	616	354	232	158	102	84	90	2,460	2,020	552	265	265
2	602	354	230	158	100	84	92	2,390	1,890	540	243	261
3	576	360	225	158	98	85	96	2,400	1,860	540	235	*248
4	558	*369	222	156	*97	86	98	2,350	1,880	509	239	239
5	546	374	217	156	97	88	98	2,270	1,880	492	239	243
6	540	374	210	*155	95	88	100	2,260	1,960	463	284	239
7	521	384	210	155	95	90	105	2,240	2,290	436	441	235
8	498	384	207	152	95	90	110	2,170	2,620	404	558	231
9	475	384	205	148	93	92	115	2,060	2,650	379	521	231
10	458	384	203	143	93	92	120	2,140	2,420	359	452	231
11	436	399	200	140	92	94	130	2,260	2,220	344	399	227
12	426	452	200	140	92	94	160	2,350	1,970	302	349	227
13	410	469	197	135	90	94	350	2,260	1,710	354	311	227
14	404	498	194	132	90	94	500	2,100	1,490	452	279	239
15	404	515	*190	130	90	94	800	2,780	1,320	546	256	293
16	399	509	188	130	90	92	1,100	4,780	1,170	583	231	307
17	389	480	185	127	88	88	1,800	5,750	1,070	583	239	452
18	379	475	183	125	88	85	2,500	5,560	977	590	239	503
19	374	360	180	123	88	83	3,700	4,880	907	564	243	527
20	374	350	180	123	88	82	*5,100	4,000	886	515	239	540
21	379	305	177	123	87	80	5,890	3,610	886	463	206	540
22	384	290	175	122	86	79	4,910	3,430	872	431	193	590
23	384	280	172	122	84	*78	4,250	3,130	817	394	193	758
24	384	275	170	120	82	78	3,860	3,010	*746	364	189	942
25	384	272	170	120	82	80	3,560	3,010	680	335	176	1,030
26	380	265	165	117	82	80	3,290	2,880	622	311	180	1,030
27	375	252	162	115	83	82	3,100	2,660	583	284	193	963
28	370	245	160	110	83	84	2,880	2,560	590	256	193	893
29	365	238	160	108		86	*2,730	2,460	583	*243	218	851
30	360	235	160	105	---------	86	2,580	2,310	583	248	261	991
31	358	----------	160	102	---------	88	----------	2,150	----------	270	270	----------
Total	13,508	10,885	5,889	4,108	2,530	2,680	54,214	90,670	42,152	13,106	8,534	14,553
Mean	436	363	190	133	90.4	86.5	1,807	2,925	1,405	423	275	485
Cfsm	0.299	0.249	0.130	0.091	0.062	0.059	1.24	2.00	0.962	0.290	0.188	0.332
In.	0.34	0.28	0.15	0.10	0.06	0.07	1.38	2.31	1.07	0.33	0.22	0.37

Calendar year 1964: Max 4,750 Min 62 Mean 555 Cfsm 0.380 In. 5.18
Water year 1964-65: Max 5,890 Min 78 Mean 720 Cfsm 0.493 In. 6.68

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 20. No gage-height record Oct. 26 to Nov. 3.

5-1335. Rainy River at Manitou Rapids, Minn.

(International gaging station)

Location.--Lat 48°38'04", long 93°54'47", in sec.36, T.160 N., R.26 W., on left bank at Manitou Rapids, 3½ miles east of Manitou Post Office and 4 miles west of Indus.

Drainage area.--19,400 sq mi, approximately.

Records available.--July 1928 to September 1965. Monthly discharge only for some periods, published in WSP 1308. October 1911 to October 1924 (gage heights only) at site near Birchdale in files of Corps of Engineers. Published as "near Birchdale" 1932-34.

Gage.--Water-stage recorder. Datum of gage is 1,062.48 ft above mean sea level, datum of 1929. Prior to Nov. 10, 1934, chain gage at site near Birchdale 7 miles downstream at different datum.

Average discharge.--37 years, 12,000 cfs.

Extremes.--Maximum discharge during year, 37,900 cfs June 10 (gage height, 13.92 ft); minimum, 3,800 cfs Sept. 7 (gage height, 1.74 ft).
1928-65: Maximum discharge, 71,600 cfs May 12, 1950 (gage height, 21.04 ft); minimum daily, 928 cfs Dec. 26, 1929.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Diurnal fluctuation caused by powerplant at International Falls. Some regulation at low and medium flows by Rainy and Namakan Lakes.

Cooperation.--This station is maintained by the United States under agreement with Canada.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.5	3,520	7.0	14,700
2.0	4,130	10.0	23,300
3.0	5,620	12.0	30,000
4.0	7,500	14.0	38,300
5.0	9,660		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	22,800	15,000	13,000	12,300	10,300	10,300	11,000	24,600	32,100	19,100	11,500	9,660
2	24,900	15,000	13,000	12,400	10,400	10,200	10,900	24,300	31,500	19,200	10,700	10,200
3	25,900	*15,000	12,900	12,600	10,200	9,800	10,800	24,500	31,700	19,100	11,300	10,100
4	26,000	15,100	12,900	12,700	10,100	9,700	10,700	24,400	32,400	18,600	11,700	10,100
5	25,600	15,000	12,800	12,600	*9,900	9,700	10,700	22,500	34,000	18,400	11,700	9,410
6	23,800	13,800	12,900	12,300	10,000	9,900	10,800	21,300	34,800	18,600	11,700	5,520
7	22,600	13,600	12,900	12,000	10,500	10,200	11,000	21,200	35,600	18,700	11,800	4,120
8	22,300	13,200	13,000	11,900	10,700	10,100	11,300	20,900	36,700	18,600	12,500	7,480
9	22,100	13,300	13,000	12,000	10,400	9,800	11,700	20,400	37,800	18,300	12,400	9,320
10	21,900	13,800	13,100	12,200	10,100	9,600	12,100	19,900	37,500	18,200	12,600	9,800
11	21,600	12,800	13,100	12,200	10,000	9,700	12,200	19,800	36,400	18,000	12,300	9,730
12	21,200	12,000	13,100	12,300	10,200	10,100	12,400	19,900	35,200	17,600	12,000	8,970
13	18,500	12,100	13,000	12,300	10,400	10,300	12,700	19,600	34,000	17,800	11,700	5,720
14	16,500	12,200	12,900	12,400	10,600	10,400	13,200	18,900	33,000	18,000	11,500	8,750
15	15,900	12,100	12,800	12,400	10,600	10,400	14,200	19,100	32,300	17,900	10,900	11,000
16	15,800	12,000	12,700	12,500	10,600	10,400	16,000	21,300	31,600	15,900	7,520	11,200
17	15,800	12,100	12,700	12,600	10,500	10,300	19,200	24,500	30,800	15,100	9,870	12,100
18	15,500	12,400	12,700	12,800	10,400	9,600	21,500	26,900	29,000	14,800	10,600	13,600
19	15,300	12,000	12,700	12,200	10,400	9,000	24,500	27,500	26,200	14,200	10,900	14,000
20	15,400	11,100	12,600	10,800	10,400	9,900	*28,400	26,600	25,200	14,800	11,100	13,400
21	15,500	11,000	12,600	10,500	10,500	10,800	31,000	27,500	24,600	15,100	11,100	13,800
22	15,500	11,700	12,600	10,400	10,600	11,000	33,800	27,200	24,400	15,000	10,400	14,200
23	15,500	11,500	12,700	10,500	10,700	10,800	33,200	26,700	24,300	14,900	7,240	15,000
24	15,400	11,300	12,600	10,700	10,600	10,600	28,500	26,800	24,300	14,600	7,780	15,800
25	15,400	12,000	12,400	10,400	10,500	10,500	26,300	31,100	24,200	14,300	10,200	16,300
26	15,500	12,800	12,300	10,100	10,400	10,600	25,200	32,400	23,900	13,700	10,600	16,600
27	15,000	13,200	12,400	10,000	10,400	10,700	24,700	33,700	23,600	12,700	11,000	16,500
28	14,800	13,600	12,500	10,000	10,400	10,800	25,500	33,900	23,300	12,200	10,800	15,700
29	15,000	13,400	12,600	10,100		10,800	25,400	33,500	20,600	*11,900	10,000	15,300
30	15,000	13,000	12,600	10,300	---------	10,900	*25,100	32,900	19,500	11,800	6,000	15,900
31	15,000	---------	12,500	10,200	---------	11,000	---------	32,500	---------	11,700	8,530	---------
Total	577,000	387,100	395,600	358,700	290,800	317,900	564,000	786,300	890,500	498,800	329,940	349,280
Mean	18,610	12,900	12,760	11,570	10,390	10,250	18,800	25,360	29,680	16,090	10,640	11,640
Cfsm	0.959	0.665	0.658	0.596	0.536	0.528	0.969	1.31	1.53	0.829	0.548	0.600
In.	1.11	0.74	0.76	0.69	0.56	0.61	1.08	1.51	1.71	0.96	0.63	0.67

Calendar year 1964: Max 47,500 Min 4,940 Mean 16,610 Cfsm 0.856 In. 11.66
Water year 1964-65: Max 37,800 Min 4,120 Mean 15,740 Cfsm 0.811 In. 11.03

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Mar. 31. No gage-height record Apr. 1-19, June 20, 21.

5-1342. Rapid River near Baudette, Minn.

Location.--Lat 48°32'10", long 94°33'45", in NE¼ sec.1, T.158 N., R.31 W., on left bank 20 ft upstream from bridge on State Highway 72, 1.2 miles downstream from North Branch Rapid River, and 12 miles south of Baudette.

Drainage area.--543 sq mi.

Records available.--October 1956 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,093.92 ft above mean sea level, datum of 1929 (Minnesota Highway Department bench mark).

Average discharge.--9 years, 297 cfs.

Extremes.--Maximum discharge during year, 4,580 cfs Apr. 16 (gage height, 14.90 ft); maximum gage height, 16.12 ft Apr. 15 (backwater from ice); minimum daily discharge, 2.5 cfs Jan. 30 to Feb. 3; minimum gage height, 1.99 ft Aug. 25.
1956-65: Maximum discharge, 5,750 cfs May 24, 1962 (gage height, 17.13 ft); minimum, 0.1 cfs Aug. 13, 1961 (gage height, 1.18 ft).

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair, and those for periods of shifting control, which are poor.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

2.0	23	5.0	648
2.3	47	6.0	944
2.6	80	9.0	1,920
3.0	139	12.0	3,020
3.5	240	15.0	4,330
4.0	368		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,850	294	85	23	2.5	3.8	7.3	*1,150	968	430	143	215
2	1,940	272	80	22	2.5	4.0	7.8	1,100	1,030	494	125	192
3	1,950	*257	75	20	2.5	4.1	10	1,270	1,450	555	125	170
4	1,920	242	72	19	2.6	4.2	17	1,270	1,680	550	144	152
5	1,810	231	70	*17	*2.6	4.3	21	1,360	1,700	455	129	134
6	1,670	211	68	16	2.7	4.8	26	1,500	1,870	344	114	137
7	1,510	200	68	14	2.7	5.4	35	1,440	2,080	302	106	159
8	1,390	188	66	13	2.8	5.8	80	1,290	2,340	238	106	*198
9	1,340	176	66	11	2.8	6.2	150	1,220	2,290	211	100	192
10	1,320	165	66	10	2.9	6.4	350	1,430	1,930	182	91	180
11	1,300	165	64	9.0	2.9	6.4	600	1,710	1,620	172	82	153
12	1,260	209	62	8.0	3.0	6.5	1,100	1,580	1,360	425	73	152
13	1,110	279	62	7.4	3.0	6.6	1,750	1,400	1,140	962	63	209
14	1,020	323	60	6.8	3.0	6.6	2,500	1,220	956	1,270	54	310
15	953	346	56	6.2	3.1	6.6	3,150	1,380	845	1,220	46	747
16	887	328	52	5.6	3.1	6.5	3,550	1,750	744	1,110	42	1,000
17	824	282	50	5.2	3.1	6.4	3,880	1,680	671	1,170	41	1,110
18	758	238	46	5.0	3.2	6.4	3,640	1,590	499	1,010	42	1,190
19	703	185	43	4.8	3.2	6.3	3,360	1,460	446	818	44	1,150
20	660	160	41	4.6	3.3	6.2	*2,850	*1,350	438	634	43	1,030
21	616	135	39	4.3	3.2	6.2	2,410	1,340	417	561	37	914
22	573	120	37	3.9	3.2	6.2	1,950	1,330	392	488	30	893
23	544	115	35	3.6	3.2	6.3	1,740	1,320	368	398	27	1,140
24	513	110	33	3.4	3.2	*6.3	*1,570	1,240	*349	323	24	1,350
25	480	108	32	3.1	3.3	6.3	1,480	1,220	336	286	31	1,430
26	455	103	31	3.0	3.4	6.4	1,360	1,160	328	224	73	1,420
27	457	100	31	2.8	3.5	6.6	1,280	1,080	289	196	170	1,330
28	449	97	30	2.7	3.6	6.7	1,220	1,080	368	* 182	250	1,210
29	408	92	28	2.6		6.8	1,170	1,070	368	152	252	1,140
30	368	88	26	2.5	---------	7.0	1,140	1,040	363	137	238	1,330
31	328	----------	24	2.5	---------	7.1	----------	974	----------	150	235	----------
Total	31,366	5,819	1,598	262.0	84.1	185.4	42,404.1	41,004	29,635	15,649	3,080	20,937
Mean	1,012	194	51.5	8.45	3.00	5.98	1,413	1,323	988	505	99.4	698
Cfsm	1.86	0.357	0.095	0.016	0.0055	0.011	2.60	2.44	1.82	0.930	0.183	1.29
In.	2.15	0.40	0.11	0.02	0.006	0.01	2.90	2.81	2.03	1.07	0.21	1.43

Calendar year 1964: Max 3,370 Min 4.1 Mean 500 Cfsm 0.921 In. 12.54
Water year 1964-65: Max 3,880 Min 2.5 Mean 526 Cfsm 0.969 In. 13.15

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 16 (no gage-height record Dec. 26 to Jan. 4). Shifting-control method used Oct. 1 to Nov. 18, Apr. 17-23, Apr. 28 to May 14.

GPO 826-476-6

5-1395. Warroad River near Warroad, Minn.

Location.--Lat 48°52'00", long 95°21'20", in SE¼NE¼ sec.12, T.162 N., R.37 W., on upstream handrail of bridge near center of span, half a mile upstream from Bulldog Run and 2½ miles south of Warroad.

Drainage area.--110 sq mi, approximately.

Records available.--March 1946 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Chain gage read once daily. Datum of gage is 1,070.74 ft above mean sea level, datum of 1929 (levels by Stanley Johnson, consulting engineer and instructor at University of North Dakota).

Average discharge.--19 years, 38.2 cfs.

Extremes.--Maximum discharge during year, 1,780 cfs Apr. 15 (gage height, 9.95 ft); minimum, 0.2 cfs Aug. 27, 28.
1946-65: Maximum discharge, that of Apr. 15, 1965; no flow Mar. 28, 1947, Aug. 20-29, 1953, Sept. 11-16, 19-22, 1960, June 25 to Sept. 2, 1961.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 27 to Nov. 15, Apr. 13, 18-20, May 22 to Aug. 14, Sept. 10-30)

1.6	0.1	2.3	6.4	6.0	227
1.7	.3	2.6	13	7.0	355
1.8	.7	3.0	26	8.0	711
1.9	1.3	3.5	47	9.0	1,260
2.0	2.1	4.0	76	10.0	1,820
2.1	3.2	5.0	142		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	652	72	9.0	6.3	4.1	*4.4	4.3	131	95	41	8.2	1.7
2	430	103	8.8	6.3	4.1	4.5	4.7	122	96	54	9.0	1.5
3	400	134	8.6	6.2	4.0	4.6	5.2	118	106	55	8.0	1.3
4	364	133	8.4	6.2	4.0	4.6	5.8	122	148	59	7.2	1.4
5	336	117	8.3	6.2	4.0	4.6	6.3	133	171	49	6.2	1.5
6	301	110	8.1	6.0	4.0	4.7	6.7	155	174	42	5.5	2.1
7	274	98	8.0	5.8	4.0	4.7	7.5	245	188	30	6.2	2.6
8	214	82	8.0	5.6	4.0	4.7	9.5	248	224	24	9.0	3.1
9	197	77	7.9	5.4	4.0	4.8	20	215	255	21	17	3.3
10	177	76	7.9	5.3	4.0	4.8	55	212	245	20	13	4.0
11	143	71	7.8	5.1	4.1	4.8	140	219	214	20	9.0	3.2
12	124	100	7.6	5.0	4.2	4.8	*400	246	171	19	7.4	3.6
13	108	117	7.4	4.8	4.2	4.8	*759	221	136	30	5.0	3.3
14	95	103	7.3	4.7	4.3	4.8	868	196	108	41	4.3	4.5
15	84	89	7.2	4.6	4.4	4.8	1,530	175	79	36	3.5	7.0
16	73	70	7.1	4.5	4.5	4.6	1,290	174	58	26	2.7	12
17	68	54	7.0	4.4	4.6	4.4	1,010	176	56	21	2.5	18
18	59	42	7.0	4.4	4.6	4.2	862	175	55	19	2.6	22
19	51	34	6.8	4.4	4.6	4.0	701	172	50	18	2.2	26
20	46	27	6.7	4.4	4.6	3.9	*540	167	46	*19	1.6	24
21	44	24	6.7	4.5	4.5	3.7	461	163	36	18	1.4	20
22	42	22	6.6	4.6	4.5	3.6	400	153	34	16	1.3	16
23	38	19	6.6	4.6	4.4	3.5	*362	140	33	15	1.0	21
24	36	17	6.5	4.6	4.4	3.5	323	129	32	14	.9	36
25	38	*15	6.5	*4.5	4.3	3.5	288	*121	30	12	*.8	39
26	35	14	6.4	4.5	4.3	*3.5	262	119	26	9.4	.6	52
27	33	12	6.4	4.4	4.3	3.5	217	112	29	9.0	.2	48
28	*31	11	6.4	4.3	4.4	3.6	184	109	63	8.8	.2	*46
29	29	10	*6.4	4.2		3.7	*159	107	*52	8.4	1.1	44
30	30	9.2	6.4	4.2	---	3.8	140	108	45	7.2	1.2	49
31	55	---	6.3	4.2	---	4.0	---	101	---	7.6	1.5	---
Total	4,607	1,862.2	226.1	154.2	119.4	131.4	11,021.0	4,984	3,055	769.4	140.3	517.1
Mean	149	62.1	7.29	4.97	4.26	4.24	367	161	102	24.8	4.53	17.2
Cfsm	1.35	0.565	0.066	0.045	0.039	0.039	3.34	1.46	0.927	0.225	0.041	0.156
In.	1.56	0.63	0.08	0.05	0.04	0.04	3.73	1.69	1.03	0.26	0.05	0.02

Calendar year 1964: Max 775 Min 0.6 Mean 70.6 Cfsm 0.642 In. 8.73
Water year 1964-65 Max 1,530 Min 0.2 Mean 75.6 Cfsm 0.687 In. 9.18

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 16 to Apr. 12 (no gage-height record Jan. 15-24, Jan. 26 to Feb. 5, Feb. 23 to Mar. 4.

MISSISSIPPI RIVER MAIN STEM

5-2010. Winnibigoshish Lake near Deer River, Minn.

Location.--Lat 47°25'42", long 94°03'00", in sec.25, T.146 N., R.27 W., at dam on Mississippi River, 1 mile northwest of Little Winnibigoshish Lake and 14 miles northwest of town of Deer River.

Drainage area.--1,442 sq mi.

Records available.--April 1884 to September 1965. Prior to October 1941 month-end contents only, published in WSP 1308. Published as Winnibigoshish Reservoir near Deer River October 1941 to September 1956.

Gage.--Water-stage recorder. Datum of gage is 1,289.47 ft above mean sea level, adjustment of 1912. Prior to July 8, 1949, staff gage at same site and datum.

Extremes.--Maximum contents during year, 668,400 acre-ft July 14 (gage height, 11.35 ft); minimum, 406,600 acre-ft Feb. 24 (gage height, 7.58 ft).
1884-1965: Maximum contents observed, 996,500 acre-ft July 30, 1905 (gage height, 14.45 ft); minimum observed, 33,680 acre-ft below zero of capacity table Oct. 20, 1931 (gage height, -0.69 ft).

Remarks.--Reservoir is formed by Winnibigoshish Lake and several other natural lakes controlled by a concrete and timber dam, completed in 1884; storage began in 1884. Capacity between gage heights 6.00 ft and 14.2 ft (maximum allowable range) is 653,570 acre-ft, of which 416,270 acre-ft is controlled storage between gage heights 6.00 ft and 12.0 ft (normal operating range). Contents shown herein are contents above gage height 0.00 ft. Water is used to benefit navigation on Mississippi River below Minneapolis.

Cooperation.--Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Month-end gage height and contents, water year October 1964 to September 1965

	Gage height (feet)/	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	9.18	511,200	-
Oct. 31	8.84	487,900	-23,300
Nov. 30	8.48	466,100	-21,800
Dec. 31	8.17	444,300	-21,800
Calendar year 1964	-	-	-53,100
Jan. 31	7.85	424,500	-19,800
Feb. 28	7.62	410,600	-13,900
Mar. 31	8.03	436,400	+25,800
Apr. 30	8.94	495,900	+59,500
May 31	10.15	575,200	+79,300
June 30	11.05	642,600	+67,400
July 31	10.85	624,800	-17,800
Aug. 31	10.31	587,100	-37,700
Sept.30	10.12	573,200	-13,900
Water year 1964-65	-	-	+62,000

/ Gage height at 2400

5-2015. Mississippi River at Winnibigoshish Dam near Deer River, Minn.

Location.--Lat 47°25'42", long 94°03'00", in SW¼ sec.25, T.146 N., R.27 W., at dam 1 mile northwest of Little Winnibigoshish Lake and 14 miles northwest of town of Deer River.

Drainage area.--1,442 sq mi.

Records available.--May 1884 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder on headwater and staff gage on tailwater. Tailwater gage read twice daily. Datum of gage is 1,289.47 ft above mean sea level, adjustment of 1912. Prior to July 8, 1949, staff headwater gage at same site and datum.

Average discharge.--81 years, 499 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 1,250 cfs July 21, 22; minimum daily, 50 cfs July 14.
1884-65: Maximum daily discharge, 4,370 cfs Aug. 6, 1905; no flow at times in several years.

Remarks.--Daily discharge is computed on the basis of modified weir formula and corrected to conform with discharge measurements, the head being determined from readings of headwater and tailwater gages. Flow completely regulated by Winnibigoshish Lake (see preceding page).

Cooperation.--Computations of daily discharge furnished by Corps of Engineers; eight discharge measurements made and records reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	747	670	683	560	584	111	68	102	120	120	1,020	590
2	811	674	677	563	593	115	68	102	120	120	1,020	590
3	780	665	706	552	590	117	68	102	120	120	840	590
4	777	684	703	549	586	117	68	102	120	120	840	590
5	784	714	692	557	618	117	68	105	120	120	840	590
6	747	714	683	589	614	118	68	105	120	120	840	590
7	717	703	681	600	614	117	68	107	120	120	840	590
8	731	699	676	630	605	118	68	107	120	120	840	590
9	713	694	686	618	596	68	68	108	120	120	840	590
10	703	679	676	614	605	68	68	108	120	120	840	590
11	699	679	730	614	596	*68	68	110	120	120	840	590
12	703	703	723	609	593	68	68	110	120	120	840	590
13	699	714	719	608	592	68	68	115	120	100	840	590
14	694	668	719	603	581	68	68	115	120	50	840	590
15	690	692	705	597	581	68	68	117	120	175	835	590
16	688	714	715	590	575	68	68	119	120	360	835	*625
17	699	748	711	586	576	68	68	119	120	560	835	625
18	744	703	650	584	569	68	68	120	120	750	835	625
19	707	679	595	580	564	68	68	120	120	971	835	625
20	670	664	595	574	556	68	68	120	120	1,160	835	*763
21	690	683	592	568	561	68	68	120	120	1,250	835	750
22	662	633	588	607	549	68	68	120	120	*1,250	835	*951
23	662	616	585	602	545	68	68	120	120	1,170	835	775
24	702	664	588	598	540	68	68	120	120	1,020	835	760
25	694	705	585	598	389	68	68	120	120	1,020	835	750
26	690	701	585	613	237	68	68	120	120	1,020	835	750
27	687	699	592	603	108	68	68	120	120	1,020	835	750
28	713	701	588	600	108	68	*102	120	120	1,020	590	750
29	679	699	574	596		68	102	120	120	1,020	590	750
30	667	687	569	591	---	68	102	120	120	1,020	590	750
31	670	---	565	584	---	68	---	120	---	1,020	590	---
Total	22,019	20,648	20,136	18,337	14,825	2,494	2,142	3,533	3,600	17,396	25,335	19,849
Mean	710	688	650	592	529	80.5	71.4	114	120	561	817	662
Cfsm	0.492	0.477	0.451	0.411	0.367	0.056	0.050	0.079	0.083	0.389	0.567	0.459
In.	0.57	0.53	0.52	0.47	0.38	0.06	0.06	0.09	0.09	0.45	0.65	0.51

Calendar year 1964: Max 878 Min 101 Mean 442 Cfsm 0.307 In. 4.15
Water year 1964-65: Max 1,250 Min 50 Mean 467 Cfsm 0.324 In. 4.38

* Discharge measurement made on this day.

5-2060. Leech Lake at Federal Dam, Minn.

Location.--Lat 47°12'23", long 94°18'31", in lot 2, sec.14, T.143 N., R.29 W., at head of Leech Lake River on Waboose Bay, 5 miles southwest of town of Federal Dam.

Drainage area.--1,163 sq mi.

Records available.--April 1884 to September 1965. Month-end contents only for some periods, published in WSP 1308. Prior to October 1956, published as "Leech Lake Reservoir."

Gage.--Water-stage recorder. Datum of gage is 1,293.23 ft above mean sea level, adjustment of 1912. Prior to Dec. 31, 1884, staff gage half a mile north of outlet to Leech Lake River at datum 5.76 ft lower. Dec. 31, 1884, to May 24, 1931, staff gage half a mile north of outlet to Leech Lake River at present datum.

Extremes.--Maximum contents during year, 382,800 acre-ft June 20, 27 (gage height, 2.78 ft); minimum, 145,200 acre-ft Apr. 5 (gage height, 0.85 ft).
1884-1965: Maximum contents observed, 734,300 acre-ft June 30, 1916 (gage height, 5.18 ft); minimum observed, 72,830 acre-ft below zero of capacity table Sept. 30, Nov. 19, 1934, Jan. 9, 1935 (gage height, -1.18 ft).

Remarks.--Reservoir is formed by Leech Lake and several other natural lakes controlled by concrete and timber dam; storage began in 1884; original timber structure completed in 1884, replaced by present dam in 1902. Capacity between gage heights 0.00 ft and 5.24 ft (maximum allowable range) is 689,780 acre-ft, of which 356,570 acre-ft is controlled storage between gage heights 0.00 ft and 3.00 ft (normal operating range). Contents shown herein are contents above gage height -0.50 ft. Water is used to benefit navigation on Mississippi River below Minneapolis.

Cooperation.--Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Month-end gage height and contents, water year October 1964 to September 1965

	Gage height (feet)/	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	1.90	271,700	-
Oct. 31	1.54	226,100	-45,600
Nov. 30	1.43	212,200	-13,900
Dec. 31	1.35	202,300	-9,900
Calendar year 1964	-	-	+15,800
Jan. 31	1.20	183,300	-19,000
Feb. 28	1.06	168,000	-15,300
Mar. 31	0.88	148,400	-19,600
Apr. 30	1.48	218,200	+69,800
May 31	2.17	305,500	+87,300
June 30	2.65	365,000	+59,500
July 31	2.15	303,500	-61,500
Aug. 31	1.68	244,000	-59,500
Sept.30	1.75	251,900	+7,900
Water year 1964-65	-	-	-19,800

/ Gage height at 2400.

5-2065. Leech Lake River at Federal Dam, Minn.

Location.--Lat 47°14'45", long 94°13'12", in sec.29, T.144 N., R.28 W., on right bank at dam on Leech Lake River at town of Federal Dam, 2 miles downstream from natural outlet of Leech Lake.

Drainage area.--1,163 sq mi.

Records available.--May 1884 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder, headwater gage, and staff tailwater gage, read twice daily. Datum of gage is 1,293.23 ft above mean sea level, adjustment of 1912. Prior to July 3, 1948, staff headwater gage at same datum. May 27 to Nov. 30, 1929, staff gage at site 600 ft downstream at different datum.

Average discharge.--81 years, 340 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 1,060 cfs July 15; minimum daily, 47 cfs May 20.
1884-1965: Maximum daily discharge, 2,520 cfs June 7, 1957 (result of dam failure); no flow at times.

Remarks.--Discharge computed on basis of modified weir formula, the head being obtained from readings on tailwater gage and mean gage height from recording headwater gage. Flow Completely regulated by Leech Lake (see preceding page).

Cooperation.--Computations of daily discharge furnished by Corps of Engineers; four discharge measurements made and records reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	533	473	489	539	523	804	751	65	347	483	910	747
2	539	479	493	543	537	742	736	68	361	498	899	732
3	520	498	489	537	533	751	727	70	414	482	894	*716
4	504	513	485	539	526	754	747	53	431	482	884	696
5	501	506	477	539	526	751	747	51	446	457	879	759
6	487	510	477	537	549	758	751	57	466	457	884	691
7	487	506	477	537	568	751	790	61	487	460	859	705
8	469	502	481	535	560	754	748	62	516	449	884	711
9	477	483	481	514	557	754	744	58	521	657	879	711
10	547	493	481	525	557	742	708	68	504	861	863	722
11	539	511	485	525	563	*738	732	53	504	836	874	691
12	543	526	489	514	563	738	570	51	498	813	859	696
13	536	525	485	533	563	738	304	50	490	1,040	835	722
14	532	471	470	523	560	742	113	51	487	1,050	853	705
15	506	502	470	519	568	742	54	51	490	1,060	830	722
16	498	533	470	530	560	742	54	57	487	1,020	825	722
17	502	529	470	534	563	749	55	59	487	922	815	726
18	518	502	532	534	562	761	57	73	490	982	793	751
19	506	473	543	534	560	761	62	51	490	945	787	751
20	498	454	539	534	568	742	60	47	510	939	778	747
21	487	492	539	526	525	733	64	55	*529	945	741	737
22	477	484	536	526	525	737	65	52	510	939	751	767
23	495	465	536	543	532	733	68	49	507	929	747	793
24	491	465	543	543	532	726	54	52	498	934	747	803
25	481	508	539	546	584	740	57	64	487	918	726	783
26	473	508	537	561	646	740	*59	58	466	892	737	761
27	487	497	528	557	750	733	63	60	472	875	722	747
28	492	508	525	543	758	733	63	52	529	925	722	741
29	498	505	532	538		744	65	190	484	898	716	737
30	479	492	539	527	---	740	66	240	482	883	716	759
31	473	---	537	523	---	717	---	361	---	914	747	---
Total	15,575	14,913	15,674	16,558	15,918	23,090	10,134	2,389	14,390	24,945	25,156	22,051
Mean	502	497	506	534	568	745	338	77.1	480	805	811	735
Cfsm	0.432	0.427	0.435	0.459	0.488	0.641	0.291	0.066	0.413	0.692	0.697	0.632
In.	0.50	0.48	0.50	0.53	0.51	0.74	0.32	0.08	0.46	0.80	0.80	0.71

Calendar year 1964: Max 547 Min 90 Mean 292 Cfsm 0.251 In. 3.43
Water year 1964-65: Max 1,060 Min 47 Mean 550 Cfsm 0.473 In. 6.43

* Discharge measurement made on this day.

5-2105. Pokegama Lake near Grand Rapids, Minn.

Location.--Lat 47°10'00", long 93°33'20", in NW¼ sec.17, T.54 N., R.25 W., at narrows on U. S. Highway 169, 4 miles south of Grand Rapids.

Drainage area.--3,265 sq mi.

Records available.--April 1884 to September 1965. Prior to October 1941 month-end contents only, published in WSP 1308. Published as Pokegama Reservoir near Grand Rapids October 1941 to September 1956.

Gage.--Water-stage recorder. Datum of gage is 1,264.89 ft above mean sea level, adjustment of 1912. Prior to May 30, 1949, staff gage at Pooles Arm of Pokegama Lake, 5 miles northwest at same datum.

Extremes.--Maximum contents during year, 89,060 acre-ft Apr. 29 (gage height, 11.23 ft); minimum, 28,360 acre-ft Apr. 10 (gage height, 6.80 ft).
1884-1965: Maximum contents, 121,400 acre-ft May 8, 1897 (gage height, 13.50 ft); minimum observed, 4,520 acre-ft below zero of capacity table Sept. 30, 1934 (gage height, 4.12 ft).

Remarks.--Reservoir is formed by Pokegama Lake and several other natural lakes controlled by concrete dam; storage began in 1884; original timber dam completed in 1884, replaced by present structure in 1888-89. Capacity between gage heights 6.00 ft and 12.0 ft (maximum allowable range) is 81,720 acre-ft, of which 53,150 acre-ft is controlled storage between gage heights 6.00 ft and 10.00 ft (normal operating range). Contents shown herein are contents above gage height 4.50 ft. Water is used to benefit navigation on Mississippi River below Minneapolis.

Cooperation.--Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Month-end gage height and contents, water year October 1964 to September 1965

Date	Gage height (feet)/	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	9.06	57,980	-
Oct. 31	8.99	56,930	-1,050
Nov. 30	8.86	55,140	-1,790
Dec. 31	8.70	53,160	-1,980
Calendar year 1964	-	-	-3,420
Jan. 31	8.53	50,780	-2,380
Feb. 28	8.50	50,380	-400
Mar. 31	7.26	34,310	-16,070
Apr. 30	11.15	87,870	+53,560
May 31	8.93	56,130	-31,740
June 30	9.85	69,220	+13,090
July 31	9.08	58,310	-10,910
Aug. 31	8.99	56,930	-1,380
Sept.30	9.52	64,460	+7,530
Water year 1964-65	-	-	+6,480

/ Gage height at 2400.

5-2110. Mississippi River at Grand Rapids, Minn.

Location.--Lat 47°13'56", long 93°31'48", in SW¼NW¼ sec.21, T.55 N., R.24 W., in super-calendar room of Blandin Paper Mill in Grand Rapids, 400 ft upstream from bridge on U. S. Highway 169, 2.5 miles upstream from Prairie River, and at mile 1,182 above Ohio River.

Drainage area.--3,370 sq mi, approximately.

Records available.--October 1883 to September 1965. Monthly discharge only for some periods, published in WSP 1308. Published as "at Pokegama Dam near Grand Rapids" 1942-44.

Gage.--Water-stage recorder. Datum of gage is 1,242.00 ft above mean sea level, adjustment of 1912. Prior to Feb. 17, 1945, staff gages operated by Corps of Engineers at Pokegama Dam 3½ miles upstream at datum 22.89 ft higher. Feb. 17, 1945, to Sept. 3, 1948, water-stage recorder at site 300 ft upstream, within 0.10 ft of present datum. Sept, 9, 1948, to Jan. 6, 1949, staff gage at site 400 ft downstream at present datum. Jan. 7, 1949, to Jan. 16, 1951, tape float and inside staff gages at present site and datum.

Average discharge.--82 years, 1,111 cfs.

Extremes.--Maximum discharge during year, 2,710 cfs May 5 (gage height, 8.12 ft, backwater from Prairie River); minimum daily, 530 cfs June 5.
1883-65: Maximum discharge, 12,500 cfs Sept. 3, 1948 (gage height, 15.2 ft, from floodmark), caused by dam failure at gage, from rating curve extended above 4,500 cfs by logarithmic plotting; maximum daily, 5,250 cfs Sept. 5, 8, 1905; no flow at times in several years.

Remarks.--Records fair. Flow completely regulated by Pokegama Lake (see preceding page). Backwater from Prairie River occurs at times in most years. Records of chemical analyses for the water year 1965 are published in Part 2 of this report.

Cooperation.--Records furnished by Corps of Engineers, 1883-1944, 1959-64.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,180	1,330	1,220	1,270	1,250	1,240	1,200	*1,980	980	1,760	1,600	1,840
2	1,170	1,340	1,220	1,260	1,250	1,280	1,160	1,970	1,240	1,710	1,650	1,750
3	1,160	1,330	1,220	1,250	1,260	1,260	1,190	1,930	1,670	1,880	1,840	1,740
4	1,120	1,360	1,210	1,230	1,260	*1,250	1,120	2,090	1,120	1,880	2,150	1,720
5	1,080	1,350	1,210	1,220	1,260	1,230	1,140	2,640	530	1,690	1,980	1,760
6	1,100	1,330	1,220	1,210	1,270	1,200	1,170	2,650	624	1,480	2,010	1,760
7	1,200	1,350	1,230	1,240	1,270	1,190	*1,280	2,410	827	1,490	1,900	1,760
8	1,170	1,340	1,260	1,300	1,280	1,170	1,200	*2,470	*1,010	1,370	1,890	1,780
9	*1,170	1,320	1,300	1,310	1,280	1,150	1,320	2,110	960	1,270	1,910	1,760
10	1,170	1,360	1,310	1,300	1,280	1,130	1,500	2,210	905	1,260	1,880	1,740
11	1,180	1,400	1,320	1,300	1,290	1,150	1,730	2,000	935	1,190	1,840	1,730
12	1,200	1,410	1,320	1,300	1,290	1,260	1,780	1,890	1,120	1,150	1,690	1,820
13	1,170	1,410	1,320	1,300	1,300	1,240	1,990	1,680	1,770	*1,180	1,670	1,860
14	1,240	1,410	1,320	1,300	1,300	1,250	2,160	1,550	1,940	1,160	1,710	1,900
15	1,290	1,430	1,320	1,300	1,300	1,160	2,190	1,500	1,980	1,100	1,670	1,920
16	1,280	1,430	1,310	1,290	1,290	1,150	2,090	1,570	1,940	1,100	1,730	1,870
17	1,290	1,430	1,310	1,290	1,280	1,200	*1,890	1,650	1,950	1,110	1,780	1,880
18	1,260	1,420	1,310	1,290	1,280	1,220	1,430	1,990	2,060	1,120	1,720	1,840
19	1,280	*1,410	1,300	1,280	1,290	1,220	592	2,000	2,050	1,040	1,710	1,830
20	1,280	1,390	1,300	1,280	1,290	1,230	547	1,930	1,990	886	*1,740	1,810
21	1,290	1,320	1,290	1,280	1,300	1,160	624	1,920	1,870	886	1,730	1,810
22	1,300	1,250	1,280	1,280	1,290	1,100	822	1,840	2,010	858	1,710	1,810
23	1,290	1,240	1,280	1,280	1,260	1,080	886	1,800	1,960	858	1,720	1,820
24	1,300	1,220	1,280	1,280	1,250	1,060	854	1,760	1,870	910	1,710	*1,820
25	1,330	1,240	1,280	*1,290	1,240	1,260	780	1,720	1,940	925	1,760	1,820
26	1,340	1,220	1,280	1,290	1,230	1,230	720	1,640	1,870	1,160	1,710	1,820
27	1,330	1,270	1,280	1,300	1,220	1,220	645	1,400	1,800	1,520	1,780	1,920
28	1,290	1,230	1,280	1,290	1,200	1,200	575	1,360	1,780	1,530	1,760	1,820
29	1,330	1,270	1,280	1,280		1,150	1,250	1,040	2,110	1,540	1,770	1,800
30	1,330	1,230	*1,280	1,270	----------	1,290	1,500	1,080	1,920	1,540	1,820	2,100
31	1,340	----------	1,280	1,250	----------	1,250	----------	1,050	----------	1,570	1,800	----------
Total	38,460	40,040	39,620	39,610	35,560	37,180	37,335	56,830	46,731	40,123	55,340	54,610
Mean	1,241	1,335	1,278	1,278	1,270	1,199	1,244	1,833	1,558	1,294	1,785	1,820
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max 3,080 Min 470 Mean 1,108 Ac-ft -
Water year 1964-65: Max 2,650 Min 530 Mean 1,429 Ac-ft -

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 30 to Mar. 10 (no gage-height record Dec. 1-20). No gage-height record Mar. 24 to Apr. 4, Apr. 25, 26, 29, 30, July 28, 29. Backwater from Prairie River Oct. 1-31, Apr. 15 to June 27, Sept. 15-30.

5-2168. O'Brien Creek near Pengilly, Minn.

Location.--Lat 47°18'56", long 93°09'26", in SE¼ sec.20, T.56 N., R.22 W., on right bank 200 ft upstream from Duluth, Missabe and Iron Range Railroad bridge, 1.0 mile upstream from mouth and 2 miles southeast of Pengilly.

Records available.--April 1963 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,338.44 ft above mean sea level, datum of 1929 (Lake Survey reference mark). Prior to July 24, 1963, reference point at same site and datum.

Extremes.--Maximum discharge during year, 265 cfs Apr. 19 (gage height, 4.29 ft); minimum, 4.1 cfs Dec. 6, 7 (gage height, 1.90 ft).
1963-65: Maximum discharge, that of Apr. 19, 1965; minimum, 3.2 cfs Feb. 21, 22, 1964; minimum gage height, 1.85 ft Jan. 13-16, 1964.

Remarks.--Records good. Flow affected by natural storage in lakes above station. One hundred thirty-two discharge measurements were made during the year. Records of chemical analyses for the water year 1965 are published in Part 2 of this report.

Cooperation.--One hundred twenty-one discharge measurements furnished by M. A. Hanna Mining Co.

Rating table, water year 1964-65 (gage height, in feet, and discharge, in cubic feet per second)

1.9	4.1	2.6	48
2.0	6.4	3.0	94
2.1	9.8	3.5	157
2.2	14	4.0	224
2.3	20	4.3	266

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	18	7.6	4.9	5.6	6.1	6.9	7.9	58	34	22	40	17
2	18	7.2	4.9	5.6	6.1	7.2	7.9	59	46	19	37	18
3	20	7.2	4.5	5.6	6.1	6.6	7.9	64	84	19	32	17
4	17	7.2	4.3	5.8	6.1	6.6	8.2	59	88	22	26	14
5	14	7.6	4.3	6.4	6.1	6.6	8.2	50	116	22	20	13
6	12	7.6	4.1	7.2	6.4	6.6	12	51	139	22	20	13
7	12	7.9	4.3	7.9	6.4	6.6	19	51	127	21	26	14
8	14	7.6	4.3	8.2	6.6	6.6	30	47	100	24	28	14
9	13	7.9	4.5	7.6	7.6	6.9	44	46	77	29	22	15
10	13	7.9	4.7	7.2	7.6	7.9	59	44	60	26	17	14
11	14	9.8	5.1	6.9	6.9	7.2	74	40	47	24	14	13
12	14	12	5.1	6.6	6.6	6.6	92	36	40	22	14	14
13	14	16	5.1	6.4	6.1	6.4	132	30	41	22	13	28
14	14	16	4.9	6.1	5.6	6.4	132	29	39	22	12	32
15	13	14	4.7	6.1	5.1	6.1	132	62	33	23	12	42
16	13	17	4.9	6.1	5.1	6.6	147	144	33	26	11	45
17	14	16	4.7	6.6	5.6	7.6	161	140	34	23	11	32
18	13	10	4.5	6.9	5.8	7.9	203	102	33	21	11	27
19	11	8.6	4.5	6.9	6.1	7.6	258	75	32	20	10	24
20	9.4	7.2	4.5	6.6	6.1	7.6	230	59	44	20	9.4	20
21	8.6	6.1	4.5	6.1	6.1	7.6	193	83	50	20	9.4	20
22	8.6	5.4	4.5	5.4	6.1	7.6	173	96	41	20	9.4	21
23	7.9	5.4	4.7	5.1	6.1	7.2	152	72	33	20	8.6	24
24	7.2	5.6	4.7	5.1	6.1	6.6	118	66	27	19	7.9	24
25	7.2	5.8	4.7	5.4	6.4	6.4	101	62	20	18	8.6	20
26	7.2	5.6	4.5	5.6	6.4	6.6	90	55	14	17	9.0	18
27	7.2	5.8	4.3	5.6	6.6	6.9	84	46	13	17	9.0	17
28	7.2	5.6	4.3	5.6	6.9	7.6	77	42	21	17	9.0	14
29	6.9	5.6	4.9	5.8		7.9	68	42	29	17	9.4	16
30	6.9	5.4	5.1	5.8	----------	7.9	62	40	27	22	11	83
31	6.9	----------	5.4	6.1	----------	7.9	----------	36	----------	32	14	----------
Total	362.2	258.6	144.4	193.9	174.8	218.7	2,883.1	1,886	1,522	668	490.7	683
Mean	11.7	8.62	4.66	6.25	6.24	7.05	96.1	60.8	50.7	21.5	15.8	22.8
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max 223 Min 3.2 Mean 17.7 Ac-ft -
Water year 1964-65: Max 258 Min 4.1 Mean 26.0 Ac-ft -

5-2168.6 Swan River near Calumet, Minn.

Location.--Lat 47°17'20", long 93°13'54", in SW¼ sec.35, T.56 N., R.23 W., on left bank 1.0 mile downstream from Snowball Creek, 2.1 miles downstream from bridge on U. S. Highway 65 at outlet of Swan Lake and 3.1 miles southeast of Calumet.

Records available.--January 1964 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,331.05 ft above mean sea level, datum of 1929 (Hanna Mining Company bench mark). Prior to June 5, 1964, reference point at same site and datum.

Extremes.--Maximum discharge during year, 534 cfs Apr. 22 (gage height, 4.98 ft); maximum gage height, 5.07 ft Apr. 22 (backwater from temporary footbridge); minimum discharge, 11 cfs Aug. 31 (gage height, 1.56 ft).
1964-65: Maximum discharge, that of Apr. 22, 1965; maximum gage height, that of Apr. 22, 1965; minimum discharge, 8.1 cfs Aug. 16, 1964.

Remarks.--Records good. Flow affected by natural storage in Swan Lake.

Cooperation.--Additional discharge measurements and gage readings furnished by M. A. Hanna Mining Company.

Rating table, water year 1964-65 (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Apr. 16-22, June 10-12)

1.5	8.5	3.0	155
1.7	17	4.0	337
2.0	34	5.0	538
2.5	80		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	43	24	27	27	20	24	27	288	130	64	32	14
2	43	24	30	26	19	26	27	266	148	60	33	15
3	45	23	*30	26	19	30	27	249	160	60	34	15
4	46	22	29	24	18	29	27	235	174	59	33	16
5	44	21	27	24	18	24	26	222	208	55	32	15
6	44	21	26	24	19	24	29	210	244	53	38	17
7	43	21	24	24	18	23	30	195	*269	47	43	*16
8	41	22	24	23	20	23	33	186	275	44	42	17
9	41	22	24	23	20	24	36	183	264	42	42	18
10	40	22	25	24	22	24	43	167	248	42	41	17
11	40	25	26	24	22	23	58	*152	221	41	38	17
12	40	24	25	24	*24	23	72	146	195	40	35	22
13	*39	26	25	23	23	22	96	141	186	40	34	26
14	35	29	24	23	22	23	*140	138	179	39	31	32
15	32	26	24	*26	22	*23	179	152	157	35	27	37
16	30	24	26	25	21	24	222	174	136	39	23	43
17	30	23	26	24	21	24	*276	206	122	40	23	45
18	29	24	26	23	21	26	350	222	108	40	22	47
19	27	26	25	22	21	26	417	224	103	38	20	49
20	27	26	25	22	20	26	490	221	110	35	20	50
21	26	25	24	22	20	26	523	224	104	32	18	52
22	26	24	24	21	20	26	*531	231	100	31	17	53
23	25	24	26	21	20	25	528	231	88	29	16	54
24	26	23	26	22	20	25	506	230	83	28	16	53
25	25	23	26	22	20	24	479	219	75	27	16	54
26	26	22	26	22	20	24	443	204	68	26	15	54
27	26	24	25	22	21	24	411	190	61	24	13	54
28	25	24	25	22	22	24	373	185	54	22	12	52
29	24	24	25	21		24	339	169	58	21	12	54
30	25	23	26	21	----------	25	314	152	63	26	13	92
31	24	----------	27	20	----------	26	----------	136	----------	30	12	----------
Total	1,037	711	798	717	573	764	7,052	6,148	4,391	1,209	803	1,100
Mean	33.5	23.7	25.7	23.1	20.5	24.6	235	198	146	39.0	25.9	36.7
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max 423 Min 8.4 Mean 49.3 Ac-ft -
Water year 1964-65: Max 531 Min 12 Mean 69.3 Ac-ft -

* Discharge measurement made on this day.
Note.--No gage-height record Nov. 30, Dec. 1, 5, 6, Jan. 9, 10, 16-18, 27, 28, 30, 31, Feb. 2, 3.

5-2170. Swan River near Warba, Minn.

Location.--Lat 47°06'40", long 93°15'50", in SE¼ sec.33, T.54 N., R.23 W., on left bank 75 ft upstream from highway bridge, 1¼ miles south of Warba, 3¾ miles northwest of Swan River, and 22 miles upstream from mouth.

Drainage area.--254 sq mi.

Records available.--October 1953 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,259.80 ft above mean sea level (Minnesota State Highway Department bench mark).

Average discharge.--12 years, 123 cfs.

Extremes.--Maximum discharge during year, 1,080 cfs Apr. 17 (gage height, 9.49 ft, backwater from ice); maximum gage height, 9.53 ft Apr. 16 (backwater from ice); minimum discharge 39 cfs Aug. 29, 30 (gage height, 2.32 ft).

1953-65: Maximum discharge, that of Apr. 17, 1965; maximum gage height, that of April 16, 1965; minimum discharge, 15 cfs Sept. 4, 5, 1961 (gage height, 1.65 ft).

Flood of May 1950 reached a stage of about 11.5 ft from information by local residents.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

2.3	38	5.0	255
2.6	56	6.0	372
3.0	84	8.0	698
3.5	121	9.2	1,080
4.0	161		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	124	57	66	52	47	45	60	647	263	125	76	51
2	147	56	67	52	47	47	62	617	331	127	73	45
3	154	56	68	52	46	48	63	586	438	135	71	42
4	144	56	69	52	46	50	64	549	498	132	71	40
5	141	55	69	53	46	52	66	510	545	123	70	42
6	135	55	68	54	46	53	68	480	598	115	76	46
7	125	54	68	54	46	54	71	*468	629	107	88	49
8	119	55	67	54	47	56	74	445	661	100	94	52
9	111	54	67	53	47	58	80	414	663	95	95	52
10	104	54	66	52	47	60	90	382	631	92	90	51
11	99	65	*65	52	48	62	120	354	585	85	83	49
12	99	80	64	51	48	63	165	326	532	81	80	58
13	98	81	64	51	47	64	210	292	483	89	78	95
14	94	75	62	50	46	65	*280	278	433	88	71	110
15	90	73	61	50	46	65	500	290	385	83	66	130
16	88	74	60	50	45	64	800	344	337	80	62	148
17	77	71	59	50	45	64	1,060	387	287	79	59	149
18	71	59	58	50	45	64	1,000	444	242	79	54	153
19	75	51	57	49	*45	63	913	443	212	*80	51	155
20	74	56	57	49	46	62	854	422	219	77	48	153
21	70	61	56	*49	46	62	*824	451	241	74	46	150
22	69	62	55	49	45	*61	808	455	229	72	45	158
23	68	63	55	49	44	60	799	445	205	70	*42	172
24	66	64	54	50	43	60	787	443	191	66	40	174
25	65	64	54	51	43	60	779	433	166	63	40	167
26	62	64	53	50	43	59	764	418	153	59	42	159
27	62	63	53	49	43	58	750	396	147	56	42	152
28	61	63	52	48	44	58	735	370	*144	54	41	147
29	60	63	52	48		58	710	346	132	51	39	145
30	*57	64	52	47	---	58	680	320	129	54	42	260
31	57	---	52	47	---	59	---	289	---	66	50	---
Total	2,866	1,868	1,870	1,567	1,277	1,812	14,236	13,044	10,709	2,657	1,925	3,354
Mean	92.4	62.3	60.3	50.5	45.6	58.4	474	421	357	85.7	62.1	112
Cfsm	0.364	0.245	0.237	0.199	0.180	0.230	1.87	1.66	1.40	0.337	0.244	0.441
In.	0.42	0.27	0.27	0.23	0.19	0.27	2.08	1.91	1.57	0.39	0.28	0.49

Calendar year 1964: Max 568 Min 19 Mean 113 Cfsm 0.445 In. 6.06
Water year 1964-65: Max 1,060 Min 39 Mean 157 Cfsm 0.618 In. 8.37

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 17 (no gage-height record Jan. 4-14).

5-2185. Sandy Lake at Libby, Minn.

Location.--Lat 46°46'40", long 93°19'20", in sec.36, T.50 N., R.24 W., on dam on Sandy River at Libby, 2.2 miles upstream from mouth, and 14 miles north of McGregor.

Drainage area.--421 sq mi.

Records available.--July to December 1893, October to December 1894, July 1895 to September 1965. Month-end contents only for some periods, published in WSP 1308. Published as Sandy Lake Reservoir at Libby October 1941 to September 1956.

Gage.--Water-stage recorder. Datum of gage is 1,207.71 ft above mean sea level, adjustment of 1912. Prior to Sept. 23, 1949, float gage at same site and datum.

Extremes.--Maximum contents during year, 97,190 acre-ft Apr. 28 (gage height, 13.15 ft); minimum, 29,160 acre-ft Apr. 11 (gage height, 6.26 ft).
1895-1965: Maximum contents, 167,200 acre-ft May 19, 1950 (gage height, 17.51 ft); minimum observed, 5,950 acre-ft below zero of capacity table Jan. 20, 1921 (gage height, 0.65 ft).

Remarks.--Reservoir is formed by Sandy, Flowage, Snake, and Aitkin Lakes controlled by concrete dam. Storage began in 1893; original timber crib dam completed in 1895, replaced by present structure in 1911. Capacity between gage heights 7.00 ft and 14.00 ft (minimum allowable limit to top of structure) is 73,330 acre-ft, of which 37,550 acre-ft is controlled storage between gage heights 7.00 ft and 11.00 ft (normal operating range). Contents shown herein are contents above gage height 1.72 ft. Water is used to benefit navigation on Mississippi River below Minneapolis.

Cooperation.--Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Month-end gage height and contents, water year October 1964 to September 1965

	Gage height (feet)✓	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	9.03	52,780	-
Oct. 31	8.83	50,980	-1,780
Nov. 30	8.52	48,000	-2,980
Dec. 31	8.06	44,030	-3,970
Calendar year 1964	-	-	-7,180
Jan. 31	7.49	39,070	-4,960
Feb. 28	7.06	35,500	-3,570
Mar. 31	6.84	33,720	-1,780
Apr. 30	12.98	95,210	+61,490
May 31	8.85	51,170	-44,040
June 30	8.92	51,770	+600
July 31	8.91	51,570	-200
Aug. 31	8.95	51,970	+400
Sept.30	9.10	53,550	+1,580
Water year 1964-65	-	-	+790

✓ Gage height at 2400.

5-2190. Sandy River at Sandy Lake Dam, at Libby, Minn.

Location.--Lat 46°47'18", long 93°19'06", in sec.25, T.50 N., R.24 W., at dam at outlet of Sandy Lake, a quarter of a mile north of Libby and 1.2 miles above mouth.

Drainage area.--421 sq mi.

Records available.--July 1893 to March 1894, July 1894, November 1894 to March 1895, August 1895 to September 1965. Monthly discharge only for some periods, published in WSP 1308. Published as "below Sandy Lake Reservoir" 1893-1916.

Gage.--Water-stage recorders on headwater and tailwater. Datum of gages is 1,207.71 ft above mean sea level, adjustment of 1912. Prior to June 20, 1949, staff gages at same site and datum.

Average discharge.--70 years (1895-1965), 202 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 2,780 cfs May 1; no flow Apr. 14-19; minimum daily, o cfs many days.
1893-65: Maximum daily discharge, 3,740 cfs July 12, 1897; no flow at times.

Remarks.--Discharge computed on basis of head over dam, using modified weir formula, head being obtained from headwater and tailwater recorder records. Flow completely regulated by Sandy Lake (see preceding page).

Cooperation.--Two discharge measurements made and records reviewed by Geological Survey. Computations of daily discharge furnished by Corps of Engineers.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	370	156	142	130	120	122	50	2,780	620	136	6	6
2	360	156	140	128	61	121	48	2,600	620	134	6	6
3	365	156	132	128	61	119	48	2,520	1,300	136	6	6
4	350	156	134	128	61	118	49	2,420	846	140	6	6
5	350	156	134	128	61	116	48	2,130	497	140	6	6
6	190	156	134	128	62	115	171	1,860	520	142	6	6
7	190	156	134	128	62	114	585	1,730	595	88	6	6
8	195	156	134	128	61	113	490	1,620	675	6	76	6
9	195	156	134	128	61	112	460	1,580	720	6	78	6
10	195	154	134	128	61	112	430	1,680	770	6	78	6
11	80	154	132	126	92	113	380	1,630	825	6	78	6
12	82	154	132	126	91	114	275	1,640	948	6	80	6
13	82	152	132	126	90	114	99	1,620	1,660	6	80	6
14	82	152	132	126	90	112	0	1,610	1,940	6	52	6
15	82	152	134	126	89	109	0	1,700	1,900	6	6	190
16	82	150	136	126	126	107	0	1,700	1,860	6	6	185
17	154	150	134	124	124	104	0	1,650	1,760	105	6	180
18	154	150	134	124	123	14	0	1,540	1,760	105	6	340
19	154	150	132	124	123	14	0	1,420	1,690	105	6	330
20	154	150	132	124	123	54	32	1,320	1,630	105	6	330
21	154	152	134	124	123	57	829	1,170	1,550	44	6	330
22	154	156	132	124	123	53	1,660	1,060	1,480	44	6	330
23	156	154	130	124	123	104	1,870	1,030	1,470	44	6	325
24	156	150	130	122	123	104	*2,150	1,000	1,450	26	6	320
25	158	148	130	122	123	104	1,660	1,000	1,040	6	6	320
26	158	146	130	122	123	102	1,430	1,030	923	6	6	320
27	158	146	130	120	123	51	*1,480	1,170	490	6	6	320
28	156	150	130	120	122	50	1,670	1,110	305	6	6	228
29	156	150	130	120		51	2,000	859	114	6	6	175
30	156	144	130	120	---	51	2,340	737	136	6	6	135
31	158	---	130	120	---	51	---	620	---	6	6	---
Total	5,586	4,568	4,118	3,872	2,725	2,795	20,254	47,536	32,094	1,590	666	4,442
Mean	180	152	133	125	97.0	90.2	675	1,533	1,070	51.3	21.5	148
Cfsm	0.428	0.361	0.316	0.297	0.230	0.214	1.60	3.64	2.54	0.122	0.051	0.352
In.	0.49	0.40	0.36	0.34	0.24	0.25	1.79	4.20	2.84	0.14	0.06	0.39

Calendar year 1964: Max 1,740 Min 6 Mean 269 Cfsm 0.639 In. 8.69
Water year 1964-65: Max 2,780 Min 0 Mean 357 Cfsm 0.848 In. 11.50

* Discharge measurement made on this day.

5-2205. Mississippi River below Sandy River, near Libby, Minn.

Location.--Lat 46°47', long 93°20', in sec.25, T.50 N., R.24 W., on right bank 600 ft downstream from Sandy River, three-quarters of a mile northwest of Libby, and at mile 1,106 upstream from Ohio River.

Drainage area.--5,060 sq mi, approximately.

Records available.--April 1930 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,204.55 ft above mean sea level, adjustment of 1912. Prior to July 28, 1931, staff gage at site 600 ft upstream at datum 3.16 ft higher.

Average discharge.--35 years, 1,861 cfs.

Extremes.--Maximum discharge during year, 7,340 cfs Apr. 24 (gage height, 14.50 ft); minimum , 1,100 cfs July 25 (gage height, 3.82 ft).
1930-65: Maximum discharge, 16,000 cfs May 17, 1950 (gage height, 20.02 ft); minimum, 83 cfs Nov. 16, 1936 (gage height, 1.44 ft).

Remarks.--Records good except those for period of ice effect, which are fair. Flow regulated by powerplants and Winnibigoshish, Leech, Pokegama, and Sandy Lakes (see p. 74, 76, 78, 83).

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

3.5	949	9.0	3,880
4.0	1,190	11.0	5,020
5.0	1,710	13.0	6,270
7.0	2,780	15.0	7,710

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,220	1,800	1,840	1,690	1,550	1,680	2,000	6,690	3,510	2,720	1,720	1,790
2	2,310	1,800	1,820	1,690	1,540	1,700	2,050	6,670	3,780	2,730	1,750	1,790
3	2,410	1,790	1,800	1,690	*1,510	1,710	2,050	6,660	4,740	2,570	1,810	1,810
4	2,440	1,780	1,800	1,690	1,500	1,720	2,050	6,600	5,090	2,480	1,840	1,760
5	2,400	1,780	1,800	1,680	1,510	1,730	2,100	6,510	5,170	2,480	1,940	1,710
6	2,200	*1,790	1,800	1,680	1,520	1,750	2,300	6,470	5,210	2,440	2,130	1,690
7	2,110	1,790	1,800	1,680	1,520	1,750	2,550	6,440	5,070	2,240	2,240	1,740
8	2,100	1,770	1,800	1,650	1,520	1,750	2,650	6,500	5,020	2,010	2,290	1,780
9	2,120	1,790	1,800	1,630	1,520	1,780	2,700	6,460	4,980	1,920	2,190	1,780
10	2,090	1,790	1,810	1,620	1,520	1,800	2,750	6,340	4,900	1,850	2,120	1,780
11	1,950	1,840	1,820	1,610	1,520	1,800	2,850	6,130	4,740	1,800	2,080	1,780
12	1,900	1,900	1,830	1,610	1,520	1,800	3,000	*5,940	4,590	1,720	2,060	1,830
13	1,910	1,940	1,830	1,620	1,520	1,800	3,300	5,700	4,780	1,700	1,980	2,000
14	1,900	1,950	1,830	1,640	1,520	1,800	3,900	5,450	*5,010	1,650	1,850	2,130
15	1,890	1,950	1,840	1,640	1,530	1,810	*4,360	5,250	5,080	1,620	1,770	2,510
16	1,910	1,940	1,820	1,650	1,540	1,820	4,600	5,130	5,270	1,600	1,750	2,610
17	2,000	1,960	1,820	1,660	1,540	1,830	4,850	5,100	5,230	1,550	1,740	2,660
18	2,010	1,960	1,810	1,650	1,540	1,850	5,200	5,120	5,140	1,510	1,750	2,810
19	2,000	1,950	1,800	1,640	1,550	1,890	5,480	5,150	5,070	*1,490	1,760	2,850
20	1,980	1,920	1,800	1,650	1,570	1,890	*5,830	5,180	5,110	1,470	1,750	2,820
21	1,950	1,800	1,790	*1,640	1,600	1,890	6,400	5,290	5,020	1,320	1,730	2,810
22	1,920	1,630	1,780	1,630	1,600	1,900	*6,910	5,340	4,850	1,220	1,730	2,860
23	1,890	1,700	*1,720	1,630	1,600	1,900	7,220	5,340	4,700	1,190	1,700	2,910
24	1,860	1,780	1,700	1,620	1,600	1,910	7,290	5,340	4,580	1,140	1,670	2,920
25	1,790	1,880	1,700	1,600	1,610	1,910	7,100	5,280	4,290	1,110	1,700	2,920
26	1,780	1,990	1,700	1,600	1,620	1,950	6,850	5,170	3,740	1,120	1,680	2,900
27	1,820	2,000	1,690	1,590	1,630	1,950	6,700	5,040	3,300	1,140	1,680	2,870
28	1,840	1,850	1,690	1,580	1,650	1,960	6,610	4,880	3,080	1,380	1,680	2,770
29	1,830	1,820	1,690	1,580		1,950	6,560	4,540	2,780	1,550	1,730	2,690
30	1,790	1,820	1,690	1,570	---------	1,940	6,600	4,170	2,690	1,620	1,750	3,240
31	1,800	----------	1,690	1,560	---------	1,940	----------	3,740	----------	1,720	*1,770	----------
Total	62,120	55,460	55,110	50,670	43,470	56,860	134,810	173,620	136,520	54,060	57,340	70,520
Mean	2,004	1,849	1,778	1,634	1,552	1,834	4,494	5,601	4,551	1,744	1,850	2,351
Cfsm	0.396	0.365	0.351	0.323	0.307	0.362	0.888	1.11	0.899	0.345	0.366	0.465
In.	0.46	0.41	0.40	0.37	0.32	0.42	0.99	1.28	1.00	0.40	0.42	0.52

Calendar year 1964: Max 6,190 Min 651 Mean 1,966 Cfsm 0.389 In. 5.30
Water year 1964-65: Max 7,290 Min 1,110 Mean 2,604 Cfsm 0.515 In. 6.99

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 17. No gage-height record July 9-18.

