

1967

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, Soils and Minerals; 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

1967

Part 1: Surface Water Records

Prepared in cooperation with

Minnesota Department of Conservation, Division of
Waters, Soils and Minerals
Through the Division of Waters, Soils and Minerals
Nine Mile Creek Watershed District
City of Austin
City of Rochester
Erie Mining Company
Eveleth Taconite Company
Hanna Mining Company
Pickands Mather and Company
Minnesota Department of Highways
Corps of Engineers, U. S. Army
U. S. Department of State
U. S. Department of Interior
Federal Water Pollution Control Administration
Bureau of Sport Fisheries and Wildlife

Copies of this report may be obtained from
District Chief, Water Resources Division
U. S. Geological Survey
1002 Post Office Building
St. Paul, Minnesota 55101

1968

CALENDAR FOR WATER YEAR 1967

OCTOBER 1966

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JANUARY 1967

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AUGUST 1967

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SEPTEMBER 1967

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WATER RESOURCES DATA FOR MINNESOTA, 1967

Part 1. Surface Water Records

INTRODUCTION

The surface-water records for the 1967 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 C. R. Collier, district chief.

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, Soils and Minerals, Eugene R. Gere,
Director.

Minnesota Department of Highways, N. T. Waldor,
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.

Hydrologic bench-mark station is one that provides hydrologic data for a basin in which the hydrologic regimes will likely be governed solely by natural conditions. Data

collected at a bench-mark station may be used to separate effects of natural from manmade changes in other basins which have been developed and in which the physiography, climate, and geology are similar to those in the underdeveloped bench-mark basin.

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.

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.

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.

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."

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 indentation in the listing of gaging stations in the table of contents of this report represents one rank. This downstream order and system of indentation 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.

EXPLANATION OF DATA

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 non-recording 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 1967 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 available. 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 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. The maximum day and the minimum day for each month are shown in the line with the respective headings. 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 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.

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.

For most gaging stations equipped with digital recorders the figures of mean daily discharge are shown to the nearest hundredth of a cfs for discharges less than 1 cfs. This has been done as a matter of uniformity in the computer program and should not be construed to indicate an accuracy greater than that used in the past.

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.

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

STREAMS TRIBUTARY TO LAKE SUPERIOR

4-0105. Pigeon River at Middle Falls, near Grand Portage, 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, 2½ miles upstream from Grand Portage Port of Entry, 3½ miles upstream from mouth, and 4.7 miles northeast of village of Grand Portage.

Drainage area.--600 sq mi.

Records available.--June to October 1921, April to November 1922, March 1923 to September 1967. Published as "at International Bridge" April 1924 to September 1940; as "below International Bridge" October 1940 to September 1965. 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, 5¼ miles upstream at datum 100.24 ft higher.

Average discharge.--44 years (1923-67), 483 cfs.

Extremes.--Maximum discharge during year, 3,990 cfs Apr. 17 (gage height, 7.06 ft); minimum, 59 cfs Sept. 13, 30; minimum gage height, 0.36 ft Sept. 13.
1923-67: 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 winter months, which are fair.

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

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	102	120	90	108	74	78	230	2,150	682	487	255	90
2	104	95	90	105	74	78	360	2,610	648	484	319	86
3	114	90	88	105	74	80	530	2,300	586	471	436	85
4	126	100	88	102	72	80	680	1,950	558	446	524	80
5	136	125	94	100	72	80	710	1,690	534	418	520	76
6	132	130	120	100	72	80	725	1,560	527	390	436	75
7	121	125	140	97	72	80	690	1,510	568	357	390	72
8	112	123	140	95	72	78	710	1,580	686	331	357	69
9	109	119	135	93	70	78	1,000	1,580	971	319	340	68
10	106	125	132	93	70	76	1,300	1,510	928	325	325	64
11	106	120	130	91	70	74	1,220	1,410	843	299	305	62
12	102	95	130	88	70	74	1,160	1,320	971	294	288	60
13	102	100	132	84	70	71	1,080	1,240	1,170	282	274	60
14	102	110	132	80	70	69	1,590	1,190	1,170	274	263	75
15	132	110	132	76	70	66	2,620	1,160	1,230	258	252	89
16	165	110	135	74	70	66	2,870	1,100	1,210	247	244	96
17	165	107	135	71	70	66	3,490	938	1,040	250	250	98
18	152	100	138	69	72	64	3,740	772	892	260	252	96
19	159	90	140	68	72	64	3,220	772	806	255	258	92
20	165	92	143	68	74	64	2,560	971	1,270	244	247	86
21	174	93	145	69	74	64	2,250	976	1,240	239	231	86
22	161	94	135	70	76	65	2,140	928	1,060	266	224	83
23	239	96	128	72	76	66	1,910	910	874	291	211	78
24	239	98	122	74	76	66	1,630	900	768	328	189	76
25	214	98	120	76	76	67	1,440	882	689	343	150	72
26	196	98	118	76	76	69	1,300	864	626	328	140	69
27	186	96	113	76	76	72	1,200	838	568	308	130	69
28	174	94	110	76	78	75	1,130	809	500	285	116	66
29	163	92	110	76	78	78	1,280	780	465	280	107	61
30	159	90	110	76	85	85	1,700	744	481	274	102	61
31	152	-----	108	74	-----	110	-----	709	-----	258	99	-----
Total	4,569	3,135	3,783	2,582	2,038	2,283	46,465	38,653	24,561	9,891	8,234	2,300
Mean	147	104	122	83.3	72.8	73.6	1,549	1,247	819	319	266	76.7
Max	239	130	145	108	78	110	3,740	2,610	1,270	487	524	98
Min	102	90	88	68	70	64	230	709	465	239	99	60
Cfsm	0.245	0.173	0.203	0.139	0.121	0.123	2.58	2.08	1.36	0.532	0.443	0.128
In.	0.28	0.19	0.23	0.16	0.13	0.14	2.88	2.40	1.52	0.61	0.51	0.14
Cal yr 1966: Total	207,850	Mean	569	Max	4,030	Min	88	Cfsm	0.948	In.	12.88	
Wtr yr 1967: Total	148,494	Mean	407	Max	3,740	Min	60	Cfsm	0.678	In.	9.20	

Peak discharge (base, 3,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-17	1830	7.06	3,990				

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

Location.--Lat 47°20'15", long 91°12'00", in SE $\frac{1}{4}$ NE $\frac{1}{4}$ 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 1967. 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.--40 years, 159 cfs.

Extremes.--Maximum discharge during year, 2,220 cfs Apr. 17 (gage height, 4.88 ft); minimum, 10 cfs Sept. 10, 11 (gage height, 1.89 ft).
1927-67: 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, 11.06 ft Apr. 12, 1965 (from floodmark, backwater from ice); minimum daily discharge, 0.4 cfs Jan. 5, 6, 1940.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	18	60	40	20	16	11	340	706	106	208	76	22
2	18	51	39	20	15	12	290	829	98	176	82	20
3	27	52	39	20	15	13	220	630	86	155	78	18
4	30	55	40	19	15	13	270	487	80	138	76	17
5	25	51	41	19	15	13	385	385	76	119	71	16
6	21	49	41	19	14	13	259	333	100	100	64	15
7	19	48	40	20	14	13	238	333	216	86	88	13
8	18	45	38	20	14	13	358	385	519	82	110	12
9	18	42	36	20	13	14	867	376	592	74	106	11
10	17	43	32	20	13	14	791	349	421	65	93	10
11	17	39	30	20	13	15	668	333	582	74	77	12
12	17	38	29	20	13	15	563	312	810	115	65	14
13	17	38	28	19	13	16	544	277	896	113	53	20
14	30	40	28	18	13	16	744	259	848	85	46	195
15	85	40	28	18	13	16	1,210	243	1,250	68	41	216
16	90	39	27	18	13	16	1,130	216	1,220	83	51	192
17	75	37	26	18	12	16	1,980	200	848	102	98	158
18	92	35	26	18	12	16	1,760	192	563	149	76	126
19	119	34	26	18	12	16	1,110	188	715	108	54	97
20	117	37	26	18	12	16	791	184	1,330	88	45	80
21	121	41	26	17	12	17	648	173	1,010	72	39	74
22	155	38	26	17	12	18	582	164	686	82	34	65
23	170	46	24	17	12	19	458	176	478	136	30	55
24	161	47	24	17	12	20	367	184	340	161	27	47
25	128	47	23	16	12	24	312	176	270	155	26	42
26	110	46	22	16	11	34	265	170	208	141	40	39
27	100	45	21	16	11	37	248	164	180	134	44	34
28	90	43	20	16	12	51	238	155	161	104	38	31
29	83	41	20	16	11	56	358	146	158	95	33	30
30	74	40	20	15	- - - - -	67	440	131	248	86	28	29
31	70	- - - - -	20	15	- - - - -	320	- - - - -	119	- - - - -	77	24	- - - - -
Total	2,132	1,307	906	560	364	950	18,434	8,975	15,095	3,431	1,813	1,710
Mean	68.8	43.6	29.2	18.1	13.0	30.6	614	290	503	111	58.5	57.0
Max	170	60	41	20	16	320	1,980	829	1,330	208	110	216
Min	17	34	20	15	11	11	220	119	76	65	24	10
Cfsm	0.491	0.311	0.209	0.129	0.093	0.219	4.39	2.07	3.59	0.793	0.418	0.407
In.	0.57	0.35	0.24	0.15	0.10	0.25	4.90	2.38	4.01	0.91	0.48	0.45

Cal yr1966: Total 69,273 Mean 190 Max 2,120 Min 16 Cfsm 1.36 In. 18.40
Wtr yr1967: Total 55,677 Mean 153 Max 1,980 Min 10 Cfsm 1.09 In. 14.79

Peak discharge (base, 1,300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-17	1230	4.88	2,220	6-20	0530	4.43	1,480
5-15	1430	4.53	1,640				

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 1967.

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.--12 years, 18.3 cfs.

Extremes.--Maximum discharge during year, 118 cfs Apr. 1 (gage height, 5.16 ft, backwater from ice); minimum daily discharge, 7.5 cfs Jan. 20; minimum gage height, 3.48 ft Sept. 11.
1955-67: 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 winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	12	13	8.7	8.6	7.8	8.2	108	54	14	25	17	12
2	13	13	8.4	8.6	7.8	8.2	78	53	13	23	18	12
3	19	13	9.0	8.6	7.8	8.2	63	44	12	20	20	11
4	28	12	9.5	8.6	7.8	8.2	45	37	12	19	18	10
5	30	11	10	8.4	7.8	8.2	44	32	13	18	17	9.8
6	25	11	10	8.4	7.8	8.2	43	28	18	16	20	9.8
7	24	12	10	8.4	7.8	8.2	39	28	24	16	25	10
8	21	13	10	8.4	7.8	8.2	39	32	28	16	28	9.8
9	19	13	10	8.2	7.8	8.2	54	30	30	16	25	9.0
10	17	12	9.8	8.2	7.8	8.4	47	27	27	15	22	9.0
11	16	12	9.8	8.0	7.8	8.6	39	30	26	24	20	8.7
12	14	11	9.8	8.0	7.8	8.6	35	29	26	24	19	8.7
13	13	10	9.8	8.0	7.9	8.6	35	27	27	22	20	12
14	15	9.8	10	8.0	7.9	8.6	42	26	49	19	19	14
15	26	9.4	10	7.8	7.9	8.6	44	24	66	17	18	15
16	24	10	10	7.8	7.9	8.6	42	23	68	19	17	15
17	22	11	10	7.8	7.9	8.6	77	20	57	24	16	14
18	21	10	10	7.6	7.9	8.6	84	21	42	24	16	12
19	19	11	10	7.6	7.9	8.6	77	20	36	22	15	12
20	19	11	9.6	7.5	7.9	9.0	68	20	41	21	15	15
21	17	11	9.5	7.6	8.0	9.0	62	20	41	20	14	18
22	16	14	9.4	7.6	8.0	9.0	51	19	36	23	14	17
23	17	15	9.2	7.6	8.0	9.4	43	20	30	24	13	16
24	16	15	9.2	7.6	8.1	11	36	20	25	24	13	16
25	16	16	9.0	7.6	8.1	18	31	20	24	23	13	14
26	15	16	8.8	7.6	8.1	28	30	19	22	21	14	13
27	14	16	8.8	7.6	8.1	38	27	19	27	20	14	13
28	14	16	8.8	7.6	8.2	46	27	18	31	19	14	12
29	13	15	8.8	7.6	-----	58	39	17	27	18	13	12
30	14	13	8.8	7.6	-----	79	45	16	27	17	13	13
31	13	-----	8.8	7.8	-----	84	-----	16	-----	17	12	-----
Total	562	375.2	293.5	246.3	221.4	558.0	1494	809	919	626	532	372.8
Mean	18.1	12.5	9.47	7.95	7.91	18.0	49.8	26.1	30.6	20.2	17.2	12.4
Max	30	16	10	8.6	8.2	84	108	54	68	25	28	18
Min	12	9.4	8.4	7.5	7.8	8.2	27	16	12	15	12	8.7
Cfsm	0.688	0.475	0.360	0.302	0.301	0.684	1.89	0.992	1.16	0.768	0.654	0.471
In.	0.79	0.53	0.42	0.35	0.31	0.79	2.11	1.14	1.30	0.89	0.75	0.53

Cal yr 1966: Total 9,056.4 Mean 24.8 Max 113 Min 6.6 Cfsm 0.943 In. 12.81
Wtr yr 1967: Total 7,009.2 Mean 19.2 Max 108 Min 7.5 Cfsm 0.730 In. 9.91

Peak discharge (base, 60 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4- 1	1100	5.16	118	6-15	1600	4.46	76
4-18	1800	4.55	86				

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 1967.

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.--25 years, 121 cfs (adjusted for storage and diversion).

Extremes.--Maximum discharge during year, 535 cfs Apr. 23 (gage height, 4.31 ft); minimum, 15 cfs Feb. 23 (gage height, 1.57 ft).
1942-67: 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 the winter months, which are fair. 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 (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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	22	48	33	24	20	17	203	324	63	109	96	30
2	22	50	33	24	21	17	166	356	55	101	92	29
3	29	48	32	24	21	17	117	379	54	94	88	28
4	40	48	31	24	20	17	101	396	53	89	79	26
5	41	47	31	24	20	17	96	372	52	84	71	26
6	41	45	31	23	21	17	90	337	61	76	76	25
7	45	45	30	22	20	17	85	302	72	69	88	24
8	49	45	29	22	20	17	83	289	83	66	97	23
9	52	44	29	23	20	17	112	278	92	59	104	21
10	52	44	28	23	20	17	101	275	97	54	98	20
11	52	42	28	23	20	18	93	266	94	65	92	20
12	52	39	27	24	20	19	84	255	94	70	90	20
13	47	38	27	22	20	20	80	238	101	89	87	24
14	55	37	27	22	20	20	90	225	155	98	78	26
15	65	36	27	22	19	20	89	210	190	97	65	25
16	61	36	27	22	19	20	94	196	203	96	57	25
17	63	35	27	22	19	19	146	179	222	96	52	24
18	63	34	27	21	18	19	150	168	236	96	45	23
19	58	33	28	20	17	19	179	150	280	87	40	23
20	59	33	28	20	16	20	252	141	305	80	36	27
21	60	33	27	21	16	21	324	130	305	74	35	31
22	58	35	27	21	16	22	465	120	286	78	36	29
23	56	35	27	21	16	24	525	112	264	83	38	29
24	56	36	27	21	17	25	490	108	230	102	40	28
25	55	37	26	22	17	29	455	106	196	125	40	27
26	53	36	25	22	17	36	337	102	172	114	39	26
27	57	36	25	21	17	51	280	99	159	123	38	26
28	55	35	25	20	17	73	250	96	146	114	36	26
29	50	35	25	20		101	258	89	126	105	34	26
30	52	34	25	20		151	272	80	118	99	32	27
31	48		25	21		215		73		98	31	
Total	1,568	1,179	864	681	524	1,112	6,067	6,451	4,564	2,790	1,930	764
Mean	50.6	39.3	27.9	22.0	18.7	35.9	202	208	152	90.0	62.3	25.5
(Δ)	+15.9	+0.25	-0.02	-0.06	0	+1.28	+161	+24.0	+42.2	+22.9	+15.4	+0.9
Mean	66.5	39.6	27.9	21.9	18.7	37.2	363	232	194	113	77.7	25.6
Max	65	50	33	24	21	215	525	396	305	125	104	31
Min	22	33	25	20	16	17	80	73	52	54	31	20
Cfsm	0.426	0.254	0.179	0.140	0.120	0.238	2.33	1.49	1.24	0.724	0.498	0.164
In.	0.49	0.28	0.21	0.16	0.12	0.27	2.60	1.72	1.39	0.83	0.57	0.18

Calendar year 1966: Max 1,350 Min 22 Mean 135 Mean Δ 149 Cfsm Δ 0.955 In. Δ 12.89
Water year 1966-67: Max 525 Min 16 Mean 78.1 Mean Δ 102 Cfsm Δ 0.654 In. Δ 8.82

Δ Change in contents in Partridge Reservoir and diversion to iron-ore processing plant, equivalent in cubic feet per second; furnished by Erie Mining Co.

Δ Adjusted for change in contents and diversion.

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 1967.

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.--25 years, 234 cfs (adjusted for storage and diversion).

Extremes.--Maximum discharge during year, 909 cfs Apr. 23 (gage height, 3.48 ft); minimum daily, 17 cfs Feb. 24 to Mar. 10; minimum gage height, 0.94 ft Oct. 1, 2.

1942-67: 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 winter months, which are fair. 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	47	145	91	58	29	17	410	690	158	265	208	64
2	46	140	86	58	29	17	385	729	147	251	205	60
3	63	135	82	56	28	17	335	734	139	232	205	58
4	78	135	80	56	28	17	300	719	132	216	191	56
5	75	134	79	54	28	17	265	685	124	202	176	56
6	71	132	79	54	27	17	235	623	132	181	191	56
7	76	132	78	53	26	17	222	594	154	171	208	56
8	82	130	78	52	26	17	213	589	162	169	210	54
9	86	126	74	52	25	17	296	570	176	156	222	49
10	88	122	72	50	25	17	304	556	181	143	208	46
11	86	116	70	50	25	18	311	537	178	145	188	45
12	88	110	70	49	24	18	300	518	176	141	178	44
13	84	108	68	48	24	18	300	496	199	162	169	47
14	99	100	67	47	23	18	333	473	300	174	158	52
15	117	98	66	46	23	18	344	440	378	171	145	51
16	114	96	66	44	22	19	355	416	428	169	135	49
17	116	94	65	42	21	19	518	389	448	166	126	47
18	128	93	64	40	21	20	613	363	440	164	116	46
19	130	91	64	38	20	20	666	329	465	158	107	45
20	134	90	64	37	19	21	714	314	518	151	101	50
21	141	90	64	35	18	24	779	289	537	145	94	57
22	143	90	64	34	18	27	860	279	518	166	91	54
23	143	92	64	33	18	31	898	265	482	188	91	54
24	145	94	64	32	17	36	843	255	444	248	91	53
25	147	96	64	31	17	46	753	245	401	279	91	52
26	149	101	62	31	17	54	685	235	374	262	88	51
27	154	104	62	31	17	70	623	232	348	262	84	49
28	158	114	61	30	17	84	575	216	322	251	79	48
29	154	109	60	30		104	584	205	293	235	75	47
30	156	102	60	30	-----	190	599	188	282	222	71	47
31	151	-----	59	30	-----	320	-----	174	-----	213	68	-----
Total	3,449	3,319	2,147	1,331	632	1,345	14,618	13,347	9,036	6,058	4,370	1,543
Mean	111	111	69.3	42.9	22.6	43.4	487	431	301	195	141	51.4
(%)	+15.9	+0.25	-.02	-.06	0	+1.28	+161	+24.0	+42.2	+22.9	+15.4	+0.9
Mean #	127	111	69.3	42.8	22.6	44.7	648	455	343	218	156	51.5
Max	158	145	91	58	29	320	898	734	537	279	222	64
Min	46	90	59	30	17	17	213	174	124	141	68	44
Cfsm #	0.407	0.356	0.222	0.138	0.072	0.143	2.08	1.46	1.10	0.699	0.500	0.165
In. #	0.47	0.40	0.26	0.16	0.08	0.17	2.32	1.68	1.23	0.81	0.58	0.18

Calendar year 1966: Max 2,060 Min 44 Mean 280 Mean # 294 Cfsm # 0.942 In. # 12.79
 Water year 1966-67: Max 898 Min 17 Mean 168 Mean # 192 Cfsm # 0.615 In. # 8.35

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.

4-0187.5 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 1967.

Gage.--Digital 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 and Oct. 28, 1964 to Sept. 1, 1967, graphic water-stage recorder at same site and datum.

Extremes.--Maximum discharge during year, 2,540 cfs Apr. 3 (gage height 13.10 ft, from floodmark, backwater from ice); minimum, 24 cfs Nov. 26 (gage height 5.23 ft).
1964-67: Maximum discharge, 4,140 cfs Apr. 23, 1966 (gage height 14.60 ft); minimum, that of Nov. 26, 1966.

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 winter months, which are fair. There is some regulation at medium and low flows and diversion for iron-ore processing at Eveleth Taconite Company dam ½ mile upstream. Diversion began Dec. 5, 1965.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	80	282	200	140	98	78	1,900	1,630	387	600	285	136
2	98	347	180	125	98	76	2,200	1,710	380	546	314	122
3	115	407	165	130	96	76	2,460	1,690	354	504	314	115
4	155	350	180	130	96	76	2,100	1,650	330	462	278	102
5	184	311	165	130	94	76	1,810	1,590	304	431	294	68
6	175	291	155	130	92	77	1,680	1,520	262	404	291	96
7	161	228	170	125	92	78	1,220	1,430	340	320	344	96
8	158	256	170	125	92	76	1,020	1,380	370	377	354	91
9	166	250	165	120	90	75	1,170	1,320	466	373	347	108
10	184	246	150	120	90	74	1,280	1,310	456	337	307	106
11	181	235	165	120	88	50	1,210	1,260	373	285	324	102
12	175	225	150	120	86	36	1,180	1,200	438	294	304	100
13	172	230	170	115	83	120	1,130	1,180	515	282	291	109
14	190	231	165	115	82	80	1,180	1,140	854	291	259	121
15	207	225	165	110	81	73	1,250	1,080	1,080	294	237	126
16	246	216	145	110	80	75	1,230	968	1,220	307	250	114
17	246	213	150	110	80	73	1,440	934	1,210	275	207	107
18	246	205	135	110	80	70	1,740	873	1,140	307	225	102
19	266	190	160	110	80	69	1,810	783	1,110	301	213	84
20	266	195	150	110	78	68	1,830	761	1,230	285	201	96
21	275	165	150	105	75	68	1,900	717	1,250	246	175	108
22	285	105	145	105	79	69	1,920	639	1,200	285	181	122
23	294	160	160	95	76	70	1,940	650	1,140	360	178	113
24	301	115	120	115	75	72	1,920	589	1,060	370	178	108
25	298	155	140	105	77	76	1,840	589	972	397	145	85
26	269	125	170	102	78	80	1,680	466	873	414	178	79
27	285	190	150	102	77	90	1,600	421	739	390	178	80
28	294	140	160	100	76	120	1,460	435	724	377	172	88
29	298	180	135	100	76	290	1,450	448	661	360	296	78
30	288	135	125	98	---	620	1,460	438	639	337	169	87
31	288	---	135	98	---	1,500	---	373	---	320	152	---
Total	6,846	6,603	4,845	3,530	2,369	4,531	48,010	31,174	22,077	11,131	7,641	3,049
Mean	221	220	156	114	84.6	146	1,600	1,006	736	359	246	102
Max	301	407	200	140	98	1,500	2,460	1,710	1,250	600	354	136
Min	80	105	120	95	75	36	1,020	373	262	246	145	68
Ac-ft												
Cal yr 1966: Total	166,580											
Mean	456											
Max	2,540											
Min	60											
Ac-ft												
Wtr yr 1967: Total	151,806											
Mean	416											
Max	2,460											
Min	36											
Ac-ft												

Note.--No gage-height record Apr. 3.

STREAMS TRIBUTARY TO LAKE SUPERIOR

4-0189. East Two River near Iron Junction, Minn.

Location.--Lat 47°24'04", long 92°39'52", in NW¼NW¼ sec.29, T.57 N., R.18 W., on right bank downstream from bridge on State Highway 37 and 2.2 miles southwest of Iron Junction.

Drainage area.--40.0 sq mi.

Records available.--June 1966 to September 1967. Occasional low-flow measurements, water years 1957-62.

Gage.--Water-stage recorder. Altitude of gage is 1,335 ft (from topographic map).

Extremes.--Maximum discharge during year, 370 cfs Apr. 1 (gage height, 9.48 ft, backwater from ice); minimum, 6.0 cfs Sept. 30; minimum gage height, 2.88 ft Sept. 10.

1966-67: Maximum discharge, that of Apr. 1, 1967; minimum, that of Sept. 30, 1967.

Remarks.--Records good except those for winter months, which are fair.

Cooperation.--Records computed by U. S. Steel Corporation and reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	16	20	17	13	12	9.9	310	120	13	19	8.8	8.3
2	15	20	17	13	12	9.8	247	123	10	18	8.5	8.1
3	17	23	17	13	11	9.7	177	109	8.1	16	8.5	8.1
4	20	22	17	13	11	9.9	142	100	7.7	15	8.5	7.9
5	21	22	16	13	11	10	119	87	7.5	14	8.1	7.7
6	21	22	16	13	10	10	93	70	8.1	13	10	7.7
7	20	22	16	12	10	10	73	59	9.7	12	14	7.3
8	20	22	16	12	9.5	10	70	55	12	13	13	7.1
9	19	22	16	12	9.4	10	102	51	17	13	13	7.1
10	19	23	15	12	9.4	9.5	101	50	16	12	11	6.7
11	18	22	15	12	9.4	9.8	86	55	15	12	10	6.5
12	18	18	15	13	9.5	10	77	48	14	11	9.7	6.7
13	18	18	15	13	9.6	11	73	45	18	11	9.1	7.5
14	21	18	15	13	9.7	12	79	40	46	11	9.1	10
15	20	17	15	13	10	12	84	37	83	9.4	8.8	10
16	20	17	15	13	10	11	78	34	97	9.1	8.8	10
17	19	17	15	13	10	11	128	32	86	9.7	8.8	10
18	19	17	15	12	10	11	166	29	58	10	8.8	9.7
19	19	18	15	12	10	10	145	27	50	11	8.8	9.4
20	18	18	14	12	11	11	126	26	54	10	8.5	9.1
21	18	18	14	12	11	12	122	26	50	10	8.5	9.7
22	19	19	14	12	10	15	107	25	46	13	8.8	9.7
23	19	19	14	12	10	20	89	25	43	19	8.8	8.3
24	19	19	14	11	10	30	76	23	38	19	8.8	7.7
25	19	19	13	11	10	40	66	22	33	17	9.1	7.3
26	18	19	13	11	10	50	57	21	30	17	10	6.9
27	19	18	13	11	10	9.5	48	20	26	15	10	6.5
28	19	18	13	12	9.9	133	43	18	23	15	10	6.5
29	18	18	13	12		205	47	17	21	14	9.7	6.2
30	18	17	13	12	-----	300	54	17	20	13	9.7	6.0
31	18	-----	13	12	-----	361	-----	15	-----	10	8.8	-----
Total	582	582	459	380	285.4	1468.6	3185	1426	960.1	411.2	296.0	239.7
Mean	18.8	19.4	14.8	12.3	10.2	47.4	106	46.0	32.0	13.3	9.55	7.99
Max	21	23	17	13	12	361	310	123	97	19	14	10
Min	15	17	13	11	9.4	9.5	43	15	7.5	9.1	8.1	6.0
Cfsm	0.470	0.485	0.370	0.308	0.255	1.18	2.65	1.15	0.800	0.332	0.239	0.200
In.	0.54	0.54	0.43	0.35	0.27	1.37	2.96	1.33	0.89	0.38	0.28	0.22

Cal yr 1966: Total

Wtr yr 1967: Total 10,275

Mean

Mean 28.2

Max

Max 361

Min

Min 6.0

Cfsm

Cfsm 0.705

In.

In. 9.55

Location.--Lat 47°24'05", long 92°42'10", in SW¼SW¼ sec.24, T.57 N., R.19 W., on right bank 40 ft upstream from bridge on State Highway 37, 5 miles southwest of Iron Junction, and 9½ miles upstream from St. Louis River.

Cooperation.--Records for 1967 water year computed by U. S. Steel Corporation and reviewed by Geological Survey.

Cal yr 1966: Total	20,322.2	Mean	55.7	Max	510	Min	6.0	Cfsm	0.814	In.	11.05
Wtr yr 1967: Total	9,800.4	Mean	26.8	Max	500	Min	5.7	Cfsm	0.392	In.	5.33

STREAMS TRIBUTARY TO LAKE SUPERIOR

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

Location.--Lat 47°17'36", long 93°02'30", in SW¼ 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 1967.

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, 308 cfs Mar. 31 (gage height, 4.61 ft); minimum, 0.6 cfs Aug. 17-23, 28; minimum gage height, 0.94 ft. Aug. 19, 20.
1963067: Maximum discharge, 340 cfs Sept. 30, 1965 (gage height, 4.81 ft); minimum, 0.3 cfs Aug. 8, 1963.

Remarks.--Records good except those for winter months, which are fair.

Cooperation.--Additional discharge measurements furnished by M. A. Hanna Mining Co.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.9	5.1	4.9	4.6	4.1	3.5	184	52	1.2	3.2	1.7	0.7
2	3.7	4.9	4.9	4.6	4.1	3.6	119	61	1.1	2.8	1.8	.8
3	5.3	4.8	5.0	4.6	4.0	3.7	70	38	1.0	2.2	1.5	.8
4	11	4.8	5.0	4.6	4.1	3.7	50	20	.9	2.2	1.6	.8
5	9.0	4.8	5.1	4.7	4.1	3.8	34	12	.9	2.2	1.5	.8
6	8.2	4.9	5.2	4.7	4.1	3.9	22	8.2	1.0	2.2	1.7	.8
7	7.1	5.0	5.3	4.8	4.0	4.0	16	7.1	1.7	2.3	4.0	.8
8	6.8	5.0	5.2	4.8	3.9	4.1	15	8.2	2.2	2.4	3.4	.8
9	6.2	5.0	5.2	4.8	3.9	4.3	52	6.5	2.7	1.8	2.9	.8
10	5.4	5.0	5.1	4.7	3.9	4.3	58	6.2	2.5	1.5	2.2	.8
11	5.3	5.0	5.0	4.7	3.8	4.4	32	12	2.2	1.7	1.7	.9
12	7.9	4.9	5.1	4.7	3.8	4.4	22	10	2.2	1.2	1.3	1.0
13	5.1	4.9	5.2	4.7	3.8	4.6	22	7.6	2.5	1.1	1.1	1.8
14	5.7	4.8	5.3	4.7	3.7	4.7	28	6.2	6.0	.9	1.1	2.2
15	7.4	4.8	5.3	4.7	3.7	4.7	43	4.7	11	1.1	.9	1.7
16	8.2	4.9	5.2	4.6	3.7	4.7	39	4.3	7.4	1.2	.7	1.5
17	7.1	5.0	5.0	4.4	3.7	4.7	51	3.7	4.4	1.2	.7	1.5
18	6.5	5.1	4.9	4.4	3.6	4.7	73	3.4	3.4	1.2	.7	1.6
19	6.2	5.2	4.8	4.3	3.6	4.6	57	3.1	5.2	1.0	.6	1.5
20	6.0	5.2	4.7	4.4	3.6	4.7	37	2.8	16	1.0	.6	1.8
21	6.2	5.2	4.6	4.3	3.7	4.7	41	2.8	13	1.0	.6	1.8
22	6.5	5.2	4.5	4.1	3.7	4.8	38	2.9	6.8	1.7	.6	1.4
23	6.5	5.2	4.4	4.1	3.7	5.0	24	3.1	4.8	2.0	.6	1.4
24	6.2	5.0	4.3	4.1	3.7	5.0	16	2.9	3.7	2.0	.7	1.2
25	5.7	4.9	4.2	4.1	3.6	5.0	11	2.9	3.1	2.2	.8	1.3
26	5.3	5.0	4.1	4.1	3.5	5.0	7.6	2.8	2.8	2.8	1.1	1.4
27	4.8	5.0	4.0	4.0	3.4	5.5	6.0	2.8	3.1	2.3	.9	1.5
28	5.3	5.1	4.0	4.0	3.5	8.0	5.1	2.4	3.4	2.3	.6	1.5
29	5.4	5.0	4.1	3.9	---	22	18	2.3	3.3	2.4	.8	1.5
30	5.7	5.0	4.1	3.9	---	110	24	2.0	3.1	2.0	.8	1.7
31	5.7	---	4.4	4.0	---	290	---	1.4	---	1.7	.7	---
Total	195.3	149.7	148.1	137.1	106.0	550.1	1214.7	305.3	122.6	56.8	39.9	38.1
Mean	6.30	4.99	4.78	4.42	3.79	17.7	40.5	9.85	4.09	1.83	1.29	1.27
Max	11	5.2	5.3	4.8	4.1	290	184	61	16	3.2	4.0	2.2
Min	3.7	4.8	4.0	3.9	3.4	3.5	5.1	1.4	0.9	0.9	0.6	0.7
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-
Cal yr 1966: Total	5,186.9		Mean	14.2	Max	155	Min	0.9	Ac-ft	-		
Wtr yr 1967: Total	3,063.7		Mean	8.39	Max	290	Min	0.6	Ac-ft	-		

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 8¼ miles upstream from St. Louis River.

Drainage area.--112 sq mi.

Records available.--September 1953 to September 1962, October 1964 to September 1967.

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

Average discharge.--12 years (1953-62, 1964-67), 90.3 cfs.

Extremes.--Maximum discharge during year, 1,360 cfs Apr. 1 (gage height, 17.36 ft, backwater from ice); minimum daily, 12 cfs Feb. 18-24, minimum gage height, 3.24 ft Aug. 18.

1953-62, 1964-67: 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, 12 cfs Feb. 22-26, 1965, Feb. 18-24, 1967, 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 period of no gage-height record and those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	41	40	28	22	19	13	1330	395	34	69	19	18
2	47	37	27	22	18	14	1110	469	31	57	22	19
3	54	34	27	22	18	14	610	392	30	50	20	19
4	68	32	27	22	18	14	330	290	26	47	20	19
5	72	31	27	22	18	15	280	231	25	42	18	20
6	58	31	28	22	18	15	235	198	26	37	18	20
7	44	30	28	23	18	14	230	169	47	35	32	19
8	40	30	28	23	17	14	223	164	48	36	27	19
9	38	29	27	23	17	14	351	152	59	36	26	19
10	35	29	27	24	16	14	410	140	51	30	22	18
11	32	28	26	24	16	14	340	161	40	25	20	19
12	32	28	26	24	15	14	264	160	37	23	19	22
13	31	28	25	24	15	14	254	144	57	22	19	23
14	36	28	25	23	14	14	270	131	188	22	19	33
15	66	28	25	23	14	14	313	116	289	21	18	28
16	69	28	25	23	13	14	298	104	224	20	18	25
17	58	29	24	23	13	14	377	93	146	20	18	24
18	50	29	24	22	12	15	537	86	102	20	17	22
19	45	30	24	22	12	15	505	78	87	20	18	23
20	42	31	24	22	12	16	390	71	168	19	20	24
21	43	31	24	22	12	17	375	67	160	18	21	27
22	47	31	24	22	12	18	364	62	118	34	21	27
23	52	32	23	22	12	20	301	65	97	83	18	24
24	46	32	23	21	12	24	248	65	80	69	19	25
25	40	32	23	21	13	30	212	58	69	44	22	24
26	37	31	23	21	13	40	186	59	59	43	23	25
27	36	31	23	21	13	60	166	57	52	40	22	26
28	36	30	23	20	13	115	152	51	67	30	20	25
29	40	30	22	20		215	203	45	63	24	20	23
30	43	29	22	19	-----	450	265	41	67	22	19	23
31	43	-----	22	19	-----	980	-----	37	-----	21	19	-----
Total	1,421	919	774	683	413	2,254	11,129	4,351	2,547	1,079	634	682
Mean	45.8	30.6	25.0	22.0	14.8	72.7	371	140	84.9	34.8	20.5	22.7
Max	72	40	28	24	19	980	1,330	469	289	83	32	33
Min	31	28	22	19	12	13	152	37	25	18	17	18
Cfsm	0.409	0.273	0.223	0.196	0.132	0.649	3.31	1.25	0.758	0.311	0.183	0.203
In.	0.47	0.31	0.26	0.23	0.14	0.75	3.70	1.44	0.85	0.36	0.21	0.23

Cal yr 1966: Total	45,659	Mean	125	Max	1,030	Min	22	Cfsm	1.12	In.	15.16
Wtr yr 1967: Total	26,886	Mean	73.7	Max	1,330	Min	12	Cfsm	0.658	In.	8.93

Peak discharge (base, 400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-1	1430	17.36	1,360	4-18	2200	10.77	556
4-10	0030	9.60	421	5-2	1100	9.93	473

Note.--No gage-height record Nov. 9 to Dec. 13.

STREAMS TRIBUTARY TO LAKE SUPERIOR

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 1967. Monthly discharge only for some periods published in WSP 1307. Published as "near Thomson" 1908-50.

Gage.--Digital 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. Aug. 4, 1953, to May 13, 1966, graphic water-stage recorder at present site and datum.

Average discharge.--59 years, 2,202 cfs (unadjusted).

Extremes.--Maximum discharge during year, 14,600 cfs Apr. 1, 2 (gage height, 8.85 ft); minimum, 408 cfs June 5; minimum gage height, 2.28 ft Dec. 23.
1908-67: 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 Boulders Island, Rice and Fish Lakes (combined capacity, 332,160 acre-ft).

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	1,320	1,360	928	1,310	1,130	1,160	14,400	6,520	1,040	2,260	1,540	1,340
2	1,320	1,380	775	1,230	1,100	1,170	13,900	8,770	885	2,030	1,530	1,250
3	1,320	1,230	685	1,280	1,110	1,200	11,700	8,200	877	2,110	1,530	1,160
4	1,340	979	1,590	1,210	1,110	1,200	10,400	7,080	805	1,960	1,440	1,130
5	1,520	1,130	1,230	1,230	1,110	1,230	8,950	6,240	745	2,040	1,660	1,120
6	1,790	1,470	1,470	1,200	1,160	1,240	7,240	5,520	634	1,820	1,590	1,100
7	1,670	1,600	1,280	1,220	1,200	1,230	5,720	5,010	738	1,740	1,550	1,120
8	1,290	1,500	1,350	1,180	1,090	1,240	5,420	4,700	805	1,570	1,700	1,110
9	1,230	1,380	1,300	1,160	1,120	1,240	7,690	4,580	1,090	1,570	1,580	1,040
10	1,230	1,360	1,290	1,220	1,120	1,330	9,280	4,240	997	1,500	1,690	1,060
11	1,170	1,320	861	1,190	1,120	1,320	8,380	4,430	1,140	1,570	1,580	1,060
12	1,300	1,080	953	1,240	1,120	1,320	7,210	4,600	1,020	1,470	1,570	1,040
13	1,330	1,120	1,480	1,270	1,110	1,320	6,440	4,240	997	1,300	1,500	988
14	1,480	1,180	1,470	1,280	1,140	1,240	6,370	3,970	3,210	1,240	1,480	945
15	2,400	1,240	1,500	1,240	1,070	1,320	7,100	3,620	4,710	1,240	1,460	894
16	2,000	1,370	1,430	1,220	1,120	1,220	7,130	3,160	6,540	1,250	1,470	821
17	1,330	1,310	1,460	1,150	1,130	1,310	7,450	3,030	6,390	1,270	1,460	821
18	1,820	1,240	1,470	1,100	1,110	1,220	9,460	2,750	5,080	1,220	1,410	894
19	1,850	1,150	1,360	1,000	1,070	1,290	9,460	2,490	4,770	1,210	1,240	853
20	1,850	1,100	1,250	1,070	1,130	1,340	8,650	2,300	6,270	1,140	1,400	845
21	1,850	1,150	1,390	1,120	1,110	1,340	8,020	2,060	7,300	1,220	1,330	829
22	1,630	1,230	885	1,110	1,110	1,350	7,570	2,030	6,420	1,600	1,330	813
23	1,640	1,330	953	1,100	1,120	1,390	6,940	1,860	4,910	2,010	1,230	805
24	1,350	1,490	1,340	1,160	1,170	1,580	6,240	1,620	4,470	1,620	1,230	790
25	1,500	1,480	1,420	1,180	1,210	1,340	5,740	1,760	4,300	1,690	1,330	798
26	1,300	1,480	1,170	1,070	1,110	1,100	5,220	1,570	3,820	1,390	1,380	805
27	1,290	1,520	1,270	1,110	1,150	1,230	4,680	1,500	3,620	1,320	1,440	798
28	1,230	1,400	1,230	1,080	1,170	1,700	4,320	1,330	2,850	1,520	1,270	798
29	1,170	1,320	1,220	1,150	-----	2,640	4,220	1,170	2,800	1,400	1,220	798
30	1,160	1,270	1,230	1,090	-----	4,560	4,660	1,180	2,520	1,360	1,220	798
31	1,160	-----	1,270	1,140	-----	11,900	-----	1,040	-----	1,340	1,220	-----
TOTAL	46,480	39,159	38,510	36,310	31,520	55,270	229,960	117,570	91,753	47,980	44,580	28,623
MEAN	1,499	1,306	1,242	1,171	1,126	1,783	7,665	3,631	3,058	1,548	1,438	954
MAX	2,400	1,600	1,590	1,310	1,210	11,900	14,400	8,770	7,300	2,260	1,700	1,340
MIN	1,160	979	685	1,000	1,070	1,100	4,220	1,040	634	1,140	1,220	790
CFSM	.44	.38	.36	.34	.33	.52	2.23	1.06	.89	.45	.42	.28
IN.	.50	.42	.42	.39	.34	.60	2.49	1.22	.99	.52	.48	.31

CAL YR 1966: TOTAL 1,254,809 MEAN 3,438 MAX 17,400 MIN 685 CFSM 1.00 IN 13.61
WAT YR 1967: TOTAL 802,725 MEAN 2,199 MAX 14,400 MIN 634 CFSM .64 IN 8.70

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 1967.

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

Average discharge.---30 years, 55.0 cfs (39,820 acre-ft per year).

Extremes.---Maximum discharge during year, 267 cfs June 22 (gage height, 4.27 ft); maximum gage height, 5.47 ft Feb. 15 (backwater from ice); minimum discharge, 0.8 cfs Sept. 9 (gage height 2.62 ft).

1937-67: 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 winter months, which are fair. Flow partly regulated by dams of Minnesota Department of Conservation on several lakes above station.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	42	40	33	33	31	33	108	217	75	245	78	7.8
2	41	42	33	33	31	34	97	211	92	245	72	7.5
3	39	40	34	33	31	35	93	208	112	235	66	6.8
4	31	39	35	33	31	36	90	205	116	226	62	3.0
5	32	39	36	33	31	37	90	205	119	220	57	2.3
6	33	38	36	33	31	37	92	208	121	217	54	1.5
7	34	38	36	33	31	37	108	208	132	211	46	1.1
8	35	38	36	33	31	37	119	211	144	205	39	1.0
9	34	37	36	33	31	37	134	211	151	199	39	1.0
10	28	37	36	33	31	37	139	211	151	197	40	1.0
11	21	37	36	33	32	37	141	214	146	174	45	1.1
12	23	40	36	33	32	37	132	211	151	144	43	1.3
13	25	37	36	32	32	37	129	208	167	154	41	1.3
14	41	37	36	32	32	37	137	202	208	177	39	1.0
15	46	36	37	31	32	38	146	197	238	164	38	1.3
16	44	36	38	31	32	39	156	188	241	149	36	1.8
17	47	35	38	30	32	40	172	183	241	129	34	1.8
18	51	35	39	30	32	41	183	174	238	108	31	2.6
19	47	35	40	30	32	43	188	169	245	119	28	4.0
20	46	35	40	30	32	46	197	161	248	119	26	4.0
21	45	35	40	30	32	49	199	159	254	116	25	3.8
22	42	35	39	30	33	48	202	154	264	112	22	3.5
23	41	35	38	31	33	40	202	154	254	108	21	3.0
24	41	36	37	31	33	45	202	156	245	99	18	2.8
25	42	35	35	30	33	47	205	161	238	77	15	2.6
26	42	35	34	31	33	52	205	161	235	78	9.3	2.3
27	43	36	33	31	33	57	202	164	241	77	8.9	2.3
28	43	35	33	31	33	54	202	167	248	75	8.9	2.1
29	43	34	33	31		68	208	161	251	74	8.6	1.9
30	42	33	33	31	- - - - -	101	211	156	251	75	8.2	1.8
31	41	- - - - -	33	31	- - - - -	119	- - - - -	118	- - - - -	85	8.2	- - - - -
Total	1,205	1,100	1,115	980	893	1,435	4,689	5,713	5,817	4,613	1,067.1	79.3
Mean	38.9	36.7	36.0	31.6	31.9	46.3	156	184	194	149	34.4	2.64
Max	51	42	40	33	33	119	211	217	264	245	78	7.8
Min	21	33	33	30	31	33	90	118	75	74	8.2	1.0
Ac-ft	2,390	2,180	2,210	1,940	1,770	2,850	9,300	11,330	11,540	9,150	2,120	157
Cal yr 1966: Total	33,947		Mean	93.0	Max	283	Min	21	Ac-ft	67,330		
Wtr yr 1967: Total	28,706.4		Mean	78.6	Max	261	Min	1.0	Ac-ft	56,940		

RED RIVER OF THE NORTH BASIN

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 1967.

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.--28 years (1909-12, 1942-67), 77.3 cfs (55,960 acre-ft per year).

Extremes.--Maximum discharge during year, 655 cfs Mar. 30 (gage height, 6.99 ft, backwater from ice); minimum, 22 cfs Sept. 30; minimum gage height, 3.26 ft Sept. 10-12.

1909-12, 1942-67: Maximum discharge, 756 cfs Mar. 29, 1943 (gage height, 8.53 ft, present datum); maximum gage height, 8.99 ft Mar. 21, 1966 (backwater from ice); no flow on many days in 1946, 1949-50.

Remarks.--Records good except those for winter months, which are fair. Flow affected by storage in lakes above station.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	75	70	67	58	62	59	290	295	238	224	73	36
2	75	55	66	58	61	61	228	305	233	199	70	35
3	75	72	66	58	60	62	203	310	228	194	68	30
4	73	77	66	58	60	63	199	315	228	190	65	31
5	72	80	67	57	60	64	194	300	224	186	64	31
6	72	75	67	58	60	64	207	290	228	182	63	31
7	72	73	68	58	60	64	220	285	233	174	61	30
8	72	56	67	58	60	64	242	280	260	170	61	29
9	72	68	66	59	60	64	270	275	260	156	60	28
10	70	74	64	60	60	64	270	275	256	152	60	27
11	68	72	62	60	60	63	260	285	246	142	59	26
12	67	71	61	61	60	63	256	295	242	135	57	27
13	67	71	60	61	60	63	251	305	251	129	56	26
14	82	72	59	62	60	63	265	300	360	123	54	26
15	90	77	59	62	60	64	260	295	355	120	53	26
16	90	82	58	63	59	64	265	285	370	120	53	26
17	92	84	59	64	59	65	305	285	360	114	52	26
18	88	85	60	65	59	67	300	280	335	108	51	29
19	82	86	61	66	58	70	315	275	310	101	50	30
20	78	88	62	66	58	72	330	265	285	94	49	29
21	77	82	62	66	57	78	315	260	270	92	48	29
22	80	78	62	65	56	88	320	256	265	86	45	28
23	86	77	62	65	56	96	310	251	270	84	44	28
24	86	72	61	64	56	110	295	251	265	82	43	28
25	80	72	61	64	55	135	290	246	260	84	43	27
26	78	72	61	63	56	155	285	251	260	84	42	26
27	78	70	60	63	57	220	285	246	256	82	41	25
28	80	64	60	62	58	300	290	251	251	82	40	25
29	78	66	60	62		450	290	256	242	80	39	24
30	78	67	60	62	-----	600	285	246	238	78	39	22
31	78	-----	59	62	-----	465	-----	242	-----	77	38	-----
Total	2,411	2,208	1,933	1,910	1,647	3,980	3,095	3,556	3,079	3,924	1,641	841
Mean	77.8	73.6	62.4	61.6	58.8	128	270	276	269	127	52.9	28.0
Max	92	88	68	66	62	600	330	315	370	224	73	36
Min	67	55	58	57	55	59	194	242	224	77	38	22
Ac-ft	4,780	4,380	3,830	3,790	3,270	7,890	16,060	16,970	16,020	7,780	3,250	1,670

Cal yr 1966: Total 48,886 Mean 134 Max 520 Min 44 Ac-ft 96,960
 Wtr yr 1967: Total 45,225 Mean 124 Max 600 Min 22 Ac-ft 89,700

5-0459.5 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 1967.

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, 14,350 acre-ft Oct. 20 (elevation, 1,070.22 ft); minimum, 1,210 acre-ft Mar. 23 (elevation, 1,049.05 ft).

1953-67: Maximum contents, 16,920 acre-ft June 17, 1962, May 23, 1966 (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 gage height and contents, water year October 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	1,069.76	13,840	-
Oct. 31	1,069.99	14,090	+250
Nov. 30	1,067.81	11,830	-2,260
Dec. 31	1,062.36	7,350	-4,480
Calendar year 1966	-	-	-5,100
Jan. 31	1,056.70	3,960	-3,390
Feb. 28	1,052.80	2,330	-1,630
Mar. 31	1,060.92	6,350	+4,020
Apr. 30	1,056.83	4,020	-2,330
May 31	1,056.72	3,970	-50
June 30	1,065.27	9,620	+5,650
July 31	1,056.20	3,740	-5,880
Aug. 31	1,064.74	9,190	+5,450
Sept. 30	1,069.72	13,790	+4,600
Water year 1966-67	-	-	-50

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 1967. 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.--37 years, 282 cfs (204,200 acre-ft per year).

Extremes.--Maximum discharge during year, 1,130 cfs May 18 (gage height, 4.14 ft); minimum 35 cfs Sept. 14, 15, 16, 17 (gage height, 2.01 ft).
1930-67: 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 except those for period of no gage-height record, which are fair. Flow regulated by Orwell Reservoir beginning Mar. 21, 1953 (see preceding page) and powerplants upstream.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	406	496	490	457	372	375	656	867	1,000	940	395	145
2	406	496	490	457	372	390	662	885	984	940	370	145
3	423	502	485	457	372	400	691	891	972	925	380	145
4	434	502	485	451	372	380	790	915	965	915	380	145
5	468	502	479	451	372	375	814	940	953	900	385	137
6	490	507	474	446	372	375	861	959	934	900	385	113
7	485	507	468	446	372	370	879	978	934	890	350	103
8	485	502	468	440	367	365	843	998	934	880	285	100
9	490	507	462	440	362	360	819	1,000	940	870	235	97
10	479	507	462	434	362	375	825	998	946	865	235	100
11	451	507	462	429	367	390	831	1,020	959	850	240	76
12	451	513	457	423	362	400	814	1,030	965	845	246	60
13	446	507	457	423	367	390	796	1,060	972	835	246	60
14	451	507	451	423	362	410	784	1,080	778	825	246	45
15	451	513	474	418	367	410	814	1,100	714	810	246	36
16	451	513	502	415	372	410	831	1,120	576	795	240	35
17	446	513	496	418	378	415	831	1,120	490	775	251	36
18	446	519	485	418	372	420	837	1,120	519	755	256	36
19	474	519	485	412	367	430	831	1,120	547	740	256	36
20	485	513	485	401	367	457	837	1,120	639	665	256	36
21	485	519	496	401	372	412	837	1,110	837	610	210	95
22	496	513	490	395	372	362	861	1,100	925	600	165	187
23	496	513	490	395	360	362	861	1,110	930	600	165	235
24	490	507	485	390	360	378	861	1,110	935	575	149	235
25	479	502	479	390	350	401	855	1,100	940	540	137	201
26	474	502	474	390	345	434	861	1,100	940	450	137	178
27	479	496	474	384	370	479	855	1,090	940	440	137	182
28	485	496	468	378	385	272	861	1,070	940	450	141	182
29	490	496	462	372		395	861	1,060	935	450	141	182
30	490	490	457	372	- - - -	559	861	1,040	935	450	141	178
31	496	- - - -	457	372	- - - -	639	- - - -	1,020	- - - -	460	145	- - - -
Total	14,478	15,186	14,749	12,898	10,290	12,590	24,620	32,231	25,978	22,545	7,551	3,541
Mean	467	506	476	416	368	406	821	1,040	866	727	244	118
Max	496	519	502	457	385	639	879	1,120	1,000	940	395	235
Min	406	490	451	372	345	272	656	867	490	440	137	35
Ac-ft	28,720	30,120	29,250	25,580	20,410	24,970	48,830	63,930	51,530	44,720	14,980	7,020
Cal yr 1966: Total	241,365		Mean	661	Max	1,470	Min	95	Ac-ft	478,700		
Wtr yr 1967: Total	196,657		Mean	539	Max	1,120	Min	35	Ac-ft	390,100		

Note.--No gage-height record June 21 to August 8.

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

Location.--Lat 45°51'45", long 96°34'35", 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 1967.

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.--26 years, 85 1 cfs (61,610 acre-ft per year).