5-2275. Mississippi River at Aitkin, Minn.

Location.--Lat 46°32'26", long 93°42'26", in W½ sec.24, T.47 N., R.27 W., at upstream side of highway bridge at north edge of Aitkin, 1 mile downstream from Mud River and at mile 1,055.9 upstream from Ohio River.

Drainage area.--6,140 sq mi, approximately.

Records available.--March 1945 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,185.41 ft above mean sea level, datum of 1929 (levels by Corps of Engineers). Mar. 1, 1945, to July 12, 1954, staff gage, July 13, 1954, to June 23, 1955, chain gage, June 24, 1955, to Mar. 14, 1961, wire-weight gage, at same site and datum. Diversion channel: Wire-weight gage. Datum of gage is 1,185.02 ft above mean sea level, datum of 1929. Apr. 9, 1955, to Apr. 10, 1956, staff gage at site 4 miles downstream and at different datum. Apr. 11, 1956, to Sept. 6, 1960, staff gage, at same site and datum.

Average discharge.--20 years, 2,775 cfs.

Extremes.--Maximum discharge during year, 13,400 cfs Apr. 26; minimum, 1,340 cfs July 28. River gage: Maximum discharge during year, 7,540 cfs Apr. 18 (gage height, 14.50 ft); minimum, 1,340 cfs July 28 (gage height, 1.08 ft). Diversion gage: Maximum discharge during year, 5,870 cfs Apr. 25 (gage height, 14.81 ft); no flow for many days.
1945-65: Maximum discharge, 20,000 cfs May 20, 1950 (gage height, 19.49 ft); minimum, 151 cfs Sept. 1, 1961 (gage height, -2.40 ft).

Remarks.--Records good except those for period of ice effect, which are fair. Slight regulation by powerplants and by Winnibigoshish, Leech, Pokegama, and Sandy Lakes (see p. 74, 76, 78, 83). Water diverted at medium and high stages into Aitkin diversion channel 6½ miles above station, bypasses station and returns to river 15½ miles below station. Diversion began Apr. 2, 1955. These records include flow in diversion channel.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3,600	2,110	2,050	1,810	1,610	1,700	2,180	11,600	6,200	3,610	1,780	1,850
2	3,660	2,120	2,000	1,810	*1,600	1,740	2,140	11,200	6,710	3,460	1,810	1,870
3	3,580	2,090	2,000	1,820	1,600	1,750	2,140	*10,800	8,010	3,410	1,850	1,880
4	3,480	2,080	2,000	1,820	1,600	1,760	2,150	10,400	8,580	3,210	1,890	1,880
5	3,430	2,080	2,000	1,820	1,650	1,780	2,300	10,000	9,030	3,110	1,920	1,860
6	3,390	2,070	1,950	1,820	1,660	1,780	2,420	9,770	9,660	3,000	2,040	1,820
7	3,160	2,080	1,900	1,820	1,660	1,790	2,650	9,600	10,000	2,910	2,240	1,800
8	2,980	2,080	1,900	1,800	1,660	1,800	3,000	9,510	10,800	2,740	2,370	1,820
9	2,900	2,040	1,860	1,800	1,650	1,800	3,100	9,430	11,100	2,550	2,570	1,850
10	2,860	2,040	*1,850	1,760	1,640	1,810	3,290	9,140	11,100	2,400	2,570	1,870
11	2,760	2,090	1,850	1,730	1,640	1,820	3,660	8,930	10,900	2,260	2,500	1,860
12	2,630	2,160	1,850	1,700	1,630	1,830	4,080	8,660	10,500	2,150	2,400	1,900
13	2,530	2,230	1,840	1,700	1,630	1,840	4,820	8,360	9,980	2,080	2,300	1,990
14	2,500	2,270	1,830	1,700	1,620	1,840	6,100	7,980	9,560	2,000	2,220	2,110
15	2,470	2,300	1,820	1,700	1,620	1,850	7,550	7,660	*9,250	1,930	2,080	2,370
16	2,440	2,300	1,800	1,700	1,610	1,870	9,350	7,290	8,960	1,900	1,980	2,700
17	2,440	2,280	1,800	1,710	1,610	1,890	11,500	7,160	8,670	1,800	*1,940	2,970
18	2,460	2,280	1,800	1,720	1,640	1,900	13,000	7,110	8,350	1,860	1,910	3,070
19	2,470	2,260	1,800	1,720	1,650	1,910	13,100	7,070	8,020	1,810	1,900	3,250
20	*2,440	2,000	1,800	1,720	1,670	1,930	13,000	* 7,050	7,900	1,770	1,900	3,310
21	2,430	1,870	1,800	1,710	1,680	1,950	*13,000	7,180	7,690	1,730	1,880	3,310
22	2,390	1,830	1,800	1,700	1,680	1,960	*13,000	7,390	7,340	*1,650	1,850	3,300
23	2,360	1,840	1,800	1,690	1,680	1,990	13,100	7,510	6,910	1,550	1,840	3,300
24	2,310	1,890	1,800	1,680	1,680	2,000	13,200	7,860	6,530	1,490	1,810	3,320
25	2,250	2,000	1,800	1,650	1,680	2,000	13,300	8,080	6,140	1,420	1,790	3,300
26	2,190	2,100	1,800	1,650	1,680	2,000	13,300	8,050	5,780	1,360	1,760	3,210
27	2,160	2,200	1,800	1,650	1,690	2,050	13,200	7,940	5,200	1,350	1,770	3,130
28	2,160	2,250	1,800	1,640	1,700	2,060	12,900	7,680	4,890	1,350	1,760	3,060
29	2,150	2,200	1,820	1,630		2,070	12,500	7,480	4,440	1,470	1,760	3,090
30	2,140	2,150	1,850	1,630	---	2,100	12,100	6,990	3,970	1,630	1,790	3,850
31	2,120	---	1,820	1,630	---	2,110	---	6,680	---	1,720	1,820	---
Total	82,840	63,290	57,590	53,440	46,120	58,680	241,130	261,560	242,170	66,680	62,000	76,900
Mean	2,672	2,110	1,858	1,724	1,647	1,893	8,038	8,437	8,072	2,151	2,000	2,563
Cfsm	0.435	0.344	0.303	0.281	0.268	0.308	1.31	1.37	1.31	0.350	0.326	0.417
In.	0.50	0.38	0.35	0.32	0.28	0.36	1.46	1.58	1.47	0.40	0.38	0.47

Calendar year 1964: Max 8,990 Min 828 Mean 2,569 Cfsm 0.418 In. 5.70
Water year 1964-65: Max 13,300 Min 1,350 Mean 3,596 Cfsm 0.586 In. 7.95

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 18 at River gage and Mar. 29 to Apr. 17 at Diversion gage.

$\frac{3596}{6140} \times 13,570 = 7,9$
.585

5-2305. Pine River Reservoir at Cross Lake, Minn.

Location.--Lat 46°40'09", long 94°06'44", in SW¼NW¼ sec.21, T.137 N., R.27 W., at dam on Pine River, at outlet of Cross Lake at village of Cross Lake.

Drainage area.--562 sq mi.

Records available.--March 1886 to September 1965. Month-end contents only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,216.32 ft above mean sea level, datum of 1929 (levels by Corps of Engineers). Prior to May 3, 1949, staff gage at same site and datum.

Extremes.--Maximum contents during year, 115,600 acre-ft June 12 (gage height, 14.25 ft); minimum, 72,200 acre-ft Apr. 10 (gage height, 11.04 ft).
1886-1965: Maximum contents observed, 173,600 acre-ft July 10, 1916 (gage height, 18.24 ft); minimum observed, 1,310 acre-ft below zero of capacity table Aug. 20, 1918 (gage height, 1.35 ft).

Remarks.--Reservoir is formed by Trout, Whitefish, Rush, and Cross Lakes and several other natural lakes controlled by timber crib dams; storage began in 1886; dam completed in 1886. Capacity between gage heights 10.00 ft and 18.5 ft (maximum allowable range) is 118,710 acre-ft of which 53,280 acre-ft is controlled storage between gage heights 10.00 ft and 14.00 ft (normal operating range). Contents shown herein are contents above a gage height of 2.35 ft. Water is used to benefit navigation on Mississippi River below Minneapolis.

Cooperation.--Records furnished by Corps of Engineers in terms of cfs-days and converted to acre-feet by Geological Survey.

Month-end gage height and contents, water year October 1964 to September 1965

	Gage height (feet)/	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	12.78	95,400	-
Oct. 31	12.47	91,240	-4,160
Nov. 30	12.13	86,680	-4,560
Dec. 31	11.82	82,510	-4,170
Calendar year 1964	-	-	-11,360
Jan. 31	11.44	77,550	-4,960
Feb. 28	11.34	76,170	-1,380
Mar. 31	11.15	73,590	-2,580
Apr. 30	12.51	91,640	+18,050
May 31	13.07	99,370	+7,730
June 30	13.04	98,980	-390
July 31	12.94	97,590	-1,390
Aug. 31	12.82	95,800	-1,790
Sept.30	13.24	101,600	+5,800
Water year 1964-65	-	-	+6,200

/ Gage height at 2400.

5-2310. Pine River at Cross Lake Dam, at Cross Lake, Minn.

Location.--Lat 46°40'09", long 94°06'44", in SW¼NW¼ sec.21, T.137 N., R.27 W., at dam at outlet of Cross Lake at Village of Cross Lake.

Drainage area.--562 sq mi.

Records available.--April 1886 to September 1965. Monthly discharge only for some periods, published in WSP 1308. Published as "below Pine River Reservoir" 1895-1916, 1929, and as "at Pine River Dam, at Cross Lake" 1941-56.

Gage.--Water-stage recorder, headwater gage, and tape float tailwater gage, read twice daily. Datum of gages is 1,216.32 ft above mean sea level, datum of 1929. Mar. 26, 1886, to May 31, 1929, staff gages on headwater and tailwater at same sites and datum. June 1 to Nov. 30, 1929, staff gage in tailwater at datum 1.60 ft lower. Dec. 1, 1929, to May 2, 1949, staff gage on headwater and Dec. 1, 1929, to August 1949, staff gage on tailwater at present sites and datum.

Average discharge.--79 years, 207 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 1,400 cfs June 13-27; minimum daily, 90 cfs Sept. 4-6. 1886-1965: Maximum daily discharge, 2,250 cfs in June 1896 (does not include flow bypassing dam through crevasse); no flow at times.

Remarks.--Discharge computed principally on basis of modified weir formula, the head being obtained from twice-daily readings on tailwater gage and from headwater recorder. Flow completely regulated by Pine River Reservoir (see preceding page).

Cooperation.--Computations of daily discharge furnished by Corps of Engineers; two discharge measurements made and records reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	255	255	240	235	235	150	285	210	1,030	770	150	170
2	255	255	240	235	235	150	285	210	1,030	750	173	170
3	255	255	240	235	235	150	285	210	1,030	660	240	120
4	255	255	235	235	235	150	285	210	1,120	510	240	90
5	255	255	235	235	235	150	285	257	1,350	490	240	90
6	255	255	235	235	230	150	327	350	1,350	365	296	90
7	255	255	235	235	230	150	458	350	1,350	315	390	120
8	255	250	235	235	195	150	525	350	1,350	300	390	170
9	255	250	235	235	110	150	525	362	1,370	280	385	170
10	255	250	235	235	110	150	525	515	1,370	330	* 385	170
11	270	250	235	235	110	150	525	640	1,370	330	385	170
12	270	250	235	235	110	162	525	615	1,370	330	380	170
13	270	250	235	235	110	190	600	540	1,400	330	380	307
14	270	250	235	235	110	190	830	485	1,400	335	380	411
15	270	245	235	235	110	203	*1,090	510	1,400	335	380	485
16	270	245	235	235	110	235	1,230	635	1,400	325	320	485
17	270	245	235	235	110	235	990	616	1,400	325	200	640
18	270	245	235	235	110	235	990	485	1,400	325	193	630
19	270	245	235	235	110	235	1,080	485	1,400	308	165	640
20	270	245	235	235	123	235	1,250	538	1,400	255	165	630
21	270	245	235	235	155	235	1,170	699	1,400	255	165	630
22	260	245	235	235	155	252	1,010	790	1,400	255	165	620
23	260	245	235	235	155	285	1,020	790	1,400	255	150	625
24	260	245	235	235	155	285	1,020	790	1,400	250	105	620
25	255	240	235	235	155	285	1,020	808	1,400	245	100	620
26	255	240	235	230	155	285	983	1,010	1,400	226	125	620
27	255	240	235	230	155	285	850	1,020	1,400	180	120	620
28	255	240	235	230	155	285	654	1,020	1,300	180	120	620
29	255	240	235	235		285	472	1,020	1,070	180	120	615
30	255	240	235	235	---	285	278	1,020	1,010	171	135	615
31	255	---	235	235	---	285	---	1,030	---	150	170	---
Total	8,085	7,425	7,300	7,270	4,403	6,622	21,372	18,570	39,470	10,315	7,312	12,133
Mean	261	248	235	235	157	214	712	599	1,316	333	236	404
Cfsm	0.464	0.441	0.418	0.418	0.279	0.381	1.27	1.07	2.34	0.593	0.420	0.719
In.	0.54	0.49	0.48	0.48	0.29	0.44	1.41	1.23	2.61	0.68	0.48	0.80

Calendar year 1964: Max 730 Min 80 Mean 231 Cfsm 0.411 In. 5.59
Water year 1964-65: Max 1,400 Min 90 Mean 412 Cfsm 0.733 In. 9.93

* Discharge measurement made on this day.

GPO 826-476-7

5-2315. Pelican Lake near Pequot Lakes, Minn.

Location.--Lat 46°37', long 94°11', in NE¼NE¼ sec.10, T.136 N., R.28 W., on downstream side of right abutment of dam and bridge on channel between Ossawinnamakee and Pelican Lakes, 0.5 mile upstream from Pelican Lake and 6 miles east of town of Pequot Lakes.

Records available.--April 1938 to September 1965 (fragmentary). Prior to October 1956, published as Pelican Lake diversion near Pequot Lakes.

Gage.--Staff gage read about three times weekly during open-water period. Datum of gage is 1,203.69 ft above mean sea level, datum of 1929 (levels by Minnesota Department of Conservation).

Extremes.--Maximum gage height observed during year, 3.74 ft June 11; minimum observed, 3.10 ft May 3.
1938-65: Maximum gage height observed, 4.12 ft May 23, 25, 27, 1950; minimum observed, 1.36 ft May 2, 1938.

Remarks.--Crest of stoplogs on dam is normally fixed at 1,207.19 ft, but may be lowered to 1,203.69 ft (elevation of sill and apron) by removal of stoplogs.

Gage height, in feet, October 1964 to September 1965

Oct. 18.....3.62	June 30 .....3.58	Aug. 30 .....3.30
May 31.....3.46	July 30 .....3.36	Sept.30 .....3.50

Note.--Gage readings other than those shown are available.

5-2440. Crow Wing River at Nimrod, Minn.

Location.--Lat 46°39', long 94°53', in sec.32, T.137 N., R.33 W., on right bank 200 ft upstream from highway bridge, 0.2 mile north of Nimrod, and 0.7 mile upstream from Cat River.

Drainage area.--1,010 sq mi, approximately.

Records available.--April 1910 to September 1914, July 1930 to September 1965 (winter records incomplete prior to 1940).

Gage.--Water-stage recorder. Datum of gage is 1,313.27 ft above mean sea level, datum of 1929 (levels by Wadena County Highway Department from Minnesota Highway Department bench mark). Apr. 15, 1910, to Sept. 30, 1914, chain gage at bridge 10 ft downstream at datum 2.2 ft lower. July 28, 1930, to Aug. 19, 1948, chain gage and Aug. 20, 1948, to Nov. 4, 1949, wire-weight gage, at bridge 10 ft downstream at same datum.

Average discharge.--26 years (1939-65), 453 cfs.

Extremes.--Maximum discharge during year, 2,890 cfs Apr. 13 (gage height, 7.57 ft, backwater from ice); minimum, 153 cfs Nov. 20 (gage height, 2.42 ft).
1910-14, 1930-65: Maximum discharge, that of Apr. 13, 1965; maximum gage height, 7.64 ft Apr. 20, 1950 (backwater from ice); minimum discharge observed, 45 cfs Aug. 7, 1936.

Remarks.--Records good except those for period of ice effect, which are fair. Flow affected by natural storage in many lakes.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1-26 and Sept. 12-30)

2.6	225	4.0	1,070
2.8	320	5.0	1,790
3.0	430	6.0	2,580
3.5	740	7.0	3,400

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	514	353	280	315	266	271	330	1,010	896	740	392	380
2	502	348	282	313	262	276	340	980	1,330	720	392	375
3	496	348	282	313	260	278	345	948	1,590	662	392	364
4	490	348	283	311	257	280	360	909	1,760	610	392	358
5	484	342	288	310	257	282	420	902	1,780	592	397	375
6	472	342	289	308	*257	286	550	922	1,930	592	402	386
7	466	342	290	307	257	289	660	896	1,940	592	408	392
8	448	342	290	303	257	290	780	870	2,190	580	397	386
9	454	342	*293	300	257	293	980	857	1,970	574	375	370
10	454	348	293	298	260	296	1,200	838	1,860	550	358	364
11	448	392	300	293	261	298	1,600	831	1,790	538	358	370
12	454	419	303	292	263	300	1,960	824	1,720	550	348	436
13	448	430	308	292	265	302	2,600	*818	1,640	562	348	472
14	430	430	302	292	266	304	2,420	812	1,540	556	342	502
15	419	424	300	292	266	306	2,360	954	1,440	544	342	538
16	*414	424	298	292	266	308	*2,330	1,110	*1,360	532	342	544
17	414	424	298	291	266	309	2,580	1,110	1,300	508	336	562
18	414	419	300	289	267	309	2,310	1,080	1,220	490	*331	580
19	414	380	300	289	268	309	*2,020	1,040	1,180	490	331	610
20	408	225	300	288	269	309	1,860	994	1,130	*496	326	630
21	397	240	300	286	270	309	1,730	987	1,090	484	320	656
22	392	269	302	*282	271	*309	1,630	974	1,040	466	320	688
23	375	280	303	282	270	309	*1,540	1,010	980	436	310	766
24	364	290	302	282	269	309	1,430	1,110	942	424	315	701
25	358	290	303	282	268	309	1,380	1,160	896	419	342	688
26	358	285	304	280	266	309	1,320	1,150	857	408	353	662
27	358	280	305	276	267	310	1,240	1,100	857	402	353	642
28	353	280	308	272	268	312	1,180	1,040	831	392	353	630
29	353	280	310	271		317	1,110	994	798	386	348	636
30	353	280	311	270	---	320	1,060	942	766	386	375	760
31	353	---	312	268	---	328	---	909	---	392	380	---
Total	13,057	10,196	9,239	9,039	7,396	9,336	41,625	30,081	40,623	16,073	11,078	15,823
Mean	421	340	298	292	264	301	1,388	970	1,354	518	357	527
Cfsm	0.417	0.337	0.295	0.289	0.261	0.298	1.37	0.960	1.34	0.513	0.353	0.522
In.	0.48	0.38	0.34	0.33	0.27	0.34	1.53	1.11	1.50	0.59	0.41	0.58

Calendar year 1964: Max 1,230 Min 225 Mean 418 Cfsm 0.414 In. 5.62
Water year 1964-65: Max 2,600 Min 225 Mean 585 Cfsm 0.579 In. 7.86

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 14 (no gage-height record, Nov. 24 to Dec. 8, Jan. 17-21, Mar. 16-21).

5-2465. Gull Lake near Brainerd, Minn.

Location.--Lat 46°24'40", long 94°21'26", in N½ sec.20, T.134 N., R.29 W., in pool of dam on Gull River, 800 ft south of outlet of Gull Lake, a quarter of a mile upstream from Gull Lake Dam, and 8 miles northwest of Brainerd.

Drainage area.--287 sq mi.

Records available.--August 1911 to September 1965. Prior to October 1941 month-end contents only, published in WSP 1308. Published as Gull Lake Reservoir October 1941 to September 1956.

Gage.--Water-stage recorder. Datum of gage is 1,188.14 ft above mean sea level, adjustment of 1912. Prior to Aug. 10, 1949, staff gage 800 ft north of present site at same datum.

Extremes.--Maximum contents during year, 64,860 acre-ft June 10, 11 (gage height, 6.55 ft); minimum, 44,430 acre-ft Apr. 2, 3 (gage height, 4.97 ft).
1911-65: Maximum contents, 74,800 acre-ft June 30, 1914 (gage height, 7.30 ft); minimum observed, 22,250 acre-ft Mar. 20, 1924 (gage height, 3.00 ft).

Remarks.--Reservoir is formed by Gull Lake and several other natural lakes controlled by concrete dam completed in 1913; storage began in 1912. Capacity between gage heights 5.00 ft and 7.00 ft (maximum allowable range and normal operating range) is 26,020 acre-ft. Contents shown herein are contents above gage height 1.00 ft. Water is used to benefit navigation on Mississippi River below Minneapolis.

Cooperation.--Records furnished by Corps of Engineers, in terms of cfs-days and converted to acre-feet by Geological Survey.

Month-end gage height and contents, water year October 1964 to September 1965

	Gage height (feet)✗	Contents (acre-feet)	Change in contents (acre-feet)
Sept.30	5.97	57,320	-
Oct. 31	5.65	53,160	-4,160
Nov. 30	5.57	52,170	-990
Dec. 31	5.61	52,760	+590
Calendar year 1964	-	-	+300
Jan. 31	5.56	51,970	-790
Feb. 28	5.26	48,200	-3,770
Mar. 31	5.00	44,830	-3,770
Apr. 30	6.07	58,710	+13,880
May 31	6.20	60,300	+1,590
June 30	6.04	58,310	-1,990
July 31	6.07	58,710	+400
Aug. 31	5.98	57,520	-1,190
Sept.30	6.28	61,490	+3,970
Water year 1964-65	-	-	+4,170

✗ Gage height at 2400.

5-2470. Gull River at Gull Lake Dam, near Brainerd, Minn.

Location.--Lat 46°24'40", long 94°21'12", in sec.20, T.134 N., R.29 W., in headwater and tailwater of dam at outlet of Gull Lake, 8 miles northwest of Brainerd.

Drainage area.--287 sq mi.

Records available.--August 1911 to September 1965. Monthly discharge only for some periods, published in WSP 1308. Published as "at Gull Lake Reservoir" 1929.

Gage.--Water-stage recorder on headwater and staff gage on tailwater. Datum of gages is 1,188.14 ft above mean sea level, adjustment of 1912. August 1911 to May 23, 1929, and Dec. 1, 1929, to Aug. 1, 1949, both gages were staff gages at same site and datum. May 24 to Nov. 30, 1929, staff gage 500 ft downstream at different datum.

Average discharge.--54 years, 101 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 850 cfs June 9-11; minimum daily, 19 cfs Aug. 23, 24. 1911-65: Maximum daily discharge, 1,120 cfs May 15, 1938; no flow at times.

Remarks.--Discharge computed at dam on basis of modified weir formulas, the head being obtained from twice-daily readings on tailwater gage and from headwater recorder. Flow completely regulated by Gull Lake (see preceding page).

Cooperation.--Computations of daily discharge furnished by Corps of Engineers; one discharge measurement made and records reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	112	77	65	69	64	120	162	354	740	69	72	23
2	110	78	65	68	64	126	160	354	740	70	67	22
3	108	78	65	68	62	130	162	352	740	69	67	22
4	106	78	64	68	62	130	163	261	760	69	66	23
5	105	76	64	68	63	129	162	223	775	68	65	23
6	101	76	64	68	63	129	192	352	810	66	69	23
7	98	76	64	68	63	126	240	460	825	66	116	25
8	98	76	64	68	62	124	238	458	835	69	114	25
9	95	76	64	67	115	123	236	460	850	72	112	28
10	91	76	64	66	176	120	238	550	850	71	110	26
11	90	77	64	67	174	120	249	534	850	69	*61	25
12	90	79	65	67	173	144	336	525	845	68	24	29
13	90	78	65	67	169	200	441	346	835	69	24	130
14	90	78	64	67	168	198	584	193	825	69	24	134
15	90	78	64	67	166	195	630	281	810	68	23	198
16	90	77	64	66	162	191	660	366	785	66	22	198
17	91	76	65	66	162	190	* 670	360	765	66	22	198
18	91	75	64	66	159	193	670	368	740	65	22	198
19	90	73	64	66	157	190	670	362	520	64	21	198
20	89	73	64	66	157	185	670	362	435	62	21	198
21	86	68	64	65	154	182	670	458	420	62	20	200
22	84	66	64	65	149	180	670	453	258	63	20	203
23	83	66	66	65	146	177	670	453	188	25	19	203
24	81	66	68	65	122	176	580	552	115	25	19	268
25	81	68	68	66	120	171	580	607	64	25	22	265
26	80	66	68	65	119	168	575	688	63	24	23	258
27	80	67	67	66	118	168	625	820	65	24	24	254
28	80	69	67	65	118	168	625	765	71	22	23	252
29	79	66	68	64		168	443	740	69	22	24	254
30	77	65	68	64	---	166	358	740	69	24	24	306
31	77	---	68	64	---	163	---	740	---	29	24	---
Total	2813	2198	2022	2057	3487	4950	13329	14537	16717	1700	1364	4209
Mean	90.7	73.3	65.2	66.4	125	160	444	469	557	54.8	44.0	140
Cfsm	0.316	0.255	0.227	0.231	0.436	0.557	1.55	1.63	1.94	0.191	0.153	0.488
In.	0.36	0.28	0.26	0.27	0.45	0.64	1.73	1.88	2.17	0.22	0.18	0.55

Calendar year 1964: Max 478 Min 15 Mean 94.1 Cfsm 0.328 In. 4.44
Water year 1964-65: Max 850 Min 19 Mean 190 Cfsm 0.662 In. 8.99

* Discharge measurement made on this day

5-2670. Mississippi River near Royalton, Minn.

Location.--Lat 45°51'40", long 94°21'30", in lot 2, sec.20, T.39 N., R.32 W., at plant of Minnesota Power & Light Co., 4 miles northwest of Royalton, and 4.5 miles downstream from Swan River, and at mile 956 upstream from Ohio River.

Drainage area.--11,600 sq mi, approximately.

Records available.--March 1924 to September 1965.

Average discharge.--41 years, 3,952 cfs.

Extremes.--Maximum daily discharge during year, 37,700 cfs Apr. 16; minimum daily, 1,490 cfs Nov. 29. 1924-65: Maximum daily discharge, that of Apr. 16, 1965; minimum daily, 254 cfs Nov. 25, 1936.

Remarks.--Records fair. Discharge computed on basis of powerplant records. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Flow partly regulated by powerplants and Winnibigoshish, Leech, Pokegama, Sandy, and Gull Lakes and by Pine River Reservoir (see p. 74, 76, 78, 83, 91, 87).

Cooperation.--Records collected by Minnesota Power & Light Co. under general supervision of Geological Survey, in connection with a Federal Power Commission project.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	6,180	3,470	2,620	2,620	2,680	2,630	3,240	21,600	16,200	8,430	3,280	3,260
2	5,680	3,620	2,620	2,690	2,520	2,550	3,740	20,500	14,800	7,580	3,040	3,170
3	5,680	3,620	2,700	2,650	2,510	2,490	3,150	19,900	16,200	7,090	3,280	2,980
4	5,600	3,570	2,810	2,720	2,600	2,420	2,980	19,800	17,300	6,230	*3,280	3,170
5	5,680	3,350	2,680	2,720	2,530	2,390	3,070	18,700	18,800	6,130	3,290	3,230
6	5,490	3,420	2,790	2,720	2,500	2,290	3,750	16,900	20,300	6,050	4,330	3,010
7	5,460	3,340	2,830	2,740	2,460	2,230	4,180	16,700	22,600	5,810	4,110	3,390
8	5,680	3,370	2,900	2,750	2,530	2,310	4,360	16,000	24,400	6,090	3,900	3,170
9	4,930	3,450	2,820	2,620	2,450	2,380	5,070	17,200	26,100	5,760	3,820	3,130
10	5,080	3,220	3,020	2,760	2,470	2,420	7,860	16,500	27,400	5,000	4,260	3,110
11	4,730	3,510	3,020	2,740	2,500	2,400	11,300	16,500	27,600	4,920	4,200	3,290
12	4,700	3,740	2,990	2,760	2,400	2,510	*17,100	16,600	27,000	4,790	4,370	3,400
13	4,700	3,380	2,880	*2,720	2,430	2,580	24,100	15,500	25,600	4,920	3,960	4,120
14	4,090	4,010	2,920	2,660	2,370	2,550	31,900	15,300	24,000	4,430	3,390	4,300
15	4,330	3,840	2,980	2,710	2,380	2,570	37,400	15,000	*22,600	4,310	3,730	5,390
16	4,140	3,860	2,890	2,710	2,460	2,640	37,700	14,100	21,100	4,180	3,250	5,300
17	4,120	3,720	2,870	2,690	2,450	2,860	36,300	14,400	19,500	4,080	3,200	6,190
18	4,480	3,610	2,750	2,660	2,490	2,610	32,500	14,400	18,300	4,030	3,370	6,500
19	4,540	3,720	2,720	2,600	2,470	2,740	32,200	14,200	17,500	3,750	2,980	6,590
20	4,050	3,170	2,750	2,670	2,430	2,760	31,300	14,300	16,800	3,560	2,940	7,060
21	3,970	2,660	2,790	2,710	2,460	2,720	*29,700	15,100	15,900	3,590	2,910	7,060
22	3,880	2,180	2,780	2,580	2,490	2,640	28,200	15,300	15,500	3,760	2,860	7,120
23	3,740	2,450	2,800	2,620	2,500	2,680	27,200	15,100	14,700	3,760	2,840	7,110
24	3,940	2,840	2,830	2,640	2,480	2,630	26,500	16,200	12,200	3,300	2,770	7,120
25	3,820	3,200	2,760	2,620	2,520	2,560	25,900	17,800	11,400	3,080	3,040	7,120
26	3,590	2,690	2,760	2,590	2,550	2,600	25,400	18,400	10,700	3,010	3,500	7,120
27	3,480	2,410	2,710	2,600	2,540	2,720	24,800	18,500	11,000	2,930	3,280	6,960
28	*2,930	2,410	2,720	2,640	2,540	2,810	24,700	18,900	10,600	2,630	2,930	7,120
29	3,330	1,490	2,700	2,610		2,800	23,800	18,000	9,900	2,630	2,960	7,120
30	3,320	2,200	2,720	2,630	---------	2,820	23,300	17,300	8,680	2,830	3,320	9,300
31	3,480	---------	2,720	2,700	---------	3,330	---------	16,500	---------	3,170	3,140	---------
Total	138,820	95,520	86,850	82,850	69,710	80,640	592,700	521,200	544,680	141,830	105,530	156,910
Mean	4,478	3,184	2,802	2,673	2,490	2,601	19,760	16,810	18,160	4,575	3,404	5,230
Cfsm	0.386	0.274	0.242	0.230	0.215	0.224	1.70	1.45	1.57	0.394	0.293	0.451
In.	0.45	0.31	0.28	0.27	0.22	0.26	1.90	1.67	1.75	0.45	0.34	0.50

= 8.40

Calendar year 1964: Max 14,900 Min 1,430 Mean 4,483 Cfsm 0.386 In. 5.27
Water year 1964-65: Max 37,700 Min 1,490 Mean 7,171 Cfsm 0.618 In. 8.40

* Discharge measurement made on this day.

$\frac{7171}{11,600} \times 13.574 =$

$.6182 = 8.39$

5-2705. Sauk River near St. Cloud, Minn.

Location.--Lat 45°33'35", long 94°14'00", in SE¼SW¼ sec.8, T.124 N., R.28 W., on right bank half a mile northwest of Waite Park, 3 miles west of St. Cloud, and 5 miles upstream from mouth.

Drainage area.--925 sq mi.

Records available.--July 1909 to December 1912, April to December 1913, May to November 1929, March 1930 to September 1931, April to November 1932, March to November 1933, March 1934 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 1,034.95 ft above mean sea level, adjustment of 1912. Prior to Nov. 22, 1934, chain gage on highway bridge 1 mile downstream at datum 6.77 ft lower.

Average discharge.--35 years (1909-12, 1930-31, 1934-65), 247 cfs.

Extremes.--Maximum discharge during year, 9,100 cfs Apr. 13 (gage height, 10.68 ft); minimum daily, 33 cfs Nov. 29, 30, Dec. 1, 2; minimum gage height, 0.72 ft Nov. 20.
1909-13, 1929-65: Maximum discharge, that of Apr. 13, 1965 (gage height, 10.68 ft); minimum, 0.3 cfs Nov. 25, 1936.

Remarks.--Records good except those for period of ice effect, which are fair. Flow regulated by powerplants and reservoirs above station.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1 - 15, June 26 to Sept. 30)

0.7	44	4.0	1,200
1.0	89	5.0	1,900
1.5	199	7.0	4,050
2.0	346	10.7	9,130
3.0	720		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	154	67	33	41	50	56	53	1,530	1,140	188	216	*78
2	160	76	33	41	51	55	55	1,440	1,150	225	202	75
3	147	83	34	41	53	55	65	1,340	1,500	216	*196	73
4	147	87	34	*41	54	55	80	1,240	1,500	222	188	72
5	123	86	35	41	56	55	100	732	1,540	225	186	75
6	117	84	35	40	58	57	150	716	1,680	237	186	75
7	114	84	36	40	*58	64	*250	870	1,600	260	205	78
8	112	84	37	40	58	80	450	855	1,680	*312	196	81
9	*99	81	37	40	58	64	800	915	1,650	377	188	87
10	98	84	37	40	58	57	1,500	945	1,600	377	188	91
11	92	84	37	40	58	56	2,500	1,000	1,560	377	186	91
12	92	91	37	40	57	56	*4,500	1,030	1,490	384	175	91
13	92	94	37	41	57	55	7,500	970	1,420	394	172	98
14	92	86	36	41	58	54	*7,940	940	1,350	380	167	110
15	92	83	35	41	58	54	*7,440	960	1,300	368	162	132
16	89	87	35	42	58	53	6,800	960	*1,240	371	170	125
17	87	91	35	42	59	52	*6,040	920	1,170	374	170	138
18	87	89	35	43	60	52	5,270	920	1,120	371	180	157
19	84	86	35	44	60	52	4,610	870	1,050	349	319	175
20	79	68	35	45	60	51	4,050	840	1,000	343	335	188
21	78	74	35	45	60	51	*3,610	895	950	340	208	202
22	73	74	35	45	61	50	3,210	865	900	321	164	231
23	70	70	36	45	61	50	2,840	930	840	318	170	245
24	68	62	36	45	61	50	2,520	1,080	744	321	140	237
25	67	56	37	45	60	*50	2,360	1,200	696	298	117	216
26	*66	49	37	45	59	50	2,230	1,200	596	283	86	205
27	64	43	38	45	58	50	2,040	1,220	237	274	81	205
28	66	37	39	45	58	50	1,910	1,200	199	263	75	205
29	64	33	40	46		50	1,770	1,160	188	248	76	248
30	66	*33	40	47	---------	51	1,650	1,140	183	231	86	440
31	64	----------	41	48	---------	52	----------	1,140	----------	231	84	----------
Total	2,903	2,206	1,122	1,325	1,617	1,687	84,293	32,023	33,273	9,478	5,274	4,524
Mean	93.6	73.5	36.2	42.7	57.8	54.4	2,810	1,030	1,110	306	170	151
Cfsm	0.101	0.079	0.039	0.046	0.062	0.059	3.04	1.11	1.20	0.331	0.184	0.163
In.	0.12	0.09	0.05	0.05	0.07	0.07	3.39	1.29	1.34	0.38	0.21	0.18

Calendar year 1964	Max	1,300	Min	33	Mean	131	Cfsm	0.142	In.	1.93
Water year 1964-65	Max	7,940	Min	33	Mean	492	Cfsm	0.532	In.	7.24

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 13 (no gage-height record Mar. 25-30).

5-2747. St. Francis River at Santiago, Minn.

Location.--Lat 45°32'30", long 93°48'50", in NE¼ sec.10, T.35 N., R.28 W., on the right bank, 0.2 mile east of Santiago and 0.4 mile upstream from bridge on county road.

Records available.--June to September 1965.

Gage.--Water-stage recorder.

Extremes.--Maximum discharge during period, 2,940 cfs Apr. 14 (gage height, 12.17 ft, from floodmark); minimum, 5.6 cfs Aug. 24 (gage height, 3.44 ft).

Remarks.--Records good.

Rating table, Apr. 1 to Sept. 30, 1965 (gage height, in feet, and discharge, in cubic feet per second)

3.4	6.0	5.0	86
3.5	7.6	6.0	172
3.7	15	7.0	318
4.0	26	8.0	490
4.5	52	9.0	770

Discharge, in cubic feet per second, April 1 to September 30, 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									75	7.6	7.6	* 26
2									80	9.0	7.3	24
3									* 96	7.6	* 11	19
4									147	6.9	11	16
5									355	6.6	9.4	13
6									391	6.9	12	12
7									427	8.0	34	11
8									610	9.8	71	10
9									580	*13	45	10
10									428	10	28	13
11									308	8.3	20	10
12							(*)		173	7.6	16	8.7
13									114	24	13	9.4
14							(*)		54	40	11	13
15									38	26	9.4	31
16							(*)		22	30	9.4	51
17									27	24	9.4	50
18									21	19	8.3	46
19									19	16	7.3	41
20									17	13	6.9	40
21									15	12	6.6	40
22							(*)	*66	14	11	6.3	52
23									13	10	6.0	57
24		* 2.1			*0.8				11	12	6.0	50
25									11	11	12	42
26									9.8	9.0	14	34
27									9.8	7.6	20	28
28									9.0	7.3	20	25
29						(*)			8.7	6.3	18	28
30					----------				8.0	6.9	22	143
31		----------			----------		----------		----------	7.6	26	----------
Total									4,091.3	394.0	503.9	953.1
Mean									136	12.7	16.3	31.8
Ac-ft									-	-	-	-

Calendar year : Max Min Mean Ac-ft
Water year : Max Min Mean Ac-ft

* Discharge measurement made on this day.

5-2749. St. Francis River near Big Lake, Minn.

Location.--Lat 45°23'07", long 93°44'02", in NW¼NW¼ sec.5, T.33 N., R.27 W., on right bank 3.6 miles north of Big Lake and 4 miles upstream from mouth.

Records available.--May to September 1965.

Gage.--Water-stage recorder. Altitude of gage is 925 ft (from topographic map).

Extremes.--Maximum discharge during period, 2,700 cfs Apr. 16 (gage height, 11.34 ft, from floodmarks); minimum discharge, 48 cfs Aug. 25 (gage height, 5.26 ft).

Remarks.--Records good.

Rating table, Apr. 1 to Sept. 30, 1965 (gage height, in feet, and discharge, in cubic feet per second)

5.3	50	8.0	256
5.5	60	8.5	337
6.0	87	9.0	470
7.0	154	9.5	820

Discharge, in cubic feet per second, April 1 to September 30, 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									236	99	66	67
2									319	93	64	66
3									*351	85	*65	65
4									341	79	62	65
5									321	76	59	65
6									301	77	58	66
7									284	77	72	67
8									294	85	77	67
9									341	*88	68	65
10									438	82	64	64
11									470	79	62	62
12									495	78	60	67
13									525	89	60	72
14							(*)	*398	568	88	58	87
15									580	80	62	88
16							(*)		505	85	65	91
17									449	85	67	92
18									390	83	64	95
19									310	82	60	97
20								*268	260	82	58	100
21									220	82	55	106
22							(*)		193	81	54	109
23									159	86	52	112
24		(*)			(*)				141	89	55	114
25									126	81	54	115
26								249	114	76	66	117
27								243	104	72	66	119
28								230	99	68	61	119
29						(*)		217	93	65	59	131
30					----------			205	88	63	66	148
31		----------			----------		----------	207	----------	68	*68	----------
Total									9.115	2.503	1.927	2.698
Mean									304	80.7	62.2	89.9
Ac-ft									580	99	77	148

Calendar year 1964: Max Min Mean Ac-ft
Water year 1964-65: Max Min Mean Ac-ft

* Discharge measurement made on this day.

5-2750. Elk River near Big Lake, Minn.

Location.--Lat 45°20', long 93°40', in sec.23, T.33 N., R.27 W., on right bank at upstream side of highway bridge, 4 miles east of Big Lake and 4 miles downstream from St. Francis River.

Drainage area.--615 sq mi.

Records available.--April 1911 to September 1917, April to September 1931, April to November 1932, March to November 1933, March 1934 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 899.60 ft above mean sea level, datum of 1929. April 1911 to Sept. 30, 1917, staff gage and Apr. 1, 1931, to July 26, 1934, chain gage, at same site and datum.

Average discharge.--37 years (1911-17, 1934-65), 244 cfs.

Extremes.--Maximum discharge during year, 7,360 cfs Apr. 16 (gage height, 10.86 ft); minimum discharge, 26 cfs Nov. 20 (gage height, 0.52 ft).
1911-17, 1931-65: Maximum discharge, that of Apr. 16, 1965; minimum, 3.6 cfs July 31, 1934.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 14		Apr. 15 to Sept. 30			
0.5	23	1.1	152	5.0	1,650
0.7	58	1.5	289	8.0	3,500
1.0	128	2.0	469	10.0	5,850
		3.0	830	11.0	7,630

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	76	85	65	77	64	67	83	941	1,100	275	195	247
2	74	85	65	77	64	69	85	874	*1,010	375	192	244
3	72	91	66	77	63	70	89	804	934	303	*212	236
4	72	89	67	*77	63	71	97	739	908	268	202	229
5	74	100	67	77	63	72	113	689	904	250	195	222
6	78	96	68	77	63	71	134	667	941	247	199	212
7	76	93	68	77	63	70	*156	753	948	258	247	205
8	72	93	69	76	*63	69	180	889	941	272	293	205
9	72	93	70	74	63	68	230	1,000	967	*314	296	202
10	72	93	71	72	63	68	290	1,010	1,090	300	275	195
11	72	98	73	71	64	69	390	1,020	1,340	286	258	185
12	*76	103	72	70	64	69	*569	1,020	1,500	272	240	185
13	76	108	72	69	64	69	970	1,010	1,510	303	226	202
14	76	111	72	68	64	70	*2,690	945	1,380	286	209	212
15	76	108	72	67	64	70	4,940	882	1,240	282	199	247
16	76	106	71	67	64	71	*7,170	826	1,070	293	205	264
17	72	106	71	66	64	71	7,030	761	919	289	212	286
18	70	100	72	67	64	71	5,900	717	793	282	202	307
19	72	96	72	68	64	72	*4,350	689	696	272	192	318
20	70	53	72	69	64	72	3,260	678	613	264	178	325
21	72	96	72	70	64	72	2,590	674	541	254	172	332
22	70	89	72	70	64	73	2,200	671	512	250	172	339
23	70	87	71	69	64	74	*1,890	671	473	247	162	343
24	70	91	72	68	64	74	1,610	696	422	268	159	347
25	74	98	73	67	64	74	1,460	735	379	275	199	347
26	72	90	74	66	65	*74	1,360	782	343	258	229	332
27	74	78	74	66	65	76	*1,230	830	318	240	250	321
28	76	69	75	65	65	77	1,120	908	293	226	233	321
29	78	66	76	65		78	1,050	996	275	212	229	332
30	*80	*65	77	64	---------	79	1,000	1,030	264	195	*250	455
31	82	----------	78	64	---------	80	----------	1,070	----------	192	254	----------
Total	2,292	2,736	2,209	2,177	1,787	2,230	54,236	25,977	24,624	8,308	6,736	8,197
Mean	73.9	91.2	71.3	70.2	63.8	71.9	1,808	838	821	268	217	273
Cfsm	0.120	0.148	0.116	0.114	0.104	0.117	2.94	1.36	1.33	0.436	0.353	0.444
In.	0.14	0.17	0.13	0.13	0.11	0.13	3.28	1.57	1.49	0.50	0.41	0.50

Calendar year 1964: Max 1,590 Min 35 Mean 164 Cfsm 0.267 In. 3.63
Water year 1964-65: Max 7,170 Min 53 Mean 388 Cfsm 0.631 In. 8.56

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 26 to Apr. 14 (no gage-height record Jan. 9 to Feb. 7, Feb. 9-23).

5-2780. Middle Fork Crow River near Spicer, Minn.

Location.--Lat 45°15'45", long 94°48'10", in NE¼ sec.27, T.121 N., R.33 W., on right bank 75 ft upstream from highway bridge, 1½ miles downstream from Lake Calhoun, 3 miles downstream from Green Lake, and 6.8 miles northeast of Spicer.

Drainage area.--179 sq mi.

Records available.--March 1949 to September 1965.

Gage.--Water-stage recorder and concrete and steel V-notch sharp-crested weir. Datum of gage is 1,147.93 ft above mean sea level, datum of 1929 (Kandiyohi County Highway Department bench mark). Prior to July 20, 1950, chain gage at bridge 75 ft downstream at same datum.

Average discharge.--16 years, 47.8 cfs.

Extremes.--Maximum discharge during year, 343 cfs May 26 (gage height, 6.12 ft); maximum gage height, 6.29 ft Apr. 9 (backwater from ice); no flow Feb. 10-21; minimum gage height, 1.77 Nov. 20,27.
1949-65: Maximum discharge, 408 cfs June 29, 1953; maximum gage height, 6.67 ft June 25, 1957; no flow Mar. 15-24, 1949, Feb. 26 to Mar. 26, 1960, Dec. 8, 1963, Feb. 10-21, 1965.

Remarks.--Records good except those for period of ice effect, which are fair. Flow affected by natural storage and some regulation from lakes above station.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.8	1.3	2.5	26
1.9	2.3	3.0	58
2.0	4.7	4.0	140
2.1	8.1	5.0	230
2.3	17	6.1	341

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.7	1.6	1.4	1.3	0.4	0.4	1.0	270	293	96	38	18
2	1.9	1.6	1.4	1.3	.4	.5	1.0	252	292	96	35	16
3	2.0	1.6	1.3	1.3	.4	.6	1.0	224	310	86	33	16
4	1.8	*1.5	1.3	1.3	.3	.6	1.2	197	314	78	32	16
5	1.6	1.5	1.3	1.3	.3	.6	1.5	198	331	68	31	17
6	1.6	1.5	1.2	1.3	.2	.7	2.0	201	319	*68	31	16
7	1.5	1.5	* 1.2	1.3	.2	.7	3.0	206	311	69	32	17
8	1.4	1.5	1.2	* 1.2	.1	.7	6.0	210	307	76	30	17
9	1.4	1.5	1.2	1.2	.1	.8	55	218	*302	76	28	18
10	1.5	1.5	1.2	1.2	0	.8	230	208	293	67	26	18
11	1.5	1.6	1.2	1.2	0	.9	260	207	283	62	25	15
12	* 1.5	1.5	1.2	1.2	0	.9	*240	211	270	60	24	16
13	1.4	1.4	1.2	1.2	0	.9	220	217	256	64	23	19
14	1.4	1.4	1.2	1.2	0	.9	200	221	247	62	22	19
15	1.4	1.5	1.2	1.1	* 0	.9	190	227	242	58	21	19
16	1.4	1.4	1.2	1.1	0	* .9	200	225	236	57	23	19
17	1.4	1.5	1.2	1.1	0	1.0	203	209	230	57	*23	23
18	1.4	1.4	1.2	1.0	0	1.0	194	197	226	55	22	22
19	1.4	1.4	1.2	1.0	0	1.0	175	227	221	52	20	24
20	1.4	1.3	1.2	1.0	0	1.0	165	274	217	49	19	24
21	1.4	1.3	1.3	1.0	0	1.0	166	298	212	48	18	25
22	1.4	1.4	1.3	1.0	.1	1.0	*172	302	212	48	17	26
23	1.5	1.5	1.3	1.0	.1	1.0	178	308	203	48	16	27
24	1.5	1.4	1.3	1.0	.1	1.0	187	322	188	48	15	27
25	1.5	1.4	1.3	1.0	.2	1.0	198	341	168	46	22	27
26	1.5	1.4	1.3	1.0	.2	1.0	209	341	145	44	20	24
27	1.6	1.4	1.3	.9	.2	1.0	243	337	138	42	21	23
28	1.5	1.4	1.3	.8	.3	1.0	270	324	139	40	17	24
29	1.5	1.3	1.3	.7		1.0	281	311	126	38	16	28
30	1.5	1.4	1.3	.6	---	1.0	280	302	108	37	*18	51
31	1.5	---	1.3	.5	---	1.0	---	297	---	41	19	---
Total	47.0	43.6	39.0	33.3	3.6	26.8	4,532.7	7,882	7,139	1,836	737	651
Mean	1.52	1.45	1.26	1.07	0.13	0.86	151	254	238	59.2	23.8	21.7
Cfsm	0.0085	0.0081	0.0070	0.0060	0.00073	0.0048	0.844	1.42	1.33	0.331	0.133	0.121
In.	0.010	0.009	0.008	0.007	0.0007	0.006	0.94	1.64	1.48	0.38	0.15	0.14

Calendar year 1964: Max 183 Min 0.8 Mean 24.0 Cfsm 0.134 In. 1.83
Water year 1964-65: Max 341 Min 0 Mean 62.9 Cfsm 0.351 In. 4.77

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 29 to Apr. 17.

5-2790. South Fork Crow River near Mayer, Minn.

Location.--Lat 44°54'20", long 93°53'05", in SW¼SW¼ sec.30, T.117 N., R.25 W., near center of span on downstream side of bridge on State Highway 7, 1.3 miles north of Mayer, 4.3 miles southwest of Watertown, and 16 miles upstream from confluence with North Fork.

Drainage area.--1,170 sq mi, approximately.

Records available.--April 1934 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Wire-weight gage read once or twice daily. Datum of gage is 926.00 ft above mean sea level (levels by Hennepin County Park Board Survey). Prior to June 14, 1940, chain gage at same site and datum.

Average discharge.--31 years, 227 cfs.

Extremes.--Maximum discharge during year, 16,100 cfs Apr. 13 (gage height, 19.23 ft, from floodmark); minimum daily, 1.1 cfs Feb. 7 to Mar. 7; minimum gage height, 0.76 ft Dec. 21.
1934-65: Maximum discharge, that of Apr. 13, 1965, no flow at times.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 9		Apr. 10 to Sept. 30			
0.9	11	1.5	53	9.0	2,300
1.1	22	2.0	121	12.0	4,400
1.3	40	3.0	290	15.0	7,800
		4.0	494	19.2	16,800
		6.0	1,050		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	25	13	5.8	2.2	1.2	1.1	2.0	2,360	1,630	296	190	83
2	24	14	5.5	2.1	1.2	1.1	2.4	2120	1,630	290	172	83
3	19	16	5.3	2.1	1.2	1.1	4.0	1,950	1,510	251	161	72
4	25	* 16	5.1	2.1	1.2	1.1	9.5	1,760	* 1,310	262	153	71
5	* 25	14	4.9	2.1	1.2	1.1	34	1,640	1,210	236	145	64
6	26	14	4.8	2.0	1.2	1.1	* 68	1,510	1,180	*236	142	64
7	24	14	* 4.7	2.0	1.1	1.1	250	1,550	1,200	273	158	63
8	21	18	4.7	* 2.0	1.1	1.2	*1,160	1,670	1,160	279	192	62
9	19	18	4.6	2.0	1.1	1.2	*2,060	1,820	1,120	536	158	61
10	21	17	4.5	2.0	1.1	1.2	5,910	1,950	1,110	506	140	60
11	18	19	4.3	1.9	1.1	1.2	*10,800	1,970	1,080	459	121	61
12	21	21	4.2	1.9	1.1	1.2	*14,500	1,760	1,020	445	116	56
13	21	19	4.0	1.8	1.1	1.2	*15,900	1,730	912	483	110	64
14	19	18	3.8	1.8	1.1	1.2	15,200	1,600	798	656	94	74
15	19	18	3.6	1.7	*1.1	1.2	13,600	1,430	700	624	89	70
16	21	17	3.3	1.6	1.1	1.2	11,400	1,310	632	652	83	69
17	17	16	3.1	1.6	1.1	1.2	9,120	1,280	559	742	77	69
18	16	15	3.0	1.5	1.1	1.2	7,390	1,190	492	705	* 79	76
19	14	13	2.8	1.5	1.1	1.2	6,330	1,160	445	702	75	89
20	13	12	2.7	1.4	1.1	1.3	5,510	1,160	404	659	94	94
21	17	10	2.6	1.4	1.1	1.3	5,160	1,160	382	516	87	99
22	16	9.1	2.6	1.4	1.1	1.3	* 4,710	1,100	404	445	83	104
23	16	8.3	2.5	1.4	1.1	1.3	4,060	1,060	453	378	77	113
24	14	8.2	2.5	1.4	1.1	1.4	3,630	1,040	418	336	75	104
25	15	8.1	2.4	1.3	1.1	*1.4	3,330	1,070	408	320	79	90
26	14	7.9	2.4	1.2	1.1	1.5	* 3,170	1,230	386	288	90	87
27	14	7.5	2.4	1.2	1.1	1.5	2,990	1,320	370	257	98	84
28	13	6.8	2.3	1.2	1.1	1.6	2,840	1,430	360	219	83	90
29	14	6.3	2.3	1.2		1.7	2,710	1,630	338	204	77	104
30	13	6.0	2.3	1.2	---------	1.7	* 2,540	1,740	306	188	* 79	360
31	13	----------	2.2	1.2	---------	1.9	----------	1,700	----------	205	83	----------
Total	567	400.2	111.2	51.4	31.4	40.0	154,389.9	47,400	23,927	12,648	3,460	2,640
Mean	18.3	13.3	3.59	1.66	1.12	1.29	5,146	1,529	798	408	112	88.0
Cfsm	0.016	0.011	0.0031	0.0014	0.00096	0.0011	4.40	1.31	0.682	0.349	0.096	0.075
In.	0.02	0.01	0.004	0.002	0.001	0.001	4.91	1.51	0.76	0.40	0.11	0.08

Calendar year 1964: Max 483 Min 2.2 Mean 51.1 Cfsm 0.044 In. 0.60
Water year 1964-65: Max 15,900 Min 1.1 Mean 673 Cfsm 0.575 In. 7.81

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19 to Apr. 9 (no gage-height record Dec. 11, 13, 14, Mar. 1, 2, 17, 18).

5-2800. Crow River at Rockford, Minn.

Location.--Lat 45°05'15", long 93°44'00", in sec.29, T.119 N., R.24 W., on right bank at Rockford, 150 ft downstream from bridge on State Highway 55 and 1 mile downstream from confluence of North and South Forks.

Drainage area.--2,520 sq mi, approximately.

Records available.--April to July 1906 (published as "near Dayton"), June 1909 to September 1917, April to November 1929, March 1930 to September 1931, April to November 1932, March to November 1933, March 1934 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 893.65 ft above mean sea level, adjustment of 1912. Apr. 13 to July 21, 1906, staff gage at Berning Mill 14 miles downstream at different datum. June 4, 1909, to Sept. 30, 1917, staff gage at site 600 ft downstream at different datum. Apr. 23, 1929, to Aug. 21, 1934, chain gage at site 600 ft downstream at present datum.

Average discharge.--40 years (1909-17, 1930-31, 1934-65), 571 cfs.

Extremes.--Maximum discharge during year, 22,400 cfs Apr. 16 (gage height, 19.27 ft, from floodmark); minimum daily, 20 cfs Dec. 31, Jan. 1, 2; minimum gage height, 1.68 ft Mar. 19.
1909-17, 1929-65: Maximum discharge, that of Apr. 16, 1965; minimum, 1.8 cfs Nov. 15, 1936 (gage height, 1.05 ft), caused by ice jam upstream.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 11		Apr. 12 to Sept. 30			
1.5	30	2.5	220	7.0	3,410
1.6	38	3.0	401	10.0	6,210
1.7	47	3.5	662	14.0	10,800
1.8	61	4.0	1,010	18.0	18,400
2.0	97	5.0	1,800	19.2	22,200
2.1	117				

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	115	60	35	20	*35	36	30	6,200	3,470	1,120	899	342
2	107	63	35	20	35	35	30	5,700	3,450	1,110	877	342
3	99	68	35	22	35	35	30	5,240	3,430	1,050	849	300
4	91	70	34	23	35	35	31	4,810	3,300	987	766	276
5	91	77	34	23	35	34	32	4,490	3,170	942	681	263
6	93	77	34	24	34	34	50	*4,230	3,070	921	656	253
7	91	78	34	26	34	34	160	4,150	2,970	921	662	250
8	91	78	33	28	34	33	450	4,280	2,920	979	681	247
9	88	84	33	30	34	33	*1,400	4,540	2,860	1,180	638	244
10	86	76	33	31	33	33	3,100	4,600	2,820	1,270	591	241
11	82	77	33	32	33	32	*6,800	4,580	2,810	1,260	552	235
12	84	79	33	33	33	*32	11,900	4,450	2,780	1,250	504	238
13	86	80	32	34	33	32	*15,700	4,230	2,710	1,330	475	250
14	84	79	32	35	33	32	*19,500	3,990	2,600	1,420	437	260
15	82	78	32	*35	33	32	21,900	3,740	2,460	1,510	410	272
16	82	77	*31	35	33	32	22,100	3,510	2,310	1,570	388	269
17	84	76	31	35	33	31	20,700	3,300	2,180	1,670	371	279
18	80	74	31	35	33	31	18,900	3,200	2,060	1,740	358	286
19	73	72	31	35	33	31	17,200	3,060	1,950	1,760	346	311
20	73	70	30	35	33	31	*15,300	2,990	1,900	1,770	326	334
21	73	68	29	35	33	31	13,700	3,000	1,750	1,750	326	354
22	73	60	28	35	33	31	*12,400	2,930	1,710	1,680	314	362
23	75	52	27	35	34	30	11,300	2,900	1,710	1,600	300	371
24	72	46	27	35	34	30	10,200	2,870	1,640	1,500	272	358
25	72	42	26	35	34	29	9,370	2,860	1,560	1,400	300	350
26	72	40	25	35	*35	29	*8,750	2,890	1,500	1,310	314	318
27	75	38	24	35	36	30	8,190	2,970	1,420	1,220	330	318
28	61	37	23	35	37	30	7,700	3,060	1,340	1,120	326	314
29	57	36	21	35		30	7,180	*3,170	1,260	*1,020	314	354
30	*57	*35	*21	35	---------	30	*6,680	3,300	*1,180	957	*330	*688
31	57	----------	20	35	---------	*30	----------	3,410	----------	913	362	----------
Total	2506	1,947	927	976	950	988	270,783	118,650	70,290	40,230	14,955	9,279
Mean	80.8	64.9	29.9	31.5	33.9	31.9	9,026	3,827	2,343	1,298	482	309
Cfsm	0.032	0.026	0.012	0.012	0.013	0.013	3.58	1.52	0.930	0.515	0.191	0.123
In.	0.04	0.03	0.01	0.02	0.01	0.01	4.00	1.75	1.04	0.59	0.22	0.14

Calendar year 1964: Max 1,410 Min 20 Mean 180 Cfsm 0.071 In. 0.98
Water year 1964-65: Max 22,100 Min 20 Mean 1,459 Cfsm 0.579 In. 7.86 ✓

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Dec. 1 to Apr. 11. No gage-height record Nov. 10-30.

$\frac{1459}{2520} \times 13.5744 = 7.86$

.57897

5-2840. Mille Lacs Lake at Garrison, Minn.

Location.--Lat 46°18'05", long 93°49'05", in SW¼SE¼ sec.12, T.44 N., R.28 W., at pumphouse of Minnesota Division of Game and Fish, a quarter of a mile southwest of Borden Lake Outlet and three-quarters mile northeast of Garrison.

Records available.--June 1931 to September 1965. Prior to October 1939, published as "at Wealthwood."

Gage.--Water-stage recorder. Datum of gage is 1,240.40 ft above mean sea level, datum of 1929. Prior to Oct. 1, 1941, staff gage at Wealthwood at various datums; gage readings have been reduced to elevations above mean sea level, adjustment of 1912. Oct. 1, 1941, to Sept. 30, 1958, water-stage recorder at datum 1,240.50 ft above mean sea level, adjustment of 1912. To convert these records to datum of 1929, subtract 0.10 ft.

Extremes.--Maximum elevation during year, 1,252.33 ft June 13 (affected by wind action); minimum, 1,250.15 ft Oct. 3 (affected by wind action).
1931-65: Maximum elevation, 1,253.51 ft July 25, 1952; minimum observed, 1,245.74 ft Oct. 16-19, 1936.

Remarks.--Water level affected by fixed-crest spillway at outlet of Ogechie Lake with crest at elevation 1,250.50 ft. Water level subject to fluctuation caused by change in direction and velocity of wind and by seiches.

Mean daily elevation, in feet, October 1964 to September 1965

Oct. 31.....1,250.42	Feb. 3.....1,250.50	June 17.....1,252.17
Nov. 21.....1,250.20	Mar. 19.....1,250.86	July 30.....1,251.42
Dec. 23.....1,250.40	Apr. 14.....1,251.16	Aug. 31.....1,251.62
Jan. 13.....1,250.47	May 24.....1,251.89	Sept.28.....1,251.83

Note.--Elevations other than those shown are available.

5-2860. Rum River near St. Francis, Minn.

Location.--Lat 45°19'40", long 93°22'20", in SE¼ sec.19, T.33 N., R.24 W., on left bank at upstream side of highway bridge, 4 miles south of St. Francis and 15¾ miles upstream from mouth.

Drainage area.--1,360 sq mi, approximately.

Records available.--May to November 1929, March 1930 to September 1931, April to November 1932, March 1933 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 861.12 ft above mean sea level, adjustment of 1912. Prior to Nov. 9, 1933, chain gage at site 50 ft downstream at same datum.

Average discharge.--33 years (1930-31, 1933-65), 535 cfs.

Extremes.--Maximum discharge during year, 10,100 cfs Apr. 20 (gage height, 11.57 ft); minimum, 106 cfs Nov. 20 (gage height, 2.25 ft).
1929-65: Maximum discharge, that of Apr. 20, 1965; minimum, 29 cfs Aug. 18, 1934 (gage height, 1.91 ft).

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Occasional regulation by Ogechie (also controls Mille Lacs Lake) and Onamia Lakes.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 14		Apr. 15 to Sept. 30			
2.1	80	2.7	222	5.0	1,890
2.5	202	3.0	342	7.0	4,080
3.0	400	3.5	632	9.0	6,690
		4.0	1,010	11.5	9,960

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	130	142	124	117	120	136	129	2,700	2,220	461	316	502
2	*133	142	*123	116	121	139	132	2,490	* 2,160	473	*311	456
3	133	145	123	115	122	141	136	2,260	1,910	479	324	439
4	130	145	123	115	123	141	144	2,000	1,720	450	320	402
5	127	145	124	115	124	142	160	1,760	1,620	444	311	400
6	124	142	125	*116	126	141	182	1,550	1,610	* 433	320	390
7	118	139	126	117	127	141	202	1,520	1,640	423	386	375
8	115	136	128	116	*127	140	227	1,630	1,770	433	412	370
9	115	136	129	115	128	138	268	1,830	1,930	456	439	365
10	115	136	130	113	128	137	310	2,040	2,130	456	439	*355
11	112	138	131	112	126	134	500	2,200	2,330	433	396	335
12	112	145	130	112	124	130	* 1,080	2,250	2,520	428	357	335
13	115	151	129	111	122	127	1,600	2,250	2,660	461	329	345
14	118	151	124	112	121	126	2,200	2,230	2,720	552	307	370
15	118	151	120	110	121	123	2,740	2,150	2,580	646	294	415
16	121	148	118	117	121	120	4,040	2,010	2,240	686	282	455
17	121	151	115	119	121	118	* 6,710	1,800	1,800	786	278	485
18	124	151	114	123	122	117	8,890	1,680	1,420	735	274	520
19	133	148	115	127	122	116	* 9,900	1,570	1,190	646	270	555
20	136	125	116	128	122	115	9,880	1,480	1,020	572	254	590
21	136	127	117	128	123	114	* 9,180	1,420	906	496	251	620
22	136	132	118	128	123	114	* 8,060	1,320	818	456	247	650
23	136	142	120	127	124	113	7,290	1,220	749	418	247	670
24	136	142	119	127	127	113	6,320	1,160	700	418	240	700
25	139	142	118	126	127	114	5,480	1,190	639	402	270	700
26	139	140	118	125	127	*116	4,720	1,230	592	381	266	680
27	139	138	118	124	128	117	* 4,130	1,310	572	366	333	650
28	139	132	119	123	130	118	3,640	1,490	546	338	456	630
29	*142	129	119	122		120	3,250	1,710	527	320	515	670
30	142	125	119	121		122	2,940	1,940	485	316	527	780
31	142		118	120		125		2,130		324	*515	
Total	3,976	4,216	3,770	3,697	3,477	3,908	104,440	55,520	45,724	14,688	10,486	15,209
Mean	128	141	122	119	124	126	3,481	1,791	1,524	474	338	507
Cfsm	0.094	0.104	0.090	0.088	0.091	0.093	2.56	1.32	1.12	0.349	0.249	0.373
In.	0.11	0.12	0.10	0.10	0.10	0.11	2.86	1.52	1.25	0.40	0.29	0.42

Calendar year 1964: Max 4,070 Min 97 Mean 330 Cfsm 0.243 In. 3.29
Water year 1964-65: Max 9,900 Min 110 Mean 737 Cfsm 0.542 In. 7.38

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20-22, Nov. 26 to Apr. 14. No gage-height record Sept. 5-30.