Extremes.--Maximum discharge during year, 530 cfs Apr. 17 (gage height, 7.33 ft); no flow for many days. 1941-67: 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 winter months, 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). Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0	1.1				0	21	378	1.0	223	1.7	0.3
2	0	13				0	20	381	1.0	222	1.5	.5
3	0	20				0	18	359	.8	226	1.4	.3
4	0	15				0	16	348	.9	213	1.2	.3
5	0	11				0	14	242	.9	211	.6	.4
6	0	11				.1	11	113	1.0	212	.2	.4
7	0	9.4				.2	10	122	1.0	212	.1	.4
8	0	16				.2	9.4	118	1.9	218	0	.4
9	0	15				.4	10	111	1.8	220	0	.4
10	0	6.2				.6	9.8	116	1.8	276	0	.3
11	0	.2				1.5	7.5	116	1.7	336	0	.3
12	0	.5				1.8	6.1	115	1.9	336	0	.5
13	0	.4				2.0	6.4	114	2.1	374	0	.3
14	.3	.5				2.0		98	5.8	415	0	.5
15	2.5	.4				2.0	415	79	18	397	0	.5
16	3.3	.2				2.0	411	68	22	379	0	.5
17	46	.2				2.5	480	55	15	366	1.0	.6
18	93	.1				3.0	418	58	68	294	.2	.6
19	99	.1				2.5	395	61	4.2	246	.1	.7
20	84	.1				2.5	391	54	2.8	229	.1	.7
21	74	.1				4.1	407	54	2.1	194	.1	.7
22	79	0				9.4	411	47	2.1	157	.1	.5
23	71	0				20	397	22	2.4	128	.1	.4
24	46	0				40	387	2.8	2.2	79	11	.5
25	42	0				70	387	4.0	1.9	25	1.3	.4
26	41	0				75	383	4.6	1.9	1.6	.9	.4
27	40	0				55	376	2.6	7.4	1.4	.4	.4
28	15	0				40	368	2.0	192	2.5	.4	.4
29	.2	0				35	370	1.7	204	1.2	.4	.4
30	.1	0				29	368	1.3	211	1.4	.5	.4
31	.2	-----			-----	24	-----	1.2	-----	2.1	.4	-----
Total	7366	120.5	0	0	0	424.8	6,713.2	3,249.2	786	6,198.2	23.7	13.4
Mean	23.8	4.02	0	0	0	13.7	224	105	26.2	200	0.76	0.45
Max	99	20	0	0	0	75	480	381	211	415	11	0.7
Min	0	0	0	0	0	0	6.1	1.2	0.8	1.2	0	0.3
Ac-ft	1,460	239	0	0	0	843	13,320	6,440	1,560	12,290	47	27
Cal yr1966: Total	50,780.6	Mean	139	Max	895	Min	0	Ac-ft	100,700			
Wtr yr1967: Total	18,265.6	Mean	50.0	Max	480	Min	0	Ac-ft	36,230			

RED RIVER OF THE NORTH BASIN

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 1967. 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.--24 years (1943-67), 539 cfs (390,200 acre-ft per year).

Extremes.--Maximum discharge during year, 2,500 cfs June 15 (gage height, 8.81 ft); maximum gage height, 9.14 ft Mar. 28 (backwater from ice); minimum discharge, 12 cfs Sept. 17, 18 (gage height, 2.05 ft).

1942-67: Maximum discharge, 7,130 cfs Apr. 12, 1952 (gage height, 14.99 ft); minimum, 8 cfs Aug. 25, 1961 (gage height, 2.26 ft); minimum gage height that of Sept. 17, 18, 1967.

Maximum stage known, 17.0 ft in spring of 1897.

Remarks.--Records good except those for the winter period, 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	370	433	260	420	380	370	1110	1530	1010	1120	361	134
2	370	448	285	415	380	380	960	1510	996	1100	346	134
3	373	433	445	380	380	375	878	1530	982	1100	313	134
4	385	424	495	380	380	380	834	1530	982	1090	322	134
5	400	430	470	360	370	380	906	1520	973	1070	325	136
6	418	439	455	350	355	375	973	1430	973	1050	319	131
7	439	436	435	375	340	370	1000	1280	973	1040	325	104
8	445	460	410	400	340	365	1040	1260	986	1030	310	91
9	439	373	375	425	345	410	1110	1270	973	1020	241	90
10	442	442	290	435	345	425	1230	1260	973	1040	218	89
11	454	532	350	440	350	410	1170	1260	982	1190	218	94
12	430	567	415	420	350	410	1090	1260	1020	1210	216	89
13	418	439	420	400	360	425	1050	1260	1090	1150	218	50
14	445	525	425	380	360	435	1110	1250	2060	1110	221	39
15	457	553	415	360	350	460	1290	1240	2470	1110	225	34
16	439	539	425	375	340	460	1570	1210	2460	1080	232	24
17	427	536	445	380	350	415	1860	1200	2230	1050	225	15
18	421	367	440	390	360	420	2160	1180	1560	1020	229	21
19	439	256	435	395	370	430	2080	1170	1060	932	232	32
20	484	475	435	400	380	440	1980	1180	847	860	229	58
21	532	697	430	395	395	460	1980	1180	822	805	232	53
22	518	616	295	390	390	460	1810	1170	937	735	207	77
23	532	457	290	380	380	490	1700	1150	1010	693	158	184
24	525	421	415	375	375	550	1630	1140	1010	672	154	236
25	518	412	425	380	370	750	1570	1100	996	620	160	241
26	494	412	380	380	365	1250	1540	1080	978	542	138	225
27	475	409	420	380	360	1650	1510	1080	973	445	134	203
28	466	412	430	385	355	1680	1510	1070	964	370	134	192
29	469	415	435	395	395	1800	1490	1060	1050	364	136	194
30	460	364	440	390	- - - -	1840	1500	1040	1120	370	132	201
31	433	- - - -	435	395	- - - -	1380	- - - -	1020	- - - -	370	132	- - - -
Total	13,917	13,722	12,520	12,125	10,175	20,445	41,641	38,420	35,460	27,358	7,042	3,439
Mean	449	457	404	391	363	660	1,388	1,239	1,182	883	227	115
Max	532	697	495	440	395	1,840	2,160	1,530	2,470	1,210	361	241
Min	370	256	260	350	340	365	834	1,020	822	364	132	15
Ac-ft	27,600	27,220	24,830	24,050	20,180	40,550	82,590	76,200	70,330	54,260	13,970	6,820
Cal yr1966: Total	324,720			Mean 890	Max 4,530	Min 256	Ac-ft 644,100					
Wtr yr1967: Total	236,264			Mean 647	Max 2,470	Min 15	Ac-ft 468,600					

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 waterplant 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 1967. Published as "at Moorhead, Minn." 1901. Monthly discharge only 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 Sept. 30, 1960, water-stage recorder at site 2 miles upstream at datum 5.6 ft higher. Oct. 1, 1960, to Sept. 30, 1962, water-stage recorder at present site at datum 5.6 ft higher. Since Oct. 1, 1960, auxiliary water-stage recorder 2 miles upstream.

Average discharge.--66 years, 528 cfs (382,300 acre-ft per year, unadjusted); median of yearly mean discharges, 440 cfs (319,000 acre-ft per year, unadjusted).

Extremes.--Maximum discharge during year, 5,900 cfs June 19; maximum gage height, 22.34 ft June 19; minimum discharge, 24 cfs Sept. 24 (gage height, 13.23 ft).
1901-67: 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 (discharge, 25,000 cfs).

Remarks.--Records good. 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 cities of Fargo and Moorhead. Records of chemical analyses for water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	380	510	398	482	400	360	4,040	1,920	1,130	1,340	423	114
2	374	510	316	489	400	360	3,200	1,950	1,110	1,410	423	114
3	380	475	236	475	420	380	2,150	1,950	1,080	1,420	416	118
4	374	436	257	475	420	400	1,580	1,940	1,060	1,420	392	114
5	374	496	339	462	400	420	1,340	1,940	1,050	1,410	368	114
6	380	503	468	449	380	440	1,260	1,940	1,060	1,400	362	114
7	386	489	524	442	400	440	1,230	1,900	1,050	1,400	362	114
8	404	462	531	442	400	440	1,260	1,800	1,060	1,370	356	111
9	423	398	517	410	380	420	1,300	1,670	1,050	1,340	333	101
10	416	299	496	392	380	400	1,370	1,630	1,050	1,310	304	91
11	423	272	475	410	360	380	1,520	1,630	1,050	1,280	277	78
12	436	310	423	442	360	360	1,570	1,620	1,060	1,270	257	73
13	449	416	423	442	360	380	1,500	1,590	1,080	1,400	236	73
14	462	517	462	442	360	400	1,450	1,570	1,540	1,540	222	73
15	468	538	489	430	360	420	1,450	1,550	2,060	1,650	227	76
16	468	552	489	430	380	440	1,670	1,530	3,970	1,670	236	59
17	475	582	489	410	380	480	2,030	1,520	5,200	1,640	232	52
18	475	582	496	380	380	500	2,440	1,470	5,760	1,500	232	48
19	462	540	510	380	380	520	3,200	1,450	5,760	1,440	241	46
20	462	480	517	370	380	520	3,860	1,430	5,220	1,340	241	41
21	462	420	524	390	360	520	3,940	1,400	3,920	1,240	241	33
22	517	350	524	400	380	540	3,850	1,380	2,810	1,170	241	32
23	568	545	531	400	380	580	3,630	1,380	2,220	1,090	236	26
24	582	628	475	410	400	650	3,190	1,360	1,720	968	218	26
25	582	560	404	420	400	800	2,690	1,330	1,560	905	173	29
26	582	510	462	410	400	1,200	2,490	1,320	1,450	844	152	81
27	575	503	510	430	380	1,700	2,240	1,270	1,400	764	141	152
28	568	489	510	420	380	2,400	2,080	1,230	1,340	684	129	173
29	552	475	489	450		3,100	1,980	1,210	1,320	605	125	152
30	531	436	482	450		3,800	1,940	1,190	1,290	489	122	141
31	517		482	430		4,230		1,160		442	114	
Total	14,507	14,283	14,248	13,264	10,760	27,980	67,450	48,230	62,430	37,751	8,032	2,569
Mean	468	476	460	428	384	903	2,248	1,556	2,081	1,218	259	85.6
Ac-ft	28,770	28,330	28,260	26,310	21,340	55,500	133,800	95,660	123,800	74,880	15,930	5,100
+	675	652	660	690	704	693	595	713	761	1,160	1,220	915

Adjusted for diversion in acre-ft by cities of Fargo and Moorhead

	Mean	Max	Min	Ac-ft
Mean	479	487	470	439
Max	582	628	531	489
Min	374	272	236	370
Ac-ft	29,450	28,980	28,920	27,000
Observed	29,450	28,980	28,920	27,000
Adjusted	29,450	28,980	28,920	27,000

Calendar year 1966: Total 447,276 Mean 1,225 Max 10,600 Min 236 Ac-ft 887,200
 Water year 1966-67: Total 321,504 Mean 881 Max 5,760 Min 26 Ac-ft 637,700

+ Diversion in acre-ft by the cities of Fargo and Moorhead.

RED RIVER OF THE NORTH BASIN

5-0610. Buffalo River near Hawley, Minn.

Location.--Lat 46°51'00", long 96°19'45", near center of SE $\frac{1}{4}$ 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 1967.

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.--22 years, 74.4 cfs (53,860 acre-ft per year).

Extremes.--Maximum discharge during year, 669 cfs Mar. 30 (gage height, 7.57 ft); minimum, 12 cfs Sept. 6-11, 1945-67; 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, spring of 1921, from information by local resident.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	28	41	33	30	31	28	530	253	88	116	30	14
2	26	40	33	30	31	28	500	259	84	112	28	14
3	26	41	32	30	31	27	470	242	76	106	26	14
4	26	42	32	30	31	27	450	228	72	99	25	13
5	26	42	31	30	31	27	432	217	69	93	24	13
6	27	42	31	30	31	27	407	206	78	89	25	13
7	29	41	31	30	30	27	350	196	90	85	25	13
8	27	40	30	30	30	26	324	187	125	87	28	12
9	26	39	30	30	30	26	326	180	163	81	26	12
10	26	37	30	30	30	26	342	178	156	78	25	12
11	25	36	30	30	30	26	315	184	138	72	23	13
12	25	35	30	30	29	26	298	188	131	68	23	14
13	25	35	30	30	29	26	291	182	162	64	22	14
14	36	34	30	30	29	26	281	174	190	60	21	14
15	54	34	29	30	28	26	267	166	208	57	20	14
16	57	33	29	30	28	26	247	158	199	55	19	17
17	50	33	29	30	28	26	278	151	186	52	19	17
18	48	33	29	31	28	27	319	143	177	50	18	16
19	45	34	29	31	28	28	330	136	160	48	17	19
20	43	35	29	31	28	30	382	131	160	45	17	20
21	41	35	29	31	28	36	422	126	166	43	17	20
22	47	35	29	31	28	45	457	127	163	41	16	21
23	55	35	29	31	28	85	442	126	158	39	15	20
24	53	34	29	31	28	130	407	121	153	37	15	19
25	50	33	29	31	28	175	386	115	144	35	15	18
26	49	33	29	32	28	200	351	121	135	32	15	17
27	48	33	29	32	28	215	315	126	130	32	14	18
28	46	34	29	32	28	255	280	117	125	29	14	17
29	45	34	29	32		438	252	109	121	29	14	23
30	43	34	29	31	- - - - -	633	243	101	118	28	14	20
31	43	- - - - -	30	31	- - - - -	561	- - - - -	93	- - - - -	29	14	- - - - -
Total	1,195	1,087	927	948	815	3,309	10,694	5,041	4,125	1,891	624	481
Mean	38.5	36.2	29.9	30.6	29.1	107	356	163	138	61.0	20.1	16.0
Max	57	42	33	32	31	633	530	259	208	116	30	23
Min	25	33	29	30	28	26	243	93	69	28	14	12
Ac-ft	2,370	2,160	1,840	1,880	1,620	6,560	21,200	10,000	8,180	3,750	1,240	954
Cal yr1966: Total	42,822		Mean	117	Max	1,500	Min	17	Ac-ft	84,900		
Wtr yr1967: Total	31,137		Mean	85.3	Max	633	Min	12	Ac-ft	61,800		

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

Location.--Lat 46°46'20", long 96°37'40", in SW $\frac{1}{4}$ SW $\frac{1}{4}$ 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 Whisky Creek and 1 mile east of Sabin.

Drainage area.--522 sq mi.

Records available.--March 1945 to September 1967.

Gage.--Wire-weight gage read once or twice daily and crest-stage gage. 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.--22 years, 57.3 cfs (41,480 acre-ft per year).

Extremes.--Maximum discharge during year, 1,240 cfs Mar. 27 (gage height, 12.95 ft, from floodmark); minimum daily, 0.1 cfs Feb. 13 to Mar. 1.
1945-67: Maximum discharge, 6,340 cfs June 9, 1962 (gage height, 17.04 ft); no flow for many days in most years.

Remarks.--Records fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7.7	24	10	0.9	0.2	0.1	466	117	31	30	0.6	0.4
2	7.8	21	10	.9	.2	.2	350	117	28	26	.6	.4
3	7.9	19	9.2	.8	.2	.2	277	117	26	22	.5	.4
4	8.1	18	9.0	.8	.2	.2	201	110	24	19	.4	.3
5	8.2	17	8.6	.7	.2	.3	162	104	22	18	.4	.2
6	7.7	16	8.0	.7	.2	.3	147	96	28	14	.4	.2
7	8.2	15	7.1	.6	.2	.3	141	87	36	13	.5	.2
8	9.3	14	6.0	.6	.2	.3	154	80	45	12	.7	.2
9	9.6	13	5.2	.5	.2	.3	168	77	52	10	1.1	.2
10	10	13	4.0	.5	.2	.3	196	74	58	8.6	1.6	.2
11	9.8	12	3.6	.5	.2	.4	219	82	72	7.9	3.1	.2
12	9.8	12	3.2	.5	.2	.4	200	104	86	6.2	3.2	.5
13	12	12	2.9	.4	.1	.5	166	141	94	5.2	3.1	1.0
14	14	12	2.7	.4	.1	.6	159	138	134	4.1	2.9	3.0
15	23	12	2.5	.4	.1	.7	182	122	239	3.8	2.9	6.0
16	31	12	2.4	.4	.1	.8	228	105	394	3.0	2.6	7.2
17	33	12	2.3	.4	.1	.9	271	91	667	3.1	2.6	4.0
18	33	12	2.2	.3	.1	1.2	332	77	720	3.0	2.5	3.0
19	29	12	2.1	.3	.1	1.5	466	70	577	3.2	2.4	2.3
20	25	12	2.0	.3	.1	1.9	591	66	413	3.2	2.3	3.4
21	20	12	2.0	.3	.1	2.4	626	61	259	2.5	2.3	4.6
22	19	12	1.9	.3	.1	3.2	625	56	172	1.6	2.2	3.5
23	22	12	1.8	.3	.1	7.6	565	52	129	1.2	2.1	1.5
24	25	13	1.6	.3	.1	20	437	50	101	0.8	1.9	1.0
25	29	13	1.5	.2	.1	40	311	47	83	.8	1.5	.5
26	28	13	1.4	.2	.1	280	228	45	65	.7	1.1	1.2
27	28	13	1.3	.2	.1	850	180	47	53	.7	.9	1.2
28	28	13	1.1	.2	.1	1,080	146	44	44	.7	.7	.3
29	28	12	1.1	.2		842	116	41	38	.7	.5	1.1
30	26	11	1.0	.2	- - - - -	653	114	37	33	.7	.5	1.0
31	25	- - - - -	1.0	.2	- - - - -	552	- - - - -	35	- - - - -	.6	.4	- - - - -
Total	582.1	414	118.7	13.5	4.0	4,341.6	8,424	2,490	4,723	226.3	48.5	49.2
Mean	18.8	13.8	3.83	0.44	0.14	140	281	80.3	157	7.30	1.56	1.64
Max	33	24	10	0.9	0.2	1,080	626	141	720	30	3.2	7.2
Min	7.7	11	1.0	0.2	0.1	0.1	114	35	22	0.6	0.4	0.2
Ac-ft	1,150	821	235	27	7.9	8,610	16,710	4,940	9,370	449	96	98

Cal yr 1966: Total 31,584.1 Mean 86.5 Max 3,060 Min 0 Ac-ft 62,650
Wtr yr 1967: Total 21,434.9 Mean 58.7 Max 1,080 Min .0.1 Ac-ft 42,520

RED RIVER OF THE NORTH BASIN

5-0620. Buffalo River near Dilworth, Minn.

Location.--Lat 46°57'40", long 96°39'40", in SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.6, T.140 N., R.47 W., on left bank $4\frac{1}{2}$ miles southeast of Kragnes, $6\frac{1}{2}$ miles northeast of Dilworth, and 9 miles downstream from South Branch.

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

Records available.--March 1931 to September 1967. 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.--36 years, 124 cfs (89,770 acre-ft per year).

Extremes.--Maximum discharge during year, 1,820 cfs Mar. 30 (gage height, 16.68 ft); minimum, 11 cfs Sept. 10, 11, (gage height, 1.94 ft).

1931-67: Maximum discharge, 6,140 cfs June 11, 1962 (gage height, 23.56 ft); no flow at times in 1936.

Remarks.--Record fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	25	74	36	32	39	42	1,520	440	145	194	27	13
2	26	60	35	32	39	43	1,390	417	133	186	26	13
3	26	56	35	32	39	44	1,230	401	124	174	27	13
4	26	54	36	33	39	45	1,090	388	114	162	26	13
5	26	53	36	33	40	46	952	371	106	150	25	12
6	27	52	36	33	40	46	836	354	102	138	25	12
7	27	51	36	34	40	46	744	335	105	127	24	12
8	28	49	35	34	40	46	674	323	122	119	24	12
9	30	47	35	34	40	46	635	309	160	116	24	12
10	33	46	34	35	40	46	586	299	202	113	26	11
11	35	44	34	36	40	46	553	304	236	103	26	11
12	34	43	33	36	40	46	547	313	252	95	25	12
13	34	41	34	36	40	46	526	316	255	87	24	12
14	35	40	34	36	40	46	553	330	290	80	22	12
15	38	40	35	36	40	46	573	334	354	74	22	13
16	53	39	35	37	40	45	520	320	420	69	20	14
17	74	38	35	37	40	45	611	299	498	63	20	15
18	92	37	35	37	40	45	712	276	647	59	19	18
19	97	37	35	37	40	46	804	256	783	55	18	19
20	94	36	35	38	40	46	988	239	846	51	17	19
21	89	36	34	38	39	47	1,170	224	812	48	17	19
22	85	36	33	39	39	49	1,190	213	674	45	16	21
23	80	36	32	39	40	54	1,190	203	510	42	16	22
24	82	36	32	39	40	65	1,180	194	394	39	16	22
25	87	36	31	38	40	85	1,120	189	329	37	16	23
26	88	36	31	38	40	150	1,010	179	295	34	16	23
27	89	36	32	39	41	230	857	181	266	32	15	22
28	87	37	32	39	42	320	706	188	241	30	15	21
29	86	37	32	39		770	581	182	222	29	15	19
30	83	37	32	39	-----	1,710	491	169	205	29	14	19
31	79	-----	32	39	-----	1,660	-----	156	-----	28	14	-----
Total	1,795	1,300	1,052	1,124	1,117	6,047	25,539	8,702	9,842	2,608	637	479
Mean	57.9	43.3	33.9	36.3	39.9	195	851	281	328	84.1	20.5	16.0
Max	97	74	36	39	42	1,710	1,520	440	846	194	27	23
Min	25	36	31	32	39	42	491	156	102	28	14	11
Ac-ft	3,560	2,580	2,090	2,230	2,220	11,990	50,660	17,260	19,520	5,170	1,260	950
Cal yr 1966: Total	91,321		Mean	250	Max	5,000	Min	25	Ac-ft	181,100		
Wtr yr 1967: Total	60,242		Mean	165	Max	1,710	Min	11	Ac-ft	119,500		

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 1967. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Digital 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, graphic water-stage recorder 80 ft upstream from present site at present datum, and Aug. 3, 1950, to Aug. 14, 1967, graphic water-stage recorder at present site and datum.

Average discharge.--45 years, 165 cfs (119,500 acre-ft per year).

Extremes.--Maximum discharge during year, 1,710 cfs Apr. 1 (gage height, 9.09 ft, backwater from ice); maximum gage height, 10.62 ft Mar. 29 (backwater from ice); minimum daily discharge, 12 cfs Sept. 24, 30. 1909-17, 1930-67: 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 fair. 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	40	95	57	53	66	62	1,650	711	288	451	65	19
2	40	67	55	53	66	61	1,390	713	270	437	55	18
3	41	64	52	54	66	60	1,200	690	256	422	52	17
4	39	62	51	55	67	59	1,060	687	252	407	55	17
5	37	61	50	56	66	58	1,000	656	256	387	55	17
6	36	60	50	56	65	58	920	651	268	370	52	16
7	37	60	50	56	65	58	900	635	282	350	52	15
8	40	59	51	57	65	58	890	617	302	340	55	15
9	38	58	51	57	66	57	910	607	320	330	50	15
10	57	58	52	58	66	57	930	600	348	310	47	15
11	57	57	52	59	67	56	910	592	340	290	45	14
12	63	57	52	60	67	56	880	590	340	270	45	14
13	60	56	53	61	68	56	860	570	348	265	43	14
14	63	57	53	62	67	55	860	540	360	250	45	15
15	66	58	53	63	66	55	870	510	388	220	47	17
16	82	58	53	63	64	54	880	480	420	200	40	20
17	96	59	53	63	62	53	900	465	455	185	35	22
18	93	60	52	62	61	53	930	445	500	180	32	25
19	93	60	52	62	60	55	1,000	418	530	170	29	24
20	98	61	52	62	60	59	1,090	400	520	155	25	20
21	100	62	51	63	60	66	1,310	375	512	150	27	19
22	101	62	51	64	60	73	1,240	355	512	140	25	18
23	104	63	51	64	61	79	1,090	340	507	135	24	14
24	111	62	51	64	62	84	993	320	528	130	27	12
25	112	62	51	65	63	90	915	324	540	115	27	13
26	108	62	51	65	64	102	844	331	538	100	25	14
27	108	61	51	65	64	150	781	335	524	95	24	17
28	108	60	51	65	63	390	734	330	509	85	22	16
29	104	59	51	65		1,200	698	328	492	80	21	14
30	104	58	52	66	-----	1,420	685	314	469	75	20	12
31	103	-----	52	66	-----	1,570	-----	300	-----	70	19	-----
Total	2,339	1,838	1,607	1,884	1,797	6,364	29,320	15,229	12,174	7,164	1,185	498
Mean	75.5	61.3	51.8	60.8	64.2	205	977	491	406	231	38.2	16.6
Max	112	95	57	66	68	1,570	1,650	713	540	451	65	25
Min	36	56	50	53	60	53	685	300	252	70	19	12
Ac-ft	4,640	3,650	3,190	3,740	3,560	12,620	58,160	30,210	24,150	14,210	2,350	988
Cal yr 1966 Total	103,109		Mean 282		Max 2,000	Min 31		Ac-ft 204,500				
Wtr yr 1967 Total	81,399		Mean 223		Max 1,650	Min 12		Ac-ft 161,500				

Note.--No gage-height record Apr. 1.

RED RIVER OF THE NORTH BASIN

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 1967.

Gage.--Wire-weight gage read once or twice daily and crest stage gage. 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.--23 years, 231 cfs (167,200 acre-ft per year).

Extremes.--Maximum discharge during year, 3,250 cfs Apr. 1 (gage height, 20.57 ft, from floodmark, backwater from Red River of the North); maximum gage height, 21.29 ft Apr. 22 (from graph based on gage readings, backwater from Red River of the North); minimum discharge, 12 cfs Sept. 24.

1944-67: Maximum discharge 6,800 cfs Apr. 14, 1965; maximum gage height, 29.52 ft Apr. 15, 1965 (from floodmark, backwater from Red River of the North); no flow some days in 1948-49.

Remarks.--Records good except those for period of backwater from Red River of the North and those for winter months, 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	45	110	61	53	63	69	3,170	987	306	507	72	20
2	46	92	59	53	64	68	2,800	1,050	289	484	71	19
3	43	78	57	54	64	67	2,140	1,100	272	460	64	19
4	44	72	55	55	65	66	1,640	1,060	282	440	66	18
5	43	70	54	56	65	66	1,410	981	292	419	64	18
6												
7	42	68	54	58	66	65	1,230	922	299	400	62	17
8	39	67	53	58	67	64	1,120	870	320	380	60	17
9	39	65	53	59	68	64	1,050	829	368	361	60	16
10	38	63	54	60	68	64	1,000	794	465	348	60	16
11	33	62	54	60	68	64	1,140	751	605	341	50	16
12												
13	37	62	55	61	68	64	1,080	737	622	318	50	16
14	54	62	56	62	69	63	932	738	571	296	51	16
15	61	62	56	62	69	63	907	738	534	277	51	16
16	64	62	56	63	70	62	968	704	554	277	45	16
17	72	62	57	63	71	62	1,010	671	628	238	54	16
18												
19	79	63	58	64	72	62	1,050	635	671	224	43	18
20	87	63	58	64	72	61	1,080	567	659	210	36	22
21	100	63	58	65	71	61	1,150	526	647	202	34	22
22	109	64	56	65	70	60	1,380	501	718	190	32	21
23	108	64	57	65	70	60	1,850	461	726	177	29	20
24												
25	106	65	56	65	70	61	2,740	451	624	166	31	20
26	113	65	55	65	71	61	3,070	426	577	159	30	19
27	118	66	54	65	72	64	2,960	405	584	148	27	17
28	116	66	53	64	72	78	2,420	392	599	143	34	12
29	119	67	52	64	72	140	1,950	387	602	119	29	13
30												
31	118	67	52	64	71	200	1,530	396	601	107	29	13
32	125	67	52	63	70	240	1,240	396	587	100	28	18
33	120	66	52	63	70	750	1,090	385	570	92	26	14
34	115	65	52	63		1,400	1,020	385	552	81	25	17
35	113	63	53	63	- - - - -	2,300	985	367	529	87	24	13
36	117	- - - - -	53	63	- - - - -	3,000	- - - - -	331	- - - - -	84	22	- - - - -
Total	2,463	2,031	1,705	1,902	1,928	9,569	47,112	19,943	15,653	7,835	1,359	515
Mean	79.5	67.7	55.0	61.4	68.9	309	1,570	643	522	253	43.8	17.2
Max	125	110	61	65	72	3,000	3,170	1,100	726	507	72	22
Min	33	62	52	53	63	60	907	331	272	81	22	12
Ac-ft	4,890	4,030	3,380	3,770	3,820	18,980	93,450	39,560	31,050	15,540	2,700	1,020

Cal yr1966: Total 167,980 Mean 460 Max 4,110 Min 33 Ac-ft 333,200
 Wtr yr1967: Total 112,015 Mean 307 Max 3,170 Min 12 Ac-ft 222,200

Note.--Backwater from Red River of the North Apr. 1-5.

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 1967.

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.

Average discharge.--6 years, 1,990 cfs (1,441,000 acre-ft per year).

Extremes.--Maximum discharge during year, 13,800 cfs Apr. 23 (gage height, 22.71 ft); minimum, 133 cfs Sept. 26 (gage height, 1.99 ft).
1936-37, 1942-67: Maximum discharge, 26,800 cfs Mar. 27, 1966 (gage height, 35.35 ft, backwater from ice); 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. Some regulation by many controlled lakes and reservoirs on tributaries.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	592	790	640	660	540	500	10,800	5,280	2,290	2,220	800	206
2	599	758	580	660	540	520	10,400	5,280	2,210	2,160	750	206
3	599	722	620	660	540	520	9,300	5,310	2,140	2,150	660	199
4	599	690	620	660	520	540	7,750	5,230	2,080	2,160	620	196
5	589	693	580	660	500	540	6,220	5,110	2,060	2,140	582	194
6	579	672	540	660	500	580	5,170	5,020	2,020	2,090	570	192
7	570	690	540	660	500	640	4,380	4,930	2,010	2,040	560	187
8	570	680	600	640	500	660	3,970	4,810	2,040	2,000	540	183
9	576	700	640	640	500	720	3,780	4,660	2,070	1,960	549	181
10	573	760	660	640	500	740	3,760	4,390	2,180	1,960	549	181
11	582	820	660	620	500	780	3,820	4,120	2,220	1,940	534	178
12	592	800	660	620	500	820	4,090	3,870	2,170	1,840	513	168
13	609	720	650	610	500	860	4,350	3,710	2,120	1,780	474	162
14	630	700	620	620	500	900	4,500	3,550	2,110	1,780	420	155
15	657	680	600	620	500	900	4,710	3,450	2,290	1,880	387	152
16	672	740	620	620	500	940	4,940	3,360	2,830	1,980	375	152
17	668	740	640	640	500	900	5,060	3,270	3,850	2,030	369	154
18	672	760	640	620	520	900	5,410	3,190	4,960	2,020	369	162
19	711	740	660	620	520	920	6,020	3,110	5,850	1,930	366	162
20	744	700	660	600	540	940	8,420	3,040	6,480	1,830	355	155
21	747	720	680	580	560	960	12,100	2,960	6,820	1,740	355	148
22	754	700	700	560	560	960	13,500	2,880	6,790	1,650	347	148
23	758	680	700	580	560	960	13,700	2,810	6,180	1,520	341	142
24	801	640	700	580	560	960	12,700	2,750	4,910	1,450	344	142
25	823	660	720	580	540	1,000	11,000	2,680	3,650	1,300	330	138
26	838	680	700	560	520	1,150	9,500	2,640	3,000	1,250	322	134
27	841	720	660	560	520	1,600	8,050	2,600	2,700	1,100	302	134
28	845	700	640	560	500	2,800	6,850	2,560	2,510	1,050	268	142
29	845	680	660	560	-----	4,220	6,000	2,500	2,390	950	255	194
30	826	660	680	560	-----	6,750	5,540	2,440	2,300	900	248	250
31	805	-----	680	560	-----	10,900	-----	2,370	-----	850	227	-----
Total	21,266	21,395	19,950	18,970	14,540	47,080	215,790	113,880	97,230	53,650	13,681	5,097
Mean	686	713	644	612	519	1,519	7,193	3,674	3,241	1,731	441	170
Max	845	820	720	660	560	10,900	13,700	5,310	6,820	2,220	800	250
Min	570	640	540	560	500	500	3,760	2,370	2,010	850	227	134
Ac-ft	42,180	42,440	39,570	37,630	28,840	93,380	428,000	225,900	192,900	106,400	27,140	10,110

Cal yr 1966: Total 1,023,862 Mean 2,805 Max 26,400 Min 540 Ac-ft 2,031,000
Wtr yr 1967: Total 642,529 Mean 1,760 Max 13,700 Min 134 Ac-ft 1,274,000

RED RIVER OF THE NORTH BASIN

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, 3¼ miles southeast of Shelly and 10 miles upstream from mouth.

Drainage area.--151 sq mi.

Records available.--March 1944 to September 1967. Monthly discharge only for March 1944, published in WSP 1308.

Gage.--Wire-weight gage read once or twice daily and crest-stage gage. Datum of gage is 841.14 ft above mean sea level, datum of 1929 (levels by Corps of Engineers). Prior to Oct. 1, 1965, chain gage at datum 3.0 ft higher. Oct. 1, 1965, to June 27, 1966, chain gage at same datum.

Average discharge.--23 years, 83.7 cfs (60,600 acre-ft per year).

Extremes.--Maximum discharge during year, 866 cfs Mar. 30 (gage height, 11.54 ft, from floodmark); no flow for many days.

1944-67: Maximum discharge, 4,660 cfs May 11, 1950 (gage height, 18.96 ft, from floodmark); no flow for many days most years.

Remarks.--Records good. Large part of high flow of Wild Rice River diverted into Marsh River basin at overflow section 3¼ 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						0	496	70	5.0	3.1		
2	0.4	.1				0	312	89	4.3	3.6		
3	.2	.1				0	188	101	3.1	4.2		
4	.2	.1				0	142	78	3.0	4.5		
5	.2	.1				0	90	61	3.5	4.0		
6						0	64	52	4.0	3.4		
7	.2	.1				0	52	40	6.1	2.6		
8	.1	.1				0	41	37	9.8	1.0		
9	.1	.1				0	36	34	16	.8		
10	.4	0				0	31	32	24	1.0		
11	.6	0				0	29	31	20	1.5		
12	.4	0				0	26	30	16	1.2		
13	.3	0				0	24	28	14	1.2		
14	.3	0				0	36	26	17	.6		
15	.3	0				0	48	25	20	.6		
16	.3	0				0	45	23	18	.4		
17	.2	0				0	39	21	15	.3		
18	.2	0				0	44	18	11	.2		
19	.2	0				0	111	17	10	.2		
20	.2	0				0	373	16	10	.1		
21	.2	0				0	699	14	10	.1		
22	.2	0				0	499	12	12	.1		
23	.1	0				0.2	266	11	10	.6		
24	.1	0				.5	170	10	9.3	.4		
25	.1	0				2.3	133	9.8	6.7	.3		
26	.1	0				7.5	95	10	6.5	.2		
27	.1	0				23	72	8.6	3.4	.1		
28	.1	0				68	54	8.6	3.6	0		
29	.1	0				300	45	7.7	3.1	0		
30	.1	0				724	49	6.9	3.1	0		
31	.1	0				738		5.7		0		
Total	6.5	0.9	0	0	0	1,863.5	4,309	933.3	297.5	36.3	0	0
Mean	0.21	0.03	0	0	0	60.1	144	30.1	9.92	1.17	0	0
Max	0.6	0.1	0	0	0	738	699	101	24	4.5	0	0
Min	0.1	0	0	0	0	0	24	5.7	3.0	0	0	0
Ac-ft	13	1.8	0	0	0	3,700	8,550	1,850	590	72	0	0

Cal yr1966: Total 22,886.0 Mean 62.7 Max 1,400 Min 0 Ac-ft 45,390
 Wtr yr1967: Total 7,447.0 Mean 20.4 Max 738 Min 0 Ac-ft 14,770

5-0690. Sandhill River at Climax, Minn.

Location (revised).--Lat 47°36'43", long 96°48'52", in NE¼NE¼ sec.30, T.148 N., R.48 W., near center of span on downstream side of bridge on U.S. Highway 75 in Climax and 3.7 miles upstream from mouth.

Records available.--March 1943 to September 1967 (winter records incomplete in some years). Monthly discharge only for some periods, published in WSP 1308.

Gage.--Wire-weight gage and crest-stage gage; gage read once or twice daily. Altitude of gage is 820 ft (from topographic map). Prior to Oct. 1, 1966, chain gage at site 3.2 miles upstream at different datum.

Average discharge.--21 years (1946-67), 64.3 cfs (46,550 acre-ft per year).

Extremes.--Maximum discharge during year, 2,060 cfs Mar. 30 (gage height, 14.46 ft, from floodmark); minimum observed, 9.8 cfs Sept. 6-8 (gage height, 4.79 ft).

1943-67: Maximum discharge, 4,560 cfs Apr. 14, 1965 (gage height 17.81 ft, site and datum then in use); minimum not determined.

Remarks.--Records good except those for winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	16	18	11	11	16	14	673	160	50	39	17	10
2	17	16	10	11	16	14	608	170	47	37	16	10
3	17	14	10	11	16	14	790	188	44	37	15	10
4	17	14	11	11	16	14	820	167	42	36	14	10
5	17	13	11	11	16	14	658	147	42	34	16	10
6	16	13	11	11	16	14	439	137	99	37	17	9.8
7	17	13	11	11	16	14	279	135	128	34	17	9.8
8	18	13	10	12	16	14	236	130	125	37	13	9.8
9	16	12	10	12	16	14	204	124	140	35	13	10
10	15	12	10	12	16	14	171	121	134	33	13	10
11	15	12	10	12	15	14	163	117	122	32	13	10
12	16	12	10	13	15	14	157	113	110	30	13	10
13	16	12	10	13	15	14	142	107	101	29	13	10
14	18	11	10	13	15	14	154	103	92	28	13	10
15	18	11	11	13	14	14	164	99	84	28	13	11
16	18	11	11	13	13	14	163	97	80	26	12	13
17	20	11	11	12	13	14	154	94	86	24	12	17
18	19	11	11	12	13	14	148	90	74	23	12	19
19	20	11	11	12	12	14	154	85	62	22	12	19
20	20	11	11	12	12	14	552	81	55	23	12	17
21	20	11	11	12	12	15	892	78	50	22	12	15
22	20	12	11	12	13	15	607	68	50	20	11	14
23	21	12	11	13	13	16	350	66	52	20	12	12
24	23	12	10	13	13	18	320	69	53	20	11	11
25	23	12	10	13	13	21	290	71	51	19	11	12
26	24	12	10	14	13	28	240	66	46	18	11	12
27	25	12	10	14	13	50	210	62	44	17	11	12
28	23	12	10	14	13	96	180	60	43	16	10	13
29	22	11	10	14		210	160	58	41	15	10	13
30	21	11	10	15	-----	960	150	56	42	16	10	14
31	19	-----	11	15	-----	1,080	-----	54	-----	16	10	-----
Total	587	368	325	387	400	2,789	10,228	3,173	2,189	823	395	3634
Mean	18.9	12.3	10.5	12.5	14.3	90.0	341	102	73.0	26.5	12.7	12.1
Max	25	18	11	15	16	1,080	892	188	140	39	17	15
Min	15	11	10	11	12	14	142	54	41	15	10	9.8
Ac-ft	1,160	730	645	768	793	5,530	20,290	6,290	4,340	1,630	783	721
Cal yr 1966: Total	52,526		Mean 144	Max 4,120	Min 10	Ac-ft 104,200						
Wtr yr 1967: Total	22,027.4		Mean 60.3	Max 1,080	Min 9.8	Ac-ft 43,690						

RED RIVER OF THE NORTH BASIN

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 1967 (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 Apr. 30 (affected by wind action); maximum daily, 6.27 ft Apr. 30; minimum, 4.19 ft Sept. 23 (affected by wind action).
1930-67: 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 1966 to September 1967

Oct. 31	5.24	Feb. 28	4.81	June 30	5.87
Nov. 30	5.07	Mar. 31	4.94	July 31	5.56
Dec. 31	4.92	Apr. 30	6.27	Aug. 31	5.10
Jan. 31	4.87	May 31	5.84	Sept.30	4.52

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 1967. 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.--34 years, 433 cfs (313,500 acre-ft per year).

Extremes.--Maximum daily discharge during year, 1,240 cfs July 2; maximum gage height, 6.66 ft July 28 (affected by backwater from aquatic vegetation); minimum discharge, 63 cfs Apr. 4.
1933-67: 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.080	996	1.060	820	960	970	97	720	949	1.220	856	508
2	1.080	984	1.050	820	960	960	90	684	946	1.240	844	752
3	1.070	968	1.030	810	960	960	85	495	934	1.220	833	782
4	1.060	965	1.010	810	960	950	82	461	938	1.210	837	793
5	1.050	960	990	810	960	950	205	448	923	1.070	837	808
6	1.050	960	990	810	960	950	354	445	923	900	837	811
7	1.060	965	980	830	960	950	508	461	934	841	837	804
8	1.060	970	970	840	960	950	666	461	972	804	830	822
9	1.060	970	960	850	970	960	720	481	953	782	830	841
10	1.050	975	960	850	990	965	669	662	949	774	822	826
11	1.040	975	960	850	1.010	965	634	691	934	882	811	833
12	1.040	980	950	840	1.000	992	648	694	934	1.010	800	837
13	1.030	980	950	830	1.000	996	648	698	938	1.020	789	841
14	1.050	950	940	830	1.000	988	651	712	949	1.030	785	844
15	1.050	830	930	840	1.010	1.010	691	716	953	1.020	793	833
16	1.030	780	920	950	1.010	1.000	651	727	961	1.010	804	830
17	1.030	840	920	1.000	1.010	1.000	687	730	968	992	819	822
18	1.030	990	910	990	1.010	1.000	648	763	976	984	822	830
19	1.020	1.000	910	990	1.010	1.010	634	782	1.010	976	796	830
20	1.020	990	910	990	1.010	1.010	640	734	1.020	968	819	819
21	1.020	960	900	980	1.010	1.020	584	727	1.020	953	830	815
22	1.050	940	900	980	1.000	1.020	464	727	1.030	949	734	727
23	1.020	930	890	980	1.000	976	425	730	1.040	934	532	616
24	1.010	910	890	970	1.000	953	420	734	1.040	919	458	560
25	1.010	900	890	970	1.000	976	420	745	1.050	915	422	612
26	999	890	880	970	990	976	461	856	878	908	394	539
27	999	890	880	970	990	976	651	968	529	893	375	539
28	1.010	880	870	970	980	976	658	984	857	863	357	525
29	1.000	880	860	970	- - - -	723	687	980	1.120	870	357	532
30	1.010	1.000	840	960	- - - -	398	684	965	1.210	859	345	546
31	1.010	- - - -	830	960	- - - -	165	- - - -	953	- - - -	856	339	- - - -
Total	32,098	28,208	28,930	28,040	27,680	28,695	15,462	21,934	28,838	29,872	21,544	22,077
Mean	1,035	940	933	905	989	926	515	708	961	964	695	736
Max	1.080	1,000	1,060	1,000	1,010	1,020	720	984	1,210	1,240	856	844
Min	.99	780	830	810	960	165	82	445	529	774	339	508
Ac-ft	63,670	55,950	57,380	55,620	54,900	56,920	30,670	43,510	57,200	59,250	42,730	43,790
Cal yr 1966: Total	337,708		Mean 925	Max 1,480	Min 68	Ac-ft 669,800						
Wtr yr 1967: Total	313,378		Mean 859	Max 1,240	Min 82	Ac-ft 621,600						

RED RIVER OF THE NORTH BASIN

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 1967. 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.--38 years, 459 cfs (332,300 acre-ft per year).

Extremes.--Maximum discharge during year, 2,480 cfs Mar. 30 (gage height, 10.84 ft); minimum, 495 cfs Sept. 2. 1929-67: 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 winter months, which are fair. Flow regulated by outlet dam on Lower Red Lake.

Discharge, in cubic feet per second, water year October 1966 to September 67

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,140	1,090	800	860	980	1,000	1,300	1,970	1,180	1,000	869	503
2	1,150	1,090	900	850	980	1,000	967	2,190	1,160	1,060	876	506
3	1,150	1,080	1,000	840	970	1,010	764	1,930	1,150	1,090	867	583
4	1,150	1,070	1,050	830	970	1,010	685	1,630	1,120	1,110	860	678
5	1,150	1,070	1,070	820	970	1,020	680	1,480	1,110	1,110	852	753
6	1,150	1,060	1,070	810	980	1,020	833	1,360	1,130	1,080	848	795
7	1,140	1,070	1,050	810	980	1,020	909	1,260	1,170	998	850	824
8	1,140	990	1,040	800	990	1,040	1,110	1,210	1,230	912	855	831
9	1,130	1,070	1,030	800	990	1,040	1,250	1,150	1,300	848	852	840
10	1,130	1,220	1,000	810	1,000	1,030	1,220	1,180	1,280	800	845	860
11	1,120	1,180	970	830	1,000	1,030	1,170	1,300	1,260	769	843	874
12	1,130	1,170	930	840	1,000	1,020	1,130	1,310	1,260	769	840	879
13	1,130	1,230	930	860	1,010	1,020	1,100	1,280	1,280	819	833	889
14	1,140	1,180	940	870	1,010	1,020	1,110	1,250	1,290	855	821	904
15	1,150	1,160	940	870	1,020	1,010	1,130	1,240	1,280	884	816	909
16	1,150	1,020	940	890	1,020	1,010	1,130	1,220	1,270	886	816	909
17	1,150	900	930	910	1,020	1,010	1,140	1,210	1,240	889	819	909
18	1,140	780	930	970	1,030	1,000	1,170	1,190	1,230	892	821	912
19	1,130	890	930	1,020	1,030	1,000	1,290	1,150	1,240	886	824	926
20	1,130	1,000	920	1,030	1,030	1,000	1,670	1,140	1,270	882	824	919
21	1,130	1,050	920	1,040	1,020	990	2,030	1,130	1,270	879	824	914
22	1,130	1,070	910	1,050	1,020	990	1,670	1,100	1,250	879	826	909
23	1,120	1,100	910	1,050	1,020	1,020	1,240	1,080	1,240	869	828	884
24	1,110	1,120	900	1,050	1,010	1,050	1,150	1,070	1,230	857	795	802
25	1,110	1,100	900	1,040	1,010	1,100	1,130	1,060	1,220	855	716	738
26	1,110	1,090	890	1,030	1,010	1,150	1,100	1,040	1,210	860	654	700
27	1,110	1,060	890	1,020	1,010	1,240	1,160	1,090	1,130	855	615	676
28	1,110	1,000	880	1,010	1,010	1,450	1,290	1,180	833	852	574	660
29	1,110	950	880	1,000		1,630	1,430	1,220	709	845	543	646
30	1,110	850	870	990	- - - -	2,300	1,610	1,220	886	850	524	636
31	1,090	- - - -	860	990	- - - -	2,090	- - - -	1,210	- - - -	857	513	- - - -
Total	35,040	31,710	29,180	28,590	28,090	35,220	35,568	40,050	35,428	27,997	24,243	23,768
Mean	1,130	1,057	941	922	1,003	1,136	1,186	1,292	1,181	903	782	792
Max	1,150	1,230	1,070	1,050	1,030	2,200	2,030	2,190	1,300	1,110	876	926
Min	1,090	780	800	800	970	990	680	1,040	709	769	513	503
Ac-ft	69,500	62,900	57,880	56,710	55,720	69,860	70,550	79,440	70,270	55,530	48,090	47,140

Cal yr1966: Total 418,319 Mean 1,146 Max 3,250 Min 300 Ac-ft 829,700
 Wtr yr1967: Total 374,884 Mean 1,027 Max 2,200 Min 503 Ac-ft 743,600

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 1967. 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.--50 years, 147 cfs (106,400 acre-ft per year).

Extremes.--Maximum discharge during year, 3,100 cfs Apr. 21 (gage height, 13.26 ft); maximum gage height, 15.82 ft Apr. 2 (backwater from ice); no flow Sept. 28-30.

1909-17, 1919-26, 1928-67: 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 period of no gage-height record and those for winter months, which are fair. Some regulation by Thief and Mud Lakes.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7.9	7.5	34	1.5	1.3	1.3	1,690	2,760	787	274	17	8.7
2	6.4	32	33	1.5	1.3	1.2	2,350	2,990	764	274	22	7.6
3	6.4	35	33	1.4	1.4	1.2	2,190	2,860	732	276	28	6.8
4	6.0	34	32	1.4	1.4	1.2	1,970	2,580	459	372	30	6.0
5	6.0	33	32	1.4	1.4	1.2	1,760	2,460	338	377	28	3.9
6	6.0	33	31	1.4	1.4	1.1	1,520	2,400	332	372	20	2.2
7	5.6	33	30	1.4	1.4	1.1	1,380	2,330	403	369	21	1.5
8	5.0	32	26	1.3	1.4	1.1	1,350	2,280	483	363	15	1.5
9	4.4	31	17	1.3	1.5	1.1	1,240	2,230	835	360	12	1.4
10	9.9	31	15	1.3	1.5	1.0	1,070	2,190	851	358	13	0.7
11	12	31	14	1.3	1.5	1.0	1,050	2,150	784	352	15	.6
12	12	31	13	1.3	1.5	0.9	1,020	2,110	716	346	11	.9
13	12	31	10	1.3	1.6	.9	989	2,050	624	346	6.8	1.2
14	12	31	8.0	1.3	1.6	.9	1,080	1,990	618	344	11	1.2
15	14	31	6.0	1.3	1.6	.8	1,230	1,930	609	335	5.3	1.2
16	14	31	5.5	1.3	1.6	.8	1,170	1,850	573	330	4.7	.9
17	14	30	4.5	1.3	1.5	.8	1,090	1,770	543	321	5.0	.7
18	12	30	4.0	1.3	1.5	.8	1,070	1,650	522	212	6.4	1.0
19	35	30	3.2	1.3	1.5	.8	1,360	1,460	480	88	33	1.4
20	35	30	2.7	1.2	1.5	.8	2,650	1,360	409	73	45	1.0
21	23	31	2.5	1.2	1.4	.8	3,080	1,280	412	71	44	.7
22	19	32	2.3	1.2	1.4	.8	2,940	1,160	394	73	42	.4
23	20	33	2.1	1.3	1.3	.8	2,840	1,030	372	73	39	.3
24	22	34	2.0	1.3	1.3	.9	2,610	1,030	346	55	39	.2
25	23	35	1.9	1.3	1.3	.9	2,330	1,000	335	36	34	.1
26	23	36	1.9	1.3	1.3	1.0	2,090	968	332	25	27	.1
27	23	36	1.8	1.3	1.3	1.2	1,990	940	321	18	18	.1
28	22	35	1.7	1.3	1.3	1.8	1,910	919	310	15	17	.1
29	20	35	1.7	1.3		3.4	2,010	888	307	26	14	0
30	17	34	1.6	1.3	-----	250	2,350	854	302	26	10	0
31	11	-----	1.6	1.3	-----	1,450	-----	816	-----	20	9.5	-----
Total	458.6	948.5	375.0	40.9	40.0	1,731.6	53,379	54,285	15,293	6,580	642.7	52.4
Mean	14.8	31.6	12.1	1.32	1.43	55.9	1,779	1,751	510	212	20.7	1.75
Max	35	36	34	1.5	1.6	1,450	3,080	2,990	851	377	45	8.7
Min	4.4	7.5	1.6	1.2	1.3	0.8	989	816	302	15	4.7	0
Ac-ft	910	1,880	744	81.1	79.3	3,430	105,900	107,700	30,300	13,050	12,750	104

Cal yr 1966: Total 194,494.3 Mean 533 Max 3,160 Min 1.6 Ac-ft 385,800
 Wtr yr 1967: Total 133,826.7 Mean 367 Max 3,080 Min 0 Ac-ft 265,400

Note.--No gage-height record Feb. 19 to Mar. 21.

RED RIVER OF THE NORTH BASIN

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 4¼ miles east of Gonvick.

Drainage area.--45.2 sq mi.

Records available.--April 1960 to September 1967. Monthly and daily figures for April 1, 1960 to June 30, 1960 published in WSP 1913.

Gage.--Wire-weight gage read once daily and crest-stage gage. 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.--7 years, 15.6 cfs (11,290 acre-ft per year).

Extremes.--Maximum discharge during year, 453 cfs Mar. 30 (gage height, 6.35 ft, from graph based on gage readings); maximum gage height, 6.55 ft Mar. 29 (from graph based on gage readings, backwater from ice); minimum discharge, 0.3 cfs Sept. 24, 26-30.
1960-67: Maximum discharge, that of Mar. 30, 1967; maximum gage height, that of Mar. 29, 1967; minimum discharge, 0.3 cfs July 24, 1966, Sept. 24, 26-30, 1967; minimum gage height, 1.09 ft Aug. 20, 1964, July 24, 1966.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2.8	5.0	4.1	2.0	2.2	1.8	267	77	6.9	16	3.2	0.8
2	2.8	4.8	3.8	2.0	2.2	1.8	202	77	6.6	15	3.2	.5
3	3.2	4.6	3.6	2.0	2.2	1.7	133	63	5.7	15	3.0	.5
4	3.7	4.5	3.4	2.0	2.2	1.7	95	60	5.4	13	2.8	.5
5	3.2	4.5	3.2	2.0	2.2	1.6	75	57	5.0	10	2.4	.5
6	3.4	4.6	3.0	2.0	2.2	1.6	63	56	8.8	8.2	2.4	.4
7	3.4	4.9	2.9	2.0	2.2	1.5	54	45	9.6	8.2	2.8	.4
8	3.4	5.1	2.8	2.0	2.2	1.4	49	47	9.3	8.5	2.8	.4
9	3.0	5.2	2.7	2.0	2.2	1.3	53	39	42	7.4	2.8	.4
10	3.2	5.3	2.6	2.1	2.2	1.1	40	35	14	6.4	2.8	.4
11	3.2	5.4	2.5	2.1	2.2	1.0	37	33	42	5.4	2.2	.8
12	3.4	5.4	2.4	2.1	2.2	0.9	37	30	51	5.2	2.2	.5
13	3.4	5.5	2.3	2.1	2.2	.8	37	28	54	4.5	2.2	1.2
14	6.2	5.5	2.3	2.1	2.2	.7	43	26	57	4.5	2.0	1.0
15	9.6	5.5	2.3	2.1	2.4	.7	40	24	53	4.3	1.6	1.0
16	8.2	5.5	2.2	2.1	2.4	.6	43	20	52	4.3	1.6	1.0
17	6.9	5.5	2.2	2.1	2.4	.6	74	16	43	4.1	1.2	1.0
18	5.9	5.4	2.2	2.1	2.6	.6	75	16	37	4.1	1.4	1.0
19	5.9	5.4	2.2	2.1	2.6	.6	69	14	37	4.1	1.4	1.2
20	5.4	5.4	2.1	2.1	2.8	.6	93	13	51	3.4	1.6	1.0
21	5.4	5.4	2.1	2.1	2.8	.6	96	11	44	3.2	1.6	.7
22	6.4	5.3	2.1	2.1	2.8	.6	80	10	36	3.4	1.4	.7
23	6.4	5.3	2.1	2.1	2.6	.6	65	10	32	3.2	1.4	.6
24	6.6	5.2	2.1	2.1	2.6	.6	58	11	29	3.2	1.6	.3
25	6.4	5.2	2.0	2.1	2.4	.8	50	9.9	24	3.2	1.4	.4
26	6.4	5.1	2.0	2.1	2.2	2.0	44	13	25	3.7	1.4	.3
27	6.2	5.0	2.0	2.2	2.0	20	40	12	27	3.2	1.6	.3
28	6.2	4.8	2.0	2.2	1.8	50	38	12	30	4.1	1.2	.3
29	5.7	4.6	2.0	2.2		102	38	9.3	26	4.3	1.0	.3
30	5.7	4.4	2.0	2.2		350	50	8.2	19	4.8	1.0	.3
31	5.9		2.0	2.2		390		7.6		3.9	1.0	
Total	157.5	153.3	77.2	64.7	65.2	939.8	2,138	890.0	882.3	191.8	60.2	18.7
Mean	5.08	5.11	2.49	2.09	2.33	30.3	71.3	28.7	29.4	6.19	1.94	0.62
Max	9.6	5.5	4.1	2.2	2.8	390	267	77	57	16	3.2	1.2
Min	2.8	4.4	2.0	2.0	1.8	0.6	37	7.6	5.0	3.2	1.0	0.3
Ac-ft	312	304	153	128	129	1,860	4,240	1,770	1,750	380	119	37

Cal yr 1966: Total 7,349.1 Mean 20.1 Max 258 Min 0.6 Ac-ft 14,580
Wtr yr 1967: Total 5,638.7 Mean 15.4 Max 390 Min 0.3 Ac-ft 11,180

Peak discharge (base, 65 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-30	2000	6.35	453	5-2	0200	2.91	83
4-21	0400	3.23	100				

5-0780. Clearwater River at Plummer, Minn.

Location.--Lat 47°55', long 96°03', in SE 1/4 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 1967.

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.--28 years, 174 cfs (126,000 acre-ft per year).

Extremes.--Maximum discharge during year, 2,470 cfs Apr. 3 (gage height, 10.19 ft); maximum gage height, 11.02 ft Apr. 1 (backwater from ice); minimum discharge, 20 cfs Sept. 9, 12 (gage height, 2.29 ft).
1939-67: Maximum discharge, 3,640 cfs June 9, 1962 (gage height, 11.90 ft); maximum gage height, 11.97 ft Apr. 11, 1965 (backwater from ice); minimum discharge, 7.9 cfs July 8, 1940.

Remarks.--Records good except those for periods of no gage-height record and those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	57	77	60	60	60	55	1,750	916	210	237	48	25
2	57	68	60	60	60	54	1,980	1,230	252	227	58	25
3	57	65	58	61	60	54	2,330	1,360	243	215	55	24
4	57	90	58	62	59	54	1,640	1,240	236	206	51	23
5	58	105	59	62	59	55	1,420	1,130	227	203	50	23
6	61	97	61	63	58	56	1,360	1,100	232	198	47	22
7	61	91	62	63	58	56	1,250	1,020	248	188	44	21
8	63	85	63	63	59	58	1,130	924	213	178	48	21
9	63	80	62	63	59	58	1,040	791	261	174	46	21
10	63	78	61	64	59	56	960	645	331	172	48	21
11	64	76	60	64	60	56	828	660	320	166	49	21
12	64	76	60	64	60	55	702	681	306	156	45	21
13	63	78	60	64	60	54	622	645	349	146	36	21
14	64	78	62	64	61	52	605	608	406	128	44	21
15	65	80	64	63	61	52	569	574	436	103	39	27
16	98	83	65	63	61	50	552	436	436	98	32	29
17	107	86	65	63	61	50	560	329	413	90	30	32
18	107	86	65	63	60	50	650	285	384	84	36	37
19	107	84	65	62	60	51	772	260	366	80	35	47
20	106	84	64	62	59	51	988	243	382	84	32	42
21	106	86	64	62	59	52	1,410	232	429	83	29	40
22	103	88	64	62	58	52	1,470	225	448	77	29	37
23	104	88	64	62	58	54	1,250	217	443	66	28	40
24	107	84	63	61	57	56	1,070	212	415	66	26	41
25	106	80	62	61	57	58	948	201	388	60	25	41
26	104	73	62	61	56	59	844	196	364	54	25	37
27	103	68	62	60	56	61	756	196	340	54	25	37
28	101	65	61	60	55	62	676	198	335	58	27	35
29	100	64	61	60	55	90	660	195	310	57	27	33
30	101	62	60	60	-----	510	708	187	258	46	26	32
31	97	-----	60	60	-----	1,300	-----	179	-----	46	26	-----
Total	2,574	2,405	1,917	1,922	1,650	3,431	31,500	17,315	9,981	3,800	1,166	897
Mean	83.0	80.2	61.8	62.0	58.9	111	1,050	559	333	123	37.6	29.9
Max	107	105	65	64	61	1,300	2,330	1,360	448	237	58	47
Min	57	62	58	60	55	50	552	179	210	46	25	21
Ac-ft	5,110	4,770	3,800	3,810	3,270	6,810	62,480	34,340	19,800	7,540	2,310	1,780

Cal yr 1966: Total	92,640	Mean	254	Max	1,980	Min	45	Ac-ft	183,700
Wtr yr 1967: Total	78,558	Mean	215	Max	2,330	Min	21	Ac-ft	155,800

Peak discharge (base, 500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-3	1430	10.19	2,470	5-3	0600	7.88	1,380
4-21	2400	8.25	1,530				

Note.--No gage-height record Nov. 2 to Dec. 4, Dec. 5 to Jan. 8, Jan. 15 to Feb. 15, Feb. 17 to Mar. 20.

RED RIVER OF THE NORTH BASIN

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.---April 1960 to September 1967. Monthly and daily figures for April 1, 1960 to June 30, 1960 published in WSP 1913.

Gage.---Wire-weight gage read once or twice daily and crest-stage gage. 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. September 9, 1960, to Sept. 30, 1964, wire-weight gage at same site at datum 8.00 ft higher.

Average discharge.---7 years, 79.1 cfs (57,270 acre-ft per year).

Extremes.---Maximum discharge during year, 2,880 cfs Mar. 31 (gage height, 14.17 ft, from graph based on gage readings); minimum, 0.4 cfs Sept. 9, 10; minimum gage height, 2.00 ft Sept. 9, 29, 30.

1960-67: Maximum discharge, that of Mar. 31, 1967; 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.

Remarks.---Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	6.8	12	8.7	5.7	7.8	9.4	1,110	512	41	59	7.0	0.8
2	8.6	11	8.3	5.8	8.0	9.6	629	572	38	54	13	.7
3	9.1	10	7.9	5.8	8.1	9.6	452	466	34	51	7.3	.7
4	9.6	9.0	7.5	5.9	8.2	9.6	399	400	32	44	6.4	.7
5	8.2	7.8	7.3	6.0	8.3	9.6	365	352	33	42	4.7	.7
6	7.2	7.1	7.1	6.0	8.4	9.6	329	295	46	40	4.7	.6
7	6.3	7.6	6.9	6.1	8.5	9.6	300	247	73	38	4.9	.5
8	5.3	8.0	6.6	6.2	8.6	9.6	276	226	126	38	5.1	.5
9	5.3	9.5	6.3	6.3	8.7	9.6	262	200	200	35	5.6	.4
10	5.6	9.2	6.1	6.4	8.9	9.6	234	186	184	34	4.9	.4
11	5.3	9.0	6.0	6.6	9.1	9.5	212	192	158	32	4.9	.6
12	5.3	8.8	5.9	6.7	9.2	9.4	203	178	143	31	4.2	.6
13	6.0	8.6	5.9	6.8	9.3	9.4	192	151	166	28	2.3	.6
14	6.8	8.6	5.9	6.8	9.4	9.3	203	139	180	20	.8	1.1
15	8.2	8.8	5.9	6.8	9.5	9.2	202	133	170	17	1.2	.9
16	12	9.0	5.9	6.8	9.5	9.2	208	110	143	15	1.6	.8
17	12	9.0	5.9	6.8	9.5	9.2	230	109	82	14	1.1	1.1
18	13	9.2	5.9	6.9	9.4	9.3	265	100	71	13	1.2	1.7
19	10	9.5	5.9	6.9	9.4	9.4	498	93	73	11	1.1	4.2
20	8.2	9.8	5.8	6.9	9.3	9.6	519	83	95	9.3	1.1	5.5
21	9.1	10	5.7	7.0	9.3	9.8	581	78	136	11	1.0	3.1
22	10	12	5.6	7.0	9.2	10	467	74	121	12	.9	2.1
23	12	14	5.3	7.0	9.1	10	368	71	107	8.6	.9	1.4
24	14	14	5.2	7.1	9.1	11	320	67	96	8.4	1.0	1.4
25	13	13	5.2	7.2	9.1	11	284	61	82	7.5	.9	1.4
26	12	12	5.2	7.2	9.2	11	253	61	68	10	.9	1.2
27	11	11	5.2	7.3	9.2	12	223	70	63	7.7	.9	1.2
28	12	10	5.3	7.4	9.2	18	221	56	63	7.7	.8	1.1
29	12	9.6	5.4	7.5		113	253	53	73	7.3	.8	1.0
30	12	9.1	5.5	7.6	-----	1,450	320	46	65	7.7	.8	1.0
31	12	-----	5.6	7.7	-----	2,560	-----	44	-----	7.3	.8	-----
Total	287.9	296.2	190.9	208.2	250.5	4,405.1	10,378	5,425	2,962	720.5	92.8	38.0
Mean	9.29	9.87	6.16	6.72	8.95	142	346	175	98.7	23.2	2.99	1.27
Max	14	14	8.7	7.7	9.5	2,560	1,110	572	200	59	13	5.5
Min	5.3	7.1	5.2	5.7	7.8	9.2	192	44	32	7.3	0.8	0.4
Ac-ft	571	588	379	413	497	8,740	20,580	10,760	5,880	1,430	184	75

Cal yr 1966: Total 35,222.8 Mean 96.5 Max 2,110 Min 2.2 Ac-ft 69,860
Wtr yr 1967: Total 25,255.1 Mean 69.2 Max 2,560 Min 0.4 Ac-ft 50,090

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

Location.--Lat 47°53'15", long 96°16'25", in NW 1/4 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 1967. 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.--41 years, 300 cfs (217,200 acre-ft per year).

Extremes.--Maximum discharge during year, 5,820 cfs Mar. 31 (gage height, 9.32 ft); maximum gage height, 9.67 ft Mar. 30 (from floodmark, backwater from ice); minimum discharge, 22 cfs Sept. 9 (gage height 1.61 ft). 1909-17, 1934-67: 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 winter months, which are fair. Slight regulation by Clearwater Lake and several smaller lakes.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	90	117	82	82	80	71	5,040	2,010	276	417	58	34
2	90	84	82	81	80	72	4,190	2,650	335	396	65	31
3	90	78	80	81	78	72	3,660	2,640	335	380	78	30
4	88	92	80	81	78	72	3,410	2,340	320	359	92	29
5	90	105	82	80	78	72	2,500	2,000	305	339	76	29
6	90	140	84	80	76	72	2,280	1,800	339	320	73	27
7	90	132	86	80	76	72	2,100	1,650	430	305	74	26
8	96	125	86	81	76	72	1,930	1,500	556	290	67	24
9	98	118	84	82	76	72	1,730	1,370	697	270	64	23
10	98	113	81	83	76	71	1,580	1,170	795	254	67	23
11	98	110	81	83	76	71	1,440	1,110	722	233	67	23
12	96	107	81	83	74	71	1,300	1,130	658	210	69	23
13	94	105	82	83	74	70	1,180	1,080	658	194	69	24
14	92	105	84	82	74	70	1,190	1,010	753	174	64	24
15	90	110	86	82	74	69	1,250	947	784	155	58	27
16	92	114	88	82	73	69	1,150	850	769	128	60	26
17	113	117	88	82	72	68	1,140	682	702	117	55	34
18	126	115	88	81	72	68	1,250	593	634	96	46	37
19	130	110	88	81	71	68	1,530	538	593	100	43	50
20	128	110	86	81	70	70	2,160	502	579	96	47	54
21	128	115	86	81	69	74	2,930	472	663	96	47	55
22	128	120	86	81	68	77	2,950	447	682	96	46	55
23	126	120	84	81	68	85	2,410	421	673	90	43	47
24	123	117	84	80	69	88	1,970	409	634	80	41	44
25	130	107	84	80	69	89	1,720	388	593	74	41	44
26	128	92	83	80	69	91	1,540	376	552	71	40	43
27	128	85	83	80	70	97	1,390	355	520	64	38	41
28	128	83	82	80	70	108	1,260	359	498	58	36	40
29	126	82	82	80		305	1,210	347	507	73	36	38
30	121	82	82	80	-----	3,350	1,330	328	459	71	36	37
31	119	-----	82	80	-----	5,210	-----	301	-----	67	36	-----
Total	3,364	3,210	2,597	2,514	2,056	10,986	60,720	31,775	17,021	5,673	1,732	1,042
Mean	108	107	83.8	81.1	73.4	354	2,020	1,025	567	183	55.9	34.7
Max	130	140	88	83	80	5,210	5,040	2,650	795	417	92	55
Min	88	82	80	80	68	68	1,140	301	276	58	36	23
Ac-ft	6,670	6,370	5,150	4,990	4,080	21,790	120,400	63,020	33,760	11,250	3,440	2,070
Cal yr 1966: Total	195,513		Mean	536	Max	8,710	Min	66	Ac-ft	387,800		
Wtr yr 1967: Total	142,690		Mean	391	Max	5,210	Min	23	Ac-ft	283,000		

RED RIVER OF THE NORTH BASIN

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 U. S. Highway 75, and 53 miles above mouth.

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

Records available.--May 1901 to September 1967. 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.--Digital water-stage recorder. 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, graphic water-stage recorder, Oct. 1, 1919, to Sept. 30, 1930, chain gage and Oct. 1, 1930, to June 10, 1965, graphic water-stage recorder, at present site and datum.

Average discharge.--66 years, 1,040 cfs (752,900 acre-ft per year).

Extremes.--Maximum discharge during year, 19,300 cfs Apr. 1 (gage height, 23.49 ft); minimum, 394 cfs Sept. 4 (gage height, 3.41 ft).

1901-67: Maximum discharge, 27,400 cfs May 7, 1950 (gage height, 25.70 ft); maximum gage height, 25.82 ft Apr. 12, 1965 (backwater from ice); no flow for part of July 13, 1960 (caused by regulation of power-plant upstream).

Remarks.--Records good except those for period of no gage-height record and those for winter months, which are fair. Diurnal fluctuation caused by powerplant upstream.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	1,180	1,200	970	1,060	1,110	1,060	18,000	6,550	2,600	1,450	925	542
2	1,170	1,040	920	1,050	1,110	1,060	14,500	9,670	2,510	1,550	912	500
3	1,180	983	870	1,050	1,110	1,070	11,100	9,900	2,500	1,640	915	486
4	1,190	1,140	950	1,050	1,100	1,080	9,030	8,890	2,350	1,690	947	438
5	1,190	1,310	1,100	1,040	1,100	1,100	7,840	7,690	2,170	1,750	922	504
6	1,180	1,300	1,230	1,040	1,100	1,100	6,170	6,800	1,970	1,820	912	666
7	1,170	1,170	1,280	1,030	1,100	1,100	5,370	6,240	2,090	1,840	902	717
8	1,180	818	1,250	1,030	1,100	1,070	5,030	5,780	2,240	1,800	765	771
9	1,160	671	1,200	1,040	1,090	1,040	4,850	5,420	2,550	1,670	891	822
10	1,190	672	1,150	1,060	1,090	1,060	4,690	5,120	3,140	1,540	874	788
11	1,190	607	1,130	1,060	1,090	1,100	4,320	4,790	3,350	1,440	873	867
12	1,170	799	1,120	1,060	1,080	1,120	4,040	4,830	3,130	1,350	890	880
13	1,180	897	1,120	1,050	1,080	1,130	3,810	4,880	2,970	1,270	871	903
14	1,240	1,150	1,130	1,040	1,080	1,130	3,720	4,790	2,900	1,250	865	925
15	1,170	1,380	1,130	1,040	1,080	1,120	4,060	4,640	2,960	1,290	855	970
16	1,130	1,670	1,140	1,030	1,070	1,120	4,200	4,460	2,960	1,350	851	1,010
17	1,230	1,650	1,150	1,030	1,070	1,110	4,040	4,240	2,840	1,360	841	1,010
18	1,290	1,570	1,160	1,020	1,070	1,100	3,820	4,010	2,690	1,370	802	1,020
19	1,270	1,150	1,160	1,010	1,070	1,100	3,900	3,780	2,570	1,310	809	1,060
20	1,210	962	1,150	1,010	1,070	1,120	5,870	3,490	2,560	1,200	888	1,050
21	1,270	1,030	1,140	1,020	1,060	1,140	11,500	3,240	2,450	1,120	873	1,070
22	1,220	1,240	1,130	1,030	1,060	1,130	13,100	3,200	2,510	1,110	870	1,040
23	1,210	1,330	1,120	1,050	1,060	1,130	10,700	3,070	2,510	1,100	862	1,040
24	1,250	1,340	1,100	1,060	1,060	1,130	8,260	2,820	2,450	1,040	860	1,020
25	1,230	1,350	1,100	1,070	1,050	1,140	6,800	2,820	2,360	1,030	865	992
26	1,170	1,320	1,100	1,080	1,050	1,150	5,960	2,760	2,280	1,030	850	905
27	1,190	1,330	1,080	1,100	1,050	1,170	5,330	2,700	2,210	984	791	841
28	1,230	1,310	1,080	1,100	1,050	1,200	4,940	2,610	2,130	918	685	751
29	1,200	1,140	1,070	1,100	-----	1,400	4,850	2,660	1,990	926	654	724
30	1,190	1,040	1,070	1,110	-----	4,010	5,190	2,720	1,620	929	588	693
31	1,210	-----	1,060	1,110	-----	8,750	-----	2,690	-----	916	548	-----
TOTAL	37,240	34,569	34,360	32,630	30,210	45,240	204,990	147,260	75,560	41,043	25,976	25,011
MEAN	1,201	1,152	1,108	1,053	1,079	1,459	6,833	4,750	2,519	1,324	838	834
MAX	1,290	1,670	1,280	1,110	1,110	8,750	18,000	9,900	3,350	1,840	947	1,070
MIN	1,130	607	870	1,010	1,050	1,040	3,720	2,610	1,620	916	548	438
AC-FT	73,860	68,570	68,150	64,720	59,920	89,730	406,600	292,100	149,900	81,410	51,520	49,610

CAL YR 1966: TOTAL 905,889 MEAN 2,482 MAX 19,900 MIN 607 AC-FT 1,797,000
 WAT YR 1967: TOTAL 734,089 MEAN 2,011 MAX 18,000 MIN 438 AC-FT 1,456,000

Note.--No gage-height record Jan. 1 to Feb. 1.

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 296.0.

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

Records available.--April 1882 to September 1967. 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 records 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.--85 years, 2,397 cfs (1,735,000 acre-ft per year).

Extremes.--Maximum discharge during year, 28,200 cfs Apr. 4 (gage height, 37.50 ft); minimum, 460 cfs Sept. 6 (gage height, 3.83 ft).

1882-1967: 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 the winter period, which are fair. Flow regulated by many lakes and reservoirs on tributaries. Records of chemical analyses and water temperatures for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1760	2140	1900	1800	1650	1600	13800	13500	5040	4180	1710	656
2	1750	2100	1700	1750	1650	1600	25200	13100	4920	3890	1620	611
3	1760	2000	1600	1750	1650	1600	27800	14100	4770	3830	1510	548
4	1780	1860	1450	1750	1650	1600	23000	15200	4670	3840	1480	516
5	1780	1880	1400	1750	1650	1600	25400	15500	4560	3870	1440	496
6	1780	2010	1450	1800	1650	1650	21400	15100	4520	3920	1410	471
7	1780	2000	1600	1750	1600	1650	17200	14300	4470	3950	1420	558
8	1760	1880	1750	1750	1600	1650	14000	13300	4560	3920	1390	684
9	1750	1580	1850	1750	1600	1750	12000	12400	4800	3840	1310	774
10	1740	1460	1900	1750	1650	1800	10500	11700	5140	3710	1260	798
11	1760	1440	1900	1700	1650	1850	9700	11000	5620	3560	1270	794
12	1760	1540	1900	1700	1650	1900	9200	10200	5890	3440	1260	834
13	1780	1520	1900	1700	1650	2000	8900	9600	5730	3290	1240	874
14	1800	1640	1900	1700	1650	2100	8750	9000	5470	3140	1210	906
15	1810	1680	1850	1700	1650	2100	8700	8400	5310	3040	1170	918
16	1810	1720	1850	1750	1600	2150	9000	8000	5350	3110	1100	926
17	1820	1760	1850	1750	1600	2200	9800	7700	5710	3230	1060	1010
18	1880	1780	1850	1750	1550	2200	9800	7500	6380	3320	1050	1040
19	1940	1740	1900	1700	1550	2150	9600	7250	7290	3330	1010	1070
20	2000	1720	1900	1700	1550	2200	10800	7000	8080	3230	966	1080
21	2000	1720	1900	1650	1550	2200	15300	6700	8670	3050	1020	1080
22	2070	1680	1950	1650	1550	2200	20300	6450	9110	2890	1040	1070
23	2080	1780	1900	1600	1550	2200	24600	6250	9320	2730	1040	1030
24	2060	1900	1850	1600	1550	2200	27000	6120	9040	2600	1040	1050
25	2080	1880	1800	1650	1550	2300	27300	5820	8060	2480	1030	1010
26	2120	1840	1800	1650	1550	2400	25300	5670	6790	2360	1040	1010
27	2120	1860	1800	1650	1550	2650	22300	5540	5800	2210	1030	970
28	2120	1940	1750	1650	1550	3650	19400	5390	5170	2080	970	938
29	2140	1900	1750	1650		5800	16700	5260	4830	1980	886	1050
30	2140	2000	1750	1650	- - - -	8600	14700	5190	4530	1900	814	1080
31	2150	- - - -	1800	1650	- - - -	12400	- - - -	5140	- - - -	1810	720	- - - -
Total	59,080	53,950	55,450	52,800	44,850	83,950	507,450	287,380	179,600	97,730	36,516	25,852
Mean	1,906	1,798	1,789	1,703	1,602	2,708	16,920	9,270	5,987	3,153	1,178	862
Max	2,150	2,140	1,950	1,800	1,650	12,400	28,000	15,500	9,320	4,180	1,710	1,080
Min	1,740	1,440	1,400	1,600	1,550	1,600	8,700	5,140	4,470	1,810	720	471
Ac-ft	117,200	107,000	110,000	104,700	88,960	166,500	1,007,000	570,000	356,200	193,800	72,430	51,280
Cal yr 1966: Total	2,119,320	Mean	5,806	Max	54,800	Min	1,400	Ac-ft	4,204,000			
Wtr yr 1967: Total	1,484,608	Mean	4,067	Max	28,000	Min	471	Ac-ft	2,945,000			

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 1967.

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.--17 years (1950-67), 41.1 cfs (29,760 acre-ft per year).

Extremes.--Maximum discharge during year, 1,320 cfs Apr. 23 (gage height 13.41 ft); maximum gage height, 14.39 ft Apr. 3 (backwater from ice); no flow Aug. 17 to Sept. 30.

1945, 1950-67: Maximum discharge, 2,590 cfs Apr. 12, 1965 (gage height, 15.29 ft); maximum gage height, 16.00 ft Apr. 3, 1966 (backwater from ice); no flow at times in 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 winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.3	2.3	1.4	0.7	0.6	0.6	480	384	30	11	0.2	
2	3.6	2.1	1.4	.7	.6	.6	670	526	28	10	.2	
3	3.7	2.0	1.3	.7	.6	.7	830	908	27	9.0	.1	
4	3.2	2.0	1.3	.7	.6	.7	700	993	24	8.4	.1	
5	2.7	2.1	1.2	.7	.6	.7	590	824	22	7.8	.1	
6	2.8	2.2	1.1	.7	.6	.7	510	638	22	10	.4	
7	3.0	2.2	1.0	.7	.5	.8	408	479	21	10	.6	
8	3.3	2.2	1.0	.7	.5	.9	329	366	20	10	.8	
9	3.8	2.1	1.0	.7	.5	1.0	284	288	19	10	.7	
10	3.8	2.1	.9	.7	.5	1.1	244	237	19	10	.5	
11	3.3	2.0	.9	.7	.5	1.2	219	203	20	8.4	.4	
12	3.3	1.9	.8	.7	.5	1.3	182	175	22	6.7	.3	
13	3.4	1.8	.8	.7	.5	1.3	159	151	24	5.7	.2	
14	5.5	1.8	.8	.7	.5	1.3	152	132	25	5.0	.1	
15	5.5	1.8	.8	.7	.5	1.3	160	114	24	4.7	.1	
16	5.7	1.8	.8	.7	.5	1.4	202	100	22	4.1	.1	
17	5.2	1.8	.8	.6	.5	1.4	271	88	23	3.6	0	
18	5.8	1.9	.8	.6	.5	1.5	269	81	22	3.2	0	
19	6.5	1.9	.9	.6	.5	1.7	232	71	22	2.6	0	
20	5.8	1.8	.9	.6	.5	1.9	305	65	22	2.4	0	
21	6.7	1.8	.9	.6	.5	2.2	600	61	20	2.0	0	
22	9.4	1.9	.8	.6	.5	2.5	980	57	18	1.8	0	
23	7.1	2.0	.8	.6	.5	3.0	1,270	53	18	1.2	0	
24	6.4	2.0	.8	.6	.5	3.7	1,040	49	19	1.1	0	
25	6.0	2.0	.8	.6	.5	5.0	826	46	20	1.0	0	
26	6.4	1.9	.8	.6	.5	8.0	679	44	19	.8	0	
27	6.5	1.9	.7	.6	.6	12	531	42	17	.6	0	
28	7.1	1.7	.7	.6	.6	25	406	40	15	.4	0	
29	7.2	1.5	.7	.6		40	331	38	14	.3	0	
30	6.5	1.4	.7	.6	-----	90	317	36	12	.2	0	
31	4.0	-----	.7	.6	-----	270	-----	34	-----	.3	0	-----
Total	156.5	57.9	28.3	20.2	14.8	483.5	14,176	7,323	630	152.3	4.9	0
Mean	5.05	1.93	0.91	0.65	0.53	15.6	473	236	21.0	4.91	0.16	0
Max	9.4	2.3	1.4	0.7	0.6	270	1,270	993	30	11	0.8	0
Min	2.7	1.4	0.7	0.6	0.5	0.6	152	34	12	0.2	0	0
Ac-ft	310	115	56.1	40.1	29.4	959	28,120	14,520	1,250	302	9.7	0

Cal yr 1966: Total 38,099.0 Mean 104 Max 1,700 Min 0.6 Ac-ft 75,570
 Wtr yr 1967: Total 23,047.4 Mean 63.1 Max 1,270 Min 0 Ac-ft 45,710

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 1967 (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.--18 years (1949-67) 3,623 cfs (2,623,000 acre-ft per year); median of yearly mean discharges, 3,000 cfs (2,170,000 acre-ft per year).

Extremes.--Maximum discharge during year, 32,200 cfs Apr. 8; maximum gage height, 36.70 ft Apr. 8); minimum discharge, 555 cfs Sept. 8 (gage height, 9.25 ft).
1936-37, 1941-67: 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. Some regulation by reservoirs on tributaries.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,770	2,140	1,700	1,800	1,550	1,550	11,800	25,300	5,490	4,760	1,910	900
2	1,770	2,100	1,600	1,800	1,550	1,550	17,500	24,700	5,350	4,380	1,820	850
3	1,770	2,070	1,450	1,800	1,550	1,550	22,500	24,200	5,170	4,040	1,770	778
4	1,770	2,100	1,300	1,800	1,550	1,550	26,200	23,700	5,000	3,850	1,730	718
5	1,770	2,030	1,200	1,800	1,550	1,550	23,500	23,400	4,840	3,790	1,700	675
6	1,770	1,940	1,100	1,800	1,550	1,550	31,300	23,200	4,700	3,820	1,650	651
7	1,770	1,890	1,050	1,800	1,550	1,550	32,200	22,700	4,620	3,850	1,600	603
8	1,770	1,460	1,100	1,800	1,550	1,550	31,500	22,200	4,560	3,880	1,550	579
9	1,740	1,240	1,200	1,800	1,550	1,600	29,500	21,300	4,600	3,880	1,550	627
10	1,710	1,430	1,300	1,800	1,550	1,650	27,200	20,700	4,730	3,840	1,500	692
11	1,700	1,500	1,500	1,800	1,550	1,650	24,600	19,700	5,040	3,720	1,500	778
12	1,710	1,440	1,550	1,800	1,550	1,700	22,400	13,700	5,450	3,580	1,450	841
13	1,710	1,360	1,600	1,800	1,550	1,800	20,200	17,500	5,840	3,470	1,400	850
14	1,720	1,350	1,650	1,800	1,550	1,900	13,600	16,100	5,880	3,320	1,300	880
15	1,740	1,360	1,650	1,800	1,550	1,950	17,200	14,800	5,720	3,180	1,250	900
16	1,760	1,480	1,650	1,750	1,550	2,000	16,100	13,500	5,500	3,050	1,200	930
17	1,780	1,600	1,650	1,750	1,550	2,050	15,400	12,200	5,460	3,040	1,170	940
18	1,790	1,660	1,650	1,750	1,550	2,100	14,900	11,300	5,640	3,110	1,140	961
19	1,800	1,780	1,700	1,700	1,550	2,100	14,600	10,600	6,120	3,190	1,070	1,020
20	1,830	1,900	1,700	1,700	1,550	2,150	14,400	9,700	6,820	3,230	1,050	1,030
21	1,880	1,900	1,750	1,700	1,550	2,150	17,200	9,000	7,480	3,220	1,040	1,050
22	1,910	1,900	1,750	1,650	1,550	2,150	20,200	8,300	7,900	3,140	1,030	1,060
23	1,980	1,800	1,750	1,600	1,550	2,150	22,800	7,700	8,350	2,980	1,040	1,030
24	1,980	1,700	1,750	1,550	1,550	2,150	25,100	7,200	8,600	2,840	1,070	1,060
25	2,000	1,750	1,750	1,550	1,550	2,150	26,600	6,800	8,600	2,700	1,060	1,020
26	2,010	1,800	1,800	1,550	1,550	2,200	26,900	6,500	8,000	2,580	1,070	1,030
27	2,030	1,800	1,800	1,550	1,550	2,250	27,000	6,200	7,100	2,460	1,060	1,020
28	2,060	1,800	1,800	1,550	1,550	2,350	27,100	6,000	6,300	2,340	1,050	983
29	2,070	1,800	1,800	1,550	1,550	2,700	26,500	5,750	5,700	2,240	1,050	930
30	2,060	1,800	1,800	1,550	1,550	5,000	25,300	5,700	5,220	2,120	1,030	900
31	2,120	- - - -	1,800	1,550	- - - -	8,300	- - - -	5,500	- - - -	2,010	961	- - - -
Total	57,250	51,880	48,850	53,000	43,400	68,600	681,300	450,150	179,780	101,610	40,771	26,286
Mean	1,847	1,729	1,576	1,710	1,550	2,213	22,710	14,520	5,993	3,278	1,315	876
Max	2,120	2,140	1,800	1,800	1,550	8,300	32,200	25,300	8,600	4,760	1,910	1,060
Min	1,700	1,240	1,050	1,550	1,550	1,550	11,800	5,500	4,560	2,010	961	579
Ac-ft	113,600	102,900	96,890	105,100	86,080	136,100	1,351,000	892,900	356,600	201,500	80,870	52,140

Cal yr1966: Total 2,578,390 Mean 7,064 Max 66,100 Min 1,050 Ac-ft 5,114,000

Wtr yr1967: Total 1,802,877 Mean 4,939 Max 32,200 Min 579 Ac-ft 3,576,000

RED RIVER OF THE NORTH BASIN

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 70 ft upstream from culvert 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 1967. Monthly discharge only for some periods, published in WSP 1308. Published as South Fork Two Rivers at Bronson prior to 1941.

Gage.--Digital 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, graphic water-stage recorder at same site at datum 2.00 ft higher and Oct. 6, 1963 to July 19, 1967, graphic water-stage recorder at same site and datum.

Average discharge.--26 years (1928-36, 1941-43, 1945-47, 1953-67), 84.0 cfs (60,810 acre-ft per year).

Extremes.--Maximum discharge during year, 2,430 cfs Apr. 21 (gage height, 11.43 ft); minimum daily, 0.9 cfs Feb. 7-18; minimum gage height, 3.17 ft Sept. 5, 25.
1928-37, 1941-47, 1953-67: Maximum discharge, 5,410 cfs Apr. 5, 1966 (gage height 18.23 ft); no flow at times in 1937, 1941, 1960.

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

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.0	3.0	3.9	2.3	1.1	5.1	1,540	1,440	213	4.8	3.6	2.6
2	4.0	2	3.8	2.3	1.0	5.6	1,850	1,370	263	4.8	3.6	1.8
3	3.6	1.8	3.8	2.3	1.0	5.8	1,880	1,430	257	4.8	3.6	1.8
4	3.6	1.8	3.7	2.2	1.0	6.0	1,770	1,520	221	4.6	3.4	1.6
5	4.0	2.0	3.7	2.2	1.0	6.0	1,660	1,580	94	4.2	3.0	1.6
6	4.0	2.2	3.7	2.1	1.0	6.0	1,450	1,510	141	5.2	3.0	1.6
7	3.0	2.5	3.7	2.1	.9	6.0	1,040	1,310	349	5.2	3.0	1.8
8	2.8	2.8	3.7	2.1	.9	6.0	895	968	173	4.8	3.4	1.6
9	2.8	3.0	3.7	2.0	.9	6.0	810	749	135	4.8	3.4	1.8
10	2.2	3.0	3.6	2.0	.9	6.0	807	700	188	4.8	3.4	1.6
11	2.8	3.0	3.6	2.0	.9	5.9	797	678	184	4.8	3.0	2.0
12	3.4	2.9	3.5	2.0	.9	5.9	588	552	175	4.6	3.0	2.0
13	4.0	2.9	3.5	1.9	.9	5.7	470	542	92	4.8	3.0	1.8
14	4.6	2.9	3.5	1.9	.9	5.7	440	608	16	4.6	3.0	2.0
15	4.2	2.9	3.4	1.8	.9	5.6	468	460	98	4.6	2.8	2.2
16	4.2	3.0	3.4	1.7	.9	5.5	503	344	194	4.2	3.0	2.2
17	4.6	3.2	3.4	1.7	.9	5.5	475	398	104	4.2	3.0	2.0
18	4.6	3.5	3.3	1.6	.9	5.4	380	452	52	4.0	3.4	2.2
19	5.8	3.8	3.3	1.6	1.0	5.5	360	288	54	4.0	2.8	2.0
20	10	3.9	3.2	1.5	1.1	5.6	803	390	37	4.0	3.0	2.0
21	24	3.8	3.2	1.4	1.1	5.9	1,920	331	21	4.2	2.8	2.2
22	23	3.8	3.1	1.4	1.1	6.2	2,210	304	32	4.2	2.5	2.2
23	22	3.9	3.0	1.4	1.1	6.6	2,070	373	56	4.2	2.2	2.2
24	22	4.0	2.9	1.3	1.1	7.3	2,000	356	42	4.2	2.2	2.5
25	22	4.2	2.8	1.3	1.1	8.9	1,850	322	27	4.0	2.2	2.2
26	21	4.3	2.7	1.2	1.2	13	1,600	269	26	4.0	2.5	2.2
27	21	4.3	2.6	1.2	2.5	19	1,260	298	26	4.0	2.8	2.2
28	21	4.2	2.6	1.2	4.3	28	939	296	18	4.0	2.2	2.5
29	21	4.2	2.5	1.1		50	797	292	7.0	4.0	2.5	3.0
30	20	4.1	2.4	1.1	- - - - -	105	1,080	271	5.5	3.6	2.5	2.5
31	16	- - - - -	2.4	1.1	- - - - -	340	- - - - -	197	- - - - -	3.6	89	- - - - -
Total	315.2	96.9	101.6	53.0	32.5	704.7	34,712	20,598	3,300.5	135.8	176.8	85.3
Mean	10.2	3.23	3.28	1.71	1.16	22.7	1,157	664	110	4.38	5.70	2.84
Max	24	4.3	3.9	2.3	4.3	340	2,210	1,580	349	5.2	89	26
Min	2.2	1.8	2.4	1.1	0.9	5.1	360	197	5.5	3.6	2.2	1.6
Ac-ft	625	192	202	105	64	1,400	68,850	40,860	6,550	269	351	169
Cal yr 1966: Total	110,491.6	Mean 303	Max 5,290	Min 1.4	Ac-ft 219,200							
Wtr yr 1967: Total	60,312.3	Mean 165	Max 2,210	Min 0.9	Ac-ft 119,600							

Note.--No gage-height record Feb. 28 to Mar. 27.

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 1967.

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 Sept. 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.--55 years (1912-67) 2,980 cfs (2,157,000 acre-ft per year); median of yearly mean discharges, 2,500 cfs (1,810,000 acre-ft per year).

Extremes.--Maximum discharge during year, 33,600 cfs Apr. 9 (gage height, 80.79 ft); minimum, 612 cfs Sept. 10 (gage height, 46.38 ft).
1912-67: 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 the winter period, which are fair. Discharge partially regulated by reservoirs on tributaries.

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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1920	2290	2290	1720	1480	1480	10500	33200	7110	5400	2190	1120
2	1900	2320	2270	1720	1480	1480	14100	33000	5860	5310	2090	1040
3	1880	2320	2190	1720	1470	1480	17000	32200	5650	4630	2000	955
4	1880	2300	2060	1740	1470	1480	19300	31000	6470	4320	1920	876
5	1890	2300	1880	1760	1460	1480	21700	30000	6320	4120	1860	832
6	1890	2280	1740	1770	1460	1470	25100	30100	5150	4030	1770	784
7	1890	2200	1600	1780	1450	1470	25700	30500	5970	4010	1700	732
8	1900	2000	1480	1770	1460	1480	31400	30400	5820	4010	1690	688
9	1910	2170	1430	1750	1460	1480	32500	29900	5790	4030	1640	636
10	1880	2140	1460	1740	1450	1500	33000	28900	5730	4030	1620	616
11	1870	2040	1520	1690	1460	1520	32600	27400	5680	4000	1590	640
12	1860	2010	1650	1670	1470	1550	31600	25800	5760	3920	1540	712
13	1860	1950	1750	1650	1480	1600	30000	24300	5970	3820	1480	796
14	1860	1850	1810	1630	1480	1650	28200	22900	5170	3700	1470	848
15	1860	1780	1840	1630	1500	1710	26900	21400	5190	3590	1470	884
16	1890	1750	1840	1620	1500	1720	24600	20000	6050	3440	1460	930
17	1900	1820	1840	1620	1500	1860	22800	18400	5870	3320	1430	995
18	1920	1930	1830	1620	1500	1940	21200	17000	5830	3260	1380	1020
19	1950	2080	1840	1620	1500	2000	19600	15700	5910	3270	1340	1040
20	1980	2170	1860	1630	1500	2060	18500	14400	6200	3330	1300	1080
21	2000	2180	1880	1620	1490	2110	20200	13100	6650	3370	1250	1110
22	2030	2190	1890	1600	1480	2120	22100	11900	7210	3380	1220	1140
23	2100	2200	1900	1590	1480	2120	23700	10900	7690	3310	1190	1150
24	2160	2210	1910	1560	1470	2120	25600	10100	8060	3170	1180	1140
25	2180	2220	1900	1520	1470	2120	27600	9450	8300	3020	1190	1160
26	2200	2230	1890	1500	1480	2180	29000	8940	8310	2880	1200	1140
27	2200	2240	1860	1480	1480	2280	30500	8510	7950	2740	1200	1140
28	2220	2250	1830	1460	1490	2410	31400	8130	7270	2620	1200	1140
29	2240	2260	1800	1460		2610	31900	7840	5580	2500	1200	1110
30	2260	2280	1760	1470		3430	33200	7580	5930	2400	1170	1080
31	2260	- - - -	1740	1480	- - - -	8760	- - - -	6960	- - - -	2300	1160	- - - -
Total	61740	63960	56540	50590	41370	64670	762500	619910	196450	111230	46100	28534
Mean	1,990	2,130	1,820	1,630	1,480	2,090	25,400	20,000	6,550	3,590	1,490	951
Max	2,260	2,320	2,290	1,780	1,500	8,760	33,200	33,200	8,310	5,400	2,190	1,160
Min	1,860	1,750	1,430	1,460	1,450	1,470	10,500	6,960	5,680	2,300	1,160	616
Ac-ft	122,500	126,900	112,100	100,300	82,100	128,300	1,512,000	1,230,000	389,700	220,600	91,440	56,600

Cal yr 1966: Total 3,031,650 Mean 8,310 Max 66,300 Min 1,430 Ac-ft 6,013,000
Wtr yr 1967: Total 2,103,594 Mean 5,760 Max 33,200 Min 616 Ac-ft 4,172,000

RED RIVER OF THE NORTH BASIN

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 1967.

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

Average discharge.--21 years, 144 cfs (104,300 acre-ft per year).

Extremes.--Maximum discharge during year 2,890 cfs Mar. 31 (gage height, 18.67 ft, backwater from ice); minimum, 0.3 cfs Aug. 22-26, Aug. 30 to Sept. 5, Sept. 17-19.

1946-67: Maximum discharge, 4,750 cfs Apr. 3, 1966 (gage height 23.37 ft, backwater from ice); 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 winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	20	17	9.6	5.3	2.8	1.9	2,280	1,260	164	66	3.7	0.3
2	23	16	8.5	5.3	2.7	1.9	1,840	1,640	152	64	4.0	.3
3	24	16	8.0	5.2	2.6	1.9	1,320	1,790	140	59	3.7	.3
4	22	15	7.3	5.2	2.6	1.8	1,130	1,740	130	52	3.1	.3
5	23	14	7.3	5.1	2.5	1.8	984	1,560	122	44	2.6	.4
6	22	14	7.6	5.0	2.3	1.8	888	1,400	110	39	2.0	.4
7	22	15	7.6	5.0	2.3	1.8	760	1,240	105	38	2.2	.4
8	21	14	7.8	4.9	2.2	1.8	620	1,080	98	36	2.3	.4
9	18	14	7.8	4.9	2.2	1.8	530	964	110	33	2.7	.4
10	16	14	7.3	4.8	2.1	1.8	450	858	150	34	1.7	.4
11	15	14	7.1	4.8	2.1	1.8	400	740	200	28	1.4	.4
12	13	11	7.0	4.7	2.0	1.8	332	670	220	24	1.3	.5
13	12	11	6.8	4.7	2.0	1.8	309	590	232	22	1.1	.5
14	14	11	6.8	4.6	2.0	1.8	317	530	240	18	.9	.5
15	15	11	6.8	4.6	2.0	1.8	376	480	274	15	.8	.5
16	16	12	6.7	4.5	1.9	1.8	484	465	293	12	.6	.4
17	16	13	6.6	4.4	1.9	1.9	517	391	290	9.9	.5	.3
18	18	12	6.6	4.3	1.9	1.9	509	344	259	7.8	.5	.3
19	19	11	6.6	4.2	1.9	1.9	545	309	227	6.4	.4	.4
20	19	12	6.5	4.0	1.9	1.9	800	271	212	5.5	.4	.4
21	19	12	6.4	3.9	1.9	1.9	1,300	252	215	5.1	.4	.4
22	20	14	6.2	3.8	1.9	2.0	1,560	245	210	6.2	.3	.4
23	33	14	6.2	3.7	1.9	2.0	1,700	234	193	6.8	.3	.4
24	32	15	6.0	3.6	1.9	2.1	1,730	230	168	5.3	.3	.4
25	31	15	5.9	3.5	1.9	2.1	1,780	220	148	6.8	.3	.4
26	27	15	5.8	3.4	1.9	2.2	1,660	220	151	6.8	.4	.4
27	25	15	5.7	3.3	1.9	2.4	1,440	219	111	5.8	.4	.4
28	22	13	5.6	3.2	1.9	2.8	1,250	213	101	5.5	.4	.4
29	19	11	5.5	3.1		5.0	1,080	200	89	4.9	.5	.4
30	17	11	5.4	3.1	- - - - -	1,050	1,000	190	78	4.3	.4	.4
31	15	- - - - -	5.4	3.0	- - - - -	2,750	- - - - -	180	- - - - -	4.2	.3	- - - - -
Total	628	402	210.4	133.1	59.1	3,859.2	29,891	20,725	5,192	675.3	39.9	11.8
Mean	20.3	13.4	6.79	4.29	2.11	124	996	669	173	21.8	1.29	0.39
Max	33	17	9.6	5.3	2.8	2,750	2,280	1,790	293	66	4.0	0.5
Min	12	11	5.4	3.0	1.9	1.8	309	180	78	4.2	0.3	0.3
Ac-ft	1,250	797	417	264	117	7,650	59,290	41,110	10,300	1,340	79	23
Cal yr 1966: Total	99,063		Mean	271	Max	4,580	Min	5.4	Ac-ft	196,500		
Wtr yr 1967: Total	61,826.8		Mean	169	Max	2,750	Min	0.3	Ac-ft	122,600		

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 1967 (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 at same site and datum.

Average discharge.--28 years (1928-29, 1940-67), 61.1 cfs (44,230 acre-ft per year).

Extremes.--Maximum discharge during year, 1,100 cfs Apr. 22 (gage height, 12.45 ft); minimum daily, 0.1 cfs Feb. 12-21; minimum gage height, 1.87 ft Sept. 28.

1928-67: 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 winter months, which are fair.

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

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.4	12	4.5	1.5	0.5	0.2	275	437	63	58	7.3	0.7
2	5.0	8.8	4.5	1.6	.4	.2	255	398	55	44	7.6	.8
3	3.9	8.5	4.5	1.6	.4	.2	220	358	49	34	6.8	.9
4	3.4	8.2	4.2	1.6	.4	.2	190	340	45	28	5.7	.8
5	3.3	7.9	3.7	1.5	.3	.2	149	340	38	23	6.7	.7
6	4.2	7.4	3.6	1.5	.3	.2	161	333	29	39	4.8	.7
7	3.7	6.4	3.7	1.5	.2	.2	181	315	23	75	4.0	.5
8	4.5	6.2	4.0	1.4	.2	.2	202	297	21	75	4.2	.4
9	4.0	6.2	3.9	1.4	.2	.2	222	275	32	68	4.8	.2
10	3.2	5.8	3.7	1.4	.2	.2	201	270	34	65	5.5	.5
11	2.6	4.8	3.4	1.5	.2	.2	209	274	27	57	4.4	.5
12	4.2	4.2	3.2	1.6	.1	.2	191	255	23	46	3.4	.4
13	4.5	4.5	3.2	1.6	.1	.2	196	233	31	35	3.1	.4
14	5.6	4.8	3.2	1.5	.1	.2	232	215	34	26	2.5	.7
15	11	5.0	3.0	1.5	.1	.2	293	195	29	21	2.4	.6
16	19	3.9	3.2	1.5	.1	.2	306	176	25	16	2.0	.6
17	15	6.6	3.3	1.4	.1	.2	300	160	19	13	2.2	.6
18	11	5.6	3.2	1.4	.1	.3	251	145	16	12	2.5	.6
19	10	5.4	3.3	1.3	.1	.3	271	131	17	11	1.8	.6
20	9.4	5.6	3.3	1.2	.1	.3	405	117	47	9.6	1.8	.6
21	9.1	5.8	3.2	1.2	.1	.3	893	109	55	8.6	2.0	.6
22	10	6.2	3.0	1.1	.2	.3	1,060	106	47	8.6	1.5	.7
23	14	6.0	2.9	1.0	.3	.3	1,020	105	35	8.3	1.5	1.0
24	15	5.8	2.9	1.0	.4	.4	841	101	26	8.1	2.4	.6
25	14	5.8	2.9	.9	.4	.6	695	96	25	6.8	1.4	.7
26	14	5.8	2.8	.8	.3	1.5	575	105	32	6.5	1.0	.5
27	14	4.8	2.6	.8	.3	3.5	484	102	38	6.3	1.2	.6
28	17	4.8	2.4	.7	.2	8.5	420	96	31	5.1	1.0	.6
29	24	4.2	2.1	.6		20	404	81	35	4.9	1.1	.6
30	14	4.3	1.8	.6	-----	49	435	76	69	4.4	1.0	.6
31	12	-----	1.6	.5	-----	140	-----	80	-----	3.8	.9	-----
Total	288.0	181.3	100.8	38.7	6.4	228.7	11,537	6,321	1,050	827.0	98.5	18.3
Mean	9.29	6.04	3.25	1.25	0.23	7.38	385	204	35.0	26.7	3.18	0.61
Max	24	12	4.5	1.6	0.5	140	1,060	437	69	75	7.6	1.0
Min	2.6	3.9	1.6	0.5	0.1	0.2	149	76	16	3.8	0.9	0.2
Ac-ft	571	360	200	76.8	12.7	454	22,880	12,540	2,080	1,640	195	36.3

Cal yr 1966: Total 39,729.8 Mean 109 Max 921 Min 1.6 Ac-ft 78,800
Wtr yr 1967: Total 20,695.7 Mean 56.7 Max 1,060 Min 0.1 Ac-ft 41,050

RED RIVER OF THE NORTH BASIN

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

Location.--Lat 48°54'22", long 95°49'55", in SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.28, T.163 N., R.40 W., on upstream bridge piling on left bank at Roseau Lake, $3\frac{1}{2}$ miles upstream from Pine Creek, $3\frac{1}{4}$ miles downstream from Sprague Creek, and 7 miles northwest of Roseau.

Records available.--November 1939 to September 1967 (incomplete).

Gage.--Wire-weight gage read once daily. Datum of gage is 1,018.59 ft above mean sea level, adjustment of 1928 by Geodetic Survey of Canada. Prior to Sept. 6, 1967, staff gage at same site and datum. Gage readings have been reduced to elevations above mean sea level.

Extremes.--Maximum elevation observed during year, 1,034.02 ft May 6; minimum observed, 1,020.64 ft Sept 11, 14.

1939-67: Maximum elevation observed, 1,036.86 ft May 13, 1950; minimum observed, 1,019.75 ft Aug. 16, 1941.

Flood of July 1919 reached an elevation of about 1,034 ft.

Elevation, in feet, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	21.19	21.81					32.26		27.86			
2							32.36					
3		21.81					32.16		26.81	22.41		
4							32.06		26.36		21.26	
5	21.31	21.81					31.96				21.16	
6							31.84	34.02	25.26			20.66
7											20.92	
8	21.41						31.76		24.86	23.46		
9	21.39						31.61	33.95			20.94	
10												
11								33.75	25.36		20.88	20.64
12	21.23						30.91	33.57				
13							30.76	33.49		22.46	20.74	
14								33.35		22.21		20.64
15	21.43						30.66		24.86	22.02		
16							30.56	32.81			20.70	20.84
17	21.69						30.46		24.61	21.65		
18							30.26					21.02
19										21.29		21.35
20	21.71											
21							32.27		24.46	21.26		21.19
22	21.73						32.47		24.26			
23							32.86					21.05
24									23.86			
25							33.46	30.51	23.46	21.16		
26	22.03						33.71		23.16			20.99
27							33.81	29.96				
28	22.03							29.56		21.26		21.05
29	22.03					22.36			23.16	21.21		
30												21.08
31		-----			-----	31.71	-----		-----			-----

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 SE $\frac{1}{4}$ 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 1967.

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.--39 years, 253 cfs (183,200 acre-ft per year).

Extremes.--Maximum discharge during year, 2,860 cfs Apr. 30 (gage height, 14.98 ft); minimum, 0.7 cfs Sept. 13-16 (gage height, 0.82 ft).

1928-67: 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 winter months, which are fair. High flow regulated by natural storage in Roseau Lake.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	22	45	25	16	11	9.8	935	2,760	935	184	27	1.5
2	20	41	24	16	11	9.8	1,300	2,680	840	168	35	1.7
3	22	43	23	16	11	9.8	1,440	2,680	732	158	38	1.7
4	24	42	22	16	11	10	1,490	2,700	603	135	35	1.6
5	22	40	22	16	11	10	1,520	2,690	502	120	31	1.6
6	20	36	23	16	11	11	1,550	2,700	424	122	28	1.6
7	20	31	23	16	11	11	1,580	2,690	369	172	23	1.6
8	22	31	24	15	10	11	1,620	2,690	312	203	21	1.5
9	22	32	24	15	10	12	1,690	2,680	303	195	23	1.4
10	22	32	23	15	10	12	1,700	2,660	338	176	23	1.3
11	20	32	23	15	10	12	1,650	2,580	454	167	22	1.2
12	18	31	22	15	10	12	1,590	2,480	464	148	19	1.0
13	17	30	22	15	10	12	1,540	2,390	444	122	16	.9
14	20	30	21	15	9.8	12	1,500	2,310	416	101	14	.7
15	2'	30	21	15	9.8	12	1,460	2,240	402	88	12	.7
16	33	28	20	15	9.6	12	1,440	2,140	379	80	10	.9
17	40	26	20	15	9.6	13	1,410	2,050	371	68	9.3	1.5
18	45	25	20	15	9.6	13	1,390	1,970	346	52	8.5	3.3
19	47	22	19	14	9.4	13	1,370	1,890	316	37	7.4	4.8
20	49	20	19	14	9.4	13	1,450	1,840	310	30	6.2	5.1
21	49	21	19	14	9.4	14	1,630	1,760	324	30	5.1	3.5
22	46	25	19	13	9.4	14	1,800	1,680	322	30	4.4	2.6
23	46	28	19	13	9.4	15	2,030	1,620	298	34	4.0	2.2
24	48	30	18	13	9.6	16	2,260	1,560	261	39	3.5	1.9
25	49	31	18	12	9.6	17	2,440	1,480	225	39	2.6	1.8
26	51	31	18	12	9.6	17	2,600	1,410	199	41	2.3	1.6
27	52	30	18	12	9.6	18	2,660	1,340	190	39	2.2	1.5
28	52	30	17	12	9.8	20	2,720	1,270	174	32	1.8	1.4
29	52	29	17	12		27	2,740	1,190	163	27	1.4	1.2
30	51	27	17	11	- - - - -	96	2,760	1,120	169	24	1.3	1.1
31	50	- - - - -	16	11	- - - - -	340	- - - - -	1,030	- - - - -	24	1.4	- - - - -
Total	1,077	929	636	440	280.6	824.4	53,265	64,280	11,585	2,885	438.4	54.4
Mean	34.7	31.0	20.5	14.2	10.0	26.6	1,776	2,074	386	93.1	14.1	1.81
Max	52	45	25	16	11	340	2,760	2,760	935	184	38	5.1
Min	17	20	16	11	9.4	9.8	935	1,030	163	24	1.3	0.7
Ac-ft	2,140	1,840	1,260	873	557	1,640	105,600	127,500	23,000	5,720	870	108
Cal yr 1966: Total	223,197		Mean	611	Max	4,620	Min	9.5	Ac-ft	442,700		
Wtr yr 1967: Total	136,694.8		Mean	375	Max	2,760	Min	0.7	Ac-ft	271,100		

RED RIVER OF THE NORTH BASIN

5-1080. Roseau River near Badger, Minn.