5-2885. Mississippi River near Anoka, Minn.

Location.--Lat 45°07'36", long 93°17'48", in SW¼ sec.12, T.119 N., R.21 W., on right bank half a mile downstream from Coon Creek, 1½ miles downstream from hydroelectric plant of Northern States Power Co. at Coon Rapids, 6½ miles downstream from Anoka, and at mile 864.8 upstream from Ohio River.

Drainage area.--19,100 sq mi, approximately.

Records available.--June 1931 to September 1965. Prior to October 1931 published as "at Coon Rapids, near Anoka."

Gage.--Water-stage recorder. Datum of gage is 805.02 ft above mean sea level, adjustment of 1912. Prior to June 14, 1932, at site 1¼ miles upstream at different datum.

Average discharge.--34 years, 6,859 cfs.

Extremes.--Maximum discharge during year, 91,000 cfs Apr. 17 (gage height, 19.53 ft, from floodmark); minimum, 1,740 cfs Nov. 29 (gage height, 1.25 ft).
1931-65: Maximum discharge, that of Apr. 17, 1965; minimum, 586 cfs Sept. 13, 1934 (gage height, 0.37 ft).

Remarks.--Records good. Flow slightly regulated by six reservoirs on headwaters; total usable capacity, 1,640,600 acre-ft. Diurnal regulation caused by powerplant above station. Records of chemical analyses for the water year 1965 are published in Part 2 of this report.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.3	1,820	9.0	28,000
2.0	3,090	12.0	43,500
3.0	5,320	16.0	67,500
4.0	8,160	19.5	90,800
6.0	15,100		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7,490	4,060	2,450	3,400	3,250	3,250	3,820	35,800	29,700	12,900	5,740	5,430
2	7,650	4,670	2,750	3,500	3,300	3,150	3,970	33,600	27,300	13,500	5,960	* 5,090
3	6,800	5,070	3,250	3,400	3,350	3,250	4,000	31,700	* 27,000	12,300	5,930	5,580
4	6,200	4,960	3,350	3,300	3,200	3,250	4,500	*30,200	27,900	11,400	5,910	5,230
5	6,120	* 4,300	3,550	3,300	3,100	3,150	4,300	29,600	29,200	10,500	* 5,860	4,850
6	6,670	4,200	3,550	3,400	3,200	3,250	4,350	27,700	30,900	9,600	5,850	4,930
7	6,190	4,320	3,500	3,500	3,100	3,050	5,080	27,200	33,100	9,920	6,600	5,210
8	6,550	4,150	3,600	3,400	3,050	3,000	6,020	27,200	34,900	9,810	7,010	5,040
9	6,490	4,380	3,750	3,400	3,050	3,050	7,590	28,500	36,200	10,500	6,500	5,520
10	5,750	4,330	3,950	3,350	3,100	3,050	10,300	28,700	38,000	*10,000	6,800	5,260
11	5,220	4,280	4,000	3,300	3,200	3,050	15,900	*28,400	39,600	9,180	6,500	4,830
12	5,450	4,240	3,900	3,300	3,150	2,950	38,200	28,000	40,300	9,030	6,630	4,920
13	*5,420	4,840	3,750	3,350	3,000	3,050	51,000	28,000	39,600	9,330	6,210	4,970
14	5,390	4,580	3,600	3,400	2,950	3,050	63,600	26,600	37,700	8,860	6,170	5,980
15	4,700	4,590	3,400	3,250	2,900	3,250	79,800	26,300	35,500	8,830	5,820	6,380
16	5,090	4,800	3,450	3,350	3,050	3,200	89,200	25,600	32,700	8,790	5,460	7,340
17	5,200	5,110	3,400	3,250	3,150	3,200	*90,300	24,200	30,100	8,680	5,600	6,940
18	5,040	4,780	3,250	3,250	3,050	3,050	86,400	24,500	27,400	8,730	5,460	8,290
19	5,190	4,450	3,300	3,250	3,050	3,200	81,600	23,800	25,400	8,600	5,380	8,830
20	5,490	4,240	3,350	3,350	3,000	3,400	76,100	23,000	24,000	7,840	5,220	9,380
21	4,920	3,340	3,300	3,300	3,100	3,400	*70,500	23,500	22,400	7,940	4,950	9,810
22	4,960	3,360	3,250	3,500	3,100	3,400	64,900	23,900	21,400	7,800	4,940	9,920
23	4,680	3,030	3,200	3,400	3,100	3,350	* 59,200	23,500	20,900	7,900	4,770	9,710
24	4,620	3,490	3,400	3,350	3,200	3,350	54,300	24,300	19,700	7,780	4,710	10,200
25	4,840	3,580	3,500	3,350	3,100	3,200	51,000	26,000	17,100	7,340	4,860	10,100
26	4,400	3,650	3,450	3,200	3,000	3,250	*48,100	27,900	16,200	6,790	4,680	10,200
27	4,710	2,930	3,350	3,350	3,150	3,100	44,900	28,600	15,500	6,650	5,640	10,100
28	4,580	3,130	3,200	3,250	3,150	3,150	42,400	28,700	15,500	6,330	5,710	9,920
29	4,200	2,350	3,400	3,250		3,100	40,400	28,700	14,400	5,810	5,450	10,300
30	3,930	2,100	3,550	3,200	---------	3,550	38,300	28,700	13,500	5,730	5,280	11,700
31	4,160	----------	3,450	3,200	---------	4,000	----------	29,100	----------	5,470	5,430	----------
Total	168,100	121,310	106,150	103,350	87,100	99,700	1,245,030	851,500	823,100	273,840	177,030	221,960
Mean	5,423	4,044	3,424	3,334	3,111	3,216	41,500	27,470	27,440	8,834	5,711	7,399
Cfsm	0.284	0.212	0.179	0.175	0.163	0.168	2.17	1.44	1.44	0.463	0.299	0.387
In.	0.33	0.24	0.21	0.20	0.17	0.19	2.42	1.66	1.60	0.53	0.34	0.43

Calendar year 1964: Max 23,700 Min 1,820 Mean 5,856 Cfsm 0.307 In. 4.20
Water year 1964-65: Max 90,300 Min 2,100 Mean 11,720 Cfsm 0.614 In. 8.32

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 30 to Apr. 12. No gage-height record May 17-29, Aug. 6-10.

$\frac{11720}{19,100} \times 13,574 = 8,329$

.6136

$\frac{11716}{19,100} \times 13,57$

5-2900. Little Minnesota River near Peever, S. Dak.

Location.--Lat 45°36'05", long 96°52'18", in SW¼ sec.13, T.125 N., R.50 W., on right bank, 2 miles northwest of town of Browns Valley, Minn., 3¼ miles upstream from proposed Lake Traverse diversion, 5.3 miles northeast of Peever, 7¼ miles downstream from Jorgenson River, and 8 miles upstream from Big Stone Lake.

Drainage area.--447 sq mi.

Records available.--October 1939 to September 1965.

Gage.--Water-stage recorder. Altitude of gage is 1,000 ft (from topographic map). Oct. 1, 1939, to Mar. 20, 1940, staff gage at site 4½ miles downstream at different datum. Mar. 21 to Apr. 12, 1940, staff gage at site 100 ft downstream at present datum. Apr. 13 to Aug. 27, 1940, staff gage at present site and datum.

Average discharge.--26 years, 48.0 cfs (34,750 acre-ft per year).

Extremes.--Maximum discharge during year, 2,920 cfs June 2 (gage height, 9.46 ft); maximum gage height, 9.48 ft May 21; minimum daily discharge, 0.2 cfs Feb. 11 to Mar. 3; minimum gage height, 2.00 ft Feb. 4, 5, Sept. 5. 1939-65: Maximum discharge, 4,730 cfs Apr. 8, 1952 (gage height, 12.16 ft); maximum gage height, 13.35 ft Mar. 25, 1943, from floodmark (backwater from ice); no flow at times in 1940, 1942, 1950, 1954, 1957, 1959, 1963.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.8	0.1	2.4	7.1	3.6	163
1.9	.3	2.5	10	4.0	264
2.0	.6	2.6	16	4.5	394
2.1	1.4	2.8	32	5.0	525
2.2	2.9	3.0	52	6.0	870
2.3	4.8	3.3	98	8.0	1,900

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.5	0.5	0.5	0.4	0.3	0.2	2.6	47	301	23	8.2	*1.5
2	.4	.5	*.5	.4	.3	.2	3.3	42	1,740	20	7.4	1.4
3	.5	.5	.5	.4	.3	.2	16	36	* 565	20	6.6	1.1
4	.5	.5	.4	.4	.3	.3	*116	32	417	17	6.6	1.1
5	.5	.5	.4	*.4	.3	.3	*426	30	321	15	5.6	.8
6	.5	.5	.4	.4	.3	.3	*250	29	316	23	5.6	1.1
7	.5	.5	.4	.4	.3	.4	288	27	334	22	7.1	1.3
8	*.5	.5	.4	.4	.3	.5	*624	23	389	*25	7.6	1.2
9	.5	.5	.4	.4	.3	.8	*494	22	324	26	6.8	1.2
10	.5	.5	.5	.4	.3	1.0	480	20	238	26	* 6.6	1.1
11	.5	.6	.5	.4	.2	1.3	800	21	198	25	5.6	1.0
12	.4	.6	.5	.4	*.2	1.5	881	19	166	25	5.0	2.0
13	.3	.5	.5	.3	.2	1.7	689	16	142	31	4.3	2.2
14	.3	.6	.5	.3	.2	1.7	541	16	125	26	3.7	1.5
15	.2	.6	.5	.3	.2	1.8	471	37	108	21	2.9	1.5
16	.2	.6	.4	.3	.2	1.8	391	145	91	17	2.9	2.0
17	.2	*.6	.4	.3	.2	*1.8	300	158	77	13	2.7	2.4
18	.2	.6	.4	.3	.2	1.8	243	* 154	66	12	3.1	2.9
19	.2	.6	.4	.3	.2	1.8	210	112	60	11	2.7	3.1
20	.3	.6	.4	.3	.2	1.8	190	93	52	11	2.6	3.1
21	.3	.6	.4	.3	.2	1.8	173	1,210	61	11	2.0	5.0
22	.3	.6	.4	.3	.2	1.8	161	634	54	10	1.9	5.0
23	.4	.6	.4	.3	.2	1.8	*145	534	49	13	1.6	6.1
24	.4	.6	.4	.3	.2	1.8	125	819	40	12	1.4	7.4
25	.4	.6	.4	.3	.2	1.8	108	1,000	36	11	2.0	7.1
26	.4	.6	.4	.3	.2	1.9	94	750	32	9.5	1.7	5.4
27	.4	.6	.4	.3	.2	1.9	82	570	32	9.5	1.9	4.8
28	.5	.6	.4	.3	.2	2.0	71	451	29	18	1.5	4.8
29	.5	.5	.4	.3		2.1	64	371	27	16	1.7	6.6
30	.6	.5	.4	.3	----------	2.2	55	326	24	12	1.6	18
31	.5	----------	.4	.3	----------	2.4	----------	272	----------	9.2	1.5	----------
Total	12.4	16.7	13.3	10.5	6.6	42.7	8,493.9	8,016	6,414	540.2	122.4	103.7
Mean	0.40	0.56	0.43	0.34	0.24	1.38	283	259	214	17.4	3.95	3.46
Cfsm	0.00089	0.0013	0.00096	0.00076	0.00054	0.0031	0.633	0.579	0.479	0.039	0.0088	0.0077
In.	0.001	0.001	0.001	0.0009	0.0005	0.004	0.71	0.67	0.53	0.04	0.01	0.009
Ac-ft	25	33	26	21	13	85	16,850	15,900	12,720	1,070	243	206

Calendar year 1964: Max 213 Min 0.2 Mean 15.1 Cfsm 0.034 In. 0.46 Ac-ft 10,980
Water year 1964-65: Max 1,740 Min 0.2 Mean 65.2 Cfsm 0.146 In. 1.98 Ac-ft 47,190

Peak discharge (base, 450 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-12	1400	6.27	920	5-25	1630	6.55	1,160
5-21	1530	9.48	2,880	6- 2	0715	9.46	2,920

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 28 to Apr. 11.

GPO 826-476-8

5-2910. Whetstone River near Big Stone City, S. Dak.

Location.--Lat 45°17'32", long 96°29'14", in SE¼NW¼ sec.18, T.121 N., R.46 W., on right bank 20 ft downstream from highway bridge, 1½ miles west of Big Stone City, and 4½ miles upstream from Big Stone Lake.

Drainage area.--389 sq mi.

Records available.--March 1910 to November 1912 (no winter records) and March 1931 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 996.96 ft above mean sea level, adjustment of 1912. Mar. 8, 1910, to Nov. 30, 1912, staff gage 2 miles downstream at different datum. Mar. 18, 1931, to Aug. 27, 1938, chain gage and Aug. 28, 1938, to May 3, 1939, wire-weight gage, at site 20 ft upstream at present datum. May 4, 1939, to Nov. 8, 1952, water-stage recorder at site 80 ft downstream at present datum.

Average discharge.--34 years (1931-65), 45.8 cfs (33,160 acre-ft per year).

Extremes.--Maximum discharge during year, 1,740 cfs Apr. 6 (gage height, 8.57 ft); minimum, 0.9 cfs Oct. 1 (gage height, 1.85 ft).
1910-12, 1931-65: Maximum discharge, 5,710 cfs Apr. 8, 1952 (gage height, 13.64 ft, from floodmark); maximum gage height, 13.95 ft Apr. 11, 1947; no flow at times in most years.
Maximum stage known, about 26 ft in June 1919, present site and datum, from information by local resident.

Remarks.--Records good except those for period of ice effect, which are fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.3	4.9	*4.2	3.0	2.2	2.0	6	41	90	21	6.9	*3.1
2	1.6	6.6	4.2	3.0	2.2	2.0	27	38	81	21	6.9	3.1
3	1.7	4.2	4.2	2.9	2.1	2.0	130	37	77	21	6.9	2.7
4	1.8	4.3	4.2	2.8	2.1	2.0	*427	35	*75	18	6.4	2.6
5	2.0	5.1	4.2	*2.7	2.1	2.0	*1,010	35	72	17	6.1	2.6
6	1.7	4.2	4.2	2.7	2.0	2.1	*1,680	38	86	25	6.4	3.2
7	1.7	4.2	4.1	2.7	2.0	2.1	1,630	36	96	35	6.9	3.4
8	*1.6	4.2	4.1	2.7	2.0	2.2	*1,460	33	121	*43	6.9	3.2
9	1.7	5.4	4.2	2.7	1.9	2.2	*976	36	117	45	6.4	3.2
10	1.7	4.5	4.2	2.7	1.9	2.3	705	35	97	41	*5.4	2.8
11	1.8	4.5	4.2	2.7	*1.9	2.4	1,000	35	73	34	4.9	3.1
12	2.8	5.4	4.2	2.6	1.9	2.6	905	33	61	28	4.6	3.8
13	2.7	5.1	4.1	2.6	1.9	2.7	498	30	55	24	4.3	4.3
14	2.4	4.6	4.0	2.5	1.9	2.8	354	31	49	20	4.0	4.3
15	2.0	4.9	4.0	2.5	1.9	2.9	313	40	45	17	4.0	4.3
16	2.0	5.1	3.9	2.5	1.9	3.0	281	177	39	15	4.5	4.5
17	2.0	4.6	3.8	2.4	1.9	3.0	187	132	35	14	4.6	4.6
18	2.4	*4.6	3.7	2.4	1.9	3.1	130	79	32	12	4.9	4.5
19	2.8	4.6	3.7	2.4	1.9	3.1	107	*58	30	12	4.9	5.6
20	2.7	4.6	3.7	2.4	1.9	3.2	103	48	30	12	4.3	5.4
21	2.7	4.6	3.6	2.4	1.9	3.2	100	48	29	12	4.3	7.2
22	3.4	4.6	3.5	2.4	1.9	3.3	92	50	29	11	4.3	7.2
23	3.4	4.6	3.5	2.4	1.9	*3.3	88	149	27	10	4.2	7.2
24	3.4	4.5	3.4	2.4	1.9	3.3	*78	683	25	10	4.2	5.8
25	3.4	4.5	3.3	2.4	1.9	3.4	73	909	25	8.8	4.2	5.6
26	4.6	4.5	3.3	2.4	1.9	3.6	65	608	26	8.5	3.4	5.1
27	4.3	4.4	3.2	2.3	1.9	3.7	61	345	25	8.2	3.2	5.8
28	4.2	4.4	3.2	2.3	2.0	3.9	54	174	23	6.9	3.2	5.6
29	4.2	4.4	3.1	2.3		4.1	50	126	22	6.9	3.7	9.7
30	4.2	4.3	3.1	2.2	----------	4.4	46	108	20	7.2	3.8	21
31	4.2	----------	3.0	2.2	----------	4.7	----------	100	----------	6.9	3.4	----------
Total	82.4	140.4	117.3	78.6	54.8	90.6	12,636	4,327	1,612	571.4	152.1	154.5
Mean	2.66	4.68	3.78	2.54	1.96	2.92	421	140	53.7	18.4	4.91	5.15
Cfsm	0.0068	0.012	0.0097	0.0065	0.0050	0.0075	1.08	0.360	0.138	0.047	0.013	0.013
In.	0.008	0.01	0.01	0.008	0.005	0.009	1.21	0.40	0.15	0.05	0.01	0.01
Ac-ft	163	278	233	156	109	180	25,060	8,580	3,200	1,130	302	306

Calendar year 1964: Max 379 Min 0.3 Mean 19.2 Cfsm 0.049 In. 0.668 Ac-ft 13,910
Water year 1964-65: Max 1,680 Min 1.3 Mean 54.8 Cfsm 0.141 In. 1.89 Ac-ft 39,700

Peak discharge (base, 200 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4- 6	1030	8.57	1,740	5-24	2300	6.63	1,100
5-16	1500	3.87	218				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 7 (no gage-height record Feb. 1-10, Feb. 12 to Mar. 22, Mar. 24 to Apr. 1).

5-2915. Big Stone Lake at Ortonville, Minn.

Location.--Lat 45°18'18", long 96°26'57", in NW¼SW¼ sec.9, T.121 N., R.46 W., at powerplant intake at west edge of Ortonville, half mile north of concrete dam at outlet, half a mile southwest of Ortonville.

Records available.--March 1937 to September 1965.

Gage.--Wire-weight gage read once a day. Datum of gage is 957.69 ft above mean sea level, datum of 1929. Prior to Sept. 17, 1947, staff gage at site ½ mile south at same datum. Sept. 18, 1947, to June 30, 1963, water-stage recorder at site ½ mile south at same datum. Sept. 21, 1959, to June 30, 1963, supplementary wire-weight gage read once daily, at present site and datum.

Extremes.--Maximum gage height during year, 9.35 ft June 8; minimum, 5.68 ft Feb. 12.
1937-65: Maximum gage height, 12.73 ft Apr. 17, 1952; minimum observed, 2.20 ft Nov. 20, 1940.

Remarks.--Reservoir is formed by natural lake with concrete dam at outlet. Fixed crest of dam is at elevation 963.64 ft, with one 5-foot gate and two 2½-foot gates with lowest sill at elevation 958.40 ft (all elevations are referred to datum of 1929). Changes in gate openings are not made.
Silt barrier dam 700 ft upstream in outlet channel of lake completed July 7, 1958; crest elevation, 963.6 ft. Supplementary wire-weight gage readings used for stages below crest of silt barrier to June 30, 1963. Water level subject to fluctuation caused by wind action.

Gage height, in feet, October 1964 to September 1965

Oct. 24.....5.69	Feb. 28.....6.17	June 30.....7.77
Nov. 26.....5.82	Mar. 31.....6.28	July 31.....7.18
Dec. 31.....5.94	Apr. 30.....8.47	Aug. 31.....6.82
Jan. 30.....5.97	May 31.....8.78	Sept.30.....6.60

Note.--Gage-height record other than that shown above is available.

MNR at Ortonville

$\frac{150}{1160} \cdot 13.57 = 1.76''$

5-2920. Minnesota River at Ortonville, Minn.

Location.--Lat 45°17'44", long 96°26'38", in NE¼NW¼ sec.16, T.121 N., R.46 W., on left bank 400 ft downstream from bridge on U. S. Highway 12 and 1,300 ft downstream from dam at outlet of Big Stone Lake, at Ortonville.

Drainage area.--1,160 sq mi, approximately.

Records available.--February 1938 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 956.38 ft above mean sea level, datum of 1929. Prior to Mar. 31, 1939, staff gage on downstream side of dam 1,300 ft upstream at datum 1.31 ft higher.

Average discharge.--27 years, 115 cfs (83,260 acre-ft per year).

Extremes.--Maximum discharge during year, 1,160 cfs June 7 (gage height, 9.89 ft); minimum, 0.4 cfs Oct. 26 (gage height, 1.11 ft).
1938-65: Maximum discharge, 3,060 cfs Apr. 13, 1952 (gage height, 12.92 ft); no flow Dec. 13, 1940.

Remarks.--Records good except those for periods of ice effect and no gage-height record, which are fair. Flow affected by natural storage in Big Stone Lake (see preceding page).

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Nov. 14-19, July 8 to Aug. 19, Sept. 6-30)

Oct. 1 to Apr. 7

1.0	.3
1.1	1.6
1.3	9.8

Apr. 8 to Sept. 30

1.4	15	4.0	170
1.5	20	6.0	380
2.0	46	8.0	670
3.0	105	10.0	1,210

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.1	1.0	* 0.9	0.7	0.7	0.9	6.9	476	658	316	35	25
2	3.3	1.2	.9	.7	.7	.9	8.7	512	844	312	30	*21
3	4.9	1.2	.9	.7	.7	.9	10	457	928	290	30	20
4	2.2	1.2	.9	.7	.7	.9	*25	361	*949	274	28	30
5	1.6	1.2	.8	* .7	.7	.9	*210	320	997	261	28	24
6	1.6	1.2	.9	.7	.8	1.0	*500	379	994	240	29	34
7	3.3	1.2	.9	.7	.8	1.0	600	373	922	213	35	58
8	* 2.9	1.0	.9	.7	.8	1.0	*725	372	928	284	52	42
9	2.2	1.2	.9	.7	.8	1.0	551	340	894	*269	56	55
10	2.5	1.2	.9	.7	.8	1.0	411	408	852	214	* 53	41
11	2.5	1.2	.9	.7	* .8	1.0	500	298	816	174	51	25
12	1.6	1.6	.9	.7	.8	1.1	569	281	778	187	54	35
13	1.2	1.2	.9	.7	.8	1.1	600	281	698	270	41	49
14	1.2	1.2	.9	.7	.8	1.1	614	272	682	224	45	59
15	1.2	1.2	.8	.7	.8	1.2	628	380	636	198	37	42
16	1.6	1.2	.8	.7	.8	1.2	624	344	590	198	33	23
17	2.2	1.2	.8	.7	.8	*1.3	621	269	573	183	35	46
18	2.2	*1.2	.8	.7	.8	1.3	618	397	514	162	41	33
19	1.8	1.2	.8	.7	.8	1.4	603	*295	526	94	38	41
20	2.2	1.2	.8	.7	.9	1.5	584	230	570	46	34	49
21	1.8	1.2	.8	.7	.9	1.5	590	381	465	47	35	53
22	1.0	1.2	.8	.7	.9	1.7	591	368	468	51	31	50
23	.8	1.2	.8	.7	.9	1.8	591	401	456	60	26	71
24	.6	1.2	.8	.7	.9	2.0	*566	477	379	52	29	33
25	.6	1.2	.8	.7	.9	2.4	546	644	313	46	32	39
26	.6	1.1	.8	.7	.9	2.6	600	772	276	44	29	22
27	.6	1.0	.8	.7	.9	3.0	642	853	379	49	38	24
28	.6	1.0	.7	.7	.9	3.5	548	717	364	48	21	40
29	.6	.9	.7	.7		4.2	542	658	348	44	18	46
30	.6	.9	.7	.7		4.8	490	658	330	57	28	87
31	.8		.7	.7		5.7		612		56	35	
Total	54.9	34.9	25.7	21.7	22.8	54.9	14,714.6	13,586	19,127	4,963	1,107	1,217
Mean	1.77	1.16	0.829	0.700	0.814	1.77	490	438	638	160	35.7	40.6
Ac-ft	109	69	51	43	45	109	29,190	26,947	37,940	9,844	2,196	2,414

Calendar year 1964: Max 564 Min 0.6 Mean 36.5 Ac-ft 26,530
Water year 1964-65: Max 997 Min 0.6 Mean 150 Ac-ft 109,000

1160 x 600 = 109,000 / 74,400 = 1.468 x 12 = 1.76"

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20, Nov. 26 to Apr. 7 (no gage-height record Jan. 6 to Feb. 10, Feb. 12 to Mar. 16, Mar. 18-31). No gage-height record June 27 to July 7.

5-2930. Yellow Bank River near Odessa, Minn.

Location.--Lat 45°13'35", long 96°21'12", in SE¼SE¼ sec.1, T.120 N., R.46 W., on left bank 150 ft downstream from highway bridge, 2½ miles southwest of Odessa, and 4½ miles upstream from mouth.

Drainage area.--398 sq mi.

Records available.--October 1939 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 953.34 ft above mean sea level, datum of 1929 (Corps of Engineers bench mark). Prior to Aug. 28, 1940, wire-weight gage at site 150 ft upstream at same datum.

Average discharge.--26 years, 56.7 cfs (41,040 acre-ft per year).

Extremes.--Maximum discharge during year, 3,540 cfs Apr. 8 (gage height, 13.46 ft); no flow Feb. 11 to Mar. 9; minimum gage height, 1.85 ft Nov. 17.
1939-65: Maximum discharge, 6,260 cfs Apr. 4, 1952 (gage height, 17.06 ft); maximum gage height, 17.98 ft Mar. 25, 1943, from floodmark (backwater from ice); no flow Jan. 26 to Feb. 8, 1940, Jan. 8, 9, 1942, Jan. 25 to Feb. 25, 1959.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1 to Nov. 6, May 31 to June 3)

Oct. 1 to Apr. 7		Apr. 8 to Sept. 30			
1.6	0.3	1.8	2.5	3.0	94
1.7	1.3	1.9	4.6	4.0	250
1.8	2.5	2.0	7.4	6.0	705
1.9	4.6	2.1	11	9.0	1,600
		2.2	16	12.0	2,680
		2.3	23	14.0	3,540
		2.5	38		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.2	2.5	1.1	1.0	0.3	0	28	81	172	28	7.4	3.9
2	1.3	2.9	*1.0	1.0	.3	0	70	77	*174	26	6.8	*3.5
3	1.1	3.1	1.0	1.0	.2	0	150	73	188	22	6.8	3.3
4	1.1	3.1	1.0	1.0	.2	0	300	63	154	20	6.2	3.1
5	.8	3.5	1.0	*1.0	.2	0	*650	65	137	18	5.9	2.9
6	.8	4.2	1.0	1.0	.2	0	*1,500	65	195	59	5.7	3.1
7	.6	3.5	1.0	1.0	.2	0	*2,580	64	248	57	6.2	3.3
8	*.6	3.1	1.1	1.0	.1	0	*3,330	65	291	63	6.2	3.3
9	.7	2.9	1.1	1.0	.1	0	*2,170	71	255	*70	5.4	3.5
10	.6	3.1	1.1	1.0	.1	.1	1,280	71	211	58	*5.1	3.3
11	.6	3.3	1.1	1.0	*0	.1	1,120	71	161	47	4.9	3.1
12	.6	3.3	1.1	.9	0	.1	1,210	77	133	38	4.4	3.5
13	.6	3.5	1.1	.8	0	.1	900	71	123	34	4.4	3.9
14	.6	3.7	1.1	.7	0	.1	625	63	137	30	3.9	4.4
15	.9	3.5	1.1	.7	0	.2	481	68	133	29	3.5	3.9
16	1.0	4.4	1.1	.7	0	.2	381	79	114	31	4.2	4.4
17	1.0	3.1	1.1	.6	0	.2	317	268	91	30	4.4	4.6
18	1.0	*2.7	1.1	.6	0	.2	268	225	75	26	4.4	4.4
19	1.4	2.5	1.1	.6	0	.2	230	*174	66	22	4.2	5.4
20	1.4	2.1	1.1	.6	0	.3	207	149	57	20	4.4	6.2
21	1.5	2.0	1.1	.6	0	.3	190	131	48	19	4.2	8.2
22	1.6	2.1	1.1	.5	0	.3	174	115	45	17	3.7	8.6
23	1.7	2.1	1.1	.5	0	*.4	155	182	41	16	3.7	8.6
24	1.9	2.1	1.1	.5	0	.6	140	304	36	14	9.7	9.4
25	1.9	2.0	1.1	.5	0	1.0	133	740	35	13	14	9.8
26	1.9	1.7	1.0	.4	0	1.7	126	585	*35	12	5.7	9.0
27	1.9	1.5	1.0	.4	0	2.7	*120	432	36	11	4.6	9.4
28	2.0	1.3	1.0	.4	0	4.2	115	318	34	9.8	4.4	9.4
29	2.1	1.2	1.0	.3	0	6.3	103	252	32	9.0	4.4	12
30	2.1	1.1	1.0	.3	----------	12	90	216	29	9.4	4.4	21
31	2.7	----------	1.0	.3	----------	18	----------	193	----------	7.8	4.2	----------
Total	39.2	81.1	32.9	21.9	1.9	49.3	19,143	5,408	3,486	866.0	167.4	182.4
Mean	1.26	2.70	1.06	0.71	0.07	1.59	638	174	116	27.9	5.40	6.08
Cfsm	0.0032	0.0068	0.0027	0.0018	0.0002	0.0040	1.60	0.437	0.291	0.070	0.014	0.015
In.	0.004	0.008	0.003	0.002	0.0002	0.005	1.79	0.51	0.33	0.08	0.02	0.02
Ac-ft	78	161	65	43	3.8	98	37,970	10,730	6,910	1,720	332	362

Calendar year 1964: Max 359 Min 0.2 Mean 20.3 Cfsm 0.051 In. 0.70 Ac-ft 14,770
Water year 1964-65: Max 3,330 Min 0 Mean 80.8 Cfsm 0.203 In. 2.77 Ac-ft 58,470

Peak discharge (base, 300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4- 8	0800	13.46	3,540	5-25	1300	6.37	806
5-17	1200	4.28	302				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 7.

5-2940. Pomme de Terre River at Appleton, Minn.

Location.--Lat 45°12'10", long 96°01'20", in SW¼NW¼ sec.14, T.120 N., R.43 W., on left bank at Appleton, 60 ft upstream from bridge on U.S. Highway 59 and State Highway 119 and 8 miles upstream from mouth.

Drainage area.--905 sq mi, approximately.

Records available.--March 1931 to September 1935 (no winter records), October 1935 to September 1965. Prior to October 1953, published as "near Appleton."

Gage.--Water-stage recorder and concrete control. Datum of gage is 978.00 ft above mean sea level, datum of 1929. Prior to Dec. 22, 1952, staff gage at site 4 miles upstream at datum 25.17 ft higher.

Average discharge.--30 years (1935-65), 95.4 cfs (69,070 acre-ft per year).

Extremes.--Maximum discharge during year, 2,310 cfs Apr. 9 (gage height, 9.63 ft); minimum daily, 5.0 cfs Mar. 8-17; minimum gage height, 4.31 ft Mar. 22.
1931-65: Maximum discharge, 5,050 cfs Apr. 8, 1952 (gage height, 10.13 ft, site and datum then in use); no flow for several periods.

Remarks.--Records good except those for period of ice effect, which are fair. Flow affected by lakes above station. Occasional regulation at low flow by old milldam 500 ft upstream.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1 to Nov. 17, Apr. 19 to May 5, June 3 to July 21, Sept. 30)

Oct. 1 to Apr. 8		Apr. 9 to Sept. 30			
4.1	7.7	5.0	85	7.0	958
4.3	15	5.3	162	8.0	1,450
4.5	26	5.6	287	9.0	1,970
		6.0	473	9.7	2,350

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	21	21	12	10	7.1	5.3	5.8	402	411	305	239	128
2	21	21	*12	10	7.0	5.2	6.4	384	420	305	243	*125
3	19	20	12	9.9	7.0	5.2	7.3	374	483	292	239	123
4	20	20	12	9.8	6.9	5.2	8.9	361	478	269	225	120
5	21	21	12	9.8	6.8	5.2	*17	351	473	252	208	120
6	20	20	12	* 9.7	6.7	5.1	62	347	487	283	217	123
7	22	20	12	9.5	6.6	5.1	* 230	342	521	356	243	125
8	*22	21	12	9.4	6.6	5.0	*1,940	338	559	449	287	128
9	21	16	12	9.4	6.6	5.0	2,170	351	598	*430	230	128
10	21	16	12	9.3	6.6	5.0	*1,950	370	641	425	199	123
11	20	18	12	90	* 6.4	5.0	1,750	361	660	420	*169	120
12	20	19	12	8.8	6.4	5.0	1,660	338	679	411	169	123
13	21	20	13	8.7	6.4	5.0	*1,880	315	694	402	156	123
14	20	25	12	8.6	6.4	5.0	1,930	319	689	402	148	130
15	21	24	12	8.6	6.3	5.0	1,720	328	675	379	148	130
16	21	22	12	8.6	6.2	5.0	1,460	342	651	370	153	133
17	20	13	12	8.5	6.2	* 5.0	1,290	333	612	361	148	142
18	20	*12	12	8.4	6.1	5.2	1,180	310	574	356	142	153
19	21	12	12	8.3	6.0	5.2	1,080	301	545	342	133	156
20	20	12	11	8.2	5.8	5.3	973	*305	511	328	130	159
21	21	12	11	8.2	5.7	5.4	894	324	483	310	123	169
22	22	12	11	8.2	5.6	5.4	826	333	478	296	117	180
23	24	12	11	8.1	5.6	5.4	772	370	463	283	110	192
24	22	13	11	8.1	5.6	5.4	708	407	444	283	96	188
25	21	13	11	8.0	5.5	5.4	660	439	425	287	142	184
26	21	13	11	7.9	5.5	5.4	612	444	402	269	162	173
27	20	13	10	7.7	5.5	5.4	*564	439	388	261	148	173
28	20	13	10	7.6	5.4	5.5	526	425	365	252	133	180
29	20	12	10	7.5		5.6	478	430	342	243	130	199
30	20	12	10	7.4	----------	5.6	435	435	319	234	128	247
31	20	----------	10	7.3	----------	5.7	----------	435	----------	234	128	----------
Total	643	498	356	268.5	174.5	162.2	27,795.4	11,353	15,470	10,089	5,243	4,497
Mean	20.7	16.6	11.5	8.66	6.23	5.23	927	366	516	325	169	150
Cfsm	0.023	0.018	0.013	0.0096	0.0069	0.0058	1.02	0.404	0.570	0.359	0.187	0.166
In.	0.03	0.02	0.01	0.01	0.007	0.007	1.14	0.47	0.64	0.41	0.22	0.18
Ac-ft	1,280	988	706	533	346	322	55,130	22,520	30,680	20,010	10,400	8,920

Calendar year 1964: Max 495 Min 9.3 Mean 56.2 Cfsm 0.062 In. 0.84 Ac-ft 40,760
Water year 1964-65: Max 2,170 Min 5.0 Mean 210 Cfsm 0.232 In. 3.14 Ac-ft 151,800

Peak discharge (base, 200 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4 -9	2130	9.63	2,310	7-8	1500	6.15	463
6-13	1215	6.61	700				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 8.

5-3000. Lac qui Parle River near Lac qui Parle, Minn.

Location.--Lat 45°00', long 95°55', in SW¼SW¼ sec.27, T.118 N., R.42 W., on right bank 40 ft downstream from highway bridge and half a mile southwest of village of Lac qui Parle.

Drainage area.--983 sq mi.

Records available.--April 1910 to November 1914; March 1931 to September 1965 (winter records incomplete prior to 1934). Published as "at Lac qui Parle", 1910-14.

Gage.--Water-stage recorder. Datum of gage is 951.98 ft above mean sea level (Minnesota Highway Department bench mark). Apr. 27, 1910, to Nov. 15, 1914, staff gage at site 2 miles downstream at different datum. Mar. 17, 1931, to Mar. 9, 1937, staff gage at site 40 ft upstream at present datum.

Average discharge.--34 years (1912-13, 1931-32, 1933-65), 116 cfs (82,650 acre-ft per year).

Extremes.--Maximum discharge during year, 8,370 cfs Apr. 9 (gage height, 19.37 ft, from floodmark, backwater from ice); minimum daily, 0.2 cfs Oct. 5-16.
1910-14, 1931-65: Maximum discharge, 11,100 cfs Apr. 6, 1952 (gage height, 18.18 ft); maximum gage height, that of Apr. 9, 1965; no flow at times in several years.

Remarks.--Records good except those for periods of ice effect or backwater from beaver dam, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1 to Nov. 17, May 25 to June 11)

0.1	0.05	0.7	8.9	2.5	316
.2	.4	.8	16	3.0	460
.3	1.1	1.0	33	4.0	780
.4	1.9	1.3	67	6.0	1,610
.5	2.8	1.6	112	9.0	3,110
.6	4.5	2.0	192	13.0	5,510

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.2	2.8	2.3	0.9	0.6	0.6	2.0	330	492	138	28	15
2	1.1	3.0	2.2	.9	.6	.6	10	305	466	129	25	14
3	.8	3.0	2.1	.9	.6	.6	30	276	642	120	22	12
4	.4	2.9	2.1	.9	.6	.6	75	256	616	112	*17	10
5	.2	2.7	2.1	.9	.6	.7	125	239	1,420	102	16	8.4
6	*.2	2.6	2.0	*.9	.6	.7	* 445	229	*2,020	110	16	8.9
7	.2	2.6	2.0	.9	.6	.7	*1,000	217	1,800	112	15	8.9
8	.2	2.7	* 2.0	.9	.6	.7	*5,600	215	1,800	112	14	8.9
9	.2	2.8	1.9	.9	.6	.7	*7,200	217	1,380	124	14	8.4
10	.2	2.8	1.9	.9	*.5	.8	5,800	206	1,070	119	14	* 7.9
11	.2	2.8	1.8	.9	.5	.8	4,960	210	861	110	12	7.4
12	.2	2.8	1.7	.9	.5	.8	*4,220	215	710	104	*10	7.9
13	.2	2.9	1.6	.9	.5	.8	3,630	204	620	106	10	8.4
14	.2	2.9	1.4	.8	.5	.9	2,850	210	553	104	8.4	8.4
15	.2	3.0	1.2	.8	.5	.9	2,260	220	508	*106	6.9	9.5
16	.2	2.9	1.0	.8	.5	.9	1,850	220	436	110	6.9	9.5
17	.3	2.5	1.0	.8	.5	1.0	1,520	227	375	98	7.4	10
18	.3	2.5	1.0	.8	.5	1.0	1,250	232	324	84	15	10
19	.3	*2.4	1.0	.8	.5	1.0	1,070	225	289	73	14	14
20	.5	2.4	.9	.8	.5	1.0	922	217	263	66	11	18
21	.8	2.5	.9	.8	.5	1.0	797	263	234	60	11	22
22	1.4	2.5	.9	.8	.5	1.1	700	284	220	58	11	26
23	1.8	2.5	.9	.8	.5	1.1	610	796	206	53	12	28
24	2.2	2.5	.9	.8	.5	*1.1	540	1,260	192	51	11	30
25	2.6	2.5	.9	.7	.5	1.1	498	1,340	183	46	12	29
26	2.6	2.5	.9	.7	.6	1.2	470	1,400	177	41	32	29
27	2.7	2.5	.9	.7	.6	1.2	454	1,300	163	37	25	31
28	2.6	2.5	.9	.7	.6	1.2	436	1,030	161	34	18	33
29	2.6	2.4	.9	.7		1.2	*407	792	157	31	15	38
30	2.6	2.3	.9	.7	----------	1.4	366	658	146	30	14	77
31	2.6	---------	.9	.7	----------	1.7	----------	566	----------	28	14	----------
Total	31.8	79.7	43.1	25.4	15.2	29.1	50,097	14,359	18,484	2,608	457.6	548.5
Mean	1.03	2.66	1.39	0.82	0.54	0.94	1,670	463	616	84.1	14.8	18.3
Cfsm	0.0010	0.0027	0.0014	0.00083	0.00055	0.00096	1.70	0.471	0.627	0.086	0.015	0.019
In.	0.001	0.003	0.002	0.001	0.0006	0.001	1.90	0.54	0.70	0.10	0.02	0.02
Ac-ft	63	158	85	50	30	58	99,370	28,500	36,660	5,170	908	1,090

Calendar year 1964: Max 407 Min 0.2 Mean 38.2 Cfsm 0.039 In. 0.525 Ac-ft 27,750
Water year 1964-65: Max 7,200 Min 0.2 Mean 238 Cfsm 0.242 In. 3.29 Ac-ft 172,100

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 18 to Apr. 10 (no gage-height record Feb. 6 to Mar. 31).

5-3010. Minnesota River near Lac qui Parle, Minn.

Location.--Lat 45°01'17", long 95°52'05", in NW¼NE¼ sec.24, T.118 N., R.42 W., on left bank 200 ft downstream from dam at Lac qui Parle Outlet, 2.4 miles northeast of village of Lac qui Parle, and 3.5 miles west of Watson.

Drainage area.--4,050 sq mi, approximately.

Records available.--October 1942 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 900.00 ft above mean sea level, datum of 1929 (levels by Corps of Engineers). Prior to Nov. 10, 1944, at datum 0.20 ft lower.

Average discharge.--23 years, 644 cfs (466,200 acre-ft per year).

Extremes.--Maximum discharge during year, 10,700 cfs Apr. 14 (gage height, 36.17 ft); minimum, 20 cfs Oct. 12 (gage height, 20.49 ft).
1942-65: Maximum discharge, 19,700 cfs Apr. 10, 1952 (gage height, 37.98 ft, from floodmark); no flow Nov. 17, 1942, Sept. 29, 1947, Oct. 19 to Nov. 18, 1951, Nov. 24, 1952.

Remarks.--Records good except those for period of ice effect, which are fair. Part of flow from 2,050 square miles of Chippewa River basin at times diverted into Minnesota River above station. Some regulation by Big Stone Lake since Apr. 17, 1927, Lac qui Parle Lake since January 1938, and Marsh Lake since Nov. 1, 1939.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 6-11)

20.5	28	26.0	1,400
20.7	52	29.0	2,350
21.0	103	32.0	3,550
21.5	195	34.0	5,280
22.0	300	35.0	6,780
23.0	541	36.0	10,000
24.0	841	37.0	14,300

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	41	34	31	30	32	36	108	3,320	2,210	1,980	117	79
2	38	34	30	30	32	36	109	3,260	2,090	1,930	117	81
3	38	34	30	30	32	37	110	3,190	2,160	1,900	117	81
4	38	34	30	31	32	37	111	3,090	2,280	1,910	117	81
5	38	34	30	31	32	38	112	3,000	2,440	1,830	117	83
6	37	34	30	*32	32	38	120	2,930	*2,750	1,850	150	83
7	*36	34	30	32	32	39	*380	2,830	3,040	1,870	287	103
8	36	34	*30	32	32	40	*2,000	2,620	3,300	1,870	379	118
9	35	34	30	32	29	42	3,110	2,500	3,440	1,880	403	118
10	36	34	30	32	*27	43	4,700	2,470	3,470	1,810	429	128
11	37	34	30	32	27	45	7,270	2,260	3,460	1,750	427	139
12	33	34	30	32	28	116	*9,560	1,970	3,440	1,810	*427	142
13	34	34	30	32	30	110	10,500	1,660	3,380	1,870	400	*155
14	35	34	30	32	31	75	10,600	1,500	3,320	1,910	304	166
15	36	34	30	32	31	44	10,200	1,540	3,280	*1,940	273	195
16	36	34	30	32	31	46	9,640	1,540	3,220	1,900	271	220
17	35	33	30	32	31	47	8,880	1,520	3,170	1,870	264	260
18	35	33	30	32	32	47	7,940	1,650	3,100	1,840	262	313
19	34	*33	30	32	32	47	7,050	1,700	3,040	1,800	260	313
20	35	31	30	32	32	99	6,300	1,680	2,990	1,770	195	313
21	35	31	30	32	31	106	5,930	1,720	2,870	1,730	135	313
22	36	31	30	32	31	115	5,460	1,710	2,800	1,700	134	315
23	36	31	30	32	31	*106	5,070	1,810	2,720	1,660	100	320
24	36	30	30	32	31	120	4,700	1,920	2,600	1,610	60	318
25	36	30	30	32	32	130	4,390	1,840	2,480	1,550	45	311
26	36	30	30	32	34	135	4,120	1,970	2,360	1,280	45	311
27	36	30	30	32	35	125	3,930	2,130	2,320	1,030	62	313
28	35	30	30	32	36	118	3,700	2,060	2,260	740	78	311
29	34	30	30	32		115	*3,540	2,020	2,180	309	78	315
30	34	30	30	32	----------	114	3,420	2,120	2,080	88	79	329
31	34	----------	30	32	----------	113	----------	2,160	----------	117	79	----------
Total	1,111	977	931	984	878	2,359	143,060	67,690	84,250	49,104	6,211	6,327
Mean	35.8	32.6	30.0	31.7	31.4	76.1	4,770	2,184	2,808	1,584	200	211
Ac-ft	2,200	1,930	1,850	1,950	1,740	4,680	283,800	134,300	167,100	97,400	12,320	12,550

Calendar year 1964: Max 1,480 Min 30 Mean 189 Ac-ft 137,500
Water year 1964-65: Max 10,600 Min 27 Mean 997 Ac-ft 721,800

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 8 (no gage-height record Dec. 18 to Jan. 1, Mar. 18, 20, 21, 27, 28).

5-3045. Chippewa River near Milan, Minn.

Location.--Lat 45°06'39", long 95°47'57", in SE¼SE¼ sec.16, T.119 N., R.41 W.; on right bank 800 ft upstream from bridge on State Highway 40, 2.0 miles upstream from small tributary, and 5½ miles east of Milan.

Drainage area.--1,870 sq mi, approximately.

Records available.--March 1937 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 959.69 ft above mean sea level, datum of 1929. Prior to Mar. 23, 1940, chain gage and Mar. 23, 1940, to June 14, 1942, wire-weight gage, on bridge 800 ft downstream at same datum.

Average discharge.--28 years, 239 cfs (173,000 acre-ft per year).

Extremes.--Maximum discharge during year, 6,770 cfs Apr. 11 (gage height, 11.93 ft); minimum daily, 2.9 cfs Mar. 4-27; minimum gage height, 1.31 ft Oct. 10, 21, 22.
1937-65: Maximum discharge, 6,930 cfs Apr. 9, 1952 (gage height, 12.12 ft); maximum gage height, 12.29 ft Apr. 7, 1952 (backwater from ice); no flow at times during 1940.

Remarks.--Records good except those for period of ice effect, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Flow regulated by several small lakes above gage.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.2	14	3.0	479
1.4	34	4.0	1,020
1.6	60	6.0	2,160
1.8	93	9.0	4,430
2.0	138	12.0	6,830
2.5	283		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	30	31	15	12	5.8	3.0	3.0	1,150	1,230	465	274	196
2	32	32	14	12	5.6	3.0	3.0	1,120	1,200	456	268	187
3	32	32	13	12	5.4	3.0	4.0	1,080	1,600	441	261	*185
4	28	34	*12	12	5.3	2.9	5.0	1,040	1,510	423	249	176
5	28	34	12	12	5.1	2.9	11	1,030	1,670	406	234	171
6	26	34	12	*12	4.9	2.9	*40	1,030	2,180	432	225	173
7	*24	34	12	12	4.7	2.9	500	1,010	*1,800	479	225	176
8	21	34	12	11	4.6	2.9	*1,750	973	1,570	515	234	179
9	21	34	12	11	*4.4	2.9	*3,100	1,040	1,460	572	234	182
10	20	41	12	11	4.3	2.9	3,900	1,040	1,380	572	234	179
11	21	41	12	11	4.2	2.9	*6,170	995	1,320	546	228	171
12	21	40	12	11	4.1	2.9	6,270	951	1,260	541	*210	173
13	21	38	12	10	4.0	2.9	*5,710	912	1,190	546	199	173
14	20	42	12	10	3.9	2.9	5,160	902	1,120	* 535	185	173
15	21	41	12	9.4	3.8	2.9	4,620	946	1,040	520	173	173
16	21	38	12	9.0	3.7	2.9	3,920	1,160	978	499	176	182
17	22	38	12	8.8	3.6	2.9	2,990	1,060	907	484	179	185
18	22	35	12	8.5	3.5	2.9	2,450	968	841	456	176	199
19	21	*36	12	8.2	3.4	2.9	2,190	907	793	441	168	208
20	21	30	12	7.9	3.3	2.9	2,020	885	739	428	162	210
21	21	31	12	7.6	3.2	2.9	1,880	* 946	690	410	154	219
22	21	32	12	7.5	3.1	2.9	1,730	940	679	398	152	222
23	23	32	12	7.3	3.1	2.9	1,610	1,490	647	373	146	228
24	25	30	12	7.2	3.1	*2.9	1,510	2,930	610	362	143	231
25	27	26	12	6.9	3.0	2.9	1,440	2,550	578	354	168	231
26	28	23	12	6.7	3.0	2.9	1,390	2,120	567	343	179	219
27	29	21	12	6.5	3.0	2.9	1,330	1,780	556	329	199	219
28	29	19	12	6.4	3.0	3.0	*1,270	1,570	541	312	202	216
29	29	18	12	6.2		3.0	1,230	1,460	504	299	196	246
30	29	16	12	6.1	----------	3.0	1,190	1,380	484	283	193	312
31	30	----------	12	6.0	----------	3.0	----------	1,300	----------	277	196	----------
Total	764	967	378	285.2	112.1	90.6	65,396	38,665	31,644	13,497	6,222	5,994
Mean	24.6	32.2	12.2	9.20	4.00	2.92	2,180	1,247	1,055	435	201	200
Cfsm	0.013	0.017	0.0065	0.0049	0.0021	0.0016	1.17	0.667	0.564	0.233	0.108	0.107
In.	0.02	0.02	0.008	0.006	0.002	0.002	1.30	0.77	0.63	0.27	0.12	0.12
Ac-ft	1,520	1,920	750	566	222	180	129,700	76,690	62,760	26,770	12,340	11,890

Calendar year 1964: Max 1,350 Min 12 Mean 118 Cfsm 0.063 In. .86 Ac-ft 85,890
Water year 1964-65: Max 6,270 Min 29 Mean 449 Cfsm 0.240 In. 3.27 Ac-ft 325,300

Peak discharge (base, 400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-11	1630	11.93	6,770	6-6	0600	6.18	2,270
5-24	1530	7.27	3,050				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 10.

5-3110. Minnesota River at Montevideo, Minn.

Location.--Lat 44°56'00", long 95°44'00", in NW¼NW¼ sec.19, T.117 N., R.40 W., on right bank 100 ft upstream from bridge on U. S. Highway 212, at Montevideo, and 400 ft downstream from Chippewa River.

Drainage area.--6,180 sq mi, approximately.

Records available.--July 1909 to September 1917, October 1917 to September 1929 (no winter records), October 1929 to September 1965. Prior to October 1939, published as "near Montevideo." Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 910.87 ft above mean sea level, adjustment of 1912. July 22, 1909, to Feb. 4, 1932, chain gage at bridge 600 ft downstream at present datum. Feb. 5, 1932, to Nov. 26, 1934, chain gage at bridge 100 ft downstream at present datum.

Average discharge.--44 years (1909-17, 1929-65), 633 cfs (458,300 acre-ft per year).

Extremes.--Maximum discharge during year, 12,900 cfs Apr. 14 (gage height, 16.64 ft); minimum daily, 39 cfs Feb. 8-17; minimum gage height, 1.74 ft Nov. 20.
1909-65: Maximum discharge, 24,500 cfs Apr. 10, 1952 (gage height, 20.02 ft, from floodmark); no flow for several days in 1933-34, 1936.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Flow regulated by Big Stone Lake since Apr. 17, 1937, Lac qui Parle since January 1938 and Marsh Lake since Nov. 1, 1939.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1-10)

Oct. 1 to Apr. 13		Apr. 14 to Sept. 30			
1.7	57	2.9	229	8.0	1,820
2.0	92	3.0	246	11.0	3,200
2.5	164	3.5	337	14.0	5,010
3.0	246	4.0	450	16.0	9,480
Note.--Same as following table above 3.0 ft.		5.0	690	17.0	13,200
		6.0	982		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	74	78	45	45	42	46	111	4,460	3,460	2,470	390	263
2	69	80	43	45	41	46	112	4,330	3,300	2,350	395	261
3	70	80	43	45	41	47	114	4,220	3,800	2,260	383	254
4	70	79	*43	45	41	47	116	4,100	3,800	2,260	374	249
5	69	79	43	46	40	48	123	3,990	3,800	2,190	363	241
6	68	*79	43	46	40	48	200	3,870	*3,800	2,110	400	238
7	*68	80	43	*46	40	49	800	3,760	3,920	2,170	510	239
8	65	80	43	46	39	49	2,500	3,620	4,050	2,220	610	244
9	65	80	44	46	*39	50	4,000	3,620	4,140	2,270	640	280
10	67	80	44	46	39	50	5,350	3,460	4,230	2,310	670	280
11	67	84	45	46	39	50	*8,080	3,260	4,320	2,260	660	300
12	67	86	45	46	39	50	10,600	2,930	4,380	2,180	630	308
13	66	85	45	46	39	56	12,300	2,540	4,380	*2,220	*582	*317
14	66	85	44	45	39	78	*12,600	2,400	4,330	2,300	532	337
15	66	86	44	45	39	92	12,200	2,490	4,270	2,370	464	344
16	66	87	44	45	39	49	11,600	2,710	4,190	2,330	452	390
17	67	85	44	45	39	50	10,900	2,590	4,100	2,260	450	404
18	67	84	44	45	40	50	10,000	2,620	4,000	2,240	445	469
19	67	78	44	45	40	*52	9,220	2,610	3,890	2,170	443	498
20	67	68	44	45	40	56	8,460	2,570	3,800	2,100	425	503
21	68	80	44	45	41	78	7,800	2,670	3,680	2,040	321	510
22	68	76	44	44	42	120	7,170	2,660	3,590	1,990	302	515
23	69	74	44	44	42	110	6,900	3,340	3,490	1,940	287	517
24	72	73	44	44	43	124	6,500	4,880	3,350	1,870	238	524
25	72	65	44	44	43	134	6,110	4,400	3,190	1,790	238	522
26	74	55	44	44	44	140	5,700	4,100	3,040	1,620	244	517
27	75	55	44	43	45	130	5,390	3,940	2,920	1,230	248	520
28	75	52	44	43	45	125	5,100	3,640	2,830	1,160	249	517
29	75	51	44	43		120	*4,820	3,490	2,730	738	256	560
30	76	48	45	42	----------	118	4,620	3,520	2,610	432	261	724
31	76	----------	45	42	----------	117	----------	3,480	----------	381	261	----------
Total	2,151	2,252	1,363	1,387	1,140	2,379	179,496	106,270	111,390	60,231	12,723	11,845
Mean	69.4	75.1	44.0	44.7	40.7	76.7	5,980	3,429	3,713	1,943	410	395
Ac-ft	4,270	4,470	2,700	2,750	2,260	4,720	356,000	210,800	220,900	119,500	25,240	23,490

Calendar year 1964: Max 2,370 Min 43 Mean 317 Ac-ft 229,800
Water year 1964-65: Max 12,600 Min 39 Mean 1,350 Ac-ft 977,100

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 10 (no gage-height record Nov. 29 to Dec. 3). No gage-height record May 14 to June 6, Aug. 6-12.

5-3114. South Branch Yellow Medicine River at Minneota, Minn.

Location.--Lat 44°33'50", long 95°59'50", in SE¼ sec.26, T.113 N., R.43 W., on downstream side of bridge on State Highway 68, 0.5 mile northwest of Minneota, and 6 miles upstream from confluence with North Branch Yellow Medicine River.

Drainage area.--111 sq mi, approximately.

Records available.--July 1960 to September 1965.

Gage.--Wire-weight gage read once daily. Datum of gage is 1,150.00 ft above mean sea level, datum of 1929. Prior to Mar. 21, 1963, staff gage at same site and datum.

Average discharge.--5 years, 24.4 cfs (17,660 acre-ft per year).

Extremes.--Maximum discharge during year, 1,360 cfs Apr. 6 (gage height, 10.62 ft, backwater from ice); no flow at times.
1959-65: Maximum discharge, 1,660 cfs July 27, 1963 (gage height, 10.66 ft); no flow at times.
Flood of Apr. 6, 1960 reached a stage of 11.10 ft, from readings by Corps of Engineers' observer (discharge, 1,830 cfs).

Remarks.--Records good except those for period of ice effect, which are fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.4	0.7	0.4				0	43	56	14	0.5	0
2	.4	.8	.3				0	39	50	12	.6	0
3	.4	.7	*.3				0	40	49	9.8	.4	0
4	.5	.5	.3				0	36	46	7.3	.2	0
5	.3	*.5	.2				*100	36	93	5.8	.2	0
6	*0	.5	.2				* 900	37	270	8.2	.1	0
7	0	.7	.2	(*)			* 860	39	176	9.1	.3	0
8	.2	.8	.2		(*)		820	41	*88	7.1	.9	0
9	.1	.9	.2				* 770	136	75	6.6	.7	*0
10	.2	.8	.1				710	196	60	5.4	.8	0
11	.1	1.0	.1				620	137	50	4.2	.4	0
12	.3	1.0	.1				472	83	44	* 3.6	.2	0
13	.4	.8	.1				* 329	64	44	5.8	.1	0
14	.3	.9	.1				240	54	41	3.6	.1	0
15	.1	.8	.1				172	64	38	3.0	0	0
16	.3	1.0	.1				117	120	35	2.4	*0	.2
17	.4	1.0	.1				113	86	32	2.6	.4	1.8
18	.7	1.0	.1				105	64	29	2.1	.1	1.4
19	.8	1.1	0				81	54	26	2.2	.4	2.1
20	.4	1.0	0				67	47	26	1.9	0	2.6
21	.3	1.0	0				62	132	25	2.5	0	2.4
22	.3	1.0	0			(*)	56	102	27	1.8	0	2.7
23	.6	.9	0				53	68	36	1.6	0	2.1
24	.5	.8	0				51	98	29	1.3	0	1.4
25	.8	.7	0				69	137	26	.8	0	.9
26	.8	.7	0				* 76	123	23	.4	0	.6
27	.8	.6	0				68	95	21	.5	0	1.4
28	.9	.5	0				56	75	18	.5	0	4.9
29	.7	.5	0				49	62	16	.3	0	5.1
30	.7	.4	0		----------		44	60	15	.4	0	24
31	.7	----------	0		----------		----------	57	----------	.5	0	----------
Total	13.4	23.6	3.2	0	0	0	7,060	2,425	1,564	127.3	6.4	53.6
Mean	0.43	0.79	0.10	0	0	0	235	78.2	52.1	4.11	0.21	1.79
Ac-ft	27	47	6.4	0	0	0	14,000	4,810	3,100	252	13	106

Calendar year 1964: Max 100 Min 0 Mean 7.79 Ac-ft 5,650
Water year 1964-65: Max 900 Min 0 Mean 30.9 Ac-ft 22,310

* Discharge measurement or observation of no flow made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 11.

5-3135. Yellow Medicine River near Granite Falls, Minn.

Location.--Lat 44°43', long 95°31', in sec.35, T.115 N., R.39 W., on right bank 50 ft downstream from highway bridge, 6 miles upstream from mouth, and 8 miles south of town of Granite Falls.

Drainage area.--653 sq mi.

Records available.--March 1931 to September 1935 (no winter records), October 1935 to September 1938, October 1939 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 971.59 ft above mean sea level, datum of 1929. Mar. 16, 1931, to June 10, 1936, chain gage and June 11, 1936, to June 13, 1938, wire-weight gage, on bridge 50 ft upstream at same datum. Oct. 12, 1939, to Nov. 30, 1952, staff gage 500 ft downstream at same datum.

Average discharge.--29 years (1935-38, 1939-65), 103 cfs (74,570 acre-ft per year).

Extremes.--Maximum discharge during year, 6,820 cfs Apr. 10 (gage height, 9.78 ft, from floodmark); minimum daily discharge, 1.7 cfs Oct. 16, 21; minimum gage height, 2.18 ft Sept. 4,5.

1931-38, 1939-65: Maximum discharge, 11,800 cfs June 18, 1957 (gage height, 12.41 ft); no flow at times in 1931, 1933, 1948, 1959.

Flood in June 1919 reached a stage of 17.5 ft, from information by local residents.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 1 to Nov. 19)

1.97	1.7	2.5	35	5.0	1,180
2.0	1.9	2.7	65	6.0	1,880
2.1	3.1	3.0	145	7.0	2,750
2.2	6.2	3.5	326	8.0	3,950
2.3	13	4.0	560	10.0	7,210

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2.3	2.4	2.5	2.8	3.5	4.1	3.5	310	706	87	18	5.8
2	2.2	2.4	2.5	2.8	3.6	4.1	3.5	274	605	80	18	5.4
3	2.1	2.6	*2.5	2.8	3.6	4.1	3.5	236	628	72	17	5.0
4	2.0	3.1	2.5	2.8	3.7	4.1	4.0	219	616	63	15	4.6
5	*2.1	*3.1	2.5	2.8	3.8	4.1	4.5	212	694	60	14	4.3
6	2.1	3.3	2.5	2.8	3.9	4.1	20	195	748	63	14	4.3
7	2.1	3.3	2.5	*2.8	4.0	4.1	100	185	974	65	14	4.3
8	2.2	3.3	2.5	2.8	*4.1	4.1	400	192	*1.040	69	13	4.3
9	2.1	3.3	2.5	2.8	4.2	4.1	*2.000	230	967	67	12	4.3
10	1.8	3.5	2.5	2.8	4.2	4.2	*6.140	326	790	62	11	*4.3
11	1.8	3.5	2.5	2.9	4.2	4.2	5.120	565	640	57	9.0	4.3
12	2.0	3.7	2.5	2.9	4.2	4.2	*4.440	495	515	*59	8.3	5.0
13	2.0	3.7	2.5	2.9	4.2	4.2	3.700	410	428	85	7.7	5.4
14	1.9	3.7	2.6	2.9	4.2	4.2	2.930	326	382	63	6.7	5.4
15	1.8	3.7	2.6	3.0	4.2	4.2	2.400	297	352	57	6.2	5.4
16	1.7	3.7	2.6	3.0	4.2	4.2	2.030	297	297	51	*7.7	5.8
17	1.8	3.7	2.6	3.0	4.2	4.2	1.740	352	255	46	6.7	6.2
18	1.8	3.7	2.7	3.0	4.1	4.2	1.440	360	222	42	7.2	6.7
19	1.9	3.7	2.7	3.1	4.1	4.1	1.190	310	195	38	6.7	7.7
20	1.8	3.3	2.7	3.1	4.1	4.1	1.000	270	175	36	6.2	9.0
21	1.7	3.3	2.8	3.1	4.1	4.1	826	289	152	35	7.7	11
22	1.8	3.1	2.8	3.1	4.1	*4.1	700	343	155	33	5.8	15
23	2.0	3.1	2.8	3.2	4.1	4.0	605	712	142	32	5.4	12
24	2.0	2.9	2.8	3.2	4.1	4.0	535	670	236	29	6.2	12
25	2.0	2.9	2.8	3.2	4.1	4.0	500	1.060	247	26	10	14
26	2.0	2.8	2.8	3.2	4.1	4.0	*490	1.560	181	25	11	15
27	2.1	2.8	2.8	3.3	4.1	4.0	495	1.750	162	24	8.3	16
28	2.2	2.6	2.8	3.4	4.1	3.6	496	1.620	133	22	7.2	16
29	2.4	2.6	2.8	3.4		3.5	414	1.280	111	20	7.2	22
30	2.3	2.6	2.8	3.5	----------	3.5	356	1.010	98	20	7.2	59
31	2.3	----------	2.8	3.5	----------	3.5	----------	838	----------	19	7.2	----------
Total	62.3	95.4	81.8	93.9	113.1	125.2	40.086.0	17.193	12.846	1.507	301.6	299.5
Mean	2.01	3.18	2.64	3.03	4.04	4.04	1,336	555	428	48.6	9.73	9.98
Cfsm	0.0031	0.0049	0.0040	0.0046	0.0062	0.0062	2.05	0.850	0.655	0.074	0.015	0.015
In.	0.004	0.005	0.005	0.005	0.006	0.007	2.28	0.98	0.73	0.09	0.02	0.02
Ac-ft	124	189	162	186	224	248	79,470	34,100	25,480	2,990	598	594

- 4.152

Calendar year 1964: Max 476 Min 1.7 Mean 49.7 Cfsm 0.076 In. 1.05 Ac-ft 36,080
Water year 1964-65: Max 6,140 Min 1.7 Mean 199 Cfsm 0.305 In. 4.15 Ac-ft 144,400

Peak discharge (base, 100 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-10	0630	9.78	6,820	6-8	1400	4.81	1,050
5-11	1100	4.05	585	6-24	2400	3.45	306
5-27	1500	5.84	1,760	7-13	0800	2.86	103

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 20 to Apr. 19.