Location.--Lat 48°54'42", long 96°00'24", in SW $\frac{1}{4}$ 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 1967 (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, 1,030.52 ft May 1; minimum recorded, 1,017.36 ft Sept. 16.

1928-67: Maximum elevation, 1,032.65 ft May 13, 1950; minimum recorded, 1,017.42 ft Aug. 30, 1961.
Maximum elevation known, about 1,034 ft in 1896.

Mean elevation, in feet, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		18.80						30.46	25.69	20.78	18.45	17.48
2		18.93						30.36	25.28	20.68	18.62	17.50
3								30.37	24.79	20.46	18.77	17.51
4							29.07	30.38	24.19	20.26	18.75	17.52
5	18.34						28.80	30.36	23.60	20.04	18.69	17.51
6	18.30						28.63	30.37	23.10	20.02	18.61	17.49
7	18.28						28.60	30.37	22.63	20.56	18.46	17.49
8	18.32						28.54	30.36	22.17	21.06	18.40	17.50
9	18.35						28.47	30.35	21.93	21.05	18.38	17.46
10	18.36						28.41	30.35	22.25	20.87	18.38	17.46
11	18.32						28.26	30.36	22.84	20.76	18.37	17.48
12	18.25						28.04	30.16	22.95	20.59	18.33	17.47
13	18.21						27.88	30.03	22.84	20.27	18.24	17.46
14	18.27						27.75	29.93	22.66	19.96	18.16	17.42
15	18.38						27.62	29.80	22.55	19.72	18.08	17.39
16	18.51						27.51	29.64	22.40	19.52	18.01	17.38
17	18.59						27.45	29.45	22.33	19.36	18.00	17.39
18	18.64						27.35	29.26	22.16	19.11	17.95	17.46
19	18.61						27.28	29.03	21.94	18.75	17.90	17.62
20	18.58						27.75	28.93	21.88	18.55	17.86	17.65
21	18.57						28.41	28.59	21.98	18.50	17.81	
22	18.61						28.75	28.33	21.99	18.52	17.78	
23	18.67						29.16	28.18	21.83	18.57	17.74	
24	18.84					19.54	29.58	27.89	21.55	18.68	17.72	
25	19.05						29.88	27.64	21.23	18.73	17.70	
26	19.13						30.07	27.40	20.94	18.77	17.66	
27	19.09						30.21	27.18	20.82	18.76	17.64	
28	19.04						30.33	26.93	20.70	18.69	17.60	
29	19.00						30.37	26.67	20.55	18.58	17.56	
30	19.04						30.44	26.39	20.58	18.49	17.53	
31	18.96	-----			-----	27.71	-----	26.06	-----	18.44	17.50	-----

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 SE 1/4 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 1967 (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, 2,410 cfs May 12 (gage height, 9.16 ft); minimum daily recorded, 1.0 cfs Sept. 16-22.

1917, 1920-67: 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, 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	43	78	106				710	2,310	1,820	182	26	5.2
2	46	69	106				770	2,310	1,770	190	25	4.7
3	44	72	104				775	2,330	1,710	188	25	3.9
4	42	74	104				780	2,360	1,630	171	27	3.7
5	42	71	102				820	2,380	1,530	152	32	3.0
6	45	70	102				1,180	2,360	1,410	134	29	2.4
7	46	53	100				1,400	2,350	1,240	141	28	1.8
8	45	62	100				1,510	2,330	1,020	179	26	1.5
9	46	66					1,560	2,330	787	227	24	1.5
10	45	65					1,600	2,360	637	235	23	1.1
11	46	64					1,630	2,400	586	220	19	1.1
12	47	64					1,660	2,400	597	206	18	1.1
13	47	63					1,700	2,390	605	196	17	1.1
14	52	63					1,760	2,380	586	147	17	1.1
15	57	63					1,780	2,350	541	115	16	1.1
16	59	64					1,820	2,310	518	97	15	1.0
17	63	66					1,820	2,280	476	85	14	1.0
18	66	64					1,830	2,260	450	73	13	1.0
19	68	63					1,840	2,220	428	63	12	1.0
20	72	62					1,980	2,190	411	50	12	1.0
21	85	62					2,120	2,180	389	42	12	1.0
22	76	64					2,040	2,170	384	38	11	1.0
23	72	75					2,030	2,160	377	36	10	1.4
24	71	98					2,030	2,150	354	36	9.2	1.5
25	80	105					2,020	2,120	312	36	8.8	1.5
26	91	108					2,040	2,100	267	36	8.1	1.6
27	94	110					2,070	2,070	231	36	7.7	1.6
28	91	110					2,120	2,020	212	36	7.1	1.4
29	88	108					2,180	1,970	202	34	6.1	1.1
30	91	108					2,260	1,920	186	34	6.1	1.2
31	97					600		1,870		31	5.8	
Total	1,957	2,264					49,835	69,330	21,666	3,446	509.9	52.6
Mean	63.1	75.5					1,661	2,236	722	111	16.4	1.75
Max	97	110					2,260	2,400	1,820	235	32	5.2
Min	42	53					710	1,870	186	31	5.8	1.0
Ac-ft	3,880	4,490					98,850	137,500	42,970	6,840	1,010	104
Cal yr 1966: Total	-	-	Mean	-	Max	-	Min	-	Ac-ft	-	-	-
Wtr yr 1967: Total	-	-	Mean	-	Max	-	Min	-	Ac-ft	-	-	-

Note.--Stage-discharge relation affected by ice Nov. 1 to Dec. 8, Mar. 31 to Apr. 7 (no gage-height record Apr. 3, 4).

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 1967 (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, 1,007.38 ft Apr. 7 (ice jam); minimum observed, 1,002.27 ft Sept. 12. 1933-67: 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 1966 to September 1967.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.25	3.18							6.83	3.86	3.17	
2	3.27								6.79	3.90	3.16	
3	3.25								6.74	3.89	3.19	
4	3.24								6.68	3.83	3.25	
5	3.25						6.69		6.60	3.78	3.26	
6	3.26						6.79		6.45	3.76	3.25	
7	3.27						6.95		6.25	3.80	3.24	
8	3.28						6.76	7.04	5.83	3.94	3.21	
9	3.28						6.79	7.04	5.25	4.02	3.15	
10	3.25							7.04	4.85	4.01	3.14	
11	3.26							7.05	4.73	3.96	3.14	
12	3.25							7.05	4.75	3.87	3.13	2.27
13	3.28							7.05	4.79	3.83		
14	3.34							7.05	4.74	3.79		
15	3.35							7.05	4.63	3.70		
16	3.35							7.05	4.53	3.66		
17	3.37							7.03	4.44	3.59		
18	3.38							7.01	4.36	3.55		
19	3.39						6.81	6.97	4.34	3.47		
20	3.48						6.88	6.96	4.32	3.38		
21	3.51						6.94	6.96	4.27	3.33		
22	3.45						6.92	6.96	4.27	3.28		
23	3.46							6.96	4.26	3.27		2.38
24	3.45							6.95	4.25	3.27		2.56
25	3.51							6.95	4.12	3.31		2.54
26	3.55							6.95	4.02	3.33		2.53
27	3.54							6.95	3.93	3.32		2.52
28								6.94	3.91	3.30		2.48
29								6.92	3.89	3.27		2.45
30								6.87	3.85	3.26		2.45
31		-----			-----	6.32	-----	6.87	-----	3.23		-----

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

5-1244.8 Kawishiwi River near Ely, Minn.

(Hydrologic bench-mark station)

Location.--Lat 47°55'22", long 91°32'06", in SE¼ sec.24, T.63 N., R.10 W., on left bank upstream from rapids, 2 miles upstream from South Kawishiwi River, 2½ miles southwest of Fernberg Lookout Tower and 14 miles east of Ely.

Records available.--June 1966 to September 1967.

Gage.--Water-stage recorder. Altitude of gage is 1,450 ft (from topographic map).

Extremes.--Maximum discharge during year, 1,090 cfs Apr. 30 (gage height, 5.39 ft); minimum, 25 cfs Oct. 1-3, 11-14 (gage height, 2.72 ft).
1966-67: Maximum discharge, that of Apr. 30, 1967; minimum, 24 cfs Sept. 28, 29, 1966 (gage height, 2.71 ft).

Remarks.--Records good. Records of chemical analyses and water temperatures for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	25	27	30	46	63	58	88	1080	373	236	128	73
2	25	28	31	46	63	58	84	1080	354	232	128	73
3	28	29	32	47	63	58	79	1070	340	222	130	70
4	32	30	34	48	63	58	78	1050	318	213	132	69
5	32	30	35	48	63	57	79	1020	287	206	130	66
6	31	31	35	48	63	56	81	988	266	200	130	65
7	30	31	36	48	62	56	84	967	270	192	134	63
8	30	31	36	49	62	56	88	960	262	186	134	59
9	29	31	36	50	63	56	102	939	262	184	132	56
10	28	31	37	50	63	54	105	911	255	179	127	52
11	26	30	37	52	64	54	107	890	244	174	110	52
12	25	30	38	54	64	53	113	869	236	165	107	52
13	25	30	38	56	64	52	122	849	232	158	105	52
14	27	29	39	57	64	52	139	815	244	150	105	65
15	28	29	40	57	64	51	158	775	247	148	107	65
16	30	29	40	58	63	51	182	748	251	148	107	63
17	30	28	41	59	62	50	262	716	247	148	105	62
18	31	28	42	62	60	50	363	696	236	144	103	59
19	30	28	42	64	60	48	459	658	236	141	97	58
20	29	28	42	64	59	48	559	639	244	137	96	57
21	29	27	42	65	59	48	639	608	244	132	96	57
22	29	27	42	65	60	48	716	583	244	132	92	56
23	29	27	42	65	60	48	815	571	244	137	91	52
24	29	27	42	65	60	48	876	548	244	139	90	50
25	29	27	42	65	59	48	939	525	240	139	88	46
26	28	27	42	64	59	48	974	502	236	141	86	44
27	28	28	42	64	59	48	1000	480	236	137	84	42
28	29	28	42	63	59	48	1010	464	229	134	82	41
29	28	29	44	62		48	1050	448	225	135	78	40
30	27	29	46	63	- - - - -	53	1050	428	232	132	77	40
31	27	- - - - -	46	63	- - - - -	76	- - - - -	402	- - - - -	130	73	- - - - -
Total	883	864	1213	1767	1727	1637	12401	23279	7778	5051	3284	1699
Mean	28.5	28.8	39.1	57.0	61.7	52.8	413	751	259	163	106	56.6
Max	32	31	46	65	64	76	1,050	1,080	373	236	134	73
Min	25	27	30	46	59	48	78	402	225	130	73	40
Ac-ft	1,750	1,710	2,400	3,500	3,430	3,250	24,600	46,170	1,540	10,020	6,510	3,370
Cal yr	: Total		Mean	Max	Min	Ac-ft						
Wtr yr 1967:	Total 61,583		Mean 169	Max 1,080	Min 25	Ac-ft 122,100						

5-1270. Kawishiwi River near Winton, Minn.

Location.--Lat 47°56'05", long 91°45'50", in NE 1/4 NW 1/4 sec. 20, T. 63 N., R. 11 W., at powerplant of Minnesota Power and 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 1967. Monthly discharge only for some periods, published in WSP 1308.

Average discharge.--48 years (1905-06, 1915-17, 1918-19, 1923-67), 969 cfs (unadjusted).

Extremes.--Maximum daily discharge during year, 4,240 cfs May 4; no flow Jan. 28.
1905-07, 1912-19, 1923-67: Maximum daily discharge, 16,000 cfs May 18, 1950; no flow at times.

Remarks.--Records fair. Daily discharge computed from powerplant records. Flow regulated by powerplant and by Camp Six, Bald Eagle, Gabbro, Little Gabbro, Birch, White Iron, South 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	233	528	497	97	298	396	723	3,780	1,060	1,590	834	391
2	32	561	432	97	266	428	548	3,820	992	1,580	769	353
3	528	594	432	361	298	395	580	4,230	960	1,470	834	321
4	297	613	161	200	266	458	647	4,240	960	1,190	931	418
5	233	613	497	297	32	523	790	4,130	928	1,020	866	321
6	233	580	497	264	331	587	786	4,160	960	992	834	377
7	233	626	400	329	294	361	850	4,160	960	1,090	963	415
8	32	613	362	297	229	289	951	4,090	992	960	901	448
9	65	613	297	382	293	487	1,040	4,120	1,080	960	1,000	415
10	165	645	161	350	296	423	1,130	3,840	1,180	992	1,060	415
11	133	580	194	316	331	455	1,170	3,390	1,180	1,180	992	415
12	165	613	330	413	299	520	1,280	3,960	1,090	1,060	960	414
13	165	613	297	349	170	520	1,230	3,240	1,110	926	960	379
14	165	580	265	381	270	487	1,550	3,220	1,400	799	897	477
15	198	529	297	381	401	487	1,570	3,050	1,470	831	890	380
16	129	529	297	316	351	455	1,800	2,950	1,620	960	945	380
17	298	529	265	381	376	487	1,900	2,720	1,690	1,020	853	380
18	298	497	394	323	171	520	2,270	2,510	1,750	796	749	380
19	434	497	466	316	207	422	2,420	2,330	1,810	988	652	380
20	434	426	434	362	276	422	2,650	2,250	2,180	891	574	380
21	531	464	434	32	233	454	2,960	2,050	2,350	817	539	445
22	434	464	529	129	330	454	3,250	1,580	2,220	985	604	348
23	467	464	400	421	273	422	3,640	1,630	2,150	827	507	348
24	431	265	265	299	213	486	3,660	1,490	2,030	802	515	348
25	496	400	97	323	329	454	4,040	1,220	1,970	866	506	380
26	528	330	129	277	376	452	4,130	1,480	1,980	866	506	316
27	528	330	289	266	267	451	3,940	1,390	1,880	899	474	348
28	561	497	353	0	384	451	3,740	1,390	1,640	834	506	348
29	561	464	305	161		419	3,710	1,150	1,560	899	441	348
30	528	497	369	330	-----	451	3,770	1,120	1,580	866	312	348
31	496	-----	97	298	-----	582	-----	1,080	-----	866	345	-----
Total	10,031	15,554	10,242	8,748	7,860	14,198	62,725	85,770	44,732	30,822	22,719	11,416
Mean	324	518	330	282	281	458	2,091	2,767	1,491	994	733	381
(%)	+93	-69	-5	+10	-43	-270	+403	+236	+17	-21	-39	-174
Mean	417	449	325	292	238	188	2,494	3,003	1,508	973	694	207
Max	561	645	497	421	401	587	4,130	4,240	2,350	1,590	1,060	477
Min	32	265	97	0	32	289	548	1,080	928	796	312	316
Cfsm	0.348	0.374	0.271	0.243	0.198	0.157	2.08	2.50	1.26	0.811	0.578	0.172
In.	0.40	0.42	0.31	0.28	0.21	0.18	2.32	2.88	1.40	0.94	0.67	0.19
Calendar year 1966:	Max	7,600	Min	32	Mean	1,373	Mean	1,348	Cfsm	1.12	In.	15.25
Water year 1967:	Max	4,240	Min	0	Mean	890	Mean	902	Cfsm	0.752	In.	10.20

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.

5-1272.05 Burntside River near Ely, Minn.

Location.--Lat 47°54'55", long 91°56'59", in NE¼NE¼ sec.26, T.63 N., R.13 W., on left bank on downstream wing-wall of bridge on County Road 88, 2½ miles upstream from mouth, 4 miles northwest of Ely and 5 miles downstream from outlet on Burntside Lake.

Records available.--May to September 1967.

Gage.--Staff gage read once daily. Altitude of gage is 1,340 ft (from topographic map).

Extremes.--Maximum discharge during period, 125 cfs May 10 (gage height, 6.74 ft); maximum gage height, 6.75 ft July 26 (backwater from aquatic vegetation); minimum daily discharge, 1.9 cfs Sept. 29, 30.

Remarks.--Records good.

Cooperation.--Gage readings furnished by Federal Water Pollution Control Administration.

Discharge, in cubic feet per second, May to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									69	61	38	20
2									68	60	40	18
3									62	57	41	18
4									59	55	40	19
5									60	51	39	16
6									58	48	36	16
7									62	46	36	16
8									66	43	37	14
9								122	65	43	45	12
10								125	66	42	44	13
11								124	66	48	42	11
12								122	67	46	39	9.0
13								118	67	43	37	7.6
14								115	76	42	36	11
15								110	78	39	43	12
16								106	80	43	42	12
17								102	78	43	41	11
18								98	77	45	43	9.8
19								89	75	41	41	9.0
20								89	83	38	36	9.4
21								88	84	36	36	11
22								86	85	38	34	11
23								87	81	44	31	9.4
24								85	76	42	30	8.0
25								84	71	47	30	6.8
26								82	65	50	28	4.8
27								84	63	47	28	4.0
28								81	60	45	26	3.3
29								79	57	46	26	1.9
30								76	60	44	24	1.9
31		-----			-----		-----	71	-----	38	21	-----
Total									2,084	1,411	1,110	3,25.9
Mean									69.5	45.5	35.8	10.9
Max									85	61	45	20
Min									57	36	21	1.9
Ac-ft									4,130	2,800	2,200	646
Cal yr	: Total		Mean		Max		Min		Ac-ft			
Wtr yr	: Total		Mean		Max		Min		Ac-ft			

LAKE OF THE WOODS BASIN

5-1272.10 Armstrong Creek near Ely, Minn.

Location.--Lat 47°53'48", long 91°55'50", in SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.36, T.63 N., R.13 W., near right bank 10 ft downstream from culvert on County Road 88, 1 $\frac{1}{4}$ miles upstream from mouth and 2 $\frac{1}{4}$ miles southwest of Ely.

Records available.--May to September 1967.

Gage.--Staff gage read once daily. Altitude of gage is 1,365 ft (from topographic map).

Extremes.--Maximum discharge during period, 11 cfs June 15 (gage height 3.26 ft, from graph based on gage readings); minimum daily, 0.6 cfs Sept. 9-12.

Remarks.--Records good.

Cooperation.--Gage readings furnished by Federal Water Pollution Control Administration.

Discharge, in cubic feet per second, May to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									1.8	1.9	1.7	0.9
2									1.6	1.9	2.2	.9
3									1.5	1.6	2.1	.8
4									1.4	1.5	2.0	.8
5									1.3	1.3	1.7	.7
6									1.2	1.1	1.7	.7
7									1.4	1.1	1.7	.7
8									2.2	1.1	2.0	.7
9								8.4	3.0	1.0	3.9	.6
10								7.2	2.9	1.0	2.8	.6
11								6.4	2.2	2.0	2.1	.6
12								5.8	2.7	1.5	1.9	.6
13								5.3	4.2	1.2	1.8	.7
14								4.7	7.4	1.0	1.7	1.2
15								4.3	10	.8	3.7	1.2
16								3.9	7.5	1.6	2.6	1.0
17								3.5	4.6	1.7	2.0	.9
18								3.2	2.7	1.2	2.0	.9
19								3.1	2.4	1.0	1.8	.8
20								2.5	6.0	.9	1.6	.8
21								2.6	7.9	1.4	1.7	1.2
22								2.5	6.2	2.1	1.4	1.2
23								3.6	4.2	2.0	1.4	1.1
24								3.2	2.9	2.3	1.3	1.1
25								3.1	2.2	2.0	1.4	1.0
26								3.3	1.9	2.3	1.4	1.0
27								4.0	1.6	2.0	1.3	1.0
28								2.9	1.4	1.8	1.2	1.0
29								2.5	1.8	2.1	1.1	1.0
30								2.0	1.8	1.8	1.1	1.0
31		- - - - -			- - - - -		- - - - -	1.9	- - - - -	2.0	1.0	- - - - -
Total									99.5	48.2	57.3	26.7
Mean									3.32	1.55	1.85	0.89
Max									10	2.3	3.9	1.2
Min									1.2	0.8	1.0	0.6
Ac-ft									197	96	114	53
Cal yr	: Total		Mean		Max		Min		Ac-ft			
Wtr yr	: Total		Mean		Max		Min		Ac-ft			

5-1272.15 Longstorff Creek near Ely, Minn.

Location.--Lat 47°53'33", long 91°54'55", in SE¼SW¼ sec.31, T.63 N., R.12 W., at left bank on downstream side of culvert on U.S. Highway 169, 0.7 mile upstream from mouth, 1½ miles southwest of Ely and 2½ miles downstream from outlet of Mitchell Lake.

Records available.--May to September 1967.

Gage.--Staff gage read once daily. Datum of gage is 1,360.67 ft above mean sea level, datum of 1929 (levels by Minnesota Highway Department).

Extremes.--Maximum discharge during period, 18 cfs May 9 (gage height 1.76 ft); minimum daily, 0.1 cfs Sept. 8, 10-12, 26-30; minimum gage height, 0.46 ft Sept. 26, 28-30.

Remarks.--Records good.

Cooperation.--Gage readings furnished by the Federal Water Pollution Control Administration.

Discharge, in cubic feet per second, May to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									3.3	3.7	2.2	0.7
2									3.2	3.2	3.5	.8
3									2.7	3.1	5.0	.7
4									2.4	2.8	4.6	.5
5									2.3	2.4	3.9	.2
6									2.2	2.2	3.9	.2
7									2.5	2.0	3.6	.2
8									4.0	2.0	4.4	.1
9								18	5.0	1.5	7.4	.2
10								16	4.2	1.6	6.1	.1
11								13	4.2	4.2	5.0	.1
12								11	4.4	3.7	4.5	.1
13								10	6.7	2.9	3.7	.2
14								8.5	13	2.1	3.3	1.7
15								7.8	13	2.0	6.0	.9
16								7.3	9.8	3.6	4.3	.6
17								6.7	7.9	3.6	4.1	.6
18								6.1	6.6	3.5	3.4	.5
19								5.7	5.4	2.7	2.0	.3
20								5.3	14	2.4	2.1	.3
21								5.0	16	2.9	2.4	1.3
22								4.9	11	4.8	3.2	.6
23								5.9	7.9	4.5	1.9	.5
24								5.3	6.4	4.4	1.8	.5
25								5.1	5.4	3.7	1.9	.5
26								5.7	4.4	4.6	1.6	.1
27								5.7	4.3	3.7	1.5	.1
28								5.2	3.9	2.8	1.3	.1
29								4.8	3.8	3.9	1.6	.1
30					-----			3.9	4.0	3.4	1.2	.1
31		-----			-----		-----	3.7	-----	3.1	1.1	-----
Total									183.9	97.0	102.5	12.9
Mean									6.13	3.13	3.31	0.43
Max									16	4.8	7.4	1.7
Min									2.2	1.5	1.1	0.1
Ac-ft									365	192	203	26
Cal yr	: Total			Mean		Max		Min		Ac-ft		
Wtr yr	: Total			Mean		Max		Min		Ac-ft		

LAKE OF THE WOODS BASIN

5-1272.20 Burgo Creek near Ely, Minn.

Location.--Lat 47°55'32", long 91°51'40", in SW¼NW¼ sec.22, T.63 N., R.12 W., near right bank 6 ft upstream from twin culverts on County Road 88, 0.5 mile upstream from mouth and 1½ miles north of Ely.

Records available.--May to September 1967.

Gage.--Staff gage and crest-stage gage; gage read once daily. Altitude of gage is 1,340 ft (from topographic map).

Extremes.--Maximum discharge during period, 11 cfs June 14 (gage height 5.84 ft, from graph based on gage readings); no flow Sept. 8-13.

Remarks.--Records good.

Cooperation.--Gage readings furnished by Federal Water Pollution Control Administration.

Discharge, in cubic feet per second, May to September, 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									0.4	1.2	0.8	0.1
2									.4	1.2	1.0	.1
3									.3	1.0	1.7	.1
4									.4	.8	1.2	.1
5									.2	.6	.7	.2
6									.2	.4	.6	.1
7									.2	.4	1.0	.1
8									.9	.3	1.2	0
9								6.1	1.6	.4	3.0	0
10								5.7	1.0	.3	2.2	0
11								4.9	.8	.9	1.6	0
12								4.2	1.2	.6	1.2	0
13								3.6	4.7	.4	1.0	0
14								3.0	10	.4	.7	.1
15								2.6	9.6	.3	1.6	.1
16								2.2	6.1	.8	1.0	.1
17								1.9	3.4	.5	.8	.1
18								1.6	2.2	.3	1.0	.1
19								1.4	2.3	.3	2.3	.1
20								1.4	8.5	.2	1.0	.1
21								1.1	7.4	.2	.6	.1
22								.8	4.5	6.1	.4	.1
23								1.3	3.7	4.1	.2	.1
24								1.2	2.4	2.7	.2	.1
25								.9	2.0	1.9	.2	.1
26								1.5	1.5	3.0	.2	.1
27								1.5	1.1	2.2	.1	.1
28								1.1	.9	1.2	.1	.1
29								1.0	.7	1.9	.1	.1
30								.7	1.2	1.4	.1	.1
31		-----			-----		-----	.6	-----	1.0	.1	-----
Total									79.8	37.0	27.9	2.5
Mean									2.66	1.19	0.90	0.08
Max									10	6.1	3.0	0.2
Min									0.2	0.2	0.1	0
Ac-ft									158	73	55	5.0
Cal yr	: Total			Mean	Max	Min	Ac-ft					
Wtr yr	: Total			Mean	Max	Min	Ac-ft					

5-1272.25 Shagawa Lake at Ely, Minn.

Location.--Lat 47°54'18", long 91°53'00", in NE¹/₄NE¹/₄ sec.33, T.36 N., R.12 W., on south shore of Shagawa Lake, on east pier of dock at U. S. Forest Service Seaplane Base in Ely.

Records available.--April to September 1967. April 1962 to July 1966 (fragmentary) in files of Minnesota Department of Conservation, Division of Waters, Soils and Minerals.

Gage.--Staff gage read once daily. Datum of gage is 1,330.00 ft above mean sea level, adjustment of 1929 (levels by Minnesota Department of Conservation). Gage readings have been reduced to elevations above mean sea level.

Extremes.--Maximum elevation observed during period, 1,338.69 ft May 9, 10; minimum observed, 1,337.13 ft Sept. 28.

Maximum elevation observed since 1962, 1,339.95 ft Apr. 27, 28, 1966, from Minnesota Department of Conservation, Division of Waters, Soils and Minerals.

Mean daily elevation, in feet, April to September 1967

Apr. 28	1338.25	June 30	1338.03	Aug. 31	1337.45
May 31	1338.21	July 30	1337.88	Sept. 28	1337.13

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

LAKE OF THE WOODS BASIN

5-1272.30 Shagawa River at Ely, Minn.

Location.--Lat 47°55'09", long 91°50'08", in SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.23, T.63 N., R.12 W., on right bank, 300 ft downstream from outlet of Shagawa Lake, 150 ft north of the village limits of Ely, $\frac{1}{2}$ mile upstream from County Road 88 and 3 miles upstream from Fall Lake.

Records available.--May to September 1967.

Gage.--Water-stage recorder. Altitude of gage is 1,335 ft (from topographic map). Prior to Aug. 2, 1967, staff gage at same site and datum.

Extremes.--Maximum discharge during period, 183 cfs May 10 (gage height, 5.33 ft); minimum daily, 11 cfs Sept. 29, 30; minimum gage height, 3.89 ft Sept. 30.

Remarks.--Records good.

Cooperation.--Gage readings May 18 to Aug. 1 furnished by Federal Water Pollution Control Administration.

Discharge, in cubic feet per second, May to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1									107	107	65	32
2									107	100	67	31
3									120	96	68	29
4									95	96	67	29
5									92	92	66	27
6									90	87	65	26
7									90	84	65	25
8									92	80	68	24
9									95	76	70	21
10								183	90	76	70	19
11								181	89	85	70	17
12								179	92	82	65	16
13								173	96	73	64	18
14								170	106	71	63	23
15								164	107	67	63	22
16								160	109	78	62	22
17								157	109	73	61	22
18								154	107	72	58	21
19								156	100	70	56	20
20								142	114	71	53	21
21								138	114	67	50	21
22								134	112	80	48	20
23								134	110	78	47	19
24								130	110	76	46	16
25								124	109	72	45	16
26								128	107	78	42	14
27								124	105	76	41	13
28								122	103	74	42	12
29								118	105	76	41	11
30								113	109	74	37	11
31		-----			-----		-----	112	-----	73	33	-----
Total									3,091	2,460	1,758	618
Mean									103	79.4	56.7	20.6
Max									120	107	70	32
Min									89	67	33	11
Ac-ft									6,130	4,880	3,490	1,230
Cal yr	: Total		Mean		Max		Min		Ac-ft			
Wtr yr	: Total		Mean		Max		Min		Ac-ft			

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 1967. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Digital water-stage recorder. Datum of gage is 1,296.80 ft (revised) 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 datum 3.0 ft higher. June 2 to Oct. 27, 1938, staff gage at Williams Island half a mile northeast of present gage at datum 3.0 ft higher. Oct. 28, 1938 to Sept. 30, 1966, graphic water-stage recorder at datum 3.0 ft higher and Oct. 1, 1966 to June 28, 1967, graphic water-stage recorder at present datum.

Average discharge.--39 years (1925-27, 1930-67), 1,318 cfs.

Extremes.--Maximum discharge during year, 4,580 cfs May 11 (gage height, 5.77 ft); minimum, 375 cfs Oct. 22 (gage height, 2.69 ft).

1924, 1925-27, 1930-67: 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	500	411	494	462	423	430	665	3,840	2,320	1,990	1,210	917
2	500	417	494	462	423	430	694	3,980	2,220	1,970	1,250	897
3	529	417	500	455	417	442	703	4,110	2,140	1,960	1,290	872
4	544	417	507	442	417	455	703	4,150	2,060	1,930	1,300	847
5	544	423	507	436	417	462	732	4,220	1,960	1,880	1,290	829
6	536	436	522	430	411	468	741	4,300	1,900	1,800	1,280	800
7	522	462	522	423	405	474	780	4,390	1,860	1,750	1,280	777
8	514	468	529	417	405	481	810	4,450	1,850	1,700	1,280	744
9	494	481	536	417	405	488	860	4,470	1,810	1,640	1,280	727
10	481	488	536	417	405	488	910	4,540	1,790	1,590	1,270	706
11	462	494	522	430	405	494	940	4,560	1,750	1,530	1,270	689
12	448	500	507	430	405	500	980	4,540	1,740	1,500	1,260	674
13	436	500	500	436	405	507	1,000	4,450	1,710	1,450	1,250	682
14	442	507	488	436	405	514	1,080	4,360	1,750	1,410	1,250	764
15	442	522	474	436	411	514	1,190	4,280	1,760	1,390	1,270	756
16	430	529	468	442	411	522	1,280	4,180	1,750	1,390	1,270	730
17	417	536	468	448	417	522	1,460	4,090	1,750	1,380	1,270	714
18	405	529	468	455	423	529	1,600	3,990	1,760	1,350	1,250	698
19	399	536	474	455	423	536	1,740	3,830	1,810	1,340	1,200	682
20	392	536	474	462	417	536	1,880	3,740	1,890	1,300	1,190	673
21	386	536	474	462	423	551	2,020	3,610	1,930	1,280	1,150	666
22	386	529	481	462	423	565	2,150	3,500	1,990	1,300	1,120	652
23	386	529	488	455	423	573	2,320	3,390	2,020	1,300	1,090	604
24	380	529	488	448	417	573	2,470	3,230	2,030	1,290	1,070	590
25	386	529	488	462	417	573	2,630	3,060	2,030	1,280	1,050	573
26	392	529	481	455	417	580	2,820	2,920	2,020	1,300	1,030	547
27	399	522	474	448	417	588	2,970	2,820	2,000	1,270	1,020	527
28	405	507	468	442	417	597	3,140	2,750	1,990	1,260	1,000	515
29	405	500	462	436		606	3,380	2,650	1,970	1,260	970	503
30	411	494	462	430	- - - - -	622	3,700	2,570	2,000	1,240	940	495
31	405	- - - - -	462	430	- - - - -	648	- - - - -	2,430	- - - - -	1,200	926	- - - - -
Total	13,778	14,813	15,218	13,721	11,604	16,268	48,348	117,400	57,560	46,230	36,576	20,850
Mean	444	494	491	443	414	525	1,612	3,787	1,919	1,491	1,180	695
Max	544	536	536	462	423	648	3,700	4,560	2,320	1,990	1,300	917
Min	380	411	462	417	405	430	665	2,430	1,710	1,200	926	495
Cfsm	0.255	0.284	0.282	0.255	0.238	0.302	0.926	2.18	1.10	0.857	0.678	0.399
In.	0.29	0.32	0.33	0.29	0.25	0.35	1.03	2.51	1.23	0.99	0.78	0.45

Cal yr 1966: Total 655,249 Mean 1,795 Max 7,650 Min 380 Cfsm 1.03 In. 14.01

Wtr yr 1967: Total 412,366 Mean 1,130 Max 4,560 Min 380 Cfsm 0.649 In. 8.81

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 1967, in reports of Geological Survey. Monthly discharge only for some periods, published in WSP 1308. August 1921 to September 1967 in reports of Inland Waters Branch, Department of Energy, Mines and 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.--45 years (1922-67), 3,608 cfs.Extremes.--Maximum discharge during year, 12,200 cfs May 18 (elevation, 1,188.11 ft); minimum, 1,060 cfs Sept. 30 (elevation, 1,182.28 ft).

1921-67: 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 excellent.Cooperation.--This station is maintained by Canada under agreement with the United States.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.		
1	1,500	1,190	1,150	1,280	1,270	1,200	1,300	8,180	9,860	6,520	4,240	3,090		
2	1,490	1,160	1,150	1,280	1,270	1,190	1,350	8,640	9,680	6,450	4,260	3,060		
3	1,490	1,180	1,140	1,280	1,260	1,190	1,390	9,170	9,480	6,390	4,260	2,990		
4	1,490	1,190	1,160	1,270	1,260	1,190	1,420	9,660	9,190	6,340	4,230	2,930		
5	1,480	1,190	1,170	1,270	1,270	1,190	1,470	10,100	8,970	6,260	4,220	2,910		
6	1,470	1,200	1,180	1,270	1,270	1,190	1,500	10,400	8,810	6,150	4,150	2,860		
7	1,450	1,190	1,220	1,250	1,260	1,190	1,540	10,800	8,690	6,080	4,170	2,810		
8	1,440	1,150	1,230	1,260	1,250	1,190	1,610	11,000	8,590	5,990	4,120	2,740		
9	1,390	1,150	1,240	1,260	1,250	1,180	1,700	11,300	8,450	5,900	4,080	2,710		
10	1,340	1,150	1,240	1,260	1,260	1,180	1,780	11,600	8,290	5,800	4,050	2,670		
11	1,330	1,160	1,240	1,270	1,250	1,190	1,860	11,700	8,130	5,650	4,020	2,610		
12	1,340	1,160	1,250	1,290	1,250	1,190	1,950	11,900	7,990	5,540	3,960	2,570		
13	1,340	1,150	1,240	1,280	1,260	1,190	2,040	12,000	7,810	5,420	3,950	2,530		
14	1,300	1,120	1,250	1,280	1,240	1,190	2,180	12,100	7,780	5,290	3,880	2,530		
15	1,320	1,140	1,250	1,280	1,240	1,190	2,320	12,100	7,650	5,170	3,860	2,500		
16	1,390	1,120	1,250	1,280	1,240	1,190	2,470	12,100	7,530	5,070	3,840	2,450		
17	1,390	1,150	1,270	1,280	1,230	1,180	2,780	12,100	7,390	4,990	3,810	2,430		
18	1,380	1,120	1,280	1,280	1,230	1,160	3,130	12,000	7,280	4,890	3,790	2,400		
19	1,390	1,150	1,290	1,280	1,230	1,150	3,440	11,900	7,210	4,810	3,730	2,360		
20	1,330	1,160	1,290	1,270	1,220	1,160	3,780	11,900	7,140	4,700	3,700	2,320		
21	1,310	1,150	1,290	1,270	1,220	1,170	4,100	11,800	7,120	4,600	3,630	2,280		
22	1,300	1,160	1,290	1,270	1,230	1,190	4,420	11,700	7,070	4,660	3,620	2,250		
23	1,300	1,150	1,290	1,270	1,220	1,190	4,810	11,600	6,960	4,660	3,550	2,210		
24	1,240	1,150	1,290	1,260	1,220	1,180	5,170	11,500	6,910	4,620	3,500	2,170		
25	1,230	1,150	1,290	1,260	1,220	1,190	5,540	11,300	6,800	4,570	3,460	2,130		
26	1,240	1,150	1,280	1,230	1,220	1,190	5,900	11,100	6,700	4,510	3,410	2,070		
27	1,240	1,140	1,290	1,280	1,210	1,200	6,230	11,000	6,680	4,410	3,360	2,060		
28	1,240	1,140	1,280	1,280	1,210	1,200	6,660	10,800	6,610	4,410	3,310	2,040		
29	1,220	1,150	1,270	1,280		1,240	7,190	10,600	6,570	4,410	3,240	2,010		
30	1,230	1,150	1,270	1,270	- - - -	1,270	7,690	10,400	6,540	4,320	3,200	1,980		
31	1,210	- - - -	1,270	1,270	- - - -	1,260	- - - -	10,100	- - - -	4,280	3,140	- - - -		
Total	41,810	34,670	38,600	39,410	34,760	36,960	98,720	342,550	233,880	162,860	117,740	74,670		
Mean	1,349	1,156	1,245	1,271	1,241	1,192	3,291	11,050	7,800	5,254	3,798	2,489		
Max	1,500	1,200	1,290	1,290	1,270	1,270	7,690	12,100	9,860	6,520	4,260	3,090		
Min	1,210	1,120	1,140	1,230	1,210	1,150	1,300	8,180	6,540	4,280	3,140	1,980		
Cfsm	0.261	0.224	0.241	0.246	0.240	0.231	0.637	2.14	1.51	1.02	0.735	0.482		
In.	0.30	0.25	0.28	0.28	0.25	0.27	0.71	2.47	1.68	1.17	0.85	0.54		
Ac-ft	82,930	68,770	76,560	78,170	68,950	73,310	195,800	679,400	463,900	323,000	233,500	148,100		
Cal yr 1966: Total	1,715,430		Mean	4,700	Max	16,300	Min	1,120	Cfsm	0.910	In.	12.35	Ac-ft	3,402,000
Wtr yr 1967: Total	1,256,630		Mean	3,443	Max	12,100	Min	1,120	Cfsm	0.667	In.	9.05	Ac-ft	2,492,000

5-1282. Vermilion Lake near Soudan, Minn.

Location.--Lat 47°49'52", long 92°16'20", in SW $\frac{1}{4}$ SE $\frac{1}{4}$ 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 1967 (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, 1,358.39 ft May 7 (affected by wind action); maximum daily, 1,358.32 ft May 8; minimum, 1,356.59 ft Sept. 30.

1913-15, 1941-42, 1946-67: 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).

Daily mean elevation, in feet, October 1966 to September 1967

Oct. 31.....1,357.03	Feb. 28.....1,357.01	June 30.....1,357.75
Nov. 30.....1,356.90	Mar. 31.....1,357.11	July 31.....1,357.42
Dec. 31.....1,356.99	Apr. 30.....1,358.11	Aug. 31.....1,356.94
Jan. 31.....1,356.98	May 31.....1,357.89	Sept.30.....1,356.62

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

LAKE OF THE WOODS BASIN

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

Location.--Lat 47°57'41", long 92°28'33", in SE $\frac{1}{4}$ SW $\frac{1}{4}$ 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 1967.

Gage.--Digital 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. Apr. 12, 1939, to Sept. 6, 1967, graphic water-stage recorder at same site and datum.

Average discharge.--45 years, 303 cfs.

Extremes.--Maximum discharge recorded during year, 850 cfs May 12 (gage height, 2.61 ft); minimum, 7.6 cfs Sept. 26 (gage height, -0.60 ft, affected by seiche action).
1911-17, 1928-67: 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	52	36	47	67	92	88	127	730	559	489	255	73
2	55	45	47	67	92	83	142	770	549	470	230	74
3	57	43	47	70	97	82	157	780	554	457	224	71
4	62	42	51	67	91	82	170	790	499	457	224	63
5	67	44	53	68	90	80	182	795	480	457	222	60
6	71	42	59	67	90	80	196	800	475	444	214	60
7	67	44	57	68	90	80	210	800	484	430	214	58
8	67	46	59	74	90	80	227	805	484	408	212	40
9	64	47	62	75	90	80	252	805	470	398	198	43
10	47	48	62	75	91	78	271	810	470	403	194	48
11	43	45	65	80	91	74	288	816	466	426	188	46
12	54	48	64	82	91	74	305	828	466	394	182	45
13	57	47	64	82	92	74	320	816	466	360	178	42
14	53	44	62	80	92	74	351	800	475	368	168	49
15	53	44	62	82	92	74	372	794	480	364	166	46
16	67	44	62	83	92	73	385	778	480	360	161	43
17	70	44	62	87	88	72	430	778	480	351	155	41
18	62	44	64	90	87	73	466	745	484	351	153	40
19	60	43	68	88	85	72	509	694	514	343	149	47
20	66	43	68	88	84	73	564	719	509	328	134	45
21	68	44	68	87	84	80	579	714	509	328	129	41
22	56	43	67	87	84	84	564	719	514	343	129	50
23	49	44	66	85	84	83	589	704	509	324	122	27
24	52	47	65	84	85	82	600	704	504	320	125	31
25	57	48	64	91	85	82	610	694	499	308	108	33
26	57	48	64	91	85	79	620	654	499	288	91	14
27	53	47	64	92	87	82	630	644	499	277	94	17
28	50	47	63	90	87	80	650	649	494	265	97	20
29	51	49	64	88		91	670	634	489	262	76	17
30	60	47	65	91	- - - - -	103	690	609	484	255	75	14
31	31	- - - - -	67	92	- - - - -	117	- - - - -	584	- - - - -	252	74	- - - - -
Total	1,778	1,347	1,902	2,518	2,488	2,509	12,126	22,962	14,844	11,280	4,941	1,298
Mean	57.4	44.9	61.4	81.2	88.9	80.9	404	741	495	364	159	43.3
Max	71	49	68	92	97	117	690	828	559	489	255	74
Min	31	36	47	67	84	72	127	584	466	252	74	14
Cfsm	0.119	0.093	0.127	0.168	0.184	0.167	0.836	1.53	1.02	0.754	0.329	0.090
In.	0.14	0.10	0.15	0.19	0.19	0.19	0.93	1.77	1.14	0.87	0.38	0.10
Cal yr 1966: Total	164,456	Mean	451	Max	1,900	Min	31	Cfsm	0.934	In.	12.66	
Wtr yr 1967: Total	79,993	Mean	219	Max	828	Min	14	Cfsm	0.453	In.	6.16	

5-1294. Rainy Lake near Fort Frances, Ontario
(Formerly published as Rainy Lake at Fort Frances)

(International gaging station)

Location (revised).--Lat 48°38'30", long 93°20'00", at Five Mile dock, approximately 5 miles northeast of town of Fort Frances.

Records available.--January 1910 to September 1917 and October 1934 to September 1967 in reports of Geological Survey. August 1911 to September 1967 in reports of Inland Waters Branch, Department of Energy, Mines and Resources, Canada. Prior to October 1949, published as "at Ranier, Minn.", and as "at Fort Frances, Ontario" October 1949 to September 1964.

Gage.--Water-stage recorder. Datum of gage is at mean sea level (United States and Canadian Boundary Survey). January 1910 to December 1949, staff gage 3 miles northeast at Ranier, Minn., at same datum. January 1950 to October 1964, water-stage recorder on Government dock at Pither's Point in Fort Frances and supplementary gage in town pumping station, half a mile south, used during winter months, at same datum.

Extremes.--Maximum elevation during year, 1,108.41 ft June 29; minimum, 1,104.56 ft Mar. 29.
1910-17, 1934-67: 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 1966 to September 1967

Oct. 31	6.15	Feb. 28	5.01	June 30	8.26
Nov. 30	5.93	Mar. 31	4.70	July 31	8.02
Dec. 31	5.66	Apr. 30	7.10	Aug. 31	7.57
Jan. 31	5.38	May 31	7.77	Sept. 30	6.79

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 NE 1/4 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 11 1/2 miles north of Chisholm.

Drainage area.--187 sq mi.

Records available.--August 1942 to September 1967.

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.--25 years, 119 cfs.

Extremes.--Maximum discharge during year, 1,040 cfs Apr 2 (gage height, 4.06 ft, backwater from ice); minimum, 8.8 cfs Sept. 12 (gage height, 0.20 ft).

1942-67: 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 daily, 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 no gage-height record and those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	52	78	33	30	32	26	800	500	110	91	31	13
2	52	68	33	30	31	26	960	576	104	85	34	13
3	59	61	33	30	31	26	799	585	97	78	32	12
4	79	56	32	30	30	26	633	544	91	72	31	11
5	89	52	32	30	30	26	496	476	84	66	29	11
6	89	51	32	30	29	26	423	415	84	61	28	16
7	88	49	32	30	29	26	358	372	89	56	28	11
8	84	47	31	30	29	26	341	355	110	59	30	9.9
9	79	44	31	29	28	26	387	341	132	53	31	9.5
10	76	41	30	29	28	26	397	328	134	49	28	9.2
11	72	38	30	29	28	26	401	317	124	46	26	9.7
12	70	36	30	29	27	25	394	311	119	42	24	9.0
13	68	35	30	29	27	25	358	297	124	38	22	10
14	79	35	30	29	27	25	352	277	150	35	21	12
15	97	34	29	29	26	25	358	260	169	32	21	12
16	104	34	29	28	26	25	355	246	176	31	20	12
17	103	33	29	28	26	25	469	233	165	29	20	12
18	98	33	29	28	26	24	590	218	144	29	20	11
19	91	34	28	29	26	24	673	205	132	28	20	11
20	86	35	28	29	26	24	673	198	198	26	20	12
21	82	35	28	29	26	24	623	186	233	26	21	14
22	82	36	28	30	26	24	553	178	243	49	20	14
23	84	36	28	30	26	24	500	174	225	58	19	13
24	81	36	28	31	26	24	449	167	188	60	19	12
25	78	35	28	32	26	25	390	158	158	58	18	12
26	84	35	28	33	26	26	345	156	134	58	18	11
27	86	34	28	33	26	29	311	152	113	49	17	10
28	88	34	29	34	26	36	283	148	104	43	16	10
29	88	34	29	33		50	314	138	97	39	15	9.9
30	86	33	29	33	-----	178	380	128	95	35	14	9.7
31	84	-----	30	33	-----	470	-----	117	-----	32	14	-----
Total	2,538	1,242	924	936	770	1,418	14,365	8,756	4,126	1,513	707	3,419
Mean	81.9	41.4	29.8	30.2	27.5	45.7	479	282	138	48.8	22.8	11.4
Max	104	78	33	34	32	470	960	585	243	91	34	16
Min	52	33	28	28	26	24	283	117	84	26	14	9.0
Cfsm	0.438	0.221	0.159	0.161	0.147	0.244	2.56	1.51	0.738	0.261	0.122	0.061
In.	0.50	0.25	0.18	0.19	0.15	0.28	2.86	1.74	0.82	0.30	0.14	0.07

Cal yr 1966: Total 62,168 Mean 170 Max 1,400 Min 23 Cfsm 0.909 In. 12.36
Wtr yr 1967: Total 37,636.9 Mean 103 Max 960 Min 9.0 Cfsm 0.551 In. 7.49

Peak discharge (base, 500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4-2	1300	4.06	1,040	5-2	2330	3.02	595
4-19	2200	3.21	688				

Note.--No gage-height record Oct. 27 to Nov. 28.

5-1310. Dark River near Chisolm, Minn.

Location.--Lat 47°41'27", long 92°49'15", in SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.12, T.60 N., R.20 W., on right bank 50 ft downstream from remains of abandoned highway bridge, $\frac{3}{4}$ miles upstream from mouth, and 12 $\frac{1}{4}$ miles northeast of Chisolm.

Drainage area.--50.6 sq mi.

Records available.--August 1942 to September 1961, October 1965 to September 1967.

Gage.--Water-stage recorder. Datum of gage is 1,316.8 ft above mean sea level, datum of 1929 (surveyed by Topographic Division). Prior to Aug. 24, 1944, staff gage at site 50 ft upstream at same datum.

Average discharge.--21 years, 36.2 cfs.

Extremes.--Maximum discharge during year, 200 cfs Apr. 1 (gage height, 3.32 ft); minimum, 2.8 cfs Sept. 10 (gage height, 1.06 ft).

1942-61, 1966-67: Maximum discharge, 1.170 cfs May 7, 1950 (gage height, 7.10 ft); minimum, 0.3 cfs Aug. 3, 1956; minimum gage height, 0.87 ft Mar. 22, 23, 1949, Aug. 16, 17, 1961.

Remarks.--Records good except those for winter months, which are fair.

Cooperation.--Records for 1967 water year computed by U. S. Steel Corporation and reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	11	21	9.2	8.8	8.3	7.5	170	112	18	22	9.1	5.4
2	11	20	9.2	8.8	8.2	7.5	184	119	17	20	9.8	5.1
3	15	18	9.2	8.7	8.2	7.5	182	122	16	18	9.6	5.9
4	23	17	9.2	8.7	8.2	7.4	172	122	15	16	9.1	5.8
5	24	17	9.2	8.7	8.2	7.4	162	118	14	14	8.5	5.5
6	26	17	9.2	8.7	8.2	7.4	154	108	14	13	9.3	5.6
7	28	17	9.2	8.7	8.1	7.3	143	93	18	12	8.9	5.6
8	27	17	9.2	8.6	8.1	7.3	132	84	23	13	9.3	5.9
9	25	16	9.1	8.6	8.1	7.3	124	76	28	12	9.6	4.5
10	23	16	9.1	8.6	8.0	7.2	114	74	31	11	9.1	3.0
11	22	16	9.1	8.6	8.0	7.2	105	71	32	11	8.5	3.2
12	21	15	9.1	8.6	8.0	7.2	95	65	32	11	8.2	3.3
13	20	14	9.1	8.6	8.0	7.2	87	61	33	10	7.4	4.5
14	25	14	9.0	8.6	8.0	7.2	81	57	39	9.6	6.8	4.9
15	28	14	9.0	8.6	7.9	7.1	80	53	42	9.1	6.6	4.1
16	28	14	9.0	8.6	7.9	7.2	76	49	44	9.1	6.4	3.9
17	29	13	9.0	8.5	7.9	7.2	118	44	43	9.3	6.6	3.9
18	28	13	9.0	8.5	7.8	7.4	148	41	38	9.1	6.4	3.6
19	28	12	9.0	8.5	7.8	7.7	140	37	39	8.5	5.9	3.4
20	27	12	9.0	8.5	7.8	8.0	146	35	56	8.4	6.2	3.9
21	26	11	9.0	8.4	7.8	8.7	144	33	57	8.7	6.5	4.2
22	25	11	9.0	8.4	7.7	10	125	32	56	17	6.2	3.9
23	25	11	9.0	8.4	7.7	12	112	30	52	17	6.8	3.8
24	26	11	9.0	8.4	7.6	15	100	30	44	17	7.1	3.5
25	26	10	8.9	8.4	7.6	18	93	29	38	16	7.1	3.2
26	25	10	8.9	8.4	7.6	21	84	28	33	15	6.6	3.4
27	24	9.8	8.9	8.4	7.6	26	76	28	30	12	7.0	3.5
28	24	9.6	8.8	8.4	7.6	32	70	26	27	11	6.6	3.6
29	23	9.4	8.8	8.4		39	63	24	24	11	6.4	3.8
30	23	9.3	8.8	8.4	- - - - -	52	76	22	24	9.8	6.0	3.6
31	22	- - - - -	8.8	8.4	- - - - -	78	- - - - -	20	- - - - -	9.1	5.5	- - - - -
Total	738	415.1	280.0	264.9	221.9	458.9	3556	1843	977	389.7	233.1	127.5
Mean	23.8	13.8	9.03	8.54	7.92	14.8	119	59.5	32.6	12.6	7.52	4.25
Max	29	21	9.2	8.8	8.3	78	184	122	57	22	9.8	5.9
Min	11	9.3	8.8	8.4	7.6	7.1	63	20	14	8.4	5.5	3.2
Cfsm	0.470	0.273	0.178	0.169	0.157	0.292	2.35	1.18	0.644	0.249	0.149	0.084
In.	0.54	0.30	0.21	0.19	0.16	0.34	2.61	1.35	0.72	0.29	0.17	0.09

Cal yr 1966: Total 16,340.1 Mean 44.8 Max 421 Min 6.9 Cfsm 0.885 In. 12.01
 Wtr yr 1967: Total 9,505.1 Mean 26.0 Max 184 Min 3.2 Cfsm 0.514 In. 6.99

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

Location (revised).--Lat 48°24', long 93°34', in NW¼ sec. 9, T. 68 N., R. 25 W., on left bank 100 ft downstream from highway bridge at town of Little Fork, 0.3 mile downstream from bridge on State Highway 217, 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 1967.

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.--44 years (1911-16, 1928-67), 988 cfs.

Extremes.--Maximum discharge during year, 6,880 cfs Apr. 8 (gage height, 19.12 ft); maximum gage height, 22.61 ft Apr. 8 (backwater from ice); minimum discharge, 55 cfs Sept. 25 (gage height 4.80 ft).
1909-17, 1928-67: 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 backwater from Rainy River and those for winter months, which are fair. Records of chemical analyses for the water year 1967 published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	182	440	193	120	132	100	3,200	5,220	914	848	315	87
2	178	370	187	121	131	100	5,600	6,450	838	790	289	81
3	185	330	178	123	130	99	5,800	6,420	768	752	274	78
4	200	310	170	124	129	97	5,500	5,620	712	724	250	74
5	218	295	163	126	128	96	5,100	4,860	650	678	240	69
6	228	288	157	128	127	94	5,300	4,150	616	616	242	68
7	236	286	150	131	126	93	5,900	3,540	594	555	240	63
8	272	280	144	133	125	92	6,600	3,130	656	510	236	62
9	287	276	138	135	124	90	5,570	2,880	816	481	226	62
10	283	272	133	137	124	88	4,180	2,730	917	432	218	61
11	280	268	128	140	123	87	3,650	2,650	971	398	216	60
12	265	267	123	143	122	86	3,380	2,530	1,000	372	207	62
13	248	264	120	144	120	86	3,250	2,330	1,040	339	205	69
14	272	263	116	146	119	85	3,180	2,130	1,070	312	194	71
15	349	261	114	147	118	85	3,400	1,960	1,210	292	187	65
16	501	258	112	148	116	85	3,550	1,810	1,360	280	167	63
17	579	254	111	147	115	84	3,600	1,660	1,410	269	150	62
18	650	252	110	146	113	85	4,080	1,530	1,300	257	137	63
19	662	250	110	144	111	86	4,810	1,450	1,130	244	118	63
20	659	248	110	142	109	87	5,040	1,340	1,190	236	122	65
21	634	244	110	141	108	88	5,210	1,230	1,430	230	128	68
22	600	240	111	140	106	90	5,200	1,190	1,760	236	136	64
23	579	237	112	139	104	93	4,780	1,120	1,930	236	134	60
24	552	234	112	138	103	94	4,250	1,080	1,780	252	126	60
25	510	230	113	137	102	96	3,710	1,060	1,510	476	122	57
26	513	224	113	137	100	98	3,250	1,030	1,260	737	119	56
27	510	219	114	136	99	100	2,830	1,010	1,060	641	112	56
28	498	211	114	135	99	103	2,560	989	978	504	104	57
29	486	204	115	134		107	2,900	978	878	454	100	60
30	484	200	116	134	- - - - -	160	4,310	971	858	404	95	63
31	472	- - - - -	117	133	- - - - -	1,370	- - - - -	954	- - - - -	354	91	- - - - -
Total	12,572	7,975	4,014	4,229	3,263	4,204	129,690	76,002	32,606	13,909	5,500	1,949
Mean	406	266	129	136	117	136	4,323	2,452	1,087	449	177	65
Max	662	440	193	148	132	1,370	6,600	6,450	1,930	848	315	87
Min	178	200	110	120	99	84	2,560	954	594	230	91	56
Cfsm	0.235	0.154	0.075	0.079	0.068	0.079	2.50	1.42	0.628	0.260	0.102	0.038
In.	0.27	0.17	0.09	0.09	0.07	0.09	2.79	1.63	0.70	0.30	0.12	0.04
Cal yr 1966: Total	565,959			Mean 1,551	Max 14,600	Min 110	Cfsm 0.897	In. 12.17				
Wtr yr 1967: Total	295,913			Mean 811	Max 6,600	Min 56	Cfsm 0.469	In. 6.36				

Note.--Stage-discharge relation affected by backwater from Rainy River Apr. 17 to May 31.

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 4¼ 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 1967.

Gage.--Digital 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. Dec. 18, 1937, to Sept. 6, 1967, graphic water-stage recorder at same site and datum.

Average discharge.--39 years (1928-1967), 658 cfs.

Extremes.--Maximum discharge during year, 5,250 cfs Apr. 8 (gage height, 8.88 ft); maximum gage height, 9.34 ft Apr. 2 (backwater from ice); minimum discharge, 56 cfs Sept 18 (gage height, 2.73 ft, result of regulation). 1909-12, 1928-67: 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 winter months, which are fair. Some diurnal fluctuation at low flow caused by powerplant a quarter of a mile upstream. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	364	596	360	264	255	179	3,200	3,860	1,080	810	239	121
2	354	503	350	364	252	178	3,720	4,120	1,030	772	227	121
3	359	394	345	264	250	172	4,000	3,590	991	726	218	121
4	384	307	340	264	248	168	3,800	3,540	942	661	218	121
5	420	410	330	264	246	162	3,200	3,230	886	616	210	121
6	436	515	320	264	241	158	3,000	2,930	824	564	197	105
7	452	570	313	267	238	152	3,030	2,700	810	527	189	117
8	458	552	308	274	237	145	3,910	2,600	858	509	176	111
9	452	463	300	277	235	140	3,490	2,530	1,140	492	176	106
10	436	435	292	280	231	139	2,970	2,480	1,270	447	168	110
11	420	415	286	280	230	137	2,890	2,440	1,280	415	168	110
12	431	400	281	284	230	135	2,800	2,330	1,220	389	164	113
13	452	400	279	289	228	131	2,680	2,240	1,200	364	157	118
14	469	405	271	289	225	130	2,640	2,140	1,310	340	138	122
15	583	410	269	289	221	128	2,810	2,050	1,540	330	134	123
16	720	415	267	288	220	127	2,810	1,920	1,600	311	134	123
17	798	415	267	287	216	127	2,850	1,810	1,520	293	134	124
18	804	405	267	287	215	127	3,180	1,710	1,320	270	131	121
19	778	400	269	284	212	127	3,470	1,650	1,180	265	131	130
20	746	390	270	282	210	129	3,570	1,570	1,440	256	134	131
21	739	385	270	279	209	129	3,800	1,520	1,680	226	142	127
22	706	380	270	275	206	130	4,010	1,440	1,760	242	145	127
23	694	380	270	272	204	134	3,830	1,380	1,700	404	142	121
24	687	390	271	271	201	135	3,560	1,360	1,520	410	142	123
25	687	395	271	270	198	137	3,220	1,340	1,300	394	138	122
26	687	400	271	268	191	139	2,920	1,320	1,100	364	138	121
27	668	390	271	265	188	141	2,670	1,310	956	354	134	119
28	661	380	270	262	184	145	2,440	1,290	886	324	131	122
29	648	375	269	260		150	2,740	1,260	830	311	131	120
30	635	370	268	260	- - - -	200	3,430	1,170	810	288	124	121
31	609	- - - -	266	255	- - - -	950	- - - -	1,120	- - - -	256	121	- - - -
Total	17,737	12,645	8,951	8,478	6,221	5,281	96,640	65,950	35,983	12,930	4,931	3,592
Mean	572	422	289	273	222	170	3,221	2,127	1,199	417	159	120
Max	804	596	360	289	255	950	4,010	4,120	1,760	810	239	131
Min	354	307	266	255	184	127	2,440	1,120	810	226	121	105
Cfsm	0.392	0.289	0.198	0.187	0.152	0.116	2.21	1.46	0.821	0.286	0.109	0.082
In.	0.45	0.32	0.23	0.22	0.16	0.13	2.46	1.68	0.92	0.33	0.13	0.09
Cal yr 1966: Total	439,061		Mean	1,203	Max	9,440	Min	153	Cfsm	0.824	In.	11.18
Wtr yr 1967: Total	279,339		Mean	765	Max	4,120	Min	105	Cfsm	0.524	In.	7.12

LAKE OF THE WOODS BASIN

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 1967. 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.---Digital 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. Nov. 10, 1934, to Sept. 20, 1967, graphic water-stage recorder at present site and datum.

Average discharge.---39 years, 12,236 cfs.

Extremes.---Maximum discharge during year, 33,900 cfs May 5 (gage height, 12.98 ft); minimum daily, 2,370 cfs Nov. 25; minimum gage height, 1.79 ft Nov. 7.

1928-67: 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 winter months, which are fair. Diurnal fluctuation caused by power-plant 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	10,200	7,260	8,270	4,540	7,090	6,880	11,500	25,000	18,900	20,700	12,200	8,770
2	9,360	8,290	7,470	4,250	7,410	6,240	15,500	28,500	18,500	20,800	12,300	8,570
3	8,640	8,020	7,340	5,000	6,740	6,940	18,000	32,900	16,200	20,500	12,200	8,100
4	8,680	7,920	4,580	6,280	5,920	6,480	18,900	33,100	14,500	20,000	12,100	5,810
5	8,380	6,920	4,100	6,430	5,020	6,470	19,500	33,600	14,100	19,200	12,000	4,740
6	7,760	4,920	6,440	6,070	4,870	3,160	17,800	32,800	13,300	16,900	11,900	6,160
7	7,980	3,940	8,100	6,590	6,720	5,170	16,400	31,200	13,000	15,900	11,800	7,280
8	8,020	4,650	7,410	5,100	6,950	5,810	17,200	30,300	13,600	15,700	11,800	8,120
9	7,000	5,620	6,750	4,840	6,310	6,020	17,300	29,600	13,400	15,500	11,800	9,200
10	6,120	6,760	6,200	5,000	5,920	5,650	16,400	28,900	16,400	15,200	11,800	8,790
11	6,400	5,780	4,910	5,950	5,360	5,830	16,400	28,200	16,500	14,000	11,800	7,080
12	7,200	6,350	4,790	6,500	5,710	5,450	15,500	28,500	16,500	13,400	11,800	7,100
13	7,700	4,290	5,900	6,300	4,410	4,050	14,400	29,600	19,100	13,300	11,700	7,440
14	6,600	4,300	6,420	7,140	5,140	5,870	13,800	30,000	20,400	13,000	11,700	7,160
15	6,720	3,010	6,430	5,780	6,530	5,290	13,800	29,600	20,700	12,800	11,800	7,280
16	6,530	3,530	5,360	4,350	7,000	6,330	14,700	29,200	20,900	12,500	11,800	8,750
17	6,140	5,520	5,640	5,860	6,750	6,440	14,700	28,900	20,900	12,500	11,700	8,080
18	7,520	5,190	5,000	6,820	7,020	6,840	18,000	28,300	20,400	12,400	11,700	5,960
19	8,990	5,840	4,900	6,920	5,310	5,600	20,600	26,800	20,000	12,300	11,700	7,520
20	9,200	5,390	6,860	6,450	3,490	3,960	23,000	25,800	20,400	12,300	11,700	9,000
21	8,970	3,390	6,180	5,680	5,010	5,820	25,500	26,400	21,200	12,100	11,600	9,280
22	8,550	6,100	7,750	5,130	6,360	5,970	26,600	26,300	21,400	12,200	11,600	9,470
23	7,660	6,120	7,100	4,770	5,870	6,250	26,300	26,200	21,800	12,300	11,700	9,340
24	6,000	6,460	6,460	5,300	6,400	6,010	25,500	25,500	21,500	12,300	11,600	9,480
25	7,520	2,370	5,180	5,610	7,210	5,880	24,300	23,600	20,900	12,500	10,100	7,630
26	9,270	5,920	4,850	6,250	4,570	5,610	22,900	23,200	20,300	12,800	9,590	8,900
27	8,970	3,360	6,100	7,140	4,180	4,130	21,600	23,300	18,600	12,900	9,640	10,100
28	7,280	2,880	6,170	6,700	5,760	5,260	20,700	23,300	17,900	12,800	8,310	9,990
29	7,160	5,820	6,480	4,910	- - - -	5,780	20,800	22,900	18,900	12,700	7,900	9,560
30	6,900	6,910	6,560	4,620	- - - -	6,340	22,400	20,600	20,400	12,500	7,920	9,870
31	6,100	- - - -	6,850	6,150	- - - -	8,000	- - - -	19,400	- - - -	12,300	8,000	- - - -
Total	239,520	162,830	192,550	178,430	165,030	179,530	570,000	851,500	552,600	446,300	345,260	244,530
Mean	7,726	5,428	6,211	5,756	5,894	5,791	19,000	27,470	18,420	14,400	11,140	8,151
Max	10,200	8,290	8,270	7,140	7,410	8,000	26,600	33,600	21,800	20,800	12,300	10,100
Min	6,000	2,370	4,100	4,250	3,490	3,160	11,500	19,400	13,000	12,100	7,900	4,740
Cfsm	0.398	0.280	0.320	0.297	0.304	0.299	0.979	1.42	0.949	0.742	0.574	0.420
In.	0.46	0.31	0.37	0.34	0.32	0.34	1.09	1.63	1.06	0.86	0.66	0.47
Cal yr1966: Total	6,599,570		Mean	18,080	Max	53,000	Min	2,370	Cfsm	0.932	In.	12.65
Wtr yr1967: Total	4,128,080		Mean	11,310	Max	33,600	Min	2,370	Cfsm	0.583	In.	7.91

Location.---Lat 48°32'10", long 94°33' 5", 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.

Records available.--October 1956 to September 1967.

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.--11 years, 334 cfs.

Extremes---Maximum discharge during year, 3,320 cfs May 2 (gage height, 12.07 ft); minimum, 1.4 cfs Sept. 9-12 (gage height, 1.50 ft).

1956-67: 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).

Flood of May 11, 1950 reached a stage of 21.1 ft, from information by local residents and Minnesota Highway Department (discharge, about 8,500 cfs).

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	42	60	31	14	9.0	6.0	1,770	3,070	374	650	20	2.7
2	42	54	30	14	8.8	6.0	1,780	3,310	319	569	21	2.4
3	42	52	29	14	8.6	6.0	1,530	3,160	278	498	22	2.3
4	45	51	28	14	8.3	6.0	1,400	2,880	248	431	21	2.1
5	51	45	27	13	8.0	6.0	1,320	2,700	223	347	19	2.0
6	53	44	26	13	7.8	6.1	1,230	2,530	207	288	17	2.0
7	53	41	25	13	7.6	6.1	1,150	2,380	227	244	16	1.8
8	49	40	23	13	7.4	6.1	1,160	2,240	484	234	14	1.7
9	44	39	21	13	7.4	6.2	1,180	2,060	1,380	214	13	1.5
10	39	38	20	13	7.2	6.2	1,150	1,890	1,430	189	12	1.4
11	37	37	20	13	7.0	6.2	1,060	1,800	1,220	164	11	1.4
12	36	37	19	13	6.9	6.2	999	1,680	1,080	131	10	1.5
13	36	38	18	13	6.8	6.3	976	1,560	1,250	110	9.2	1.7
14	62	40	18	13	6.7	6.3	970	1,440	1,300	97	8.4	1.7
15	61	41	18	13	6.6	6.4	1,090	1,330	1,200	83	7.4	1.8
16	62	41	17	12	6.5	6.4	1,110	1,220	1,040	70	7.8	1.8
17	64	41	17	12	6.5	6.6	1,170	1,120	876	59	8.1	1.8
18	62	42	17	12	6.4	6.9	1,320	1,040	724	54	7.6	1.8
19	59	41	16	12	6.3	7.2	1,650	951	628	45	6.8	2.3
20	55	41	16	12	6.2	7.8	2,250	876	882	39	6.2	2.8
21	53	40	16	11	6.2	8.2	2,950	829	970	32	5.8	2.4
22	54	40	16	11	6.2	8.8	2,890	789	879	38	5.3	2.2
23	58	39	15	11	6.1	9.4	2,730	758	749	37	4.8	2.1
24	60	39	15	11	6.1	10	2,600	730	628	32	4.4	2.0
25	68	39	15	11	6.0	11	2,460	690	529	27	4.1	1.8
26	58	38	15	10	6.0	12	2,230	659	449	24	3.7	2.1
27	54	37	15	10	6.0	13	2,000	659	413	22	3.4	2.0
28	55	36	15	10	6.0	17	1,840	619	392	20	3.4	1.8
29	57	34	14	9.8		135	2,150	569	557	19	3.3	1.7
30	63	33	14	9.4		900	2,620	507	609	19	3.0	1.7
31	68	- - - -	14	9.1	- - - -	1,400	- - - -	440	- - - -	19	2.8	- - - -
Total	1,642	1,238	600	372.3	194.6	2,651.4	50,735	46,486	21,545	4,805	301.5	58.3
Mean	53.0	41.3	19.4	12.0	6.95	85.5	1,691	1,500	718	155	9.73	1.94
Max	68	60	31	14	9.0	1,400	2,950	3,310	1,430	650	22	2.7
Min	36	33	14	9.1	6.0	6.0	970	440	207	19	2.8	1.4
Cfsm	0.098	0.076	0.036	0.022	0.013	0.157	3.11	2.76	1.32	0.285	0.018	0.0036
In.	0.11	0.08	0.04	0.02	0.01	0.18	3.47	3.18	1.48	0.33	0.02	0.004

5-1395. Warroad River near Warroad, Minn.

Location.--Lat 48°52'00", long 95°21'20", in SE 1/4 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 1967. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Wire-weight gage read once daily, and crest-stage gage. 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). Prior to Sept. 6, 1967, chain gage at same site and datum.

Average discharge.--21 years, 42.0 cfs.

Extremes.--Maximum discharge during year, 1,550 cfs Apr. 22 (gage height, 9.35 ft, from floodmark); no flow Sept. 10-30.

1946-67: Maximum discharge, 1,780 cfs Apr. 15, 1965 (gage height 9.95 ft); no flow at times.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7.2	9.6	6.0	4.0	3.2	1.7	333	554	39	22	2.8	0.2
2	5.8	9.8	5.8	4.0	3.1	1.7	416	604	33	23	3.8	.2
3	3.9	9.8	5.7	3.9	3.1	1.7	360	578	27	21	3.6	.1
4	4.0	9.2	5.6	3.9	3.0	1.7	333	509	24	18	3.2	.2
5	4.1	9.0	5.4	3.9	3.0	1.7	289	468	22	16	2.4	.2
6	4.4	8.8	5.3	3.8	3.0	1.7	255	436	20	12	2.3	.2
7	4.1	8.3	5.1	3.8	2.9	1.6	238	401	19	11	2.2	.2
8	4.1	8.0	4.8	3.8	2.9	1.6	222	385	19	9.2	2.1	.1
9	4.1	7.5	4.6	3.7	2.8	1.6	209	366	52	9.4	2.0	.1
10	4.9	6.8	4.3	3.7	2.7	1.5	194	305	67	7.4	2.0	0
11	6.1	6.5	4.1	3.7	2.6	1.5	176	284	70	6.4	1.8	0
12	6.9	6.3	4.1	3.7	2.6	1.5	157	269	102	5.9	1.7	0
13	7.2	6.3	4.0	3.6	2.5	1.5	152	248	118	4.6	1.8	0
14	8.0	6.3	4.0	3.6	2.5	1.5	143	223	130	3.9	1.6	0
15	7.2	6.4	4.0	3.6	2.4	1.5	150	203	146	3.4	1.3	0
16	7.1	6.4	4.0	3.6	2.3	1.5	154	175	160	3.0	1.1	0
17	6.1	6.3	4.1	3.6	2.2	1.5	189	152	124	2.7	1.3	0
18	6.7	6.2	4.2	3.6	2.2	1.5	184	141	91	2.6	1.0	0
19	7.1	6.2	4.2	3.6	2.2	1.5	174	121	72	2.2	.9	0
20	8.0	6.2	4.1	3.6	2.1	1.6	160	114	77	2.1	.9	0
21	9.8	6.3	4.0	3.6	2.1	1.6	1,100	102	74	1.8	.9	0
22	9.4	6.4	3.9	3.5	2.0	1.6	1,490	99	74	4.2	.3	0
23	9.2	6.4	3.9	3.5	2.0	1.6	929	96	67	4.8	.3	0
24	8.5	6.5	3.8	3.4	2.0	1.6	841	94	48	4.2	.4	0
25	9.8	6.5	3.8	3.4	1.9	1.7	710	92	35	6.2	.3	0
26	10	6.6	3.8	3.4	1.9	1.7	590	85	30	5.6	.2	0
27	9.8	6.5	3.8	3.3	1.8	1.8	509	79	26	4.6	.2	0
28	9.6	6.4	3.9	3.3	1.8	3.0	436	72	21	4.2	.1	0
29	8.7	6.4	3.9	3.3		10	395	66	19	3.2	.2	0
30	9.1	6.2	4.0	3.2	- - - -	70	425	54	18	2.7	.2	0
31	9.8	- - - -	4.0	3.2	- - - -	220	- - - -	48	- - - -	3.4	.2	- - - -
Total	220.7	214.1	136.2	111.8	68.8	346.2	11,913	7,423	1,824	230.7	43.1	1.5
Mean	7.12	7.14	4.39	3.61	2.46	11.2	397	239	60.8	7.44	1.39	0.05
Max	10	9.8	6.0	4.0	3.2	220	1,490	604	160	23	3.8	0.2
Min	3.9	6.2	3.8	3.2	1.8	1.5	143	48	18	1.8	0.1	0
Cfsm	0.065	0.065	0.040	0.033	0.022	0.102	3.61	2.18	0.553	0.068	0.013	0.00045
In.	0.08	0.07	0.05	0.04	0.02	0.12	4.03	2.51	0.62	0.08	0.01	0.0005
Cal yr 1966: Total	31,332.9	Mean	85.8	Max	973	Min	3.9	Cfsm	0.780	In.	10.6	
Wtr yr 1967: Total	22,533.1	Mean	61.7	Max	1,490	Min	0	Cfsm	0.561	In.	7.62	

5-1400. Bulldog Run near Warroad, Minn.

Location (revised).--Lat 48°51'30", long 95°20'20", in SE¼ sec.7, T.162 N., R.36 W., near right bank 5 ft downstream from culvert on county highway, three-quarters of a mile upstream from mouth and 3 miles south of Warroad.

Drainage area.--14.2 sq mi.

Records available.--March 1946 to November 1951, June 1966 to September 1967.

Gage.--Staff gage read once daily. Altitude of gage is 1,090 ft (from topographic map).

Average discharge.--6 years (1946-51, 1967) 3.94 cfs.

Extremes.--Maximum discharge during year, 401 cfs Apr. 21 (gage height, 6.82 ft, from graph based on gage readings); no flow for many days.

1946-51, 1966-67: Maximum discharge, 420 cfs June 10, 1947 (gage height, 6.91 ft); no flow for many days.

Remarks.--Records fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						0	71	33	0.6	0.1	0.2	
2						0	27	28	.5	.1	.2	
3						0	17	22	.4	.1	.1	
4						0	7.7	22	.4	.1	.1	
5						0	4.7	25	.2	.1	.1	
6						0	2.4	24	.2	.2	.1	
7						0	1.6	22	.2	.3	.1	
8						0	1.5	15	.6	.3	.1	
9						0	1.6	11	.8	.2	0	
10						0	1.5	8.7	.8	.1	0	
11						0	1.5	7.4	.6	.1	0	
12						0	1.3	5.6	.4	0	0	
13						0	1.3	4.9	.5	0	0	
14						0	1.6	4.7	.5	0	0	
15						0	2.4	3.8	.3	0	0	
16						0	2.9	3.0	.1	0	0	
17						0	2.4	2.6	.1	0	0	
18						0	2.5	1.6	.1	0	0	
19						0	4.9	1.2	.2	0	0	
20						0	32	1.2	.4	0	0	
21						0	305	1.2	.4	0	0	
22						0	134	1.2	.4	.1	0	
23						0	54	1.2	.3	7.8	0	
24						0	29	1.2	.3	13	0	
25						0	20	1.2	.2	2.1	0	
26						0	14	1.2	.2	.5	0	
27						.2	10	1.2	.2	.3	0	
28						1.5	5.6	1.0	.1	.2	0	
29						9.0	8.0	1.0	.1	.1	0	
30						55	23	.8	.1	.1	0	
31						120		.8		.1	0	
Total	0	0	0	0	0	185.7	791.4	258.7	10.2	26.0	1.0	0
Mean	0	0	0	0	0	5.99	26.4	8.35	0.34	0.84	0.03	0
Max	0	0	0	0	0	120	305	33	0.8	13	0.2	0
Min	0	0	0	0	0	0	1.3	0.8	0.1	0	0	0
Cfsm	0	0	0	0	0	0.422	1.86	0.588	0.024	0.059	0.0021	0
In.	0	0	0	0	0	0.49	2.07	0.68	0.027	0.068	0.003	0
Cal yr	: Total											
Wtr yr 1967: Total	1,273					Mean	3.49	Max	305	Min	0	
								Cfsm	0.246	In.	0.33	

5-1405. East Branch Warroad River near Warroad, Minn.

Location.--Lat 48°51'30", long 95°18'40", in SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.8, T.162 N., R.36 W., near right bank on piling at upstream side of highway bridge, 2 miles upstream from mouth and 3 miles south of Warroad.

Drainage area.--102 sq mi.

Records available.--March 1946 to September 1954, June 1966 to September 1967 (fragmentary prior to April 1947).

Gage.--Staff gage read once daily. Altitude of gage is 1,080 ft (from topographic map).

Average discharge.--8 years (1947-54, 1967), 21.7 cfs.

Extremes.--Maximum discharge during year, 574 cfs Apr. 21 (gage height, 8.72 ft, from floodmark); no flow many days.

1946-54, 1967: Maximum discharge, 1,340 cfs June 11, 1947 (gage height 9.36 ft, from floodmark); no flow for many days.

Remarks.--Records fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	5.5	4.6	3.7	0.4	0.4	0.7	105	237	25	12	1.2	
2	6.6	4.8	3.6	.4	.4	.7	150	253	27	8.0	1.2	
3	8.0	4.9	3.5	.4	.4	.7	168	240	25	3.6	2.0	
4	7.5	5.0	3.3	.4	.4	.7	156	218	26	2.6	1.4	
5	7.5	5.0	3.1	.3	.4	.8	133	207	23	1.1	1.4	
6	8.3	4.8	2.9	.3	.5	.8	116	202	26	.7	1.2	
7	8.3	4.6	2.7	.3	.5	.8	103	215	35	.6	1.9	
8	7.8	4.4	2.6	.3	.5	.9	93	209	29	.1	2.6	
9	7.5	4.3	2.5	.3	.5	.9	80	183	45	.1	2.0	
10	7.5	4.2	2.5	.3	.5	.9	68	166	60	.1	1.8	
11	8.3	4.1	2.4	.3	.6	.9	65	145	60	0	1.8	
12	7.8	4.0	2.3	.3	.6	.9	82	129	54	.1	1.7	
13	7.5	4.0	2.2	.3	.6	.9	66	114	63	0	1.6	
14	9.2	3.9	2.2	.3	.6	.8	59	98	69	0	1.2	
15	8.3	3.9	2.1	.3	.6	.8	67	82	85	0	.5	
16	7.4	3.8	1.9	.3	.6	.8	69	70	76	0	0	
17	6.8	3.8	1.7	.3	.6	.8	63	67	57	0	0	
18	8.0	3.8	1.5	.4	.6	.9	64	58	41	0	0	
19	7.5	3.8	1.3	.4	.6	.9	75	53	39	0	0	
20	7.0	3.9	1.2	.4	.6	.9	195	50	69	0	0	
21	8.0	3.9	1.0	.4	.6	1.0	350	48	103	0	0	
22	7.2	4.0	.9	.4	.6	1.0	451	45	71	.1	0	
23	6.8	4.1	.8	.4	.6	1.0	290	58	47	2.4	0	
24	6.1	4.1	.7	.4	.6	1.1	294	46	32	1.7	0	
25	6.0	4.2	.7	.4	.6	1.1	248	42	26	1.6	0	
26	6.0	4.2	.6	.4	.6	1.2	195	42	16	1.3	0	
27	5.8	4.1	.5	.4	.6	1.4	208	37	13	.7	0	
28	5.4	4.0	.5	.4	.6	2.1	189	37	9.4	.4	0	
29	5.3	4.0	.4	.4	.4	4.0	184	34	9.5	.7	0	
30	4.9	3.8	.4	.4	-----	15	204	31	11	.5	0	
31	4.7	-----	.4	.4	-----	45	-----	29	-----	.9	0	-----
Total	218.5	126.0	56.1	11.1	15.3	90.4	4,590	3,445	1,271.9	39.3	23.5	0
Mean	7.05	4.20	1.81	0.36	0.55	2.92	153	111	42.4	1.27	0.76	0
Max	9.2	5.0	3.7	0.4	0.6	45	451	253	103	12	2.6	0
Min	4.7	3.8	0.4	0.3	0.4	0.7	59	29	9.4	0	0	0
Cfsm	0.069	0.041	0.018	0.0035	0.0054	0.029	1.50	1.09	0.416	0.012	0.0074	0
In.	0.08	0.05	0.02	0.004	0.006	0.03	1.67	1.26	0.46	0.01	0.009	0
Cal yr	: Total	-	Mean	-	Max	-	Min	-	Cfsm	-	In.	-
Wtr yr 1967	Total	9,887.1	Mean	27.1	Max	451	Min	0	Cfsm	0.266	In.	3.60

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 1967. 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, 628,800 acre-ft June 30, July 1 (gage height, 10.90 ft); minimum, 442,300 acre-ft Mar. 20 (gage height, 8.13 ft).
1884-1967: 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 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	9.72	547,400	-
Oct. 31	9.36	523,600	-23,800
Nov. 30	9.00	499,800	-23,800
Dec. 31	8.79	486,000	-13,800
Calendar year 1966	-	-	-29,700
Jan. 31	8.60	474,000	-12,000
Feb. 28	8.35	456,200	-17,800
Mar. 31	8.28	452,200	-4,000
Apr. 30	9.34	521,700	+69,500
May 31	10.09	571,200	+49,500
June 30	10.85	624,800	+53,600
July 31	10.35	589,100	-35,700
Aug. 31	9.49	531,600	-57,500
Sept. 30	8.79	486,000	-45,600
Water year 1966-67	-	-	-61,400

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 1967. 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.--83 years, 505 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 935 cfs July 1; minimum daily, 100 cfs Mar. 31 to Apr. 7. 1884-1967: 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; two discharge measurements made and records reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	895	895	740	771	807	793	100	500	510	935	865	525
2	878	890	740	771	805	795	100	505	510	910	870	610
3	897	890	740	771	805	795	100	505	510	900	870	610
4	897	890	735	771	805	793	100	505	510	890	870	610
5	895	890	735	770	805	795	100	500	510	885	865	610
6	895	890	735	770	800	795	100	500	510	890	860	610
7	890	890	740	771	800	795	100	505	510	885	860	610
8	893	893	775	771	800	790	104	505	515	890	860	615
9	898	890	776	770	800	790	104	505	525	890	860	610
10	905	890	776	770	797	793	104	505	515	890	860	610
11	898	890	775	770	795	790	104	505	515	890	855	610
12	890	885	775	770	795	790	104	505	510	895	855	605
13	890	900	775	770	795	790	104	505	510	890	855	605
14	890	900	775	770	795	790	108	500	520	880	855	610
15	895	885	775	770	796	790	106	500	525	885	855	610
16	895	735	775	770	795	790	106	505	525	885	822	610
17	890	735	775	770	790	790	106	510	525	885	725	610
18	895	740	775	761	790	790	108	510	525	880	725	610
19	895	735	775	750	795	788	106	510	525	880	729	610
20	890	740	775	750	796	788	108	510	675	880	729	605
21	890	740	775	800	796	790	108	510	675	875	729	610
22	905	740	775	803	798	790	110	510	830	875	698	610
23	900	740	771	805	797	790	110	510	825	875	700	615
24	895	740	771	805	795	790	110	510	825	875	700	610
25	890	740	771	803	795	682	303	510	820	875	700	605
26	890	740	773	805	795	614	500	510	820	875	700	378
27	890	745	771	803	795	501	490	510	815	870	700	129
28	890	740	773	800	795	368	500	510	815	870	698	124
29	895	740	773	803	795	309	500	510	843	870	698	144
30	890	745	771	805	795	190	500	510	925	870	698	372
31	905	---	770	802	---	100	---	510	---	865	695	---
Total	27,711	24,463	23,736	24,191	22,332	21,754	5,303	15,705	18,673	27,410	24,361	16,302
Mean	894	815	766	780	798	702	177	507	622	884	786	543
Max	905	900	776	805	807	795	500	510	925	935	870	615
Min	878	735	735	750	790	100	100	500	510	865	695	124
Cfsm	0.620	0.565	0.531	0.541	0.553	0.487	0.123	0.352	0.431	0.613	0.545	0.377
In.	0.71	0.63	0.61	0.62	0.57	0.56	0.14	0.41	0.48	0.71	0.63	0.42

Cal yr 1966: Total 300,831 Mean 824 Max 963 Min 100 Cfsm 0.571 In. 7.76
 Wtr yr 1967: Total 251,941 Mean 690 Max 935 Min 100 Cfsm 0.478 In. 6.50

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 1967. 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, 289,600 acre-ft June 20 (gage height, 2.05 ft); minimum, 123,400 acre-ft Mar. 24 (gage height, 0.65 ft).
1884-1967: 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 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	1.70	246,000	-
Oct. 31	1.47	216,200	-29,800
Nov. 30	1.28	192,800	-23,400
Dec. 31	1.11	173,600	-19,200
Calendar year 1966	-	-	-28,700
Jan. 31	1.02	163,600	-10,000
Feb. 28 .....	.80	139,800	-23,800
Mar. 31 .....	.77	136,500	-3,300
Apr. 30	1.63	236,000	+99,500
May 31	1.73	249,900	+13,900
June 30	2.00	283,600	+33,700
July 31	1.70	246,000	-37,600
Aug. 31	1.32	197,800	-48,200
Sept. 30	1.08	170,200	-27,600
Water year 1966-67	-	-	-75,800

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 1967. 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.--83 years, 346 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 863 cfs Feb. 4, 5; minimum daily, 76 cfs Sept. 11. 1884-1967: 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	702	660	656	740	811	787	125	457	465	133	98	90
2	679	629	656	740	798	805	136	582	475	134	106	88
3	665	629	684	730	782	815	131	582	272	128	108	86
4	716	647	673	721	863	796	107	562	270	122	98	85
5	692	637	684	726	863	805	111	530	196	126	95	85
6	692	633	681	712	810	800	112	506	94	127	95	84
7	687	625	755	726	806	750	118	518	94	122	93	86
8	679	628	751	712	810	768	116	541	99	122	97	85
9	692	604	765	721	801	773	134	514	111	121	96	79
10	730	655	751	730	834	782	134	469	101	122	91	77
11	692	628	737	707	787	782	109	478	98	126	92	76
12	647	624	732	712	773	759	109	510	99	126	90	78
13	633	624	737	756	783	788	114	522	109	120	89	80
14	655	628	737	765	801	773	117	522	114	118	89	81
15	655	620	737	742	787	768	128	518	114	116	111	81
16	701	689	737	760	768	788	121	514	117	117	110	83
17	716	694	737	709	763	768	120	522	119	116	111	85
18	716	710	732	705	796	750	100	537	117	114	104	85
19	711	682	722	700	800	745	95	572	116	113	109	85
20	701	682	747	700	810	745	97	499	134	113	106	89
21	692	677	732	756	796	788	125	490	134	113	97	91
22	774	685	727	756	806	768	108	502	125	112	95	84
23	790	689	718	779	806	764	96	493	127	118	95	88
24	706	685	718	765	773	737	92	493	126	115	97	85
25	688	682	718	811	768	654	306	478	128	107	97	81
26	674	682	713	802	763	627	498	510	126	106	95	294
27	679	689	709	798	787	543	513	506	124	105	95	282
28	669	682	705	798	773	369	490	481	125	108	96	281
29	679	677	745	792	292	468	478	129	102	102	92	281
30	699	685	735	787	215	453	447	133	99	99	88	279
31	725	---	730	816	---	117	---	447	---	100	88	---
Total	21,536	19,761	22,361	23,174	22,318	21,421	5,483	15,780	4,591	3,621	3,023	3,514
Mean	695	659	721	748	797	691	183	509	153	116	97.5	117
Max	790	710	765	816	863	815	513	582	475	134	111	294
Min	633	604	656	700	763	117	92	447	94	99	88	76
Cfsm	0.598	0.567	0.620	0.643	0.685	0.594	0.157	0.438	0.132	0.100	0.084	0.101
In.	0.69	0.63	0.72	0.74	0.71	0.68	0.18	0.50	0.15	0.12	0.10	0.11
Cal yr1966: Total	251,932		Mean 690	Max 967	Min 79	Cfsm 0.593	In. 8.06					
Wtr yr1967: Total	166,583		Mean 456	Max 863	Min 76	Cfsm 0.392	In. 5.33					

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 1967. 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, 57,920 acre-ft June 28 (gage height, 9.06 ft); minimum, 21,820 acre-ft Mar. 20 (gage height, 6.28 ft).
1884-1967: 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 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	8.98	56,930	-
Oct. 31	9.00	57,120	+190
Nov. 30	8.63	52,170	-4,950
Dec. 31	8.34	48,200	-3,970
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Calendar year 1966	-	-	+1,000
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Jan. 31	8.39	48,990	+790
Feb. 28	6.85	28,960	-20,030
Mar. 31	6.78	28,170	-790
Apr. 30	8.28	47,400	+19,230
May 31	8.65	52,360	+4,960
June 30	9.04	57,720	+5,360
July 31	8.89	55,740	-1,980
Aug. 31	8.92	56,130	+390
Sept. 30	8.56	51,170	-4,960
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Water year 1966-67	-	-	-5,760

5-2110. Mississippi River at Grand Rapids, Minn.

Location.--Lat 47°13'56", long 93°31'48", in SW¼ sec. 21, T.55 N., R.25 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 1967. Monthly discharge only for some periods, published in WSP 1308. Published as "at Pokegama Dam near Grand Rapids" 1942-44.

Gage.--Digital 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. Jan. 17, 1951, to July 11, 1966, graphic water-stage recorder at present site and datum.

Average discharge.--84 years, 1,130 cfs.

Extremes.--Maximum daily discharge during year, 2,950 cfs Apr. 1, 2; minimum discharge, 540 cfs Aug. 24. 1883-1967: 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 1967 are published in Part 2 of this report.

Cooperation.--Records furnished by Corps of Engineers, 1883-1944, 1959-64.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	1,930	2,310	1,740	1,630	2,010	2,120	2,950	1,690	1,310	1,300	1,030	958
2	1,930	2,080	1,960	1,630	2,010	2,010	2,950	1,730	1,250	1,350	1,040	894
3	1,970	2,110	1,960	1,640	1,980	1,910	1,930	1,730	1,090	1,320	1,010	898
4	2,000	2,060	1,870	1,620	1,900	1,800	1,900	1,780	1,110	1,320	1,010	890
5	1,960	2,040	1,800	1,650	1,880	1,770	2,050	1,780	1,070	1,280	1,010	886
6	2,020	2,030	1,710	1,640	1,890	1,770	2,630	1,810	1,130	1,230	1,030	898
7	1,990	2,000	1,670	1,620	1,860	1,810	2,590	1,850	1,130	1,220	1,020	874
8	1,980	2,000	1,630	1,740	1,840	1,800	2,470	1,870	1,120	1,250	1,030	874
9	2,020	1,990	1,530	1,760	1,810	1,800	2,520	1,860	1,130	1,230	1,020	878
10	1,990	2,030	1,590	1,700	1,930	1,770	2,630	1,880	1,130	1,150	1,010	799
11	2,000	2,000	1,550	1,700	2,310	1,710	2,580	1,730	1,130	1,090	1,030	862
12	2,000	1,960	1,560	1,690	2,320	1,680	2,450	1,680	1,200	1,070	1,020	842
13	2,010	1,970	1,520	1,660	2,220	1,620	2,200	1,580	1,160	1,080	1,020	818
14	2,030	1,380	1,550	1,640	2,190	1,610	2,180	1,580	1,180	1,050	1,020	811
15	2,070	1,830	1,470	1,670	2,160	1,610	2,130	1,550	1,190	1,080	1,030	811
16	2,070	1,840	1,500	1,760	2,220	1,620	2,130	1,520	1,160	1,110	1,030	814
17	2,130	1,840	1,490	2,120	2,190	1,650	2,130	1,560	1,170	1,090	1,030	803
18	2,120	1,820	1,490	2,030	2,160	1,660	2,160	1,500	1,160	1,090	1,000	791
19	2,090	1,730	1,510	1,950	2,130	1,660	2,140	1,490	1,230	1,090	998	807
20	2,030	1,680	1,550	1,880	2,120	1,670	2,010	1,470	1,200	1,030	1,000	803
21	2,080	1,630	1,560	1,820	2,250	1,690	1,940	1,510	1,170	1,040	974	803
22	2,090	1,700	1,630	1,740	2,220	1,680	1,930	1,530	1,220	1,050	906	795
23	2,060	1,740	1,750	1,710	2,190	1,680	1,950	1,410	1,240	1,050	910	764
24	2,110	1,780	1,700	1,720	2,150	1,680	1,860	1,340	1,240	1,010	818	757
25	2,080	1,760	1,730	1,720	2,120	1,710	1,720	1,350	1,230	1,010	854	764
26	2,080	1,770	1,690	1,760	2,070	1,810	1,700	1,350	1,250	1,030	746	772
27	2,070	1,790	1,680	1,760	2,060	1,810	1,710	1,320	1,300	1,010	818	731
28	2,080	1,780	1,690	1,740	2,090	1,870	1,700	1,330	1,290	1,030	749	727
29	2,080	1,740	1,680	1,740	-----	2,040	1,680	1,340	1,400	1,050	870	749
30	2,070	1,710	1,650	1,820	-----	2,330	1,720	1,330	1,390	1,030	746	746
31	2,100	-----	1,640	2,020	-----	2,840	-----	1,320	-----	1,010	803	-----
TOTAL	63,340	56,350	51,050	54,280	58,280	56,190	64,640	48,770	35,980	34,750	29,582	24,619
MEAN	2,043	1,878	1,647	1,751	2,081	1,813	2,155	1,573	1,199	1,121	954	821
MAX	2,180	2,110	1,960	2,120	2,320	2,840	2,950	1,880	1,400	1,350	1,040	958
MIN	1,930	1,680	1,470	1,620	1,810	1,610	1,680	1,320	1,070	1,010	746	727
CAL YR 1966: TOTAL	774,640											
MEAN	2,122											
WAT YR 1967: TOTAL	577,831											
MEAN	1,583											
MAX	3,510											
MIN	727											

Note.--No gage-height record Mar. 25 to Apr. 7.

5-2127. Prairie River near Taconite, Minn.

Location.--Lat 47°23'20", long 93°22'50", in NW¼SW¼ sec.27, T.57 W., R.24 W., on left bank 125 ft upstream from highway bridge, 1½ miles downstream from outlet of Lawrence Lake and 5 miles north of Taconite.

Records available.--April to September 1967.

Gage.--Graphic water-stage recorder. Prior to Aug. 31, 1967, staff gage at site 125 ft downstream at same datum.

Extremes.--Maximum discharge observed during period, 1,020 cfs Apr. 22, 23; maximum gage height observed, 7.96 ft Apr. 23; minimum discharge 25 cfs Sept. 12, 13; minimum gage height, 2.02 ft Sept. 29, 30.

Remarks.--Records good.

Cooperation.--Additional discharge measurements and gage readings furnished by M. A. Hanna Mining Co.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1								811	214	207	84	38
2								821	194	196	90	37
3								815	170	184	82	36
4								817	158	170	80	36
5								821	149	163	76	36
6								815	151	155	73	36
7								813	149	146	78	35
8								811	152	144	73	32
9								779	152	132	70	32
10							836	748	152	125	68	30
11								850	735	154	66	27
12								864	694	161	62	26
13								880	662	170	60	28
14								900	628	191	58	30
15								925	606	196	93	29
16								923	578	200	89	28
17								952	526	214	82	28
18								963	494	242	77	28
19								963	460	250	70	28
20								974	424	251	68	28
21												
22							1,000	392	250	66	44	30
23							1,020	368	246	64	44	33
24							1,020	355	263	71	42	33
25							1,010	322	272	76	42	29
							998	310	270	76	42	30
26								967	293	254	86	31
27								930	278	262	86	27
28								886	262	239	88	26
29								866	246	221	99	26
30								832	230	216	94	26
31		- - - - -			- - - - -		- - - - -	217	- - - - -	90	39	- - - - -
Total								17,131	6,163	3,449	1,788	919
Mean								553	205	111	57.7	30.6
Max								821	272	207	90	38
Min								217	149	64	39	26
Ac-ft								-	-	-	-	-

Cal yr	: Total	Mean	Max	Min	Ac-ft
Wtr yr	: Total	Mean	Max	Min	Ac-ft

SWAN RIVER BASIN

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 1967.

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, 262 cfs Mar. 31 (gage height, 4.29 ft); minimum, 1.0 cfs Sept. 19 (gage height, 1.56 ft).
1963-67: Maximum discharge, 265 cfs Apr. 19, 1965 (gage height 4.29 ft); minimum, 0.9 cfs Sept. 27, 1966.

Remarks.--Records good. Flow affected by natural storage in lakes above station.

Cooperation.--Additional discharge measurements furnished by M. A. Hanna Mining Co.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.8	5.4	2.9	2.7	2.7	2.9	212	56	4.2	10	3.7	1.5
2	2.2	5.2	2.6	2.7	2.7	2.8	151	71	4.0	9.4	3.7	1.5
3	3.8	4.4	2.6	2.7	2.6	2.7	67	54	3.6	6.5	3.7	1.5
4	7.1	4.2	2.5	2.7	2.6	2.6	49	39	3.0	4.9	3.2	1.5
5	8.4	4.4	2.5	2.7	2.7	2.7	42	29	3.1	4.4	3.0	1.5
6	7.4	4.6	2.7	2.8	2.7	2.7	37	24	5.4	4.2	3.0	1.5
7	6.2	5.7	2.7	2.9	2.8	2.7	30	20	9.4	3.6	3.2	1.4
8	5.2	6.2	2.9	2.7	2.8	2.7	32	21	10	3.7	3.3	1.4
9	4.9	6.0	2.9	2.9	2.7	2.6	63	21	10	3.1	3.3	1.4
10	2.7	6.0	3.1	2.9	2.9	2.5	70	18	10	3.0	3.4	1.4
11	2.5	5.2	3.1	2.9	2.8	2.8	54	19	8.4	4.4	3.2	1.5
12	2.9	4.9	3.0	2.8	2.8	2.8	39	18	8.0	3.0	3.2	1.5
13	3.0	4.4	3.0	2.8	2.7	2.4	36	18	10	2.5	3.1	1.8
14	4.6	4.3	2.8	2.8	2.8	2.8	36	16	28	1.8	3.0	2.1
15	10	4.3	2.8	2.7	2.9	2.8	46	14	28	4.3	2.7	2.0
16	9.7	4.4	2.9	2.9	2.9	2.8	47	12	19	8.4	2.5	1.6
17	8.7	4.4	3.0	2.9	2.8	2.8	60	10	12	4.2	2.2	1.6
18	8.0	4.9	3.4	2.6	2.8	2.7	80	8.7	8.7	3.4	2.0	1.4
19	7.7	4.3	3.7	2.6	2.8	2.6	68	7.1	9.9	3.4	1.8	1.1
20	8.0	4.3	3.7	2.6	2.9	3.1	52	7.7	27	6.0	1.8	1.2
21	5.7	4.9	3.8	2.6	2.9	3.1	50	9.7	30	4.2	1.7	1.2
22	5.2	5.7	3.4	2.7	3.0	2.9	48	7.1	24	3.7	1.6	1.2
23	6.2	5.2	3.2	2.5	3.0	2.6	37	8.0	19	4.2	1.5	1.2
24	5.4	4.6	3.0	2.6	3.0	2.5	29	8.4	7.7	6.2	1.7	1.2
25	5.2	4.4	3.1	2.8	2.8	2.6	33	9.0	6.0	6.8	1.9	1.2
26	5.4	4.9	3.0	2.8	2.8	3.1	22	9.4	4.2	7.1	1.9	1.2
27	4.4	5.2	2.8	2.7	3.0	3.6	13	8.7	5.7	6.5	1.8	1.2
28	4.4	4.3	2.6	2.7	2.9	7.4	12	8.7	7.1	5.7	1.6	1.2
29	4.9	3.7	2.6	2.6	2.6	17	20	7.4	9.0	4.6	1.5	1.2
30	4.6	3.2	2.6	2.6	2.6	80	29	6.0	10	4.0	1.5	1.2
31	5.2	- - - -	2.7	2.9	- - - -	2.41	- - - -	5.7	- - - -	3.8	1.5	- - - -
Total	171.4	143.6	91.6	84.8	78.8	420.3	1,564	571.6	344.4	151.0	77.2	42.4
Mean	5.53	4.79	2.95	2.74	2.81	13.6	52.1	18.4	11.5	4.87	2.49	1.41
Max	10	6.2	3.8	2.9	3.0	241	212	71	30	10	3.7	2.1
Min	1.8	3.2	2.5	2.5	2.6	2.4	12	5.7	3.0	1.8	1.5	1.1
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-
Cal yr 1966: Total	10,832.3		Mean	29.7	Max	234	Min	1.0	Ac-ft	-		
Wtr yr 1967: Total	3,741.1		Mean	10.2	Max	241	Min	1.1	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 1967.

Gage.--Water-stage recorder. Datum of gage is 1,331.19 ft above mean sea level, datum of 1929. Prior to June 5, 1964, reference point at same site and datum.

Extremes.--Maximum discharge during year, 187 cfs Apr. 3 (gage height 5.11 ft); minimum, 3.7 cfs Oct. 1 (result of weir construction); minimum gage height, 3.70 ft Sept. 30.
1964-67: Maximum discharge, 540 cfs Apr. 19, 1966; maximum gage height, that of Apr. 3, 1967; minimum discharge, 3.0 cfs Sept. 26, 27, 1966 (result of weir construction).

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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.7	7.0	18	15	9.9	8.1	135	129	25	36	11	7.3
2	3.8	7.3	18	15	9.7	8.2	174	129	22	34	11	7.2
3	3.8	7.6	16	13	9.4	8.2	184	135	16	32	10	7.1
4	4.0	8.1	18	15	9.3	8.2	181	138	13	28	10	7.0
5	4.0	8.6	20	16	9.3	8.2	171	135	15	25	9.7	6.9
6	4.1	9.1	20	16	9.1	8.3	165	129	16	23	10	6.8
7	4.2	11	20	16	9.1	8.3	162	123	23	22	11	6.7
8	4.2	22	22	16	9.1	8.3	153	120	22	23	11	6.6
9	4.2	23	22	16	9.0	8.3	159	118	23	23	11	6.6
10	4.2	25	20	15	9.0	8.3	165	118	25	20	10	6.6
11	4.3	25	20	13	9.0	8.3	168	112	25	15	9.7	6.5
12	4.4	25	18	12	9.0	8.3	165	103	25	13	9.4	6.5
13	4.4	23	18	11	9.0	8.3	162	100	25	11	9.1	6.6
14	4.5	23	18	11	9.0	8.3	159	95	45	11	9.0	6.6
15	4.5	23	18	11	8.9	8.3	153	86	53	10	9.0	6.6
16	4.6	23	18	12	8.8	8.3	162	83	58	9.9	9.0	6.6
17	4.6	23	18	13	8.8	8.3	165	75	58	9.9	8.9	6.6
18	4.7	22	18	13	8.7	8.3	174	68	56	9.9	8.7	6.6
19	4.7	22	20	13	8.7	8.4	181	63	58	9.7	8.4	6.5
20	4.7	22	20	11	8.7	8.5	181	63	63	9.7	8.4	6.5
21	4.9	22	20	11	8.6	8.6	174	63	65	9.4	8.2	6.5
22	4.9	22	20	11	8.6	8.7	174	61	68	9.7	8.1	6.5
23	5.1	22	20	11	8.6	8.8	171	58	65	9.4	8.0	6.3
24	5.3	20	20	11	8.4	8.8	168	56	63	9.3	7.8	6.2
25	5.6	20	16	11	8.3	8.8	159	53	58	9.4	7.9	6.2
26	5.8	22	16	10	8.2	9.0	147	47	56	10	7.9	6.2
27	6.2	25	16	10	8.1	9.0	135	47	53	10	7.8	6.1
28	6.4	23	15	9.7	8.1	9.0	132	45	49	9.7	7.7	6.1
29	6.6	22	15	9.7	9.9	9.9	129	40	43	11	7.6	6.0
30	6.6	20	15	9.9	- - - -	23	132	36	40	11	7.5	6.0
31	6.8	- - - -	15	9.9	- - - -	73	- - - -	28	- - - -	11	7.4	- - - -
Total	149.8	577.7	568	387.2	248.4	342.3	4840	2656	1226	4850	2802	1965
Mean	4.83	19.3	18.3	12.5	8.87	11.0	161	85.7	40.9	15.6	9.04	6.55
Max	6.8	25	22	16	9.9	73	184	138	68	36	11	7.3
Min	3.7	7.0	15	9.7	8.1	8.1	129	28	13	9.3	7.4	6.0
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-
Cal yr 1966: Total	30,497.9	Mean	83.6	Max	530	Min	3.2	Ac-ft	-			
Wtr yr 1967: Total	11,957.1	Mean	32.8	Max	184	Min	3.7	Ac-ft	-			

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, 3¼ miles northwest of Swan River, and 22 miles upstream from mouth.

Drainage area.--254 sq mi.

Records available.--October 1953 to September 1967.

Gage.--Graphic water-stage recorder. Datum of gage is 1,259.80 ft above mean sea level (Minnesota State Highway Department bench mark).

Average discharge.--14 years, 130 cfs.

Extremes.--Maximum discharge during year, 747 cfs Apr. 1 (gage height, 8.85 ft, backwater from ice); minimum, 22 cfs Sept. 1-10; minimum gage height, 1.98 ft Sept. 1, 2.

1953-67: Maximum discharge, 1,080 cfs Apr. 17, 1965 (gage height, 9.49 ft, backwater from ice); maximum gage height, 9.53 ft Apr. 16, 1965 (backwater from ice); 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 winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	60	60	56	45	54	44	730	384	104	102	36	22
2	64	58	56	44	54	44	700	406	94	100	36	22
3	65	57	56	44	54	44	600	394	84	98	38	22
4	67	57	57	44	53	44	530	366	76	89	37	22
5	68	57	57	45	53	44	480	338	66	82	35	22
6	70	60	57	46	52	44	450	320	62	76	32	22
7	70	66	57	47	50	44	435	311	73	67	33	22
8	70	70	57	47	49	45	430	294	79	62	37	22
9	69	72	56	48	48	45	461	274	86	61	39	22
10	67	73	55	49	47	45	482	263	81	57	37	22
11	64	72	53	50	47	45	490	270	75	56	35	24
12	62	71	51	51	46	45	476	274	76	54	33	24
13	62	70	49	52	46	45	457	254	97	49	31	25
14	62	68	48	52	46	45	445	233	135	45	30	31
15	66	66	47	52	46	46	445	215	166	42	28	30
16	68	64	46	53	46	46	445	203	169	41	26	30
17	72	62	46	54	45	46	451	189	154	38	26	28
18	76	61	46	56	45	47	457	174	137	35	25	30
19	78	60	46	56	45	47	461	166	143	32	25	27
20	78	59	45	58	45	48	461	151	220	30	24	24
21	76	58	45	58	45	48	466	139	232	30	24	27
22	74	58	45	58	45	50	472	140	194	31	24	30
23	70	57	44	60	45	53	468	151	167	39	24	32
24	67	57	44	60	45	57	448	150	154	41	24	33
25	63	57	44	60	45	61	422	143	142	38	24	31
26	60	58	44	58	44	65	403	135	131	35	27	33
27	59	58	44	58	44	68	379	128	127	33	27	33
28	58	59	44	58	44	74	352	117	123	31	27	33
29	58	58	44	56	44	81	348	114	117	37	27	33
30	58	57	45	56	44	200	355	121	106	37	27	34
31	59	-----	45	54	-----	350	-----	113	-----	36	24	-----
Total	2060	1860	1529	1629	1328	2010	13999	6930	3670	1604	922	812
Mean	66.5	62.0	49.3	52.5	47.4	64.8	467	224	122	51.7	29.7	27.1
Max	78	73	57	60	54	350	730	406	232	102	39	34
Min	58	57	44	44	44	44	348	113	62	30	24	22
Cfsm	.262	.244	.194	.207	.187	.255	1.84	.882	.480	.204	.117	.107
In.	.30	.27	.22	.24	.19	.29	2.05	1.01	.54	.23	.13	.12

Cal yr 1966: Total 69,443 Mean 190 Max 932 Min 42 Cfsm .748 In. 10.17
Wtr yr 1967: Total 38,353 Mean 105 Max 730 Min 22 Cfsm .413 In. 5.62

5-2185. Sandy Lake at Libby, Minn.