199/653 × 13,574.1 = 4.1367
.30475

5-3150. Redwood River at Marshall, Minn.

Location.--Lat 44°27'05", long 95°47'13", in SE¼NW¼ sec.4, T.111 N., R.41 W., on upstream side of highway bridge on Fourth Street in Marshall and 10 miles upstream from Threemile Creek.

Drainage area.--307 sq mi.

Records available.--March 1940 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Chain gage read twice daily. Datum of gage is 1,144.88 ft above mean sea level, datum of 1929.

Average discharge.--25 years, 48.8 cfs (35,300 acre-ft per year).

Extremes.--Maximum discharge during year, 2,220 cfs Apr. 9. River channel: maximum discharge during year, 1,150 cfs Apr. 11; maximum gage height, 5.76 ft Apr. 6 (from floodmark, backwater from ice); minimum daily, 1.1 cfs Oct. 4, 6. Diversion channel: maximum discharge during year, 1,850 cfs Apr. 9; maximum gage height, 78.07 ft Apr. 6 (backwater from ice); no flow on many days.
1940-65: Maximum discharge, 5,370 cfs June 17, 1957 (gage height, 10.14 ft); maximum gage height, 11.05 ft Apr. 6, 1951 (from floodmark); no flow at times.

Remarks.--Records good except those for period of ice effect, which are fair, and those for periods of no gage-height record on diversion channel, which are poor. Water diverted at medium and high stages into diversion channel 3 miles above station, bypasses station and returns to river 1 mile below station. Diversion began Mar. 18, 1964. These records include flow in diversion channel. Unknown amount of natural diversion into Cottonwood River basin at extremely high stages.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.5	2.8	2.1	1.6	1.5	2.3	3.0	143	131	38	6.1	4.4
2	1.2	3.1	2.0	1.6	1.5	2.3	3.2	127	117	33	4.8	4.3
3	1.3	4.0	*1.9	1.5	1.5	2.3	3.3	*115	*131	30	5.2	4.3
4	1.1	*4.4	1.8	1.5	1.5	2.3	*3.5	114	119	26	6.1	4.0
5	1.2	4.0	1.8	*1.5	1.5	2.4	*138	115	123	25	4.8	3.9
6	1.1	4.0	1.8	1.5	1.6	2.5	*574	110	189	*36	5.2	5.4
7	*1.3	4.8	1.8	1.5	1.6	2.6	758	104	157	34	5.2	7.1
8	1.3	3.4	1.8	1.5	1.6	2.6	*1,500	101	139	34	5.6	6.0
9	1.5	3.7	1.8	1.5	*1.6	2.7	1,880	174	121	29	6.5	*6.3
10	1.4	4.8	1.9	1.5	1.6	2.8	1,500	292	110	24	*3.4	5.9
11	1.4	4.8	1.9	1.5	1.6	2.8	1,560	301	96	24	4.9	5.0
12	2.3	4.0	2.0	1.5	1.6	2.8	1,110	232	90	20	4.6	7.1
13	2.1	4.0	2.0	1.5	1.6	2.8	979	186	80	24	5.4	4.2
14	2.3	4.8	1.9	1.5	1.6	2.9	*864	176	73	16	4.7	4.9
15	1.6	4.8	1.8	1.5	1.6	*3.0	761	242	65	15	4.5	5.8
16	1.6	4.4	1.8	1.5	1.7	3.0	616	290	60	15	4.7	5.9
17	1.8	4.4	1.8	1.5	1.7	3.0	534	285	57	15	4.4	7.5
18	2.5	6.1	1.7	1.6	1.7	2.9	440	244	50	14	4.2	7.5
19	2.3	4.0	1.7	1.6	1.7	2.8	373	212	49	14	4.2	8.7
20	2.5	3.1	1.7	1.6	1.8	2.7	320	189	42	14	4.4	12
21	2.3	2.8	1.7	1.6	1.8	2.7	285	207	41	15	5.4	8.4
22	3.7	3.1	1.7	1.6	1.7	2.7	255	196	69	15	4.4	6.7
23	3.7	3.0	1.7	1.6	1.7	2.7	228	205	55	15	3.8	5.2
24	3.4	3.1	1.7	1.6	1.8	2.7	223	200	38	15	4.0	6.7
25	3.7	2.9	1.7	1.6	1.9	2.7	246	218	36	11	3.0	5.9
26	4.4	2.7	1.7	1.5	2.0	2.7	260	239	39	9.3	3.5	7.0
27	4.0	2.6	1.7	1.5	2.1	2.7	235	239	55	7.9	3.2	10
28	5.2	2.5	1.7	1.5	2.2	2.7	198	193	60	7.4	3.2	12
29	4.8	2.3	1.6	1.5		2.8	176	174	47	6.5	3.7	15
30	6.1	2.2	1.6	1.5	----------	2.8	159	159	42	4.0	4.9	32
31	3.1	---------	1.6	1.5	----------	2.9	----------	143	---------	6.4	5.4	---------
Total	77.7	110.6	55.4	47.5	47.3	83.6	16,185	5,925	2,481	592.5	143.4	229.1
Mean	2.51	3.69	1.79	1.53	1.69	2.70	540	191	82.7	19.1	4.63	7.64
Cfsm	0.0082	0.012	0.0058	0.005	0.0055	0.0088	1.76	0.622	0.269	0.062	0.015	0.025
In.	0.009	0.01	0.007	0.006	0.006	0.01	1.96	0.72	0.31	0.07	0.02	0.03
Ac-ft	154	219	110	94	94	166	32,100	11,750	4,920	1,180	284	454

Calendar year 1964: Max 124 Min 0.7 Mean 15.6 Cfsm 0.051 In. 0.69 Ac-ft 11,300
Water year 1964-65: Max 1,880 Min 1.1 Mean 71.2 Cfsm 0.233 In. 3.17 Ac-ft 51,520

* Discharge measurement or observation of no flow made on this day.

Note.--Stage-discharge relation affected by ice Nov. 22 to Apr. 11 (no gage-height record Dec. 27, 28, Jan. 16, 17, Feb. 4, 9-13, Mar. 1-5, 12, 15-20, Mar. 24 to Apr. 3. No gage-height record on Diversion channel Apr. 1-3,18, Aug. 10 to Sept. 30.

5-3165. Redwood River near Redwood Falls, Minn.

Location.--Lat 44°31'25", long 95°10'20", in SE¼NE¼ sec.9, T.112 N., R.36 W., on right bank 20 ft upstream from highway bridge, 3 miles west of town of Redwood Falls, and 8.5 miles upstream from mouth.

Drainage area.--697 sq mi.

Records available.--July 1909 to September 1911 (no winter records), October 1911 to September 1912, October 1912 to September 1914 and August 1930 to September 1935 (no winter records), October 1935 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 972.33 ft above mean sea level, datum of 1929. July 1909 to September 1914, chain gage at bridge 20 ft downstream at datum 0.22 ft lower. August 1930 to Mar. 25, 1940, chain gage and Mar. 26, 1940, to Oct. 25, 1949, wire-weight gage, at bridge 20 ft downstream at present datum.

Average discharge.--31 years (1911-12, 1935-65), 101 cfs (73,120 acre-feet per year).

Extremes.--Maximum discharge during year, 7,050 cfs Apr. 9 (gage height, 13.32 ft); maximum gage height, 15.88 ft Apr. 8 (backwater from ice); minimum daily discharge, 1.3 cfs Jan. 29 to Feb. 18; minimum gage height, 1.26 ft Feb. 4.
1909-14, 1930-65: Maximum discharge, 19,700 cfs June 18, 1957 (gage height, 15.92 ft, from floodmark); no flow for several days in January 1940 and for part of each day Aug. 19, 20, 1959.

Remarks.--Records good except those for period of ice effect, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Natural discharge affected by unknown amount of interbasin flow between Yellow Medicine, Redwood and Cottonwood River basins during extreme floods.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Oct. 27 to Nov. 7)

1.3	2.4	2.1	97	5.0	1,660
1.4	5.5	2.6	240	7.0	3,260
1.5	11	3.0	410	9.0	5,280
1.6	18	3.5	690	11.0	7,730
1.8	39	4.0	1,000		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.8	8.8	3.5	2.1	1.3	1.5	2.0	*336	284	86	20	8.2
2	5.2	16	3.5	2.1	1.3	1.5	4.0	308	336	80	17	7.7
3	5.5	18	*3.5	2.1	1.3	1.5	9.0	276	410	74	18	7.2
4	4.8	16	3.4	2.1	1.3	1.5	80	248	320	64	16	6.3
5	4.5	15	3.4	*2.1	1.3	1.5	300	230	288	89	15	5.9
6	*9.4	14	3.4	2.1	1.3	1.5	650	223	284	*140	17	6.3
7	12	13	3.4	2.1	1.3	1.5	1,000	220	*324	163	18	6.7
8	10	13	3.4	2.0	*1.3	1.5	3,900	206	340	135	20	6.7
9	8.8	13	3.3	2.0	1.3	1.5	*6,600	223	348	160	18	5.9
10	10	13	3.3	2.0	1.3	1.5	*5,940	276	316	106	*16	5.9
11	6.7	12	3.2	1.9	1.3	1.5	5,270	375	268	84	14	5.9
12	7.7	12	3.1	1.8	1.3	1.5	4,260	410	268	78	13	6.7
13	7.2	12	3.0	1.8	1.3	1.6	*3,210	370	213	169	12	9.4
14	5.9	12	2.9	1.7	1.3	1.6	2,520	332	194	115	11	10
15	5.9	11	2.8	1.7	1.3	*1.6	2,120	340	175	84	8.8	10
16	7.7	11	2.7	1.6	1.3	1.6	1,820	405	157	74	7.7	12
17	8.8	11	2.6	1.6	1.3	1.6	1,540	430	140	62	8.8	11
18	9.4	11	2.5	1.6	1.3	1.6	1,260	430	125	53	9.4	11
19	9.4	11	2.4	1.5	1.4	1.6	992	385	115	46	8.8	15
20	7.7	11	2.4	1.5	1.4	1.6	810	344	106	44	7.7	22
21	7.7	11	2.3	1.5	1.4	1.6	708	328	97	43	7.2	27
22	7.2	9.5	2.3	1.4	1.4	1.6	624	332	106	41	6.7	25
23	7.7	8.3	2.2	1.4	1.4	1.6	552	320	154	39	5.9	25
24	7.2	8.2	2.2	1.4	1.4	1.5	495	332	148	35	6.3	23
25	8.2	8.1	2.2	1.4	1.4	1.5	495	365	115	31	6.7	20
26	11	7.1	2.2	1.4	1.5	1.5	522	385	104	30	5.9	16
27	8.8	5.8	2.2	1.4	1.5	1.5	510	410	106	28	5.5	15
28	8.8	4.6	2.1	1.4	1.5	1.5	480	410	106	25	5.5	16
29	8.8	4.0	2.1	1.3		1.5	430	370	108	24	7.7	31
30	8.8	3.6	2.1	1.3	----------	1.5	370	332	99	22	8.8	68
31	8.2	----------	2.1	1.3	----------	1.5	----------	304	----------	20	8.8	----------
Total	243.8	324.0	85.7	52.6	37.7	47.6	47,473.0	10,255	6,154	2,244	351.2	445.8
Mean	7.86	10.8	2.76	1.70	1.35	1.54	1,583	331	205	72.4	11.3	14.9
Cfsm	0.011	0.015	0.0040	0.0024	0.0019	0.0022	2.27	0.475	0.294	0.104	0.016	0.021
In.	0.01	0.02	0.005	0.003	0.002	0.003	2.53	0.55	0.33	0.12	0.02	0.02
Ac-ft	483	643	170	104	75	94	94,160	20,340	12,210	4,520	697	884

Calendar year 1964: Max 348 Min 2.1 Mean 45.5 Cfsm 0.065 In. 0.89 Ac-ft 33,060
Water year 1964-65: Max 6,600 Min 1.3 Mean 186 Cfsm 0.267 In. 3.61 Ac-ft 134,400

Peak discharge (base, 150 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-9	0400	13.32	7,050	7-9	0200	2.55	197
6-2	2030	3.22	522	7-13	0300	2.57	209

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 22 to Apr. 10 (no gage-height record Mar. 19-31).

$\frac{186}{697} \times 13.5744 = 3.62$

5-3170. Cottonwood River near New Ulm, Minn.

Location.--Lat 44°17'40", long 94°26'40", in N½ sec.33, T.110 N., R.30 W., on left bank 600 ft upstream from highway bridge, 1.8 miles south of New Ulm, and 2 miles upstream from mouth.

Drainage area.--1,280 sq mi, approximately.

Records available.--July 1909 to December 1913, March 1931 to March 1938, August 1938 to September 1965 (winter records incomplete prior to 1936).

Gage.--Water-stage recorder. Datum of gage is 799.09 ft above mean sea level, adjustment of 1912. July 1, 1909, to Dec. 13, 1913, chain gage at site 2.7 miles upstream at different datum. Mar. 15, 1931, to Mar. 31, 1938, chain or wire-weight gage 2¼ miles upstream at datum 11.41 ft higher. Aug. 23, 1938, to June 25, 1948, staff gage at present site and datum.

Average discharge.--31 years (1911-13, 1935-37, 1938-65), 258 cfs (186,000 acre-ft per year).

Extremes.--Maximum discharge during year, 26,000 cfs Apr. 8 (gage height, 20.86 ft, from floodmark, backwater from ice); minimum, 6.5 cfs Nov. 20 (gage height, 0.72 ft).
1909-13, 1931-65: Maximum discharge, that of Apr. 8, 1965; maximum gage height, that of Apr. 8, 1965; minimum observed, 0.5 cfs Nov. 27, 1952; minimum gage height, 0.72 ft Nov. 20, 1964.

Remarks.--Records good except those for periods of ice effect, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Some regulation by dam at Cottonwood Lake and several other small lakes above station.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Sept. 2-30)

Oct. 1 to Apr. 5		Apr. 6 to Sept. 30			
0.8	3.5	2.7	34	7.0	1,360
.9	12	3.0	73	9.0	2,910
1.1	22	3.5	150	11.0	4,750
1.3	36	4.0	235	13.0	8,240
1.5	55	5.0	469	16.0	16,900
		6.0	800	19.0	26,000

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	47	44	20	18	12	13	16	985	955	380	109	58
2	44	44	20	18	12	13	17	904	930	328	100	54
3	42	44	20	18	12	13	20	845	1,200	289	100	48
4	39	42	20	19	12	13	80	778	894	264	92	46
5	38	40	20	19	12	14	350	727	818	239	85	45
6	38	*40	20	19	12	14	1,640	698	1,430	258	106	45
7	35	40	*20	19	12	14	*10,700	712	1,420	323	121	45
8	*33	40	19	*19	12	14	23,000	1,160	1,160	461	116	42
9	32	40	18	17	12	14	*21,000	4,030	917	786	110	40
10	33	39	17	15	12	14	15,900	3,800	845	719	98	40
11	37	39	16	14	*12	14	14,100	3,620	694	536	82	38
12	42	39	15	13	13	14	*11,700	2,460	594	*420	68	38
13	39	40	14	13	13	14	*8,940	1,720	521	412	*76	38
14	38	40	13	13	13	14	*7,010	1,500	437	349	73	38
15	37	40	12	13	13	14	5,340	1,520	392	298	66	38
16	36	39	12	13	13	14	4,300	2,280	345	262	61	*44
17	36	39	12	13	13	14	3,440	2,770	310	235	58	48
18	34	39	12	12	13	14	2,890	2,850	277	215	58	53
19	33	35	11	12	13	14	2,440	2,440	254	198	57	74
20	34	18	12	12	13	14	2,130	1,970	239	186	58	82
21	33	28	12	12	13	14	1,820	1,540	218	176	64	85
22	33	29	12	12	13	*14	1,660	1,540	567	162	58	85
23	34	29	13	12	13	14	1,330	1,620	1,510	155	56	80
24	35	28	14	12	13	14	1,240	1,490	1,630	140	54	76
25	34	27	15	12	13	14	1,340	2,210	1,240	132	62	76
26	35	26	16	12	13	14	1,580	2,650	840	127	51	64
27	36	24	16	12	13	14	1,460	2,370	654	115	48	73
28	36	21	17	12	13	14	1,310	1,820	533	106	46	94
29	36	20	17	12		14	*1,170	1,400	445	100	58	165
30	36	20	17	12	----------	14	*1,080	1,180	412	100	67	683
31	35	---------	18	12	----------	15	----------	*1,100	----------	108	68	----------
Total	1,130	1,033	490	441	353	431	149,003	56,689	22,681	8,579	2,326	2,435
Mean	36.5	34.4	15.8	14.2	12.6	13.9	4,967	1,829	756	277	75.0	81.2
Cfsm	0.029	0.027	0.012	0.011	0.0098	0.011	3.88	1.43	0.591	0.216	0.059	0.063
In.	0.03	0.03	0.01	0.01	0.01	0.01	4.33	1.65	0.66	0.25	0.07	0.07
Ac-ft	2,240	2,050	972	875	700	855	295,500	112,400	44,990	17,020	4,610	4,830

Calendar year 1964: Max 952 Min 11 Mean 133 Cfsm 0.104 In. 1.42 Ac-ft 96,850
Water year 1964-65: Max 23,000 Min 11 Mean 673 Cfsm 0.526 In. 7.13 Ac-ft 487,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Dec. 17, Dec. 21 to Apr. 9.

$\frac{623}{1280} \times 13.5744 = 7.14$

5-3180. East Branch Blue Earth River near Bricelyn, Minn.

Location.--Lat 43°37'50", long 93°47'25", in NE¼NE¼ sec.23, T.102 N., R.25 W., in center of span on downstream side of highway bridge, 2 miles upstream from Brush Creek, 3 miles downstream from South Walnut Lake, and 5 miles northeast of Bricelyn.

Drainage area.--132 sq mi.

Records available.--March 1951 to September 1965. Prior to October 1957, published as East Fork Blue Earth River near Bricelyn.

Gage.--Wire-weight gage read twice daily. Datum of gage is 1,131.86 ft above mean sea level, datum of 1929 (Minnesota State Highway Department bench mark).

Average discharge.--14 years, 34.8 cfs (25,190 acre-ft per year).

Extremes.--Maximum discharge during year, 1,260 cfs Apr. 7 (gage height, 11.70 ft); no flow on many days. 1951-65: Maximum discharge, 1,320 cfs Apr. 7, 1951 (gage height, 10.68 ft, from graph based on gage readings); maximum gage height, that of Apr. 17, 1965; no flow on many days.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used May 10 to Aug. 11)

3.7	0	4.1	2.0	4.6	12	6.0	110
3.8	0.2	4.3	3.2	4.8	24	9.0	500
3.9	.6	4.4	6.7	5.0	38	10.0	770
4.0	1.0	4.5	8.9	5.5	72	11.7	1,260

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	43	6.7	3.4	1.1	0	2.2	10	242	152	63	2.8	0
2	42	6.5	3.2	1.1		1.6	50	219	139	54	3.0	0
3	40	6.0	3.1	1.1	0	1.2	100	196	171	46	2.8	0
4	38	6.0	2.9	1.0	0	.5	300	176	216	37	2.5	0
5	37	6.3	2.8	1.0	0	0	500	159	296	30	1.9	0
6	37	6.3	2.6	1.0	0	0	900	149	351	23	1.7	0
7	34	6.0	* 2.5	.9	0	0	* 1,240	141	377	18	2.1	0
8	31	5.8	2.4	.9	0	0	1,210	134	389	13	2.0	0
9	28	* 6.3	2.4	.8	0	0	1,160	121	402	24	1.7	0
10	26	6.3	2.3	.8	0	0	1,110	*110	408	35	1.2	0
11	22	6.3	2.2	* .7	0	0	1,070	100	387	53	.9	0
12	*18	6.5	2.1	.6	0	0	994	90	364	60	.6	0
13	14	6.9	2.0	.5	0	0	921	81	334	62	.4	0
14	12	6.9	2.0	.4	0	0	840	72	309	59	.3	0
15	12	7.1	1.9	.3	* 0	0	* 781	72	*282	52	.2	.1
16	12	6.7	1.8	.2	0	0	714	92	256	46	.1	.1
17	13	6.7	1.8	.1	0	0	652	102	233	37	.1	.2
18	14	6.3	1.7	0	0	0	586	110	210	30	0	.6
19	13	5.8	1.7	0	0	0	534	111	191	* 22	0	2.0
20	12	5.8	1.6	0	0	0	490	108	170	15	0	*7.6
21	11	5.4	1.6	0	0	0	448	104	155	11	0	14
22	10	5.2	1.5	0	0	* 0	414	100	145	8.9	0	27
23	9.2	5.0	1.5	0	0	0	384	111	139	7.4	* 0	40
24	8.9	4.8	1.4	0	0	0	359	125	129	5.8	0	49
25	8.7	4.6	1.4	0	0	0	345	137	118	4.2	0	52
26	8.5	4.4	1.4	0	.5	0	343	167	96	3.6	0	49
27	8.2	4.2	1.3	0	1.6	.5	332	174	90	3.0	0	49
28	8.0	3.9	1.3	0	3.0	1.0	316	178	88	2.2	0	56
29	7.8	3.7	1.2	0		1.6	293	174	82	1.6	0	90
30	7.6	3.6	1.2	0	---------	3.1	269	171	73	1.4	0	122
31	7.1	---------	1.2	0	---------	6.0	---------	163	---------	2.2	0	---------
Total	593.0	172.0	61.4	12.5	5.1	17.7	17,665	4,189	6,752	830.3	24.3	558.6
Mean	19.1	5.73	1.98	0.40	0.18	0.57	589	135	225	26.8	0.78	18.6
Cfsm	0.145	0.043	0.015	0.0030	0.0014	0.0043	4.46	1.02	1.70	0.203	0.0059	0.141
In.	0.17	0.05	0.02	0.004	0.001	0.005	4.98	1.18	1.90	0.23	0.007	0.16

Calendar year 1964: Max 125 Min 0 Mean 11.4 Cfsm 0.086 In. 1.20
Water year 1964-65: Max 1,240 Min 0 Mean 84.6 Cfsm 0.641 In. 8.71

* Discharge measurement or observation of no flow made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 6 (no gage-height record Nov. 29 to Dec. 6, Feb. 26 to Mar. 4).

5-3200. Blue Earth River near Rapidan, Minn.

Location.--Lat 44°05'44", long 94°06'33", in SE¼SE¼ sec.6, T.107 N., R.27 W., on left bank 0.2 mile downstream from powerplant of Northern States Power Co., 2 miles west of Rapidan, 3½ miles downstream from Watonwan River, and 7¾ miles upstream from LeSueur River.

Drainage area.--2,430 sq mi, approximately.

Records available.--July 1909 to November 1910 (no winter records), October 1939 to September 1945, July 1949 to September 1965. Published as "at Rapidan Mills" 1909-10.

Gage.--Water-stage recorder (digital). Datum of gage is 808.80 ft above mean sea level, adjustment of 1912. July 20, 1909, to Apr. 28, 1910, chain gage at site a quarter mile upstream at different datum. Apr. 29 to Nov. 12, 1910, staff gage at site 800 ft upstream at different datum. Oct. 4 to Nov. 14, 1939, staff gage at present site and datum.

Average discharge.--22 years (1939-45, 1949-65), 794 cfs (574,800 acre-ft per year).

Extremes.--Maximum discharge during year, 43,100 cfs Apr. 9 (gage height, 21.36 ft, from floodmark); minimum, 11 cfs Jan. 22 (gage height, 1.07 ft).
1909-10, 1939-45, 1949-65: Maximum discharge, that of Apr. 9, 1965; minimum, 6.9 cfs Oct. 12, 1955 (gage height, 1.04 ft).

Remarks.--Records good. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Flow regulated by Rapidan Reservoir (capacity, 2,980 acre-ft). Rapidan Reservoir gates destroyed during April 1965 flood and not replaced during 1965. Capacity reduced to an undetermined figure.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,670	335	312	66	44	175	230	4,260	3,470	1,140	248	205
2	1,550	302	249	122	78	165	400	3,840	3,230	1,080	280	166
3	1,490	410	248	51	108	185	1,360	3,520	3,040	990	285	166
4	1,260	412	241	197	74	200	3,660	3,310	2,820	909	225	159
5	1,280	413	189	135	103	317	8,380	3,170	2,740	825	248	122
6	1,180	410	131	143	77	1,090	*15,700	3,070	2,740	782	213	115
7	1,030	371	224	*135	40	630	*28,500	3,350	3,610	734	315	128
8	977	330	227	125	92	470	*41,400	3,650	4,990	818	225	106
9	*928	301	*163	95	90	390	*42,500	3,530	5,280	982	217	115
10	788	410	223	61	*105	350	*37,000	3,530	5,060	1,510	213	115
11	786	410	224	192	105	310	*31,600	3,650	4,610	1,630	201	118
12	723	405	192	191	110	280	*26,600	3,680	3,960	1,340	181	106
13	703	356	212	111	124	260	*21,700	3,440	3,310	*1,110	152	112
14	698	360	263	34	110	250	*17,700	3,410	2,810	925	163	115
15	663	292	321	112	106	280	*14,700	2,960	2,440	818	138	112
16	600	*220	336	18	160	240	12,800	3,030	2,160	727	138	122
17	605	412	272	40	155	240	11,300	3,370	1,940	662	148	138
18	593	407	226	118	160	230	10,000	3,910	1,770	604	*110	135
19	547	329	220	120	105	220	8,820	4,080	1,620	545	109	205
20	494	141	58	120	97	210	7,880	3,710	1,500	497	112	297
21	491	21	205	119	86	180	7,100	3,250	1,470	473	115	491
22	484	222	195	63	105	118	6,420	2,930	1,640	467	86	*623
23	474	304	175	66	108	155	5,720	2,870	2,270	425	98	656
24	466	296	155	59	112	150	5,230	3,160	2,370	403	112	610
25	462	283	66	85	112	*135	4,940	*3,410	2,210	381	125	539
26	459	263	189	80	116	120	4,980	3,960	1,990	335	112	479
27	459	305	68	100	120	135	5,170	4,140	1,700	290	103	455
28	422	318	175	100	130	135	5,280	4,370	1,510	275	112	449
29	422	307	185	95		150	*5,180	4,520	1,360	243	112	564
30	422	331	135	78	----------	200	4,740	4,160	1,210	256	135	1,380
31	421	---------	188	84	----------	190	----------	3,700	----------	270	166	----------
Total	23,547	9,676	6,267	3,115	2,932	8,160	396,990	110,940	80,830	22,446	5,197	9,103
Mean	760	323	202	100	105	263	13,230	3,580	2,690	724	168	303
Cfsm	0.313	0.133	0.083	0.041	0.043	0.108	5.44	1.47	1.11	0.298	0.069	0.125
In.	0.36	0.15	0.10	0.05	0.04	0.12	6.08	1.70	1.24	0.34	0.08	0.14
Ac-ft	46,700	19,190	12,430	6,180	5,820	16,190	787,400	220,000	160,300	44,520	10,310	18,060

Calendar year 1964 Max 5,160 Min 16 Mean 650 Cfsm 0.267 In. 3.65 Ac-ft 472,000
Water year 1964-65 Max 42,500 Min 18 Mean 1,861 Cfsm 0.766 In. 10.40 Ac-ft 1,347,000

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Dec. 19, 21-24, 28, 29, Jan. 7-9, 18-20, 25-31, Feb. 11 to Mar. 3, Mar. 6-21, Mar. 23 to Apr. 2.

$\frac{186}{2430} \times 13,574 = 10,396$

$176584 =$

GPO 826-476-9

5-3205. Le Sueur River near Rapidan, Minn.

Location.--Lat 44°06'40", long 94°02'28", in SW¼ sec.35, T.108 N., R.27 W., on right bank 600 ft downstream from highway bridge, 1.8 miles northeast of Rapidan, and 2.3 miles upstream from mouth.

Drainage area.--1,100 sq mi, approximately.

Records available.--October 1939 to September 1945, July 1949 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 775.76 ft above mean sea level, datum of 1929. Prior to Nov. 15, 1939, staff gage at same site and datum.

Average discharge.--22 years, 370 cfs (267,900 acre-ft per year).

Extremes.--Maximum discharge during year, 24,700 cfs Apr. 8 (gage height, 22.10 ft, from floodmark); minimum daily, 36 cfs Feb. 13-14; minimum gage height, 1.59 ft Nov. 20 (result of freeze-up).
1939-45, 1949-65: Maximum discharge, that of Apr. 8, 1965; maximum gage height, 22.72 ft May 22, 1960 (from floodmark); minimum daily, 1.6 cfs Feb. 9-25, 1959; minimum gage height, that of Nov. 20, 1965.

Remarks.--Records good except for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Aug. 5 to Sept. 19)

1.6	25	6.0	1,560
2.0	58	8.0	3,250
2.5	119	11.0	6,380
3.0	214	15.0	11,700
3.5	352	20.0	19,900
4.0	535	22.2	25,000
5.0	980		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	491	135	77	66	41	105	150	2,030	1,190	370	132	121
2	455	133	76	65	40	135	270	1,790	1,100	322	135	111
3	436	137	75	64	40	190	600	1,640	1,560	292	172	91
4	425	140	74	62	40	280	1,500	1,540	1,540	264	162	79
5	417	130	74	61	39	295	4,700	1,470	1,620	238	164	72
6	406	129	73	59	39	290	14,600	1,410	1,770	226	168	65
7	389	127	72	*58	38	275	*20,200	1,460	1,760	210	166	61
8	367	127	* 71	58	38	260	*23,400	1,570	2,000	267	176	59
9	*340	125	71	58	38	240	*20,000	1,540	2,400	861	172	57
10	316	124	72	57	* 37	225	*18,200	1,370	3,450	1,550	162	54
11	301	124	73	56	37	210	*15,500	1,210	3,370	1,750	139	52
12	286	125	74	56	37	191	*12,100	1,070	2,640	1,560	119	50
13	275	122	75	55	36	179	9,670	944	2,070	* 1,200	105	49
14	264	122	76	54	36	169	*7,490	854	1,660	935	91	50
15	256	124	77	54	37	159	*5,710	894	1,360	742	81	51
16	248	*124	78	53	38	151	4,660	1,320	1,110	606	74	56
17	238	127	79	52	39	142	4,030	1,420	930	499	* 73	*59
18	226	127	79	51	41	138	3,540	1,640	778	440	72	81
19	212	119	79	50	43	130	3,130	1,460	660	386	66	495
20	203	63	78	49	44	126	2,770	1,400	563	340	63	840
21	194	76	78	48	43	120	2,500	1,300	491	304	61	971
22	186	100	77	48	42	116	2,290	1,190	642	272	60	1,080
23	178	92	75	47	42	112	2,130	1,140	1,060	248	55	958
24	172	90	74	47	43	* 109	2,050	1,180	1,110	226	52	800
25	168	86	74	47	46	109	2,300	*1,340	1,060	205	62	665
26	162	84	72	47	52	109	2,800	1,470	858	184	58	547
27	157	83	72	46	64	110	2,900	1,640	701	166	52	479
28	153	81	71	46	81	113	2,850	1,820	580	153	48	511
29	148	80	70	45		116	2,570	1,730	495	140	51	822
30	144	79	68	44	----------	121	*2,290	1,540	421	130	58	1,800
31	139	----------	67	42	----------	132	----------	1,360	----------	133	79	----------
Total	8,352	3,335	2,301	1,645	1,191	5,157	196,900	43,742	40,949	15,219	3,128	11,186
Mean	269	111	74.2	53.1	42.5	166	6,563	1,411	1,365	491	101	373
Cfsm	0.245	0.101	0.067	0.048	0.039	0.151	5.97	1.28	1.24	0.446	0.092	0.339
In.	0.28	0.11	0.08	0.06	0.04	0.17	6.66	1.48	1.38	0.51	0.11	0.38
Ac-ft	16,570	6,610	4,560	3,260	2,360	10,230	390,500	86,760	81,220	30,190	6,200	22,190

Calendar year 1964: Max 2,400 Min 15 Mean 281 Cfsm 0.255 In. 3.47 Ac-ft 203,700
Water year 1964-65: Max 23,400 Min 36 Mean 913 Cfsm 0.830 In. 11.26 Ac-ft 660,700

Peak discharge (base, 1,300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4 -8	0500	22.10	24,700	5-28	1500	6.41	1,860
4-27	2400	7.68	2,960	6-10	2300	8.53	3,730
5-18	0800	6.14	1,660	7-11	1230	6.32	1,790

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 5 (no gage-height record Mar. 7-11).

913 / 1100 = .83 ; 13.574 = 11.27

5-3250. Minnesota River at Mankato, Minn.

Location.--Lat 44°10'10", long 94°00'15", in sec.7, T.108 N., R.26 W., on left bank at downstream side of Main Street Bridge in Mankato, 1.8 miles downstream from Blue Earth River and at mile 106.4 upstream from Mississippi River.

Drainage area.--14,900 sq mi, approximately.

Records available.--May 1903 to September 1965 (no winter records 1904, 1906-10, 1918-29). Monthly discharge only for some periods, published in WSP 1308. Published as "near Mankato" 1903-21.

Gage.--Water-stage recorder. Datum of gage is 747.92 ft above mean sea level, datum of 1929. Prior to Aug. 6, 1910, staff gage and Aug. 6, 1910, to Oct. 19, 1921, chain gage, at site 1.8 miles upstream at datum 6.4 ft higher. Mar. 15, 1922, to Nov. 30, 1924, chain gage at present site and datum.

Average discharge.--44 years (1905, 1910-17, 1929-65), 2,488 cfs (1,801,000 acre-ft per year).

Extremes.--Maximum discharge during year, 94,100 cfs Apr. 10 (gage height, 29.09 ft); minimum daily, 175 cfs Jan. 17; minimum gage height, 1.01 ft Jan. 17.
1903-65: Maximum discharge, that of Apr. 10, 1965; minimum observed, 26 cfs Aug. 4, 1934.
Maximum stage known, 29.9 ft Apr. 26, 1881, from floodmark, present site and datum (discharge, 90,000 cfs).

Remarks.--Records good except those for periods of ice effect, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Some diurnal fluctuation at low and medium stages caused by powerplants on Blue Earth River.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used Aug. 23 to Sept. 29)

Oct. 1 to Apr. 4		Apr. 5 to Sept. 30			
1.3	288	2.7	620	10.0	8,340
1.5	340	3.0	800	14.0	14,400
2.0	525	3.5	1,160	17.0	21,400
3.0	1,240	4.0	1,580	20.0	35,300
5.0	3,180	5.0	2,520	24.0	60,000
		7.0	4,620	29.0	93,500

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,580	769	340	250	184	370	430	18,600	15,000	6,350	2,180	972
2	2,520	626	330	248	184	500	900	17,300	14,200	5,990	1,980	916
3	2,240	828	310	243	190	640	1,800	16,200	14,900	5,630	1,830	888
4	2,180	842	300	242	200	820	5,900	15,200	14,000	5,290	1,640	881
5	2,120	835	290	240	215	930	13,300	14,200	13,000	5,020	1,550	794
6	1,960	812	285	*240	226	1,020	30,000	13,500	12,800	4,800	1,510	782
7	1,820	776	285	238	237	1,050	51,100	13,200	13,100	4,670	1,590	770
8	1,680	762	* 294	232	246	1,000	*79,000	13,600	14,900	4,650	1,580	734
9	1,590	*638	298	228	250	920	*92,200	13,800	16,500	5,390	1,520	716
10	1,400	805	300	222	265	810	*92,700	15,000	16,900	6,510	1,500	698
11	1,380	805	300	212	*301	700	91,600	16,000	16,500	6,890	1,380	662
12	*1,340	805	290	203	312	610	89,600	16,000	15,000	6,490	1,370	655
13	1,270	734	287	193	318	570	83,200	14,700	13,500	*5,900	1,360	674
14	1,260	720	282	184	319	520	74,400	13,200	12,200	5,590	1,350	650
15	1,230	692	278	178	319	500	66,000	12,400	11,200	5,560	1,280	650
16	1,140	624	272	176	318	480	58,600	12,600	10,400	5,480	1,320	674
17	1,110	783	270	175	313	465	*52,800	12,900	9,710	5,300	*1,290	*698
18	1,100	783	265	178	305	450	47,600	13,400	9,150	5,060	1,220	710
19	1,050	678	260	180	300	430	42,800	14,000	8,670	4,730	1,180	979
20	992	449	255	187	280	415	*38,300	13,300	8,290	4,400	1,120	1,400
21	940	310	253	192	275	405	34,700	12,300	7,930	4,150	1,110	1,690
22	932	362	250	198	275	403	31,400	11,400	8,100	3,970	1,060	1,990
23	910	536	250	200	279	400	28,400	11,000	8,890	3,760	1,050	1,970
24	872	572	248	200	280	* 397	*26,100	*11,400	9,770	3,600	1,040	1,840
25	872	577	246	202	287	375	24,600	12,100	9,660	3,330	1,100	1,700
26	865	563	247	200	290	349	24,000	13,100	9,040	3,150	993	1,550
27	858	505	249	200	300	360	23,400	13,900	8,270	2,990	944	1,480
28	812	470	250	197	310	363	*22,400	14,900	7,680	2,850	902	1,520
29	798	410	250	192		360	21,300	*16,000	7,220	2,690	951	1,900
30	790	370	250	188	----------	365	19,900	16,400	6,770	2,490	1,000	3,570
31	783	---------	250	184	----------	380	----------	15,800	----------	2,360	986	----------
Total	41,394	19,441	8,534	6,402	7,578	17,357	1,268,430	437,400	343,250	145,040	40,886	35,113
Mean	1,335	648	275	207	271	560	42,280	14,110	11,440	4,679	1,319	1,170
Cfsm	0.090	0.043	0.018	0.014	0.018	0.038	2.84	0.947	0.768	0.314	0.089	0.079
In.	0.10	0.05	0.02	0.02	0.02	0.04	3.17	1.09	0.86	0.36	0.10	0.09
Ac-ft	82,100	38,560	16,930	12,700	15,030	34,440	2,516,000	867,600	680,800	287,700	81,100	69,650

Calendar year 1964: Max 12,400 Min 246 Mean 1,818 Cfsm 0.122 In. 1.65 Ac-ft 1,320,000
Water year 1964-65: Max 92,700 Min 175 Mean 6,495 Cfsm 0.436 In. 5.92 Ac-ft 4,702,000

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 27 to Mar. 23, Mar. 30 to Apr. 4.

$\frac{6495}{14,900} \times 13.5744 = 5.917$

5-3300. Minnesota River near Carver, Minn.

Location.--Lat 44°43'28", long 93°37'58", in NE¼SW¼ sec.31, T.115 N., R.23 W., on left bank 2½ miles south of Carver and at mile 36 upstream from Mississippi River.

Drainage area.--16,200 sq mi, approximately.

Records available.--September 1934 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 690.00 ft above mean sea level, datum of 1929. Prior to Dec. 5, 1934, staff gage at same site and datum. Auxiliary chain gage 2¾ miles upstream at same datum read twice daily.

Average discharge.--31 years, 3,148 cfs (2,279,000 acre-ft per year).

Extremes.--Maximum discharge during year, 117,000 cfs Apr. 11; maximum gage height, 34.37 ft Apr. 12 (backwater from Mississippi River); minimum daily discharge, 372 cfs Feb. 16; minimum gage height, 3.54 ft Jan. 20. 1934-65: Maximum discharge, that of April 11, 1965; maximum gage height, that of Apr. 12, 1965; minimum discharge, 79 cfs Nov. 17, 1955; minimum gage height, 2.66 ft Nov. 22, 1935.

Remarks.--Records good except those for periods of ice effect or shifting-control, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report.

Cooperation.--Auxiliary gage readings furnished by Corps of Engineers.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3,470	1,030	605	485	401	410	582	23,000	16,400	7,120	2,950	1,140
2	3,260	1,030	610	483	403	430	608	21,300	16,600	6,520	2,720	1,150
3	3,020	1,010	620	480	410	490	651	19,800	16,500	6,010	2,660	1,140
4	2,770	968	630	478	411	540	775	18,600	*16,000	5,660	2,580	1,110
5	2,590	1,020	640	475	415	650	1,390	17,500	15,900	5,280	2,370	1,080
6	2,490	1,040	650	473	415	720	3,780	16,100	15,900	5,280	2,140	1,030
7	2,390	1,030	660	472	410	840	8,900	16,100	14,900	5,110	2,030	977
8	2,120	1,030	665	470	408	1,000	*19,000	15,500	14,200	5,160	2,070	959
9	1,940	1,010	675	460	403	1,060	43,500	16,200	13,900	5,980	2,100	950
10	1,850	995	*686	457	400	1,050	94,000	16,600	14,200	6,540	1,970	920
11	1,760	959	690	*451	395	1,030	112,000	16,500	15,300	7,060	1,830	870
12	1,660	1,000	680	450	390	950	*112,000	16,800	15,300	7,430	1,730	850
13	*1,620	1,010	670	450	382	900	108,000	17,200	16,800	7,990	1,640	860
14	1,540	1,000	655	445	380	820	105,000	17,100	15,900	*7,520	1,550	850
15	1,490	977	630	440	*376	770	95,000	16,300	14,700	6,910	1,480	870
16	1,470	968	585	420	372	740	73,800	15,300	13,000	7,230	1,410	880
17	1,420	*930	560	410	380	710	*70,200	14,500	11,800	6,770	1,340	1,000
18	1,350	890	545	405	382	670	62,500	14,200	10,800	6,250	1,310	1,110
19	1,310	950	535	400	390	650	52,900	14,100	10,000	6,140	*1,220	1,240
20	1,280	959	530	400	399	630	50,600	14,700	9,340	5,610	1,170	1,430
21	1,260	751	525	405	395	610	46,600	14,900	8,680	5,150	1,140	*1,920
22	1,210	650	525	410	390	580	41,400	14,200	9,010	4,820	1,180	2,530
23	1,180	630	525	420	380	560	39,400	13,400	9,160	4,470	1,140	2,790
24	1,170	620	530	430	377	540	*35,900	12,500	9,090	4,390	1,080	2,880
25	1,140	630	520	440	375	530	32,800	12,000	9,530	4,050	1,120	2,810
26	1,130	640	510	440	385	520	29,700	12,400	9,790	3,860	1,160	2,710
27	1,110	640	500	430	396	520	28,400	12,600	9,590	3,610	1,180	2,520
28	1,090	620	495	420	407	520	26,800	13,000	9,020	3,430	1,060	2,490
29	1,080	610	490	415		*540	25,400	13,300	8,350	3,280	1,000	2,690
30	1,050	600	490	410	---	540	24,300	13,900	7,630	3,190	1,010	4,420
31	1,030	---	488	405	---	550	---	14,800	---	3,110	1,070	---
Total	53,250	26,197	18,119	13,629	11,027	21,070	1,345,886	484,400	378,290	170,930	50,410	48,176
Mean	1,718	873	584	440	394	680	44,860	15,630	12,610	5,514	1,626	1,606
Cfsm	0.106	0.054	0.036	0.027	0.024	0.042	2.77	0.965	0.778	0.340	0.100	0.099
In.	0.12	0.06	0.04	0.03	0.03	0.05	3.09	1.11	0.87	0.39	0.12	0.11
Ac-ft	105,600	51,960	35,940	27,030	21,870	41,790	2,670,000	960,800	750,300	339,000	99,990	95,560

= 6.02

Calendar year 1964: Max 12,900 Min 385 Mean 2,080 Cfsm 0.128 In. 1.75 Ac-ft 1,510,000
Water year 1964-65: Max 112,000 Min 372 Mean 7,182 Cfsm 0.443 In. 6.20 Ac-ft 5,200,000

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 22 to Apr. 10. Shifting-control method used Aug. 7 to Sept. 20.

$$\frac{7182}{16,200} \times 13.5744 = 6.018$$

.44333

5-3309. Nine Mile Creek at Bloomington, Minn.

Location.--Lat 44°48'46", long 93°18'07", in NW¼ sec.21, T.27 N., R.24 W., on left bank between 105th and 106th street in Bloomington, Minn., 1.2 miles downstream from bridge on Old Shakopee Road and 2.1 miles upstream from mouth.

Records available.--January 1963 to September 1965.

Gage.--Water-stage recorder. Altitude of gage is 731 ft (from topographic map). Prior to May 16, 1963, staff gage 30 ft upstream at datum 0.81 ft higher.

Extremes.--Maximum discharge during year, 535 cfs Apr. 8 (gage height, 4.32 ft); minimum daily, 1.2 cfs Feb. 24; minimum gage height, 1.33 ft Aug. 15, 16.
1963-65: Maximum discharge, that of Apr. 8, 1965; minimum daily, that of Feb. 24, 1965; minimum gage height, that of Aug. 15, 16, 1965.

Remarks.--Records good.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second).
(Shifting-control method used Oct. 1-8, May 31 to June 3)

Oct. 1 to Apr. 7				Apr. 8 to Sept. 30			
1.4	1.1	2.0	26	1.3	5.0	2.5	103
1.5	2.1	2.5	68	1.4	7.2	3.0	165
1.6	3.8	3.0	115	1.5	10	3 5	240
1.7	6.5	3.5	201	1.6	14	4.0	375
1.8	11	4.0	375	1.8	26	4.2	475
				2.0	45		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	20	5.1	2.5	1.8	1.8	*27	7.2	40	*105	11	10	14
2	16	6.2	2.7	1.8	1.9	1.9	11	35	117	11	14	11
3	12	6.2	2.7	1.8	1.7	1.7	*20	33	120	10	12	8.5
4	12	6.5	2.7	1.8	1.7	1.5	48	30	111	10	11	7.4
5	13	5.6	2.8	1.9	1.8	1.9	71	28	93	9.1	10	7.0
6	12	5.9	2.5	1.9	1.8	1.8	** 143	45	78	35	16	6.5
7	9.9	4.6	2.5	2.0	1.9	2.1	309	*61	73	19	13	6.8
8	* 9.9	5.9	2.7	* 2.0	1.7	1.7	430	75	61	56	12	6.8
9	9.9	4.6	* 2.7	2.1	1.8	1.6	411	96	46	63	11	6.8
10	9.4	4.8	3.8	2.0	1.9	1.7	356	95	37	51	9.7	6.3
11	10	5.1	4.7	2.0	1.7	1.6	* 347	86	29	46	8.2	5.9
12	12	6.6	3.6	2.0	* 1.7	1.7	329	65	22	44	7.2	9.2
13	10	5.9	3.4	2.0	1.7	2.3	289	45	17	60	6.8	9.1
14	10	4.3	2.8	1.9	1.7	3.4	247	38	14	* 45	6.3	19
15	10	4.8	2.7	1.9	1.7	3.2	207	79	13	44	5.7	19
16	9.9	3.8	2.6	2.1	1.7	3.4	173	107	12	36	* 6.5	31
17	8.4	* 4.1	2.3	1.9	1.8	2.5	152	117	11	30	6.3	39
18	7.6	4.1	2.0	1.9	1.8	2.5	134	113	11	24	6.8	50
19	7.6	3.3	2.0	1.9	1.6	2.4	115	95	10	22	6.3	69
20	7.6	3.2	2.0	1.9	2.4	2.2	96	81	12	19	6.1	73
21	7.2	3.6	1.9	2.0	1.7	1.9	80	57	11	17	22	*78
22	7.6	3.2	1.9	2.0	1.5	1.9	71	39	29	15	16	72
23	7.2	3.0	1.8	1.9	1.4	1.9	61	33	17	15	16	65
24	7.2	3.4	1.8	1.9	1.2	1.9	53	32	13	14	13	53
25	6.8	4.1	1.8	1.9	1.3	2.0	61	32	12	14	23	39
26	7.6	4.1	1.9	1.9	1.3	*2.0	65	28	11	13	16	29
27	7.6	3.6	1.8	1.9	2.1	1.9	68	24	12	12	13	24
28	6.2	3.2	1.8	2.1	3.5	1.9	65	22	11	9.4	11	31
29	6.2	2.8	1.8	2.2		2.1	54	18	11	7.9	13	46
30	6.2	2.6	1.8	2.2	----------	2.6	48	16	11	8.4	14	67
31	5.3	----------	1.8	2.0	----------	3.7	----------	36	----------	9.4	15	----------
Total	292.3	134.2	75.8	60.6	49.8	91.9	4521.2	1,701	1,130	780.2	356.9	909.3
Mean	9.43	4.47	2.45	1.95	1.78	2.96	151	54.9	37.7	25.2	11.5	30.3
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max 42 Min 1.6 Mean 8.83 Ac-ft -
Water year 1964-65: Max 430 Min 1.2 Mean 27.7 Ac-ft -

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 30, Dec. 16, 17, Jan. 13, 14, 28-30, Feb. 13, 16, 21, 22, 24, Mar. 20. No gage-height record Mar. 24, 25.

5-3310. Mississippi River at St. Paul, Minn.

Location.--Lat 44°56'40", long 93°05'20", in SE¼NE¼ sec.6, T.28 N., R.22 W., on left bank in St. Paul, 300 ft upstream from Robert Street Bridge, 6 miles downstream from Minnesota River, and at mile 839.3 upstream from Ohio River.

Drainage area.--36,800 sq mi, approximately.

Records available.--March 1892 to September 1965 (prior to 1901, fragmentary during some winters). Records prior to March 1892, published in the 19th Annual Report, Part 4, have been found to be unreliable and should not be used. Monthly discharge only for some periods, published in WSP 1308. Gage-height records (winter records incomplete) collected at same site since 1866 are contained in reports of U. S. Weather Bureau, War Department and Mississippi River Commission.

Gage.--Water-stage recorder. Datum of gage is 684.16 ft above mean sea level, adjustment of 1912. Prior to Mar. 18, 1925, staff or chain gage at several sites within 300 ft of present site at same datum. Mar. 18, 1925, to Mar. 10, 1933, water-stage recorder and Mar. 11, 1933, to Sept. 14, 1939, staff gage, at present site and datum. Since September 1938, auxiliary water-stage recorder 5.4 miles downstream.

Average discharge.--67 years (1894-95, 1896-97, 1900-1965), 9,952 cfs (adjusted for diversion).

Extremes.--Maximum discharge during year, 171,000 cfs Apr. 16 (gage height, 26.01 ft, from floodmark); minimum daily, 2,240 cfs Nov. 30.
1892-1965: Maximum discharge, that of Apr. 16, 1965; minimum daily, 632 cfs Aug. 26, 1934.
Maximum stage known since at least 1851, that of Apr. 16, 1965. Flood of Apr. 11, 1870 reached a stage of 19.4 ft and the flood of Apr. 29, 1881 reached a stage of 19.7 ft (107,000 cfs), determined by Corps of Engineers.

Remarks.--Records good. Records of water temperatures for the water year 1965 are published in Part 2 of this report. Slight regulation except during extreme floods by reservoirs on headwaters and by powerplants. Beginning July 20, 1938, sewage from Minneapolis and St. Paul, which formerly entered above station, was diverted to a sewage-disposal plant, thence to river below station. Figures of daily discharge do not include this diversion.

Cooperation.--Records of Mississippi River at Twin City lock and dam computed and furnished by Ford Motor Co. Gage-height record at South St. Paul furnished by Corps of Engineers. Diversion through sewage-disposal plant furnished by Minneapolis-St. Paul Sanitary District.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	12,500	4,830	2,810	4,050	3,600	4,460	4,070	66,100	48,800	21,800	8,670	6,910
2	11,200	5,360	3,040	4,050	3,630	3,740	4,660	62,500	46,200	21,800	*9,060	6,690
3	10,800	5,910	3,490	3,930	3,880	3,780	5,040	* 58,900	45,100	20,500	9,760	6,740
4	9,030	* 5,570	4,020	3,920	3,670	3,930	5,160	55,800	45,100	19,000	8,840	7,290
5	8,970	5,560	4,240	3,970	3,700	3,860	9,060	53,500	46,200	18,100	8,390	5,660
6	9,530	5,240	4,300	3,940	3,820	4,030	13,800	51,100	47,200	16,600	8,570	5,740
7	8,730	5,340	4,340	4,230	3,660	4,040	17,400	49,800	48,400	15,600	8,450	6,220
8	8,720	4,970	4,300	4,040	3,590	3,870	24,400	48,200	48,900	15,800	10,600	6,430
9	8,850	5,170	4,520	4,040	3,820	4,230	35,700	48,000	* 50,400	16,300	8,750	6,290
10	7,920	5,080	4,650	3,960	3,600	4,330	53,500	47,400	50,700	*17,100	9,580	6,390
11	7,280	5,300	4,570	3,860	3,680	4,020	91,300	47,100	51,800	16,900	9,080	5,630
12	7,150	4,910	4,740	3,870	3,640	3,800	128,000	46,600	52,800	17,100	9,000	5,540
13	7,180	5,430	4,470	3,890	3,410	3,980	*147,000	* 46,200	53,400	17,700	8,010	6,150
14	7,220	5,410	4,290	3,890	3,510	3,760	160,000	45,200	52,800	18,400	7,730	7,650
15	6,130	5,370	4,110	3,820	3,440	3,830	166,000	45,200	51,800	17,700	6,960	7,820
16	5,940	5,450	4,030	3,920	3,520	3,970	*171,000	44,800	50,000	16,600	6,850	9,420
17	5,600	5,420	4,110	3,700	3,560	4,000	169,000	43,200	47,600	17,400	6,640	10,400
18	6,380	5,510	3,640	3,750	3,640	3,640	163,000	42,400	44,400	16,600	6,410	11,000
19	6,260	* 5,120	4,110	3,900	3,580	3,980	155,000	41,200	40,800	16,100	6,480	12,300
20	6,780	5,160	3,960	3,850	3,680	4,270	147,000	40,400	38,200	15,200	6,210	12,800
21	6,220	3,640	3,780	3,780	3,470	4,270	*138,000	39,700	35,100	14,300	6,230	13,700
22	5,950	3,610	4,070	3,900	3,540	4,180	128,000	39,900	33,200	13,800	5,700	14,600
23	5,850	3,560	4,100	3,880	3,650	4,190	118,000	39,600	31,900	13,600	5,900	14,800
24	5,350	3,920	3,970	3,890	3,570	4,110	*108,000	39,500	30,700	12,900	5,620	15,500
25	6,050	4,100	4,200	3,870	3,670	4,040	99,300	40,100	28,600	12,500	6,030	15,500
26	5,370	3,970	4,110	3,660	3,680	3,980	92,000	41,500	27,200	11,800	5,830	14,800
27	5,590	3,330	3,890	3,800	3,630	3,860	84,300	42,400	26,800	11,200	6,200	14,200
28	5,470	3,480	3,800	3,610	3,690	3,790	*78,700	42,600	25,900	10,800	7,160	14,000
29	5,280	2,910	4,000	3,790		3,730	74,200	43,000	24,600	10,500	6,670	14,200
30	4,790	2,240	4,000	3,740		3,760	70,000	43,000	22,900	9,200	6,890	16,000
31	4,940		4,070	3,680		4,590		44,000		8,190	6,410	
Total	224,030	140,870	125,730	120,180	101,530	124,020	2,660,590	1,438,900	1,247,500	481,090	232,680	300,370
Mean	7,227	4,696	4,056	3,877	3,626	4,001	88,690	46,420	41,580	15,520	7,506	10,010
(≠)	+272	+261	+249	+250	+271	+283	+444	+356	+341	+341	+350	+274
Mean ≠	7,499	4,957	4,305	4,127	3,897	4,284	89,130	46,780	41,920	15,860	7,860	10,280
Cfsm ≠	0.204	0.135	0.117	0.112	0.106	0.116	2.42	1.27	1.14	0.432	0.214	0.279
In.≠	0.23	0.15	0.13	0.13	0.11	0.13	2.70	1.46	1.27	0.50	0.25	0.31

= 7.37

Calendar year 1964: Max 33,200 Min 2,170 Mean 7,820 Mean≠ 8,119 Cfsm≠ 0.221 In≠ 2.99
Water year 1964-65 : Max 171,000 Min 2,240 Mean 19,720 Mean≠ 20,030 Cfsm≠ 0.544 In≠ 7.37 ✓

* Discharge, measurement made on this day.
≠ Diversion, equivalent in cubic feet per second, through sewage-disposal plant.
≠ Adjusted for diversion.
Note.--Stage-fall discharge relation affected by ice or indefinite slope Oct. 2 to Apr. 5, July 4 to Sept. 30.

$\frac{19720}{36800} \times 13.5744 = 7.27$

$\frac{20030}{36800} \times 13.5744 = 7.39$

5-3362. Glaisby Brook near Kettle River, Minn.

Location.--Lat 46°27'19", long 92°51'34", in SE¼NW¼ sec.22, T.46 N., R.20 W., on left bank 20 ft upstream from bridge No. 2468 on State Highways 27 and 73, 1.0 mile upstream from mouth, and 2.4 miles south of Kettle River.

Records available.--October 1959 to September 1965.

Gage.--Water-stage recorder. Altitude of gage is 1,105 ft (from topographic map).

Average discharge.--6 years, 15.6 cfs.

Extremes.--Maximum discharge during year, 1,120 cfs Apr. 18 (gage height, 8.42 ft); minimum, 0.4 cfs July 29 (gage height, 2.11 ft).
1959-65: Maximum discharge, that of Apr. 18, 1965; minimum, 0.1 cfs Aug. 3, 1960, July 9, 1961, Aug. 8, Sept. 1, 1963, July 24, 25, 26, 1964.

Remarks.--Records good except those for periods of ice effect and above 500 cfs, which are fair.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used May 8, 9)

Oct. 1 to Dec. 20				Dec. 21 to Sept. 30			
2.2	1.4	2.5	8.5	2.1	.6	3.0	40
2.3	2.8	2.7	19	2.2	1.7	3.5	79
2.4	5.1	3.0	36	2.3	3.6	4.0	135
				2.4	6.5	5.0	328
				2.5	10	6.0	540
				2.6	15	8.0	1,020

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	26	4.5	2.8	2.0	1.2	1.5	1.3	58	46	6.5	4.5	6.2
2	26	4.5	2.8	2.0	1.2	1.3	1.4	53	44	8.4	2.9	4.8
3	24	4.5	*2.3	2.1	1.2	1.3	1.6	50	46	15	2.5	3.9
4	22	4.5	2.2	2.1	1.2	1.3	1.8	45	56	13	2.1	3.1
5	20	4.5	2.2	2.1	1.2	1.3	2.5	43	182	8.8	1.7	3.4
6	18	4.5	2.1	2.1	1.2	1.3	5.0	48	332	6.5	7.5	2.9
7	16	4.2	2.0	2.1	1.2	1.3	5.6	52	270	5.6	17	3.6
8	14	4.2	2.0	2.1	1.2	1.3	7.0	*52	372	6.2	15	3.1
9	12	4.5	2.0	2.1	1.2	1.3	10	50	282	7.6	9.6	2.9
10	11	4.0	2.0	2.1	1.3	1.3	20	47	*156	7.2	6.5	2.7
11	10	17	2.1	2.0	1.3	1.3	30	44	96	5.3	5.0	2.0
12	9.0	28	2.3	1.9	1.5	1.3	70	37	66	4.2	3.6	2.9
13	9.0	32	2.3	1.8	1.5	1.3	*140	32	48	3.9	2.7	5.9
14	8.5	33	2.3	1.7	1.6	1.3	250	26	34	3.1	2.1	13
15	7.4	29	2.2	1.7	1.6	1.3	470	26	25	*2.7	1.7	38
16	7.4	26	2.0	1.6	1.6	*1.2	596	26	19	2.5	1.8	34
17	7.4	22	1.9	1.5	1.6	1.3	546	26	15	2.3	1.7	32
18	7.1	19	1.8	1.5	1.6	1.3	877	36	12	1.7	1.6	33
19	7.1	13	1.7	1.5	1.6	1.3	932	40	9.6	1.6	1.3	31
20	*6.4	8.8	1.6	1.5	1.6	1.3	616	38	12	1.5	1.1	28
21	5.8	5.4	1.7	1.5	1.6	1.3	398	44	14	1.5	1.8	27
22	5.8	3.9	1.8	1.3	1.6	1.3	*324	52	13	1.6	2.0	31
23	5.4	3.5	1.9	1.3	1.6	1.3	264	56	10	1.5	1.7	30
24	5.1	3.3	2.0	1.3	1.6	1.3	198	57	7.6	1.0	1.7	26
25	4.8	3.1	2.1	1.3	1.6	1.3	141	57	6.5	.8	*4.2	22
26	4.5	3.1	2.1	1.2	*1.5	1.3	111	53	5.6	.7	3.6	19
27	4.5	2.9	2.1	1.2	1.6	1.3	92	47	6.5	.6	4.5	16
28	4.2	3.1	2.1	*1.2	1.6	1.3	80	39	10	.6	3.1	17
29	4.2	3.1	2.1	1.2		1.3	*71	32	11	.5	3.4	21
30	4.2	3.1	2.0	1.2	----------	1.3	62	27	8.0	3.1	3.6	101
31	4.2	----------	1.9	1.2	----------	1.3	----------	25	----------	6.8	7.2	----------
Total	321.0	306.2	64.4	51.4	40.3	40.4	6,324.2	1,318	2,214.8	132.3	128.7	566.4
Mean	10.4	10.2	2.08	1.66	1.44	1.30	211	42.5	73.8	4.27	4.15	18.9
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Calendar year 1964: Max 428 Min 0.1 Mean 17.9 Ac-ft —
Water year 1964-65: Max 932 Min 0.5 Mean 31.5 Ac-ft —

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 19-22, Dec. 4, 5, 14-18, Dec. 23 to Jan. 17, Mar. 16 to Apr. 15. No gage-height record Jan. 19-27, 29-31.

5-3385. Snake River near Pine City, Minn.

Location.--Lat 45°50'30", long 92°56'00", in SE¼NW¼ sec.26, T.39 N., R.21 W., on left bank at site of former powerplant and dam, half a mile downstream from Cross Lake and 1½ miles northeast of Pine City.

Drainage area.--958 sq mi.

Records available.--June 1913 to September 1917, July 1951 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 919.00 ft above mean sea level, datum of 1929. June 25, 1913, to Sept. 30, 1917, staff gage at site 500 ft downstream at different datum. July 1 to Oct. 28, 1951, staff gage at present site and datum.

Average discharge.--18 years, 541 cfs.

Extremes.--Maximum discharge during year, 11,500 cfs Apr. 18 (gage height, 9.56 ft); minimum, 5.5 cfs Oct. 1 (gage height, 2.57 ft).
1913-17, 1951-65: Maximum discharge, that of April 18, 1965; minimum discharge, 5.5 cfs Oct. 1, 1964 (gage height, 2.57 ft).
A discharge measurement of 12,500 cfs was made May 9, 1950.

Remarks.--Records good except those for period of ice effect, which are fair.

Rating table, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

2.9	34	5.0	1,870
3.0	56	6.0	3,290
3.2	133	7.0	5,160
3.4	239	9.0	10,000
3.6	369	9.6	11,600
4.0	729		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	171	99	*72	55	*88	63	60	3,740	1,300	200	205	200
2	40	107	71	54	88	63	60	3,190	1,180	289	* 205	*183
3	63	112	70	54	86	62	65	2,720	1,180	251	211	183
4	70	124	68	54	80	62	65	2,330	1,250	228	222	168
5	73	112	67	*54	76	62	65	2,060	1,480	183	217	173
6	76	103	65	54	72	62	80	1,940	1,750	173	251	129
7	80	103	64	54	70	61	95	2,000	1,960	*183	245	133
8	*87	103	64	54	69	61	120	1,980	* 2,310	194	239	124
9	87	103	63	54	68	61	160	2,270	2,460	217	222	129
10	90	99	64	55	67	61	250	2,420	2,660	200	194	124
11	99	133	65	55	66	61	630	2,460	2,880	183	178	94
12	116	158	65	55	66	61	1,350	2,420	2,990	205	158	103
13	124	148	64	56	66	61	* 2,460	2,310	2,930	810	133	120
14	133	133	64	56	65	62	4,400	2,150	2,680	1,120	133	153
15	133	132	63	56	64	62	* 6,680	1,980	2,340	1,140	107	239
16	138	138	61	57	64	*62	9,620	1,810	1,920	951	99	315
17	148	141	59	57	65	62	10,900	1,620	1,540	792	99	447
18	148	135	58	57	65	62	11,300	1,620	1,200	610	80	517
19	75	120	57	58	65	62	*11,200	1,500	940	482	73	563
20	48	102	56	58	65	62	10,900	1,390	750	408	66	573
21	77	95	56	60	66	62	10,700	1,300	582	342	56	573
22	80	91	55	61	65	61	10,500	1,160	456	301	56	591
23	90	88	54	62	65	61	10,200	1,090	392	264	56	591
24	87	86	54	64	65	61	9,550	1,110	315	239	51	582
25	99	83	54	67	65	61	8,660	1,210	282	200	124	544
26	87	82	54	68	65	61	7,670	1,370	245	168	153	509
27	94	80	54	72	64	61	6,580	1,530	251	153	178	465
28	94	78	55	74	64	61	5,680	1,590	264	129	158	439
29	*94	74	55	76		61	* 4,940	1,600	205	116	158	439
30	90	73	55	80	---------	60	4,320	1,540	189	138	189	936
31	90	----------	55	85	---------	60	----------	1,410	----------	194	217	----------
Total	2,981	3,235	1,881	1,876	1,934	1,905	149,260	58,820	40,881	11,063	4,733	10,339
Mean	96.2	108	60.7	60.5	69.1	61.5	4,975	1,897	1,363	357	153	345
Cfsm	0.100	0.113	0.063	0.063	0.072	0.064	5.19	1.98	1.42	0.373	0.160	0.360
In.	0.12	0.13	0.07	0.07	0.08	0.07	5.79	2.28	1.59	0.43	0.18	0.40

Calendar year 1964: Max 6,680 Min 40 Mean 441 Cfsm 0.460 In. 6.27
Water year 1964-65: Max 11,300 Min 40 Mean 792 Cfsm 0.827 In. 11.21

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 15 to April 11.

5-3400. Sunrise River near Stacy, Minn.

Location.--Lat 45°24'30", long 92°55'55", in NW¼NW¼ sec.26, T.34 N., R.21 W., on right bank on upstream side of highway bridge, 2½ miles northeast of Stacy, 2½ miles upstream from Minnesota Game and Fish dam and 3 miles downstream from West Branch Sunrise River.

Drainage area.--167 sq mi.

Records available.--January 1949 to July 1965 (discontinued).

Gage.--Water-stage recorder. Altitude of gage is 865 ft (from topographic map). Prior to Nov. 10, 1949, chain gage at same site and datum.

Average discharge.--15 years (1949-64), 63.6 cfs.

Extremes.--Maximum discharge during period, 684 cfs Apr. 15 (gage height, 8.11 ft); maximum gage height observed, 9.46 ft July 9 (backwater from dam); minimum discharge, 9.8 cfs Oct. 11.
1949-65: Maximum discharge, 806 cfs Apr. 12, 1952 (gage height, 7.88 ft); maximum gage height, that of July 9, 1965; minimum discharge observed, 3.6 cfs July 17, 1949 (gage height, 1.98 ft).

Remarks.--Records good Apr. 13-27, fair the remainder of the period. Subject to backwater from Minnesota Game and Fish dam approximately 2½ miles downstream after May 11, 1964. At high stages a small part of flow discharges into the Rum River and Coon Creek basins from West Arm of Coon Lake and South Coon Lake, respectively.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	16	13	14	13	*11	12	15	*241	360	124		
2	16	14	*14	13	11	12	16	254	488	125		
3	15	16	14	13	12	13	17	264	638	121		
4	14	18	14	13	12	14	19	265	*666	114		
5	13	18	14	13	12	14	22	268	603	109		
6	12	18	14	*13	12	14	27	277	531	*105		
7	10	18	14	13	12	15	33	336	492	113		
8	*11	17	15	13	12	15	40	361	614	116		
9	10	17	15	13	12	15	46	384	634	218		
10	10	17	15	13	12	14	52	402	634	245		
11	98	18	15	13	12	14	100	406	603	255		
12	10	27	15	12	11	14	* 326	376	540	280		
13	11	29	15	12	11	14	469	324	500	285		
14	11	27	15	12	11	14	634	276	519	250		
15	11	26	15	12	11	14	* 681	234	510	230		
16	11	24	14	12	11	14	667	193	510	215		
17	11	23	14	12	11	14	628	180	490	185		
18	12	22	14	12	11	14	598	181	460	180		
19	11	20	14	12	11	14	* 574	191	410	170		
20	11	19	14	12	11	14	544	255	360	160		
21	11	17	14	13	11	14	511	314	310	155		
22	11	16	14	13	11	14	480	325	270	145		
23	11	15	14	13	11	14	450	321	230	135		
24	11	15	14	13	11	14	420	296	210	125		
25	11	15	14	13	11	14	410	283	180	115		
26	11	15	13	12	11	14	410	272	170	105		
27	12	15	13	12	11	14	395	250	160	96		
28	12	15	13	12	12	14	355	232	140	93		
29	12	15	13	12		*14	335	226	130	91		
30	*12	14	13	12	---	15	303	228	120	91		
31	13	---	13	12	---	15	---	242	---	90		---
Total	362.8	553	436	388	318	434	9,577	8,657	12,482	4,841		
Mean	11.7	18.4	14.1	12.5	11.4	14.0	319	279	416	156		
Cfsm	0.070	0.110	0.084	0.075	0.068	0.084	1.91	1.67	2.49	0.934		
In.	0.08	0.12	0.10	0.09	0.07	0.10	2.13	1.93	2.78	1.08		

Calendar year 1964: Max 285 Min 4.6 Mean 28.6 Cfsm 0.171 In. 2.33
Water year 1964-65: Max Min Mean Cfsm In.

* Discharge measurement made on this day.
Note.--Stage discharge relation affected by ice Nov. 19 to Apr. 12 (no gage-height record Dec. 8 to Jan. 5, Feb. 2 to Mar. 28). No gage-height record June 17-30, July 10-31.

5-3400.5 Sunrise River near Lindstrom, Minn.

Location.--Lat 45°27'00", long 92°53'10", in SW¼NE¼ sec.7, T.34 N., R.20 W., on left bank 20 ft downstream from highway bridge and 4.5 miles northwest of Lindstrom.

Records available.--July to September 1965. Records for January 1949 to July 1965 at site 6.5 miles upstream, published as "near Stacy"' records not equivalent owing to increased drainage area and Minnesota Game and Fish reservoir between sites.

Gage.--Water-stage recorder. Altitude of gage is 850 ft (from topographic map).

Extremes.--Maximum discharge during period, 141 cfs July 15, 16 (gage height, 4.27 ft); minimum, 7.9 cfs Sept. 11 (gage height, 2.07 ft).

Remarks.--Records good. Some regulation by Minnesota Game and Fish Wildlife Refuge ponds above the station. At high stages a small part of flow discharges into the Rum River and Coon Creek basins from West Arm of Coon Lake and South Coon Lake, respectively.

Drainage Area 231 sq mi

Rating table, July to September 1965 (gage height, in feet, and discharge, in cubic feet per second)

2.0	6.2	2.5	26
2.1	8.9	3.0	51
2.2	13	3.5	79

Discharge, in cubic feet per second, July to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1											79	11
2											*75	10
3											77	*9.7
4											73	9.7
5											71	9.7
6											73	9.3
7											70	9.3
8											67	9.3
9											64	9.3
10											62	8.6
11											60	8.6
12											58	9.7
13											56	11
14											52	14
15										141	48	15
16										141	46	12
17										134	45	17
18										127	45	15
19										122	45	17
20										115	43	15
21										112	41	16
22										106	38	15
23										102	35	13
24										102	29	12
25										102	21	11
26										102	14	10
27										94	14	10
28										88	12	12
29										84	13	16
30					---					86	13	38
31		---			---		---		---	84	12	---
Total										-	1,451	383.2
Mean										-	46.8	12.7
Cfsm										-	-	-
In.												

Calendar year	: Max	Min	Mean	Cfsm	In.	
Water year	: Max	Min	Mean	Cfsm	In.	

* Discharge measurement made on this day.

5-3405. St. Croix River at St. Croix Falls, Wis.

Location.--Lat 45°24'30", long 92°38'45", in NW¼ sec.30, T.34 N., R.18 W., on left bank 1,800 ft downstream from powerplant of Northern States Power Co., in St. Croix Falls, and at mile 52.2.

Drainage area.--5,930 sq mi, approximately.

Records available.--January 1902 to September 1965 in reports of Geological Survey. Prior to January 1910, monthly discharge only, published in WSP 1308. Prior to October 1939, published as "near St. Croix Falls."

Gage.--Digital water-stage recorder. Datum of gage is 690.47 ft above mean sea level, adjustment of 1912. Prior to July 1905, gage heights and discharge measurements were used to determine flow. July 1905 to February 1940, records were computed from power generation at the St. Croix Falls powerplant 1,800 ft upstream. Mar. 16, 1940, to Nov. 30, 1963, graphic water-stage recorder at present site and datum.

Average discharge.--63 years, 4,030 cfs.

Extremes.--Maximum discharge during year, 45,700 cfs Apr. 18 (gage height, 20.98 ft); minimum daily, 1,020 cfs Nov. 21.
1902-65: Maximum discharge, 54,900 cfs May 8, 1950 (gage height, 25.19 ft); minimum daily, 75 cfs July 17, 1910.

Remarks.--Records good. Flow regulated by powerplant upstream.

Rating table, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

1.7	926	7.0	14,100
2.2	1,840	11.0	23,100
3.0	3,800	15.0	32,100
4.0	6,950	21.0	45,700

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3,240	1,910	1,640	1,740	1,850	2,100	1,890	15,200	7,370	3,190	2,780	2,680
2	3,180	1,890	1,700	1,710	1,700	1,550	2,130	13,800	8,360	2,880	2,700	2,420
3	2,690	2,090	1,640	1,920	1,600	1,800	1,760	12,100	8,990	2,950	2,660	2,500
4	2,530	1,980	1,900	2,000	1,500	1,750	1,840	9,620	8,760	2,900	2,540	1,820
5	2,490	2,000	1,700	1,730	1,640	2,060	2,090	8,960	9,260	3,040	2,710	2,270
6	2,280	1,980	1,400	1,870	1,600	2,040	4,030	9,830	9,990	3,020	2,340	1,800
7	2,510	2,090	1,800	1,730	1,410	2,020	3,370	14,200	11,900	2,820	2,810	2,060
8	2,620	2,080	1,840	1,740	1,600	2,140	4,250	16,000	14,100	2,960	2,950	2,130
9	2,280	1,970	1,860	1,810	1,700	2,040	4,710	16,500	14,700	3,480	3,250	1,990
10	2,170	2,040	1,920	1,730	1,580	2,080	7,030	17,500	16,200	3,040	3,210	1,770
11	2,350	2,120	1,900	1,900	1,790	2,100	11,400	17,400	14,800	3,360	2,880	1,880
12	2,240	2,300	2,000	1,670	1,660	2,060	17,100	17,200	12,700	3,360	2,820	1,820
13	1,920	2,800	1,800	1,740	1,620	2,000	19,300	15,900	10,800	4,310	2,750	2,300
14	2,340	2,780	2,100	1,760	1,720	1,900	25,000	14,200	9,400	4,920	2,170	2,120
15	2,340	2,680	1,850	1,810	1,740	2,020	34,400	12,900	8,010	4,810	2,260	2,700
16	2,390	2,580	1,600	1,510	1,400	2,050	40,500	11,700	7,260	4,360	1,830	3,210
17	1,990	2,950	1,690	1,690	1,740	2,000	43,500	10,200	5,820	4,580	1,930	3,940
18	1,720	2,520	1,490	1,800	1,800	1,910	45,100	10,600	5,090	4,040	1,980	3,830
19	2,270	2,500	1,420	1,580	1,900	2,140	44,400	10,500	4,360	3,840	1,870	4,190
20	1,770	1,900	1,660	2,060	1,390	1,850	*43,400	9,600	3,840	3,710	1,840	4,360
21	1,900	1,020	2,080	1,440	1,850	1,870	42,900	9,110	3,980	3,470	1,700	4,710
22	1,980	1,200	1,580	1,740	1,820	1,870	41,100	8,970	3,330	3,380	1,810	3,950
23	2,060	1,800	1,750	1,650	1,780	1,930	38,400	8,760	3,520	2,780	1,710	4,910
24	1,730	2,400	1,740	1,780	1,780	1,910	35,500	8,570	3,360	2,840	1,720	4,850
25	1,880	2,800	1,700	1,580	1,770	1,850	32,400	8,980	3,100	2,690	1,870	4,700
26	2,090	2,400	1,890	1,820	1,790	1,960	29,700	9,430	2,640	2,280	2,070	4,210
27	1,960	2,000	1,810	1,760	1,660	1,850	26,300	9,640	2,890	2,420	2,410	4,140
28	2,590	1,800	1,800	1,740	1,660	2,080	23,100	9,160	3,110	2,330	2,450	4,010
29	2,040	1,300	1,640	1,490		2,000	20,300	8,510	3,060	2,020	2,480	4,030
30	1,780	2,000	1,780	1,720	---------	1,880	17,800	7,780	3,110	1,870	2,560	5,190
31	2,140	----------	1,810	1,600	---------	1,860	----------	7,300	----------	2,510	2,770	----------
Total	69,470	63,880	54,490	53,820	47,050	60,670	664,700	360,120	223,810	100,160	73,830	96,490
Mean	2,241	2,129	1,758	1,736	1,680	1,957	22,160	11,620	7,460	3,231	2,382	3,216
Cfsm	.378	.359	.297	.293	.283	.330	3.74	1.96	1.26	.545	.402	.542
In.	.44	.40	.34	.34	.30	.38	4.17	2.26	1.40	.63	.46	.61 = 11.

Calendar year 1964: Max 27,000 Min 1,000 Mean 3,383 Cfsm 0.571 In. 7.77
Water year 1964-65: Max 45,100 Min 1,020 Mean 5,119 Cfsm 0.863 In. 11.72

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Dec. 19, 28, Jan. 28, Jan. 30 to Feb. 6, Feb. 9, 12-15, 17-19, 23, Mar. 30, 31.

$\frac{5119}{6240} \times 13.5744 = 11.14$ (.82)

$11.72 \left(\frac{5119}{5930}\right) = 11.1375$ (.9037)

$\frac{5119}{5930}(13.57\ldots) = 11.72$

5-3445. Mississippi River at Prescott, Wis.

Location.--Lat 44°44'45", long 92°48'00", in sec.9, T.26 N., R.20 W., on left bank at Prescott, 200 ft downstream from St. Croix River, 300 ft south of Chicago, Burlington & Quincy Railroad bridge, 800 ft south of bridge on U. S. Highway 10, and at mile 811.4 upstream from Ohio River.

Drainage area.--44,800 sq mi, approximately.

Records available.--June 1928 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 600.00 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers). Prior to Aug. 2, 1932, staff gage at railroad bridge 300 ft upstream at following datums: June 3, 1928, to Sept. 30, 1929, 69.27 ft higher; Oct. 1, 1929, to Sept. 30, 1930, 67.68 ft higher; Oct. 1, 1930, to Aug. 1, 1932, 69.28 ft higher. Aug. 2, 1932, to Oct. 30, 1938, water-stage recorder at present site at datum 69.28 ft higher. Auxiliary water-stage recorder 10.7 miles downstream from base gage.

Average discharge.--37 years, 15,020 cfs.

Extremes.--Maximum discharge during year, 228,000 cfs Apr. 18 (gage height, 93.11 ft); minimum daily, 3,600 cfs Dec. 1; minimum gage height, 74.45 ft Nov. 23.
1928-65: Maximum discharge, that of Apr. 18, 1965; minimum daily, 1,380 cfs July 13, 1940; minimum gage height, 65.08 ft Aug. 29, 1934, present datum.

Remarks.--Records good. Some regulation by reservoirs, navigation dams, and powerplants at low and medium stages. Flood flow not materially affected by artificial storage.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	17,000	9,310	3,600	6,400	6,000	13,500	9,100	91,500	54,300	29,800	13,100	11,600
2	17,200	9,410	4,600	6,600	5,700	12,000	8,670	84,300	54,700	29,700	12,900	11,200
3	16,500	9,390	4,800	6,600	5,500	6,700	10,000	78,400	57,400	28,800	13,900	11,700
4	15,700	10,500	5,400	6,500	5,500	6,100	11,800	73,400	58,200	26,300	14,500	12,000
5	11,300	10,400	4,800	6,600	5,500	8,100	16,600	68,700	58,500	24,700	13,700	10,700
6	11,500	9,700	5,500	6,300	5,600	7,400	22,600	65,700	58,600	23,300	14,500	10,200
7	12,800	9,000	6,000	6,700	5,700	7,500	28,600	*64,900	59,300	21,800	15,200	8,910
8	12,400	8,850	7,000	6,400	5,700	7,500	36,200	65,500	61,000	22,000	14,600	9,440
9	12,300	8,690	6,700	6,000	6,200	7,400	43,300	64,900	62,800	23,300	13,600	9,950
10	12,700	9,590	7,800	6,200	7,300	7,400	55,700	65,400	*64,800	23,800	14,500	9,490
11	12,400	9,370	7,900	6,400	5,800	8,900	75,900	65,400	66,100	24,300	14,100	10,600
12	11,800	8,940	6,900	6,300	6,300	8,900	108,000	65,400	66,500	24,300	14,000	10,500
13	11,600	9,650	7,300	6,100	6,000	7,600	143,000	64,800	66,300	*26,000	*14,100	9,740
14	11,400	10,100	6,500	6,200	5,900	7,800	*172,000	63,900	65,500	26,600	12,800	10,600
15	11,100	9,590	6,300	5,700	5,800	7,000	199,000	62,600	64,100	26,100	11,700	10,900
16	10,400	9,310	6,600	5,600	5,800	7,700	214,000	61,700	61,900	25,700	11,400	13,200
17	9,430	*9,130	6,200	5,800	5,800	7,400	*223,000	59,700	59,800	25,400	10,600	15,500
18	8,950	9,620	6,200	5,900	5,400	8,500	226,000	58,400	56,500	25,400	10,200	18,700
19	8,900	9,560	6,300	6,100	5,900	5,500	222,000	57,200	53,200	25,000	9,930	20,600
20	*9,740	9,330	6,200	6,000	5,500	5,900	214,000	56,200	50,900	24,200	9,540	20,100
21	8,840	8,640	6,100	6,300	6,000	6,300	206,000	55,200	47,000	22,700	10,300	19,900
22	9,330	7,670	6,600	6,200	5,900	6,600	192,000	54,200	44,800	21,800	10,500	20,100
23	9,380	5,100	6,500	6,100	6,100	6,900	180,000	53,500	42,800	20,700	9,630	20,000
24	9,170	6,400	6,600	6,100	5,600	6,700	167,000	53,100	40,700	19,600	9,280	19,900
25	9,050	7,000	6,500	6,300	5,600	6,900	154,000	52,500	38,900	18,900	10,200	20,100
26	9,040	7,300	6,500	6,300	5,800	7,000	*140,000	53,500	37,000	17,500	10,800	20,200
27	9,030	7,800	6,500	6,000	5,800	6,600	128,000	53,700	35,200	16,300	10,700	19,900
28	9,080	5,900	6,500	6,100	6,100	6,600	116,000	54,500	34,800	14,800	10,600	19,900
29	9,360	6,100	6,500	6,100		6,700	107,000	54,600	33,800	14,300	11,800	20,200
30	9,520	5,400	6,500	5,800	---------	6,600	99,100	54,500	31,700	13,500	12,000	21,000
31	9,530	----------	6,400	5,900	---------	6,800	----------	54,500	----------	13,300	11,400	----------
Total	346,450	256,750	193,800	191,600	163,800	232,500	3,528,570	1,931,800	1,587,100	699,900	376,080	446,830
Mean	11,180	8,558	6,252	6,181	5,850	7,500	117,600	62,320	52,900	22,580	12,130	14,890
Cfsm	0.250	0.191	0.140	0.138	0.131	0.167	2.62	1.39	1.18	0.504	0.271	0.332
In.	0.29	0.21	0.16	0.16	0.14	0.19	2.93	1.60	1.32	0.58	0.31	0.37

Calendar year 1964 Max 57,000 Min 3,260 Mean 12,620 Cfsm 0.282 In. 3.84
Water year 1964-65 Max 226,000 Min 3,600 Mean 27,270 Cfsm 0.609 In. 8.26 ✓

* Discharge measurement made on this day.
Note.--Stage-fall-discharge relation affected by ice Nov. 23 to Apr. 4.

$\frac{27,270}{44,800} \times 13.57 = 8.26$

$.6087$

$\frac{27300}{44800} \times 13.57 = 8.27$

$.609375$

5-3552. Cannon River at Welch, Minn.

Location.--Lat 44°33'50", long 92°43'55", in NW¼SW¼ sec.27, T.113 N., R.16 W., on right bank 0.3 mile downstream from highway bridge at Welch and 1.8 miles upstream from Belle Creek.

Drainage area.--1,320 sq mi, approximately.

Records available.--June 1909 to January 1914 (no winter records 1909-11), November 1930 to September 1965

Gage.--Water-stage recorder. Datum of gage is 699.16 ft above mean sea level, datum of 1929 Prior to Nov. 11, 1930, chain gage on highway bridge at site 0.3 mile upstream at datum 3.00 ft lower. Nov. 11 1930 to Oct. 11, 1938, water-stage recorder at site 0.3 mile upstream at present datum.

Average discharge.--36 years (1911-13, 1931-65), 475 cfs.

Extremes.--Maximum discharge during year, 36,100 cfs Apr. 8 (gage height, 14.01 ft); minimum, 33 cfs Nov. 12 (gage height, 1.08 ft).
1909-14, 1930-65: Maximum discharge, that of Apr. 8, 1965; minimum discharge, 2.5 cfs Jan 3, 1950 (gage height, 0.06 ft, backwater from ice).
Maximum stage known, 17.1 ft, present datum, in April 1888, from floodmark at mill about 2 400 ft upstream.

Remarks.--Records good except those for period of ice effect, which are fair. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Diurnal fluctuation caused by powerplants above station.

Rating tables, water year 1964-65, except period of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 4				Apr. 5 to Sept. 30			
1.4	78	2.2	99	4.0	670	11.0	11,300
1.6	114	2.5	165	5.0	1,300	12.0	16,200
1.8	160	3.0	287	7.0	3,020	14.0	36,000
2.0	217	3.5	447	9.0	6,120		
2.5	406	3.5					

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1964 TO SEPTEMBER 1965

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	313	92	150	90	180	3,500	360	2,030	1,010	361	143	373
2	363	141	150	130	190	*4,800	250	1,890	955	295	306	326
3	355	208	150	90	180	3,400	500	1,790	866	213	349	323
4	112	203	150	270	180	*2,000	2,500	1,710	854	116	381	249
5	218	208	150	270	150	1,300	*7,340	1,700	836	102	381	107
6	278	202	90	280	400	950	*19,800	1,700	910	333	405	249
7	275	185	130	200	450	940	27,200	1,780	*929	314	336	291
8	274	92	165	210	370	980	28,700	1,980	1,250	910	251	267
9	212	146	203	180	350	940	23,800	1,760	1,170	1,340	299	235
10	220	139	230	130	355	750	22,600	1,610	994	2,150	397	230
11	101	182	*255	200	350	720	17,500	1,470	884	2,360	332	214
12	257	198	190	200	350	720	13,500	1,180	814	1,790	321	105
13	216	*171	90	200	290	710	11,100	896	786	3,070	279	232
14	206	137	220	200	90	700	9,480	860	760	1,810	230	292
15	205	90	230	*190	290	700	7,800	*814	780	1,260	104	284
16	* 228	155	230	100	300	700	6,620	1,570	520	1,290	264	233
17	259	181	230	90	310	690	5,790	2,500	434	1,190	305	281
18	100	179	220	170	330	680	5,190	2,370	354	974	279	311
19	158	178	150	160	*320	650	*4,590	2,080	317	860	257	394
20	217	178	90	160	210	470	4,030	1,750	223	786	226	770
21	220	130	225	160	90	250	3,570	1,660	317	780	214	1,030
22	218	90	225	160	230	430	3,190	1,480	416	754	124	1,220
23	204	125	225	120	250	450	2,980	1,340	748	501	262	1,260
24	206	140	225	90	270	440	2,800	1,280	727	380	238	1,170
25	93	135	90	150	270	430	2,760	1,290	482	246	305	1,020
26	163	106	130	160	265	*410	*2,890	1,340	404	*329	309	808
27	159	120	90	170	260	250	2,960	1,360	278	344	*241	*754
28	194	102	220	160	250	200	2,720	1,270	330	342	178	614
29	216	90	230	160	------	350	2,470	1,200	359	323	103	974
30	209	145	230	120	------	360	2,210	1,120	363	316	275	1,590
31	152	------	190	90	------	360	------	1,050	------	276	327	------
TOTAL	6,601	4,448	5,543	5,060	7,550	30,230	247,200	47,830	20,090	26,117	8,421	16,404
MEAN	213	148	179	163	270	975	8,240	1,543	670	842	272	547
CFSM	.161	.112	.136	.124	.205	.739	6.24	1.17	.508	.638	.206	.414
IN	.19	.13	.16	.14	.21	.85	6.96	1.35	.57	.74	.24	.46

CALENDAR YEAR	1964	MAX	1,390	MIN	62	MEAN	194	CFSM	.147	INCHES 2.00
WATER YEAR	1964-65	MAX	28,700	MIN	90	MEAN	1,166	CFSM	.883	INCHES 11.99

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Apr. 4 (no gage-height record Mar. 19-26).

5-3730. South Fork Zumbro River near Rochester, Minn.

Location.--Lat 44°04'00", long 92°27'55", in SE¼ sec.14, T.107 N., R.14 W., on left bank 30 ft upstream from ford, a quarter of a mile downstream from sewage plant, 1.6 miles north of Rochester, 2 miles downstream from Cascade Creek, and 2½ miles downstream from Silver Lake Dam.

Drainage area.--304 sq mi.

Records available.--January 1952 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 949.56 ft (revised) above mean sea level, datum of 1929.

Average discharge.--13 years, 114 cfs.

Extremes.--Maximum discharge during year, 19,600 cfs Mar. 1 (gage height, 19.12 ft from floodmark); minimum, 19 cfs Feb. 4, 27; minimum gage height, 1.69 ft Jan. 18, 31, Feb. 2.
1952-65: Maximum discharge that of Mar. 1, 1965; minimum, 8.4 cfs Dec. 7, 1955.
Previous maximum stage known since at least 1908, about 17.5 ft July 21, 1951, from information by sewage plant superintendent.

Remarks.--Records good. Slight regulation at times from Silver Lake and at very low flows from sewage-plant effluent.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	38	31	29	27	23	10,900	*1,040	133	90	53	44	38
2	57	34	29	28	23	*2,320	1,590	125	82	53	35	36
3	42	39	29	26	23	502	2,020	129	81	50	32	34
4	34	78	28	28	23	275	*5,020	119	95	49	38	31
5	36	46	27	28	24	205	*4,540	170	104	48	44	28
6	34	46	26	28	35	172	6,430	225	85	55	52	33
7	35	40	27	41	693	145	3,240	178	82	51	49	73
8	34	35	28	57	453	119	4,100	145	111	231	47	42
9	34	38	28	35	195	100	2,790	129	90	906	44	43
10	31	38	*54	29	421	92	1,400	113	85	660	40	38
11	31	37	62	29	313	82	1,030	108	75	158	38	33
12	34	*36	48	29	93	79	1,150	102	70	99	36	31
13	34	35	38	28	67	75	406	98	63	88	35	34
14	33	34	34	*28	68	75	280	*95	62	77	33	44
15	*34	33	34	27	54	71	245	113	60	68	31	43
16	34	34	31	26	46	66	200	155	56	90	38	55
17	32	34	29	26	43	66	188	125	55	82	56	48
18	30	34	28	28	*42	52	185	136	54	59	45	52
19	31	33	27	28	40	47	170	98	*52	53	36	242
20	31	32	26	29	51	47	141	89	52	50	33	303
21	31	29	28	29	34	46	129	85	52	49	44	336
22	31	28	27	29	30	46	120	78	155	47	41	248
23	30	31	27	29	27	47	120	76	97	47	36	135
24	30	31	28	28	24	49	127	80	71	46	33	*98
25	30	33	25	29	23	50	250	113	66	42	31	88
26	31	29	25	29	22	46	377	331	64	*40	*33	76
27	31	32	25	28	37	46	268	296	64	38	32	103
28	31	31	27	27	387	42	202	155	61	36	28	1,050
29	30	27	28	26		*44	172	110	56	35	40	1,240
30	30	30	28	24	---------	53	149	98	54	42	58	1,020
31	30	----------	28	22	---------	119	----------	94	----------	84	46	----------
Total	1,034	1,068	958	905	3,314	16,078	38,079	4,101	2,244	3,486	1,228	5,675
Mean	33.4	35.6	30.9	29.2	118	519	1,269	132	74.8	112	39.6	189
Cfsm	0.110	0.117	0.102	0.096	0.388	1.71	4.17	0.434	0.246	0.368	0.130	0.622
In.	0.13	0.13	0.12	0.11	0.41	1.97	4.66	0.50	0.27	0.43	0.15	0.69

Calendar year 1964: Max 340 Min 16 Mean 41.7 Cfsm 0.137 In. 1.87
Water year 1964-65 Max 10,900 Min 22 Mean 214 Cfsm 0.704 In. 9.57

Peak discharge (base, 1,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
2-7	1500	5.70	1,010	4- 8	2330	13.27	7,160
3-1	1900	19.12	19,600	4-12	0500	8.15	1,930
4-5	0100	13.22	7,360	7- 9	1100	6.38	1,290
4-6	1130	13.55	8,010	9-29	0030	6.45	1,330

* Discharge measurement made on this day.
Note.--No gage-height record Mar. 19-25.

5-3740. Zumbro River at Zumbro Falls, Minn.

Location.--Lat 44°17'12", long 92°25'56", in sec.36, T.110 N., R.14 W., on left bank in Zumbro Falls, 1,000 ft downstream from Spring Creek, 0.7 mile upstream from bridge on U. S. Highway 63, and 6.3 miles downstream from North Fork.

Drainage area.--1,130 sq mi, approximately.

Records available.--June 1909 to September 1917, April to November 1929, March 1930 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Digital water-stage recorder. Datum of gage is 811.26 ft above mean sea level, datum of 1929. Prior to Nov. 11, 1933, chain gage on bridge 800 ft downstream at same datum. Nov. 11, 1933 to May 28, 1964, graphic water-stage recorder at present site and datum.

Average discharge.--43 years (1909-17, 1930-65), 476 cfs.

Extremes.--Maximum discharge during year, 29,600 cfs Mar. 2 (gage height, 28.40 ft, from floodmark); minimum, 52 cfs Jan. 3, 8 (gage height, 6.24 ft), result of freezeup.
1909-17, 1929-65: Maximum discharge, 35,900 cfs July 22, 1951 (gage height, 30.80 ft, from floodmark); minimum, 27 cfs Jan. 12, 1935; minimum gage height, 6.06 ft Feb. 23, 1964, result of freezeup.
Flood of April 1888 reached stage of about 30.5 ft at present site or 29.7 ft original site. Flood in 1859 is known to have exceeded that of 1888 (gage height, not determined).

Remarks.--Records good except those for periods of ice effect, which are fair. Diurnal fluctuation caused by powerplant above station.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Apr. 16				Apr. 17 to Sept. 30	
6.3	59	9.0	1,380	6.5	84
6.6	119	11.0	2,850	7.0	210
7.0	245	14.0	5,360	7.5	435
7.5	464	18.0	10,100	8.0	725
8.0	734	22.0	15,800	10.0	2,090
		26.0	23,800		

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1964 TO SEPTEMBER 1965

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	214	93	107	175	105	12,600	767	375	452	214	120	277
2	258	111	117	124	117	22,800	1,650	217	435	269	224	235
3	260	220	124	69	105	*4,020	3,470	512	468	118	180	186
4	111	217	119	106	105	1,550	10,300	677	569	102	172	118
5	105	116	109	124	130	1,130	*18,200	665	269	96	186	88
6	264	185	72	124	109	1,020	21,600	665	273	153	285	88
7	148	105	82	141	254	992	*23,100	884	446	195	217	204
8	189	95	124	138	479	946	19,700	653	871	290	109	242
9	176	92	127	63	604	533	17,100	325	761	1,460	100	198
10	100	91	*143	69	508	462	10,300	501	641	1,350	164	238
11	87	91	192	81	550	542	8,500	599	587	1,120	140	135
12	287	*104	209	112	339	574	5,650	593	249	878	135	88
13	449	139	114	173	262	282	3,110	523	153	1,480	245	127
14	521	128	124	*220	123	152	2,030	*413	257	969	125	204
15	527	93	114	141	119	289	1,620	228	186	330	90	140
16	*525	115	124	146	176	514	1,360	599	192	557	140	189
17	275	213	109	75	339	394	1,230	1,280	221	321	242	172
18	106	142	119	75	*337	264	1,160	871	321	177	122	183
19	176	144	107	114	344	374	*1,120	803	*148	204	86	145
20	102	119	75	109	176	211	1,050	707	122	294	120	242
21	85	114	81	109	85	109	1,020	677	204	424	118	457
22	84	87	112	109	119	250	1,000	316	430	485	94	683
23	133	91	130	170	202	245	1,000	201	599	457	156	*845
24	133	120	149	77	135	158	761	501	345	201	148	605
25	83	119	81	77	135	227	779	569	189	132	109	321
26	140	109	146	117	176	217	1,150	653	186	120	*145	150
27	204	83	67	102	143	187	1,190	635	137	113	238	370
28	146	124	87	95	172	95	1,050	653	201	109	148	623
29	170	81	158	105	------	*297	982	308	192	*214	92	1,220
30	138	77	167	105	------	512	949	192	195	317	109	1,770
31	218	------	154	67	------	527	------	177	------	192	269	------
TOTAL	6,414	3,618	3,743	3,533	6,508	52,473	162,898	16,972	10,339	13,341	4,828	10,543
MEAN	207	121	121	114	232	1,693	5,430	547	345	430	156	351
CFSM	.183	.107	.107	.101	.205	1.50	4.81	.484	.305	.381	.138	.311
IN	.21	.12	.12	.12	.21	1.73	5.36	.56	.34	.44	.16	.35

CALENDAR YEAR 1964 MAX 1,150 MIN 60 MEAN 182 CFSM .161 INCHES 2.19
WATER YEAR 1964-65 MAX 23,100 MIN 67 MEAN 809 CFSM .716 INCHES 9.72

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20-23, Nov. 26 to Dec. 6, Dec. 8, 9, Dec. 11 to Jan. 3, Jan. 5 to Feb. 12, Feb. 15-17, 19-26.

5-3765. South Fork Whitewater River near Altura, Minn.

Location.--Lat 44°04'10", long 91°58'49", in SE¼ sec.14, T.107 N., R.10 W., on left bank 500 ft upstream from highway bridge, 1.4 miles upstream from small tributary entering from the west, 2 miles west of Altura, and 2.4 miles upstream from Keefer Creek.

Drainage area.--76.8 sq mi.

Records available.--October 1939 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 761.80 ft above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Average discharge.--26 years, 27.3 cfs.

Extremes.--Maximum discharge during year, 2,360 cfs Apr. 7 (gage height, 7.23 ft); maximum gage height, 8.14 ft Mar. 1 (backwater from ice, from floodmarks); minimum discharge, 8.2 cfs Mar. 12 (gage height, 0.23 ft). 1939-65: Maximum discharge, 5,460 cfs Aug. 31, 1947 (gage height, 10.61 ft); minimum, 3.8 cfs Mar. 24, 1940; minimum gage height, that of Mar. 12, 1965.

Remarks.--Records good except those for periods of ice effect, which are fair.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used June 5 to Sept. 7)

Oct. 1 to Mar. 1		Mar. 2 to Sept. 30			
0.9	9.2	0.4	11	2.0	162
1.0	12	.6	17	3.0	380
1.1	15	.8	27	4.0	690
		1.0	41	6.0	1,530
		1.5	88		

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	12	13	10	10	11	700	*217	15	13	10	9.3	9.6
2	12	13	11	9.6	11	274	385	14	12	9.9	9.1	9.5
3	12	13	11	9.4	11	* 32	* 389	15	13	9.8	9.1	9.3
4	12	14	11	9.9	14	22	* 994	14	12	9.8	9.3	9.3
5	12	12	10	9.6	16	18	* 968	16	13	9.8	9.3	9.3
6	12	12	11	9.6	17	15	1,500	34	13	11	9.8	9.8
7	12	12	12	9.6	30	15	1,100	32	12	10	9.8	11
8	12	12	*12	12	28	12	1,140	24	12	11	9.9	9.6
9	12	12	11	11	24	12	492	22	12	11	9.9	10
10	12	12	11	10	26	11	228	19	11	9.8	9.6	9.9
11	12	*12	14	10	18	11	298	18	11	9.6	9.5	9.8
12	12	14	12	*11	13	10	292	17	11	9.6	9.5	9.8
13	11	12	10	10	10	12	54	*16	11	9.8	9.5	9.9
14	*11	12	9.6	10	10	12	38	14	11	9.6	9.3	12
15	12	12	10	10	10	11	32	14	11	9.6	9.3	14
16	12	12	10	10	*11	11	26	22	10	9.8	9.8	11
17	12	12	11	11	12	11	23	21	*11	9.5	9.8	11
18	12	12	11	11	11	10	22	18	11	9.5	9.8	11
19	12	11	11	11	11	10	21	16	11	9.5	9.6	98
20	12	10	11	11	11	10	18	14	11	9.3	9.5	33
21	12	10	11	11	11	10	17	14	11	9.3	9.9	24
22	12	11	11	10	12	10	16	13	12	9.3	9.6	*22
23	12	11	11	10	13	10	16	14	11	9.3	9.6	19
24	13	11	10	10	14	11	16	14	11	9.3	9.6	16
25	13	12	10	10	15	*11	19	14	10	9.3	*17	16
26	14	12	9.6	9.8	17	11	29	17	11	9.3	14	15
27	14	12	9.6	9.6	18	11	27	19	11	*9.3	9.8	15
28	13	11	10	9.8	30	10	21	16	10	9.3	9.5	55
29	13	10	10	10		11	19	14	10	9.1	9.8	65
30	13	10	10	11	---	11	17	14	10	9.5	11	66
31	13	---	10	11	---	13	---	14	---	9.8	10	---
Total	380	354	331.8	317.9	435	1,338	8,434	538	339	300.7	310.5	629.8
Mean	12.3	11.8	10.7	10.3	15.5	43.2	281	17.4	11.3	9.7	10.0	21.0
Cfsm	0.160	0.154	0.139	0.134	0.202	0.562	3.66	0.227	0.147	0.126	0.130	0.273
In.	0.18	0.17	0.16	0.15	0.21	0.65	4.08	0.26	0.16	0.15	0.15	0.30

Calendar year 1964: Max 65 Min 8.7 Mean 11.6 Cfsm 0.151 In. 2.05
Water year 1964-65: Max 1,500 Min 9.1 Mean 37.6 Cfsm 0.490 In. 6.62

Peak discharge (base, 200 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3- 1	1300	8.14	1,300	9-19	0445	2.43	231
4- 7	1630	7.23	2,630				

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 20-24, Nov. 29 to Dec. 7, Dec. 14-21, 25-30, Jan. 3, 10, 14-17, 19, Jan. 21 to Mar. 1, Mar. 12, 17-24.

5-3785. Mississippi River at Winona, Minn.

Location.--Lat 44°03'20", long 91°38'15", in sec.23, T.107 N., R.7 W., on right bank at Winona pumping station in Winona, 9½ miles upstream from Trempealeau River and at mile 725.7 upstream from the Ohio River.

Drainage area.--59,200 sq mi, approximately.

Records available.--June 1928 to September 1965. Gage-height records collected in this vicinity since 1878 are contained in reports of Mississippi River Commission.

Gage.--Water-stage recorder. Datum of gage is 639.64 ft above mean sea level, datum of 1929. June 10, 1928, to Apr. 15, 1931, staff gage at site 800 ft upstream. Prior to Oct. 1, 1929, at datum 0.20 ft higher and Oct. 1, 1929, to Apr. 15, 1931, at datum 0.12 ft lower. Apr. 16, 1931, to Nov. 12, 1934, staff gage at present site and datum. Since Mar. 31, 1937, auxiliary water-stage recorder 2.7 miles upstream at tailwater of navigation dam 5A.

Average discharge.--37 years, 24,520 cfs.

Extremes.--Maximum discharge during year, 268,000 cfs Apr. 19 (gage height, 20.77 ft, from floodmark); minimum daily, 8,000 cfs Nov. 30, Dec. 1, 2; minimum gage height, 5.05 ft Dec. 1.
1928-65: Maximum discharge, that of Apr. 19, 1965; minimum, 2,250 cfs Dec. 29, 1933 (gage height, -1.18 ft); minimum gage height, -3.38 ft Aug. 31, 1934.

Remarks.--Records good. Records of chemical analyses for the water year 1965 are published in Part 2 of this report. Some regulation by reservoirs, navigation dams, and powerplants at low and medium stages. Flood flow not materially affected by artificial storage.

Cooperation.--Gage-height record at dam 5A furnished by Corps of Engineers.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	24,600	11,400	8,000	11,600	10,300	24,500	14,400	154,000	70,000	41,600	18,400	15,600
2	23,800	10,200	8,000	11,800	10,400	40,000	21,300	144,000	70,400	40,000	16,300	16,000
3	23,000	10,200	9,600	11,800	10,500	50,000	27,200	135,000	74,200	39,100	17,300	14,700
4	23,600	12,800	10,600	11,800	10,600	43,300	35,600	124,000	78,500	35,800	18,700	13,700
5	21,700	14,500	10,600	10,700	11,200	31,700	53,200	*115,000	80,400	36,000	20,800	14,500
6	19,900	14,900	10,600	10,900	11,400	27,000	66,800	107,000	80,900	30,900	21,500	15,400
7	18,300	17,500	11,200	11,900	11,600	27,100	77,300	99,800	80,200	27,200	21,900	15,000
8	17,500	12,700	11,100	12,000	12,200	22,700	87,600	94,900	77,600	25,900	22,000	15,300
9	16,400	12,700	11,200	12,000	11,700	22,400	98,400	91,800	76,700	29,300	22,200	16,800
10	15,300	13,300	11,800	11,900	13,000	22,600	104,000	88,700	76,300	32,600	21,900	17,800
11	14,200	13,300	12,900	11,800	13,000	22,300	112,000	87,600	76,800	30,900	21,400	19,100
12	15,900	15,200	14,400	11,800	12,800	21,800	121,000	91,100	77,900	30,200	20,200	17,200
13	16,200	15,300	13,000	11,800	12,600	20,000	131,000	93,700	78,500	31,800	20,500	15,500
14	16,300	15,300	13,000	11,800	12,400	19,800	150,000	94,800	78,800	37,600	20,000	14,300
15	14,500	15,100	12,000	11,200	12,200	16,800	*178,000	94,200	78,200	36,800	19,500	14,200
16	13,900	15,500	11,400	11,000	12,000	16,000	*210,000	92,500	76,700	35,600	17,400	14,300
17	13,200	16,400	11,400	11,000	11,800	15,000	215,000	89,200	75,000	35,700	16,100	15,200
18	12,500	*19,000	11,500	11,100	11,800	15,600	238,000	89,200	*73,100	34,300	16,100	18,600
19	13,000	19,100	11,500	10,800	11,800	15,000	263,000	91,200	71,600	31,300	15,000	24,300
20	12,700	19,000	11,500	10,300	11,700	14,300	*264,000	93,200	69,000	32,500	13,900	24,400
21	*12,100	17,400	11,500	10,600	11,700	14,400	257,000	93,200	65,600	30,600	12,900	24,700
22	10,700	15,600	11,500	10,900	11,800	13,900	250,000	89,600	62,800	29,300	12,200	27,700
23	11,300	13,900	11,500	10,900	10,000	13,800	*238,000	84,300	62,400	30,900	12,200	27,300
24	10,200	12,400	11,500	11,000	10,300	13,800	227,000	79,600	59,200	27,100	10,800	27,800
25	10,200	12,500	11,500	11,000	11,200	13,400	216,000	75,700	54,500	24,600	9,810	28,200
26	9,600	11,800	11,500	10,800	12,300	13,400	205,000	74,300	47,900	24,100	*12,200	28,700
27	8,900	10,900	11,500	10,700	12,300	13,400	195,000	73,300	47,200	20,400	14,000	26,900
28	10,000	10,100	9,700	10,500	12,600	13,400	184,000	71,800	48,400	*19,900	12,700	28,500
29	11,200	9,300	10,100	9,700		13,000	*173,000	69,900	45,400	19,500	14,400	31,700
30	11,800	8,000	11,300	10,000	---------	11,000	164,000	69,500	42,500	19,200	14,700	32,500
31	11,300	----------	11,500	10,200	---------	11,200	----------	69,900	----------	18,500	15,500	----------
Total	463,800	415,300	348,400	345,300	327,200	632,600	4,576,800	2,922,000	2,056,700	940,200	522,510	615,900
Mean	14,960	13,840	11,240	11,140	11,690	20,410	152,600	94,260	68,560	30,330	16,860	20,530
Cfsm	0.253	0.234	0.190	0.188	0.197	0.345	2.58	1.59	1.16	0.512	0.285	0.347
In.	0.29	0.26	0.22	0.22	0.21	0.40	2.88	1.84	1.29	0.59	0.33	0.39

Calendar year 1964: Max 65,600 Min 6,190 Mean 18,710 Cfsm 0.316 In. 4.30
Water year 1964-65: Max 264,000 Min 8,000 Mean 38,810 Cfsm 0.656 In. 8.92

* Discharge measurement made on this day.
Note.--Fall-stage-discharge relation affected by ice Nov. 29 to Apr. 4 (no gage-height record Jan. 8-12).

GPO 826-476-10

5-3840. Root River near Lanesboro, Minn.

Location.--Lat 43°44'58", long 91°58'43", in sec.1, T.103 N., R.10 W., on left bank half a mile upstream from highway bridge, 1¼ miles upstream from South Branch, and 2½ miles northeast of Lanesboro.

Drainage area.--615 sq mi.

Records available.--February to November 1910, February 1911 to September 1914, July 1915 to September 1917, August 1940 to September 1965. Published as North Branch Root River near Lanesboro, 1910-17.

Gage.--Water-stage recorder. Datum of gage is 791.84 ft above mean sea level, adjustment of 1912. Prior to Oct. 1, 1917, chain gage at site half a mile downstream at datum about 1.5 ft higher.

Average discharge.--30 years (1911-14, 1915-17, 1940-65), 319 cfs.

Extremes.--Maximum discharge during year, 19,000 cfs Mar. 1 (gage height, 17.83 ft, from floodmark, backwater from ice); minimum discharge, 54 cfs Nov. 20 (gage height, 1.23 ft).
1910-17, 1940-65: Maximum discharge, 22,100 cfs Mar. 29, 1962 (gage height, 16.11 ft); maximum gage height, that of Mar. 1, 1965; minimum discharge, 29 cfs Aug. 27, 1949 (gage height, 1.08 ft).

Remarks.--Records good except those for periods of ice effect, and no gage-height record, which are fair. Diurnal fluctuation at times during medium and low flow caused by powerplant above station.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)

Oct. 1 to Mar. 31		Apr. 1 to Sept. 30			
1.3	60	1.3	73	4.0	1,060
1.5	85	1.5	110	5.0	1,720
2.0	205	2.0	245	7.0	3,450
		2.5	410	10.0	7,320
		3.0	610	13.0	13,800

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	84	78	74	85	108	3,000	1,610	283	202	95	106	118
2	84	78	74	85	110	3,500	2,360	260	191	91	97	106
3	82	79	74	86	111	*955	*2,420	245	172	89	91	95
4	81	87	75	87	115	650	5,920	248	164	87	93	91
5	81	100	75	88	121	410	8,950	254	234	89	156	87
6	81	103	75	88	134	381	*11,400	662	320	89	121	95
7	81	100	75	87	170	329	10,500	722	240	95	106	106
8	81	96	*75	87	210	296	*10,100	470	218	102	148	115
9	79	89	75	86	182	255	10,100	353	199	375	142	137
10	79	*87	75	85	168	230	3,930	301	196	1,080	115	137
11	81	85	75	87	158	205	3,730	*274	178	530	100	134
12	82	85	76	*87	150	190	7,990	245	164	295	106	124
13	*81	105	77	88	144	170	1,660	223	150	229	108	118
14	81	103	78	89	140	160	798	210	140	199	89	129
15	81	96	76	90	138	145	618	199	129	164	81	186
16	81	89	76	90	*136	135	514	232	*124	153	81	283
17	79	85	76	92	134	130	446	374	118	153	83	248
18	78	85	76	95	133	120	390	310	113	145	84	242
19	78	84	77	98	132	119	353	257	108	137	83	3,370
20	78	69	77	100	131	118	320	218	108	153	79	2,160
21	78	71	77	101	131	117	310	196	106	*126	87	*1,590
22	78	72	77	101	130	115	304	180	115	115	91	1,410
23	78	74	77	102	131	*114	289	178	134	110	86	920
24	78	75	78	102	133	113	277	169	126	108	*84	642
25	78	76	78	102	137	112	274	169	113	97	84	514
26	79	74	78	102	143	111	320	205	106	93	86	430
27	79	74	79	102	155	111	442	432	104	91	87	378
28	79	74	80	103	200	111	414	482	104	87	86	1,490
29	79	74	82	104		116	339	307	102	84	87	4,530
30	79	73	83	104	---	140	310	248	100	81	100	3,140
31	78	---	84	105	---	200	---	218	---	95	115	---
Total	2,476	2,520	2,384	2,908	3,985	17,858	87,388	9,124	4,578	5,437	3,062	23,125
Mean	79.9	84.0	76.9	93.8	142	576	2,913	294	153	175	98.8	771
Cfsm	0.130	0.137	0.125	0.153	0.231	0.937	4.74	0.478	0.249	0.285	0.161	1.25
In.	0.15	0.15	0.14	0.18	0.24	1.08	5.28	0.55	0.28	0.33	0.19	1.40

Calendar year 1964: Max 310 Min 63 Mean 101 Cfsm 0.164 In. 2.21
Water year 1964-65: Max 11,400 Min 69 Mean 452 Cfsm 0.735 In. 9.97

Peak discharge (base, 3,500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3- 1	1900	17.83	19,000	9-19	1430	9.56	6,640
4- 6	2300	13.33	12,800	9-29	0700	8.61	5,330
4-12	0400	12.00	11,300				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 21 to Mar. 31, Apr. 5-7 (no gage-height record Feb. 7-15).

5-3845. Rush Creek near Rushford, Minn.

Location.--Lat 43°50'00", long 91°46'40", on line between secs. 3 and 10, T.104 N., R.8 W., on downstream side near center of span of highway bridge, 1½ miles northwest of Rushford and 3 miles upstream from mouth.

Drainage area.--129 sq mi.

Records available.--August 1942 to September 1965.

Gage.--Wire-weight gage read twice daily. Datum of gage is 735.00 ft above mean sea level, adjustment of 1912. Prior to June 14, 1950, water-stage recorder at site 100 ft upstream; June 14, 1950, to Aug. 26, 1964, chain gage at present site and datum; at datum 5 ft higher, Aug. 5, 1942, to Oct. 27, 1945; at datum 3 ft higher, Oct. 28, 1945, to Aug. 3, 1949; at present datum thereafter.

Average discharge.--23 years, 54.4 cfs.

Extremes.--Maximum discharge during year, 5,490 cfs Apr. 6 (gage height, 9.06 ft, from floodmark); minimum daily, 29 cfs Feb. 27, Aug. 12; minimum gage height, June 16, 17, 18.

1942-65: Maximum discharge, 11,600 cfs Mar. 26, 1950 (gage height, 13.54 ft, from floodmark), from rating curve extended above 1,400 cfs on basis of contracted-opening measurements at gage heights 11.0 and 13.5 ft; minimum, 17 cfs May 22, 1959; minimum gage height, that of June 16, 17, 18, 1965.

Flood of June 28, 29, 1942, reached a discharge of 11,000 cfs (by slope-area measurement of peak flow).

Remarks.--Records fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	35	36	37	34	35	1,600	1,020	37	37	31	31	33
2	35	36	37	34	35	699	*404	37	36	31	31	32
3	35	36	37	35	36	*76	*268	38	36	30	31	30
4	35	38	37	35	37	68	*1,330	38	36	30	30	32
5	35	37	37	34	44	59	*1,640	39	37	31	30	32
6	35	38	37	34	48	65	3,770	37	37	32	30	35
7	36	38	37	34	90	87	1,700	36	36	32	31	34
8	36	38	*37	34	74	58	1,950	36	37	32	34	33
9	36	37	36	35	51	54	815	39	37	34	32	36
10	35	*37	36	36	52	49	211	38	35	32	32	33
11	36	37	36	36	56	46	242	37	35	31	30	32
12	36	37	35	*37	52	42	217	*36	34	31	29	34
13	*36	37	34	37	48	46	108	36	34	32	30	34
14	36	37	33	37	52	44	51	36	34	31	30	34
15	36	38	33	37	42	44	48	37	34	31	30	39
16	36	37	33	37	*44	44	44	37	*34	32	31	36
17	36	37	33	36	37	44	44	37	34	32	31	111
18	36	37	33	36	37	42	44	37	34	31	30	42
19	36	37	34	36	38	42	42	37	34	31	30	198
20	36	38	34	35	40	40	41	35	36	31	30	69
21	36	37	34	35	41	37	40	36	35	*31	32	55
22	36	37	34	35	39	34	39	36	37	32	32	*50
23	36	37	34	35	36	34	39	36	38	32	31	47
24	36	37	34	35	35	*36	40	36	34	31	*31	46
25	36	37	34	34	35	32	44	37	33	31	32	45
26	36	37	34	34	32	34	42	42	34	31	32	44
27	36	37	34	34	29	37	41	38	33	30	32	43
28	36	37	34	34	128	36	40	37	33	30	31	177
29	36	37	34	34		40	39	36	32	30	32	64
30	36	37	34	34	---	44	38	36	32	31	33	59
31	36	---	34	35	---	88	---	37	---	32	34	---
Total	1,109	1,113	1,080	1,088	1,323	3,701	14,391	1,147	1,048	969	965	1,589
Mean	35.8	37.1	34.8	35.1	47.2	119	480	37.0	34.9	31.3	31.1	53.0
Cfsm	0.278	0.288	0.270	0.272	0.366	0.922	3.72	0.287	0.271	0.243	0.243	0.410
In.	0.32	0.32	0.31	0.31	0.38	1.07	4.15	0.33	0.30	0.28	0.28	0.46

Calendar year 1964: Max 50 Min 31 Mean 35.2 Cfsm 0.273 In. 3.72
Water year 1964-65 Max 3,770 Min 29 Mean 80.9 Cfsm 0.627 In. 8.51

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 21 to Dec. 7, Dec. 15-23, Dec. 25 to Jan. 4, Jan. 8-21, Jan. 26 to Feb. 7, Feb. 22-26, Mar. 20, 21, 24.

5-3850. Root River near Houston, Minn.

Location.--Lat 43°46'05", long 91°35'11", in sec.32, T.104 N., R.6 W., on right bank 1 mile west of Houston and 2½ miles upstream from South Fork.

Drainage area.--1,270 sq mi, approximately.

Records available.--May 1909 to September 1917, May to November 1929, March 1930 to September 1965. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 671.86 ft above mean sea level, datum of 1929. May 28, 1909, to Sept. 30, 1917, staff gage at site 1½ miles downstream at different datum. May 4, 1929, to Sept. 27, 1933, chain gage at present site and datum.

Average discharge.--43 years (1909-17, 1930-65), 644 cfs.

Extremes.--Maximum discharge during year, 31,000 cfs Mar. 2 (gage height, 18.32 ft, backwater from ice); minimum daily, 210 cfs Dec. 21 to Jan. 8; minimum gage height, 1.29 ft Aug. 29.
1909-17, 1929-65: Maximum discharge, 37,000 cfs Apr. 1, 1952 (gage height, 13.90 ft); maximum gage height, that of Mar. 2, 1965; minimum discharge, 65 cfs Dec. 26, 1933, Feb. 25, 1935.

Remarks.--Records good, except those for periods of ice effect or no gage-height record, which are fair. Slight diurnal fluctuation at low flows caused by powerplants above station.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	253	250	228	210	251	7,400	2,590	673	463	301	301	256
2	250	250	225	210	253	*20,000	4,290	641	463	291	282	253
3	247	256	222	210	255	7,600	3,460	600	440	291	279	242
4	242	264	220	210	257	*1,900	* 7,950	595	435	288	282	230
5	240	266	218	210	262	1,200	*11,500	590	430	288	264	226
6	245	266	218	210	269	700	16,300	646	550	295	288	233
7	247	266	216	210	280	600	* 18,800	1,280	630	288	279	242
8	242	269	212	210	320	578	16,300	1,030	530	295	291	245
9	245	264	*211	212	345	517	17,100	784	470	382	308	315
10	245	261	211	212	340	494	9,170	700	423	714	301	295
11	245	*258	211	214	332	468	6,600	626	414	1,040	279	285
12	247	256	211	218	330	449	10,000	*561	402	617	261	266
13	250	256	212	*219	328	433	5,660	528	394	499	264	256
14	*247	264	212	219	325	418	2,460	504	382	476	261	264
15	247	269	211	219	320	402	1,900	490	366	402	247	326
16	245	261	211	220	316	387	1,610	490	347	374	247	366
17	253	264	211	222	*314	375	1,420	504	*336	347	247	1,090
18	247	264	211	225	311	367	1,270	561	332	329	245	942
19	245	264	211	228	309	361	1,140	585	322	322	245	1,460
20	240	264	212	230	308	350	1,040	504	322	318	240	4,310
21	245	263	210	232	307	340	964	454	318	315	245	2,730
22	247	265	210	234	305	330	892	414	322	304	247	* 2,430
23	245	261	210	236	304	330	838	394	585	301	247	2,020
24	245	260	210	238	303	*330	790	390	586	301	245	1,570
25	247	258	210	239	303	325	796	394	414	301	*253	1,280
26	245	252	210	240	304	325	802	410	370	301	261	1,100
27	250	248	210	241	305	325	844	500	340	*301	233	990
28	240	244	210	245	326	325	880	779	322	298	233	1,850
29	247	240	210	246		330	802	561	318	291	235	5,130
30	245	230	210	249	---	390	727	495	304	295	245	6,440
31	250	---	210	250	---	500	---	472	---	291	258	---
Total	7,628	7,753	6,604	6,968	8,482	48,849	148,895	18,155	12,330	11,456	8,113	37,642
Mean	246	258	213	225	303	1,576	4,963	586	411	370	262	1,255
Cfsm	0.194	0.203	0.168	0.177	0.239	1.24	3.91	0.461	0.324	0.291	0.206	0.988
In.	0.22	0.23	0.19	0.20	0.25	1.43	4.36	0.53	0.36	0.34	0.24	1.10

Calendar year 1964: Max 868 Min 210 Mean 288 Cfsm 0.227 In. 3.08
Water year 1964-65: Max 20,000 Min 210 Mean 882 Cfsm 0.697 In. 9.45

Peak discharge (base, 5,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-2	1200	18.32	31,000	9-30	0900	8.68	7,200
4-7	0200	12.37	19,800				

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 20 to Mar. 31 (no gage-height record Mar. 22, 23). No gage-height record May 27 to June 16, July 28 to Aug. 4.

5-3855. South Fork Root River near Houston, Minn.

Location.--Lat 43°44', long 91°34', in NE¼SW¼ sec.9, T.103 N., R.6 W., on left bank 50 ft downstream from bridge on State Highway 76, half a mile upstream from Badger Creek and 1½ miles south of Houston.

Drainage area.--275 sq mi.

Records available.--January 1953 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 680.41 ft above mean sea level, datum of 1929.

Average discharge.--12 years, 123 cfs.

Extremes.--Maximum discharge during year, 6,530 cfs Mar. 2 (gage height, 13.64 ft, backwater from ice); minimum, 62 cfs Nov. 20; minimum gage height, 1.47 ft Aug. 28.
1953-65: Maximum discharge, 8,420 cfs Mar. 29, 1962 (gage height, 13.35 ft); maximum gage height, 13.74 ft Mar. 26, 1961 (backwater from ice); minimum discharge, 11 cfs Nov. 28, 1961 (gage height, 1.47 ft).

Remarks.--Records good except those for periods of ice effect, which are fair.

Rating tables, water year 1964-65, except periods of ice effect (gage height, in feet, and discharge, in cubic feet per second)
(Shifting-control method used May 5-15)

Oct. 1 to Mar. 9		Mar. 10 to Sept. 30			
1.8	66	1.4	64	7.0	977
2.0	86	1.6	76	9.0	1,400
		2.0	113	10.0	1,720
		3.0	255	11.0	2,570
		5.0	600	12.0	4,500

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	77	77	78	72	71	*3,900	1,090	111	114	76	76	73
2	75	78	77	72	71	2,700	978	106	101	76	73	71
3	75	77	76	72	71	300	658	102	96	75	73	70
4	75	78	75	72	71	*145	*2,320	100	95	75	73	69
5	76	78	75	72	72	140	2,250	105	93	74	73	70
6	77	78	74	71	73	130	3,770	103	191	82	71	74
7	77	80	74	71	74	125	*2,260	101	100	90	73	76
8	77	77	73	71	76	120	*2,500	103	96	87	88	75
9	80	78	72	71	75	110	1,910	106	92	125	96	135
10	78	78	71	71	74	105	783	97	86	88	78	114
11	80	*76	71	71	74	100	982	97	88	81	73	83
12	81	79	72	71	73	100	920	*96	86	77	72	77
13	80	77	72	*71	72	98	307	95	85	80	72	76
14	*80	76	72	71	72	97	218	94	83	80	71	78
15	80	80	72	71	71	96	195	122	83	76	71	83
16	80	79	72	71	70	92	179	166	*82	74	72	81
17	79	79	72	71	*70	95	151	97	82	76	73	341
18	79	79	72	71	70	105	133	94	82	79	71	286
19	80	79	72	71	70	110	118	80	81	77	71	625
20	81	78	71	71	71	109	109	80	82	74	71	609
21	82	79	71	71	71	105	105	80	82	*76	71	268
22	80	79	71	71	71	100	102	80	83	75	72	*214
23	80	80	71	71	71	98	101	85	83	75	71	174
24	80	80	71	71	71	*97	105	82	81	73	71	153
25	80	80	71	71	73	96	122	91	78	73	*82	139
26	79	80	72	71	75	95	130	868	78	73	72	126
27	79	80	72	71	82	95	125	253	80	73	70	120
28	78	79	72	71	200	94	126	146	78	73	69	522
29	79	79	72	71		92	117	123	77	73	70	757
30	77	78	72	71	------	94	114	108	76	73	73	593
31	77	------	72	71	------	146	------	111	------	76	79	-------
Total	2438	2355	2250	2206	2155	9889	22978	4082	2694	2435	2291	6232
Mean	78.6	78.5	72.6	71.2	77.0	319	766	132	89.8	78.5	73.9	208
Cfsm	0.286	0.285	0.264	0.259	0.280	1.16	2.78	0.480	0.326	0.285	0.269	0.756
In.	0.33	0.32	0.30	0.30	0.29	1.34	3.11	0.55	0.36	0.33	0.31	0.84

Calendar year 1964: Max 680 Min 54 Mean 82.8 Cfsm 0.301 In. 4.09
Water year 1964-65: Max 3,900 Min 69 Mean 170 Cfsm 0.618 In. 8.38

Peak discharge (base, 900 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3- 2	0400	13.64	6,530	9-20	0015	7.71	1,120
4- 6	0930	11.86	4,170	9-29	1800	7.33	1,040
5-26	0600	9.27	1,480				

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Nov. 20 to Mar. 28, Mar. 30, 31 (no gage-height record Jan. 29 to Feb. 16).