Location (revised).--Lat 46°47'20", long 93°19'10", in sec.25, T.50 N., R.24 W., on dam on Sandy River at Libby, 1.2 miles above 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 1967. 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, 68,830 acre-ft Apr. 21 (gage height, 10.65 ft); minimum, 26,180 acre-ft May 27 (gage height, 5.87 ft).

1895-1967: 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 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	8.52	48,000	-
Oct. 31	8.70	49,790	+1,790
Nov. 30	7.98	43,240	-6,550
Dec. 31	7.56	39,670	-3,570
Calendar year 1966	-	-	-10,120
Jan. 31	7.10	35,700	-3,970
Feb. 28	6.63	31,930	-3,770
Mar. 31	6.58	31,540	-390
Apr. 30	9.86	60,890	+29,350
May 31	9.16	53,950	-6,940
June 30	8.91	51,570	-2,380
July 31	8.99	52,360	+790
Aug. 31	8.84	50,980	-1,380
Sept. 30	8.61	48,990	-1,990
Water year 1967	-	-	+990

5-2190. Sandy River at Sandy Lake Dam, at Libby, Minn.

Location (revised).--Lat 46°47'20", long 93°19'10", in sec.25, T.50 N., R.24 W., on dam on Sandy River at Libby, 1.2 miles above mouth, and 14 miles north of McGregor.

Drainage area.--421 sq mi.

Records available.--July 1893 to March 1894, July 1894, November 1894 to March 1895, August 1895 to September 1967. 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.--72 years (1895-1967), 206 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 1,280 cfs Apr. 28; no flow on Apr. 1.
1893-1967: 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.--One discharge measurement 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	107	204	100	134	110	117	0	1,240	169	10	12	12
2	108	204	100	134	106	117	258	1,210	170	10	12	12
3	107	204	101	133	103	114	185	1,170	172	10	12	12
4	107	206	99	132	101	114	235	1,160	174	10	12	12
5	106	204	96	131	100	114	384	1,150	178	12	12	12
6	106	204	94	131	100	114	625	1,130	180	81	12	12
7	106	204	132	129	101	117	725	1,100	181	81	12	12
8	106	204	132	128	102	123	800	706	180	82	12	12
9	106	204	131	127	102	123	750	755	179	180	12	12
10	106	204	132	127	102	123	675	760	179	179	12	12
11	38	202	133	127	102	126	685	725	180	179	12	12
12	37	202	133	125	101	126	710	755	179	180	12	12
13	37	202	134	125	97	129	750	515	178	181	12	12
14	37	202	134	124	91	129	755	555	294	44	12	12
15	37	196	134	123	100	129	780	354	841	44	12	12
16	37	198	134	123	117	132	850	375	965	44	12	12
17	63	202	134	122	117	132	880	384	965	44	12	12
18	104	204	138	123	117	132	900	390	990	45	12	12
19	133	204	138	121	117	135	940	136	1,010	45	12	12
20	204	206	138	119	117	132	975	143	990	45	12	12
21	206	200	138	118	117	129	1,060	147	965	12	12	12
22	206	194	138	118	117	129	1,180	10	970	12	12	12
23	206	202	135	117	114	129	1,160	10	1,000	12	12	12
24	206	204	135	116	114	129	1,200	10	1,000	12	12	12
25	206	202	135	116	117	129	1,230	30	1,000	12	12	12
26	204	202	135	116	117	129	1,240	74	1,000	12	12	12
27	204	202	133	116	117	129	1,250	74	540	12	12	12
28	206	200	134	115	117	117	1,280	109	515	12	12	12
29	206	206	134	113		111	1,180	166	185	12	12	12
30	206	206	134	113		99	1,200	167	10	12	12	12
31	206	- - - -	133	112	- - - -	42	- - - -	168	- - - -	12	12	- - - -
Total	4,054	6,078	3,951	3,808	3,033	3,750	24,842	15,678	15,539	1,638	372	360
Mean	131	203	127	123	108	121	828	506	518	52.8	12.0	12.0
Max	206	206	138	134	117	135	1,280	1,240	1,010	181	12	12
Min	37	194	94	112	91	42	0	10	10	10	12	12
Cfsm	0.311	0.482	0.302	0.292	0.257	0.287	1.97	1.20	1.23	0.125	0.028	0.028
In.	0.36	0.54	0.35	0.34	0.27	0.33	2.19	1.38	1.37	0.14	0.03	0.03
Cal yr 1966: Total	145,756		Mean	399	Max	1,580	Min	4	Cfsm	0.948	In.	12.88
Wtr yr 1967: Total	83,103		Mean	228	Max	1,280	Min	0	Cfsm	0.542	In.	7.34

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 1967.

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.--37 years, 1,926 cfs.

Extremes.--Maximum discharge during year, 5,680 cfs Apr. 22 (gage height, 12.10 ft); minimum, 718 cfs Aug. 28 (gage height, 2.99 ft).

1930-67: 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 winter months, which are fair. Flow regulated by powerplants and Winnibigoshish, Leech, Pokegama, and Sandy Lakes (see p. 81,83,85,91).

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2170	2570	2170	2050	2050	2230	4000	4950	2040	1920	1230	800
2	2160	2560	2150	2020	2100	2210	4250	4950	1980	1880	1200	855
3	2210	2500	2140	2000	2200	2180	4500	4910	1920	1860	1220	935
4	2280	2530	2130	2000	2220	2150	4800	4850	1770	1870	1200	893
5	2320	2550	2130	2000	2280	2120	5070	4780	1620	1830	1180	879
6	2320	2530	2130	1990	2250	2100	5100	4710	1550	1800	1160	879
7	2320	2510	2120	1990	2210	2100	5020	4590	1550	1760	1170	869
8	2330	2500	2100	1980	2190	2100	5060	4310	1600	1670	1180	874
9	2300	2480	2090	1980	2190	2100	5280	4240	1610	1660	1190	860
10	2280	2470	2080	1970	2190	2090	5430	4210	1610	1690	1180	855
11	2260	2480	2080	1960	2200	2080	5480	4220	1600	1660	1140	850
12	2240	2490	2080	1950	2250	2080	5540	4180	1600	1580	1110	800
13	2230	2400	2080	1950	2300	2060	5560	3940	1700	1500	1130	841
14	2280	2350	2090	1950	2310	2050	5580	3800	2360	1400	1130	860
15	2370	2300	2080	1940	2360	2050	5550	3540	3250	1370	1120	860
16	2430	2240	2050	1930	2390	2050	5500	3430	3470	1320	1110	888
17	2480	2150	2050	1900	2390	2050	5510	3340	3340	1310	1110	897
18	2540	2120	2050	1870	2380	2050	5510	3220	3160	1310	1100	869
19	2600	2120	2040	1870	2310	2050	5490	2940	3070	1280	1080	837
20	2600	2130	2040	1870	2290	2050	5480	2820	3240	1260	1060	818
21	2610	2230	2030	1870	2300	2060	5600	2710	3330	1210	1060	827
22	2580	2200	2020	1870	2310	2080	5670	2550	3230	1170	1040	818
23	2590	2120	2020	1870	2350	2110	5610	2510	3120	1210	1030	850
24	2600	2100	2030	1870	2370	2150	5530	2480	3070	1220	921	855
25	2610	2100	2040	1880	2370	2210	5450	2370	3030	1180	907	837
26	2610	2120	2050	1890	2360	2260	5340	2300	2900	1160	855	818
27	2600	2140	2060	1900	2320	2320	5240	2290	2540	1160	809	809
28	2590	2080	2070	1900	2300	2450	5120	2240	2430	1150	736	800
29	2580	2060	2090	1930	2520	2520	5050	2180	2120	1160	754	768
30	2570	2120	2100	1980	2920	4980	2130	1920	1200	750	768	768
31	2580	2090	1990	1990	3550	2090	2090	1220	795	1220	795	1220
Total	75,240	69,250	64,480	60,120	63,740	68,580	157,300	107,780	71,730	44,970	32,657	25,369
Mean	2,427	2,308	2,080	1,939	2,276	2,212	5,243	3,477	2,391	1,451	1,053	846
Max	2,610	2,570	2,170	2,050	2,390	3,550	5,670	4,950	3,470	1,920	1,230	935
Min	2,160	2,060	2,020	1,870	2,050	2,050	4,000	2,090	1,550	1,150	736	768
Cfsm	.480	.456	.411	.383	.450	.437	1.04	.687	.473	.287	.208	.167
In.	.55	.51	.47	.44	.47	.50	1.16	.79	.53	.33	.24	.19
Cal yr 1966: Total	1,266,500	Mean	3,470	Max	8,350	Min	1,950	Cfsm	.686	In.	9.31	
Wtr yr 1967: Total	841,216	Mean	2,305	Max	5,670	Min	736	Cfsm	.456	In.	6.18	

5-2275. Mississippi River at Aitkin, Minn.

Location.--Lat 46°32'26", long 93°42'26", in W $\frac{1}{2}$ 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 1967.

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.--22 years, 2,880 cfs.

Extremes.--Maximum daily discharge during year, 8,520 cfs Apr. 11, 15; minimum daily, 866 cfs Aug. 31. River gage: Maximum discharge during year, 5,230 cfs Apr. 15 (gage height, 10.07 ft); minimum, 859 cfs Aug. 31, Sept. 1 (gage height, -0.26 ft). Diversion gage: Maximum discharge during year, 3,460 cfs Apr. 1 (gage height, 10.90 ft, from graph based on gage readings, backwater from ice); minimum, no flow July 16 to Sept. 30.

1945-67: 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 winter months, which are fair. Slight regulation by powerplants and by Winnibigoshish, Leech, Pokegama, and Sandy Lakes (see p. 81,83,85,91). Water diverted at medium and high stages into Aitkin diversion channel 6 $\frac{1}{2}$ miles above station, bypasses station and returns to river 15 $\frac{1}{2}$ miles below station. Diversion began Apr. 2, 1955. These records include flow in diversion channel.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2380	2920	2290	2210	2160	2330	7200	6790	2560	3110	1370	873
2	2380	2850	2290	2180	2180	2330	7700	6760	2470	2880	1390	894
3	2400	2790	2270	2170	2250	2320	8100	6590	2390	2730	1370	918
4	2460	2750	2260	2170	2270	2300	8190	6510	2310	2600	1370	989
5	2510	2700	2250	2170	2290	2280	8050	6280	2170	2530	1360	1000
6	2570	2650	2250	2170	2280	2260	8050	6130	2020	2460	1340	982
7	2590	2660	2240	2170	2270	2240	8100	6010	1940	2390	1320	974
8	2590	2630	2210	2170	2250	2220	8030	5850	1950	2310	1320	964
9	2620	2600	2200	2170	2230	2190	8270	5590	1980	2180	1320	968
10	2610	2540	2190	2170	2260	2170	8460	5370	2020	2120	1310	954
11	2570	2480	2190	2160	2270	2160	8520	5420	2060	2080	1290	940
12	2530	2420	2190	2140	2270	2160	8480	5390	2070	2020	1280	936
13	2520	2400	2190	2110	2290	2150	8460	5340	2080	1930	1260	932
14	2580	2390	2200	2080	2320	2150	8500	5160	2440	1820	1250	929
15	2660	2380	2180	2060	2380	2150	8520	4900	3520	1720	1250	943
16	2750	2360	2180	2060	2380	2140	8430	4660	4890	1650	1240	954
17	2820	2360	2170	2060	2400	2140	8350	4510	4940	1600	1230	971
18	2890	2370	2180	2050	2380	2140	8320	4370	4920	1550	1220	989
19	2940	2370	2180	2050	2380	2140	8250	4110	4870	1540	1200	992
20	2960	2380	2170	2040	2360	2160	8180	3940	5020	1510	1190	971
21	3000	2390	2170	2060	2280	2180	8270	3670	5210	1480	1170	946
22	3020	2440	2180	2060	2250	2180	8230	3470	4860	1450	1150	936
23	3060	2520	2180	2050	2250	2180	8200	3340	5100	1410	1140	932
24	3030	2470	2180	2040	2270	2190	8060	3260	4980	1400	1100	929
25	3010	2410	2180	2040	2300	2200	7890	3160	4860	1410	1040	943
26	3010	2330	2180	2050	2310	2270	7760	3060	4670	1410	1040	943
27	3040	2320	2200	2060	2310	2400	7530	2970	4470	1370	1000	926
28	3010	2280	2220	2060	2320	2620	7360	2880	4070	1330	946	908
29	2990	2270	2220	2060		3060	7160	2820	3860	1330	894	901
30	2970	2280	2210	2090	- - - - -	4100	6900	2740	3420	1320	873	884
31	2960	- - - - -	2190	2140	- - - - -	5480	- - - - -	2640	- - - - -	1340	866	- - - - -
Total	85430	74710	68390	65270	64160	74990	241520	143690	104120	57980	37099	28321
Mean	2,756	2,490	2,206	2,105	2,291	2,419	8,051	4,635	3,471	1,870	1,197	944
Max	3,060	2,920	2,290	2,210	2,400	5,480	8,520	6,790	5,210	3,110	1,390	1,000
Min	2,380	2,270	2,170	2,040	2,160	2,140	6,900	2,640	1,940	1,320	866	873
Cfsm	.449	.406	.359	.343	.373	.394	1.31	.755	.565	.305	.195	.154
In.	.52	.45	.41	.40	.39	.45	1.46	.87	.63	.35	.22	.17

Cal yr 1966: Total 1,619,910 Mean 4,438 Max 12,600 Min 2,170 Cfsm .723 In. 9.81
 Wtr yr 1967: Total 1,045,680 Mean 2,865 Max 8,520 Min 866 Cfsm .467 In. 6.33

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 1967. 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, 99,170 acre-ft June 21 (gage height, 13.06 ft); minimum, 68,030 acre-ft Mar. 27 (gage height, 10.72 ft).

1886-1967: 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 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	12.52	91,830	-
Oct. 31	12.63	93,420	+1,590
Nov. 30	12.64	93,420	0
Dec. 31	12.24	88,070	-5,350
Calendar year 1966	-	-	+2,190
Jan. 31	11.76	81,720	-6,350
Feb. 28	11.22	74,580	-7,140
Mar. 31	10.91	70,610	-3,970
Apr. 30	12.74	94,810	+24,200
May 31	12.72	94,610	-200
June 30	12.91	97,910	+3,300
July 31	12.57	92,430	-5,480
Aug. 31	12.33	89,260	-3,170
Sept. 30	12.25	88,260	-1,000
Water year 1966-67	-	-	-3,570

PINE RIVER BASIN

5-2310. Pine River at Cross Lake Dam, at Cross Lake, Minn.

Location.--Lat 46°40'09", long 94°06'44", in SW 1/4 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 1967. 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.--81 years, 212 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 885 cfs Apr. 29, 30; minimum daily, 15 cfs Sept. 5-30. 1886-1967: 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	145	180	175	325	325	310	300	803	290	485	110	20
2	145	175	175	325	325	310	300	665	230	485	110	20
3	145	180	175	325	325	310	300	650	205	446	110	20
4	145	175	175	325	315	310	300	650	145	338	110	20
5	145	175	175	325	315	310	305	603	140	205	110	15
6	137	175	175	325	315	310	305	525	140	183	110	15
7	120	175	190	325	315	310	305	525	140	145	107	15
8	120	175	220	325	315	310	305	468	140	145	45	15
9	120	175	220	325	315	310	315	330	140	145	45	15
10	120	175	220	325	315	310	315	185	140	145	45	15
11	110	175	225	325	315	300	315	185	135	145	40	15
12	110	175	220	325	315	300	315	210	158	145	45	15
13	110	175	220	325	315	300	315	335	225	145	40	15
14	113	175	234	325	315	300	320	330	326	145	40	15
15	140	175	330	325	315	300	320	325	485	145	40	15
16	140	175	330	325	315	300	320	325	538	145	45	15
17	140	175	330	325	315	300	315	325	625	136	40	15
18	135	175	330	325	315	300	320	325	625	110	40	15
19	135	175	330	325	315	300	325	325	590	110	40	15
20	135	175	330	325	315	300	325	325	485	110	40	15
21	140	175	330	325	315	300	367	325	480	110	40	15
22	140	175	330	325	315	300	525	325	485	110	34	15
23	135	175	330	325	315	300	520	325	485	110	20	15
24	135	175	325	325	315	300	515	325	485	110	20	15
25	135	175	330	325	310	300	553	320	485	110	20	15
26	135	175	325	325	310	300	645	325	480	110	20	15
27	135	175	325	325	310	300	650	315	485	110	20	15
28	144	175	325	325	310	300	735	315	485	110	20	15
29	180	175	325	325	310	300	885	315	485	110	20	15
30	180	175	325	325	310	300	885	320	485	110	20	15
31	180	- - - -	325	325	- - - -	300	- - - -	315	- - - -	110	20	- - - -
Total	4,249	5,260	3,374	10,075	8,830	9,400	12,520	11,939	10,742	5,268	1,566	470
Mean	137	175	270	325	315	303	417	385	358	170	50.5	15.7
Max	180	180	330	325	325	310	885	803	625	485	110	20
Min	110	175	175	325	310	300	300	185	135	110	20	15
Cfsm	0.244	0.311	0.480	0.578	0.560	0.539	0.742	0.685	0.637	0.302	0.090	0.028
In.	0.28	0.35	0.55	0.67	0.58	0.62	0.83	0.79	0.71	0.35	0.10	0.03
Cal yr 1966: Total	154,953		Mean 425		Max 1,510	Min 110	Cfsm 0.756	In. 10.25				
Wtr yr 1967: Total	88,693		Mean 243		Max 885	Min 15	Cfsm 0.432	In. 5.87				

5-2315. Pelican Lake near Pequot Lakes, Minn.

Location.--Lat 46°37', long 94°11', in NE¹/₄NE¹/₄ 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 1967 (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, 4.00 ft June 19; minimum observed, 2.94 ft Sept. 30. 1938-67: Maximum gage height observed, 4.28 ft May 23, 1966; 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 1966 to September 1967

Oct. 7	.....3.58	June 21	.....3.90	Aug. 30	.....3.20
May 18	.....3.88	July 31	.....3.58	Sept. 30	.....2.94

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 1967 (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.--28 years (1939-67), 468 cfs.

Extremes.--Maximum discharge during year, 2,160 cfs Apr. 1 (gage height, 5.21 ft); maximum gage height, 5.78 ft Mar. 30 (backwater from ice); minimum daily discharge, 270 cfs Aug. 31 to Sept. 9; minimum gage height, 2.85 ft Sept. 30.
1910-14, 1930-67: Maximum discharge, 2,890 cfs 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 winter months, which are fair. Flow affected by natural storage in many lakes.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	397	508	435	390	395	375	1,840	1,220	1,060	933	336	270
2	392	500	440	390	395	375	1,410	1,280	1,020	891	331	270
3	402	505	450	390	400	380	1,400	1,240	978	877	320	270
4	414	514	450	390	400	380	1,380	1,180	948	857	326	270
5	419	514	450	390	400	385	1,380	1,150	926	818	320	270
6	414	514	450	390	400	390	1,370	1,170	898	798	300	270
7	402	508	445	395	405	390	1,300	1,160	926	786	305	270
8	402	508	445	395	405	390	1,360	1,150	1,090	766	320	270
9	402	500	445	400	405	390	1,630	1,130	1,170	740	320	270
10	402	485	440	400	405	385	1,620	1,100	1,180	708	315	280
11	397	460	440	405	405	385	1,540	1,170	1,200	675	305	280
12	386	395	435	410	405	380	1,430	1,150	1,250	662	295	290
13	364	475	435	410	405	380	1,340	1,090	1,310	656	290	315
14	436	485	435	415	400	380	1,320	1,050	1,480	616	280	310
15	484	490	430	415	400	380	1,320	1,020	1,660	586	290	300
16	490	480	430	420	395	385	1,310	1,000	1,640	574	300	320
17	496	460	425	415	395	385	1,390	970	1,570	562	295	320
18	490	415	425	410	390	385	1,490	962	1,520	538	295	331
19	478	375	420	410	390	390	1,400	919	1,150	532	290	336
20	484	510	420	405	385	390	1,350	891	1,300	508	285	331
21	484	560	420	400	385	395	1,400	884	1,260	460	285	326
22	496	544	415	400	385	405	1,390	870	1,160	454	285	320
23	496	508	410	395	380	415	1,340	1,260	1,140	436	295	315
24	490	500	410	395	380	420	1,310	1,230	1,090	419	290	315
25	472	490	410	390	380	430	1,290	1,190	1,050	419	285	315
26	466	502	405	385	375	445	1,260	1,180	1,000	419	285	315
27	466	505	405	385	375	480	1,270	1,170	1,020	414	285	310
28	496	420	400	385	375	600	1,240	1,150	1,010	419	275	305
29	496	440	400	390		880	1,210	1,130	1,020	380	275	305
30	502	430	400	390		1,250	1,200	1,100	985	364	275	300
31	514		395	390		1,300		1,070		358	270	
Total	13,929	14,500	13,215	12,350	11,015	14,700	41,490	34,236	35,011	13,625	9,223	8,969
Mean	449	483	426	398	393	474	1,383	1,104	1,167	601	298	299
Max	514	560	450	420	405	1,300	1,840	1,280	1,660	933	336	336
Min	364	375	395	385	375	375	1,200	870	898	358	270	270
Cfsm	0.445	0.478	0.422	0.394	0.389	0.469	1.37	1.09	1.16	0.595	0.295	0.296
In.	0.51	0.53	0.49	0.45	0.41	0.54	1.53	1.26	1.29	0.69	0.34	0.33

Cal yr 1966: Total 256,890 Mean 704 Max 2,200 Min 336 Cfsm 0.697 In. 9.46
Wtr yr 1967: Total 227,263 Mean 623 Max 1,840 Min 270 Cfsm 0.617 In. 8.37

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 1967. 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, 59,310 acre-ft July 22 (gage height, 6.12 ft); minimum, 45,020 acre-ft Mar. 19 (gage height, 5.02 ft).
1911-67: 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 1966 to September 1967

	Gage height (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	5.73	54,350	-
Oct. 31	5.61	52,760	-1,590
Nov. 30	5.60	52,560	-200
Dec. 31	5.48	50,980	-1,580
Calendar year 1966	-	-	-4,360
Jan. 31	5.44	50,580	-400
Feb. 28	5.15	46,810	-3,770
Mar. 31	5.25	48,000	+1,190
Apr. 30	5.83	55,540	+7,540
May 31	5.97	57,320	+1,780
June 30	5.98	57,520	+200
July 31	5.93	56,930	-590
Aug. 31	5.78	54,940	-1,990
Sept. 30	5.67	53,550	-1,390
Water year 1966-67	-	-	-800

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 1967. 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.--56 years, 103 cfs, unadjusted.

Extremes.--Maximum daily discharge during year, 441 cfs June 15; minimum daily, 15 cfs Aug. 23 to Sept. 30. 1911-67: 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; two discharge measurements made and records reviewed by Geological Survey.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	79	70	67	110	162	129	156	231	61	66	20	15
2	79	68	67	110	160	127	166	233	60	66	21	15
3	78	67	67	108	159	127	173	231	59	65	22	15
4	83	67	70	108	159	126	179	230	60	64	21	15
5	79	66	70	108	157	125	182	157	61	61	20	15
6	78	65	73	108	154	125	187	156	61	59	20	15
7	78	66	72	110	151	122	193	156	63	21	20	15
8	78	65	131	110	150	120	196	159	120	25	20	15
9	79	64	131	110	150	120	203	157	198	43	21	15
10	78	64	129	108	150	122	209	93	265	67	20	15
11	76	64	126	108	150	120	211	97	259	67	18	15
12	75	62	124	108	151	119	214	51	241	67	18	15
13	72	62	124	108	151	118	218	54	185	65	18	15
14	80	61	124	108	151	118	221	56	257	39	18	15
15	85	62	124	106	151	118	224	56	441	22	18	15
16	81	62	124	107	153	116	228	57	433	23	18	15
17	79	61	123	107	154	114	235	57	426	22	19	15
18	80	61	123	107	156	115	233	57	416	22	19	15
19	80	60	122	107	157	115	230	63	258	21	18	15
20	78	61	120	107	140	116	231	61	258	21	18	15
21	76	60	120	106	137	118	238	60	254	20	18	15
22	79	61	118	107	136	118	242	59	179	64	18	15
23	78	62	116	107	134	118	242	61	177	123	15	15
24	75	62	116	107	133	118	238	60	108	187	15	15
25	72	63	115	106	130	118	236	62	61	176	15	15
26	72	66	114	106	127	118	235	64	62	171	15	15
27	72	68	112	123	129	116	235	64	63	105	15	15
28	72	67	112	157	130	118	233	64	64	107	15	15
29	72	67	111	159	120	120	231	63	65	20	15	15
30	72	68	110	162	127	127	233	61	65	20	15	15
31	72	---	110	163	---	140	---	61	---	20	15	---
Total	2,387	1,922	3,365	3,566	4,122	3,741	6,452	3,091	5,280	1,919	558	450
Mean	77.0	64.1	109	115	147	121	215	99.7	176	61.9	18.0	15.0
Max	85	70	131	163	162	140	242	233	441	187	22	15
Min	72	60	67	106	127	114	156	51	59	20	15	15
Cfsm	0.268	0.223	0.380	0.401	0.512	0.422	0.749	0.347	0.613	0.216	0.063	0.052
In.	0.31	0.25	0.44	0.46	0.53	0.48	0.84	0.40	0.68	0.25	0.07	0.06
Cal yr 1966: Total	69,846		Mean	191	Max	610	Min	20	Cfsm	0.666	In.	9.05
Wtr yr 1967: Total	36,853		Mean	101	Max	441	Min	15	Cfsm	0.352	In.	4.78

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 1967.

Average discharge.--43 years, 4,111 cfs.

Extremes.--Maximum daily discharge during year, 21,700 cfs Apr. 3; minimum daily, 1,350 cfs Sept. 1, 2. 1924-67: Maximum daily discharge, 37,700 cfs Apr. 16, 1965; minimum daily, 254 cfs Nov. 25, 1936.

Remarks.--Records fair. Discharge computed on basis of powerplant records. Flow partly regulated by powerplants and Winnibigoshish, Leech, Pokegama, Sandy, and Gull Lakes and by Pine River Reservoir (see p. 81, 83, 85, 91, 99, 95).

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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,520	4,610	1,880	3,360	3,230	3,450	19,600	12,500	4,600	7,140	2,060	1,350
2	3,390	4,660	1,800	3,430	3,230	3,520	20,400	12,200	4,180	5,660	2,280	1,350
3	3,980	5,420	2,200	3,270	3,230	3,430	21,700	12,500	4,440	6,320	2,340	1,490
4	4,090	4,800	2,530	3,480	3,230	3,480	21,500	15,300	4,240	5,190	1,900	1,490
5	3,990	3,920	2,990	3,430	3,230	3,440	19,800	12,000	3,970	5,610	2,250	1,510
6	2,840	3,630	3,040	3,230	3,230	3,550	17,700	11,200	4,140	5,250	2,070	1,560
7	4,240	3,880	3,090	3,420	3,360	3,520	16,200	11,200	4,320	4,960	2,100	1,380
8	4,660	5,450	3,120	3,400	3,430	3,780	15,200	11,200	4,590	4,530	2,150	1,500
9	3,790	4,390	3,320	3,230	3,330	3,560	15,900	10,300	4,850	4,470	2,110	1,420
10	4,090	3,560	3,430	3,230	3,430	3,480	16,100	10,900	4,980	4,300	1,970	1,500
11	3,670	2,980	3,760	3,300	3,430	3,410	16,400	10,600	5,190	4,110	1,990	1,390
12	4,060	2,820	3,410	3,240	3,330	3,360	16,400	9,520	5,190	3,880	1,910	1,400
13	3,670	3,350	3,630	3,310	3,430	3,500	16,700	9,770	5,200	3,700	1,940	1,680
14	4,220	3,520	3,470	3,370	3,460	3,470	15,200	9,420	5,420	3,360	1,950	1,930
15	4,640	3,500	3,460	3,230	3,510	3,630	15,400	9,460	7,840	3,340	1,910	1,710
16	4,100	4,100	3,580	3,460	3,400	3,430	15,800	9,710	9,340	3,340	1,900	1,650
17	4,600	4,210	3,630	3,300	3,470	3,630	15,800	8,620	10,400	3,160	1,870	1,660
18	4,740	4,250	3,630	3,230	3,560	3,760	15,100	8,440	10,800	2,920	1,890	1,760
19	4,770	3,460	3,680	3,230	3,630	3,480	15,300	7,930	11,100	2,880	1,760	1,830
20	4,650	3,550	3,810	3,230	3,710	3,570	15,300	7,560	11,000	2,780	1,660	1,800
21	4,740	3,570	3,780	3,230	3,660	3,470	15,300	7,280	10,500	2,640	1,850	1,360
22	4,530	4,190	3,660	3,230	3,630	3,430	15,200	6,550	10,600	2,790	1,830	1,860
23	4,710	4,460	3,520	3,330	3,630	3,500	14,900	6,600	10,700	2,980	1,830	1,400
24	4,710	4,600	3,320	3,230	3,500	3,480	14,900	5,860	10,200	2,520	1,600	1,400
25	4,710	4,040	3,430	3,230	3,510	3,830	14,900	5,690	9,770	2,390	1,960	1,660
26	4,660	4,170	3,530	3,230	3,680	3,920	14,700	5,690	9,300	2,530	1,830	1,540
27	4,640	4,320	3,360	3,320	3,470	4,270	13,800	5,690	8,720	2,570	1,760	1,500
28	4,510	3,430	3,430	3,230	3,740	5,060	13,800	5,750	8,440	2,180	1,700	1,430
29	4,710	3,180	3,430	3,230	7,020	12,700	5,480	7,800	2,340	1,610	1,390	
30	4,710	2,430	3,430	3,310	- - - -	11,000	12,600	5,190	7,800	2,170	1,520	1,630
31	4,790	- - - -	3,430	3,300	- - - -	17,600	- - - -	5,190	- - - -	2,170	1,570	- - - -
Total	132,230	113,450	101,780	102,250	96,680	137,030	485,300	276,300	220,620	115,180	59,070	46,530
Mean	4,265	3,948	3,283	3,298	3,453	4,420	16,177	8,913	7,354	3,715	1,905	1,551
Max	4,790	5,450	3,810	3,480	3,740	17,600	21,700	16,300	11,100	7,140	2,340	1,930
Min	2,620	2,430	1,800	3,230	3,230	3,360	12,600	5,190	3,970	2,170	1,520	1,350
Cfsm	0.368	0.340	0.283	0.284	0.298	0.381	1.39	0.768	0.634	0.320	0.164	0.134
In.	0.42	0.38	0.33	0.33	0.31	0.44	1.56	0.89	0.71	0.37	0.19	0.15

Cal yr1966: Total 3,049,530 Mean 8,355 Max 25,300 Min 1,800 Cfsm 0.720 In. 9.78
Wtr yr1967: Total 1,891,420 Mean 5,182 Max 21,700 Min 1,350 Cfsm 0.447 In. 6.06

SAUK RIVER BASIN

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 north-west 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 1967. 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.--37 years (1909-12, 1930-31, 1934-67), 252 cfs.

Extremes.--Maximum discharge during year, 2,360 cfs Apr. 3 (gage height, 5.53 ft); minimum, 67 cfs Sept. 25, 26, 29, 30; minimum gage height, 1.07 ft Oct. 2.

1909-13, 1929-67: Maximum discharge, 9,100 cfs Apr. 13, 1965 (gage height, 10.68 ft); minimum, 0.3 cfs Nov. 25, 1936.

Remarks.--Records good except those for winter months, which are fair. Flow regulated by powerplants and reservoirs above station. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	76	92	99	84	85	89	1,950	362	150	608	103	96
2	75	90	98	84	86	89	2,290	426	152	540	110	91
3	76	86	98	84	86	89	2,270	410	152	473	112	87
4	87	94	97	83	86	89	2,220	400	154	420	106	84
5	86	99	97	82	86	89	2,100	394	154	387	96	83
6	84	99	97	82	87	89	2,010	387	154	362	96	81
7	84	101	97	82	87	90	1,960	390	167	343	94	79
8	84	104	97	83	87	91	1,850	397	175	327	94	79
9	84	97	97	84	87	92	1,750	371	177	306	94	76
10	89	92	97	84	87	92	1,620	358	170	295	87	75
11	91	97	97	84	85	92	1,470	352	177	286	86	73
12	81	100	96	83	85	93	1,350	368	186	272	84	78
13	76	100	95	82	84	95	1,240	362	208	240	81	83
14	83	101	94	82	83	97	1,160	346	240	216	78	79
15	108	101	94	82	82	100	1,120	337	277	205	78	78
16	114	102	93	81	82	101	1,000	340	400	211	75	81
17	114	102	92	80	82	102	955	309	458	211	75	76
18	116	102	92	80	84	102	885	298	536	202	73	76
19	116	103	92	80	84	103	792	289	676	191	73	76
20	112	103	91	81	85	105	732	257	772	180	72	76
21	112	103	90	82	86	107	284	231	800	172	70	76
22	136	103	90	82	86	108	283	222	815	157	72	75
23	114	103	89	82	86	110	283	219	840	150	75	72
24	94	104	88	82	86	112	303	205	840	143	75	70
25	91	104	88	82	87	114	321	194	820	136	83	68
26	91	104	88	83	88	118	337	194	784	127	132	68
27	89	104	87	83	88	130	355	194	748	123	106	68
28	92	103	86	83	88	220	358	186	700	119	103	68
29	91	102	85	83		500	358	175	656	117	104	68
30	89	101	84	83		1,180	334	164	612	110	103	68
31	94	- - - -	84	84	- - - -	1,450	- - - -	147	- - - -	106	99	- - - -
Total	2,929	2,996	2,869	2,556	2,395	6,038	33,940	9,284	13,150	7,735	2,789	2,308
Mean	94.5	99.9	92.5	82.5	85.5	195	1,131	299	438	250	90.0	76.9
Max	136	104	99	84	88	1,450	2,290	426	840	608	132	96
Min	75	86	84	80	82	89	283	147	150	106	70	68
Cfsm	0.102	0.108	0.100	0.089	0.092	0.211	1.22	0.323	0.474	0.270	0.097	0.083
In.	0.12	0.12	0.12	0.10	0.10	0.24	1.36	0.37	0.53	0.31	0.11	0.09
Cal yr 1966: Total	138,487		Mean 379	Max 2,340	Min 72	Cfsm 0.410	In. 5.57					
Wtr yr 1967: Total	88,989		Mean 244	Max 2,290	Min 68	Cfsm 0.264	In. 3.58					

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 right bank, 0.2 mile east of Santiago and 0.4 mile upstream from bridge on county road.

Records available.--June 1965 to September 1967.

Gage.--Water-stage recorder.

Extremes.--Maximum discharge during year, 1,930 cfs Mar. 30 (gage height, 10.38 ft); minimum, 2.0 cfs Aug. 22; minimum gage height, 3.22 ft Sept. 12.

1965-67: Maximum discharge, that of Mar. 30, 1967; minimum, 0.1 cfs July 10, 1966, minimum gage height, that of Sept. 12, 1967.

Flood of Apr. 14, 1965 reached a stage of 12.17 ft, backwater from ice (discharge, 2,940 cfs).

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.8	5.0	4.1	3.4	3.3	3.5	805	14	3.8	17	3.3	5.0
2	4.8	4.6	4.1	3.4	3.2	3.6	549	16	3.6	16	3.3	4.2
3	5.0	4.6	4.0	3.4	3.2	3.6	383	15	3.4	15	3.1	3.6
4	5.0	4.6	4.0	3.4	3.2	3.7	260	14	3.6	14	3.0	3.3
5	5.0	4.6	3.9	3.4	3.2	3.8	178	13	3.6	13	3.0	3.1
6	5.0	4.6	3.9	3.4	3.2	3.9	124	12	3.8	12	3.0	3.0
7	5.0	4.6	3.8	3.4	3.2	3.9	104	12	4.8	10	3.1	2.6
8	4.8	4.8	3.7	3.4	3.2	4.0	94	12	6.6	10	3.1	2.4
9	4.4	4.8	3.7	3.4	3.2	4.1	81	11	7.5	10	3.0	2.4
10	4.0	4.6	3.7	3.4	3.2	4.2	68	11	10	9.8	2.7	2.3
11	4.0	4.6	3.7	3.4	3.2	4.2	54	15	12	8.2	2.7	2.2
12	4.2	4.5	3.7	3.4	3.2	4.2	43	18	12	7.2	2.6	2.6
13	4.2	4.4	3.7	3.4	3.2	4.2	37	17	11	6.4	2.4	3.1
14	4.6	4.3	3.7	3.4	3.2	4.3	35	15	11	5.8	2.3	3.1
15	6.6	4.3	3.7	3.4	3.2	4.4	42	10	39	5.3	2.3	3.0
16	7.1	4.3	3.6	3.4	3.2	4.4	45	12	341	8.5	2.3	3.0
17	6.8	4.2	3.6	3.3	3.2	4.5	45	10	473	9.5	2.2	3.0
18	6.3	4.2	3.6	3.3	3.2	4.7	39	9.5	421	7.5	2.3	2.8
19	6.1	4.2	3.6	3.3	3.3	4.9	32	8.8	280	6.1	2.3	2.8
20	5.8	4.2	3.5	3.3	3.3	5.2	26	7.5	270	5.3	2.2	2.7
21	5.5	4.3	3.5	3.3	3.3	5.6	24	7.5	329	5.0	2.1	2.7
22	5.5	4.4	3.5	3.3	3.3	6.2	22	6.9	244	4.6	2.1	2.7
23	5.3	4.5	3.5	3.3	3.3	6.8	19	6.6	159	4.8	2.7	2.6
24	5.0	4.4	3.5	3.3	3.3	7.0	19	6.6	104	4.8	2.6	2.4
25	5.0	4.4	3.5	3.3	3.4	7.8	15	6.1	68	13	2.7	2.4
26	5.0	4.4	3.5	3.3	3.4	8.8	14	5.8	46	9.5	6.9	2.4
27	5.0	4.3	3.5	3.3	3.4	11	13	5.5	32	6.6	6.1	2.4
28	5.0	4.3	3.5	3.3	3.4	34	12	5.0	25	5.0	5.0	2.6
29	5.0	4.2	3.4	3.3	- - - -	183	12	4.6	21	4.2	12	2.6
30	5.0	4.2	3.4	3.3	- - - -	1,510	12	4.6	18	3.6	9.5	2.6
31	5.3	- - - -	3.4	3.3	- - - -	1,520	- - - -	4.2	- - - -	3.4	6.9	- - - -
Total	160.1	133.4	113.5	103.9	91.1	3,383.5	3,206	316.2	2,966.7	261.1	112.8	85.6
Mean	5.16	4.45	3.66	3.35	3.25	109	107	10.2	98.9	8.42	3.64	2.85
Max	7.1	5.0	4.1	3.4	3.4	1,520	805	18	473	17	12	5.0
Min	4.0	4.2	3.4	3.3	3.2	3.5	12	4.2	3.4	3.4	2.1	2.2
Ac-ft	-	-	-	-	-	-	-	-	-	-	-	-

Cal yr1966: Total 15,142.1 Mean 41.5 Max 1,000 Min 0.2 Ac-ft -

Wtr yr1967: Total 10,933.9 Mean 30.0 Max 1,520 Min 2.1 Ac-ft -

ELK RIVER BASIN

5-2749. St. Francis River near Big Lake, Minn.

Location.--Lat 45°23'07", long 93°44'02", in NW 1/4 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 1965 to September 1967.

Gage.--Water-stage recorder. Altitude of gage is 925 ft (from topographic map).

Extremes.--Maximum discharge during year, 992 cfs Apr. 4 (gage height, 9.49 ft); minimum, 31 cfs Aug. 22 (gage height, 4.67 ft).

1965-67: Maximum discharge, that of Apr. 4, 1967; maximum gage height, 10.15 ft about Feb. 14, 1966 (from floodmark, backwater from ice); minimum discharge, that of Aug. 22, 1967.

Flood of Apr. 16, 1965 reached a stage of 11.34 ft, from floodmarks (discharge 2,700 cfs).

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	52	64	52	43	42	36	196	102	53	268	47	39
2	50	60	49	43	42	36	232	96	52	242	47	39
3	50	56	47	43	42	36	684	105	52	216	45	38
4	54	53	46	43	41	36	976	105	52	192	43	38
5	54	53	46	43	41	36	840	102	59	166	41	37
6	52	53	46	43	41	36	707	99	65	142	41	37
7	52	53	46	43	41	36	565	98	69	123	42	37
8	51	53	46	43	41	36	469	97	75	111	41	35
9	51	52	46	43	41	36	429	96	74	102	40	35
10	52	52	46	43	41	36	389	100	83	93	40	35
11	52	52	46	43	41	36	357	106	87	86	38	34
12	50	52	46	43	41	36	323	106	85	79	37	34
13	50	52	45	43	41	36	296	101	88	74	35	40
14	51	52	45	43	41	36	279	101	90	69	35	41
15	80	52	45	43	40	36	257	98	102	64	34	39
16	103	53	45	43	40	37	243	95	137	68	32	38
17	91	53	45	43	40	37	228	92	149	69	32	38
18	84	53	45	43	40	38	210	89	138	65	33	38
19	82	53	45	43	39	42	196	86	149	62	34	39
20	82	54	45	43	39	47	181	84	162	61	32	39
21	78	55	44	43	38	52	167	78	178	60	32	38
22	75	56	44	43	38	56	156	75	204	60	32	38
23	76	57	44	43	37	62	148	72	245	67	33	37
24	76	58	44	43	37	68	140	73	287	65	36	36
25	72	57	44	43	36	73	130	70	306	63	36	35
26	68	56	43	43	36	80	123	68	305	60	50	34
27	67	55	43	43	36	88	116	68	300	58	51	36
28	64	54	43	43	36	92	109	65	293	54	44	35
29	64	54	43	43		107	99	61	286	52	42	35
30	64	54	43	42	-----	151	101	58	275	49	41	36
31	63	-----	43	42	-----	180	-----	56	-----	47	40	-----
Total	2,010	1,631	1,400	1,331	1,109	1,750	9,346	2,702	4,500	2,987	1,208	1,110
Mean	64.8	54.4	45.2	42.9	39.6	56.5	312	87.2	150	96.4	39.0	37.0
Max	103	64	52	43	42	180	976	106	306	268	47	41
Min	50	52	43	42	36	36	99	56	52	47	32	35
Ac-ft	3,990	3,240	2,780	2,640	2,200	3,470	18,540	5,360	8,930	5,920	2,400	2,200
Cal yr 1966 Total	47,852		Mean	131	Max	944	Min	43	Ac-ft	94,910		
Wtr yr 1967 Total	31,084		Mean	85.2	Max	976	Min	32	Ac-ft	61,650		

5-2750. Elk River near Big Lake, Minn.

Location (revised).--Lat 45°20'02", long 93°40'00", in NE $\frac{1}{4}$ SW $\frac{1}{4}$ 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 1967.

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.--39 years (1911-17, 1934-67), 249 cfs.

Extremes.--Maximum discharge during year, 2,630 cfs Apr. 4 (gage height, 6.72 ft); minimum 78 cfs Aug. 21, 22, 23; minimum gage height, 0.84 ft Nov. 28.
1911-17, 1931-67: Maximum discharge, 7,360 cfs Apr. 16, 1965 (gage height, 10.86 ft); minimum, 3.6 cfs July 31, 1934.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	132	160	138	112	111	105	1,100	239	146	580	132	152
2	128	149	136	112	111	104	1,700	235	138	565	156	142
3	125	135	133	111	111	103	2,160	231	135	500	138	132
4	132	163	130	111	111	102	2,570	228	142	435	138	122
5	128	152	128	110	111	102	2,340	228	156	382	138	117
6	125	149	127	110	111	101	1,990	224	163	340	135	111
7	122	152	126	110	112	101	1,710	228	180	299	132	106
8	120	152	125	110	113	101	1,460	231	213	280	114	100
9	120	152	125	110	114	101	1,290	228	209	261	108	96
10	120	152	125	110	114	101	1,130	254	224	246	100	96
11	117	163	125	110	114	101	1,020	276	250	235	98	93
12	114	163	123	110	114	101	894	272	250	213	96	93
13	114	163	120	110	114	101	789	265	250	202	93	108
14	122	162	120	110	114	101	720	257	254	188	89	122
15	188	161	119	110	114	101	667	250	265	177	89	117
16	239	160	118	110	114	101	610	235	378	184	87	114
17	224	160	118	111	114	102	565	228	489	191	85	114
18	213	158	118	111	113	103	511	224	584	177	82	114
19	213	156	118	111	112	104	470	213	652	174	85	117
20	213	154	118	112	110	108	424	205	747	166	82	120
21	202	153	117	113	110	110	386	198	793	160	78	117
22	191	153	117	112	110	113	352	191	770	152	82	108
23	184	152	117	111	110	126	321	188	777	160	85	106
24	184	151	116	111	110	145	291	184	796	156	85	98
25	177	150	116	110	109	170	268	184	793	146	91	98
26	174	149	116	110	108	220	250	180	739	142	146	96
27	170	147	115	111	107	270	231	177	682	135	166	96
28	166	143	114	111	106	350	224	177	625	142	156	98
29	163	142	114	111	111	480	213	170	584	146	177	98
30	163	140	113	111	111	580	220	163	538	138	194	98
31	163	---	112	111	---	800	---	152	---	132	174	---
Total	4,946	4,596	3,757	3,433	3,122	5,408	26,876	6,715	12,922	7,404	3,611	3,299
Mean	160	153	121	111	112	174	896	217	431	239	116	110
Max	239	163	138	113	114	800	2,570	276	796	580	194	152
Min	114	135	112	110	106	101	213	152	135	132	78	93
Cfsm	0.260	0.249	0.197	0.180	0.182	0.283	1.46	0.353	0.701	0.389	0.189	0.179
In.	0.30	0.28	0.23	0.21	0.19	0.33	1.63	0.41	0.78	0.45	0.22	0.20
Cal yr1966: Total	125,229		Mean	343	Max	2,020	Min	112	Cfsm	0.558	In.	7.57
Wtr yr1967: Total	86,089		Mean	236	Max	2,570	Min	78	Cfsm	0.384	In.	5.21

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 1967.

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.--18 years, 48.7 cfs.

Extremes.--Maximum discharge during year, 158 cfs Apr. 15 (gage height, 4.11 ft); maximum gage height, 4.14 ft Feb. 19 (backwater from ice); minimum discharge, 1.4 cfs Sept. 25, 26, 28, 29, 30 (gage height, 1.89 ft). 1949-67: 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 winter months, which are fair. Flow affected by natural storage and some regulation from lakes above station.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.6	6.5	4.0	13	20	20	105	129	38	50	10	3.6
2	2.8	4.3	4.0	13	20	20	112	140	41	50	8.9	3.2
3	3.2	4.1	4.1	13	20	20	111	138	41	46	8.4	3.8
4	4.5	3.8	4.2	14	20	20	110	135	42	40	6.8	8.0
5	4.1	3.8	4.3	14	20	21	106	132	40	37	5.7	7.6
6	3.2	3.6	4.5	14	20	21	106	127	37	35	8.0	7.2
7	3.2	3.4	4.7	14	20	21	113	127	39	34	8.0	6.8
8	3.2	3.4	5.2	15	20	20	118	129	45	38	6.8	6.8
9	3.8	3.4	6.0	15	20	21	127	121	48	36	6.0	6.0
10	4.1	3.6	7.0	15	20	21	132	110	43	37	4.5	5.5
11	3.6	3.6	8.0	16	20	22	130	103	40	36	3.8	5.0
12	2.4	3.4	8.8	16	20	21	136	103	38	34	3.4	4.8
13	2.2	3.2	9.2	17	19	21	144	106	39	32	3.2	5.5
14	3.4	3.4	9.5	16	19	21	149	103	40	32	2.7	5.5
15	6.5	3.2	9.5	16	19	21	156	100	48	28	2.5	5.7
16	5.0	3.2	9.5	16	19	21	147	96	81	27	2.2	5.7
17	6.2	3.4	10	16	19	21	149	93	72	25	2.2	5.3
18	9.5	3.3	11	15	19	22	137	88	64	24	2.2	2.2
19	9.5	3.3	11	16	19	22	135	93	62	22	2.0	2.0
20	8.9	3.4	11	18	19	21	143	85	64	21	1.9	2.0
21	6.2	3.6	11	18	19	21	153	79	62	21	1.7	2.0
22	10	4.1	11	18	19	22	148	73	56	19	1.7	1.7
23	8.0	4.1	11	18	19	22	140	72	54	20	1.9	1.7
24	6.2	4.1	12	18	19	23	142	68	52	18	1.9	1.9
25	5.0	4.3	12	19	19	26	143	62	50	20	3.6	1.6
26	4.8	4.5	12	19	19	31	145	64	48	25	7.6	1.5
27	4.8	4.7	12	19	20	34	143	63	46	20	5.5	1.5
28	5.3	4.7	12	19	20	38	136	57	48	16	4.8	1.5
29	5.0	4.3	12	19		56	134	53	51	14	5.0	1.4
30	4.5	4.1	12	20	-----	110	128	44	50	14	4.3	1.5
31	6.8	-----	12	20	-----	106	-----	38	-----	12	3.6	-----
Total	159.5	115.8	274.5	509	546	907	3,978	2,931	1,479	883	140.8	118.5
Mean	5.14	3.86	8.85	16.4	19.5	29.3	133	94.5	49.3	28.5	4.54	3.95
Max	10	6.5	12	20	20	110	156	140	81	50	10	8.0
Min	2.2	3.2	4.0	13	19	20	105	38	37	12	1.7	1.4
Cfsm	0.029	0.022	0.049	0.092	0.109	0.164	0.743	0.528	0.275	0.159	0.025	0.022
In.	0.03	0.02	0.06	0.11	0.11	0.19	0.82	0.61	0.31	0.18	0.03	0.02

Cal yr 1966: Total 22,451.7 Mean 61.5 Max 205 Min 2.2 Cfsm 0.344 In. 4.66
Wtr yr 1967: Total 12,042.1 Mean 33.0 Max 154 Min 1.4 Cfsm 0.184 In. 2.50

Location.--Lat 44°54'20", long 93°53'05", in SW¹/₄SW¹/₄ 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.

Records available.--April 1934 to September 1967. Monthly discharge only for some periods, published in WSP 1308.

Average discharge.--33 years, 232 cfs.

Extremes.--Maximum discharge during year, 3,180 cfs Apr. 7 (gage height, 10.08 ft, from graph based on gage readings); minimum daily, 1.8 cfs Jan. 15 to Feb. 1; minimum gage height, 0.88 ft Oct. 10, 11.
1934-67: Maximum discharge, 16,100 cfs Apr. 13, 1965 (gage height, 19.23 ft, from floodmark); no flow at times.

Remarks.--Records good except those for winter months, which are fair. Records of chemical analyses for the water year 1967 are published in part 2 of this report.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	17	29	17	5.8	1.8	15	2,970	379	49	1,970	82	96
2	16	19	16	5.0	1.9	15	3,020	422	47	2,230	74	80
3	15	26	16	4.6	1.9	15	3,040	375	44	2,310	70	66
4	18	27	16	4.0	1.9	15	3,030	334	40	2,140	53	54
5	17	25	16	3.5	1.9	15	2,960	319	40	1,840	49	40
6	20	22	15	3.1	2.0	15	3,000	301	47	1,430	44	38
7	19	22	15	2.8	2.0	15	3,100	292	42	1,130	43	34
8	15	22	14	2.5	2.0	15	2,820	280	72	948	40	34
9	12	22	12	2.3	2.0	15	2,470	253	87	868	38	29
10	9.8	14	12	2.1	2.0	15	2,180	233	95	798	34	24
11	9.8	19	12	2.0	2.0	15	1,980	223	119	762	36	25
12	10	19	11	2.0	2.3	15	1,790	219	197	745	32	20
13	11	26	11	1.9	2.7	16	1,380	216	287	745	28	21
14	13	23	11	1.9	3.3	16	1,200	201	308	701	27	21
15	28	26	11	1.8	4.4	17	1,090	187	399	593	24	21
16	53	26	11	1.8	5.4	18	1,010	177	752	512	25	22
17	49	28	11	1.8	6.5	20	955	167	916	625	25	23
18	38	26	11	1.8	7.6	24	784	160	871	516	22	25
19	38	22	11	1.8	9.8	30	738	148	976	435	21	22
20	40	25	11	1.8	11	37	674	140	1,580	357	22	22
21	36	25	11	1.8	12	48	625	121	1,840	310	38	22
22	32	26	10	1.8	13	52	635	109	1,900	264	22	21
23	34	26	10	1.8	13	56	578	103	1,920	223	21	20
24	30	26	10	1.8	13	68	489	100	1,940	199	19	17
25	29	22	10	1.8	14	96	454	92	1,960	168	18	15
26	29	26	9.7	1.8	14	140	431	85	1,900	150	34	13
27	29	23	9.2	1.8	14	350	416	74	1,960	133	168	12
28	28	21	8.5	1.8	14	530	371	74	2,040	114	240	12
29	25	19	8.0	1.8		1,240	346	60	2,030	101	182	11
30	30	18	7.0	1.8	- - - - -	2,260	339	57	1,940	98	133	11
31	29	- - - - -	6.5	1.8	- - - - -	2,840	- - - - -	53	- - - - -	87	114	- - - - -
Total	779.6	700	359.9	74.1	181.4	803.8	44,875	5,954	26,398	23,502	1,778	871
Mean	25.1	23.3	11.6	2.39	6.48	259	1,496	192	880	758	57.4	29.0
Max	53	29	17	5.8	14	2,840	3,100	422	2,040	2,310	240	96
Min	9.8	14	6.5	1.8	1.8	15	339	53	40	87	18	11
Cfsm	0.021	0.020	0.0099	0.0020	0.0055	0.221	1.28	0.164	0.752	0.648	0.049	0.025
In.	0.02	0.02	0.01	0.002	0.006	0.26	1.43	0.19	0.84	0.75	0.06	0.03

Cal yr1966: Total	94,251.3	Mean	258	Max	2,490	Min	6.5	Cfsm	0.221	In.	3.00
Wtr yr1967: Total	113,511.0	Mean	311	Max	3,100	Min	1.8	Cfsm	0.266	In.	3.61

CROW RIVER BASIN

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 1967. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Water-stage recorder. Datum of gage is 893.65 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.--42 years (1909-17, 1930-31, 1934-67), 581 cfs.