5-4570. Cedar River near Austin, Minn.

Location.--Lat 43°38'10", long 92°58'20", in NE¼SE¼ sec.15, T.102 N., R.18 W., on left bank 200 ft upstream from abandoned powerhouse, 500 ft downstream from highway bridge, 1.1 miles downstream from Turtle Creek, and 1.1 miles south of Austin.

Drainage area.--425 sq mi.

Records available.--May 1909 to September 1914, October 1944 to September 1965.

Gage.--Water-stage recorder. Datum of gage is 1,162.10 ft above mean sea level, datum of 1929. May 1909 to April 1912 staff gage in tailwater of powerplant 200 ft downstream at datum 3.1 ft lower. May 1912 to September 1914 chain gage on highway bridge 500 ft downstream at datum 1.1 ft lower.

Average discharge.--26 years, 171 cfs.

Extremes.--Maximum discharge during year, 9,400 cfs Mar. 1 (gage height, 18.87 ft, from floodmark, backwater from ice); minimum 45 cfs Aug. 29; minimum gage height, 2.21 ft Jan. 17, Feb. 6.
1909-14, 1944-65: Maximum discharge, 9,530 cfs Mar. 29, 1962; maximum gage height, that of Mar. 1, 1965; no flow for several days in 1911.

Remarks.--Records good except those for periods of ice effect or backwater from aquatic growth, which are fair.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	94	68	68	59	51	4,620	203	229	134	89	71	54
2	105	74	70	60	50	*3,480	561	212	124	89	72	50
3	88	77	70	57	49	* 796	* 782	209	124	84	102	50
4	83	96	70	62	50	452	*2,730	215	145	82	89	48
5	83	83	67	62	52	323	*6,410	220	153	80	84	47
6	81	81	65	62	54	264	7,920	276	148	93	84	58
7	81	77	* 68	65	58	223	5,760	258	148	106	122	62
8	88	72	68	70	61	195	5,080	232	204	231	132	52
9	81	* 74	68	62	65	164	5,470	201	273	1,760	112	76
10	75	75	* 79	57	69	148	4,280	176	206	1,070	80	58
11	74	72	85	* 57	72	132	3,770	* 162	162	500	71	48
12	* 77	77	82	59	69	114	3,460	151	132	276	63	48
13	77	77	75	57	66	104	2,340	140	116	192	62	50
14	77	72	70	57	62	97	1,780	134	109	151	57	72
15	77	75	65	57	*62	95	1,400	148	* 100	129	51	71
16	77	75	60	55	60	91	1,080	164	95	153	54	69
17	77	74	54	54	59	85	841	181	93	240	56	71
18	70	74	53	62	59	72	681	170	89	170	56	93
19	74	74	55	56	57	60	573	151	84	126	54	502
20	72	72	54	56	55	57	475	134	84	* 112	52	937
21	74	63	57	56	53	57	419	126	84	100	72	* 805
22	70	59	59	57	50	60	370	119	112	93	58	693
23	70	67	60	56	50	* 60	342	119	132	84	* 52	412
24	68	70	60	55	51	62	335	126	122	78	51	264
25	67	77	57	57	52	60	356	162	109	69	52	204
26	72	74	54	59	51	60	475	489	104	71	51	164
27	74	75	57	57	54	60	482	405	97	69	51	196
28	74	75	59	60	106	58	356	255	95	65	48	1,710
29	74	67	60	54		63	288	198	95	62	52	3,270
30	72	68	60	53	---------	72	252	164	93	71	60	2,230
31	70	----------	60	52	---------	91	----------	142	----------	82	62	----------
Total	2,396	2,214	1,989	1,802	1,647	12,275	60,271	6,068	3,766	6,577	2,133	12,464
Mean	77.3	73.8	64.2	58.1	58.8	396	2,009	196	126	212	68.8	415
Cfsm	0.182	0.174	0.151	0.137	0.138	0.932	4.73	0.461	0.296	0.499	0.162	0.976
In.	0.21	0.19	0.17	0.16	0.14	1.07	5.27	0.53	0.33	0.58	0.19	1.09

Calendar year 1964: Max 369 Min 29 Mean 76.1 Cfsm 0.179 In. 2.42
Water year 1964-65: Max 7,920 Min 47 Mean 311 Cfsm 0.732 In. 9.93

Peak discharge (base, 1,400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3- 1	2130	18.87	9,400	7- 9	1100	7.54	2,180
4- 6	1730	16.21	8,410	9-29	1400	9.78	3,500

* Discharge measurement made on this day.
Note.--Stage-discharge relation affected by ice Nov. 30, 20-24, Mar. 1, 2, 17-19. Backwater from aquatic growth Oct. 1 to Nov. 17, May 16 to Sept. 30.

5-4760. West Fork Des Moines River at Jackson, Minn.

Location.--Lat 43°37'10", long 94°59'10", in SE¼SW¼ sec.24, T.102 N., R.35 W., on right bank in Jackson, 200 ft downstream from dam at powerplant.

Drainage area.--1,220 sq mi, approximately.

Records available.--May 1909 to December 1913, August 1930 to September 1965 (winter records incomplete prior to 1936). Published as Des Moines River at Jackson, 1909-13, as Des Moines River near Jackson, 1930-35, and as West Fork Des Moines River near Jackson, 1936-44.

Gage.--Water-stage recorder. Datum of gage is 1,287.75 ft above mean sea level, datum of 1929. May 31, 1909, to Dec. 20, 1913, staff gage at site 0.6 mile downstream at datum 0.99 ft lower. Aug. 22, 1930, to Sept. 30, 1944, chain gage at site 7 miles upstream at datum 17.10 ft higher. Oct. 1, 1944, to Oct. 26, 1949, wire-weight gage at site 600 ft upstream at datum 10.64 ft higher.

Average discharge.--30 years (1935-65), 272 cfs.

Extremes.--Maximum discharge during year, 9,530 cfs Apr. 9; maximum gage height, 18.62 ft Apr. 6 (from flood-mark, backwater from ice); minimum daily discharge, 16 cfs Feb. 3-5; minimum gage height, 3.15 ft Nov. 20. 1909-13, 1930-65: Maximum discharge, that of Apr. 9, 1965; maximum gage height, that of Apr. 6, 1965; no flow at times.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are fair. Regulation at times by Yankton, Long, Shetek, and Heron Lakes.

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	198	97	45	27	17	71	77	1,590	1,660	650	90	26
2	200	97	44	27	17	49	124	1,440	1,620	584	85	26
3	194	98	42	27	16	47	295	1,440	1,510	518	80	26
4	175	102	*37	27	16	45	645	1,390	1,370	486	78	26
5	164	*91	36	27	16	44	*1,530	*1,290	1,270	441	74	26
6	152	91	36	*27	24	41	*5,300	1,170	1,370	441	73	26
7	143	92	36	28	47	40	*5,600	1,170	1,270	441	71	26
8	*143	90	36	32	31	39	*5,100	1,270	1,750	441	66	26
9	130	84	36	31	*29	37	*8,000	1,500	1,570	*441	60	26
10	136	84	36	29	29	35	*9,100	1,840	1,290	430	52	26
11	132	81	37	28	28	33	8,330	1,500	1,240	400	44	17
12	138	97	38	26	27	33	7,110	1,480	1,200	384	*56	17
13	138	88	38	25	27	33	5,980	1,510	1,200	360	56	17
14	138	88	36	24	26	34	5,360	1,550	1,270	340	44	17
15	128	84	31	23	26	38	*4,750	1,620	1,240	320	40	17
16	120	82	30	24	25	40	4,310	1,640	1,180	315	36	17
17	126	82	29	24	24	*42	3,860	1,590	1,120	290	36	17
18	124	86	26	24	23	31	3,550	1,590	1,030	250	36	26
19	116	81	24	23	22	23	3,300	1,590	964	240	36	26
20	114	46	24	23	23	24	3,070	1,640	880	200	36	43
21	116	53	24	23	25	27	2,760	1,780	848	200	40	49
22	116	53	24	23	24	30	2,320	1,730	880	190	40	49
23	114	61	25	24	23	34	2,220	1,660	1,170	185	36	49
24	114	63	25	24	22	36	2,150	1,590	914	170	36	44
25	116	66	26	24	22	34	2,150	1,780	864	160	32	40
26	114	68	26	24	22	33	2,160	*1,850	897	185	32	32
27	113	69	26	23	23	31	2,140	1,810	880	140	26	42
28	113	61	26	21	35	29	2,040	1,730	848	130	26	49
29	98	57	27	20		28	1,770	1,730	798	120	32	71
30	128	47	27	19	------	31	1,750	1,690	706	115	32	513
31	74	------	27	18	------	40	------	1,690	------	110	32	------
Total	4,125	2,339	980	769	689	1,132	106,851	48,850	34,809	9,677	1,513	1,412
Mean	133	78.0	31.6	24.8	24.6	36.5	3,561	1,576	1,160	312	48.8	47.1
Cfsm	0.109	0.064	0.026	0.020	0.020	0.030	2.92	1.29	0.951	0.256	0.040	0.039
In.	0.13	0.07	0.03	0.02	0.02	0.03	3.26	1.49	1.06	0.29	0.05	0.04

Calendar year 1964: Max 1,090 Min 12 Mean 138 Cfsm 0.113 In. 1.54
Water year 1964-65: Max 9,100 Min 16 Mean 584 Cfsm 0.479 In. 6.49

Peak discharge (base, 500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-9	2100-2300	-	9,530	5-10	1230	9.61	1,920
				6- 8	0800	9.90	2,040

* Discharge measurement made on this day.

Note.--Stage-discharge relation affected by ice Dec. 2 to Apr. 9. No gage-height record July 10, 11, 13-18, 20-25, July 27 to Aug. 10.

As the number of streams on which streamflow information is likely to be desired far exceeds the number of stream-gaging stations feasible to operate at one time, the Geological Survey collects limited streamflow data at sites other than stream-gaging stations. When limited streamflow data are collected on a systematic basis over a period of years for use in hydrologic analyses, the site at which the data are collected is called a partial-record station. Data collected at these partial-record station are usable in low-flow or floodflow analyses, depending on the type of data collected. In addition, discharge measurements are made at other sites not included in the partial-record program. These measurements are generally made in times of drought or flood to give better areal coverage to those events. Those measurements and others collected for some special reason are called measurements at miscellaneous sites.

Records collected at partial-record stations are presented in two tables. The first is a table of discharge measurements at low-flow partial-record stations and the second is a table of annual maximum stage and discharge at crest-stage stations. Discharge measurements made at miscellaneous sites for both low flow and high flow are given in a third table.

Low-flow partial-record stations

Measuring of streamflow in the area covered by this report made at low-flow partial-record stations are given in the following table. Most of these measurements were made during periods of base flow when streamflow is primarily from ground-water storage. These measurements, when correlated with the simultaneous discharge of a nearby stream where continuous records are available, will give a picture of the low-flow potentiality of the stream. The column headed "Period of record" shows the water years in which measurements were made at the same, or practically the same, site.

Discharge measurements made at low-flow partial-record stations during water year 1965

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Measurements	
					Date	Discharge (cfs)
5-2427	Little Sand Lake Outlet near Dorset, Minn.	NE¼ sec.36, T.141 N., R.34 W., ½ mile below Little Sand Lake and 3 miles northeast of Dorset.	a74	1930-41≠, 1942, 1956-65	10-13-64	18.2
					12-22-64	18.1
					1-22-65	23.3
					2- 6-65	18.2
					3-22-65	26.4
					6-17-65	54.7
					7-21-65	37.3
					8-19-65	25.4

a Approximately
≠ Operated as a continuous-record gaging station.

Crest-stage partial-record stations

The following table contains annual maximum discharges for crest-stage stations. A crest-stage gage is a device which will register the peak stage occurring between inspections of the gage. A stage-discharge relation for each gage is developed from discharge measurements made by indirect measurements of peak flow or by current meter. The date of the maximum discharge is not always certain but is usually determined by comparison with nearby continuous-record stations, weather records, or local inquiry. Only the maximum discharge for each water year is given. Information on some lower floods may have been obtained but is not published herein. The years given in the period of record represent water years for which the annual maximum has been determined.

Annual maximum discharge at crest-stage partial-record stations

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Streams tributary to Lake Superior					
4-0113.7	South Branch Devils Track River near Grand Marais, Minn.	NW¼ sec.9, T.61 N., R.1 E., at culvert on County Highway 12, 1½ miles above mouth and 2½ miles north of Grand Marais.	-	1961-65	5-21-65	17.35	137
4-0131	Lake Superior tributary near Taconite Harbor, Minn.	SW¼SE¼ sec.20, T.58 N., R.5 W., at culvert on U.S. Highway 61, 0.2 mile above mouth, and 3.7 miles southwest of Taconite Harbor.	1.56	1964-65	4-21-65	8.12	59
4-0132	Caribou River near Little Marais, Minn.	NW¼SE¼ sec.36, T.58 N., R.6 W., at culvert on U.S. Highway 61, 0.2 mile above mouth and 5.2 miles northeast of Little Marais.	22.8	1961-65	5-15-65	12.66	443
4-0151.5	Crow Creek near Silver Creek, Minn.	SW¼SW¼ sec.23, T.54 N., R.10 W., at culvert on County Highway 3, 2.3 miles northeast of Silver Creek, and 4.0 miles above mouth.	1.07	1960-65	4-19-65	a9.29	(≠)
4-0152	Encampment River tributary at Silver Creek, Minn.	NE¼SE¼ sec.33, T.54 N., R.10 W., at culvert on County Highway 3, 0.3 mile north of Silver Creek and 1.4 miles above mouth.	.96	1960-65	5-21-65	7.01	29
4-0152.5	Silver Creek tributary near Two Harbors, Minn.	SW¼NE¼ sec.16, T.53 N., R.10 W., at culvert on County Highway 3, 1.0 mile above mouth, and 4.5 miles northeast of Two Harbors.	3.72	1965	9-30-65	4.06	(≠)
4-0153	Little Stewart River near Two Harbors, Minn.	SE¼NE¼ sec.24, T.53 N., R.11 W., at culvert on county highway 2.0 miles above mouth, and 2.7 miles north of Two Harbors.	5.54	1960-65	4-19-65	10.58	127
4-0153.6	Lake Superior tributary at French River, Minn.	SW¼SE¼ sec.18, T.51 N., R.12 W., at culvert on U. S. Highway 61, 0.35 mile above mouth, and 0.7 mile west of French River.	1.41	1964-65	6-6-65	18.03	64
4-0153.7	Talmadge River at Duluth, Minn.	SE¼NE¼ sec.24, T.51 N., R.13 W., at culvert on U.S. Highway 61, 0.6 mile above mouth, and 0.5 mile northeast of Duluth city limits.	5.79	1964-65	4-19-65	13.17	(≠)
4-0154	Miller Creek at Duluth, Minn.	SE¼NE¼ sec.13, T.50 N., R.15 W., at culvert on U.S. Highway 53, 0.2 mile northwest of Duluth city limits.	4.92	1960-65	4-19-65	a16.18	190
4-0177	McKinley Lake tributary at McKinley, Minn.	SW¼NE¼ sec.18, T.58 N., R.16 W., at culvert on State Highway 135 at west edge of McKinley.	-	1960-65	3-28-65	8.34	15
4-0187	Mud Hen Creek tributary near Central Lakes, Minn.	SW¼NW¼ sec.14, T.56 N., R.17 W., at culvert on U.S. Highway 53, 0.3 mile above mouth and 3.2 miles north of Central Lakes.	-	1960-65	4-19-65	7.51	(≠)
4-0188	East Two River tributary at Virginia, Minn.	NE¼NE¼ sec.12, T.58 N., R.18 W., at culvert on U.S. Highway 169, 0.2 mile west of Virginia city limits, and 1.1 miles above mouth.	4.26	1959-65	4-19-65	a6.74	(≠)
4-0241	Rock Creek near Blackhoof, Minn.	SW¼SE¼ sec.21, T.47 N., R.16 W., at culvert on State Highway 23, 4.0 miles above mouth, and 4.4 miles east of Blackhoof.	-	1961-65	9-30-65	14.97	269
4-0241.1	Rock Creek tributary near Blackhoof, Minn.	NE¼SE¼ sec.21, T.47 N., R.16 W., at culvert on State Highway 23, 0.1 mile above mouth, and 4.5 miles east of Blackhoof.	-	1961-65	9-30-65	8.73	5.9
4-0242	South Fork Nemadji River near Holyoke, Minn.	E½SE¼ sec.6, T.46 N., R.16 W., at culvert on State Highway 23, 2.0 miles northwest of Holyoke, and 4¼ miles above Net River.	-	1961-65	9-30-65	10.87	352

≠ Discharge not determined.
a Backwater from ice.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Red River of the North basin					
5-0476	West Branch Mustinka River near Graceville, Minn.	NW¼NW¼ sec.22, T.125 N., R.46 W., at culverts on county highway, 4.1 miles north of Graceville.	-	1964-65	7-6-65	8.80	(✓)
5-0477	West Branch Mustinka River tributary near Graceville, Minn.	NE¼NW¼ sec.28, T.125 N., R.45 W., at culvert on county highway, 0.6 mile northeast of Graceville.	-	1964-65	9-30-65	6.99	(✓)
5-0492	Eighteenmile Creek near Wheaton, Minn.	On west quarter of line between secs. 24 and 25, T.127 N., R.47 W., at culvert on County Highway 67, 1.4 miles above mouth, and 2.0 miles southwest of Wheaton.	-	1965	6-1-65	9.30	701
5-0608	Buffalo River near Callaway, Minn.	SW¼SW¼ sec.17, T.141 N., R.41 W., at culvert on U.S. Highway 59, 2.7 miles north of Callaway.	49.9	1960-65	4-10-65	a16.12	245
5-0614	Hay Creek above Downer, Minn.	NW¼NW¼ sec.30, T.138 N., R.45 W., at culvert on county road, 3.1 miles east of Downer.	5.81	1961-65	5-26-63 4-15-64 4-10-65	7.78 b6.90 7.47	69 41 103
5-0622.8	Wild Rice River tributary near Bagley, Minn.	SW¼NW¼ sec.21, T.146 N., R.37 W., at culvert on State Highway 92, 5.0 miles south of Bagley.	3.34	1961-65	4-11-65	a10.30	67
5-0624.7	Marsh River tributary near Mahnomen, Minn.	SE¼SW¼ sec.36, T.145 N., R.43 W., at culvert on State Highway 31, a quarter mile above mouth, and 5¼ miles west of Mahnomen.	6.57	1961-65	4-10-65	a12.90	241
5-0627	Wild Rice River tributary near Twin Valley, Minn.	SW¼SE¼ sec.12, T.144 N., R.45 W., at culvert on State Highway 31, 1¼ miles above mouth, and 4¼ miles northwest of Twin Valley.	2.25	1961-65	6-19-65	12.66	135
5-0628	Coon Creek near Twin Valley, Minn.	NE¼NE¼ sec.26, T.144 N., R.45 W., at bridge on County Highway 28, 1.1 miles above mouth, and 4.0 miles west of Twin Valley.	32.1	1962-65	4-10-65	a13.21	745
5-0632	South Branch Wild Rice River near Ogema, Minn.	SE¼SE¼ sec.11, T.142 N., R.42 W., at culvert on county highway, 2 miles northwest of Ogema.	6.50	1963-65	4-10-65	a9.87	83
5-0736	South Branch Battle River at Northome, Minn.	NE¼ sec.25, T.151 N., R.29 W., at culvert on U.S. Highway 71, three-quarters of a mile west of Northome, and 3 miles above Battle Lake.	3.19	1960-65	4-15-65	a15.13	37
5-0737.5	South Branch Cormorant River tributary near Blackduck, Minn.	NW¼NW¼ sec.32, T.150 N., R.30 W., at culvert on County Highway 304, 3 miles above mouth, and 3¼ miles north of Blackduck.	4.45	1960-65	5-15-65	12.91	37
5-0738	Perry Creek near Shooks, Minn.	NW¼SW¼ sec.30, T.151 N., R.30 W., at culvert on State Highway 72, 5 miles west of Shooks.	2.41	1960-65	5-15-65	6.23	21
5-0766	Red Lake River tributary near Thief River Falls, Minn.	SW¼SE¼ sec.8, T.153 N., R.43 W., at culvert on County Highway 7, 0.5 mile above mouth, and 3.1 miles south of Thief River Falls.	-	1962-65	6-8-62 4-4-63 9-26-64 4-11-65	6.20 7.29 c7.39 d	36 81 77 >150
5-0781	Lost River at Gonvick, Minn.	NE¼NE¼ sec.16, T.149 N., R.38 W., at culvert on county highway, a half mile south of Gonvick, and 3 miles below Pine Lake.	30.9	1960-65	4-19-65	8.34	178
5-0781.8	Lost River tributary near Clearbrook, Minn.	NW¼ sec.13, T.148 N., R.38 W., at culvert on county highway, 3½ miles south of Clearbrook.	1.79	1960-65	4-11-65	12.19	98
5-0782	Lost River tributary at Clearbrook, Minn.	SW¼NW¼ sec.29, T.149 N., R.37 W., at culvert on county highway at north edge of Clearbrook, three-quarters of a mile above mouth.	3.05	1960-65	4-11-65	a12.99	89
5-0784	Clearwater River tributary near Plummer, Minn.	SE¼SE¼ sec.22, T.151 N., R.43 W., at culvert on county highway, 1¼ miles above mouth, and 5½ miles southwest of Plummer.	1.17	1961-65	4-11-65	a11.23	177
		Lake of the Woods basin					
5-1287	Pike River tributary near Wahlsten, Minn.	SW¼SW¼ sec.32, T.61 N., R.15 W., at culvert on State Highway 135, 1.2 miles south of Wahlsten, and 2.7 miles above mouth.	-	1961-65	4-26-65	b6.35	26

✓ Discharge not determined.
> Greater than.
a Backwater from ice.
b Affected by shifting control.
c Backwater from aquatic growth.
d Gage height unknown.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Lake of the Woods basin--continued					
5-1303	Boriin Creek near Chisholm, Minn.	SE¼SE¼ sec.9, T.59 N., R.20 W., at culvert on State Highway 73, 1.2 miles above mouth, and 7.8 miles north of Chisholm.	13.7	1959-65	9-30-65	12.18	143
		Split Hand Creek basin					
5-2150	Smith Creek near Hill City, Minn.	SE¼NW¼ sec.13, T.53 N., R.26 W., at culvert on U.S. Highway 169, 6½ miles north of Hill City.	5.06	1961-65	6-2-65	5.70	(✓)
		Swan River basin					
5-2167	O'Brien Creek near Nashwauk, Minn.	NE¼NE¼ sec.33, T.57 N., R.22 W., at culvert on U.S. Highway 169, 1.5 miles east of Nashwauk, and 3.0 miles above Welcome Creek.	-	1959-65	4-17-65	a9.28	81
5-2168.3	Hay Creek near Pengilly, Minn.	SW¼NE¼ sec.26, T.56 N., R.22 W., at culvert on Duluth, Missabe and Iron Range railroad, 1.9 miles above Hay Lake, and 5.0 miles southeast of Pengilly.	-	1964-65	6-23-64 4-21-65	b8.80 8.48	e139 123
5-2169.8	Swan River tributary at Warba, Minn.	NW¼ sec.34, T.54 N., R.23 W., at culvert on U. S. Highway 2, three-quarters of a mile above mouth, and 1 mile southeast of Warba.	2.36	1961-65	6-2-65	5.59	29
		Bluff Creek basin					
5-2177	Bluff Creek near Jacobson, Minn.	SW¼NW¼ sec.8, T.52 N., R.23 W., at culvert on State Highway 34, 1¼ miles west of Jacobson.	2.95	1961-65	5-14-61 9-11-62 4-2-63 6-23-64 6-2-65	6.94 8.35 a7.12 7.72 7.73	18 60 10 41 41
		Crow Wing River basin					
5-2441	Kitten Creek near Sebeka, Minn.	SE¼SE¼ sec.15, T.137 N., R.35 W., at culvert on county highway, 3¼ miles above mouth, and 3¼ miles north of Sebeka.	9.34	1961-65	5-6-64 4-13-65	10.52 11.14	174 320
5-2442	Cat River near Nimrod, Minn.	SW¼SW¼ sec.36, T.137 N., R.34 W., at bridge on State Highway 227, 2½ miles west of Nimrod, and 3 miles above mouth.	44.3	1961-65	4-14-65	8.93	(✓)
		Platte River basin					
5-2678	Big Mink Creek tributary near Lastrup, Minn.	NW¼SW¼ sec.14, T.41 N., R.30 W., at culvert on State Highway 25, 1.4 miles above mouth, and 2.1 miles west of Lastrup.	-	1961-65	4-12-65	10.42	(✓)
5-2679	Hillman Creek near Pierz, Minn.	NE¼SE¼ sec.9, T.40 N., R.30 W., at bridge on county highway, 1.1 miles above mouth, and 1.5 miles east of Pierz.	52.6	1964-65	4-13-65	14.68	2,560
		Sauk River basin					
5-2703	Sauk River tributary at Spring Hill, Minn.	NE¼ sec.27, T.124 N., R.33 W., at culvert on State Highway 4, 1 mile east of Spring Hill, and 1⅞ miles above mouth.	6.42	1960-65	4-11-65	a12.60	(✓)
5-2703.1	Sauk River tributary near St. Martin, Minn.	SE¼ sec.19, T.124 N., R.32 W., at culvert on county highway, 4½ miles northwest of St. Martin.	.23	1960, 1962-65	4-11-65	a8.49	17
		Johnson Creek basin					
5-2718	Johnson Creek tributary at Luxemburg, Minn.	NW¼NE¼ sec.30, T.123 N., R.28 W., at culverts on State Highway 15, 0.8 mile south of Luxemburg.	2.77	1965	4-12-65	9.43	(✓)
5-2720	Johnson Creek tributary near St. Augusta, Minn.	NE¼SE¼ sec.21, T.123 N., R.28 W., at culverts on county highway, 0.7 mile above mouth, and 3.1 miles southwest of St. Augusta.	-	1964-65	5-6-64 4-12-65	6.45 10.16	39 274

✓ Discharge not determined.
a Backwater from ice.
b Affected by shifting control.
e Revised.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Johnson Creek basin--continued					
5-2723	Johnson Creek near St. Augusta, Minn.	NW¼SW¼ sec.13, T.123 N., R.28 W., at bridge on County Highway 7, 1.0 mile south of St. Augusta, and 3.3 miles above mouth.	-	1964-65	4-13-64 4-12-65	12.85 14.77	227 682
		Otsego Creek basin					
5-2737	Otsego Creek near Otsego, Minn.	SW¼NE¼ sec.13, T.121 N., R.24 W., at culvert on County Highway 39, 1.3 miles above mouth, and 1.9 miles west of Otsego.	-	1964-65	4-6-64 4-11-65	a4.39 7.48	23 202
		Elk River basin					
5-2742	Stony Brook tributary near Foley, Minn.	NW¼ sec.2, T.36 N., R.29 W., at culvert on State Highway 25, a quarter mile above mouth, and 1½ miles south of Foley.	3.11	1960-65	4-12-65	a11.26	83
		Crow River basin					
5-2761	North Fork Crow River tributary near Paynesville, Minn.	NW¼ sec.12, T.122 N., R.33 W., at culvert on county highway, 1 mile above mouth and 3 miles west of Paynesville.	.58	1960-65	4-11-65	17.87	31
5-2783.5	Fountain Creek near Montrose, Minn.	NE¼NW¼ sec.22, T.118 N., R.26 W., at culvert on County Highway 30, 3.3 miles southwest of Montrose.	6.73	1962-65	4-9-65	a8.14	(✓)
5-2787	Otter Creek near Lester Prairie, Minn.	SE¼SE¼ sec.28, T.117 N., R.27 W., at culvert on State Highway 7, 2.1 miles northwest of Lester Prairie, and 4.4 miles above mouth.	-	1961-65	4-13-65	9.24	525
5-2787.5	Otter Creek tributary near Lester Prairie, Minn.	SE¼SE¼ sec.33, T.117 N., R.27 W., at culvert on County Highway 63, 1.7 miles northwest of Lester Prairie, and 3.3 miles above mouth.	-	1962-65	4-10-65	11.14	87
5-2788.5	Buffalo Creek tributary near Brownton, Minn.	NE¼SE¼ sec.13, T.115 N., R.30 W., at culvert on State Highway 15, 0.6 mile above mouth, and 2.6 miles northwest of Brownton.	9.45	1961-65	3-28-62 6-10-63 4-10-65	a16.16 13.71 a17.39	70 35 124
5-2790.3	South Fork Crow River tributary near Mayer, Minn.	NW¼NE¼ sec.36, T.117 N., R.26 W., at culvert on State Highway 7, 0.7 mile above mouth, and 1.4 miles north of Mayer.	-	1962-65	4-8-65	a9.06	306
5-2803	School Lake Creek tributary near St. Michael, Minn.	NW¼SE¼ sec.15, T.120 N., R.24 W., at culvert on county highway, 0.2 mile above mouth, and 1.5 miles southwest of St. Michael.	2.04	1964-65	4-11-65	12.68	434
		Rum River basin					
5-2841	Mille Lacs Lake tributary near Wealthwood, Minn.	NW¼NE¼ sec.25, T.45 N., R.27 W., at culvert on State Highway 18, 0.2 mile above mouth, and 2.0 miles west of Wealthwood.	-	1961-65	4-13-65	a10.35	20
5-2846	Robinson Brook near Onamia, Minn.	NE¼SE¼ sec.11, T.40 N., R.27 W., at culvert on U.S. Highway 169, a quarter mile above mouth, and 6¾ miles south of Onamia.	7.21	1960-65	4-13-65	a15.85	130
5-2846.2	Rum River tributary near Onamia, Minn.	E½ sec.14, T.40 N., R.27 W., at culvert on U.S. Highway 169, a quarter mile above mouth, and 7¾ miles south of Onamia.	1.84	1960-65	4-13-65	10.19	96
5-2849.2	Stanchfield Creek tributary near Day, Minn.	NW¼SE¼ sec.13, T.37 N., R.25 W., at culvert on County Highway 60, 0.5 mile above mouth, and 1.5 miles southwest of Day.	1.26	1961-65	4-12-65	7.01	55
		Minnesota River basin					
5-2991	Lazarus Creek tributary near Canby, Minn.	N½ sec.6, T.114 N., R.45 W., at culvert on State Highway 68, 3 miles west of Canby, and 3¼ miles above mouth.	3.4	1960-65	5-21-65	12.19	(✓)

✓ Discharge not determined.
a Backwater from ice.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Minnesota River basin--continued					
5-3012	Minnesota River tributary near Montevideo, Minn.	SW¼SE¼ sec.16, T.117 N., R.41 W., at culvert on U.S. Highway 212, 1 mile above mouth, and 3¾ miles west of Montevideo.	0.54	1960-65	3-29-60	a8.91	21
					7-19-62	9.28	31
					6-10-63	7.49	4.1
					4-12-64	a8.20	1.6
					5-23-65	10.20	50
5-3029.7	Lake Emily tributary near Starbuck, Minn.	NW¼ sec.27, T.124 N., R.39 W., at culvert on State Highway 29, 6¼ miles south of Starbuck.	.13	1962-65	8-6-65	8.00	(≠)
5-3034.5	Hassel Creek near Clontarf, Minn.	NW¼SE¼ sec.4, T.122 N., R.39 W., at culvert on State Highway 29, a quarter mile above Lake Hassel, and 5¼ miles east of Clontarf.	4.03	1962-65	5-23-65	7.86	(≠)
5-3052	Spring Creek near Montevideo, Minn.	SW¼SW¼ sec.32, T.118 N., R.40 W., at culvert on State Highway 29, 1¼ miles above mouth, and 2¾ miles north of Montevideo.	16.3	1959-65	8-26-63	13.92	e99
					4-12-64	13.51	e69
					4-5-65	15.21	203
5-3112	North Branch Yellow Medicine River near Ivanhoe, Minn.	NW¼ sec.2, T.111 N., R.46 W., at culvert on State Highway 19, 5¼ miles west of Ivanhoe.	15.2	1960-65	4-8-65	a15.89	(≠)
5-3112.5	North Branch Yellow Medicine River tributary near Wilno, Minn.	SE¼NE¼ sec.33, T.113 N., R.45 W., at culvert on U.S. Highway 75, 1½ miles above mouth, and 4½ miles northwest of Wilno.	.33	1960-65	5-23-65	10.19	48
5-3113	North Branch Yellow Medicine River tributary near Porter, Minn.	E½ sec.16, T.113 N., R.45 W., at culvert on U. S. Highway 75, 6¼ miles southwest of Porter.	1.46	1960-65	5-23-65	15.15	(≠)
5-3138	Chetomba Creek tributary near Blomkest, Minn.	SW¼SW¼ sec.35, T.118 N., R.35 W., at culvert on U.S. Highway 71, 2⅜ miles northwest of Blomkest.	.79	1959-65	7-12-65	7.83	(≠)
5-3149	Redwood River at Ruthton, Minn.	NW¼NW¼ sec.11, T.108 N., R.44 W., at culvert on State Highway 23, 0.1 mile northeast of Ruthton.	5.90	1959-65	4-9-65	14.81	330
5-3152	Prairie Ravine near Marshall, Minn.	SE¼NE¼ sec.20, T.112 N., R.41 W., at culvert on U.S. Highway 59, 2.7 miles north of Marshall.	-	1959-64, 1965	4-9-65	a9.84	55
5-3165.5	West Fork Beaver Creek near Olivia, Minn.	SW¼SW¼ sec.14, T.116 N., R.35 W., at culvert on U. S. Highway 71, 5½ miles northwest of Olivia.	9.71	1959-65	5-15-65	6.80	91
5-3167	Spring Creek near Sleepy Eye, Minn.	NE¼SE¼ sec.24, T.111 N., R.33 W., at culvert on county highway, 3¾ miles above mouth, and 7½ miles north of Sleepy Eye.	30.0	1959-65	4-10-65	17.79	930
5-3168	Cottonwood River tributary near Balaton, Minn.	NW¼NW¼ sec.19, T.109 N., R.42 W., at culvert on U.S. Highway 14, 4¼ miles west of Balaton.	.50	1959-65	4-9-65	5.47	23
5-3168.5	Meadow Creek tributary near Marshall, Minn.	E½ sec.34, T.111 N., R.41 W., at culvert on U. S. Highway 59, 1¼ miles above mouth, and 4½ miles south of Marshall.	-	1961-65	4-9-65	14.00	(≠)
5-3169	Dry Creek near Jeffers, Minn.	NE¼NE¼ sec.31, T.108 N., R.36 W., at culvert on County Highway 10, 4½ miles north of Jeffers.	3.24	1961-65	4-6-65	a10.64	400
5-3178.5	Foster Creek near Alden, Minn.	NE¼NE¼ sec.9, T.102 N., R.23 W., at culvert on U.S. Highway 16, 1.2 miles southwest of Alden.	-	1959-65	4-7-65	6.99	(≠)
5-3181	East Branch Blue Earth River tributary near Blue Earth, Minn.	W½SE¼ sec.24, T.102 N., R.27 W., at culvert on County Highway 13, a quarter mile above mouth, and 4¼ miles east of Blue Earth.	-	1960-65	4-6-65	f6.54	187
5-3183	North Fork Watonwan River near Delft, Minn.	E½ sec.11, T.106 N., R.36 W., at culvert on U.S. Highway 71, 1¾ miles northwest of Delft.	13.1	1960-65	4-4-65	a18.42	810
5-3202	LeSueur River tributary near Mankato, Minn.	SE¼SW¼ sec.28, T.108 N., R.26 W., at culvert on State Highway 22, 0.2 mile above mouth, and 1.5 miles southeast of Mankato Airport.	.073	1959-65	7-8-65	20.50	20
5-3203	Cobb River tributary near Mapleton, Minn.	SW¼NE¼ sec.4, T.106 N., R.26 W., at culvert on State Highway 22, 1.0 mile above mouth, and 6.3 miles north of Mapleton.	7.25	1959-65	4-6-65	18.60	293
5-3204	Maple River tributary near Mapleton, Minn.	SW¼ sec.1, T.105 N., R.27 W., at culvert on State Highway 30, 1 mile above mouth, and 3¼ miles west of Mapleton.	5.75	1959-65	4-6-65	a21.11	285
5-3204.4	Maple River tributary near Amboy, Minn.	NW¼ sec.19, T.105 N., R.27 W., at culvert on State Highway 30, 1½ miles east of Amboy.	13.8	1959-65	4-6-65	a20.30	480

≠ Discharge not determined.
≠ Operated as a continuous-record gaging station.
a Backwater from ice.
e Revised.
f Backwater from debris.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Minnesota River basin--continued					
5-3251	Minnesota River tributary near North Mankato, Minn.	SW¼SW¼ sec.13, T.109 N., R.27 W., at culvert on county road, 200 ft above U.S. Highway 169, 0.4 mile above mouth, and 4.2 miles north of North Mankato.	-	1961-65	4-6-65	a5.43	(✓)
5-3301.5	Sand Creek tributary near Montgomery, Minn.	NE¼ sec.18, T.111 N., R.22 W., at culvert on State Highway 21, 3½ miles east of Montgomery.	0.29	1961-65	4-6-65	a10.50	43
5-3302	Rice Lake tributary near Montgomery, Minn.	N½ sec.13, T.111 N., R.23 W., at culvert on State Highway 21, 1¼ miles above Rice Lake, and 2½ miles east of Montgomery.	2.49	1960-65	4-6-65	a10.96	114
5-3303	Sand Creek near New Prague, Minn.	NE¼NW¼ sec.1, T.112 N., R.23 W., at culvert on State Highways 13 and 19, 1.9 miles east of New Prague.	65	1960-65	4-8-65	14.79	1,070
5-3305.5	Raven Stream tributary near New Prague, Minn.	NW¼ sec.28, T.113 N., R.23 W., at culvert on county road, 1.6 miles about mouth, and 2.3 miles northwest of New Prague.	23	1960-65	4-7-65	14.74	505
5-3306	Sand Creek tributary near Jordan, Minn.	NW¼NE¼ sec.5, T.113 N., R.23 W., at culvert on State Highway 21, 0.8 mile above mouth, and 2.8 miles south of Jordan.	2.62	1960-65	4-7-65	a16.77	(✓)
		St. Croix River basin					
5-3363	Moose River tributary at Moose Lake, Minn.	SE¼NE¼ sec.19, T.46 N., R.19 W., at culvert on State Highway 27, 0.9 mile above mouth, and 1.2 miles west of Moose Lake.	-	1960-65	4-13-65	a11.52	104
5-3365.5	Wolf Creek tributary near Sandstone, Minn.	NE¼SE¼ sec.33, T.43 N., R.20 W., at culvert on U.S. Highway 61, 0.2 mile above mouth, and 2.2 miles north of Sandstone.	-	1960-65	4-15-65	19.20	200
5-3366	Kettle River tributary at Sandstone, Minn.	SE¼SE¼ sec.4, T.42 N., R.20 W., at culvert on U. S. Highway 61 at Sandstone, and 0.2 mile above mouth.	-	1960-65	4-15-65	10.11	(✓)
5-3382	Mission Creek near Hinckley, Minn.	SW¼SW¼ sec.25, T.41 N., R.21 W., at culvert on U. S. Highway 61, 1.2 miles south of Hinckley.	-	1960-65	4-15-65	14.96	(✓)
		Vermillion River basin					
5-3459	Vermillion River tributary near Hastings, Minn.	NE¼SE¼ sec.35, T.115 N., R.18 W., at culvert on county highway, 2.0 miles above mouth, and 4.1 miles west of Hastings.	14.3	1960-65	4-6-65	21.95	544
		Cannon River basin					
5-3527	Turtle Creek tributary near Pratt, Minn.	NW¼ sec.8, T.106 N., R.19 W., at culvert on U.S. Highway 218, 1 mile above mouth, and 1½ miles southeast of Pratt.	-	1960-65	7-8-65	18.97	185
5-3528	Turtle Creek tributary near Steele Center, Minn.	NW¼NW¼ sec.11, T.106 N., R.20 W., at culvert on township road, 1½ miles above mouth and 1½ miles northeast of Steele Center.	-	1960-65	7-8-65	9.53	228
5-3551	Little Cannon River tributary near Kenyon, Minn.	SE¼ sec.9, T.110 N., R.18 W., at culvert on State Highway 56, a quarter mile above mouth, and 5 miles north of Kenyon.	2.02	1960-65	7-13-65	14.68	280
5-3551.5	Pine Creek near Cannon Falls, Minn.	NE¼NE¼ sec.6, T.112 N., R.17 W., at culvert on State Highway 20, 2.0 miles above mouth, and 2.1 miles north of Cannon Falls.	20.2	1960-65	4-8-65	7.54	844
5-3551.8	Cannon River tributary near Miesville, Minn.	SW¼SW¼ sec.9, T.113 N., R.17 W., at culvert on State Highway 50, 2.9 miles west of Miesville.	-	1960-65	4-8-65	14.52	(✓)
5-3552.3	Cannon River tributary near Welch, Minn.	SW¼SW¼ sec.11, T.113 N., R.16 W., at culvert on U.S. Highway 61, 1.2 miles above mouth, and 2.7 miles northeast of Welch.	-	1960-65	7-8-65	11.13	80

✓ Discharge not determined.
a Backwater from ice.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Zumbro River basin					
5-3733.5	Zumbro River tributary near South Troy, Minn.	SE¼NE¼ sec.6, T.108 N., R.13 W., at culvert on county road, 0.8 mile above mouth, and 1.3 miles south of South Troy.	0.16	1962-65	4-8-65	7.90	(≠)
5-3737	North Fork Zumbro River tributary near Wanamingo, Minn.	SE¼SE¼ sec.32, T.110 N., R.17 W., at culvert on County Highway 1, 3¾ miles above mouth, and 4¼ miles southwest of Wanamingo.	9.36	1960-65	4-7-65	a13.00	870
5-3739	Trout Brook tributary near Goodhue, Minn.	SE¼ sec.4, T.110 N., R.15 W., at culvert on State Highway 58, three-quarter mile above mouth, and 3 miles south of Goodhue.	.41	1960-65	7-13-65	7.81	(≠)
		East Indian Creek basin					
5-3758	East Indian Creek tributary No. 1 near Weaver, Minn.	NW¼SE¼ sec.23, T.109 N., R.10 W., at culvert on County Highway 14, 0.3 mile above mouth, and 2.5 miles northwest of Weaver.	.21	1962-65	5-16-65	10.34	(≠)
		Garvin Brook basin					
5-3783	Straight Valley Creek near Rollingstone, Minn.	SE¼NE¼ sec.12, T.107 N., R.9 W., at bridge on county highway, 0.2 mile above mouth, and 1.5 miles southwest of Rollingstone.	5.16	1959-65	4-8-65	14.65	(≠)
		Gilmore Creek basin					
5-3790	Gilmore Creek at Winona, Minn.	N½ sec.29, T.107 N., R.7 W., about 1500 ft above bridge carrying U.S. Highway 14 at west edge of Winona and 2¼ miles above mouth.	8.95	1939-63≠, 1964-65	4-7-65	f4.65	436
		Root River basin					
5-3836	North Branch Root River tributary near Stewartville, Minn.	Near center sec.36, T.105 N., R.14 W., at culvert on State Highway 30, 2.0 miles east of Stewartville, and 2.3 miles above mouth.	.73	1959-64≠, 1965	4-7-65	7.49	71
5-3837	Mill Creek tributary near Chatfield, Minn.	SW¼NW¼ sec.14, T.105 N., R.12 W., at culvert on county highway, 0.8 mile above mouth, and 4.5 miles northwest of Chatfield.	2.36	1959-65	4-6-65	14.20	506
5-3837.2	Mill Creek near Chatfield, Minn.	SE¼NW¼ sec.23, T.105 N., R.12 W., at bridge on county highway, 3.4 miles northwest of Chatfield, and 4.8 miles above mouth.	22.4	1962-65	4-6-65	14.31	(≠)
5-3838.5	Bear Creek near Grand Meadow, Minn.	NE¼SE¼ sec.14, T.103 N., R. 15 W., at bridge on county highway, 1½ miles northwest of Grand Meadow, and 4 miles above North Fork Bear Creek.	13.6	1962-65	9-28-65	18.60	1,020
5-3841	Trout Creek tributary near Lanesboro, Minn.	SW¼ sec.6, T.102 N., R.9 W., at culvert on county highway, three-quarter mile above mouth, and 4 miles south of Lanesboro.	4.08	1959-65	9-19-65	15.68	333
5-3841.5	Root River tributary near Whalan, Minn.	SW¼ sec.17, T.103 N., R.9 W., at culvert on private road, 1¼ miles southwest of Whalan.	.30	1959-65	9-19-65	6.80	22
5-3842	Whalan Creek near Whalan, Minn.	SE¼ sec.21, T.103 N., R.9 W., at bridge on county highway, 1¾ miles southeast of Whalan, and 2¼ miles above mouth.	7.85	1959-65	9-19-65	18.57	(≠)
5-3843	Big Springs Creek near Arendahl, Minn.	NE¼SE¼ sec.7, T.104 N., R.9 W., at culvert on State Highway 250, 2.0 miles west of Arendahl.	.14	1959-65	4-6-65	8.92	18
5-3844	Pine Creek near Arendahl, Minn.	SE¼NE¼ sec.3, T.104 N., R.9 W., at bridge on County Highway 25, 1.3 miles northeast of Arendahl, and 4.9 miles above Hemingway Creek.	28.1	1959-65	4-6-65	13.32	1,140

≠ Discharge not determined.
≠ Operated as a continuous-record gaging station.
a Backwater from ice.
f Backwater from debris.

Annual maximum discharge at crest-stage partial-record stations--continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Iowa River basin					
5-4570.8	Rose Creek tributary near Dexter, Minn.	SE¼SW¼ sec.22, T.103 N., R.16 W., at culvert on county highway, 1¾ miles above mouth, and 2¼ miles southwest of Dexter.	1.20	1962-65	7-9-65	10.31	(✗)
5-4589.5	Shell Rock River tributary near Albert Lea, Minn.	SW¼SE¼ sec.25, T.103 N., R.22 W., at culvert on State Highway 13, 0.4 mile above mouth, and 2.4 miles northwest of Albert Lea city limits.	-	1960-65	4-6-65	a20.25	(✗)
		Des Moines River basin					
5-4747.5	Beaver Creek tributary near Slayton, Minn.	NW¼NW¼ sec.17, T.106 N., R.41 W., at culvert on State Highway 30, 2¼ miles west of Slayton, and 2¾ miles above mouth.	2.67	1961-65	5-9-65	18.48	(✗)
5-4747.6	Beaver Creek tributary above Slayton, Minn.	NE¼NE¼ sec.17, T.106 N., R.41 W., at culvert on State Highway 30, three-quarters of a mile above mouth, and 1½ miles west of Slayton.	.97	1961-65	5-9-65	18.12	(✗)
5-4754	Warren Lake tributary near Windom, Minn.	SE¼NE¼ sec.14, T.105 N., R.36 W., at culvert on U.S. Highway 71, a quarter mile above Warren Lake, and 2.4 miles north of Windom.	1.38	1960-65	6-22-65	5.44	47
5-4758	West Fork Des Moines River tributary near Jackson, Minn.	NW¼SE¼ sec.27, T.103 N., R.35 W., at culvert on county highway, three-quarters of a mile above mouth, and 5½ miles north of Jackson.	1.42	1960-65	3-28-62 6-9-63 4-5-65	a16.34 14.72 a17.86	g69 49 38
5-4759	West Fork Des Moines River tributary near Lakefield, Minn.	SE¼SE¼ sec.32, T.103 N., R.35 W., at culvert on County Highway 19, 1½ miles above mouth, and 5¾ miles east of Lakefield.	4.52	1960-65	4-5-65	a10.46	112
5-4761	Story Brook near Petersburg, Minn.	SW¼NW¼ sec.24, T.101 N., R.35 W., at bridge on U.S. Highway 71, 3 miles above mouth, and 4 miles west of Petersburg.	-	1960-65	4-6-65	a12.75	1,200
5-4769	East Fork Des Moines River tributary near Dunnell.	SW¼NW¼ sec.2, T.101 N., R.33 W., at bridge on State Highway 4, a half mile above mouth, and 1½ miles north of Dunnell.	7.88	1960-65	4-6-65	a14.68	370
		Big Sioux River basin					
6-4829.5	Mound Creek near Hardwick, Minn.	SE¼SE¼ sec.15, T.104 N., R.45 W., at culvert on county highway, 2¼ miles northwest of Hardwick.	2.77	1959-65	4-6-65	a10.90	88
6-4829.6	Mound Creek tributary at Hardwick, Minn.	SE¼ sec.34, T.104 N., R.45 W., at culvert on U.S. Highway 75, half a mile above mouth, and 1 mile southwest of Hardwick.	.23	1959-65	4-6-65	a10.08	(✗)
6-4830.5	Rock River tributary near Luverne, Minn.	NE¼ sec.10, T.101 N., R.45 W., at culvert on U.S. Highway 75, 5.8 miles south of Luverne.	.20	1959-65	4-6-65	a15.78	(✗)
6-4832	North Branch Kanaranzi Creek tributary near Lismore, Minn.	SW¼SW¼ sec.31, T.104 N., R.42 W., at culvert on county highway adjacent to State Highway 91, 60 ft above mouth and 1¼ miles northeast of Lismore.	e.18	1959-65	6-22-65	19.55	180
		Little Sioux River basin					
6-6035.2	Little Sioux River tributary near Spafford, Minn.	NW¼NE¼ sec.27, T.102 N., R.38 W., at culvert on U.S. Highway 16, 0.4 mile west of Spafford, and a half mile above mouth.	4.06	1959-65	4-6-65	a8.27	128
6-6035.3	Little Sioux River near Spafford, Minn.	NE¼NE¼ sec.34, T.102 N., R.37 W., at bridge on county highway, 1.6 miles below Jackson County ditch No. 11, and 5.8 miles east of Spafford.	-	1962-65	4-6-65	a11.08	(✗)

✗ Discharge not determined.
a Backwater from ice.
e Revised.
g Corrected.

Measurements at miscellaneous sites

Measurements of streamflow at points other than gaging stations or partial-record stations are given in the following table. Those that are measurements of base flow are designated by an asterisk (*).

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Streams tributary to Lake Superior						
St. Louis River	Lake Superior	SW¼ sec.12, T.57 N., R.16 W., at County Highway 4, 3 miles northwest of Palo, Minn.	-	-	9- 2-65	554
St. Louis River	Lake Superior	W½ sec.29, T.56 N., R.18 W., at County Highway 27, 3 miles west of Zim, Minn.	-	-	9- 3-65	122
St. Louis River	Lake Superior	On line between secs.14 and 23, T.53 N., R.19 W., at bridge on County Highway 133 at Meadowland, Minn.	-	-	9- 3-65	185
Cloquet River	St. Louis River	In sec.7, T.56 N., R.10 W., at bridge on County Highway 2, 1½ miles southwest of Darby Junction, Minn.	-	-	8-31-65	4.21
Cloquet River	St. Louis River	NE¼ sec.25, T.56 N., R.12 W., 6 miles northeast of Brimson, Minn.	-	-	8-31-65	17.3
Cloquet River	St. Louis River	In sec.10, T.55 N., R.12 W., at County Highway 44, 1/3 mile north of Rollins, Minn.	-	-	8-31-65	27.0
Little Cloquet River	Cloquet River	SE¼ sec.24, T.54 N., R.13 W., at County Highway 44, ¼ mile below Smith Lake dam 9 miles southwest of Wales, Minn.	-	-	9- 1-65	38.0
Cloquet River	St. Louis River	NE¼ sec.2, T.52 N., R.14 W., 1 mile above Island Lake and 4 miles east of town of Island Lake, Minn.	-	-	9- 1-65	125
Cloquet River	St. Louis River	SE¼ sec.16, T.52 N., R.15 W., 1 mile below Island Lake dam and 4 miles east of Taft, Minn.	-	-	9- 1-65	470
Cloquet River	St. Louis River	On line between secs.26 and 27, T.52 N., R.16 W., at County Highway 15, 3 miles south of Taft, Minn.	-	-	9- 2-65	511
Cloquet River	St. Louis River	In sec.26, T.52 N., R.17 W., at bridge on U. S. Highway 53 at Independence, Minn.	-	-	9- 2-65	505
Cloquet River	St. Louis River	SE¼SE¼ sec.17, T.51 N., R.17 W., at bridge on County Road 46 at Burnett, Minn.	-	-	9- 2-65	497

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Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Red River of the North basin						
Mustinka River	Bois de Sioux River	On line between secs.11 and 14, T.128 N., R.43 W., about 6.7 miles southwest of town of Elbow Lake, Minn.	-	1964	4-28-65 6-30-65 8-31-65	47.6 47.6 *18.2
Twelve Mile	Mustinka River	On line between secs.27 and 28, T.126 N., R.45 W., ½ mile above West Fork, 5 miles east and 1½ miles south of Dumont, Minn.	-	1964	4-25-65 6-30-65 9- 1-65	17.0 6.92 *1.32
West Fork Twelve Mile Creek	Twelve Mile Creek	On line between secs.28 and 33, T.126 N., R.45 W., 1 mile above mouth, 4 miles east and 2 miles south of Dumont, Minn.	-	1964	4-25-65 6-30-65 9- 1-65	2.67 0 0
Twelve Mile Creek	Mustinka River	On line between secs.30 and 31, T.127 N., R.45 W., 0.1 mile above mouth, 5¼ miles east and 2 miles south of Wheaton, Minn.	-	1964	4-25-65 6-30-65 9- 1-65	19.4 7.01 *1.07
West Branch Mustinka River	Mustinka River	On line between secs.30 and 31, T.127 N., R.45 W., ¼ mile above mouth of Twelve Mile Creek, 5¼ miles east and 2 miles south of Wheaton, Minn.	-	1964	4-28-65 6-30-65 9- 1-65	5.84 5.01 *.39
Mustinka River	Bois de Sioux River	SW¼ sec.8, T.127 N., R.46 W., on U. S. Highway 75, 1.2 miles north of Wheaton, Minn., 8 miles above mouth.	834	1916,17 1919-24≠ 1931-58≠ 1964	4-28-65 6-30-65 9- 1-65	144 105 22.7
Drainage Ditch	Rabbit River	On line between secs.7 and 12, T.130 N., R.45 and 46 W., ¼ mile above Rabbit River and ½ mile southeast of Campbell, Minn.	-	1964	4-28-65 6-30-65 9- 1-65	4.86 11.3 2.33
South Fork Rabbit River	Rabbit River	On line between secs.18 and 19, T.130 N., R.45 W., 2 miles above mouth and 2.2 miles southeast of Campbell, Minn.	-	1964	4-28-65 6-30-65 9- 1-65	1.30 .21 .09
Rabbit River	Bois de Sioux River	SE¼SE¼ sec.2, T.130 N., R.46 W., at Campbell, Minn., 1 mile below South Fork.	266	1942-51≠ 1964	4-28-65 6-30-65 9- 1-65	7.53 15.9 2.40
Bois de Sioux River	Red River of the North	NE¼NE¼ sec.21, T.131 N., R.47 W., about 4 miles downstream from Rabbit River and 4 miles southwest of Doran, Minn.	-	-	10-9-64	*1.09
Otter Tail River	Red River of the North	NW¼NE¼ sec.1, T.136 N., R.39 W., at outlet of Little Pine Lake 2.2 miles northeast of Perham, Minn.	-	1933, 1964	10-28-64 5-18-65 7- 1-65 8-27-65 9-30-65	*59.0 331 244 *79.4 152
Toad River	Otter Tail River	S½NW¼ sec.29, T.137 N., R.38 W., at County Highway 13, 1 mile above Pine Lake, and 4½ miles northeast of Perham, Minn.	-	1964	10-28-64 5-18-65 7- 1-65 8-27-65 9-30-65	*11.5 89.7 33.0 8.88 58.8
Whiskey Creek	Red River of the North	On line between secs.13 and 24, T.134 N., R.48 W., at County Highway 20, 1.7 miles southeast of Kent, Minn.	-	1964	10-29-64 4-29-65 7- 1-65 8-31-65 9-28-65	0 .90 0 .87 22.2
Wolverton Creek	Red River of the North	On line between secs.21 and 22, T.137 N., R.48 W., ¼ mile northeast of Comstock, Minn.	-	1964	10-27-64 4-29-65 7- 1-65 8-31-65 9-28-65	0 1.31 0 0 .10

* Base flow.
≠ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
		Red River of the North basin--continued				
Deerhorn Creek	South Branch Buffalo River	On line between secs.23 and 26, T.137 N., R.47 W., 3 miles above mouth, at County Highway 2, 7.4 miles west of Barnsville, Minn.	-	1964	10-27-64	*4.36
					4-29-65	18.2
					7- 1-65	*8.06
					8-31-65	5.41
					9-28-65	17.4
Whiskey Creek	South Branch Buffalo River	On line between secs.22 and 27, T.138 N., R.47 W., at County Highway 65, 3 miles southeast of Sabin, Minn. (Published as Stony Creek in 1964).	-	1964	10-27-64	*.28
					4-29-65	48.6
					7- 1-65	8.05
					8-31-65	0
					9-28-65	15.8
Buffalo River	Red River of the North	NW¼SE¼ sec.35, T.140 N., R.47 W., at County Highway 19, 1½ miles north of Glyndon, Minn.	-	-	8-26-65	24.0
Wild Rice River	Red River of the North	On line between secs.8 and 9, T.145 N., R.39 W., at County Highway 4, 1 mile below Lambert Lake Creek and 5½ miles northwest of town of Roy Lake, Minn.	-	1964	10-29-64	*29.7
					5-18-65	326
					8-27-65	14.8
					9-21-65	35.9
White Earth Creek	Wild Rice River	On line between secs.6 and 1, T.144 N., R.41 and 42 W., at County highway bridge about 1 mile above Wild Rice River and 1½ miles east of Mahnomen, Minn.	-	1964	10-29-64	*3.50
					5-17-65	140
					8-27-65	2.49
					9-28-65	10.0
Wild Rice River	Red River of the North	On line between secs.1 and 12, T.144 N., R.42 W., at County Highway 25, ¼ mile below White Earth Creek and ½ mile east of Mahnomen, Minn.	-	1964	10-29-64	*46.5
					5-17-65	586
					8-27-65	35.4
					9-28-65	74.2
Marsh Creek	Wild Rice River	On line between secs.6 and 31, T.144 and 145 N., R.42 W., at State Highway 31, 3.6 miles west of Mahnomen, Minn.	-	1964	10-30-64	*.11
					5-18-65	81.1
					8-27-65	0
					9-28-65	7.56
Wild Rice River Tributary	Wild Rice River	SW¼ sec.16, T.144 N., R.44 W., at footbridge in park at Heiberg, ¼ mile above mouth, and 1½ miles northwest of Twin Valley, Minn.	-	1964	10-30-64	*.15
					5-17-65	14.6
					8-26-65	.10
					9-28-65	1.96
Wild Rice River	Red River of the North	On line between sec.13, T.144 N., R.46 W., and sec.18, T.144 N., R.45 W., at bridge on County Highway 24, 0.3 mile south of County Highway 31, and 3.2 miles southeast of Ada, Minn.	-	1945-51	4 -7-65	1,400
					4-13-65	2,840
South Branch Wild Rice River	Wild Rice River	On line between secs.28 and 33, T.142 N., R.42 W., 3½ miles southwest of Ogema, Minn.	-	1964	10-29-64	*2.62
					5-17-65	43.8
					8-27-65	.50
					9-30-65	18.9
South Branch Wild Rice River	Wild Rice River	On line between secs.8 and 9, T.142 N., R.45 W., at bridge on County Road 63, 5½ miles northeast of Felton, Minn.	-	1959-64	10-26-64	*6.77
					4- 7-65	1,270
					4-22-65	98.4
					5-25-65	35.7
					6- 9-65	56.0
					6-28-65	13.9
					7-26-65	*7.10
					8-26-65	*3.79
					9-29-65	21.5
State Ditch No. 45	Wild Rice River	On line between secs.15 and 16, T.141 N., R.46 W., at culvert on State Highway 9, 3 miles south of Felton, Minn.	-	1959-64	10-26-64	*2.75
					4- 6-65	76.3
					4-22-65	25.6
					5-25-65	17.6
					6- 9-65	11.5
					6-28-65	4.41
					7-26-65	*2.80
					8-26-65	*2.80
					9-29-65	5.48

* Base flow.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
		Red River of the North basin--continued				
Marsh River (Ditch)	Red River of the North	On line between sec.13, T.144 N., R.46 W., and sec.18, T.144 N., R.45 W., at bridge on County Highway 24, 0.1 mile south of County Highway 31, and 3 miles east of Ada, Minn.	-	1945-51	4-13-65	556
Sandhill River	Red River of the North	At intersection of secs.15, 16, 21 and 22, T.147 N., R.44 W., 1 mile northeast of Fertile, Minn.	-	1964	10-30-64 5- 4-65 8-27-65 9-28-65	*10.8 161 11.5 21.4
Tamarack River	Upper Red Lake	Sec.8, T.154 N., R.30 W., at Waskish, Minn.	-	1961 1964	10-20-64 5- 6-65 8-17-65 9-20-65	*91.2 865 195 104
Shotley Brook	Upper Red Lake	On line between secs.11 and 14, T.153 N., R.31 W., at County Highway 23, 2 miles above mouth and 3.2 miles northeast of Shotley, Minn.	-	1964	10-21-64 5- 6-65 8-17-65 9-20-65	*10.6 98.4 .07 9.04
South Branch Battle River	Battle River	E½ sec.31, T.152 N., R.30 W., at State Highway 72, 3.4 miles west of Kelliher, Minn.	-	1964	10-21-64 5-6 -65 8-17-65 9-20-65	*5.24 63.4 2.84 3.69
Cormorant River	Blackduck River	On line between secs.7 and 12, T.152 N., R.30 and 31 W., at State Highway 72, ¼ mile below an unnamed tributary entering from the south, and 5½ miles northwest of Shooks, Minn.	-	1964	10-21-64 5- 6-65 8-18-65 9-20-65	*1.10 40.5 .03 .46
Blackduck River	Lower Red Lake	On line between secs.22 and 23, T.151 N., R.32 W., at County Highway 101, ¼ mile below South Cormorant River and ½ mile southwest of Quiring, Minn.	-	1964	10-21-64 5- 6-65 8-18-65 9-21-65	*11.6 240 5.44 10.8
Sandy River	Lower Red Lake	N½ sec.2, T.150 N., R.36 W., at U. S. Indian Service highway 2½ miles above mouth and 9½ miles west of Red Lake, Minn.	-	1964	10-21-64 5- 3-65 8-17-65 9-21-65	*12.2 64.4 8.79 16.1
Moose River	Thief River	NE¼SE¼ sec.36, T.158 N., R.40 W., at bridge on State Highway 89 about 3½ miles northeast of Gatzke, Minn.	-	1964	10-29-64 4-13-65 4-20-65	<10 1,250 320
Poplar River	Hill River	On line between secs.17 and 20, T.150 N., R.42 W., at County Road B3 2½ miles above mouth and 2¼ miles west of Brooks, Minn.	-	1950, 1964	10-21-64 5- 4-65 8-18-65 9-20-65	*11.7 151 6.03 13.0
Barnums Creek	Red Lake River	On line between secs.10 and 15, T.149 N., R.47 W., at town road about ¼ mile above U. S. Highway 75 and ¾ mile northeast of Girard, Minn.	-	1964	10-21-64 5- 4-65 8-18-65 9-21-65	*.42 39.3 0 0
Red Lake River	Red River of the North	On line between secs.21 and 22, T.150 N., R.48 W., at bridge on County Highway 15 at Fisher, Minn.	-	-	10-27-64 11-12-64	1,230 911
Red Lake River	Red River of the North	SW¼SW¼ sec.1, T.151 N., R.49 W., at bridge on State Highway 220 at East Grand Forks, Minn.	-	-	10-27-64 11-13-64	1,210 932
		Lake of the Woods basin				
Little Fork River	Rainy River	SE¼NE¼ sec.13, T.62 N., R.19 W., at bridge on U.S. Highway 53, 0.6 mile west of Cook, Minn.	-	1950, 1958-64	10-7-64 11-1-64 12-8-64 4-16-65 6-18-65 7-23-65	*30.5 *9.03 *2.53 196 *19.4 21.3
Big Fork River	Rainy River	In sec.12, T.149 N., R.47 W., at bridge on County Highway 29 at Dora Lake, Minn.	-	-	8-27-65	86.4

* Base flow.
< Less than.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Mississippi River main stem						
Mississippi River	Gulf of Mexico	NW¼SW¼ sec.35, T.144 N., R.36 W., at first culvert below Lake Itasca at Itasca State Park, near town of Lake Itasca, Minn.	-	1964	11-18-64 6-17-65 8- 3-65	*1.45 26.6 5.74
Mississippi River	Gulf of Mexico	NW¼NW¼ sec.20, T.146 N., R.33 W., at County Highway 11, ¼ mile south of Bemidji, Minn.	-	1964	11-18-64 6-18-65 8-25-65	*97.2 380 57.0
Schoolcraft River basin						
Schoolcraft River	Mississippi River	SW¼SE¼ sec.31, T.146 N., R.33 W., ¼ mile below Plantaganette Lake outlet and 3 miles south of Bemidji, Minn.	-	1947, 1964	11-17-64 6-18-65 8-25-65	*48.1 171 30.9
Turtle River basin						
Turtle River	Mississippi River	S½ sec.15, T.147 N., R.31 W., 7 miles northwest of Pennington, Minn.	-	1950, 1964	11-17-64 6-29-65	*37.7 97.6
North Turtle River	Turtle River	NW¼NW¼ sec.24, T.147 N., R.31 W., about ½ mile above mouth and 5.8 miles northwest of Pennington, Minn.	-	1950, 1964	11-17-64 6-29-65 8-25-65	*9.38 39.9 *4.23
Mississippi River main stem						
Mississippi River	Gulf of Mexico	Sec.21, T.146 N., R.30 W., at outlet of Cass Lake, 7½ miles northeast of Cass Lake, Minn.	1,090	1951-53 1955-56 1959 1962	11-5-64 4-26-65	398 590
Leech Lake River basin						
Boy River	Leech Lake	NW¼SE¼ sec.34, T.141 N., R.28 W., at Longville, Minn.	-	1953, 1964	10-16-64 5-19-65 8- 3-65	*24.1 68.6 *58.9
Boy River	Leech Lake	S½SE¼ sec.28, T.142 N., R.27 W., at County Highway 53, about 1½ miles above Boy Lake and 8¾ miles west and 1 mile north of Remer, Minn.	-	1964	10-16-64 5-19-65 8-12-65	*85.9 223 *116
Prairie River basin						
Prairie River	Mississippi River	W½ sec.19, T.58 N., R.23 W., at County Road 336, 9 miles northwest of Nashwauk, Minn.	-	1964	11-4-64 6-11-65 8-19-65	*62.8 447 *25.2
Willow River basin						
Willow River	Mississippi River	On line between secs.14 and 15, T.51 N., R.26 W., at U. S. Highway 169, 6 miles south of Hill City, Minn.	-	1964	11-5-64 6-4-65 8-25-65	*50.4 625 *46.7
Willow River	Mississippi River	At highway bridge on line between secs. 20 and 21, T.49 N., R.25 W., 2 miles west of Palisade, Minn.	442	1929 1944-49 1953-54 1957 1964	11-5-64 6- 4-65 8-26-65	153 1,770 *81.9
Rice River basin						
Rice River	Mississippi River	E½SE¼ sec.34, T.48 N., R.26 W., at U. S. Highway 169 at Hassman, Minn.	-	1936 1944-49 1951 1953-54 1957 1964	7-14-65 8-26-65	*100 *16.5

* Base flow.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Ripple River basin						
Ripple River	Mississippi River	NE¼NE¼ sec.26, T.47 N., R.27 W., at U.S. Highway 169 at Aitkin, Minn. and about ¾ mile above mouth.	-	1964	6-11-65 8-26-65	385 *37.1
Pine River basin						
Pine River	Mississippi River	NE¼SE¼ sec.11, T.137 N., R.29 W., at County Highway 15 about ¾ mile above Upper Whitefish Lake and ¼ mile east and 1¼ miles north of Jenkins, Minn.	-	1964	10-19-64 8-11-65	120 *156
Little Pine River	Pine River	On line between secs.5 and 33, T.136 and 137 N., R.26 W., at town road 6 miles east and 2½ miles south of village of Cross Lake, Minn.	-	1964	10-19-64 8-10-65	*85.0 *21.2
Rabbit River basin						
Rabbit River	Mississippi River	NE¼ sec.35, T.47 N., R.29 W., 1/3 mile downstream from Clinker Lake control dam and 2 miles north of Crosby, Minn.	8.38	1945-63≠	6-10-65	23.5
Crow Wing River basin						
Crow Wing River	Mississippi River	NW¼NW¼ sec.13, T.140 N., R.33 W., at bridge on County Highway 20, 0.1 mile below outlet dam of Eighth Crow Wing Lake, 1¾ miles southeast of Nevis, Minn.	-	-	9-27-65	27.5
Crow Wing River	Mississippi River	NW¼SW¼ sec.29, T.140 N., R.33 W., at outlet of Fifth Crow Wing Lake, 4½ miles southwest of Nevis, Minn.	-	-	9-27-65	77.6
Crow Wing River	Mississippi River	NE¼NE¼ sec.20, T.139 N., R.33 W., at State Highway 87, at outlet of Third Crow Wing Lake and about 6½ miles east of Hubbard, Minn.	-	1964	10-13-64 5-20-65 8- 4-65 9-28-65	*78.2 104 *71.4 104
Straight River	Shell River	NW¼NE¼ sec.18, T.139 N., R.34 W., at State Highway 87 about ½ mile below Fish Hook River, about 2 miles above mouth and 2 miles northwest of Hubbard, Minn.	-	1964	10-14-64 5-21-65 8- 4-65	*119 337 *150
Long Lake Outlet	Straight River	SE¼NW¼ sec.20, T.139 N., R.34 W., at outlet of Long Lake at Hubbard, Minn.	-	1964	10-14-64 7-21-65 8-19-65	*17.2 20.8 *19.4
Shell River	Crow Wing River	NW¼ sec.30, T.139 N., R.34 W., at town road about 0.2 mile below Straight River and 1 mile west of Hubbard, Minn.	-	1964	10-13-64 5-20-65 8- 4-65 9-18-65	*202 576 *221 372
Shell River	Crow Wing River	NW¼SW¼ sec.32, T.139 N., R.33 W., at bridge on County Highway 13, 2 miles north of Huntersville, Minn.	-	-	9-28-65	422
Leaf River	Crow Wing River	E½ sec.20, T.135 N., R.34 W., at County Highway 22, 5½ miles north of Verndale, Minn.	-	1964	10-15-64 7- 7-65 8-12-65	*79.4 175 *64.7
Wing River	Leaf River	N½ sec.8, T.134 N., R.34 W., at County Highway 4, 2 miles north of Verndale, Minn.	-	1964	10-15-64 5-21-65 8-12-65	*30.7 133 *26.1
Redeye River	Leaf River	On line between secs.13 and 24, T.135 N., R.34 W., at County Highway 7, 1½ miles above mouth and 8½ miles north of Aldrich, Minn.	-	1964	10-15-64 7- 8-65 8-15-65	*47.5 59.2 *24.7

* Base flow.
≠ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Crow Wing River basin--Continued						
Leaf River	Crow Wing River	SW¼SW¼ sec.34, T.135 N., R.33 W., at bridge on County Highway 29, 7 miles northeast of Aldrich, Minn.	-	-	9-29-65	713
Partridge River	Crow Wing River	NW¼SW¼ sec.15, T.134 N., R.33 W., on County Highway 29, about ¾ mile above mouth and 5½ miles northeast of Aldrich, Minn.	-	1964	10-14-64 7- 8-65 8- 5-65	*6.86 16.3 *631
Crow Wing River	Mississippi River	SW¼SW¼ sec.7, T.133 N., R.31 W., at bridge on U. S. Highway 210 at Motley, Minn.	-	1913-17 1930-31≠	9-28-65	1,840
Mosquito Creek	Crow Wing River	E½SW¼ sec.7, T.133 N., R.31 W., at U.S. Highway 210 at Motley, Minn. and about 0.2 mile above mouth.	-	1964	10-14-64 7- 8-65 8-11-65	*8.88 10.5 *2.97
Long Prairie River	Crow Wing River	NW¼ sec.19, T.133 N., R.31 W., at bridge on U. S. Highway 10, ½ mile south of Motley, Minn.	-	-	9-29-65	317
Platte River basin						
Platte River	Mississippi River	NW¼NW¼ sec.31, T.40 N., R.31 W., at bridge on County Road 35, below Rice Lake and 6 miles southeast of Little Falls, Minn.	-	1938, 1963, 1964	3-25-65 4-12-65 4-17-65	*20.1 2,450 3,890
Crow River basin						
South Fork Crow River	Crow River	In SW¼ sec.14, T.117 N., R.32 W., at bridge on State Highway 7, 1 mile east of Cosmos, Minn.	221	1945-64≠	4-14-65	1,220
Rum River basin						
Rum River	Mississippi River	SW¼ sec.33, T.43 N., R.27 W., at bridge on U. S. Highway 169, at Vineland, Minn.	-	-	7-14-65	185
Rum River	Mississippi River	SW¼ sec.31, T.42 N., R.26 W., at bridge on State Highway 27, at Onamia, Minn.	414	1910-13≠	7-14-65	198
Rum River	Mississippi River	NW¼ sec.32, T.41 N., R.26 W., just below Bradbury Brook, 5 miles south of Onamia, Minn.	-	-	7-15-65	171
Rum River	Mississippi River	NW¼SE¼ sec.36, T.38 N., R.27 W., at bridge on U. S. Highway 169 at Milaca, Minn.	-	-	7-16-65	188
Rum River	Mississippi River	SE¼ sec.28, T.36 N., R.26 W., at bridge on State Highway 95, at Princeton, Minn., and ¼ mile above West Branch Rum River.	-	1961	7-22-65	213
West Branch Rum River	Rum River	SE¼ sec.28, T.36 N., R.26 W., at bridge on U. S. Highway 169, at Princeton, Minn.	-	-	7-22-65	19.4
Spencer Brook	Rum River	NE¼ sec.15, T.35 N., R.25 W., just above mouth, ¼ mile north of Spencer Brook, Minn.	-	-	7-23-65	11.0
Rum River	Mississippi River	NW¼NE¼ sec.15, T.35 N., R.25 W., at bridge on County Highway 7, ½ mile north of Spencer Brook, Minn.	-	1960-64≠	7-22-66	295

* Base flow.
≠ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
		Rum River basin--Continued				
Rum River	Mississippi River	SE¼SE¼ sec.36, T.36 N., R.24 W., at bridge on State Highway 47 at West Point, 8 miles west of Cambridge, Minn.	-	1958-62	4-14-65 4-15-65 7-22-65	5,870 10,500 301
Green Lake Brook	Rum River	SE¼ sec.36, T.36 N., R.25 W., at bridge on State Highway 47, ½ mile north of West Point, Minn.	-	-	7-22-65	25.7
Rum River	Mississippi River	SW¼ sec.27, T.36 N., R.24 W., at bridge on State Highway 95 at Walba, 5 miles west of Cambridge, Minn.	-	1962	7-22-65	411
Stanchfield Creek	Rum River	On line between secs.11 and 14, T.36 N., R.24 W., at bridge on County Road 32, 1 mile south of Springvale and 3 miles northeast of Walba, Minn.	-	-	7-23-65	27.2
Rum River	Mississippi River	Sec.18, T.36 N., R.23 W., at bridge on State Highway 14, 2½ miles northwest of Cambridge, Minn.	-	-	7-23-65	369
Little Stanchfield Lake Outlet	Rum River	SE¼ sec.8, T.36 N., R.23 W., at bridge on county road 3 miles north of Cambridge, Minn.	-	-	7-27-65	12.0
Bekins Creek	Rum River	NW¼SW¼ sec.21, T.36 N., R.23 W., at County Road 33, ¾ mile north of Cambridge, Minn.	-	-	7-27-65	1.44
Rum River	Mississippi River	N½ sec.30, T.136 N., R.23 W., first bridge below State Highway 95, at Cambridge, Minn.	1,160	1909-14≠	7-23-65	433
Rum River	Mississippi River	W½ sec.30, T.35 N., R.23 W., at bridge on County Highway 5, 0.8 mile west of Isanti, Minn.	-	1958-60	4-15-65 4-17-65 7-23-65	3,340 8,160 429
Long Lake Outlet	Rum River	On line between secs.10 and 15, T.34 N., R.24 W., 4 miles north of St. Francis, Minn.	-	-	7-27-65	a6.9
Rum River	Mississippi River	In sec.21, T.34 N., R.24 W., at bridge on County Highway 10, 1 mile north of St. Francis, Minn.	-	-	7-27-65	432
Seeley Creek	Rum River	In sec.7, T.33 N., R.24 W., at bridge on County Highway 55, 1 mile south of St. Francis, Minn.	-	-	7-27-65	6.24
Cedar Creek	Rum River	SW¼SW¼ sec.32, T.33 N., R.24 W., 7 miles north of Anoka, Minn.	-	-	7-27-65	29.8
Rum River	Mississippi River	On line between sec.6, T.32 N., R.24 W., and sec.1, T.32 N., R.25 W., at bridge on County Road 55, 6 miles north of Anoka, Minn.	-	-	7-27-65	514
Rum River	Mississippi River	SE¼ sec.1, T.31 N., R.25 W., at bridge on main street in Anoka, Minn.	-	-	7-27-65	573
		Rice Creek basin				
Rice Creek	Mississippi River	NW¼ sec.14, T.30 N., R.24 W., at State Highway 47 in Fridley, Minn., about ½ mile above mouth.	-	-	6-28-65	606

≠ Operated as a continuous-record gaging station.
a Estimated.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Bassett Creek basin						
Bassett Creek	Mississippi River	W½ sec.28, T.118 N., R.21 W., at bridge on County Highway 66 in Golden Valley, Minn. and ¾ mile west of underpass on State Highway 100.	-	1964	10- 8-64	*2.93
					11-17-64	*.81
					4- 3-65	5.92
					4- 6-65	67.0
					5-10-65	79.5
					6- 1-65	84.8
					7-15-65	19.8
					8-16-65	*7.19
					9-24-65	13.6
North Fork Bassett Creek	Bassett Creek	NW¼ sec.21, T.118 N., R.21 W., at culvert on 34th Ave. North at Crystal, Minn., and ¾ mile above mouth.	-	1964	10- 8-64	0
					11-17-64	0
					5-10-65	14.2
					6- 1-65	31.3
					7-15-65	.80
					8-16-65	*.10
					9-24-65	2.52
South Fork Bassett Creek	Bassett Creek	Near center of W½ sec.19, T.29 N., R.24 W., at culvert on Olsen Highway, Golden Valley, Minn. and ¼ mile east of State Highway 100.	-	1964	10- 8-64	*1.06
					11-17-64	*.76
					5-10-65	4.01
					6- 1-65	29.0
					7-15-65	1.86
					8-16-65	1.55
					9-24-65	2.49
Bassett Creek	Mississippi River	SE¼ sec.20, T.29 N., R.24 W., at Fruen Mill, Minneapolis, Minn. and 700 feet downstream from Glenwood Ave.	-	1952, 1954-55	10- 8-64	*4.82
				1963	11-17-64	*2.29
				1964	4- 3-65	16.8
					4- 6-65	24.5
					5-10-65	96.9
					6- 1-65	181
					7-15-65	23.8
					8-16-65	*7.24
					9-22-65	34.7
					9-24-65	22.9
Minnehaha Creek basin						
Minnehaha Creek	Mississippi River	E½ sec.15, T.117 N., R.22 W., at bridge on County Highway 16 at Minnetonka Mills, Minn., 2.2 miles below outlet of Minnetonka Lake.	130	1953-64≠	6- 1-65	245
Minnehaha Creek	Mississippi River	In sec.18, T.28 N., R.24 W., at 50th Street in Edina, Minn.	-	-	6- 5-65	262
					6-15-65	156
Minnehaha Creek	Mississippi River	SE¼NE¼ sec.18, T.28 N., R.23 W., at bridge on Minnehaha Avenue in Minneapolis, Minn., 0.1 mile above Minnehaha Falls, and 0.8 mile above mouth.	-	-	5-19-65	245
					6- 1-65	392
					6-15-65	168
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At Washington Ave. and Dartmouth Ave. bridges in Minneapolis, Minn. and 9 miles above Minnesota River.	-	1912	4-13-65	48,900
				1953-54	4-19-65	81,400
				1957	9- 8-65	5,350
				1963-64		
Mississippi River	Gulf of Mexico	Below lock and dam No. 1, between Minneapolis and St. Paul, Minn., 4 miles upstream from Minnesota River.	19,700	1935	11-19-64	5,170
				1938	9- 9-65	5,210
				1939		
				1941		
				1945-50		
				1954		
				1959		
				1961		
				1962		
				1963		

* Base flow.

≠ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Minnesota River basin						
Pomme de Terre River	Minnesota River	NE¼SE¼ sec.13, T.129 N., R.42 W., at highway bridge 1¼ miles below Pomme de Terre Lake and 4 miles east of Elbow Lake, Minn.	-	1963, 1964	10-27-64	*1.26
Mud Creek	Pomme de Terre River	On line between secs.22 and 23, T.124 N., R.42 W., 1 mile above mouth and 3 miles south of Morris, Minn.	-	1963, 1964	10- 9-64 11-17-64	*.07 *.09
Pomme de Terre River	Minnesota River	NW¼NE¼ sec.1, T.120 N., R.43 W., at County Road 54, 3 miles northeast of Appleton, Minn. and 12 miles above mouth.	885	1931-52≠	11-18-64	*20.5
Canby Creek	Lac qui Parle River	SE¼SE¼ sec.30, T.116 N., R.44 W., at U. S. Highway 75, 8½ miles northeast of Canby, Minn.	-	-	10-6-64 11-6-64 6- 8-65 7-13-65 8- 5-65 8-17-65	0 *.56 183 11.7 *2.87 *4.79
Lac qui Parle River	Minnesota River	SW¼NE¼ sec.14, T.114 N., R.45 W., at bridge on State Highway 68, 2.4 miles southeast of Canby, Minn.	-	-	4-10-65 4-10-65	529 544
Lac qui Parle River	Minnesota River	On line between secs.3 and 10, T.115 N., R.44 W., at bridge on State Highway 67, ½ mile above Canby Creek, and 8 miles northeast of Canby, Minn.	-	1963, 1964	10-6-64 11-5-64 4- 7-65 4-10-65 4-10-65 6- 8-65 7-13-65 8- 5-65 8-17-65	0 0 241 234 239 155 *10.5 0 0
Lac qui Parle River	Minnesota River	SE¼SW¼ sec.22, T.117 N., R.43 W., ½ mile upstream from West Fork and ½ mile east of Dawson, Minn.	-	-	4- 6-65 4-10-65 8- 4-65	72.8 2,990 *5.22
West Br. Lac qui Parle River	Lac qui Parle River	S½NE¼ sec.20, T.117 N., R.43 W., at dam in Dawson, Minn.	-	1963, 1964	10-6-64 11-6-64 6- 8-65 7-13-65 8- 4-65 8-17-65	a.01 1.79 596 45.2 6.40 *3.87
Chippewa River	Minnesota River	On line between secs.17 and 18, T.125 N., R.40 W., at highway bridge 1¼ miles north of Cyrus, Minn.	-	1963, 1964	10- 9-64 11-17-64 6- 9-65 7- 7-65 8-11-65 8-31-65	0 *.81 311 176 64.3 41.2
East Branch Chippewa River	Chippewa River	SE¼NW¼ sec.29, T.122 N., R.39 W., at county highway, 1½ miles north of Benson, Minn.	-	1964	10-12-64 11-16-64 6- 9-65 7- 7-65 8-11-65 8-31-65	*6.18 *14.1 410 84.8 52.4 44.4
SNorth Yellow Medicine River	Yellow Medicine River	Near center of line between secs.1 and 2, T.113 N., R.43 W., 3 miles above confluence with So. Br. Yellow Medicine River, and 4½ miles north of Minneota, Minn.	-	1963, 1964	10-6-64 11-5-64 6- 7-65 7-12-65 8-16-65 9- 9-65	*.25 1.61 227 6.78 *.75 *.40
Yellow Medicine River	Minnesota River	On line between secs.7 and 18, T.114 N., R.41 W., at bridge on County Highway 18, 4.3 miles west of Hanley Falls, Minn.	-	-	4-12-65	2,300
Spring Creek	Yellow Medicine River	On line between sec.36, T.115 N., R.41 W., at bridge on County Highway 3, 2 miles southeast of Hazel Run, Minn.	-	-	4-12-65	736

* Base flow.
≠ Operated as a continuous-record station.
a Estimated.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Minnesota River basin--Continued						
Minnesota River	Mississippi River	NE¼ sec.28, T.27 N., R.24 W., at bridge on U. S. Interstate Highway 35W, in Bloomington, Minn.	-	-	4-13-65	113,000
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At Hastings, Minn.	37,100	1929	4-14-65	161,500
				1931-39	4-17-65	176,100
				1945-48	4-26-65	97,400
				1950	5- 7-65	49,900
				1953-57	6-10-65	54,400
				1959-64	7-13-65	23,500
St. Croix River basin						
St. Croix River	Mississippi River	At Prescott, Wis.	7,650	1939	4-14-64	12,900
				1946-48	4-17-65	43,700
				1950	4-26-65	36,600
				1953-57	5- 7-65	12,600
				1959-64	6-10-65	12,900
					7-13-65	2,590
Vermillion River basin						
Vermillion River	Mississippi River	SE¼ sec.27, T.115 N., R.17 W., at bridge on State Highway 291, ½ mile southeast of Hastings, Minn.	-	-	4- 8-65	3,510
Cannon River basin						
Cannon River	Mississippi River	SE¼ sec.17, T.109 N., R.22 W., at Lower Sakatah Lake outlet, 2 miles west of Morristown, Minn.	-	-	8-17-65	39.8
Devil Creek	Cannon River	On line between secs.9 and 16, T.109 N., R.22 W., at County Highway 16, 2 miles northwest of Morristown, Minn.	-	-	8-17-65	1.1
Cannon River	Mississippi River	SE¼ sec.13, T.109 N., R.22 W., ½ mile west of Warsaw, Minn.	-	-	8-17-65	43.4
Mackenzie Creek	Cannon River	SW¼ sec.9, T.109 N., R.21 W., at State Highway 60, 2 miles east of Warsaw, Minn.	-	-	8-17-65	.27
Cannon River	Mississippi River	S½ sec.25, T.109 N., R.21 W., at bridge on U. S. Interstate Highway 35 in Faribault, Minn.	-	-	8-17-65	98.2
Straight River	Cannon River	NE¼ sec.30, T.110 N., R.20 W., at 14th Street in Faribault, Minn.	-	-	8-17-65	55.7
Cannon River	Mississippi River	SE¼ sec.10, T.111 N., R.20 W., at State Highway 3 at Dundas, Minn.	-	-	8-17-65	159
Heath Creek	Cannon River	SE¼ sec.2, T.111 N., R.20 W., at County Road 78 at Northfield, Minn.	-	-	8-23-65	.87
Cannon River	Mississippi River	N½ sec.30, T.112 N., R.19 W., at Waterford, Minn.	-	-	8-23-65	99.9
Chub Creek	Cannon River	NW¼ sec.8, T.112 N., R.18 W., at County Road 83 at Randolph, Minn.	-	-	8-23-65	11.8
Prairie Creek	Cannon River	On line between secs.16 and 21, T.112 N., R.18 W., ¼ mile above mouth, 2 miles southeast of Randolph, Minn.	-	-	8-23-65	12.4
Cannon River	Mississippi River	SE¼SE¼ sec.12, T.112 N., R.18 W., at upstream bridge on U. S. Highway 52 at Cannon Falls, Minn.	-	-	8-23-65	639

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Cannon River basin--Continued						
Little Cannon River	Cannon River	In sec.18, T.112 N., R.17 W., at bridge on old U. S. Highway 52 at Cannon Falls, Minn.	-	-	8-23-65	27.4
Pine Creek	Cannon River	SE¼ sec.5, T.112 N., R.17 W., at County Highway 17, 2 miles northeast of Cannon Falls, Minn.	-	-	8-24-65	4.3
Belle Creek	Cannon River	SE¼SW¼ sec.34, T.113 N., R.16 W., 1½ miles south of Welch, Minn.	-	-	8-24-65	12.9
Cannon River	Mississippi River	SW¼ sec.20, T.113 N., R.15 W., at U. S. Highway 61, 4 miles west of Red Wing, Minn.	-	-	8-24-65	210
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At Red Wing, Minn.	46,600	1929-30 1935-38	4-19-65	218,000
Mississippi River	Gulf of Mexico	At lock and dam No. 4 at Alma, Wis.	57,100	-	4-20-65 4-27-65 5- 4-65	249,000 188,000 114,000
Zumbro River basin						
South Fork Zumbro River	Zumbro River	On line between secs.2 and 11, T.106 N., R.14 W., at bridge on U. S. Highway 14 and 52 in Rochester, Minn.	-	-	4- 2-65 4- 4-65	559 2,390
Bear Creek	South Fork Zumbro River	SE¼ sec.1, T.106 N., R.14 W., at bridge on U. S. Highway 14 and 52 in Rochester, Minn.	-	-	3- 2-65 4- 4-65	74.9 929
South Fork Zumbro River	Zumbro River	SW¼ sec.35, T.106 N., R.14 W., at bridge on Center Street in Rochester, Minn.	-	-	4- 4-65	3,760
Cascade Creek	South Fork Zumbro River	N½ sec.35, T.107 N., R.14 W., at 7th Street in Rochester, Minn.	-	-	3- 2-65 4- 1-65	69.1 484
Mississippi River main stem						
Mississippi River	~~South Fork Zumbro River~~	At lock and dam No. 5 near Whitman, Minn.	58,800	1935-36 1938 1941 1945 1946	4-21-65 4-28-65	253,000 179,000
Mississippi River	~~South Fork Zumbro River~~	At LaCrosse, Wis.	62,800	1929-55≠	4-22-65 4-30-65 5- 6-65	266,000 192,000 115,000
Root River basin						
South Branch Root River	Root River	In sec.6, T.102 N., R.10 W., at bridge on St. Paul 2 SW Street in Preston, Minn.	-	-	3- 3-65 4- 2-65 4- 3-65 4- 4-65	182 530 441 1,340
South Branch Root River	Root River	In sec.13, T.103 N., R.10 W., at bridge on road to ball park in Lanesboro, Minn.	-	1915, 1939-42	4- 2-65 4- 3-65 4- 4-65	899 683 2,270
Root River	Mississippi River	SW¼NW¼ sec.21, T.104 N., R.8 W., at bridge on U. S. Highway 16, 2.8 miles west of Rushford, Minn.	1,010	1959-63	4- 3-65 4- 5-65	2,790 9,250

* Base flow.
≠ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1965

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Des Moines River basin						
West Fork Des Moines River	Des Moines River	Near center of sec.20, T.105 N., R.38 W., at outlet of Talcot Lake, 3¼ miles northeast of Dundee, Minn.	-	1963	10-8-64	*1.59
					11-6-64	*1.86
					12-4-64	*1.34
					1- 1-65	*.40
					2- 8-65	*.42
					4- 8-65	3,400
					4-17-65	1,200
					5- 6-65	315
					6- 1-65	540
					7- 9-65	119
					8-12-65	*9.65
					9-15-65	0

* Base flow.

United States Department of the Interior
Geological Survey - Water Resources Division

WATER RESOURCES DATA FOR MINNESOTA

1965

Part 2. Water-Quality Records

Prepared in cooperation with

Minnesota Department of Conservation, Division of Waters

Copies of this report may be obtained from
District Engineer, Surface Water Branch
U.S. Geological Survey
1610 Post Office Building
St. Paul, Minnesota 55101

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GPO 826-476-12

WATER RESOURCES DATA FOR MINNESOTA, 1965

Part 2. Water-Quality Records

INTRODUCTION

The quality-of-water investigations of the U.S. Geological Survey are concerned with the chemical and physical characteristics of surface- and ground-water supplies of the Nation. The basic records for the 1965 water year for quality of surface waters in Minnesota are given in this report. For convenience and interest, records for a few water-quality stations in bordering States are also given.

The Geological Survey began publishing annual basic records of chemical quality, water temperatures, and suspended sediment in 1941 in the water-supply paper series, "Quality of Surface Waters of the United States." The records prior to 1948 were published each year in a single volume for the entire country and in two volumes in 1948 and 1949. Beginning in 1950, the records were published in four volumes and beginning in 1959 in five volumes; each volume covered an area where boundaries coincided with those of certain natural drainage areas. The records for Minnesota are contained in Parts 4, 5, and 6. These publications, listed on page , are available in most major public libraries.

Distribution of this report is limited, and it is primarily for local and immediate use. The records will be published in the Geological Survey water-supply papers at 5-year intervals. The first compilation will cover only the years 1964 and 1965.

COOPERATION

The records of water quality in this report were obtained under the supervision of David B. Anderson, district engineer, Surface Water Branch, U.S. Geological Survey, St. Paul, Minnesota. Most of the records for Minnesota were obtained as a part of a cooperative program with the Minnesota Department of Conservation, Division of Waters, Sidney A. Frellsen, director. Some records, for the Red River of the North, which borders the State on the west, were obtained at the

request of other federal agencies as a part of the program of the United States Department of the Interior for development of the Missouri River basin.

DEFINITION OF TERMS AND ABBREVIATIONS

Terms and abbreviations that are used in water-quality work and that are not defined in Part 1 of this report, are as follows:

Channel (watercourse) is an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, and tributary are some of the terms used to describe natural channels. Natural channels may be single or braided. Canal and floodway are some of the terms used to describe artificial channels.

Discharge, in its simplest concept, means outflow; therefore, the use of this term is not restricted as to course or location, and can be applied to describe the flow of water from a pipe or from a drainage basin. It is also correct to speak of the discharge of a canal or stream into a lake, a stream, or an ocean.

Daily mean discharge is the mean discharge for one day.

Mean daily discharge is the arithmetic mean discharge for the same day during a specific period of years.

Mean discharge is the arithmetic mean of individual daily mean discharges during a specific period.

Instantaneous discharge (at time of sampling). If the discharge value at the time of sampling is reported instead of daily mean value, the heading of the discharge column will be "Discharge (cfs)."

Drainage basin is a part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Equivalents per million (epm) is a unit for expressing the concentration of chemical constituents in terms of the interreacting values of the electrically charged particles, or ions, in solution. One equivalent per million of a positively charged ion will react with one equivalent per million of a negatively charged ion. Parts per million is converted to equivalents per million by multiplying by the reciprocal of the combining weight of the ion.

Conversion factors: Parts per million to equivalents per million

Ion	Multiply by	Ion	Multiply by
Aluminum (Al^{+3}).....	0.11119	Hydroxide (OH^{-1})....	0.05880
Arsenic (As^{+3}).....	.04004	Iodide (I^{-1}).....	.00788
Barium (Ba^{+2}).....	.01456	Iron (Fe^{+3}).....	.05372
Beryllium (Be^{+2})....	.22192	Lead (Pb^{+2}).....	.00965
Bicarbonate (HCO_3^{-1})	.01639	Lithium (Li^{-1}).....	.14411
Bromide (Br^{-1}).....	.01251	Magnesium (Mg^{+2})....	.08226
Cadmium (Cd^{+2}).....	.01779	Manganese (Mn^{+2})....	.03640
Calcium (Ca^{+2}).....	.04990	Nickel (Ni^{+2}).....	.03406
Carbonate (CO_3^{-2})...	.03333	Nitrate (NO_3^{-1}).....	.01613
Chloride (Cl^{-1}).....	.02821	Phosphate (PO_4^{-3})...	.03159
Chromium (Cr^{+6}).....	.11539	Potassium (K^{+1}).....	.02557
Cobalt (Co^{+2}).....	.03394	Sodium (Na^{+1}).....	.04350
Copper (Cu^{+2}).....	.03148	Strontium (Sr^{+2})....	.02282
Fluoride (F^{-1}).....	.05264	Sulfate (SO_4^{-2}).....	.02082
Hydrogen (H^{+1}).....	.99209	Zinc (Zn^{+2}).....	.03060

Gage height is the water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term "stage," although gage height is more appropriate when used with a reading on a gage.

Hardness of water is the property of water attributable to the presence of alkaline earths and is expressed as equivalent calcium carbonate ($CaCO_3$). Hardness is a physical-chemical characteristic, not a substance.

Particle size is the diameter, in millimeters (mm) of suspended sediment or bed material determined by sieve and sedimentation methods.

Particle-size classification is the classification recommended by the American Geophysical Union Subcommittee on sediment terminology (Lane and others, 1947, p. 937). According to this classification, a particle having a diameter:

Less than 0.004 mm is clay.
Between 0.004 and 0.062 mm is silt.
Between 0.062 and 2.0 mm is sand.

Parts per million (ppm) is a unit for expressing the concentration of chemical constituents by weight, usually as grams of constituents per million grams of a solution. In the laboratory the results are expressed in weights of solutes in a given volume of water. To express the results in parts per million, the data must be converted. For most waters this conversion is made by assuming that a liter of water weighs 1 kilogram; and thus milligrams per liter is equivalent to parts per million. Parts per million, for suspended sediment, is computed as 1 million times the ratio of the weight of sediment to the weight of the mixture of water and sediment.

Sediment is solid material both mineral and organic that is transported by, suspended in, or deposited by water. The amount, characteristics, and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are: degree of slope, length of slope, soil characteristics, land usage, and amount and intensity of precipitation.

Sediment discharge is the rate at which dry weight of sediment passes a section of a stream or is the quantity of sediment, as measured by dry weight, or by volume, that is discharged in a given time.

Solute is any substance derived from the atmosphere, vegetation, soil, or rocks and dissolved in water.

Specific conductance is a measure of the ability of a water to conduct an electrical current and is expressed in micromhos per centimeter at 25°C. Because the specific conductance is related to the number and specific chemical types of ions in solution, it can be used for approximating the salinity of the water. The following general relations are applicable:

Specific conductance x (0.65 ± 0.05)=ppm dissolved solids;

$$\frac{\text{Specific conductance}}{100} = \frac{\text{total epm}}{2}$$

Sodium-adsorption-ratio (SAR) is the expression of relative activity of sodium ions in exchange reaction with soil and is an index of sodium or alkali hazard to the soil. This ratio should be known especially for water used for irrigating farmland.

Stage is the height of a water surface above an established datum plane; also gage height.

Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff," as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.

Thermograph is a thermometer for continuously recording variations of temperature automatically on a chart. The term "temperature recorder" is used to indicate the location of the thermograph in station descriptions in the table headings.

Tons per acre-foot indicates the dry weight of dissolved solids in 1 acre-foot of water. It is computed by multiplying the concentration in parts per million by 0.00136.

Tons per day is the quantity of a substance in solution or suspension that passes a stream section during a 24-hour period.

Water year in Geological Survey reports dealing with surface-water supply is the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1964, is called the "1964 water year."

Weighted average is used in this report to indicate discharge-weighted average. It is computed by multiplying the discharge for the sampling period by the concentrations of individual constituents for the corresponding perod and dividing the sum of the products by the sum of the discharges. A discharge-weighted average approximates the composition of water that would be found in a reservoir containing all the water passing a given location during the year after thorough mixing in the reservoir.

STATION NUMBERS

A station number has been assigned as an added means of identification for each stream location where regular measurements of streamflow and determinations of water quality have been made. The numbers have been assigned to conform with the standard downstream order of listing gaging stations. The numbering system consists of two digits followed by a hyphen and a six-digit number. The notation to the left of the hyphen identifies the Part or hydrologic region used by the Geological Survey for reporting hydrologic data. The number to the right of the hyphen represents the position of the location in the standard downstream order listing the stations within each of the parts. The assigned numbers are in numerical order but are not consecutive. They are so selected from the complete six-digit-number scale that intervening numbers will be available for future assignments to new locations. The identification number for each station in this report is printed to the left of the station name and contains only the essential digits. For example, the number is printed as 5-3165 for a station whose complete identification number is 5-3165.00.

COLLECTION AND EXAMINATION OF SAMPLES

Water samples ordinarily were obtained at or near gaging stations because water-discharge data are essential for computation and interpretation of water-quality records. Samples generally were taken by Geological Survey personnel or by personnel of cooperating agencies. The map on page shows the locations of the water-quality sampling stations.

Solutes

The methods of collecting water samples and of compositing daily samples prior to laboratory analysis are described in a manual by Rainwater and Thatcher (1960). No single method of

compositing of daily samples is applicable for all water-quality stations; the method used depends on the type of water problem being studied at the station. Generally, only samples having similar dissolved-solids content, indicated by measurements of conductivity, are included in any given composite. Samples collected monthly or less frequently are analyzed individually. The laboratory results in this report are supplemented by other information in the files such as river stage, weather conditions, and, for some stations, continuous records of conductivity or frequent measurements of chloride.

Temperature

Water temperatures were measured at most of the water-quality stations. For daily stations, the water temperatures were taken at about the same time each day in order that the data would be relatively unaffected by diurnal variations in temperature. Most large swiftly flowing streams probably have a small diurnal variation in water temperature, whereas sluggish or shallow streams may have a daily range of several degrees and may follow closely the changes in air temperature. The thermometers used for determining the water temperature were accurate to plus or minus 0.5°F.

At stations where thermographs are located, the records consist of maximum and minimum temperatures for each day and the monthly averages of maximum daily and minimum daily temperatures.

REFERENCES

The following publications are available for background information on the methods for collecting, analyzing and evaluating the chemical and physical propertes of surface waters:

Colby, B. R., and Hubbell, D. W., 1961, Simplified methods for computing total sediment discharge with the modified Einstein procedure: U.S. Geol. Survey Water-Supply Paper 1593, 17 p.

Hem, J. D., 1959, Study and interpretation of the chemical characteristics of natural water: U.S. Geol. Survey Water-Supply Paper 1473, 269 p.

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Report 13, 1961, The single stage sampler for suspended sediment: U.S. Govt. Printing Office, Washington, D.C. 20402, 105 p. 51 figs.
Report 14, 1963, Determinations of fluvial sediment discharge: U.S. Govt. Printing Office, Washington, D.C. 20402, 151 p. 70 figs.

ANNUAL SERIES OF WATER-SUPPLY PAPERS FOR QUALITY OF SURFACE WATERS

The table below lists the annual Water-Supply Papers in which records on the quality of surface waters in Minnesota are given. Records for streams in the St. Lawrence River basin (northeastern Minnesota) are given in Part 4. Those for streams in the Hudson Bay, Upper Mississippi River, and Missouri River basins are given in Parts 5 and 6.

Water-supply paper numbers and parts, water years 1941-63

Water year	Parts 1-14	Parts 1-4	Parts 3-4	Parts 5-6
1941	942	--	--	--
1942	950	--	--	--
1943	970	--	--	--
1944	1022	--	--	--
1945	1030	--	--	--
1946	1050	--	--	--
1947	1102	--	--	--
1948	--	1132	--	1132
1949	--	1162	--	1162
1950	--	1186	--	1187
1951	--	1197	--	1198
1952	--	1250	--	1251
1953	--	1290	--	1291
1954	--	1350	--	1351
1955	--	1400	--	1401
1956	--	1450	--	1451
1957	--	1520	--	1521
1958	--	1571	--	1572
1959	--	--	1642	1643
1960	--	--	a 1742	a 1743
1961	--	--	1882	1883
1962	--	--	1942	1943
1963	--	--	1948	1949

a In preparation.

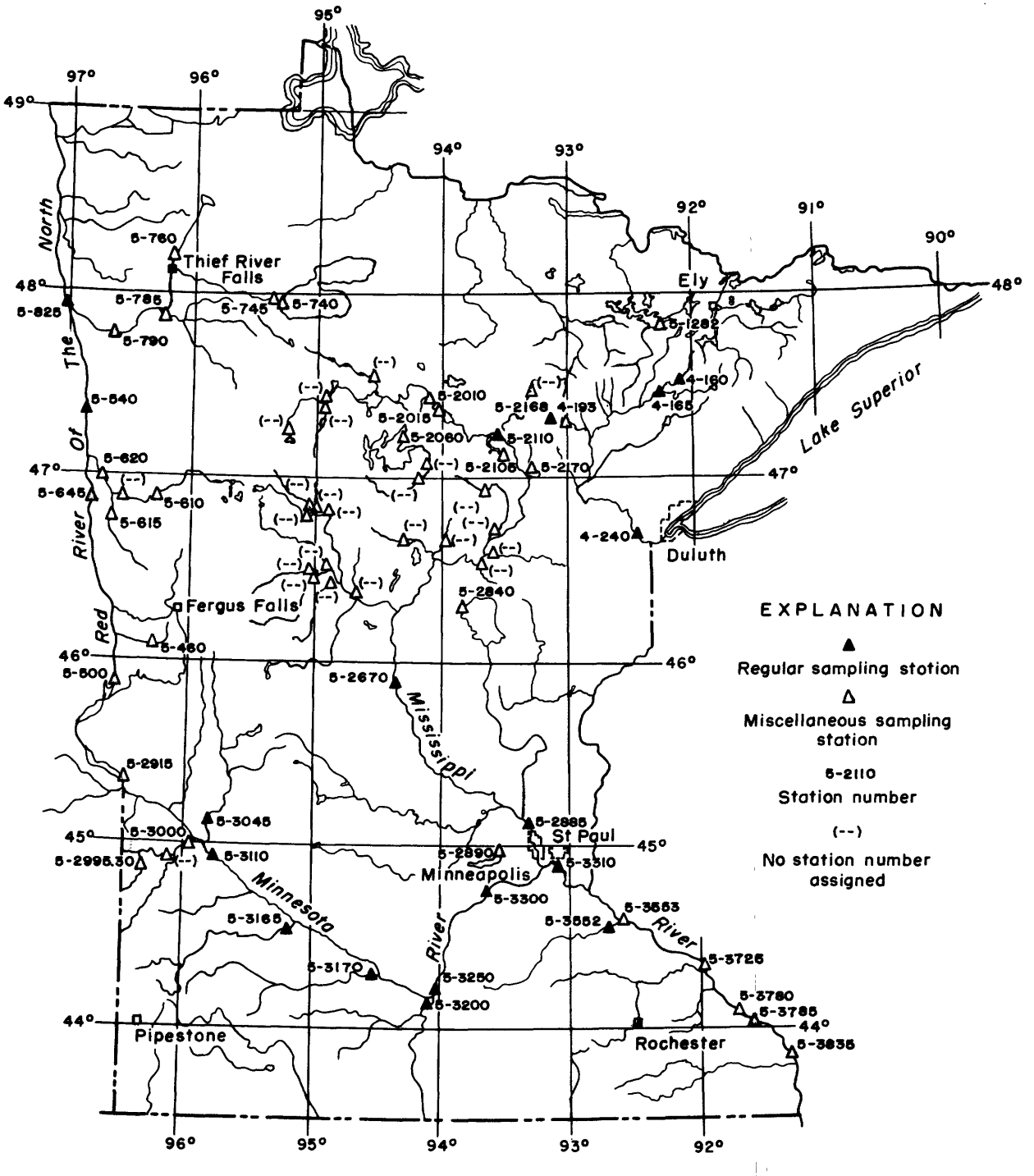

Figure 2.-- Map showing locations of water-quality stations in Minnesota, 1965 water year.

PART 4. ST. LAWRENCE RIVER BASIN

STREAMS TRIBUTARY TO LAKE SUPERIOR

4-160. PARTRIDGE RIVER NEAR AURORA, MINN.

LOCATION.--At gaging station at highway bridge, 1,000 feet downstream from Second Creek, 2.5 miles east of Aurora, St. Louis County, and 2.8 miles upstream from mouth.
DRAINAGE AREA.--156 square miles.
RECORDS AVAILABLE.--Chemical analyses: April 1956 to September 1959, July 1960 to September 1965.
Water temperatures: April 1956 to September 1959, July 1960 to September 1963.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Oct. 6, 1964.	134	11	0.0	0.72	0.07	17	12	12	2.9	53	0	55	8.8	0.4	4.8	0.25	191	90	47	0.5	236	7.1	200
Oct. 23.....	71.1	11	.2	.47	.08	22	17	20	4.8	87	0	68	13	.5	5.8	.25	242	123	52	.8	342	7.1	100
Dec. 7.....	17.5	13	1.0	.84	.19	21	17	18	4.6	96	0	54	16	.6	2.8	.07	211	121	42	.7	315	7.2	90
Jan. 18, 1965	15.0	14	.7	.51	.17	23	15	18	3.4	109	0	45	16	.6	3.4	.07	204	121	32	.7	326	7.0	110
Feb. 18.....	20.1	12	.5	.24	.12	26	17	28	5.4	134	0	48	25	.7	3.0	.09	246	136	26	1.0	417	7.3	40
Apr. 4.....	17.3	13	.4	.37	.20	26	14	17	4.2	110	0	44	18	.5	2.1	.11	217	123	33	.7	327	7.6	50
Apr. 30.....	538	6.5	.7	.35	.06	6.7	25	2.3	1.5	14	0	14	3.8	.2	3.4	.03	85	27	16	.1	75	6.3	95
June 17.....	154	5.1	--	.35	.09	11	6.7	5.6	1.8	37	0	24	5.0	.2	2.2	.05	127	55	25	.3	134	6.5	110
July 20.....	54.1	5.5	.6	.35	.12	19	12	10	2.9	71	0	45	7.2	.2	2.9	.06	169	97	39	.4	243	7.3	120
Sept. 13.....	356	11	.4	.28	.19	26	20	22	6.0	126	0	67	16	.4	3.2	.07	243	146	43	.8	398	7.9	40

4-165. ST. LOUIS RIVER NEAR AURORA, MINN.

LOCATION.--At gaging station at highway bridge, 0.8 mile downstream from Partridge River and 1.5 miles south of Aurora, St. Louis County.
DRAINAGE AREA.--312 square miles.
RECORDS AVAILABLE.--Chemical analyses: April 1956 to September 1959, July 1960 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Oct. 6, 1964.	292	7.8	0.1	0.67	0.07	9.2	6.1	4.7	1.1	34	0	20	3.6	0.3	0.9	0.10	132	48	20	0.3	111	6.4	200
Oct. 22.....	165	7.7	.1	.62	.14	12	8.5	8.1	2.3	49	0	28	6.6	.3	1.5	.12	152	65	25	.4	164	6.6	125
Dec. 4.....	59.1	13	.9	.61	.13	18	11	11	3.3	79	0	33	9.4	.4	2.5	.02	179	92	27	.5	227	7.1	90
Jan. 7, 1965.	52.4	12	.8	.61	.12	20	6.1	6.9	1.7	73	0	19	5.6	.3	2.3	.07	148	75	15	.3	181	6.8	90
Feb. 26.....	33.2	14	.6	.71	.09	16	7.1	4.6	1.7	74	0	11	4.0	.3	1.3	.02	138	69	8	.2	146	7.2	130
Apr. 30.....	898	6.0	.8	.41	.05	5.0	3.8	1.9	1.1	19	0	12	2.0	.2	2.1	.07	84	28	12	.2	68	6.5	135
June 17.....	355	3.9	--	.38	.05	5.2	6.1	3.0	1.0	27	0	16	3.0	.2	.8	.04	101	38	16	.2	85	6.5	140
July 21.....	135	5.5	.8	.39	.09	12	7.1	4.8	1.4	50	0	24	3.6	.3	1.0	.07	107	59	18	.3	139	7.2	120
Sept. 13.....	73.4	11	.6	.31	.16	19	13	13	3.7	93	0	40	8.7	.4	2.9	.02	167	100	24	.6	267	7.7	39

4-240. ST. LOUIS RIVER AT SCANLON, MINN.

LOCATION.--At gaging station at bridge on U.S. Highway 61 at Scanlon, Carlton County, 0.6 mile downstream from Minnesota Power and Light Co. powerplant, 3 miles upstream from Thomson Reservoir, and 3.2 miles upstream from Midway River.
DRAINAGE AREA.--3,430 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: July 1958 to September 1959, July 1960 to September 1965.
REMARKS.--Some spectrographic data available in district office at St. Paul, Minn.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 28, 1964	1360	7.1	0.1	0.54	0.08	22	6.8	6.8	1.5	70	0	19	12	0.2	0.2	0.26	170	83	26	0.3	191	6.7	120
Oct. 30.....	1260	7.3	.7	.52	.08	24	4.4	6.4	1.4	75	0	18	12	.4	1.0	.20	177	78	16	.3	185	6.5	170
Nov. 25.....	1190	10	.9	.40	.08	26	9.0	7.0	1.5	81	0	23	14	.3	1.7	.05	192	102	36	.3	226	7.0	90
Jan. 17, 1965	1560	9.7	.9	.50	.08	26	4.2	11	1.2	64	0	20	20	.3	.6	.13	181	82	29	.5	212	6.7	100
Feb. 26.....	1360	10	.8	.68	.06	32	5.6	6.7	1.1	94	0	21	12	.4	1.6	.04	197	103	26	.3	228	7.4	150
Apr. 9.....	855	9.9	.7	.73	.14	35	7.9	15	1.9	104	0	27	24	.3	1.6	.07	238	120	35	.6	302	7.1	160
May 28.....	5560	5.4	--	.38	.09	14	5.4	3.3	1.0	48	0	14	5.8	.4	.4	.06	129	57	18	.2	117	6.7	140
June 11.....	7590	5.6	--	.39	.07	13	4.8	4.2	.8	47	0	12	4.0	.2	.7	.06	127	52	13	.3	108	6.6	180
July 14.....	1380	17	.3	.29	.17	48	16	8.1	1.0	170	0	28	22	.2	6.8	.02	257	187	48	.3	396	7.8	20
Aug. 26.....	670	6.3	.8	.40	.11	28	6.4	9.0	1.4	73	0	22	19	.4	1.3	.15	170	96	36	.4	228	7.2	110
Sept. 30.....	2110	9.7	1.3	.58	.14	18	6.6	5.5	1.8	55	0	24	11	.3	1.7	.04	155	72	27	.3	166	7.4	130

RED RIVER OF THE NORTH BASIN

5-540. RED RIVER OF THE NORTH AT FARGO, N. DAK.

LOCATION.--At gaging station at city waterplant on 4th St. S. in Fargo, Cass County, 25 miles upstream from mouth of Sheyenne River, and at mile 453.
DRAINAGE AREA.--6,800 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1955 to September 1965.
Water temperatures: October 1955 to September 1965.
EXTREMES, 1964-65.--Dissolved solids: Maximum, 415 ppm June 1-30; minimum, 196 ppm Apr. 12.
Hardness: Maximum, 280 ppm June 1-30; minimum, 136 ppm Apr. 10-11.
Specific conductance: Maximum daily, 694 micromhos Sept. 30; minimum daily, 297 micromhos Apr. 10.
Water temperatures: Maximum, 78°F July 23, 26, 28, Aug. 15, 16; minimum, 34°F on many days during December to April.
EXTREMES, 1955-65.--Dissolved solids (1955-58, 1959-65): Maximum, 650 ppm May 6-9, 1958; minimum, 174 ppm Dec. 1-2, 1955.
Hardness: Maximum, 420 ppm May 6-9, 1958; minimum, 118 ppm Apr. 6-17, 1962.
Specific conductance: Maximum daily, 960 micromhos May 6, 1958; minimum daily, 223 micromhos Apr. 11, 1962.
Water temperatures: Maximum, 82°F on several days in 1957, 1960, and 1964; minimum, 33°F on many days in 1956 and 1959.
REMARKS.--Values reported for sodium (Na) are determined by analysis and do not include potassium (K). Daily samples for chemical analysis composited by discharge.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)			Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
															Parts per million	Tons per acre-foot	Tons per day	Calcium, Magnesium	Noncarbonate				
Oct. 1-31, 1964	236	--	--	--	--	12	--	263	0	33	--	--	--	--	270	0.37	172	236	20	0.3	469	8.1	
Nov. 1-19.....	218	--	--	--	--	10	--	264	0	29	--	--	--	--	267	.36	157	230	13	.3	456	7.9	
Nov. 20-24.....	143	--	--	--	--	10	--	270	0	32	--	--	--	--	276	.38	107	236	15	.3	471	7.9	
Nov. 25-30.....	226	--	--	--	--	11	--	286	0	32	--	--	--	--	295	.40	180	252	17	.3	498	7.9	
Dec. 1.....	209	8.6	0.01	27	37	14	4.8	215	17	38	4.5	0.3	0.2	0.09	274	.37	155	221	16	.4	444	8.3	
Dec. 2-31.....	210	--	--	--	--	11	--	299	0	30	--	--	--	--	303	.41	172	260	15	.3	514	7.7	
Jan. 1-25, 1965	195	--	--	--	--	12	--	306	0	28	--	--	--	--	308	.42	162	259	8	.3	526	7.4	
Jan. 26.....	193	16	.08	49	37	13	4.6	319	0	31	6.5	.4	.7	.05	320	.44	167	274	12	.3	538	7.7	
Jan. 27-Feb. 28	185	--	--	--	--	12	--	316	0	31	--	--	--	--	315	.43	157	277	18	.3	544	7.6	
Mar. 1-31.....	207	--	--	--	--	13	--	314	0	32	--	--	--	--	320	.44	179	276	18	.3	551	7.4	
Apr. 1-6.....	273	--	--	--	--	12	--	294	0	31	--	--	--	--	279	.38	206	255	14	.3	516	8.1	
Apr. 7-9.....	1031	--	--	--	--	9.0	--	208	0	31	--	--	--	--	241	.33	671	192	21	.3	400	7.7	
Apr. 10-11.....	4600	--	--	--	--	6.7	--	131	0	34	--	--	--	--	200	.27	2480	136	29	.3	309	7.5	
Apr. 12.....	7400	12	.20	41	8.9	5.2	6.2	130	0	32	3.0	.1	14	.04	196	.27	3920	139	32	.2	304	7.0	17
Apr. 13-18.....	9342	--	--	--	--	8.4	--	121	0	75	--	--	--	--	248	.34	6260	170	71	.3	378	7.8	
Apr. 19-21.....	4067	--	--	--	--	17	--	196	0	114	--	--	--	--	331	.45	3630	222	61	.5	506	8.0	
Apr. 22-May 31.	1842	--	--	--	--	21	--	167	0	138	--	--	--	--	400	.54	1990	276	139	.6	610	8.2	
June 1-30.....	2787	--	--	--	--	22	--	208	0	144	--	--	--	--	415	.56	3120	280	109	.6	615	7.3	
July 1-31.....	1515	--	--	--	--	21	--	224	0	120	--	--	--	--	384	.52	1570	272	88	.6	589	7.3	

5-540. RED RIVER OF THE NORTH AT FARGO, N. DAK.--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)			Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
															Parts per million	Tons per acre-foot	Tons per day	Calcium, Magnesium	Noncarbonate				
Aug. 1-31, 1965	536	--	--	--	--	15	--	240	0	63	--	--	--	--	302	0.41	437	232	35	0.4	499	7.4	
Sept. 1-30.....	508	12	--	37	40	14	4.4	245	0	75	5.5	0.1	0.1	0.08	338	.46	464	255	54	.4	521	7.8	
Weighted average....	--	--	--	--	--	17	--	197	--	103	--	--	--	--	347	0.47	932	246	85	0.4	533	7.5	
Time-weighted average....	995	--	--	--	--	15	--	253	--	67	--	--	--	--	328	--	--	257	49	0.4	532	7.5	
Tons per day.	--	--	--	--	--	45	--	528	--	277	--	--	--	--	--	--	--	--	--	--	--	--	

5-540. RED RIVER OF THE NORTH AT FARGO, N. DAK.--Continued

Specific conductance (micromhos at 25°C), water year October 1964 to September 1965

Day	October	November	December	January	February	March	April	May	June	July	August	September
1	466	464	444	507	522	538	524	642	641	590	590	432
2	462	467	558	504	528	532	521	647	650	581	605	448
3	463	448	556	509	529	532	515	652	647	582	611	471
4	467	446	523	505	529	530	504	647	661	588	533	456
5	462	447	491	509	532	532	506	651	667	595	501	456
6	452	447	494	519	533	541	488	652	668	605	473	456
7	462	454	502	521	543	539	470	648	650	625	463	453
8	486	456	503	520	543	527	405	644	669	617	472	448
9	492	454	522	520	544	536	358	644	622	610	472	458
10	485	463	510	513	548	536	297	646	611	642	475	458
11	480	449	521	506	548	536	310	652	590	555	438	461
12	481	456	521	508	547	522	304	652	586	577	462	455
13	470	461	511	511	538	527	322	604	598	659	467	455
14	458	463	506	518	539	531	367	572	610	563	474	448
15	439	465	508	522	542	525	404	563	609	569	478	441
16	436	461	502	523	538	521	435	546	598	546	479	445
17	439	461	497	526	539	529	449	539	588	550	488	437
18	441	462	495	526	535	528	473	528	585	546	501	455
19	459	462	493	528	531	525	489	526	574	548	493	453
20	473	459	485	531	538	527	486	518	565	535	479	458
21	467	468	485	541	540	519	501	526	560	531	475	497
22	480	461	487	532	540	522	528	529	559	580	467	466
23	467	482	490	527	540	522	547	531	556	530	467	484
24	454	483	517	525	541	521	550	532	556	534	455	536
25	455	483	526	529	544	521	585	502	560	536	448	538
26	460	488	534	538	543	517	613	552	563	550	475	549
27	482	488	534	536	541	509	628	595	572	542	467	556
28	489	502	520	532	538	523	639	618	577	576	461	641
29	469	509	523	532	--	541	637	656	577	652	443	684
30	455	528	516	528	--	527	643	692	579	603	441	694
31	459	--	511	530	--	521	--	663	--	603	430	--
Average	464	467	509	521	538	527	483	599	601	578	483	489

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5-540. RED RIVER OF THE NORTH AT FARGO, N. DAK.--Continued

Temperature (°F) of water, water year October 1964 to September 1965

Month	Day																														Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
October	56	55	55	54	53	52	52	50	50	49	49	49	49	49	50	51	52	51	49	48	48	48	47	47	47	47	47	46	45	45	47	50
November	49	47	48	48	47	47	49	49	46	46	46	47	47	48	48	44	42	41	39	37	36	38	36	36	36	36	36	36	36	35	--	43
December	35	35	35	35	35	35	35	34	35	35	35	36	35	35	34	35	35	35	35	35	35	35	35	35	34	34	34	34	34	34	34	35
January	34	34	34	35	35	35	34	34	35	35	34	34	34	34	34	35	35	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
February	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	--	--	--	34
March	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
April	34	34	36	36	35	34	34	35	37	42	39	39	42	42	45	44	43	45	50	49	48	52	52	52	52	54	54	52	56	54	--	44
May	56	58	57	59	60	60	62	62	60	60	60	62	62	62	60	63	63	62	61	61	62	63	61	60	61	59	57	57	58	59	58	60
June	60	60	61	61	61	63	67	66	65	65	66	67	66	68	70	70	70	70	70	70	70	70	70	70	70	70	70	69	69	70	--	67
July	70	71	70	72	73	72	74	72	72	73	72	72	72	72	73	75	75	77	77	76	76	77	78	77	77	78	77	78	77	76	75	74
August	74	75	76	76	76	75	76	75	75	75	76	76	77	77	78	78	76	76	76	75	75	75	73	72	72	71	70	67	68	66	66	74
September	65	65	64	64	64	63	62	62	63	62	62	61	60	60	59	58	57	58	57	57	57	56	55	54	57	55	52	50	50	50	--	59

5-825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.