Extremes.--Maximum discharge during year, 5,110 cfs Apr. 8 (gage height, 8.92 ft); minimum, 22 cfs Nov. 28 (gage height, 1.40 ft), result of freezeup.

1909-17, 1929-67: Maximum discharge, 22,400 cfs Apr. 16, 1965 (gage height, 19.27 ft, from floodmark); minimum, 1.8 cfs Nov. 15, 1936 (gage height, 1.05 ft), caused by ice jam upstream.

Remarks.--Records good except those for winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	91	119	81	81	101	90	4,330	1,470	285	2,170	197	172
2	91	111	80	81	101	90	4,860	1,460	266	2,170	186	151
3	99	93	76	81	100	90	5,060	1,400	254	2,240	170	136
4	97	107	75	81	99	90	5,080	1,340	238	2,310	159	124
5	97	117	75	81	99	90	5,070	1,280	241	2,280	143	109
6	95	119	76	81	99	86	5,070	1,210	238	2,030	141	98
7	97	115	77	80	99	83	5,070	1,140	251	1,710	134	90
8	103	109	79	79	99	85	5,090	1,100	263	1,470	134	80
9	93	107	79	80	99	87	4,880	1,050	282	1,330	126	76
10	84	90	79	81	99	88	4,560	988	306	1,250	122	71
11	80	86	80	82	98	86	4,280	959	330	1,190	117	69
12	78	88	83	83	96	82	4,020	931	380	1,120	111	68
13	78	88	87	84	93	82	3,770	882	430	1,080	106	76
14	86	90	89	86	91	82	3,480	840	520	1,050	96	74
15	140	119	89	88	91	82	3,200	791	550	988	90	73
16	162	128	89	89	91	82	3,000	744	610	889	82	71
17	179	134	89	89	91	82	2,890	692	800	861	78	73
18	184	107	87	89	91	82	2,760	660	950	868	74	76
19	176	107	86	90	91	83	2,620	622	1,060	777	71	78
20	168	107	86	92	91	84	2,490	586	1,200	666	69	78
21	170	113	83	92	90	87	2,370	544	1,600	574	74	74
22	165	125	82	91	90	88	2,240	514	2,000	509	84	71
23	152	134	82	91	90	89	2,150	470	2,100	498	74	69
24	145	130	82	91	90	90	2,020	450	2,180	397	69	63
25	152	130	81	91	90	93	1,880	420	2,220	350	66	60
26	136	130	81	92	90	140	1,770	397	2,280	309	111	57
27	130	130	81	93	90	350	1,670	370	2,200	276	131	54
28	128	78	81	96	90	941	1,560	354	2,170	251	260	53
29	125	80	81	101		1,700	1,480	334	2,180	229	292	53
30	123	80	81	101		2,850	1,440	316	2,190	220	238	51
31	121		81	101		3,860		298		212	197	
Total	3,825	3,271	2,538	2,718	2,639	11,994	100,160	24,612	30,574	32,274	4,002	2,448
Mean	123	109	81.9	87.7	94.2	387	3,339	794	1,019	1,041	129	81.6
Max	184	134	89	101	101	3,860	5,090	1,470	2,280	2,310	292	172
Min	78	78	75	79	90	82	1,440	298	238	212	66	51
Cfsm	0.049	0.043	0.032	0.035	0.037	0.154	1.32	0.315	0.404	0.413	0.051	0.032
In.	0.06	0.05	0.04	0.04	0.04	0.18	1.48	0.36	0.45	0.48	0.06	0.04

Cal yr 1966: Total 278,898 Mean 764 Max 4,180 Min 75 Cfsm 0.303 In. 4.12
Wtr yr 1967: Total 221,055 Mean 606 Max 5,090 Min 51 Cfsm 0.240 In. 3.26

5-2840. Mille Lacs Lake at Garrison, Minn.

Location.--Lat 46°18'05", long 93°49'05", in ~~SW 1/4~~ 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 north-east of Garrison.

Records available.--June 1931 to September 1967. 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, 1,252.41 ft July 21 (affected by wind action); maximum daily recorded 1,252.08 ft June 29; minimum recorded, 1,250.87 ft Sept. 25 (affected by wind action).
1931-67: 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.

Daily mean elevation, in feet, October 1966 to September 1967

Oct. 31	.....	1251.44	Feb. 28	.....	1251.55	June 30	.....	1252.06
Nov. 11	.....	1251.44	Mar. 17	.....	1251.50	July 31	.....	1251.78
Dec. 21	.....	1251.44	Apr. 30	.....	1251.90	Aug. 31	.....	1251.44
Jan. 31	.....	1251.56	May 31	.....	1251.64	Sept.30	.....	1251.02

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 15¼ 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 1967.

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.--35 years (1930-31, 1933-67), 552 cfs.

Extremes.--Maximum discharge during year, 5,400 cfs Apr. 5 (gage height, 8.05 ft); minimum, 216 cfs Sept. 29, 30 (gage height, 2.57 ft).
1929-67: Maximum discharge, 10,100 cfs Apr. 20, 1965 (gage height, 11.57 ft); minimum, 29 cfs Aug. 18, 1934 (gage height, 1.91 ft).

Remarks.--Records good except those for period of no gage-height record and those for winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report. Occasional regulation by Ogechie (also controls Mille Lacs Lake) and Onamia Lakes.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	392	410	312	302	332	308	2560	664	474	1550	375	318
2	388	406	317	300	338	303	2960	659	464	1400	384	306
3	388	392	324	298	341	301	3540	662	449	1240	371	298
4	384	392	333	298	350	300	4570	665	449	1120	362	287
5	384	384	340	294	355	300	5290	672	464	1050	354	280
6	379	362	339	293	362	301	4700	677	474	957	350	272
7	384	406	340	291	369	302	4240	690	501	856	354	268
8	388	415	340	290	371	307	3820	699	569	764	350	261
9	392	415	339	289	370	308	3500	708	610	721	345	254
10	375	410	325	290	370	305	3130	716	704	685	337	247
11	371	406	319	292	369	298	2830	720	882	648	329	240
12	375	321	318	295	369	291	2560	721	1040	625	318	236
13	371	310	318	298	368	284	2290	722	1140	596	314	250
14	375	309	322	299	364	281	2060	721	1180	570	306	254
15	449	310	328	299	359	283	1950	720	1210	543	302	254
16	501	311	332	300	354	288	1820	718	1300	529	294	254
17	540	312	335	301	348	295	1710	691	1580	508	291	254
18	551	314	333	304	338	300	1630	672	2040	488	291	250
19	557	320	330	307	332	307	1520	647	2810	472	280	244
20	528	327	326	311	326	316	1420	616	3780	454	272	244
21	512	329	319	318	323	328	1270	592	4580	449	272	244
22	490	329	319	321	318	341	1150	580	4680	464	265	240
23	479	329	318	324	316	354	1040	586	4380	545	272	236
24	459	320	316	319	312	368	960	580	3970	551	280	233
25	444	315	310	315	309	388	910	569	3580	569	276	226
26	439	308	309	312	309	413	853	557	3190	523	337	226
27	434	303	308	317	310	452	785	545	2830	474	358	226
28	429	302	308	320	310	500	738	528	2420	439	358	226
29	420	302	307	321		568	702	523	1980	415	358	219
30	415	306	306	324	-----	1170	687	512	1680	392	350	216
31	410	-----	305	329	-----	2120	-----	497	-----	379	329	-----
Total	13,403	10,375	9,995	9,471	9,592	12,980	67,195	19,829	55,410	20,976	10,034	7,563
Mean	432	346	322	306	343	419	2,240	640	1,847	677	324	252
Max	557	415	340	329	371	2,120	5,290	722	4,680	1,550	384	318
Min	371	302	305	289	309	281	687	497	449	379	265	216
Cfsm	0.318	0.254	0.237	0.225	0.252	0.308	1.65	0.471	1.36	0.498	0.238	0.185
In.	0.37	0.28	0.27	0.26	0.26	0.35	1.84	0.54	1.52	0.57	0.27	0.21
Cal yr 1966: Total	325,431		Mean	892	Max	5,600	Min	302	Cfsm	0.656	In.	8.90
Wtr yr 1967: Total	246,823		Mean	676	Max	5,290	Min	216	Cfsm	0.497	In.	6.75

Note.--No gage-height record Apr. 6 to May 16.

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 1967. Prior to October 1931 published as "at Coon Rapids, near Anoka."

Gage.--Digital water-stage recorder. Datum of gage is 805.02 ft above mean sea level, adjustment of 1912. Prior to June 14, 1932, at site 1½ miles upstream at different datum. June 14, 1932 to June 1, 1964 graphic water-stage recorder at present site and datum.

Average discharge.--36 years, 7,080 cfs.

Extremes.--Maximum discharge during year, 41,000 cfs Apr. 4 (gage height, 11.54 ft); minimum 1,580 cfs Aug. 22, 23 (gage height, 1.05 ft).

1931-67: Maximum discharge, 91,000 cfs Apr. 17, 1965 (gage height, 19.53 ft); 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 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4,940	6,800	2,800	5,200	4,700	5,300	34,200	16,700	7,400	14,200	3,690	2,910
2	4,430	6,080	2,200	5,000	4,500	5,300	37,200	16,600	6,510	13,100	3,840	2,850
3	3,990	6,230	2,700	4,620	4,700	4,900	38,800	16,000	6,340	12,400	3,440	2,710
4	4,960	6,260	3,000	4,400	5,100	4,900	40,300	16,200	5,970	11,800	4,020	2,850
5	5,380	6,680	3,400	4,600	4,900	5,400	40,600	15,200	6,530	10,600	3,440	2,570
6	5,620	6,140	4,000	4,700	4,800	5,100	38,300	15,700	6,510	11,100	3,400	2,420
7	5,070	5,110	4,600	4,400	4,500	5,000	35,700	14,700	6,020	9,730	3,830	3,330
8	4,900	5,400	4,700	4,100	4,860	5,100	32,700	14,700	6,640	9,300	3,810	2,480
9	5,540	6,060	4,600	4,400	4,700	5,300	30,500	14,500	7,570	8,530	3,530	2,540
10	5,260	6,460	4,300	4,700	4,900	5,300	29,500	13,600	8,130	8,230	3,610	2,520
11	5,320	5,590	4,300	4,800	4,700	5,300	27,900	14,300	8,340	8,330	3,360	2,380
12	4,960	4,550	4,400	4,800	4,900	5,100	27,200	13,800	9,080	7,450	3,020	2,480
13	5,220	3,580	4,900	4,500	5,200	5,100	25,800	12,500	9,410	7,170	2,950	2,340
14	5,090	4,240	5,000	4,800	5,000	5,100	25,500	13,200	9,490	6,720	3,060	2,510
15	6,500	5,100	5,200	4,600	4,900	5,200	24,300	12,400	11,600	6,670	3,170	2,790
16	6,860	5,760	5,200	4,600	4,800	5,000	23,400	12,300	14,300	6,270	2,990	2,830
17	6,230	5,450	5,200	4,300	4,800	4,900	23,000	11,700	16,400	6,240	2,930	3,070
18	6,500	5,920	4,700	4,300	4,800	5,300	22,600	11,100	17,800	6,050	3,140	2,610
19	6,560	4,980	4,800	4,450	4,900	5,800	21,500	10,900	19,000	5,870	3,260	3,150
20	7,130	5,590	5,000	4,600	4,900	5,300	21,500	10,600	19,900	5,270	3,310	3,080
21	6,620	5,630	5,100	4,850	5,000	5,170	21,100	9,940	20,500	5,160	2,830	2,700
22	6,350	5,650	4,800	5,100	5,400	5,000	20,200	9,550	20,900	4,910	2,650	2,890
23	6,290	5,060	5,100	4,560	5,050	5,300	19,800	9,620	20,800	5,220	2,830	2,580
24	6,680	6,370	4,600	4,600	4,800	5,400	19,300	9,460	20,200	5,100	2,880	2,770
25	6,440	6,610	4,600	5,100	4,700	5,500	19,400	8,310	19,400	5,240	2,960	2,280
26	6,590	5,630	4,200	5,100	5,200	6,300	19,000	8,830	18,300	4,370	3,890	2,210
27	6,350	5,510	4,700	4,700	5,300	7,000	18,600	8,550	17,400	4,360	4,190	2,660
28	6,260	5,550	4,800	4,600	5,300	9,000	17,900	7,340	16,400	4,470	3,630	2,680
29	6,440	3,850	4,600	4,600		11,800	17,900	7,780	15,600	4,230	3,530	2,160
30	6,020	3,700	4,400	4,700	- - - -	17,500	16,600	7,690	14,600	3,770	3,610	2,130
31	6,110	- - - -	4,800	4,800	- - - -	27,600	- - - -	6,760	- - - -	3,860	3,150	- - - -
Total	180,610	165,540	136,700	144,580	137,310	209,270	790,300	370,530	387,040	225,720	103,950	79,480
Mean	5,826	5,518	4,410	4,664	4,904	6,751	26,340	11,950	12,900	7,281	3,353	2,649
Max	7,130	6,800	5,200	5,200	5,400	27,600	40,600	16,700	20,900	14,200	4,190	3,330
Min	3,990	3,580	2,200	4,100	4,500	4,900	16,600	6,760	5,970	3,770	2,650	2,130
Cfsm	.31	.29	.23	.24	.26	.35	1.38	.63	.68	.38	.18	.14
In.	.35	.32	.27	.28	.27	.41	1.54	.72	.75	.44	.20	.15

Cal yr 1966: Total 4,335,610 Mean 11,880 Max 42,200 Min 2,200 Cfsm .62 In. 8.44

Wtr yr 1967: Total 2,931,030 Mean 8,030 Max 40,600 Min 2,130 Cfsm .42 In. 5.71

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 1967.

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 4¼ miles downstream at different datum. Mar. 21 to Apr. 12, 1940, staff gage at site 100 ft downstream at present datum. April 13 to Aug. 27, 1940, staff gage at present site and datum.

Average discharge.--28 years, 47.1 cfs (34,100 acre-ft per year).

Extremes.--Maximum discharge during year, 472 cfs Mar. 26 (gage height, 5.20 ft, backwater from ice); maximum gage height, 5.56 ft Mar. 10; minimum discharge, 0.2 cfs Sept. 8 (gage height, 1.87 ft).
1939-67: 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, 1959, 1963.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1	1.2	1.9	1.8	1.3	1.1	4.0	198	144	9.9	43	61	0.5	
2	1.0	1.7	1.8	1.3	1.1	8.5	154	193	9.5	39	52	.4	
3	1.1	1.7	1.8	1.3	1.1	10	133	196	8.8	35	46	.4	
4	1.7	2.0	1.8	1.3	1.1	12	112	173	7.9	31	43	.4	
5	1.3	2.0	1.8	1.3	1.1	11	94	142	7.6	27	3.7	.5	
6	.6	2.2	1.8	1.3	1.1	10	85	122	7.6	24	7.1	.4	
7	.6	2.1	1.8	1.3	1.1	60	80	104	9.5	21	17	.3	
8	.6	2.1	1.8	1.3	1.1	115	76	84	14	20	19	.2	
9	.7	2.1	1.8	1.2	1.1	95	72	77	25	17	9.5	.4	
10	.7	2.1	1.8	1.2	1.1	100	71	68	24	18	64	.3	
11	.7	2.1	1.6	1.2	1.0	80	66	60	17	24	52	.5	
12	.7	2.2	1.6	1.2	1.0	65	61	55	15	21	43	.6	
13	.9	2.2	1.6	1.2	1.0	55	58	55	14	17	31	.6	
14	2.0	2.2	1.6	1.2	1.0	50	60	51	28	14	27	.6	
15	2.6	2.4	1.6	1.2	1.0	45	71	47	54	13	22	.6	
16	1.3	2.4	1.6	1.2	1.0	44	70	44	61	11	24	.6	
17	.8	2.4	1.6	1.2	1.0	43	98	41	131	9.9	24	.8	
18	1.0	2.3	1.6	1.1	.9	43	145	39	168	9.2	19	.9	
19	1.6	2.2	1.6	1.1	.9	42	161	34	163	8.5	1.5	.8	
20	1.5	2.2	1.6	1.1	.9	42	158	31	152	8.2	1.5	.6	
21	1.4	2.2	1.5	1.1	.9	42	190	29	138	7.6	1.7	.6	
22	1.3	2.2	1.4	1.1	.9	50	166	29	104	7.4	1.5	.5	
23	1.0	2.2	1.4	1.1	.9	100	152	28	91	7.1	1.1	.4	
24	1.3	2.1	1.4	1.1	.9	160	136	25	89	6.8	1.0	.3	
25	1.2	2.0	1.4	1.1	.9	200	114	21	82	6.6	.8	.3	
26	1.6	2.0	1.4	1.1	1.0	350	98	19	72	6.1	.8	.3	
27	1.7	2.0	1.4	1.1	1.4	300	84	17	68	5.8	.7	.4	
28	1.7	2.0	1.3	1.1	1.3	275	74	15	65	5.4	.6	.4	
29	2.0	2.0	1.3	1.1		256	68	14	56	5.4	.6	.4	
30	1.7	2.0	1.3	1.1	-----	256	65	13	47	6.1	.5	.4	
31	2.0	-----	1.3	1.1	-----	269	-----	11	-----	64	.6	-----	
Total	39.5	63.2	49.1	36.6	28.9	3,192.5	3,170	1,981	1,738.8	481.5	120.0	14.4	
Mean	1.27	2.11	1.58	1.18	1.03	103	106	63.9	58.0	15.5	3.87	0.480	
Max	2.6	2.4	1.8	1.3	1.4	350	198	196	168	43	19	0.9	
Min	0.6	1.7	1.3	1.1	0.9	4.0	58	11	7.6	5.4	0.5	0.2	
Cfsm	0.0028	0.0047	0.0035	0.0026	0.0023	0.230	0.237	0.143	0.130	0.035	0.0087	0.0011	
In.	0.003	0.005	0.004	0.003	0.002	0.26	0.26	0.16	0.14	0.04	0.01	0.001	
Ac-ft	78	125	97	73	57	6,330	6,290	3,930	3,450	955	238	29	
Cal yr 1966: Total	15,119.8	Mean	41.4	Max	1,300	Min	0.5	Cfsm	0.0926	In.	1.26	Ac-ft	29,990
Wtr yr 1967: Total	10,915.5	Mean	29.9	Max	350	Min	0.2	Cfsm	0.067	In.	0.91	Ac-ft	21,650

Peak discharge (base, 450 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-26	1730	5.20	472				

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 1967. 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.--36 years (1931-67), 45.3 cfs (32,800 acre-ft per year).

Extremes.--Maximum discharge during year, 475 cfs Mar. 31 (gage height, 5.18 ft); maximum gage height, 8.30 ft Mar. 11 (from floodmark, backwater from ice); minimum discharge, 0.7 cfs Sept. 26; minimum gage height, 1.63 ft Aug. 30.

1910-12, 1931-67: 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 winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	6.4	7.8	6.6	5.4	5.2	6.0	268	51	11	20	5.8	2.6
2	5.8	7.8	6.6	5.4	5.2	6.6	152	109	9.9	18	6.0	2.6
3	6.6	7.8	6.6	5.4	5.1	7.6	103	98	8.8	16	5.4	2.5
4	7.2	7.8	6.6	5.4	5.1	8.4	84	78	8.5	15	5.4	2.6
5	7.5	7.8	6.7	5.4	5.0	8.7	71	63	8.5	12	5.6	2.1
6	6.4	7.8	6.7	5.4	5.0	8.9	63	54	11	11	4.8	2.6
7	6.9	7.8	6.7	5.4	5.0	9.2	57	47	20	11	4.4	2.2
8	6.6	7.8	6.8	5.4	5.0	9.7	52	42	95	10	4.4	2.1
9	6.4	7.6	6.8	5.3	5.0	11	49	36	153	11	4.1	2.1
10	6.4	7.6	6.8	5.3	5.0	15	46	33	95	12	4.1	2.0
11	7.8	7.7	6.8	5.3	4.9	45	42	32	65	13	3.9	2.0
12	7.5	7.3	6.8	5.3	4.9	108	39	32	52	11	3.5	2.0
13	7.5	7.0	6.8	5.3	4.9	100	41	31	46	9.6	3.5	2.0
14	9.7	6.8	6.8	5.3	4.9	90	46	30	40	8.5	3.4	2.0
15	10	6.8	6.9	5.3	4.9	82	52	29	96	7.8	3.0	1.5
16	9.1	6.8	6.9	5.3	4.9	74	53	27	142	7.2	2.6	1.6
17	7.8	6.8	6.9	5.3	4.9	67	66	26	96	6.6	2.6	1.6
18	8.8	6.8	6.8	5.2	4.9	63	69	24	85	6.4	2.6	3.5
19	6.6	6.8	6.7	5.2	4.9	61	75	23	67	6.0	2.6	4.3
20	6.1	6.8	6.6	5.2	4.9	61	86	20	52	5.8	2.8	3.0
21	7.5	6.9	6.0	5.2	4.9	65	103	19	42	5.6	2.5	1.9
22	7.5	7.0	5.5	5.2	4.9	90	100	18	37	5.1	2.6	1.6
23	5.8	7.0	5.4	5.2	4.9	130	76	17	34	4.9	3.1	1.2
24	6.6	7.0	5.4	5.2	5.0	220	59	16	32	4.8	2.8	1.2
25	7.2	7.0	5.4	5.2	5.1	330	50	15	34	4.4	2.6	1.1
26	7.2	7.0	5.4	5.2	5.2	370	45	15	35	3.8	3.1	1.1
27	7.5	6.6	5.4	5.2	5.4	350	41	14	33	4.1	2.7	1.2
28	7.2	6.6	5.4	5.2	5.6	303	38	14	28	3.9	2.3	1.2
29	8.2	6.6	5.4	5.2		270	37	12	26	3.6	2.7	1.3
30	8.2	6.6	5.4	5.2	-----	237	37	12	23	8.8	2.6	1.4
31	9.7	-----	5.4	5.2	-----	420	-----	11	-----	6.2	2.3	-----
Total	229.7	215.5	195.0	163.7	140.6	3627.1	2100	1048	1485.7	273.1	109.8	60.1
Mean	7.41	7.18	6.29	5.28	5.02	117	70.0	33.8	49.5	8.81	3.54	2.00
Max	10	7.8	6.9	5.4	5.6	420	268	109	153	20	6.0	4.3
Min	5.8	6.6	5.4	5.2	4.9	6.0	37	11	8.5	3.6	2.3	1.1
Cfsm	0.019	0.018	0.016	0.014	0.013	0.301	0.180	0.087	0.127	0.023	0.0091	0.0051
In.	0.02	0.02	0.02	0.02	0.01	0.35	0.20	0.10	0.14	0.03	0.01	0.006
Ac-ft	456	427	387	325	279	7,190	4,170	2,080	2,950	542	218	119

Cal yr 1966: Total	17,726.2	Mean	48.6	Max	2,120	Min	2.0	Cfsm	0.125	In.	1.69	Ac-ft	35,160
Wtr yr 1967: Total	9,648.3	Mean	26.4	Max	420	Min	1.1	Cfsm	0.068	In.	0.92	Ac-ft	19,140

Peak discharge (base, 200 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-31	0630	5.18	475				

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 1967.

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 observed during year, 8.94 ft Apr. 17; minimum observed, 6.11 ft Oct. 13. 1937-67: 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 1966 to September 1967

Oct. 31.....6.75	Feb. 28.....6.73	June 30.....7.79
Nov. 30.....6.28	Mar. 31.....8.55	July 31.....7.27
Dec. 31.....6.40	Apr. 30.....8.15	Aug. 31.....7.60
Jan. 31.....6.58	May 31.....7.34	Sept. 30.....6.40

Note.--Gage-height record other than that shown above is available.

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 1967.

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.--29 years, 114 cfs (82,530 acre-ft per year).

Extremes.--Maximum discharge during year, 898 cfs Apr. 17 (gage height, 10.04 ft); minimum, 1.0 cfs Nov. 3, 12-14, 19 (gage height, 1.11 ft).
1938-67: Maximum discharge, 3,060 cfs Apr. 13, 1952 (gage height, 12.92 ft); no flow Dec. 13, 1940.

Remarks.--Records fair. Flow affected by natural storage in Big Stone Lake (see preceding page).

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2.2	2.5	5.0	4.7	4.7	4.3	469	329	48	157	32	15
2	1.8	1.2	5.0	4.7	4.7	4.6	478	379	49	176	27	14
3	4.1	1.0	5.0	4.7	4.7	5.0	391	256	42	132	44	14
4	3.3	1.2	5.0	4.7	4.7	4.8	392	240	59	91	22	15
5	1.6	1.0	5.0	4.7	4.7	4.7	399	240	55	71	28	15
6	1.6	1.0	5.0	4.7	4.7	5.4	421	226	52	66	23	15
7	3.3	1.2	5.0	4.7	4.7	6.6	361	339	92	66	27	15
8	2.2	1.2	5.0	4.7	4.7	6.2	334	322	131	90	26	14
9	4.9	1.1	5.0	4.7	4.7	8.0	422	179	99	83	25	13
10	4.9	1.1	5.0	4.7	4.7	15	306	184	99	107	15	13
11	1.6	1.1	5.0	4.7	4.6	22	219	227	94	122	15	12
12	1.6	1.0	5.0	4.7	4.6	40	249	208	111	120	15	13
13	1.8	1.0	5.0	4.7	4.6	35	261	198	119	101	23	14
14	14	1.0	5.0	4.7	4.6	30	442	205	141	76	26	13
15	12	1.2	5.0	4.7	4.5	28	413	184	171	60	28	14
16	1.6	1.2	5.0	4.7	4.5	28	357	184	184	80	28	14
17	1.8	1.2	4.9	4.7	4.5	30	639	170	156	62	28	14
18	2.2	1.2	4.9	4.6	4.4	30	268	145	114	55	26	15
19	1.6	1.0	4.9	4.6	4.3	26	164	255	200	50	25	14
20	1.8	1.2	4.9	4.6	4.3	45	224	104	187	44	25	15
21	3.3	1.4	4.9	4.6	4.3	52	356	104	187	40	23	14
22	6.6	1.4	4.8	4.6	4.3	60	381	78	161	51	20	13
23	3.3	1.4	4.8	4.6	4.3	120	262	127	163	51	21	13
24	5.3	1.4	4.8	4.6	4.3	250	230	84	164	37	18	13
25	4.5	1.4	4.8	4.6	4.3	400	223	87	151	31	18	14
26	4.1	2.5	4.7	4.7	4.3	395	240	155	143	45	18	14
27	3.7	6.0	4.7	4.8	4.3	370	210	88	148	28	15	12
28	4.1	5.6	4.7	4.8	4.3	398	172	72	145	29	16	11
29	2.5	5.0	4.7	4.7	4.7	425	222	61	149	31	18	13
30	1.8	5.2	4.7	4.7	- - - -	440	190	48	139	31	17	14
31	5.3	- - - -	4.7	4.7	- - - -	476	- - - -	44	- - - -	24	16	- - - -
Total	114.4	54.9	151.9	145.1	126.3	3,764.6	9,695	5,522	3,753	2,207	708	412
Mean	3.69	1.83	4.90	4.68	4.51	121	323	178	125	71.2	22.8	13.7
Max	14	6.0	5.0	4.8	4.7	476	639	379	200	176	44	15
Min	1.6	1.0	4.7	4.6	4.3	4.3	164	44	42	24	15	11
Ac-ft	227	109	301	288	251	7,470	19,230	10,950	7,440	4,380	1,400	817

Cal yr 1966: Total 47,867.6 Mean 131 Max 1,220 Min 1.0 Ac-ft 94,940
Wtr yr 1967: Total 26,654.2 Mean 73.0 Max 639 Min 1.0 Ac-ft 52,870

5-2930. Yellow Bank River near Odessa, Minn.

Location.--Lat 45°13'35", long 96°21'12", in SE $\frac{1}{4}$ sec.1, T.120 N., R.46 W., on left bank 150 ft downstream from highway bridge, $2\frac{1}{4}$ miles southwest of Odessa, and $4\frac{1}{4}$ miles upstream from mouth.

Drainage area.--398 sq mi.

Records available.--October 1939 to September 1967.

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.--28 years, 56.3 cfs (40,760 acre-ft per year).

Extremes.--Maximum discharge during year, 1,440 cfs Mar. 24 (gage height, 8.90 ft, backwater from ice); minimum, 0.8 cfs Sept. 4, 28, 29, 30; minimum gage height, 1.75 ft Sept. 4.

1939-67: 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, Feb. 11 to Mar. 9, 1965.

Remarks.--Records good except those for period of no gage-height record and those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2.1	3.7	5.2	3.4	1.3	3.6	239	50	16	88	6.6	1.2
2	2.3	3.7	5.2	3.4	1.3	3.8	186	56	15	80	6.7	1.1
3	2.9	3.9	5.2	3.4	1.3	4.5	156	85	15	75	6.2	1.1
4	2.9	4.2	5.2	3.2	1.6	9.0	128	88	14	68	6.2	.9
5	2.7	4.2	5.2	3.2	1.8	12	110	76	14	64	5.1	1.0
6	2.5	4.2	5.2	3.0	1.8	14	99	66	32	58	5.1	1.0
7	2.7	4.2	5.2	2.6	1.8	13	89	59	46	54	4.4	1.0
8	2.5	3.7	5.2	2.4	1.8	15	83	54	59	52	4.4	1.0
9	2.5	4.2	5.0	2.3	2.0	30	76	49	62	50	4.2	1.0
10	2.5	4.6	5.0	2.2	2.0	200	71	46	72	46	3.9	1.0
11	2.3	4.6	5.2	2.2	2.0	320	69	45	70	46	3.5	1.0
12	2.3	5.1	5.4	2.2	2.0	480	68	44	63	46	3.1	1.3
13	2.3	5.1	5.6	2.2	2.0	450	65	42	58	46	2.7	1.6
14	3.1	5.4	5.6	2.2	2.2	380	66	43	54	46	2.3	1.3
15	3.3	5.4	5.6	2.2	2.4	330	71	43	58	40	2.3	1.3
16	3.3	5.1	5.4	2.2	2.5	320	74	41	188	35	2.3	1.4
17	4.2	4.8	5.4	2.2	2.6	250	76	37	856	30	2.0	1.6
18	3.9	4.4	5.4	2.2	2.8	220	88	36	806	25	2.0	2.3
19	3.9	4.5	5.4	2.0	3.0	200	118	32	409	22	2.0	4.2
20	3.5	4.7	5.4	1.8	3.0	220	128	30	273	19	2.0	2.9
21	3.5	4.9	5.0	1.8	3.2	210	126	30	213	17	1.9	2.0
22	3.7	5.2	5.0	2.0	3.2	290	113	28	182	15	1.7	1.7
23	3.5	5.3	5.0	2.0	3.2	520	96	26	159	14	1.7	1.1
24	3.7	5.4	4.8	1.8	3.4	950	82	24	150	12	1.6	1.2
25	3.7	5.4	4.6	1.6	3.4	1170	71	23	140	11	1.5	1.1
26	3.7	5.4	4.5	1.4	3.4	840	64	21	130	9.6	1.6	.9
27	3.7	5.4	4.0	1.3	3.6	510	59	20	120	8.5	1.6	.9
28	3.7	5.4	3.8	1.3	3.6	418	55	18	110	7.8	1.6	.8
29	3.5	5.3	3.8	1.3	3.75	375	52	18	100	7.0	1.3	.8
30	3.9	5.2	3.6	1.3	-----	313	50	17	90	6.2	1.3	.8
31	3.9	-----	3.4	1.3	-----	277	-----	16	-----	6.4	1.2	-----
Total	98.2	142.6	153.5	67.6	68.2	9,347.9	2,828	1,263	4,574	1,104.5	94.0	40.5
Mean	3.17	4.75	4.95	2.18	2.44	302	94.3	40.7	152	35.6	3.03	1.35
Max	4.2	5.4	5.6	3.4	3.6	1,170	239	88	856	88	6.7	4.2
Min	2.1	3.7	3.4	1.3	1.3	3.6	50	16	14	6.2	1.2	0.8
Cfsm	0.0080	0.012	0.012	0.0055	0.0061	0.759	0.237	0.102	0.382	0.089	0.0076	0.0034
In.	0.009	0.01	0.01	0.006	0.006	0.87	0.26	0.12	0.43	0.10	0.009	0.004
Ac-ft	195	283	304	134	135	18,540	5,610	2,510	9,070	2,190	186	80

Cal yr 1966: Total 16,454.8 Mean 45.1 Max 1,330 Min 1.9 Cfsm 0.113 In. 1.54 Ac-ft 32,640
 Wtr yr 1967: Total 19,782.0 Mean 54.2 Max 1,170 Min 0.8 Cfsm 0.136 In. 1.85 Ac-ft 39,240

Peak discharge (base, 300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-12	0730	7.22	490	3-24	2100	8.90	1,440

Note.--No gage-height record June 24 to Aug. 1

5-2940. Pomme de Terre River at Appleton, Minn.

Location.--Lat 45°12'10", long 96°01'20", in SW¼ 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 1967. 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.--32 years (1935-67), 99.8 cfs (72,250 acre-ft per year).

Extremes.--Maximum discharge during year, 1,080 cfs Mar. 26 (gage height, 7.24 ft); minimum, 3.1 cfs Nov. 1 (gage height, 3.77 ft).
1931-67: 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 winter months, which are fair. Flow affected by lakes above station. Occasional regulation at low flow by old milldam 500 ft upstream. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Discharge, in cubic feet per second, water year October 1966 to September 1967														
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept.		
1	54	52	35	39	25	25	725	270	104	294	57	29		
2	54	39	40	39	27	25	690	274	100	298	54	28		
3	54	47	42	39	29	25	645	266	98	282	54	27		
4	52	61	42	38	30	25	605	254	96	266	57	26		
5	53	58	42	38	31	25	570	242	93	246	55	25		
6	55	57	43	38	32	25	540	234	108	219	64	25		
7	54	37	44	37	33	26	510	230	104	200	58	24		
8	52	21	44	36	33	30	485	226	262	190	54	24		
9	48	29	44	35	33	32	455	226	435	180	51	23		
10	50	44	45	35	33	35	425	219	318	180	51	24		
11	53	52	45	35	33	38	400	212	286	173	51	24		
12	54	47	45	35	33	44	382	208	319	167	48	24		
13	53	45	45	35	32	51	360	204	346	154	46	24		
14	61	46	45	35	32	58	350	200	360	140	45	24		
15	75	46	44	32	32	61	355	197	405	126	45	24		
16	94	47	45	25	31	66	360	190	572	116	42	23		
17	85	49	45	17	30	74	355	183	745	108	41	24		
18	75	46	46	15	29	82	405	180	700	106	40	25		
19	70	45	46	13	28	94	405	170	555	102	40	26		
20	68	45	46	11	27	105	373	163	485	96	39	26		
21	65	46	45	13	26	107	342	160	460	89	38	24		
22	65	48	44	20	25	112	337	151	425	85	37	27		
23	65	50	42	27	24	184	332	143	396	82	37	22		
24	82	50	41	30	24	265	324	140	378	76	35	22		
25	68	50	40	33	24	521	302	137	350	73	37	21		
26	60	49	39	33	24	1,010	286	131	346	76	36	20		
27	57	46	39	33	25	970	274	128	420	67	35	20		
28	55	43	39	33	25	915	262	126	480	64	35	21		
29	54	39	39	33		840	254	128	364	61	34	21		
30	55	37	39	32	- - - - -	775	258	116	306	60	32	21		
31	55	- - - - -	39	27	- - - - -	735	- - - - -	111	- - - - -	58	31	- - - - -		
Total	1,895	1,371	1,319	941	810	7,380	12,366	5,819	10,416	4,428	1,379	718		
Mean	61.1	45.7	42.5	30.4	28.9	238	412	188	347	143	44.5	23.9		
Max	94	61	46	39	33	1,010	725	274	745	298	64	29		
Min	48	21	35	11	24	25	254	111	93	58	31	20		
Cfsm	0.068	0.050	0.047	0.034	0.032	0.263	0.455	0.208	0.383	0.158	0.049	0.026		
In.	0.08	0.06	0.05	0.04	0.03	0.30	0.51	0.24	0.43	0.18	0.06	0.03		
Ac-ft	3,760	2,720	2,620	1,870	1,610	14,640	24,530	11,540	20,660	8,780	2,740	1,420		
Cal yr1966: Total	60,151		Mean	165	Max	1,550	Min	21	Cfsm	0.182	In.	2.47	Ac-ft	119,300
Wtr yr1967: Total	48,842		Mean	134	Max	1,010	Min	11	Cfsm	0.148	In.	2.01	Ac-ft	96,880

Peak discharge (base, 200 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-26	1700	7.24	1,080	6-17	1900	6.65	775
6-9	1200	6.01	455	6-28	0400	6.14	520

5-3000. Lac qui Parle River near Lac qui Parle, Minn.

Location.--Lat 45°00', long 95°55', in SW $\frac{1}{4}$ SW $\frac{1}{4}$ 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 1967 (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.--36 years (1912-13, 1931-32, 1933-67), 116 cfs (83,980 acre-ft per year).

Extremes.--Maximum discharge during year, 1,360 cfs Mar. 27 (gage height, 6.08 ft, from graph based on gage readings, backwater from ice); no flow for part of each day Sept. 10, 11.
1910-14, 1931-67: Maximum discharge, 11,100 cfs Apr. 6, 1952 (gage height, 18.18 ft); maximum gage height, 19.37 ft Apr. 9, 1965, from floodmark, backwater from ice; no flow at times in several years.

Remarks.--Records fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.1	2.5	4.6	2.0	2.3	3.6	502	64	18	183	8.9	1.4
2	.1	2.5	4.1	2.1	2.3	3.6	427	58	17	157	6.9	1.2
3	.5	2.8	4.0	2.0	2.6	4.0	289	63	14	138	12	1.2
4	1.2	2.9	4.0	2.0	2.6	4.0	239	78	13	124	8.4	1.1
5	.9	3.0	4.1	2.0	2.6	4.0	208	78	11	112	6.9	.9
6	.8	4.0	4.2	2.0	2.5	4.0	183	71	34	99	6.1	.8
7	1.0	4.0	3.9	2.0	2.5	4.0	159	67	49	94	5.3	.5
8	.9	3.8	3.6	2.0	2.5	5.0	146	60	34	93	4.2	.3
9	.3	3.8	3.4	2.0	2.6	5.0	137	57	28	81	3.6	.1
10	.1	4.2	3.3	2.0	2.6	5.0	129	52	26	78	3.1	.1
11	.2	4.5	3.6	2.1	2.6	5.4	126	51	30	77	2.8	.1
12	.2	4.5	3.9	2.1	2.6	5.4	119	50	36	74	2.6	.1
13	.5	4.5	4.5	2.1	2.9	5.4	112	48	37	71	2.4	.1
14	1.6	4.9	4.9	2.1	2.9	5.4	109	49	133	67	2.3	.1
15	1.6	4.9	4.9	2.0	2.8	6.0	102	49	427	60	2.2	.1
16	1.9	4.9	4.9	2.0	2.8	6.6	99	48	598	54	2.2	.1
17	2.7	4.9	4.9	2.0	2.8	6.6	106	48	934	50	2.1	.1
18	2.6	4.5	4.9	2.0	2.8	7.0	104	45	926	46	1.9	.5
19	2.6	4.0	4.5	2.0	2.8	7.2	112	41	964	41	1.8	1.5
20	2.3	4.2	4.2	2.1	2.8	8.0	133	40	850	35	1.6	2.9
21	2.3	5.3	4.2	2.2	2.9	9.0	133	39	684	31	1.5	2.7
22	2.3	5.3	4.1	2.2	2.9	11	126	39	588	28	1.4	2.4
23	2.3	6.1	3.8	2.1	2.9	70	117	38	489	26	1.4	2.0
24	2.3	6.9	3.6	2.1	2.9	610	109	36	430	22	5.8	1.6
25	2.3	8.4	3.4	2.1	3.2	690	98	36	378	18	3.8	1.2
26	2.3	8.4	2.6	2.1	3.2	1110	90	36	336	15	3.3	.9
27	2.3	9.5	2.3	2.2	3.4	1240	84	34	300	14	2.6	.5
28	2.3	8.2	2.0	2.3	3.5	884	77	32	273	13	2.1	.4
29	2.3	7.0	1.9	2.3		700	74	29	241	10	2.1	.4
30	2.3	5.1	1.9	2.3		719	75	26	208	9.5	1.9	.4
31	2.3		2.0	2.3		553		22		8.9	1.6	
Total	47.4	149.5	116.2	64.8	77.8	6701.2	4524	1484	9,106	1,929.4	114.8	25.7
Mean	1.53	4.98	3.75	2.09	2.78	216	151	47.9	304	62.2	3.70	0.857
Max	2.7	9.5	4.9	2.3	3.5	1,240	502	78	964	183	12	2.9
Min	0.1	2.5	1.9	2.0	2.3	3.6	74	22	11	8.9	1.4	0.1
Cfsm	0.0016	0.0051	0.0038	0.0021	0.0028	0.220	0.154	0.049	0.309	0.063	0.0038	0.00087
In.	0.002	0.006	0.004	0.002	0.003	0.25	0.17	0.06	0.34	0.07	0.004	0.001
Ac-ft	94	297	230	129	154	13,290	8,970	2,940	18,060	3,830	228	51

Cal yr 1966: Total	49,158.2	Mean	135	Max	7,200	Min	0	Cfsm	0.137	In.	1.86	Ac-ft	97,500
Wtr yr 1967: Total	24,340.8	Mean	66.7	Max	1,240	Min	0.1	Cfsm	0.068	In.	0.92	Ac-ft	48,280

Note.--Backwater from beaver dam Oct. 1 to Nov. 6. No gage-height record Jan. 3 to Feb. 27.

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 1967.

Gage.--Digital water-stage recorder. Datum of gage is 900.00 ft above mean sea level, datum of 1929 (levels by Corps of Engineers). Oct. 1, 1942 to Nov. 10, 1944, graphic water-stage recorder at same site at datum 0.20 ft lower. Nov. 11, 1944 to Aug. 4, 1967, graphic water-stage recorder at same site and datum.

Average discharge.--25 years, 637 cfs (461,200 acre-ft per year).

Extremes.--Maximum discharge during year, 3,060 cfs Apr. 2 (gage height, 31.02 ft); minimum daily, 3.9 cfs Sept. 23-30.

1942-67: 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 no gage-height record and those for winter months, 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.

Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	52	27	44	108	56	130	2,950	1,210	132	1,620	132	38
2	52	28	45	108	56	123	3,020	1,250	80	1,600	134	4.9
3	56	28	46	108	58	118	3,070	1,190	80	1,480	138	4.9
4	80	28	50	108	56	116	3,040	1,090	78	1,180	139	4.9
5	147	28	70	108	56	115	3,000	1,010	75	907	139	4.9
6		28	82	108	56	115	2,960	997	76	701	139	4.9
7	171	27	82	108	56	115	2,880	1,000	75	696	139	4.9
8	199	27	92	108	56	118	2,780	1,000	75	696	139	4.9
9	271	28	92	108	56	118	2,780	1,000	75	696	139	4.9
10	269	27	108	109	58	130	2,760	749	75	688	138	4.9
	366	26	112	110	56	150	2,560	481	75	685	139	4.9
11		26	112	109	58	160	2,030	484	75	679	138	4.9
12	461	26	110	108	58	164	1,550	488	124	671	138	4.9
13	457	26	110	108	58	168	1,660	486	273	531	138	4.9
14	454	26	110	108	58	170	1,740	486	679	279	138	4.8
15	476	26	110	108	58	172	1,740	486	1,340	202	138	4.6
	527	26	110	108	58	172	1,740	486				
16		26	110	110	58	174	1,690	486	1,640	141	125	4.4
17	512	26	110	109	58	178	1,800	486	1,640	141	119	4.2
18	415	26	110	108	58	180	1,700	486	1,650	140	119	4.4
19	293	26	110	107	58	186	1,430	494	1,680	140	119	4.6
20	247	26	110	106	58	201	1,230	491	1,700	140	118	4.4
	128	26	110									
21		27	110	105	62	317	1,280	486	1,710	140	119	4.2
22	55	27	110	105	64	447	1,300	486	1,710	140	99	4.0
23	50	31	110	98	66	612	1,290	481	1,720	140	75	3.9
24	49	43	109	89	66	798	1,280	478	1,720	140	75	3.9
25	48	45	108	85	67	1,040	1,270	476	1,720	141	75	3.9
26	48	45	108	82	80	1,390	1,260	478	1,710	141	75	3.9
27	36	45	108	68	110	1,770	1,250	468	1,700	148	75	3.9
28	30	45	108	56	128	2,330	1,210	468	1,680	134	75	3.9
29	28	45	108	56		2,500	1,210	337	1,660	134	74	3.9
30	28	43	108	56	-----	2,690	1,220	211	1,640	134	74	3.9
31	28	-----	108	56	-----	2,860	-----	211	-----	134	75	-----
Total	6,083	931	3,028	3,020	1,787	19,737	53,160	19,430	23,592	14,843	3,557	167.6
Mean	196	31.0	97.7	97.4	63.8	637	1,939	627	953	479	115	5.59
Max	527	45	112	110	128	2,860	3,070	1,250	1,720	1,620	139	38
Min	28	26	44	56	56	115	1,210	211	75	134	74	3.9
Ac-ft	12,070	1,850	6,010	5,990	3,540	39,150	115,400	38,540	56,710	29,440	7,060	332

Cal yr1966: Total 228,919 Mean 627 Max 5,740 Min 26 Ac-ft 454,100
Wtr yr1967: Total 159,335.6 Mean 437 Max 3,070 Min 3.9 Ac-ft 316,000

Note.-- No gage-height record Sept. 1-30.

MINNESOTA RIVER BASIN

5-3045. Chippewa River near Milan, Minn.

Location.--Lat 45°06'39", long 95°47'57", in SE $\frac{1}{4}$ SE $\frac{1}{4}$ 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 5 $\frac{1}{2}$ miles east of Milan.

Drainage area.--1,870 sq mi, approximately.

Records available.--March 1937 to September 1967.

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.--30 years, 248 cfs (179,500 acre-ft per year).

Extremes.--Maximum discharge during year, 3,290 cfs Mar. 30 (gage height, 7.58 ft); maximum gage height, 7.77 ft Mar. 27 (backwater from ice); minimum discharge, 31 cfs Sept. 28, 29, 30 (gage height, 1.39 ft); minimum gage height, 1.37 ft Mar. 27.

1937-67: 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 winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report. Flow regulated by several small lakes above gage.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	79	81	70	40	38	34	2,140	706	240	556	112	59
2	76	57	66	40	38	34	1,870	706	225	535	106	57
3	78	58	62	40	38	34	1,710	685	216	494	99	57
4	79	64	58	40	38	35	1,610	668	208	470	97	56
5	79	66	54	40	37	35	1,530	647	208	437	93	53
6	79	66	52	40	37	36	1,410	631	222	410	95	50
7	76	63	50	40	37	36	1,320	610	225	389	101	45
8	73	61	49	40	37	37	1,250	583	277	381	93	41
9	71	62	48	40	37	38	1,200	567	336	370	88	38
10	68	62	48	40	37	39	1,130	551	340	354	83	35
11	68	62	49	40	36	43	1,080	530	332	343	78	34
12	68	63	49	39	35	52	1,040	510	329	322	74	35
13	70	66	49	39	35	54	1,000	494	336	302	73	35
14	90	70	49	39	34	55	984	479	393	283	68	36
15	99	74	49	39	34	56	962	456	631	274	66	37
16	99	78	49	39	34	57	940	446	984	258	66	37
17	121	81	48	39	34	60	924	428	1,170	244	63	37
18	121	81	48	38	34	66	946	415	1,020	234	60	49
19	114	81	48	38	34	72	951	389	990	222	56	76
20	110	81	48	38	34	80	940	381	1,020	213	53	59
21	110	82	48	38	34	90	924	370	934	196	53	46
22	101	84	47	38	34	110	907	358	885	185	50	46
23	99	85	46	38	34	150	880	343	858	176	53	42
24	97	85	45	38	34	250	852	332	814	165	57	38
25	95	86	44	38	34	400	836	329	771	157	52	35
26	95	88	42	38	34	900	809	315	739	146	56	34
27	91	88	41	38	34	1,600	782	305	766	141	59	32
28	91	85	40	38	34	1,900	755	286	706	133	65	31
29	91	80	40	38		2,140	733	277	636	126	65	31
30	86	76	40	38		2,930	728	283	583	121	65	31
31	84		39	38		2,490		252		116	60	
Total	2,758	2,216	1,515	1,206	990	13,913	33,143	14,332	17,394	8,753	2,259	1,292
Mean	89.0	73.9	48.9	38.9	35.4	449	1,105	462	580	282	72.9	43.1
Max	121	88	70	40	38	2,930	2,140	706	1,170	556	112	76
Min	68	57	39	38	34	34	728	252	208	116	50	31
Cfsm	0.048	0.040	0.026	0.021	0.019	0.240	0.591	0.247	0.310	0.151	0.039	0.023
In.	0.05	0.04	0.03	0.02	0.02	0.28	0.66	0.28	0.34	0.17	0.04	0.03
Ac-ft	5,470	4,400	3,000	2,390	1,960	27,600	65,700	28,400	34,500	17,360	4,480	2,560
Cal yr 1966: Total	153,389		Mean 420	Max 4,490	Min 39	Cfsm 0.225	In. 3.05	Ac-ft 304,200				
Wtr yr 1967: Total	99,771		Mean 273	Max 2,930	Min 31	Cfsm 0.146	In. 1.98	Ac-ft 197,900				

Peak discharge (base, 400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-30	0300	7.58	3,290	6-17	0730	4.33	1,200

5-3110. Minnesota River at Montevideo, Minn.

Location.--Lat 44°56'00", long 95°44'00", in NW¼ 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 1967. 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.--46 years (1909-17, 1929-67), 646 cfs (467,700 acre-ft per year).

Extremes.--Maximum discharge during year, 3,990 cfs Apr. 5 (gage height, 11.81 ft); minimum, 51 cfs Sept. 26, 29, 30 (gage height, 1.66 ft).
1909-67: 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 winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report. Flow regulated by Big Stone Lake since Apr. 17, 1937, Lac qui Parle Lake since January 1938 and Marsh Lake since Nov. 1, 1939.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	136	112	120	152	97	171	3,690	1,800	472	2,180	255	122
2	138	105	115	152	97	169	3,730	1,830	340	2,140	251	93
3	136	96	112	152	97	162	3,880	1,780	308	2,000	255	78
4	144	110	112	152	97	160	3,950	1,720	295	1,700	243	75
5	209	125	130	152	97	160	3,980	1,620	284	1,220	239	72
6	289	126	139	152	98	160	3,960	1,590	291	1,120	245	67
7	293	123	149	152	98	162	3,900	1,570	342	1,140	243	67
8	350	111	153	152	98	167	3,850	1,560	352	1,220	242	61
9	368	109	160	152	98	178	3,790	1,480	387	1,250	233	57
10	386	113	163	151	98	200	3,670	1,150	427	1,170	228	56
11	505	118	165	151	98	215	3,370	1,090	427	1,120	224	54
12	522	117	167	151	98	220	2,550	1,070	423	1,060	218	54
13	522	116	169	151	98	230	2,440	1,050	520	974	213	55
14	548	115	170	151	98	240	2,520	1,030	811	689	210	54
15	596	112	172	150	98	255	2,520	1,010	1,720	550	206	54
16	601	112	175	150	98	265	2,450	988	2,520	490	201	55
17	584	112	176	150	98	285	2,490	963	2,670	412	179	57
18	457	110	177	150	98	300	2,440	941	2,600	400	172	59
19	418	110	175	150	98	310	2,270	923	2,530	380	172	68
20	302	111	172	150	98	315	1,940	909	2,490	365	169	84
21	207	112	170	148	99	325	1,930	891	2,500	352	166	77
22	156	115	168	145	100	584	1,960	874	2,490	340	164	68
23	142	119	165	144	104	1,420	1,940	858	2,470	330	133	62
24	139	123	163	139	105	1,870	1,920	845	2,440	320	122	60
25	138	129	160	132	110	1,830	1,900	826	2,410	310	122	57
26	134	132	157	120	130	1,890	1,880	810	2,380	300	128	52
27	132	132	156	113	150	2,180	1,860	794	2,350	290	120	52
28	123	130	156	106	165	2,680	1,820	774	2,330	280	122	52
29	120	128	154	98		3,040	1,800	730	2,290	275	123	51
30	120	123	154	97	- - - - -	3,450	1,800	549	2,230	260	123	51
31	116	- - - - -	154	97	- - - - -	3,720	- - - - -	506	- - - - -	255	125	- - - - -
Total	9,031	3,506	4,828	4,362	2,918	27,313	82,200	34,531	44,099	24,892	5,846	1,924
Mean	291	117	156	141	104	881	2,740	1,114	1,470	803	189	64.1
Max	601	132	177	152	165	3,720	3,980	1,830	2,670	2,180	255	122
Min	116	96	112	97	97	160	1,800	506	284	255	120	51
Ac-ft	17,910	6,950	9,580	8,650	5,790	54,170	163,000	68,490	87,470	49,370	11,600	3,820
Cal yr:1966: Total	387,631		Mean 1,062	Max 8,070	Min 96	Ac-ft 768,900						
Wtr yr:1967: Total	245,450		Mean 672	Max 3,980	Min 51	Ac-ft 486,800						

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.--April 1960 to September 1967. Monthly and daily discharge for the period Apr. 1, 1960 to June 30, 1960, published in WSP 1914.