LOCATION (revised).--At Riverside Park in Grand Forks, Grand Forks County, 1,500 feet upstream from gaging station, 2 miles downstream from Red Lake River, and at mile 296.0.
DRAINAGE AREA.--30,100 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: September 1956 to September 1965.
Water temperatures: October 1956 to September 1965.
EXTREMES, 1964-65.--Dissolved solids: Maximum, 420 ppm Oct. 7-15, Aug. 1; minimum, 220 ppm Apr. 12.
Hardness: Maximum, 310 ppm Oct. 7-15; minimum, 126 ppm Apr. 12.
Specific conductance: Maximum daily, 648 micromhos Oct. 11; minimum daily, 313 micromhos Apr. 14.
Water temperatures: Maximum, 77°F Aug. 14, 15; minimum, 33°F on many days during November to February.
EXTREMES, 1956-65.--Dissolved solids (1956-58, 1959-65): Maximum, 540 ppm Jan. 21, 1962; minimum, 199 ppm Apr. 9-16, 1962.
Hardness: Maximum, 468 ppm Dec. 29-31, 1958; minimum, 126 ppm Apr. 12, 1965.
Specific conductance: Maximum daily, 976 micromhos Dec. 29-31, 1958; minimum daily, 298 micromhos Apr. 9, 10, 1962.
Water temperatures: Maximum, 82°F July 19, 1964; minimum, 33°F on many days in 1958-59, 1964-65.
REMARKS.--Values reported for sodium (Na) are determined by analysis and do not include potassium (K). Daily samples for chemical analysis composited by discharge. Some spectrographic and radiochemical data available in district office at Lincoln, Nebr.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)			Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
															Parts per million	Tons per acre-foot	Tons per day	Calcium, Magnesium	Noncarbonate				
Oct. 1-6, 1964.	1893	--	--	--	--	14	--	197	0	97	--	--	--	--	334	0.45	1710	242	80	0.4	515	8.0	--
Oct. 7-15.....	1517	--	--	--	--	17	--	240	0	128	--	--	--	--	420	.57	1720	310	113	.4	632	8.1	--
Oct. 16-19.....	1325	--	--	--	--	15	--	246	0	112	--	--	--	--	397	.54	1420	304	102	.4	602	8.1	--
Oct. 20-25.....	1227	--	--	--	--	14	--	253	0	106	--	--	--	--	392	.53	1300	304	96	.3	600	8.1	--
Oct. 26-30.....	1638	--	--	--	--	11	--	242	0	94	--	--	--	--	362	.49	1600	284	85	.3	558	8.2	--
Oct. 31.....	1650	4.0	0.03	60	28	10	4.4	240	0	74	5.7	0.1	0.3	0.06	337	.46	1500	266	69	.3	512	7.8	20
Nov. 1-19.....	1542	--	--	--	--	12	--	248	0	68	--	--	--	--	332	.45	1380	260	57	.3	522	7.6	--
Nov. 20-26.....	721	--	--	--	--	18	--	284	0	76	--	--	--	--	370	.50	720	282	49	.5	582	7.6	--
Nov. 27-Dec. 12	864	--	--	--	--	22	--	297	0	57	--	--	--	--	348	.47	812	278	34	.6	585	7.6	--
Dec. 13.....	855	10	.01	56	26	19	4.2	254	11	45	12	.4	.1	.06	324	.44	748	248	21	.5	528	8.4	--
Dec. 14-31.....	882	--	--	--	--	19	--	282	0	43	--	--	--	--	333	.45	793	254	23	.5	540	7.5	--
Jan. 1-30, 1965	944	--	--	--	--	16	--	269	0	38	--	--	--	--	311	.42	793	240	19	.4	502	7.8	--
Jan. 31.....	980	13	.01	59	24	16	3.8	279	0	37	11	.3	.2	.05	316	.43	836	245	16	.4	509	7.5	--
Feb. 1-27.....	912	--	--	--	--	16	--	274	0	35	--	--	--	--	314	.43	773	242	17	.4	506	7.7	--
Feb. 28.....	855	13	.00	56	25	16	3.8	281	0	34	8.5	.3	1.1	.07	316	.43	729	241	10	.4	506	7.5	--
Mar. 1-Apr. 4..	950	--	--	--	--	16	--	275	0	36	--	--	--	--	319	.43	818	245	19	.4	508	7.6	--
Apr. 5-7.....	1850	--	--	--	--	18	--	257	0	44	--	--	--	--	330	.45	1650	237	26	.5	505	7.4	--
Apr. 8-9.....	7100	--	--	--	--	10	--	186	0	41	--	--	--	--	268	.36	5140	184	31	.3	404	7.5	--
Apr. 10-11.....	13650	--	--	--	--	10	--	162	0	52	--	--	--	--	264	.36	9730	179	46	.3	395	7.7	--
Apr. 12.....	25300	13	.05	41	5.7	7.2	6.2	112	0	43	5.2	.2	13	.04	220	.30	15030	126	34	.3	345	7.4	--

5-825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)			Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
															Parts per million	Tons per acre-foot	Tons per day	Calcium, Magnesium	Noncarbonate				
Apr. 13-14, 1965.....	41200	--	--	--	--	5.9	--	129	0	41	--	--	--	--	226	0.31	25140	145	39	0.2	318	7.1	--
Apr. 15-18.....	49700	--	--	--	--	7.4	--	138	0	49	--	--	--	--	236	.32	31670	156	43	.3	353	7.1	--
Apr. 19-21.....	44200	--	--	--	--	8.7	--	131	0	63	--	--	--	--	252	.34	30070	165	58	.3	372	7.0	--
Apr. 22-25.....	34480	--	--	--	--	10	--	141	0	76	--	--	--	--	276	.38	25690	177	61	.3	408	7.1	--
Apr. 26-30.....	21180	--	--	--	--	18	--	186	0	98	--	--	--	--	332	.45	18990	217	64	.5	500	7.1	--
May 1-2, 4-10..	10030	--	--	--	--	17	--	201	0	106	--	--	--	--	365	.50	9880	250	85	.5	540	7.3	--
May 3.....	11200	13	--	60	23	17	7.0	207	0	100	8.2	0.1	0.4	0.06	347	.47	10490	243	73	.5	532	7.2	20
May 11-31.....	7138	--	--	--	--	16	--	237	0	110	--	--	--	--	399	.54	7690	287	93	.4	586	7.5	--
June 1-12.....	9756	--	--	--	--	16	--	233	0	119	--	--	--	--	401	.55	10560	292	101	.4	594	7.3	--
June 13.....	11100	15	0.05	69	29	17	5.0	241	0	116	9.5	.3	1.5	.08	416	.57	12470	293	95	.4	584	7.6	--
June 14-July 18	5925	--	--	--	--	16	--	232	0	104	--	--	--	--	377	.51	6030	273	83	.4	571	7.3	--
July 19-30.....	3608	--	--	--	--	17	--	232	0	88	--	--	--	--	353	.48	3440	258	68	.5	545	7.0	--
July 31.....	2780	17	--	53	34	26	6.6	227	0	133	9.3	.2	.4	.08	412	.56	3090	273	87	.7	611	7.5	--
Aug. 1.....	2730	15	.13	61	29	22	5.4	249	0	102	10	.1	.3	.07	420	.57	3100	273	69	.6	590	7.4	--
Aug. 2-31.....	1929	--	--	--	--	21	--	233	0	76	--	--	--	--	334	.45	1740	233	42	.6	523	7.1	--
Sept. 1-30.....	1879	10	--	41	31	16	4.0	236	0	59	9.3	.0	.1	.07	310	.42	1570	232	38	.5	488	8.0	--
Weighted average.....	--	--	--	--	--	14	--	197	--	80	--	--	--	--	321	0.44	3990	225	64	0.3	483	7.2	--
Time-weighted average....	4604	--	--	--	--	16	--	245	--	71	--	--	--	--	340	--	--	253	51	0.4	529	7.4	--
Tons per day.	--	--	--	--	--	169	--	2450	--	991	--	--	--	--	--	--	--	--	--	--	--	--	--

5-825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.--Continued

Specific conductance (micromhos at 25°C), water year October 1964 to September 1965

Day	October	November	December	January	February	March	April	May	June	July	August	September
1.....	455	524	609	492	505	496	512	512	604	547	590	451
2.....	496	523	610	490	501	494	511	512	603	556	566	443
3.....	511	522	592	521	501	494	510	532	617	586	553	428
4.....	519	518	572	484	497	489	541	520	581	578	553	444
5.....	538	516	587	517	495	494	529	527	535	573	544	445
6.....	559	521	597	--	496	494	495	527	561	574	561	442
7.....	585	524	589	505	498	494	468	542	569	578	585	439
8.....	640	520	583	500	503	494	421	536	607	581	571	436
9.....	645	518	571	502	509	498	381	574	600	588	561	437
10.....	640	527	570	502	498	500	425	598	586	587	558	443
11.....	648	527	560	500	497	498	361	571	585	591	523	448
12.....	640	527	546	503	490	500	345	567	592	583	512	448
13.....	631	516	528	507	491	502	314	575	584	583	488	456
14.....	616	516	548	505	489	497	313	597	585	539	490	463
15.....	603	511	555	505	485	496	339	600	573	484	493	471
16.....	603	513	554	505	483	498	350	597	579	472	493	484
17.....	602	515	557	499	487	498	343	572	580	479	490	476
18.....	602	520	562	476	494	491	352	580	595	514	491	471
19.....	593	528	555	500	494	493	357	589	594	525	477	449
20.....	590	554	548	504	493	492	357	594	591	528	476	462
21.....	593	594	540	511	491	488	375	596	588	531	480	468
22.....	591	589	524	506	491	487	366	591	586	534	480	502
23.....	594	591	519	509	491	491	380	587	576	542	490	524
24.....	607	608	516	515	494	492	399	580	554	549	483	538
25.....	597	583	522	510	494	494	472	581	559	550	483	518
26.....	593	592	522	514	495	492	514	581	570	550	476	504
27.....	592	605	522	514	501	487	477	579	572	502	473	489
28.....	562	637	524	510	506	485	487	581	563	549	475	504
29.....	527	617	526	509	--	491	510	585	545	545	462	523
30.....	516	613	520	506	--	499	495	585	545	578	462	541
31.....	512	--	523	509	--	507	--	591	--	611	458	--
Average	580	548	552	504	495	494	429	569	579	551	509	471

5-825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.--Continued

Temperature (°F) of water, water year October 1964 to September 1965

Month	Day																														Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
October	50	50	50	50	49	49	48	47	46	45	45	46	47	48	48	50	50	49	48	48	47	48	45	44	43	43	43	43	43	43	43	47
November	44	43	45	46	45	45	45	44	44	44	45	45	44	43	42	42	42	40	36	35	35	35	35	35	35	33	34	33	33	33	--	40
December	33	33	33	33	33	33	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	33	33	33	33	33	33	33	34
January	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	34	33	34	34	34	34	34	34	34	34	34	33	33	33	33	33
February	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	34	33	33	33	33	33	33	34	34	--	--	--	33
March	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
April	34	35	34	34	35	35	35	37	37	36	34	34	34	35	36	36	36	36	36	40	38	40	42	43	44	45	45	45	45	50	--	38
May	52	52	53	54	55	56	57	57	57	57	57	57	58	60	59	59	59	58	57	58	58	58	58	58	58	58	55	54	54	55	55	57
June	56	57	58	61	59	62	65	64	64	63	65	66	67	67	68	68	69	69	69	70	69	70	69	69	69	69	69	67	67	67	--	66
July	67	68	69	71	70	71	72	73	72	72	72	72	72	72	72	73	73	74	74	75	75	75	75	75	75	75	75	75	75	75	75	73
August	75	75	74	74	74	74	74	73	73	73	73	75	75	77	77	76	75	75	72	71	71	71	70	70	70	70	68	67	65	65	65	72
September	66	66	63	63	62	61	60	60	60	59	59	58	57	56	56	56	55	54	54	54	54	52	53	53	53	50	49	49	49	47	--	56

MISSISSIPPI RIVER MAIN STEM

5-2110. MISSISSIPPI RIVER AT GRAND RAPIDS, MINN.

LOCATION.--At gaging station at bridge on State Highway 169 at Grand Rapids, Itasca County, 2.5 miles upstream from Prairie River, and at mile 1,182 upstream from Ohio River.
DRAINAGE AREA.--3,370 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: April 1964 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Oct. 9, 1964.	1150	5.9	0.2	0.07	0.02	33	13	4.7	1.9	169	0	5.8	1.8	0.2	0.2	0.02	177	138	0	0.2	272	7.7	19
Nov. 19.....	1360	7.6	.5	.03	.02	34	15	4.6	2.3	181	0	5.5	1.6	.1	.6	.01	174	147	0	.2	284	7.2	5
Dec. 30.....	1290	10	.8	.10	.08	38	18	5.9	2.3	204	0	7.8	1.6	.2	.1	.02	199	167	0	.2	326	7.4	4
Jan. 25, 1965	1220	10	.4	.05	.06	39	18	6.0	2.1	210	0	7.5	1.8	.2	.2	.03	206	172	0	.2	333	7.6	5
Mar. 4.....	1250	10	.4	.05	.01	39	17	6.3	2.2	204	0	11	2.4	.2	.2	.08	196	169	2	.2	330	7.4	5
Apr. 7.....	1320	11	.5	.00	.00	37	17	6.3	2.1	198	0	8.2	2.3	.2	.2	.07	187	161	0	.2	320	7.4	6
May 1.....	2010	5.9	.6	.22	.04	24	6.8	4.0	2.6	106	0	9.8	2.9	.2	1.9	.06	127	88	1	.2	190	7.0	45
June 8.....	1010	3.9	.6	.17	.08	29	8.9	4.0	1.0	130	0	11	1.2	.2	.5	.05	147	109	2	.2	217	7.6	38
Sept. 2.....	1720	9.5	.5	.09	.02	30	15	5.2	2.0	176	0	5.5	2.1	.1	.1	.02	166	138	0	.2	273	8.2	13
Sept. 24.....	1820	7.8	.6	.13	.04	30	15	5.1	2.0	169	0	6.5	1.6	.2	.2	.03	161	136	0	.2	268	7.9	10

5-2168. O'BRIEN CREEK NEAR PENGILLY, MINN.

LOCATION.--At gaging station, 200 feet upstream from Duluth, Missabe and Iron Range Railroad bridge, 1.0 mile upstream from mouth, and 2 miles southeast of Pengilly, Itasca County.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Nov. 6, 1964.	7.2	12	0.2	0.16	0.15	38	16	7.3	1.9	147	0	46	4.8	0.2	1.1	0.04	223	162	41	0.3	339	7.4	10
Dec. 7.....	4.3	19	.4	.10	.71	47	18	9.1	2.7	174	0	51	5.8	.5	2.8	.03	258	190	47	.3	397	7.0	5
Jan. 4, 1965.	6.2	20	.3	.08	.69	43	16	7.9	2.3	157	0	48	4.8	.3	5.4	.05	242	174	45	.3	373	7.2	5
Feb. 9.....	7.6	19	.5	.06	.70	39	16	7.8	2.1	147	0	44	4.8	.3	6.0	.03	230	162	41	.3	345	7.5	4
Mar. 10.....	8.6	19	.0	.07	.53	39	14	7.7	2.1	144	0	41	4.5	.6	6.3	.19	216	156	38	.3	332	7.6	6
May 6.....	51.7	7.2	.2	.31	.14	20	7.6	3.5	1.5	71	0	26	2.2	.3	.7	.06	130	81	23	.2	174	7.4	55
June 30.....	28.2	8.9	--	.08	.06	33	13	5.4	1.5	131	0	30	2.8	.1	.6	.05	186	134	27	.2	279	6.9	32
Aug. 24.....	7.6	7.2	.5	.05	.09	36	16	7.1	1.9	158	0	35	3.1	.3	1.3	.02	198	156	26	.2	321	8.1	30

MISSISSIPPI RIVER MAIN STEM

5-2670. MISSISSIPPI RIVER NEAR ROYALTON, MINN.

LOCATION.--At gaging station at plant of Minnesota Power and Light Co., 4 miles northwest of Royalton, Morrison County, 4.5 miles downstream from Swan River, and at mile 956 upstream from Ohio River.
DRAINAGE AREA.--11,600 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.
REMARKS.--Some spectrographic data available in district office at St. Paul, Minn.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 12, 1964	4700	7.3	0.3	0.21	0.01	35	10	4.3	1.5	149	0	9.5	2.0	0.1	1.7	0.03	180	130	8	0.2	255	7.2	48
Oct. 30.....	3420	6.7	.2	.16	.04	37	13	4.6	1.6	170	0	9.8	2.2	.3	.5	.02	184	146	7	.2	274	7.5	42
Nov. 28.....	3430	9.7	.5	.04	.01	28	3.0	1.2	.8	97	0	4.0	.6	.2	.2	.00	110	82	2	.1	165	7.1	6
Dec. 1.....	3200	14	.5	.04	.00	49	12	4.5	1.7	207	0	7.8	1.8	.2	.1	.01	209	172	2	.1	331	7.1	5
Jan. 13, 1965	3010	13	.7	.05	.28	51	14	4.7	1.3	220	0	8.0	3.2	.2	.2	.01	210	183	3	.2	351	7.7	5
Feb. 7.....	3200	12	1.9	.04	.00	51	15	4.7	1.5	225	0	8.0	2.2	.2	.1	.02	211	188	3	.1	355	7.4	5
Mar. 25.....	6140	11	.1	.02	.01	45	14	5.4	1.5	209	0	8.0	2.4	.1	.9	.03	205	172	1	.2	340	7.6	7
Apr. 24.....	26600	7.1	.2	.26	.07	22	6.1	3.0	2.4	91	0	9.0	2.4	.1	1.4	.04	120	80	5	.1	170	6.9	48
June 15.....	20900	8.5	.4	.30	.09	32	8.8	3.2	1.7	134	0	9.5	2.5	.2	1.4	.06	169	116	6	.1	223	7.5	60
July 8.....	6110	8.5	.3	.18	.03	39	11	3.6	1.1	165	0	9.8	2.0	.1	.5	.04	187	141	6	.1	272	7.3	37
Aug. 4.....	3790	8.6	.4	.05	.11	40	13	4.8	1.5	185	0	8.8	2.5	.2	.2	.04	181	154	2	.2	298	7.5	23
Sept. 1.....	3225	9.7	.2	.04	.02	36	15	4.9	1.5	184	0	7.0	1.9	.1	.5	.11	170	150	0	.2	286	7.5	20

5-2885. MISSISSIPPI RIVER NEAR ANOKA, MINN.

LOCATION (revised).--At gaging station, 0.5 mile downstream from Coon Creek, 1.5 miles downstream from hydroelectric plant at Northern States Power Co. at Coon Rapids, 6.5 miles downstream from Anoka, Hennepin County, and at mile 864.8 upstream from Ohio River.
DRAINAGE AREA.--19,100 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: August 1960 to September 1965.
Water temperatures: August 1960 to September 1963.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 13, 1964	5360	8.4	0.4	0.17	0.02	37	12	4.9	2.7	164	0	13	6.0	0.1	2.4	0.04	206	143	8	0.2	284	7.2	80
Nov. 5.....	4350	6.7	.4	.03	.00	40	13	5.7	2.1	180	0	12	3.8	.2	.3	.02	192	154	6	.2	306	7.2	20
Dec. 3.....	3270	8.1	.9	.08	.05	49	17	7.0	2.1	221	0	15	3.6	.3	.8	.02	233	192	11	.2	376	7.7	16
Jan. 12, 1965	3030	12	.6	.06	.08	47	16	6.6	2.1	216	0	12	3.6	.2	2.0	.03	216	182	5	.2	361	7.4	5
Feb. 8.....	2760	13	.6	.06	.14	48	17	6.5	1.9	221	0	12	5.0	.2	1.3	.03	226	188	7	.2	367	7.5	5
Mar. 29.....	1230	13	.4	.02	.03	47	15	6.2	1.9	214	0	11	3.9	.2	.8	.04	220	180	4	.2	358	7.6	10
Apr. 23.....	59300	8.4	.4	.14	.17	29	8.2	2.9	3.6	100	0	21	3.7	.2	6.9	.04	163	106	24	.1	227	7.2	35
June 3.....	25800	7.3	.3	.11	.02	47	15	4.8	2.6	179	0	32	4.0	.2	2.3	.05	234	178	31	.2	343	7.5	--
July 10.....	9740	11	.3	.04	.00	46	15	5.5	2.2	195	0	22	3.0	.2	1.2	.05	246	178	18	.2	351	7.4	--
Aug. 11.....	7400	9.9	.4	.02	.00	45	16	6.2	2.1	206	0	19	5.0	.2	.1	.04	214	179	10	.2	355	7.6	15
Aug. 18.....	6100	10	--	--	--	44	14	5.6	2.1	196	0	15	3.4	.1	.2	.03	198	167	6	.2	330	7.1	17
Sept. 2.....	5200	11	.2	.04	.06	42	15	5.6	1.9	193	0	15	4.0	.1	.2	.06	196	166	8	.2	330	7.4	20

5-3045. CHIPPEWA RIVER NEAR MILAN, MINN.

LOCATION.--At gaging station, 800 feet upstream from bridge on State Highway 40, 2.0 miles upstream from small tributary, and 5.5 miles east of Milan, Chippewa County.
DRAINAGE AREA.--1,870 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1961 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Oct. 7, 1964.	23.7	18	0.5	0.24	0.07	85	47	18	5.3	310	0	166	8.4	0.3	0.1	0.10	528	406	152	0.4	769	8.0	6
Nov. 19.....	31.0	13	.2	.04	.06	108	51	18	4.6	346	13	180	8.0	.3	1.6	.09	606	479	173	.4	857	8.3	5
Dec. 4.....	12.2	19	.7	.07	.25	108	56	22	4.5	389	0	197	9.6	.3	1.3	.08	640	500	181	.4	935	7.6	6
Jan. 6, 1965.	11.7	28	.4	.10	2.6	102	50	27	5.1	355	0	179	20	.4	6.7	.12	614	462	171	.5	929	7.5	6
Feb. 9.....	4.4	31	.6	.08	.88	99	55	28	5.9	358	0	197	17	.4	5.4	.14	643	474	180	.6	952	7.5	6
Mar. 24.....	2.9	23	.2	.01	.28	120	49	29	4.9	401	0	185	21	.4	5.8	.12	657	500	171	.6	962	8.0	5
Apr. 28.....	1270	13	2.9	.05	.03	62	27	7.7	5.7	200	0	108	4.9	.3	1.2	.05	350	264	100	.2	530	7.6	30
June 7.....	1810	19	.3	.10	.04	73	34	9.6	4.5	274	0	115	4.4	.2	3.5	.08	385	320	95	.2	601	7.6	23
July 14.....	521	22	.4	.02	.05	71	37	9.6	4.3	311	0	92	4.2	.2	.3	.10	409	330	75	.2	619	7.8	42
Aug. 12.....	217	26	.2	.05	.03	76	37	13	6.2	300	0	104	7.2	.3	1.1	.10	490	340	94	.3	652	7.7	25
Sept. 3.....	180	24	.3	.05	.05	72	43	13	6.6	319	0	112	5.8	.2	1.0	.06	446	356	94	.3	679	7.3	20

5-3110. MINNESOTA RIVER AT MONTEVIDEO, MINN.

LOCATION.--At gaging station at bridge on U.S. Highway 212 at Montevideo, Chippewa County, 500 feet downstream from Chippewa River.
DRAINAGE AREA.--6,180 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: November 1961 to September 1965.
Water temperatures: November 1961 to September 1963.
REMARKS.--Some spectrographic data available in district office at St. Paul, Minn.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 7, 1964.	68.8	18	0.3	0.05	0.07	90	51	29	7.8	290	0	235	13	0.3	1.1	0.17	622	436	198	0.6	883	7.3	15
Oct. 27.....	76.4	14	.1	.01	.05	96	53	33	8.0	294	0	252	17	.3	3.2	.14	690	458	217	.7	963	7.5	10
Nov. 6.....	82.8	13	.2	.04	.10	98	57	33	7.4	298	0	267	12	.3	1.3	.16	684	477	233	.7	956	7.9	5
Dec. 4.....	42.9	14	.8	.06	.06	120	71	40	9.2	372	0	326	16	.3	2.2	.18	845	591	286	.7	1180	7.6	7
Jan. 7, 1965.	45.8	18	.5	.05	.31	104	70	42	9.4	326	0	321	17	.4	5.2	.21	797	548	281	.8	1100	7.4	6
Feb. 9.....	38.6	25	1.2	.11	.76	104	73	47	9.0	318	0	336	24	.4	6.1	.22	836	561	300	.9	1140	7.0	5
Mar. 19.....	51.7	21	.2	.04	.83	141	87	58	12	439	0	418	27	.4	2.0	.2	A984	710	350	.9	1410	7.7	22
Apr. 29.....	4690	13	.1	.22	.14	57	23	9.1	6.5	156	0	116	4.8	.2	5.1	.07	337	238	110	.3	502	7.2	31
June 6.....	3810	14	.3	.15	.00	59	22	9.3	4.7	152	0	124	2.8	.2	3.8	.07	339	239	114	.3	488	7.3	20
July 13.....	2200	7.8	.2	.02	.03	85	47	23	7.6	285	0	202	7.2	.2	2.7	.16	576	407	173	.5	811	7.6	17
Aug. 13.....	594	23	.3	.09	.06	86	46	22	8.0	300	0	179	9.0	.3	6.2	.17	619	404	158	.5	800	7.5	27

A Calculated from determined constituents.

5-3165. REDWOOD RIVER NEAR REDWOOD FALLS, MINN.

LOCATION.--At gaging station at highway bridge, 3 miles west of town of Redwood Falls, Redwood County, and 8.5 miles upstream from mouth.
DRAINAGE AREA.--697 square miles.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.
REMARKS.--Values reported for dissolved solids less than 1,000 ppm are residues at 180°C, and values more than 1,000 ppm are calculated from the determined constituents unless otherwise noted.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 6, 1964.	9.3	16	0.3	0.04	0.08	123	58	44	8.0	326	0	350	22	0.3	0.8	0.20	848	546	279	0.8	1160	7.8	11
Nov. 4.....	16.1	20	.2	.06	.18	136	78	150	11	360	0	515	101	.4	1.7	.27	1190	659	364	2.5	1710	7.9	4
Dec. 2.....	3.5	28	.4	.06	.29	137	87	178	12	360	0	598	110	.3	.5	.39	1330	700	405	2.9	1870	7.8	6
Jan. 5, 1965.	2.1	29	.1	.03	.33	97	62	36	6.7	338	0	262	11	.2	1.8	.21	718	496	219	.7	997	8.0	4
Feb. 8.....	1.3	36	.5	.02	.37	90	72	34	7.8	328	0	287	6.2	.2	5.4	.21	743	521	252	.6	1050	7.9	6
Mar. 15.....	1.6	26	--	.05	.36	62	49	21	5.9	232	0	199	4.4	.1	3.0	.14	511	357	167	.5	738	7.6	3
May 1.....	329	19	--	.02	.06	134	51	26	7.5	230	0	362	13	.2	3.4	.10	796	544	355	.5	1050	7.0	10
June 7.....	318	18	.2	.04	.02	144	60	31	6.5	263	0	403	13	.3	7.6	.12	884	608	392	.5	1140	7.6	8
July 6.....	116	15	.2	.05	.02	118	41	28	5.9	233	0	328	13	.2	.2	.12	729	463	272	.6	968	7.3	11
Aug. 10.....	16.3	19	.2	.03	.09	114	63	40	7.2	256	0	351	26	.3	1.0	.16	860	542	332	.7	1090	7.8	5
Sept. 8.....	6.5	20	.3	.02	.05	110	58	36	6.4	294	0	319	14	.2	.2	.21	746	513	272	.7	1020	7.6	10

5-3170. COTTONWOOD RIVER NEAR NEW ULM, MINN.

LOCATION.--At gaging station, 600 feet upstream from highway bridge, 1.8 miles south of New Ulm, Brown County, and 2 miles upstream from mouth.
DRAINAGE AREA.--1,280 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 8, 1964.	32.5	17	0.2	0.03	0.15	106	47	32	5.6	314	0	226	19	0.3	1.7	0.14	649	459	201	0.7	935	7.4	5
Nov. 6.....	42.5	14	.2	.03	.05	100	49	31	5.0	343	0	198	14	.3	1.4	.11	615	451	170	.6	889	8.1	2
Dec. 7.....	20.0	18	.6	.09	.30	104	61	41	5.8	313	0	284	23	.3	5.9	.16	752	511	254	.8	1040	8.1	2
Jan. 8, 1965.	18.6	22	.1	.04	.42	59	45	33	2.7	215	0	185	19	.2	4.3	.17	505	334	158	.8	742	8.0	3
Feb. 11.....	12.5	21	.6	.06	.40	86	41	35	5.1	336	0	140	21	.3	4.2	.15	536	385	109	.8	822	7.8	4
Mar. 22.....	14.2	21	.1	.09	.66	79	37	45	6.1	339	0	117	30	.3	5.5	.17	528	350	72	1.0	830	7.3	5
Apr. 29.....	1230	18	.1	.05	.08	114	38	15	5.3	220	0	252	7.8	.3	13	.07	616	439	259	.3	841	7.3	24
May 31.....	1030	19	.2	.01	.06	144	50	17	3.8	301	0	308	8.0	.4	13	.08	765	564	317	.3	1020	7.7	8
July 12.....	415	23	.2	.02	.02	136	47	17	4.1	299	0	281	7.0	.4	16	.10	745	531	286	.3	974	8.2	11
Aug. 13.....	78.4	18	.1	.03	.12	88	39	22	4.5	250	0	192	13	.3	3.8	.12	608	380	175	.5	767	7.5	5
Sept. 16.....	43.0	16	.2	.04	.12	88	40	34	4.8	308	0	171	18	.2	.5	.15	544	386	133	.8	828	7.5	10

5-3200. BLUE EARTH RIVER NEAR RAPIDAN, MINN.

LOCATION.--At gaging station, 0.2 mile downstream from powerplant of Northern States Power Co., 2 miles west of Rapidan, Blue Earth County, 3.5 miles downstream from Watonwan River, and 7.8 miles upstream from Le Sueur River.
DRAINAGE AREA.--2,430 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Oct. 9, 1964.	951	25	0.3	0.05	0.03	114	38	15	3.3	361	0	133	11	0.6	19	0.08	559	442	146	0.3	824	7.6	10
Nov. 16.....	467	11	.2	.02	.03	89	43	21	3.3	304	0	156	14	.4	8.6	.10	525	397	148	.5	782	8.0	3
Dec. 9.....	347	21	.5	.03	.14	142	48	26	4.3	468	0	174	16	.5	15	.09	707	553	169	.5	1070	7.6	6
Jan. 7, 1965.	362	23	.1	.04	.27	96	45	29	3.8	350	0	160	15	.3	6.6	.11	585	426	139	.6	863	7.7	4
Feb. 10.....	14.8	25	.5	.02	.48	106	44	38	4.7	368	0	178	18	.3	10	.12	622	445	143	.8	918	8.0	4
Mar. 25.....	153	16	.1	.09	.28	76	21	18	6.1	251	0	79	11	.3	9.3	.07	430	274	68	.5	586	7.5	10
Apr. 29.....	5170	19	.1	.04	.04	79	23	6.8	3.2	234	0	80	9.2	.3	17	.04	384	290	98	.2	564	7.7	11
May 25.....	3360	18	.2	.02	.06	88	32	9.2	3.0	292	0	97	9.4	.3	15	.05	453	351	111	.2	659	7.8	9
July 13.....	1020	26	.2	.03	.03	91	30	11	3.0	302	0	83	11	.4	24	.06	529	352	104	.3	678	7.6	14
Aug. 18.....	79.0	16	.2	.01	.21	71	34	27	5.0	279	0	119	16	.3	.2	.09	438	316	87	.7	678	7.8	7
Sept. 20.....	425	20	.2	.03	.05	82	31	31	5.3	297	0	126	20	.2	3.5	.11	488	333	89	.7	736	7.8	15

5-3250. MINNESOTA RIVER AT MANKATO, MINN.

LOCATION.--At gaging station at Main Street Bridge in Mankato, Nicollet County, 1.8 miles downstream from Blue Earth River and at mile 106.4 upstream from Mississippi River.
DRAINAGE AREA.--14,900 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.
REMARKS.--Some spectrographic data available in district office at St. Paul, Minn.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
Oct. 12, 1964	1340	22	0.3	0.07	0.06	110	41	20	3.9	370	0	148	14	0.5	4.3	0.10	571	444	140	0.4	850	7.1	23
Oct. 27.....	865	12	.1	.02	.04	89	44	24	4.4	318	0	154	15	.4	5.6	.03	534	403	142	.5	802	7.4	7
Nov. 9.....	460	12	.2	.03	.08	98	45	27	4.6	345	0	173	14	.3	3.6	.00	583	430	147	.6	853	7.9	2
Dec. 8.....	294	19	.4	.04	.26	128	55	38	5.2	438	0	209	21	.4	10	.14	737	545	186	.7	1060	7.5	5
Jan. 6, 1965.	241	21	.1	.07	.50	92	55	36	4.8	362	0	195	17	.3	4.8	.15	640	457	160	.7	945	7.6	6
Feb. 10.....	301	21	.5	.06	.71	110	42	44	6.4	343	0	206	25	.4	5.6	.14	650	446	165	.9	983	7.4	6
Mar. 24.....	385	17	.1	.12	.72	84	30	24	6.1	295	0	114	14	.3	.2	.10	463	331	89	.6	704	7.1	17
Apr. 24.....	2520	14	.2	.05	.07	62	22	9.2	5.9	151	0	120	6.4	.2	10	.06	350	244	120	.3	513	7.1	28
Apr. 28.....	2240	15	.1	.06	.16	70	23	8.9	5.5	174	0	121	6.0	.2	11	.05	370	268	125	.2	541	7.2	26
May 24.....	11600	15	.2	.04	.03	97	36	14	5.1	248	0	183	7.8	.3	8.4	.09	525	389	186	.3	744	7.8	13
July 13.....	5750	17	.2	.03	.02	90	43	17	5.5	284	0	180	8.2	.3	9.0	.10	567	400	167	.4	777	7.6	20
Aug. 17.....	1220	20	.3	.02	.13	92	42	24	6.4	321	0	174	12	.3	.7	.10	548	404	141	.5	805	7.6	10
Sept. 17.....	661	20	.3	.01	.12	93	43	25	6.0	333	0	168	13	.2	1.8	.14	554	410	137	.5	824	7.4	25

5-3300. MINNESOTA RIVER NEAR CARVER, MINN.

LOCATION.--At gaging station, 2.5 miles south of Carver, Carver County, and at mile 36 upstream from Mississippi River.
DRAINAGE AREA.--16,200 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: December 1962 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 13, 1964	1600	22	0.3	0.04	0.03	124	28	20	3.7	361	0	134	16	0.5	12	0.10	553	425	129	0.4	829	7.4	25
Nov. 17.....	898	12	.2	.04	.03	87	45	29	4.3	323	0	156	21	.3	4.7	.10	542	404	139	.6	819	7.9	4
Dec. 10.....	686	18	.5	.04	.27	124	47	36	4.6	439	0	159	28	.4	10	.09	673	504	144	.7	1000	7.5	6
Jan. 11, 1965	451	22	.2	.03	.39	86	43	39	4.7	322	0	159	29	.3	8.1	.10	553	393	129	.9	859	8.0	3
Feb. 15.....	375	20	.4	.04	.71	102	45	49	5.5	373	0	164	41	.3	5.8	.16	637	441	135	1.0	1010	7.6	6
Mar. 29.....	532	17	.4	.07	.58	87	27	29	6.3	301	0	104	25	.3	10	.12	464	330	83	.7	729	8.2	10
May 8.....	16000	14	.3	.02	.04	78	24	9.4	5.1	214	0	118	7.9	.4	7.0	.05	390	294	118	.2	586	7.6	25
June 4.....	16500	17	.2	.06	.00	90	31	11	4.1	241	0	148	7.8	.3	11	.06	469	354	156	.3	678	7.3	14
July 14.....	7760	19	.4	.03	.00	78	32	13	4.6	250	0	120	8.7	.3	13	.07	433	326	121	.3	644	7.4	24
Aug. 19.....	1210	19	.2	.01	.06	94	40	27	6.4	332	0	153	19	.3	2.3	.10	546	400	128	.6	818	7.6	10
Sept. 21.....	2110	20	.3	.05	.08	90	38	24	5.9	330	0	134	16	.2	2.8	.12	525	380	109	.5	777	7.5	25

GPO 888-476-14

MISSISSIPPI RIVER MAIN STEM

5-3310. MISSISSIPPI RIVER AT ST. PAUL, MINN.

LOCATION.--Temperature recorder at gaging station, on left bank in St. Paul, Ramsey County, 300 feet upstream from Robert Street Bridge, 6 miles downstream from Minnesota River, and at mile 839.3 upstream from Ohio River.
DRAINAGE AREA.--36,800 square miles, approximately.
RECORDS AVAILABLE.--Water temperatures: October 1956 to September 1965.
EXTREMES, 1964-65.--Water temperatures: Maximum, 81°F Aug. 13-15; minimum, freezing point on many days during January and February.
EXTREMES, 1956-65.--Water temperatures: Maximum, 87°F July 24-28, 1964; minimum, freezing point on many days during winter months.
REMARKS.--Recorder stopped Apr. 12 to May 16.

Temperature (°F) of water, water year October 1964 to September 1965
(Recorder with temperature attachment, continuous ethyl alcohol-actuated thermograph)

Month	Day																														Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
October																																
Maximum	64	64	64	64	63	63	63	62	61	61	60	60	60	60	59	59	58	58	58	58	58	58	57	57	57	56	55	55	55	55	55	59
Minimum	64	64	64	63	63	63	62	61	61	60	60	60	60	59	59	58	58	58	58	58	58	57	57	57	56	55	55	55	55	55	55	59
November																																
Maximum	55	55	54	54	54	53	52	51	50	49	49	48	47	47	46	46	45	45	44	43	43	43	43	42	42	41	41	40	40	40	--	47
Minimum	55	54	54	54	53	52	51	50	49	49	48	47	47	46	46	45	45	44	43	43	43	43	42	42	41	41	40	40	40	40	--	46
December																																
Maximum	40	40	40	39	38	37	37	36	36	36	36	36	36	37	37	36	36	36	36	35	35	35	35	34	34	34	34	34	34	34	33	36
Minimum	40	40	39	38	37	37	36	36	36	36	36	36	36	36	36	36	36	36	35	35	35	35	34	34	34	34	34	34	34	33	33	36
January																																
Maximum	33	33	33	33	33	33	33	33	34	34	34	34	34	34	34	33	33	33	32	32	33	33	33	32	32	32	32	32	32	33	33	33
Minimum	33	33	33	33	33	33	33	33	33	34	34	34	34	34	33	33	33	32	32	32	32	33	32	32	32	32	32	32	32	32	33	33
February																																
Maximum	33	33	33	33	32	32	32	32	32	32	32	32	33	33	34	34	34	33	33	34	34	34	34	34	34	34	34	33	--	--	--	33
Minimum	33	33	33	32	32	32	32	32	32	32	32	32	32	33	33	34	33	33	33	33	34	34	34	34	34	34	33	33	--	--	--	33
March																																
Maximum	33	34	34	34	34	34	34	35	35	36	36	36	36	36	36	36	36	37	37	38	38	37	38	38	38	38	38	38	38	38	38	36
Minimum	33	33	34	34	34	34	34	34	35	35	36	36	36	36	36	36	36	36	37	37	37	37	37	37	37	37	38	38	37	37	37	36
April																																
Maximum	38	38	39	39	39	39	39	39	37	36	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Minimum	37	37	38	39	39	39	39	37	36	36	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
May																																
Maximum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62	63	62	62	62	62	62	62	63	64	64	64	62	62	61	--
Minimum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	61	61	61	61	61	61	61	61	62	63	64	62	62	61	61	--
June																																
Maximum	62	63	64	65	65	66	67	67	67	68	68	69	70	70	70	70	70	70	70	70	70	70	70	70	72	72	71	72	72	71	--	69
Minimum	61	62	63	64	65	65	66	66	67	67	68	68	69	70	70	70	70	70	70	70	69	69	69	69	69	69	69	69	69	68	--	68
July																																
Maximum	73	72	72	73	72	73	71	72	72	73	73	75	75	75	75	77	77	77	77	76	75	76	78	78	79	78	78	77	77	77	76	75
Minimum	68	67	68	68	68	67	68	69	70	70	71	72	72	71	74	75	77	77	76	75	74	74	76	77	78	77	77	76	76	74	74	73

5-3310. MISSISSIPPI RIVER AT ST. PAUL, MINN.--Continued

Temperature (°F) of water, water year October 1964 to September 1965--Continued
(Recorder with temperature attachment, continuous ethyl alcohol-actuated thermograph)

Month	Day																													Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
August																																
Maximum	75	74	75	76	78	78	77	76	75	76	78	78	81	81	81	80	80	80	79	78	76	73	73	73	73	72	72	71	70	67	66	76
Minimum	73	71	73	73	74	75	74	74	73	73	73	73	73	77	77	77	78	77	75	75	73	72	72	71	71	71	71	70	67	66	65	73
September																																
Maximum	66	65	65	66	66	65	64	64	64	64	65	65	64	64	63	62	62	62	62	62	61	61	60	61	60	60	59	59	58	57	--	63
Minimum	65	64	64	65	65	64	64	64	63	64	64	64	64	63	62	62	62	61	60	61	60	60	59	59	59	59	57	57	56	56	--	62

CANNON RIVER BASIN

5-3552. CANNON RIVER AT WELCH, MINN.

LOCATION.--At gaging station, 0.3 mile downstream from highway bridge at Welch, Goodhue County, and 1.8 miles upstream from Belle Creek.
DRAINAGE AREA.--1,320 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 16, 1964	111	10	0.2	0.03	0.04	66	24	11	4.3	258	0	49	14	0.3	6.2	0.09	332	264	52	0.3	535	7.4	12
Nov. 13.....	91.2	4.3	.2	.03	.03	57	26	11	3.7	247	0	45	14	.2	4.4	.04	308	248	45	.3	509	7.4	5
Dec. 11.....	131	6.6	.6	.05	.05	65	26	13	4.9	267	0	43	18	.3	7.6	.03	330	268	49	.3	563	7.5	5
Jan. 15, 1965	106	11	.5	.05	.11	89	26	17	4.3	329	0	51	20	.3	8.0	.06	394	327	57	.4	658	7.8	5
Feb. 19.....	101	13	.7	.07	.19	65	27	16	4.7	276	0	41	20	.3	12	.04	342	274	48	.4	573	7.1	5
Mar. 26.....	146	11	.0	.06	.19	59	20	8.1	4.5	224	0	34	10	.2	13	.05	302	229	45	.2	482	7.4	12
Apr. 26.....	2870	9.9	.1	.10	.12	42	13	3.7	4.5	150	0	28	6.4	.2	9.9	.04	216	158	35	.1	327	7.9	28
May 15.....	771	4.8	.1	.05	.03	56	19	5.2	4.3	215	0	37	7.4	.2	4.4	.04	278	216	40	.2	429	7.6	22
July 30.....	133	16	.4	.04	.06	66	22	6.5	3.7	256	0	38	10	.2	7.9	.03	308	254	44	.2	496	7.6	21
Aug. 27.....	120	15	.2	.05	.13	70	23	9.1	3.7	279	0	40	13	.2	4.9	.05	327	270	41	.2	532	7.4	15
Sept. 27.....	746	17	.3	.03	.09	74	22	8.6	4.4	278	0	46	13	.2	2.8	.06	352	276	48	.2	548	7.2	30

MISSISSIPPI RIVER MAIN STEM

5-3785. MISSISSIPPI RIVER AT WINONA, MINN.

LOCATION.--At gaging station at Winona pumping station in Winona, Winona County, 9.5 miles upstream from Trempealeau River and at mile 725.7 upstream from Ohio River.
DRAINAGE AREA.--59,200 square miles, approximately.
RECORDS AVAILABLE.--Chemical analyses: October 1963 to September 1965.
REMARKS.--Some spectrographic data available in district office at St. Paul, Minn.

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
Oct. 21, 1964	12000	11	0.2	0.06	0.01	39	15	7.4	2.5	158	0	30	6.9	0.2	3.1	0.10	222	159	29	0.3	333	7.1	21
Oct. 29.....	A12300	9.2	.1	.06	.04	42	15	9.7	3.0	173	0	31	8.5	.4	1.9	.06	233	166	24	.3	356	7.8	35
Nov. 18.....	20800	10	.7	.25	.09	36	11	7.0	1.9	140	0	24	6.4	.3	2.1	.04	191	137	22	.3	290	7.5	32
Dec. 8.....	11100	10	.8	.18	.08	39	13	8.3	1.9	161	0	24	7.4	.3	1.8	.05	207	153	21	.3	320	7.5	30
Jan. 13, 1965	11800	11	.6	.21	.22	40	15	11	2.0	176	0	24	11	.4	.4	.05	225	162	18	.4	352	7.3	26
Feb. 17.....	11800	13	.9	.46	.21	41	16	12	2.5	181	0	22	12	.3	4.4	.04	236	168	20	.4	366	7.2	24
Mar. 25.....	13800	12	--	.31	.26	35	12	10	2.9	148	0	19	11	.1	1.2	.07	193	135	14	.4	308	6.9	10
Apr. 21.....	25700	7.9	--	--	--	30	6.4	3.0	3.5	90	0	19	4.0	.2	11	.02	151	101	27	.1	224	6.8	21
Apr. 25.....	206000	7.8	.3	.13	.19	26	5.1	2.7	3.1	74	0	23	3.3	.2	6.6	.02	138	86	25	.1	195	6.8	25
May 13.....	86000	8.9	--	.12	.03	40	13	5.3	3.7	128	0	44	5.6	.1	4.7	.20	214	152	47	.2	321	6.9	25
June 18.....	72800	9.8	.4	.18	.11	49	14	5.8	2.8	172	0	41	5.2	.2	1.7	.05	244	179	38	.2	359	7.4	27
Aug. 4.....	A17200	12	.4	.04	.00	51	12	7.4	2.5	170	0	41	7.3	.2	3.0	.05	233	178	39	.2	365	7.5	25
Aug. 25.....	12900	11	.3	.05	.05	44	17	9.3	2.5	184	0	39	7.7	.2	1.0	.07	230	181	30	.3	379	7.4	25
Sept. 22.....	29700	8.8	.3	.03	.05	42	16	9.7	2.7	187	0	30	9.1	.2	2.0	.06	229	172	19	.3	367	7.4	15

A Daily mean discharge.

5-3785. MISSISSIPPI RIVER AT WINONA, MINN.--Continued

Periodic determinations of suspended-sediment discharge and particle size, water year October 1964 to September 1965
(Methods of analysis: B, bottom withdrawal tube; C, chemically dispersed; D, decantation; N, in native water; P, pipet; S, sieve; V, visual accumulation tube; W, in distilled water)

Date of collection	Time (24 hour)	Water temperature (°F)	Sampling point	Discharge (cfs)	Sediment concentration (ppm)	Sediment discharge (tons per day)	Suspended sediment: Percent finer than size indicated, in millimeters										Method of analysis
							0.002	0.004	0.008	0.016	0.031	0.062	0.125	0.250	0.500	1.000	2.000	
Apr. 25, 1965.....	1000	42		217000	86	50000											
Apr. 25.....	1215	40		216000	75	44000											
Apr. 25.....	1430	40		215000	69	40000						72	76	89	100			V
Apr. 25.....	1630	40		214000	82	47000											

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA

Chemical analyses, in parts per million, water year October 1964 to September 1965

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
PART 4. ST. LAWRENCE RIVER BASIN																							
STREAMS TRIBUTARY TO LAKE SUPERIOR																							
4-193. WEST SWAN RIVER NEAR SILICA, MINN.																							
Aug. 19, 1965	3.3	8.4	0.4	0.06	0.14	34	19	7.4	1.0	179	0	20	4.8	0.3	0.3	0.02	197	162	15	0.3	325	8.0	33
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS																							
RED RIVER OF THE NORTH BASIN																							
5-460. OTTER TAIL RIVER BELOW ORWELL DAM, NEAR FERGUS FALLS, MINN.																							
Aug. 21, 1965	382	13	0.3	0.02	0.09	34	26	6.9	3.3	233	0	13	3.7	0.2	0.0	0.05	226	193	2	0.2	387	7.4	15
5-500. BOIS DE SIOUX RIVER NEAR WHITE ROCK, S. DAK.																							
Oct. 9, 1964.	1.2	25	0.8	0.95	0.23	134	99	94	18	270	0	655	21	0.4	5.8	0.32	A1190	742	521	1.5	1580	7.3	30
July 8, 1965.	575	8.8	.2	.05	.19	94	53	37	9.0	239	0	311	10	.2	.7	.19	698	451	255	.8	952	7.6	24
5-610. BUFFALO RIVER NEAR HAWLEY, MINN.																							
Aug. 26, 1965	23.4	20	0.2	0.01	0.16	78	36	16	4.5	361	0	78	4.3	0.2	0.1	0.10	430	342	46	0.4	667	7.6	10
5-615. SOUTH BRANCH BUFFALO RIVER AT SABIN, MINN.																							
Aug. 26, 1965	4.5	22	0.3	0.02	0.13	54	71	23	8.2	280	0	234	5.6	0.2	0.1	0.18	585	425	195	0.5	846	7.4	30
BUFFALO RIVER NEAR GLYNDON, MINN.																							
Aug. 26, 1965	24.0	19	0.2	0.02	0.11	72	35	14	4.5	339	0	72	3.9	0.2	0.1	0.11	402	325	47	0.3	628	7.9	25

A Calculated from determined constituents.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
RED RIVER OF THE NORTH BASIN--Continued																							
5-620. BUFFALO RIVER NEAR DILWORTH, MINN.																							
Aug. 26, 1965	27.6	17	0.3	0.02	0.10	63	38	13	4.7	323	0	75	4.2	0.2	0.2	0.12	381	312	47	0.3	613	7.6	20
5-645. RED RIVER OF THE NORTH AT HALSTAD, MINN.																							
Apr. 12, 1965	19200	13		0.08	0.08	39	13	7.8	6.0	142	0	36	5.5	0.4	18	0.12	226	152	36	0.3	340	7.6	29
5-740. LOWER RED LAKE NEAR RED LAKE, MINN.																							
Apr. 19, 1965	B1874000	5.8		0.03	0.03	36	14	3.2	2.7	172	0	10	2.4	0.1	0.1	0.04	184	148	7	0.1	290	7.3	5
5-745. RED LAKE RIVER NEAR RED LAKE, MINN.																							
Oct. 5, 1964.	58.4	10	0.4	0.07	0.06	45	11	3.4	2.5	191	0	9.8	1.6	0.1	0.3	0.04	193	159	2	0.1	306	7.8	10
Jan. 22, 1965	606	8.7	2.5	.04	.08	47	16	3.7	2.7	215	0	12	4.8	.3	.2	.04	219	184	8	.1	362	7.7	5
Aug. 17.....	770	9.9	.2	.01	.04	39	14	3.1	2.5	187	0	10	1.6	.1	.3	.02	192	156	3	.1	299	7.7	5
5-760. THIEF RIVER NEAR THIEF RIVER FALLS, MINN.																							
Oct. 21, 1964	436	5.0	0.4	0.07	0.05	88	27	3.8	5.3	196	0	174	4.1	0.2	1.0	0.06	438	332	171	0.1	618	7.5	35
Jan. 21, 1965	.2	17	2.1	.13	3.1	287	103	14	11	653	0	562	7.5	.5	7.4	.04	A1340	1140	604	.2	1860	7.7	45
Apr. 29.....	1780	2.9	--	.10	.05	48	14	1.8	4.9	128	0	74	2.0	.1	.4	.04	241	178	73	.1	363	7.3	35
Aug. 18.....	23.2	3.1	.4	.05	.25	72	32	4.5	5.2	197	0	155	1.8	.2	.3	.05	415	313	151	.1	587	7.5	37

A Calculated from determined constituents.
B Lake content, in acre-feet.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
RED RIVER OF THE NORTH BASIN--Continued																							
5-785. CLEARWATER RIVER AT RED LAKE FALLS, MINN.																							
Oct. 20, 1964	155	13	0.4	0.07	0.05	74	27	8.6	3.3	319	0	46	5.0	0.3	0.1	0.06	348	297	35	0.2	558	7.9	25
Jan. 19, 1965	55.9	21	1.5	.07	.12	77	28	11	3.5	352	0	26	5.0	.3	1.2	.05	353	308	19	.3	584	7.7	6
Apr. 8.....	1850	8.2	.7	.12	.12	30	9.7	3.4	5.0	100	0	32	2.8	.3	8.1	.03	167	115	33	.1	253	6.8	45
Aug. 19.....	73.2	12	.2	.04	.07	57	23	8.5	3.5	269	0	30	4.5	.2	.2	.04	280	237	16	.2	464	7.4	16
5-790. RED LAKE RIVER AT CROOKSTON, MINN.C/																							
Oct. 20, 1964	708	6.7	0.4	0.07	0.06	76	26	5.8	4.7	221	0	125	3.3	0.2	0.3	0.06	388	298	117	0.1	568	7.3	30
Oct. 31.....	1190	5.6	.1	.02	.02	62	21	4.4	3.8	210	0	75	2.3	.3	.3	.04	311	241	69	.1	460	8.0	19
Jan. 22, 1965	642	10	.6	.07	.00	49	19	5.0	2.7	232	0	16	2.8	.3	.3	.05	238	202	12	.2	390	7.3	5
Apr. 8.....	3900	9.6	--	.08	.10	35	12	4.0	4.9	132	0	30	2.8	.1	8.5	.03	191	138	30	.1	292	7.0	30
Aug. 19.....	746	10	.3	.06	.04	44	16	11	3.7	212	0	19	4.7	.2	2.4	.03	231	176	2	.4	370	7.2	12
LAKE OF THE WOODS BASIN																							
5-1282. VERMILION LAKE NEAR SOUDAN, MINN.																							
Sept. 14, 1965.....		5.1	0.8	0.09	0.03	7.5	2.5	1.5	0.8	29	0	9.0	1.8	0.1	0.4	0.02	56	29	5	0.1	66	7.5	27
MISSISSIPPI RIVER MAIN STEM																							
MISSISSIPPI RIVER AT ITASCA STATE PARK, MINN.																							
Aug. 3, 1965.	5.7	9.4	0.2	0.01	0.06	27	19	6.8	1.7	189	0	2.0	1.1	0.1	0.2	0.01	158	144	0	0.2	281	7.9	3

C Some spectrographic data available in district office at St. Paul, Minn.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
MISSISSIPPI RIVER MAIN STEM--Continued																							
MISSISSIPPI RIVER NEAR BEMIDJI, MINN.																							
Aug. 25, 1965	57.0	9.4	0.3	0.13	0.05	53	19	5.1	0.9	268	0	3.5	1.1	0.2	0.2	0.03	234	210	0	0.2	395	7.8	10
SCHOOLCRAFT RIVER BASIN																							
SCHOOLCRAFT RIVER NEAR BEMIDJI, MINN.																							
Aug. 25, 1965	30.9	17	0.1	0.04	0.02	33	16	4.5	1.3	184	0	4.0	1.3	0.1	0.4	0.02	175	147	0	0.2	287	7.2	5
MISSISSIPPI RIVER MAIN STEM																							
5-2010. WINNIBIGOSHISH LAKE NEAR DEER RIVER, MINN.																							
Nov. 5, 1964.	B486000	6.3	0.1	0.03	0.02	34	15	4.4	1.5	182	0	4.8	1.6	0.1	0.1	0.02	175	148	0	0.2	289	7.3	3
5-2015. MISSISSIPPI RIVER AT WINNIBIGOSHISH DAM, NEAR DEER RIVER, MINN.																							
Mar. 11, 1965	68.7	7.8	0.3	0.01	0.03	39	18	5.0	2.1	215	0	4.2	1.8	0.2	0.2	0.04	203	173	0	0.2	332	7.5	10
Apr. 28.....	102	4.8	.3	.03	.03	30	12	3.9	1.7	154	0	3.8	2.1	.2	.9	.02	149	125	0	.2	249	7.3	10
June 21.....	120	6.8	--	.03	.00	36	14	4.3	1.8	180	0	4.8	1.8	.1	.6	.03	176	149	1	.2	291	7.5	3
Sept. 2.....	590	8.1	.5	.00	.03	29	15	4.1	2.0	168	0	5.2	1.3	.1	.6	.05	160	134	0	.2	257	8.2	12
TURTLE RIVER BASIN																							
NORTH TURTLE RIVER NEAR PENNINGTON, MINN.																							
Aug. 25, 1965	4.2	16	0.3	0.08	0.08	53	18	3.4	1.7	251	0	8.5	1.2	0.1	0.1	0.05	246	206	0	0.1	385	7.6	25

B Lake content, in acre-feet.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_3)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
LEECH LAKE RIVER BASIN																							
5-2060. LEECH LAKE AT FEDERAL DAM, MINN.																							
Jan. 26, 1965	B176500	12	0.4	0.01	0.06	35	17	5.1	2.1	193	0	4.5	1.5	0.1	0.3	0.03	177	157	0	0.2	306	7.4	4
Mar. 11.....	B161500	12	.3	.02	.01	36	17	5.3	2.4	204	0	5.0	1.4	.2	.3	.04	186	161	0	.2	315	7.7	5
Apr. 26.....	B201300	5.0	.3	.09	.05	28	12	4.0	1.9	148	0	3.2	.9	.1	.3	.04	144	119	0	.2	237	7.2	5
June 21.....	B372900	7.9	--	.02	.00	33	13	4.3	1.9	166	0	4.2	1.6	.2	.3	.03	164	134	0	.2	267	7.1	7
Sept. 3.....	B172400	11	.4	.01	.03	29	16	7.8	2.0	170	0	4.5	8.0	.1	.7	.03	169	137	0	.3	286	8.0	8
BOY RIVER AT LONGVILLE, MINN.																							
Aug. 3, 1965.	59.0	7.7	0.2	0.01	0.05	23	11	3.6	1.7	136	0	2.8	0.8	0.0	0.2	0.01	117	104	0	0.2	211	7.4	2
BOY RIVER NEAR REMER, MINN.																							
Aug. 12, 1965	115.5	9.4	0.3	0.11	0.04	35	10	3.7	1.3	162	0	3.5	1.3	0.1	0.2	0.04	159	129	0	0.1	253	7.3	11
MISSISSIPPI RIVER MAIN STEM																							
5-2105. POKEGAMA LAKE NEAR GRAND RAPIDS, MINN.																							
Sept. 3, 1965	B56530	8.5	0.5	0.02	0.00	32	14	3.8	2.1	164	0	7.8	1.8	0.1	0.6	0.02	161	136	1	0.1	267	7.8	8
PRAIRIE RIVER BASIN																							
PRAIRIE RIVER NEAR NASHWAUK, MINN.																							
Aug. 19, 1965	25.1	8.5	0.3	0.52	0.11	20	4.6	3.3	0.9	86	0	5.2	1.0	0.2	0.5	0.05	108	69	0	0.2	142	7.0	45

B Lake content, in acre-feet.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
SWAN RIVER BASIN																							
5-2170. SWAN RIVER NEAR WARBA, MINN.																							
Aug. 23, 1965	40.1	8.4	0.4	0.14	0.16	32	11	5.6	1.4	137	0	20	2.8	0.2	0.2	0.04	160	126	14	0.2	260	7.9	23
WILLOW RIVER BASIN																							
WILLOW RIVER NEAR HILL CITY, MINN.																							
Aug. 25, 1965	44.6	12	0.3	0.22	0.09	44	13	6.1	1.3	203	0	7.0	2.2	0.2	0.3	0.05	195	162	0	0.2	319	7.8	20
WILLOW RIVER NEAR PALISADE, MINN.																							
Aug. 26, 1965	81.9	10	0.4	0.23	0.08	45	12	5.4	1.0	201	0	7.5	2.1	0.1	0.2	0.07	207	162	0	0.2	314	7.6	35
RICE RIVER BASIN																							
RICE RIVER AT HASSMAN, MINN.																							
July 14, 1965	101	4.0	0.5	0.91	0.07	18	4.6	2.0	0.7	72	0	8.5	1.8	0.2	1.3	0.03	110	64	5	0.1	118	7.0	90
Aug. 28.....	16.5	3.0	.4	.36	.05	18	6.6	2.4	.7	80	0	9.5	1.0	.2	.7	.05	114	72	6	.1	141	7.2	55
RIPPLE RIVER BASIN																							
RIPPLE RIVER AT AITKIN, MINN.																							
Aug. 26, 1965	3.7	9.0	0.3	0.11	0.06	23	5.5	3.1	1.3	98	0	6.8	1.8	0.2	0.7	0.00	121	80	0	0.2	163	7.0	35

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
PINE RIVER BASIN																							
PINE RIVER NEAR JENKINS, MINN.																							
Aug. 11, 1965	156.4	12	0.3	0.19	0.09	35	9.1	3.3	0.9	154	0	4.8	1.4	0.2	0.3	0.00	160	125	0	0.1	242	7.4	20
LITTLE PINE RIVER NEAR CROSS LAKE, MINN.																							
Aug. 10, 1965	21.2	11	0.4	0.59	0.11	25	5.5	2.3	0.7	101	0	6.8	1.2	0.2	0.6	0.03	133	85	2	0.1	167	7.2	45
CROW WING RIVER BASIN																							
STRAIGHT RIVER NEAR HUBBARD, MINN.																							
Aug. 4, 1965.	150.2	11	0.1	0.05	0.04	41	16	4.2	1.1	209	0	4.5	2.0	0.2	0.1	0.04	188	168	0	0.1	324	7.6	5
LONG LAKE OUTLET AT HUBBARD, MINN.																							
July 21, 1965	20.4	9.4	0.1	0.05	0.02	28	15	3.6	0.9	166	0	3.5	1.8	0.1	0.1	0.05	143	130	0	0.1	258	7.7	5
SHELL RIVER NEAR HUBBARD, MINN.																							
Aug. 4, 1965.	221.3	11	0.3	0.07	0.04	39	16	4.3	1.3	203	0	5.0	2.2	0.2	0.5	0.02	186	164	0	0.1	318	7.7	5
CROW WING RIVER NEAR HUBBARD, MINN.																							
Aug. 4, 1965.	71.7	10	0.2	0.00	0.09	22	14	3.6	1.3	146	0	3.0	1.1	0.0	0.3	0.00	127	112	0	0.1	227	7.9	5
LEAF RIVER NEAR VERNDALE, MINN.																							
Aug. 12, 1965	64.7	18	0.2	0.04	0.11	63	21	5.6	1.5	283	4	10	5.2	0.2	1.0	0.03	282	244	5	0.2	460	8.3	10

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
CROW WING RIVER BASIN--Continued																							
WING RIVER NEAR VERNDALE, MINN.																							
Aug. 12, 1965	26.1	17	0.2	0.03	0.05	74	21	3.8	1.3	308	0	15	3.5	0.2	5.8	0.05	308	272	19	0.1	507	7.5	7
REDEYE RIVER NEAR ALDRICH, MINN.																							
Aug. 5, 1965.	24.7	11	0.3	0.03	0.10	60	16	6.7	1.5	267	0	6.8	3.2	0.2	0.2	0.02	248	215	0	0.2	411	7.7	10
PARTRIDGE RIVER NEAR ALDRICH, MINN.																							
Aug. 5, 1965.	6.3	6.5	0.2	0.03	0.04	66	19	6.2	2.3	288	0	13	5.2	0.2	0.9	0.03	275	242	6	0.2	465	7.7	10
MOSQUITO CREEK AT MOTLEY, MINN.																							
Aug. 11, 1965	3.0	16	0.2	0.03	0.10	59	15	5.0	1.3	259	0	6.8	1.8	0.2	0.1	0.08	245	210	0	0.2	405	7.7	6
RUM RIVER BASIN																							
5-2840. MILLE LACS LAKE AT GARRISON, MINN.																							
Dec. 23, 1964		6.7	0.6	0.21	0.37	32	11	5.6	2.3	134	0	9.5	11	0.1	0.5	0.01	161	124	14	0.2	263	7.1	7
June 15, 1965		6.8	--	.05	.00	30	7.6	3.2	1.9	123	0	6.8	2.0	.0	.5	.04	142	106	5	.1	214	6.9	17
Aug. 21.....		11	.2	.05	.07	26	8.8	3.6	2.1	124	0	8.8	1.8	.1	.0	.04	138	101	0	.2	212	7.3	10
MINNEHAHA CREEK BASIN																							
5-2890. MINNETONKA LAKE NEAR WAYZATA, MINN.																							
Feb. 8, 1965.		0.2	0.6	0.01	0.00	35	18	16	7.0	182	0	8.8	30	0.2	0.4	0.06	236	162	13	0.5	392	7.3	5
June 16.....		.7	.2	.03	.03	32	16	13	5.7	167	0	8.0	24	.1	.8	.05	204	146	9	.5	338	7.1	6
Sept. 20.....		2.0	.2	.02	.07	27	17	13	5.6	152	0	7.0	23	.1	1.0	.04	203	136	11	.5	328	7.2	10

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued																							
MINNESOTA RIVER BASIN																							
5-2915. BIG STONE LAKE AT ORTONVILLE, MINN.																							
July 9, 1965.		3.9	0.2	0.02	0.06	54	42	31	9.2	126	0	248	8.6	0.1	6.5	0.20	510	308	205	0.8	728	7.3	9
5-2995.3. CANBY CREEK NEAR CANBY, MINN.																							
Aug. 5, 1965.	2.9	18	0.4	0.24	0.85	194	72	62	8.6	290	0	612	26	0.3	0.6	0.32	A1140	781	543	1.0	1500	7.6	6
5-3000. LAC QUI PARLE RIVER NEAR LAC QUI PARLE, MINN.																							
Aug. 4, 1965.	17.1	24	0.3	0.02	0.07	136	61	41	7.4	316	0	381	12	0.3	0.1	0.22	859	589	330	0.7	1150	8.0	9
WEST BRANCH LAC QUI PARLE RIVER AT DAWSON, MINN.																							
Aug. 4, 1965.	6.4	26	0.4	0.08	0.20	130	59	47	7.2	371	0	338	8.8	0.5	1.5	0.30	875	569	265	0.9	1150	8.1	9
MISSISSIPPI RIVER MAIN STEM																							
5-3553. MISSISSIPPI RIVER AT RED WING, MINN.																							
Apr. 19, 1965	215000	8.2				30	7.6	2.8	3.8	92	0	24.	4.2	0.2	12	0.03	139	106	31	0.1	231	7.2	25
5-3725. MISSISSIPPI RIVER AT ALMA, WIS.																							
Apr. 20, 1965	249000	6.7				8.2	1.8	1.3	2.0	24	0	8.2	1.8	0.1	2.8	0.03	63	28	8	0.1	73	6.4	30

A Calculated from determined constituents.

Chemical analyses, in parts per million, water year October 1964 to September 1965--Continued

Date of collection	Discharge (cfs)	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH	Color
																		Calcium, magnesium	Noncarbonate				

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

MISSISSIPPI RIVER MAIN STEM--Continued

5-3780. MISSISSIPPI RIVER NEAR FOUNTAIN CITY, WIS.

Apr. 21, 1965	253000	8.5				27	6.5	2.6	3.4	84	0	19	4.2	0.2	10	0.02	141	94	25	0.1	209	6.7	22

5-3835. MISSISSIPPI RIVER AT LA CROSSE, WIS.

Apr. 22, 1965	266000	7.8				26	6.8	2.6	3.4	83	0	19	3.7	0.2	8.2	0.02	136	93	25	0.1	205	6.7	20
Apr. 23.....	266000	7.9	0.3	0.16	0.09	23	7.0	2.5	3.1	75	0	20	3.7	.2	9.2	.02	127	86	24	.1	190	6.7	25

Periodic determinations of suspended-sediment discharge and particle size, water year October 1964 to September 1965
(Methods of analysis: B, bottom withdrawal tube; C, chemically dispersed; D, decantation; N, in native water; P, pipet; S, sieve; V, visual accumulation tube; W, in distilled water)

Date of collection	Time (24 hour)	Water temperature (°F)	Sampling point	Discharge (cfs)	Sediment concentration (ppm)	Sediment discharge (tons per day)	Suspended sediment: Percent finer than size indicated, in millimeters											Method of analysis
							0.002	0.004	0.008	0.016	0.031	0.062	0.125	0.250	0.500	1.000	2.000	
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS																		
MISSISSIPPI RIVER MAIN STEM																		
5-3835. MISSISSIPPI RIVER AT LA CROSSE, WIS.																		
Apr. 24, 1965.....	1115	43		259000	95	66000												
Apr. 24.....	1400	43		259000	66	46000												
Apr. 24.....	1600	43		258000	44	31000						86	89	92	96	100		V
Apr. 24.....	1800	43		258000	50	35000												

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