Gage.--Wire-weight gage read once daily. Datum of gage is 1,150.00 ft above mean level, datum of 1929. Prior to Mar. 21, 1963, staff gage at same site and datum.

Average discharge.--7 years, 21.8 cfs (15,780 acre-ft per year).

Extremes.--Maximum discharge during year, 648 cfs June 16 (gage height, 8.76 ft); no flow for many days. 1960-67: Maximum discharge, 1,830 cfs Apr. 6, 1960 (gage height, 11.10 ft); no flow at times.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.4	2.2	2.0	0.8	1.3	0.8	15	5.0	2.5	20	1.1	0
2	1.1	2.3	1.3	.8	1.2	.9	19	13	3.8	17	1.0	0
3	.8	2.7	1.1	.8	1.1	.9	26	9.0	2.7	14	.7	0
4	2.0	3.4	1.1	.8	1.0	.9	19	7.0	3.2	12	.7	0.1
5	1.8	3.6	1.0	.8	1.0	1.0	15	6.1	3.1	11	.3	0
6	3.8	4.1	.9	.8	1.0	1.1	13	5.7	5.0	10	.4	0
7	1.5	3.1	.9	.8	.9	1.3	12	5.1	4.5	8.4	.4	0
8	1.1	3.4	.9	.9	.9	1.5	10	4.6	13	9.7	.5	0
9	1.0	3.1	.8	.9	.9	3.3	14	4.5	11	9.3	.4	0
10	1.3	3.4	.8	.9	.9	5.2	8.8	4.1	8.8	21	.3	0
11	1.1	3.2	.8	1.0	.8	6.0	8.8	5.6	7.0	45	0	0
12	.8	3.2	.8	1.1	.8	6.6	8.4	5.9	8.6	32	0	0
13	.6	3.0	.8	1.2	.8	6.8	8.4	5.0	10	20	0	0
14	2.3	2.8	.8	1.2	.8	6.8	10	4.5	27	14	0	0
15	1.4	2.8	.8	1.3	.8	6.7	10	4.2	159	11	0	0
16	10	2.6	.8	1.4	.8	6.6	10	4.8	578	9.0	0	0
17	5.4	2.6	.8	1.6	.8	6.4	20	4.2	436	7.1	0	0
18	3.2	2.5	.8	1.8	.8	6.3	12	4.2	223	5.6	0	0
19	2.8	2.6	.8	2.1	.8	6.2	11	4.1	146	4.4	0	0
20	2.2	2.6	.8	2.4	.8	6.4	11	2.9	135	4.8	0	0
21	2.0	2.6	.8	2.8	.8	7.9	10	3.6	80	3.9	0	0
22	1.6	2.6	.8	3.0	.8	23	9.0	4.2	68	2.9	0	0
23	1.3	2.6	.8	3.2	.8	56	7.9	3.8	70	2.7	.1	0
24	1.1	2.6	.8	3.2	.8	57	6.2	3.6	64	2.0	.2	0
25	1.1	2.6	.8	3.2	.8	54	5.9	4.1	58	1.4	0	0
26	1.3	2.6	.8	3.0	.8	52	5.7	3.5	48	1.2	.8	0
27	1.5	2.5	.8	2.7	.8	55	5.0	3.6	42	1.2	.1	0
28	1.4	2.5	.8	2.3	.8	51	5.9	3.4	36	1.2	0	0
29	1.6	2.4	.8	2.0	.8	40	5.6	6.4	30	1.4	0	0
30	1.5	2.3	.8	1.6	-----	28	5.4	4.1	24	1.3	0	0
31	2.0	-----	.8	1.4	-----	23	-----	3.2	-----	1.1	0	-----
Total	74.6	84.5	27.6	51.8	24.6	528.6	328.0	153.0	2307.2	305.6	7.0	0.1
Mean	2.41	2.82	0.89	1.67	0.88	17.1	10.9	4.94	76.9	9.86	0.23	0
Max	14	4.1	2.0	3.2	1.3	57	26	13	578	45	1.1	0.1
Min	0.6	2.2	0.8	0.8	0.8	0.8	5.0	2.9	2.5	1.1	0	0
Ac-ft	148	168	55	103	49	1,050	651	303	4,580	606	14	0.2

Cal yr 1966: Total 7,275.68 Mean 19.9 Max 740 Min 0 Ac-ft 14,430
Wtr yr 1967: Total 3,892.6 Mean 10.7 Max 578 Min 0 Ac-ft 7,720

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 1967. 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.--31 years (1935-38, 1939-67), 101 cfs (73,120 acre-ft per year).

Extremes.--Maximum discharge during year, 1,570 cfs June 19 (gage height, 5.72 ft); minimum, 2.3 cfs Sept. 30; minimum gage height, 2.14 ft Sept. 4, 5, 6, 7, 9, 10.
1931-38, 1939-67: 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 winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.3	7.7	6.5	4.8	4.1	3.5	274	57	18	233	17	4.6
2	4.0	7.7	6.4	4.8	4.1	3.6	226	57	16	205	16	4.3
3	4.3	7.2	6.1	4.8	4.0	3.8	202	74	15	181	16	4.3
4	4.3	6.7	5.8	4.8	4.0	4.0	195	80	16	162	14	4.3
5	4.6	6.7	5.6	4.8	4.0	4.2	188	67	16	142	13	4.0
6	4.3	7.2	5.4	4.8	3.9	4.5	165	62	13	123	13	4.0
7	4.3	7.4	5.3	4.8	3.9	5.0	145	57	13	109	13	4.0
8	4.0	7.8	5.2	4.8	3.8	6.0	130	52	13	111	11	4.3
9	4.6	7.8	5.2	4.9	3.8	20	117	49	14	117	9.6	4.0
10	6.2	8.0	5.1	4.8	3.7	68	109	46	17	123	9.0	4.3
11	5.8	8.0	5.1	4.8	3.6	75	103	48	22	111	8.3	4.3
12	5.4	8.0	5.1	4.7	3.6	130	95	46	32	109	7.7	4.3
13	5.4	8.0	5.1	4.6	3.5	150	90	45	127	133	6.7	4.3
14	6.2	7.5	5.1	4.5	3.5	164	85	45	212	120	6.2	4.0
15	12	7.5	5.1	4.5	3.5	160	83	43	404	98	6.2	3.7
16	10	7.5	5.1	4.5	3.4	155	80	41	832	85	6.2	3.5
17	7.7	7.5	5.0	4.5	3.4	148	85	38	1,120	74	5.8	3.3
18	6.7	7.5	5.0	4.5	3.4	130	80	36	1,340	59	5.4	3.3
19	7.2	7.5	5.1	4.5	3.4	110	78	34	1,540	57	5.4	3.5
20	6.7	7.4	5.1	4.5	3.4	100	80	32	1,470	52	4.6	3.3
21	5.8	7.3	5.1	4.3	3.4	94	83	30	1,230	46	4.6	3.1
22	6.2	7.2	5.1	4.3	3.4	100	76	29	967	42	20	2.9
23	9.6	7.2	5.1	4.2	3.4	123	67	28	766	36	19	2.8
24	7.7	7.4	5.1	4.2	3.4	143	63	27	652	34	10	2.6
25	6.7	7.5	5.1	4.2	3.4	180	59	27	605	32	9.0	2.6
26	7.2	7.5	5.1	4.2	3.4	300	57	25	540	29	12	2.6
27	7.7	7.2	5.1	4.2	3.4	325	54	25	461	27	7.7	2.6
28	7.2	7.0	5.1	4.2	3.5	285	52	24	387	21	7.2	2.5
29	7.2	6.9	5.0	4.2	3.5	325	49	24	330	19	6.2	2.4
30	6.7	6.6	4.9	4.1	---	350	51	22	297	18	5.8	2.3
31	7.2	---	4.8	4.1	---	339	---	20	---	18	5.0	---
Total	197.2	222.4	162.9	139.9	101.3	4,008.6	3,221	1,290	13,485	2,726	300.6	106.0
Mean	6.36	7.41	5.25	4.51	3.62	129	107	41.6	450	87.9	9.70	3.53
Max	12	8.0	6.5	4.9	4.1	350	274	80	1,540	233	20	4.6
Min	4.0	6.6	4.8	4.1	3.4	3.5	49	20	13	18	4.6	2.3
Cfsm	0.0097	0.011	0.0080	0.0069	0.0055	0.198	0.164	0.064	0.689	0.135	0.015	0.0054
In.	0.01	0.01	0.009	0.008	0.006	0.23	0.18	0.07	0.77	0.16	0.02	0.006
Ac-ft	391	441	323	277	201	7,950	6,390	2,560	26,750	5,410	596	210

Cal yr 1966: Total 23,778.9 Mean 65.1 Max 1,340 Min 2.8 Cfsm 0.100 In. 1.35 Ac-ft 47,160
Wtr yr 1967: Total 25,960.9 Mean 71.1 Max 1,540 Min 2.3 Cfsm 0.109 In. 1.48 Ac-ft 51,490

Peak discharge (base, 300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-30	2230	3.61	374	6-19	2400	5.72	1,570

5-3150. Redwood River at Marshall, Minn.

Location.--Lat 44°27'05", long 95°47'13", in SE 1/4 NW 1/4 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 1967. Monthly discharge only for some periods, published in WSP 1308.

Gage.--Wire-weight gage read twice daily. Datum of gage is 1,144.88 ft above mean sea level, datum of 1929. Prior to July 12, 1966, chain gage at same site and datum. Staff gage on diversion channel. Datum of gage is 1,100.00 ft above mean sea level, datum of 1929 (levels by Corps of Engineers).

Average discharge.--27 years, 47.0 cfs (34,030 acre-ft per year).

Extremes.--Maximum discharge during year, 373 cfs June 16. River channel: Maximum discharge during year, 373 cfs June 16 (gage height, 3.00 ft); maximum gage height, 3.49 ft Mar. 25 (backwater from ice); minimum discharge, 0.3 cfs Sept. 6, 7. Diversion channel: maximum discharge during year, 46 cfs Mar. 14 (gage height, 73.03 ft, from graph based on gage readings, backwater from ice); no flow on many days.
1940-67: 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 fair. 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. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.		
1	1.3	8.8	2.6	3.1	4.4	6.0	66	37	08	50	64	1.9		
2	2.8	8.8	2.6	3.1	4.4	15	61	42	.8	42	64	1.3		
3	3.1	8.6	2.6	3.1	4.4	27	65	32	1.6	33	5.8	.6		
4	4.8	8.1	2.6	3.1	4.5	24	55	24	2.5	25	5.8	.6		
5	3.4	7.4	2.5	3.1	4.6	23	46	22	3.7	22	5.2	.6		
6	2.8	7.0	2.5	3.1	4.6	23	50	20	5.2	19	5.8	.3		
7	2.6	6.8	2.6	3.2	4.6	22	46	19	12	22	4.8	.4		
8	2.6	6.0	2.6	3.3	4.7	25	37	16	99	25	4.3	.6		
9	2.6	5.2	2.6	3.4	4.8	34	30	14	216	14	3.9	.8		
10	2.8	4.5	2.6	3.4	4.9	35	25	13	276	20	3.9	1.1		
11	3.1	4.5	2.6	3.4	5.0	35	20	15	239	19	3.2	1.3		
12	3.7	4.4	2.6	3.5	5.0	34	18	14	184	84	3.5	1.9		
13	4.4	4.3	2.6	3.6	5.0	38	20	13	149	151	3.2	.8		
14	5.2	4.2	2.6	3.6	5.0	64	24	12	143	117	3.2	1.3		
15	7.4	4.0	2.6	3.6	5.0	54	24	12	258	81	2.8	1.3		
16	9.3	3.8	2.6	3.7	5.0	34	19	9.8	334	52	2.5	1.3		
17	10	3.7	2.6	3.7	5.0	34	20	9.8	288	39	1.9	1.3		
18	8.3	3.6	2.6	3.7	5.0	34	20	10	258	29	2.5	1.9		
19	7.0	3.5	2.6	3.7	5.0	34	20	9.1	255	25	1.9	2.5		
20	6.1	3.4	2.7	3.8	5.0	35	19	8.4	216	22	1.3	2.5		
21	8.0	3.3	2.7	3.8	5.0	36	16	4.8	186	84	.8	1.9		
22	11	3.2	2.7	3.8	5.0	36	18	2.8	149	10	.8	1.1		
23	8.3	3.2	2.7	3.8	5.0	42	16	2.8	151	12	1.3	.8		
24	7.4	3.1	2.7	3.8	5.1	60	14	2.2	171	14	.8	.4		
25	8.8	3.0	2.7	3.9	5.2	78	12	1.6	167	12	1.3	.8		
26	12	3.0	2.7	4.0	5.2	98	15	1.6	159	12	2.2	.8		
27	12	2.9	2.7	4.1	5.4	87	15	1.1	141	11	2.5	.4		
28	12	2.8	2.7	4.2	5.4	76	14	1.3	110	9.8	2.5	.8		
29	12	2.7	2.8	4.2		68	13	1.6	89	7.0	2.2	1.1		
30	13	2.7	2.9	4.2		61	53	1.3	68	7.7	1.6	.8		
31	10	- - - -	3.0	4.3	- - - -	37	- - - -	1.3	- - - -	7.7	1.9	- - - -		
Total	207.8	140.5	82.2	112.3	137.2	1309.0	871	374.5	4332.6	1002.6	96.2	33.2		
Mean	6.70	4.68	2.65	3.62	4.90	42.2	29.0	12.1	144	32.3	3.10	1.11		
Max	13	8.8	3.0	4.3	5.4	98	66	42	334	151	6.4	2.5		
Min	1.3	2.7	2.5	3.1	4.4	6.0	12	1.1	0.8	7.0	0.8	0.3		
Cfsm	0.022	0.015	0.0086	0.012	0.016	0.137	0.094	0.039	0.469	0.105	0.010	0.0036		
In.	0.03	0.02	0.01	0.01	0.02	0.16	0.11	0.05	0.52	0.12	0.01	0.004		
Ac-ft	412	279	163	223	272	2,600	1,730	743	8,590	1,990	191	66		
Cal yr1966: Total	9,288.26		Mean	25.4	Max	405	Min	0.36	Cfsm	0.083	In.	1.13	Ac-ft	18,420
Wtr yr1967: Total	8,699.1		Mean	23.8	Max	334	Min	0.3	Cfsm	0.078	In.	1.05	Ac-ft	17,250

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 1967.

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.--33 years (1911-12, 1935-67), 98.6 cfs (71,380 acre-feet per year).

Extremes.--Maximum discharge during year, 1,240 cfs June 15 (gage height, 4.41 ft); minimum daily 2.7 cfs Feb. 12-22; minimum gage height, 1.38 ft Feb. 25, 26.
1909-14, 1930-67: 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 winter months, which are fair. Records of chemical analyses for the water year 1967 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.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
1	8.4	13	9.8	5.4	2.8	4.1	205	192	39	178	24	14	
2	8.8	14	9.0	5.3	2.8	8.0	245	201	38	150	26	12	
3	8.8	13	8.2	5.1	2.8	20	265	164	33	126	21	11	
4	8.4	20	7.7	5.0	2.8	35	221	141	33	112	19	10	
5	7.6	25	7.3	4.8	2.8	40	197	118	32	100	16	9.2	
6	7.6	24	6.8	4.7	2.8	38	193	104	31	91	20	8.7	
7	14	20	6.7	4.5	2.8	36	164	95	59	87	16	8.2	
8	13	19	6.6	4.3	2.9	38	141	86	82	89	14	8.2	
9	13	17	6.4	4.2	2.9	45	129	77	75	91	13	7.2	
10	13	14	6.2	4.1	2.8	150	118	70	124	93	12	6.3	
11	12	15	6.2	3.9	2.8	340	110	72	233	104	11	6.3	
12	9.8	16	6.4	3.8	2.7	300	104	74	245	102	11	7.2	
13	9.8	17	6.4	3.7	2.7	280	91	72	245	118	11	8.2	
14	12	16	6.5	3.6	2.7	270	91	70	305	178	9.7	8.2	
15	24	15	6.6	3.5	2.7	300	91	68	681	168	9.2	8.2	
16	27	16	6.7	3.4	2.7	270	87	67	1,090	135	8.7	7.7	
17	33	16	6.7	3.3	2.7	230	89	65	878	108	8.2	6.8	
18	32	14	6.7	3.2	2.7	200	87	65	760	91	7.2	7.7	
19	32	15	6.6	3.2	2.7	170	84	65	741	80	7.2	8.7	
20	27	17	6.6	3.2	2.7	150	82	62	715	72	6.8	9.7	
21	19	15	6.4	3.2	2.7	130	80	62	638	63	6.3	8.2	
22	16	17	6.2	3.2	2.7	150	79	62	510	57	4.5	7.7	
23	13	19	6.1	3.2	2.8	170	72	63	435	44	21	6.8	
24	13	21	6.0	3.1	2.8	215	68	68	394	39	16	6.3	
25	12	20	5.8	3.0	2.9	280	67	67	381	39	18	6.8	
26	12	19	5.6	2.9	2.9	400	63	65	354	36	110	6.3	
27	13	17	5.5	2.9	3.1	340	57	57	329	31	60	5.9	
28	12	15	5.4	2.8	3.5	280	59	54	301	28	41	5.9	
29	12	13	5.4	2.8	-----	253	55	51	257	26	24	5.5	
30	13	11	5.4	2.8	-----	273	65	49	217	24	18	5.9	
31	13	-----	5.4	2.8	-----	281	-----	42	-----	22	16	-----	
Total	469.2	503.0	203.3	114.9	78.7	5,696.1	3,459	2,568	10,255	2,682	646.3	238.8	
Mean	15.1	16.8	6.56	3.71	2.81	184	115	82.8	342	86.5	20.8	7.96	
Max	33	25	9.8	5.4	3.5	400	265	201	1,090	178	110	14	
Min	7.6	11	5.4	2.8	2.7	4.1	55	42	31	22	6.3	5.5	
Cfsm	0.022	0.024	0.0094	0.0053	0.0040	0.264	0.165	0.119	0.491	0.124	0.030	0.011	
In.	0.03	0.03	0.01	0.006	0.004	0.030	0.18	0.14	0.55	0.14	0.03	0.01	
Ac-ft	931	998	403	228	156	11,300	6,860	5,090	20,340	5,320	1,280	474	
Cal yrl 1966: Total	19,090.5	Mean	52.3	Max	1,120	Min	2.0	Cfsm	0.075	In.	1.02	Ac-ft	37,870
Wtr yrl 1967: Total	26,914.3	Mean	73.7	Max	1,090	Min	2.7	Cfsm	0.106	In.	1.44	Ac-ft	53,380

Peak discharge (base, 150 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-10	2330	3.52	420	5-1	1800	2.69	261
3-26	1900	3.33	420	6-15	1700	4.41	1,240
4-3	0800	2.74	281	7-14	1800	2.52	193

MINNESOTA RIVER BASIN

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 1967 (winter records incomplete prior to 1938).

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.--33 years (1911-13, 1935-37, 1938-67), 255 cfs (184,600 acre-ft per year).

Extremes.--Maximum discharge during year, 2,890 cfs Apr. 4 (gage height, 8.97 ft); maximum gage height, 10.39 ft Mar. 11 (backwater from ice); minimum discharge, 2.8 cfs Aug. 19, (gage height, 2.21 ft). 1909-13, 1931-67: Maximum discharge, 26,000 cfs Apr. 8, 1965 (gage height, 20.86 ft, from floodmark, backwater from ice); minimum observed, 0.5 cfs Nov. 27, 1952; minimum gage height, 0.72 ft Nov. 20, 1964.

Remarks.--Records good except those for winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report. Some regulation by dam at Cottonwood Lake and several other small lakes above station.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	34	48	35	23	23	24	764	318	104	370	50	58
2	30	46	31	23	22	26	1,450	365	100	312	49	48
3	28	43	29	23	23	27	2,590	332	99	269	62	45
4	31	44	28	23	23	28	2,510	305	112	235	58	37
5	25	48	28	23	22	50	1,670	302	117	209	49	34
6	24	48	28	23	22	100	1,160	285	119	185	49	33
7	24	48	28	23	22	540	926	265	148	164	43	27
8	21	44	27	23	23	540	743	245	141	185	42	26
9	21	43	27	23	23	540	615	225	162	211	39	22
10	20	43	26	23	23	700	528	205	169	229	39	20
11	22	38	26	24	23	760	451	207	177	245	35	15
12	24	35	26	25	22	740	395	201	203	219	34	16
13	22	36	26	25	22	780	365	193	237	207	29	22
14	30	38	26	24	22	790	355	183	251	185	26	23
15	93	40	26	23	22	740	358	175	320	163	24	19
16	86	42	27	23	22	630	352	166	651	162	21	20
17	95	42	27	23	22	475	340	162	800	139	22	28
18	98	40	28	22	22	450	318	158	707	128	16	21
19	89	38	28	21	22	430	292	152	588	119	3.0	28
20	83	40	27	23	22	420	280	145	525	111	3.5	33
21	80	44	27	24	22	410	265	137	539	106	15	32
22	73	48	26	25	22	460	245	131	553	101	48	31
23	68	48	25	25	22	540	229	124	497	94	11	37
24	62	50	24	24	22	700	213	123	481	83	9.5	22
25	61	50	23	23	22	1,600	201	123	514	78	7.6	19
26	57	50	23	22	23	1,500	185	119	546	69	13	25
27	54	49	23	22	23	1,150	174	116	643	64	11	23
28	51	48	23	22	24	837	170	114	619	59	80	17
29	51	46	23	22		800	166	111	560	57	60	18
30	49	38	23	23	-----	863	222	110	442	58	71	17
31	48	-----	23	24	-----	912	-----	106	-----	55	67	-----
Total	1,554	1,315	817	719	627	18,562	18,532	5,903	11,124	4,871	1,086.6	816
Mean	50.1	43.8	26.4	23.2	22.4	599	618	190	371	157	35.1	27.2
Max	98	50	35	25	24	1,600	2,590	365	800	370	80	58
Min	20	35	23	21	22	24	166	106	99	55	3.0	15
Cfsm	0.039	0.034	0.021	0.018	0.018	0.468	0.483	0.148	0.290	0.123	0.027	0.021
In.	0.05	0.04	0.02	0.02	0.02	0.54	0.54	0.17	0.32	0.14	0.03	0.02
Ac-ft	3,080	2,610	1,620	1,430	1,240	36,820	36,760	11,710	22,060	9,660	2,160	1,620
Cal yr 1966 Total	73,714			202		2,140	16	Cfsm 0.158	In. 2.14	Ac-ft 146,200		
Wtr yr 1967 Total	65,926.6			181		2,590	3.0	Cfsm 0.141	In. 1.92	Ac-ft 130,800		

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 1967. 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.--16 years, 36.2 cfs (26,210 acre-ft per year).

Extremes.--Maximum discharge during year, 725 cfs June 16 (gage height, 10.04 ft); no flow on many days. 1951-67: Maximum discharge, 1,320 cfs Apr. 7, 1951 (gage height, 10.68 ft, from graph based on gage readings); maximum gage height, 11.70 ft Apr. 7, 1965; no flow on many days.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						0	128	34	11	199	25	0.2
2						0	149	36	9.5	179	23	.2
3						0	165	45	8.8	154	15	.2
4						0	184	47	8.1	137	12	.1
5						0	187	46	7.5	114	9.5	.1
6						0.5	184	44	9.1	96	8.1	.1
7						2.0	175	39	26	86	8.1	.1
8						5	162	36	68	76	6.9	.1
9						20	148	35	197	66	5.7	.1
10						70	136	34	295	59	4.2	0
11						150	122	36	428	53	2.8	0
12						180	112	38	532	48	2.0	0
13						190	103	40	602	45	1.5	0
14						190	100	41	624	42	.9	0
15						180	98	42	678	37	.4	0
16						160	94	41	722	32	.3	0
17						130	87	39	714	28	.2	0
18						110	86	35	661	26	.3	0
19						90	82	31	591	25	.2	0
20						80	74	32	554	25	.1	0
21						70	66	28	505	23	.1	0
22						82	57	24	462	22	.3	0
23						95	55	20	410	25	.5	0
24						110	53	17	378	36	.8	0
25						130	50	16	346	46	.9	0
26						138	47	13	313	50	2.0	0
27						140	42	12	293	47	1.5	0
28						139	40	13	268	40	1.0	0
29						138	36	13	245	35	.8	0
30					-----	135	36	13	221	31	.6	0
31		-----			-----	135	-----	13	-----	28	.4	-----
Total	0	0	0	0	0	2,869.5	3,058	953	10,187.0	1,910	135.1	1.2
Mean	0	0	0	0	0	92.6	102	30.7	340	61.6	4.36	0.04
Max	0	0	0	0	0	190	187	47	722	199	25	0.2
Min	0	0	0	0	0	0	36	12	7.5	22	0.1	0
Cfsm	0	0	0	0	0	0.702	0.773	0.233	2.58	0.467	0.033	0.00030
In.	0	0	0	0	0	0.81	0.86	0.27	2.87	0.54	0.04	0.0003
Cal yr1966: Total	10,441.1			Mean 28.6	Max 265	Min 0	Cfsm 0.217	In. 2.94				
Wtr yr1967: Total	19,113.8			Mean 52.4	Max 722	Min 0	Cfsm 0.397	In. 5.39				

5-3200. Blue Earth River near Rapidan, Minn.

Location.--Lat 44°05'44", long 94°06'33", in SE $\frac{1}{4}$ SE $\frac{1}{4}$ 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, $3\frac{1}{2}$ miles downstream from Watonwan River, and $7\frac{1}{2}$ 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 1967. Published as "at Rapidan Mills" 1909-10.

Gage.--Digital water-stage recorder. 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 and Nov. 15, 1939 to June 1, 1964 graphic water-stage recorder at present site and datum.

Average discharge.--24 years (1939-45, 1949-67, 794 cfs (574,800 acre-ft per year).

Extremes.--Maximum discharge during year, 6,300 cfs June 17 (gage height, 7.04 ft); minimum, 12 cfs Oct. 21, 22; minimum gage height, 1.11 ft Dec. 31.
1909-10, 1939-45, 1949-67; Maximum discharge, 43,100 cfs Apr. 9, 1965 (gage height, 21.36 ft, from floodmark); minimum 6.9 cfs Oct. 12, 1955 (gage height, 1.04 ft).

Remarks.--Records good. Records of chemical analyses for the water year 1967 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. Capacity reduced to an undetermined figure. Regulation discontinued with closing of Northern States Power Co. plant on Dec. 31, 1966.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	102	147	56	45	45	63	1,950	1,780	350	3,900	235	155
2	80	154	89	47	46	70	2,740	1,740	350	3,380	217	140
3	82	134	74	46	46	81	4,380	1,490	326	3,160	204	126
4	62	144	31	47	47	110	5,070	1,300	321	2,540	232	117
5	99	82	85	46	46	173	5,300	1,120	322	2,580	223	109
6	54	147	68	46	46	293	4,760	1,000	317	2,220	201	87
7	75	200	93	44	46	491	4,030	927	368	1,930	183	96
8	87	111	82	44	46	719	3,460	864	501	1,870	173	90
9	17	188	83	45	46	1,210	3,050	812	872	1,830	167	85
10	92	108	83	44	48	1,490	2,790	760	1,880	1,840	158	81
11	54	112	20	44	47	2,100	2,560	704	2,610	1,740	147	77
12	56	20	84	44	47	2,730	2,280	701	3,000	1,570	136	73
13	72	101	83	44	48	3,120	2,030	704	3,360	1,350	126	77
14	92	134	72	44	49	2,820	1,880	799	3,650	1,150	119	80
15	62	181	76	44	49	2,600	1,790	782	4,400	591	113	74
16	196	177	87	44	49	2,050	1,760	731	5,650	855	105	82
17	316	165	85	44	49	1,900	1,750	682	6,240	820	100	82
18	323	144	29	44	49	1,750	1,650	643	5,960	733	96	77
19	333	34	94	44	49	1,600	1,510	599	5,430	759	94	77
20	299	144	92	44	49	1,530	1,340	564	4,720	726	89	69
21	264	225	84	44	50	1,430	1,250	522	3,960	622	86	69
22	208	181	73	45	50	1,320	1,190	484	3,370	548	103	70
23	217	169	86	46	50	1,520	1,120	452	2,920	456	113	67
24	242	162	18	47	50	1,970	1,030	430	2,550	438	187	64
25	188	165	63	47	52	3,020	936	416	2,250	386	202	61
26	192	82	60	48	54	3,420	869	391	2,020	358	251	62
27	169	112	82	47	57	3,070	824	365	1,950	336	230	61
28	151	115	59	46	60	2,360	785	351	3,190	315	264	60
29	111	55	50	46	-----	2,070	744	336	4,100	292	253	59
30	151	56	53	45	-----	1,940	1,120	328	4,300	260	206	60
31	200	-----	16	45	-----	1,940	-----	325	-----	259	177	-----
TOTAL	4,646	3,949	2,110	1,400	1,370	50,960	65,948	23,102	81,237	40,714	5,190	2,487
MEAN	150	132	68.1	45.2	48.9	1,644	2,198	745	2,708	1,313	167	82.9
MAX	333	225	94	48	60	3,420	5,300	1,780	6,240	3,900	264	155
MIN	17	20	16	44	45	63	744	325	317	259	86	59
CFSM	.06	.05	.03	.02	.02	.68	.90	.31	1.11	.54	.07	.03
IN.	.07	.06	.03	.02	.02	.78	1.01	.35	1.24	.62	.08	.04
AC-FT	9,220	7,830	4,190	2,780	2,720	101,100	130,800	45,820	161,100	80,760	10,290	4,930
CAL YR 1966: TOTAL	233,401			MEAN 639		MAX 4,700	MIN 16	CFSM .26	IN 3.57	AC-FT 462,900		
WAT YR 1967: TOTAL	283,113			MEAN 776		MAX 6,240	MIN 16	CFSM .32	IN 4.33	AC-FT 561,500		

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 1967.

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.--24 years, 380 cfs (275,100 acre-ft per year).

Extremes.--Maximum discharge during year, 8,950 cfs June 17 (gage height, 12.55 ft); minimum 16 cfs Oct. 1; minimum gage height, 1.74 ft Sept. 30.
1939-45, 1949-67: Maximum discharge, 24,700 cfs Apr. 8, 1965 (gage height, 22.10 ft, from floodmark); maximum gage height, 22.72 ft May 22, 1960 (from floodmark); minimum daily discharge, 1.6 cfs Feb. 9-25, 1959; minimum gage height, 1.59 ft Nov. 20, 1965.

Remarks.--Records good except those for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	16	111	34	24	26	33	1,430	768	190	966	161	59
2	20	106	32	24	26	33	3,020	832	182	868	155	53
3	24	98	30	25	26	34	3,450	796	172	791	148	48
4	27	95	28	25	27	34	3,500	750	166	714	140	45
5	28	96	27	25	27	35	3,430	710	166	642	135	42
6	32	99	26	25	27	35	2,820	665	172	571	144	40
7	35	100	26	25	27	37	2,290	620	194	515	146	40
8	37	96	26	25	27	39	1,900	567	224	828	157	44
9	40	93	26	25	27	43	1,700	527	478	1,900	142	48
10	42	89	25	25	27	47	1,520	487	1,260	2,220	135	51
11	45	85	25	24	28	60	1,320	459	2,170	1,890	127	54
12	48	82	25	24	28	800	1,160	428	3,410	1,450	119	56
13	53	77	25	24	28	1,100	1,030	432	4,340	1,160	111	57
14	67	73	25	24	28	1,320	958	436	6,130	962	104	52
15	121	72	26	24	28	1,240	944	428	7,360	818	98	48
16	174	70	26	24	28	1,100	1,000	396	8,340	706	92	46
17	236	68	26	24	28	1,010	1,010	373	8,690	611	88	43
18	331	68	26	24	28	1,000	944	358	7,870	519	82	41
19	301	68	26	24	28	1,000	886	337	6,080	444	78	39
20	251	68	25	24	28	950	822	322	4,490	382	74	38
21	219	65	25	24	29	908	760	301	3,340	334	70	39
22	192	63	25	24	29	850	692	284	2,610	295	74	36
23	174	61	25	25	30	1,210	634	267	2,130	267	88	35
24	161	58	25	25	30	1,890	588	254	1,820	281	113	34
25	148	57	25	25	31	2,540	527	251	1,610	286	101	32
26	139	54	25	26	32	2,860	471	238	1,430	254	98	30
27	133	50	25	26	32	2,910	436	221	1,290	219	92	30
28	127	46	24	26	33	2,310	403	221	1,180	199	84	29
29	122	42	24	26		1,910	376	219	1,080	186	78	29
30	118	37	24	26		1,690	579	212	1,050	178	72	28
31	113		24	26		1,550		203		172	64	
Total	3,574	2,247	806	767	793	30,578	40,600	13,362	79,624	21,628	3,370	1,266
Mean	115	74.9	26.0	24.7	28.3	986	1,353	431	2,654	698	109	42.2
Max	331	111	34	26	33	2,910	3,500	832	8,690	2,220	161	59
Min	16	37	24	24	26	33	376	203	166	172	64	28
Cfsm	0.105	0.068	0.024	0.022	0.026	0.896	1.23	0.392	2.41	0.635	0.099	0.038
In.	0.12	0.08	0.03	0.03	0.03	1.03	1.37	0.45	2.69	0.73	0.11	0.04
Ac-ft	7,090	4,460	1,600	1,520	1,570	60,650	80,530	26,500	157,900	42,900	6,680	2,510

Cal yr 1966: Total 114,991 Mean 315 Max 2,940 Min 11 Cfsm 0.286 In. 3.89 Ac-ft 228,100
Wtr yr 1967: Total 198,615 Mean 544 Max 8,690 Min 16 Cfsm 0.495 In. 6.71 Ac-ft 393,900

Peak discharge (base, 1,300 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-14	1800	6.84	1,370	6-17	1400	12.55	8,950
3-26	2100	8.34	3,200	7-10	0600	6.25	2,270
4- 2	2000	8.48	3,440				

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 1967 (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.--Digital 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. Mar. 18 1925, to Dec. 2, 1964, graphic water-stage recorder at present site and datum.

Average discharge.--46 years (1905, 1910-17, 1929-67), 2,511 cfs (1,818,000 acre-ft per year).

Extremes.--Maximum discharge during year, 18,700 cfs June 18 (gage height, 16.04 ft); minimum, 160 cfs Dec. 1 (gage height, 2.50 ft).

1903-67: Maximum discharge, 94,100 cfs Apr. 10, 1965 (gage height, 29.09 ft); 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 winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report. Some diurnal fluctuation at low and medium stages caused by powerplants on Blue Earth River through Dec. 31, 1966 when power plant was closed down.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	334	789	234	329	340	330	9,430	6,920	1,660	11,200	1,100	914
2	349	738	373	377	330	350	12,400	6,770	1,600	10,400	1,080	781
3	336	681	446	386	320	360	15,600	6,130	1,480	9,720	988	675
4	342	677	424	399	315	400	16,600	5,680	1,440	9,100	987	606
5	329	673	315	410	312	450	17,000	5,260	1,470	8,210	965	559
6	334	646	431	416	312	550	16,300	4,940	1,410	7,260	1,020	514
7	309	653	413	410	310	900	14,900	4,680	1,460	6,380	954	482
8	347	652	436	375	308	1,200	13,500	4,440	1,600	6,290	924	451
9	352	637	425	374	308	1,450	12,700	4,100	1,980	7,160	903	417
10	258	622	417	380	310	1,950	11,900	3,870	3,600	7,510	862	381
11	390	613	411	375	312	3,340	11,000	3,760	5,250	7,250	815	357
12	511	405	336	378	308	5,300	10,200	3,600	6,710	6,770	759	341
13	585	475	412	379	308	5,900	9,560	3,420	7,960	6,080	713	353
14	758	559	412	385	312	6,260	9,070	3,310	9,900	5,280	671	346
15	1,200	615	405	375	312	6,330	8,660	3,170	12,800	4,550	633	339
16	1,490	604	420	382	310	5,730	8,230	2,950	15,800	4,170	600	346
17	1,770	627	452	399	308	5,020	7,860	2,800	18,000	3,810	573	352
18	1,990	605	456	385	308	4,400	7,320	2,710	18,300	3,320	554	349
19	1,980	463	441	385	308	4,290	6,790	2,620	16,900	2,570	531	349
20	1,850	495	511	380	308	4,140	6,300	2,450	15,400	2,710	498	344
21	1,710	627	526	375	310	3,790	6,080	2,350	13,700	2,360	483	322
22	1,570	650	511	370	310	3,500	5,860	2,190	12,600	2,130	547	310
23	1,470	659	484	370	310	4,200	5,490	2,120	11,900	1,570	585	300
24	1,370	660	517	380	310	5,400	5,110	2,060	11,500	1,660	652	296
25	1,230	656	415	390	315	7,450	4,780	2,020	11,100	1,760	686	282
26	1,140	649	428	350	315	9,200	4,550	1,970	10,700	1,610	858	282
27	1,050	632	391	380	320	10,600	4,350	1,890	10,200	1,500	934	282
28	953	556	405	370	320	9,730	4,130	1,840	10,500	1,360	1,090	287
29	877	459	354	360	-----	9,530	4,000	1,790	11,300	1,300	1,240	274
30	835	350	365	350	-----	9,450	4,850	1,720	11,600	1,260	1,160	269
31	809	-----	375	350	-----	9,530	-----	1,680	-----	1,200	1,050	-----
TOTAL	28,828	18,167	12,950	11,764	8,769	141,030	274,520	105,210	259,820	148,520	25,415	12,160
MEAN	930	606	418	379	313	4,549	9,151	3,394	8,661	4,751	820	405
MAX	1,990	789	526	416	340	10,600	17,000	6,920	18,300	11,200	1,240	914
MIN	258	350	234	329	308	330	4,000	1,680	1,410	1,200	483	269
CFSM	.06	.04	.03	.03	.02	.31	.61	.23	.58	.32	.06	.03
IN.	.07	.05	.03	.03	.02	.35	.69	.26	.65	.37	.06	.03
AC-FT	57,180	36,030	25,690	23,330	17,390	279,700	544,500	208,700	515,300	294,600	50,410	24,120

CAL YR 1966: TOTAL 971,580 MEAN 2,662 MAX 15,300 MIN 234 CFSM .18 IN 2.43 AC-FT 1,927,000
 WAT YR 1967: TOTAL 1,047,153 MEAN 2,869 MAX 18,300 MIN 234 CFSM .19 IN 2.61 AC-FT 2,077,000

5-3300. Minnesota River near Jordan, Minn.
(Formerly published as Minnesota River near Carver)

Location.--Lat 44°41'35", long 93°38'30", in NW¼SW¼ sec.7, T.114 N., R.23 W., on left bank 1½ miles northwest of Jordan and at mile 39.4 upstream from Mississippi River.

Drainage area.--16,200 sq mi, approximately.

Records available.--September 1934 to September 1967. Prior to Oct. 1, 1966, published as "near Carver, Minn."

Gage.--Digital water-stage recorder. Datum of gage is 690.00 ft above mean sea level, datum of 1929. Auxiliary water-stage recorder 2 3/4 miles downstream at same datum. Prior to Oct. 1, 1966, graphic water-stage recorder 2 3/4 miles downstream with auxiliary chain gage at present site and same datum.

Average discharge.--33 years, 3,183 cfs (2,304,000 acre-ft per year).

Extremes.--Maximum discharge during year, 19,400 cfs Apr. 8 (gage height, 22.75 ft); minimum 418 cfs Sept. 28; minimum gage height, 4.13 ft Sept. 28, 29.
1934-67: Maximum discharge, 117,000 cfs Apr. 11, 1965; maximum gage height, 34.37 ft Apr. 12, 1965 (backwater from Mississippi River); minimum discharge, 79 cfs Nov. 17, 1955; minimum gage height, 2.66 ft Nov. 22, 1935.

Remarks.--Records good except those for winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	526	978	670	510	500	500	11,900	6,360	2,120	12,100	1,620	1,260
2	522	943	544	510	500	500	12,500	7,870	2,070	12,100	1,500	1,170
3	518	903	580	500	500	500	13,700	8,030	2,020	11,800	1,400	1,050
4	531	863	620	500	500	520	14,900	7,730	1,950	11,300	1,320	944
5	522	838	640	500	500	560	15,300	7,050	1,880	10,600	1,270	852
6	504	819	630	495	500	600	13,000	6,490	1,870	9,680	1,270	791
7	495	824	610	495	500	700	13,900	6,050	1,890	8,560	1,330	752
8	518	814	580	490	500	800	19,300	5,690	1,950	8,020	1,300	718
9	508	810	580	490	500	1,000	13,900	5,340	2,030	9,250	1,220	682
10	504	796	570	490	500	1,400	13,100	5,050	2,250	9,900	1,180	643
11	495	783	570	490	500	1,800	17,300	4,850	3,220	10,000	1,140	611
12	482	792	570	490	500	2,900	16,300	4,690	4,920	9,450	1,100	581
13	544	760	570	490	500	4,700	15,200	4,530	5,480	8,610	1,050	578
14	706	702	570	490	500	6,500	14,100	4,320	7,520	7,660	992	560
15	988	688	580	490	500	7,700	13,000	4,120	8,670	6,650	948	555
16	1,260	765	580	490	495	8,000	11,900	3,960	11,000	5,830	904	544
17	1,680	796	580	490	495	7,200	10,900	3,770	12,500	5,340	870	549
18	1,930	783	580	485	495	6,400	10,200	3,590	13,300	4,920	834	574
19	2,100	760	580	485	495	5,600	9,320	3,440	13,800	4,410	797	548
20	2,150	716	570	485	495	5,000	8,590	3,300	15,400	3,940	771	531
21	2,090	675	570	485	495	4,400	7,990	3,160	17,100	3,590	744	528
22	1,950	706	560	490	495	3,900	7,500	3,010	17,500	3,260	711	504
23	1,820	814	560	495	500	3,500	7,090	2,880	17,100	2,970	724	493
24	1,670	814	550	500	500	7,740	6,690	2,740	16,200	2,730	773	462
25	1,560	819	550	510	500	10,300	6,280	2,650	15,300	2,520	800	452
26	1,470	814	540	520	500	11,900	5,900	2,580	14,400	2,380	902	453
27	1,340	806	540	520	500	11,600	5,590	2,500	13,700	2,230	974	436
28	1,230	788	540	510	500	12,000	5,330	2,420	13,000	2,070	1,130	422
29	1,140	752	530	510	500	12,000	5,120	2,350	12,400	1,920	1,230	427
30	1,090	742	530	500	500	11,900	4,990	2,290	12,100	1,790	1,330	432
31	1,020	---	520	500	---	11,900	---	2,200	---	1,700	1,350	---
Total	33,863	23,863	17,764	15,405	13,965	164,020	351,790	135,010	265,740	197,280	33,484	19,102
Mean	1,092	795	573	497	499	5,291	11,730	4,355	8,858	6,364	1,080	637
Max	2,150	978	670	520	500	12,000	19,300	8,030	17,500	12,100	1,620	1,260
Min	482	675	520	485	495	500	4,990	2,200	1,870	1,700	711	422
Cfsm	.067	.049	.035	.031	.031	.327	.724	.269	.547	.393	.067	.039
In.	.08	.05	.04	.04	.03	.38	.81	.31	.61	.45	.08	.04
Ac-ft	67,170	47,330	35,230	30,560	27,700	325,300	697,800	267,800	527,100	391,300	66,410	37,890
Cal yr 1966: Total	1,217,700		Mean 3,336	Max 16,000	Min 482	Cfsm 0.206	In. 2.80	Ac-ft 2,415,000				
Wtr yr 1967: Total	1,271,286		Mean 3,483	Max 19,300	Min 422	Cfsm 0.215	In. 2.92	Ac-ft 2,522,000				

MINNESOTA RIVER BASIN

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 1967.

Gage.--Digital 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. May 16, 1963, to Dec. 13, 1965, graphic water-stage recorder at present site and datum.

Extremes.--Maximum discharge during year, 210 cfs Oct. 15 (gage height, 3.35 ft); minimum, 3.4 cfs July 31,

Aug. 1, 3, 4, 5; minimum gage height, 1.28 ft Oct. 14.

1963-67: Maximum discharge, 535 cfs Apr. 8, 1965 (gage height, 4.32 ft); minimum daily, 1.2 cfs Feb. 24, 1965; minimum gage height, that of Oct. 14, 1966.

Remarks.--Records good except those for winter months and those for period of no gage-height record, which are fair.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	6.5	7.7	6.4	5.2	4.6	5.0	104	61	4.1	25	3.6	5.8
2	6.3	7.0	6.2	5.2	4.6	5.2	134	62	4.1	27	3.6	5.3
3	7.9	7.0	6.1	5.2	4.6	5.2	125	48	4.0	22	3.5	5.1
4	7.4	7.2	5.9	5.2	4.7	5.1	123	28	5.8	17	3.5	4.9
5	7.0	7.0	5.7	5.2	4.8	5.1	126	17	6.8	13	4.7	4.9
6	6.3	6.1	5.6	5.2	5.0	5.2	120	11	5.5	11	22	5.3
7	6.3	5.9	5.5	5.2	5.0	5.2	110	14	22	11	20	5.1
8	6.1	5.9	5.4	5.2	4.9	5.4	103	18	21	20	30	5.1
9	5.7	5.9	5.4	5.2	4.8	6.4	93	13	13	13	29	4.9
10	5.7	6.0	5.4	5.2	4.8	12	76	16	22	13	11	4.9
11	5.7	6.1	5.3	5.2	5.0	18	61	19	28	11	6.4	5.1
12	5.7	6.2	5.3	5.2	5.1	13	49	15	40	8.8	5.8	5.3
13	5.0	6.3	5.3	5.1	5.0	11	40	12	52	6.8	5.5	8.2
14	42	6.4	5.2	5.1	5.0	11	42	10	55	6.1	5.1	7.5
15	99	6.5	5.2	4.8	5.2	13	39	9.6	76	5.3	4.9	5.7
16	74	6.6	5.3	4.8	5.2	12	34	7.3	67	5.1	5.1	4.8
17	61	6.7	5.4	4.8	5.3	12	29	7.9	58	5.1	5.3	4.8
18	41	6.9	5.5	4.8	5.1	13	23	7.9	49	4.9	5.5	5.0
19	18	7.0	5.4	4.8	5.1	15	20	7.9	46	4.9	5.5	4.9
20	13	6.9	5.6	4.8	5.0	17	19	6.4	39	4.7	5.3	5.1
21	12	6.7	5.5	4.8	5.0	19	18	5.3	36	4.4	4.7	5.3
22	11	6.6	5.4	4.7	5.0	39	16	5.5	35	4.5	4.5	5.2
23	10	6.5	5.3	4.6	5.0	44	12	5.5	29	4.5	9.6	4.8
24	9.7	6.6	5.2	4.6	5.0	78	8.8	5.8	27	4.4	12	4.8
25	9.5	6.6	5.2	4.5	4.9	127	7.9	5.8	22	4.2	6.1	5.0
26	9.4	6.8	5.2	4.5	4.7	181	7.9	5.5	28	3.8	28	5.1
27	9.1	6.9	5.2	4.6	4.7	163	6.8	4.9	24	3.8	26	5.2
28	9.2	6.8	5.2	4.6	4.8	149	6.8	4.9	25	3.7	16	5.4
29	8.5	6.8	5.2	4.6	-----	136	7.3	4.9	22	3.6	7.3	5.5
30	8.2	6.7	5.2	4.6	-----	119	34	4.4	25	3.6	6.4	5.2
31	7.9	-----	5.2	4.6	-----	109	-----	4.4	-----	3.5	6.1	-----
TOTAL	534.1	198.3	168.9	152.1	137.9	1,358.8	1,595.5	447.9	891.3	278.7	312.0	159.2
MEAN	17.2	6.61	5.45	4.91	4.93	43.8	53.2	14.4	29.7	8.99	10.1	5.31
MAX	99	7.7	6.4	5.2	5.3	181	134	62	76	27	30	8.2
MIN	5.0	5.9	5.2	4.5	4.6	5.0	6.8	4.4	4.0	3.5	3.5	4.8

CAL YR 1966: TOTAL 5,891.6

MEAN 16.1

MAX 99

MIN 5.0

WAT YR 1967: TOTAL 6,234.7

MEAN 17.1

MAX 181

MIN 3.5

Note.--No gage-height record Nov. 8 to Dec. 8.

5-3310. Mississippi River at St. Paul, Minn.

Location.--Lat 44°56'40", long 93°05'20", in SE 1/4 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 1967 (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.--69 years (1894-95, 1896-97, 1900-1967), 10,100 cfs (adjusted for diversion).

Extremes.--Maximum discharge during year, 52,200 cfs Apr. 6 (gage height, 12.26 ft); minimum daily, 2,260 cfs Sept. 30.

1892-1967: Maximum discharge 171,000 cfs Apr. 16, 1965 (gage height, 26.01 ft, from floodmark); 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 (discharge, 107,000 cfs), determined by Corps of Engineers.

Remarks.--Records good. Records of water temperatures for the water year 1967 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	5820	3090	3030	5550	5200	5460	39,000	24,000	9,130	27,400	5,100	4,230
2	5250	7590	2280	5510	4980	5420	44,400	24,500	8,020	25,800	5,240	3,860
3	4,740	6,900	3,240	5,050	5,020	5,000	47,200	25,000	7,960	25,000	4,580	3,760
4	4,940	7,540	3,110	4,920	5,360	4,580	49,800	24,900	7,150	24,200	4,850	3,630
5	5,650	3,510	3,790	4,800	5,260	5,320	51,100	23,500	8,300	22,500	4,620	3,410
6	5,850	7,310	4,390	5,100	5,080	5,280	52,100	23,400	7,950	21,100	4,610	2,920
7	5,440	5,850	5,160	4,720	4,760	5,260	51,900	22,100	7,780	19,300	5,020	3,990
8	4,990	6,300	5,280	4,490	5,020	5,560	50,900	21,000	7,960	19,600	5,040	3,180
9	6,100	6,640	5,270	4,610	4,940	6,030	49,800	20,700	9,400	19,000	4,580	3,090
10	5,490	7,960	4,960	5,000	5,380	6,310	48,800	20,700	10,800	18,400	4,620	2,920
11	5,530	6,410	4,930	5,050	5,000	6,560	47,500	19,900	11,400	18,300	4,330	2,900
12	5,300	5,570	4,990	5,210	5,140	6,690	46,300	19,200	13,200	18,300	3,710	2,810
13	5,610	4,630	5,520	5,110	5,540	7,880	44,400	17,700	16,200	17,300	3,600	2,880
14	5,810	4,820	5,620	4,680	5,400	9,800	43,200	17,900	17,700	16,000	3,880	3,090
15	8,360	5,390	5,800	5,110	5,320	11,800	41,200	17,100	20,500	14,200	3,820	3,050
16	7,760	6,830	5,760	5,010	5,080	13,100	39,000	16,800	23,800	12,400	3,840	2,880
17	7,590	6,130	5,840	4,580	5,100	13,400	37,200	16,100	26,400	12,100	3,360	3,870
18	8,120	6,760	5,370	4,470	5,070	12,600	35,400	15,400	28,700	11,100	3,830	2,960
19	8,730	5,500	5,470	4,730	5,290	12,000	33,500	15,100	32,200	10,300	3,870	3,550
20	9,510	6,180	5,660	4,780	5,220	11,100	32,600	14,500	33,700	9,340	3,570	3,380
21	8,680	6,230	5,770	4,910	5,290	10,400	31,200	13,600	35,100	8,870	3,370	3,330
22	8,720	6,410	5,490	4,950	5,670	9,900	29,400	13,300	36,400	8,400	3,120	3,060
23	7,960	5,900	5,600	4,850	5,560	9,310	28,300	13,100	36,800	8,450	3,400	3,000
24	8,490	6,880	5,220	4,280	5,120	9,230	27,300	12,600	36,500	7,970	3,320	2,870
25	8,370	7,360	4,930	5,700	5,040	14,400	26,800	11,700	35,400	7,630	3,340	2,600
26	8,430	6,620	4,720	5,440	5,440	17,400	26,200	11,600	34,000	6,940	5,120	2,500
27	8,510	6,340	5,050	5,140	5,360	18,300	25,300	12,300	32,700	6,230	4,620	2,710
28	7,700	6,460	5,410	5,060	5,380	18,900	24,400	9,790	30,600	6,570	4,560	3,040
29	8,070	4,930	5,290	5,070	-----	21,600	24,100	10,300	29,400	6,000	4,370	2,490
30	7,340	4,850	5,230	5,040	-----	25,300	23,500	10,100	27,600	5,500	4,670	2,260
31	7,540	-----	4,820	4,980	-----	33,200	-----	9,110	-----	5,220	4,540	-----
Total	216,400	192,890	153,000	153,900	146,020	347,090	1,151,800	527,000	642,750	439,420	130,500	94,220
Mean	6,981	6,430	4,935	4,965	5,215	11,200	38,390	17,000	21,420	14,170	4,210	3,141
(A)	+310	+272	+267	+278	+281	+340	+341	+317	+403	+368	+376	+339
Mean #	7,291	6,702	5,202	5,243	5,496	11,540	38,730	17,320	21,820	14,540	4,586	3,480
Max	9,510	8,510	5,840	5,700	5,670	33,200	52,100	25,000	36,800	27,400	5,240	4,230
Min	4,740	4,630	2,280	4,280	4,760	4,580	23,500	9,110	7,150	5,220	3,120	2,260
Cfsm	0.198	0.182	0.141	0.142	0.149	0.314	1.05	0.471	0.593	0.395	0.125	0.095
In. #	0.23	0.20	0.16	0.16	0.16	0.36	1.17	0.54	0.66	0.46	0.14	0.11

Calendar year 1966: Max 49,000 Min 2,280 Mean 15,730 Mean# 16,040 Cfsm# 0.436 In.# 5.90
 Water year 1966-67: Max 52,100 Min 2,260 Mean 11,490 Mean# 11,820 Cfsm# 0.321 In.# 4.35

Diversion, equivalent in cubic feet per second, through sewage-disposal plant.

Adjusted for diversion.

Note.--Stage-fall discharge relation affected by indefinite slope Oct. 1 to Nov. 30, May 11 to June 15, July 12 to Sept. 30.

5-3385. Snake River near Pine City, Minn.

Location.--Lat 45°50'30", long 92°56'00", in SE 1/4 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 1 1/2 miles northeast of Pine City.

Drainage area.--958 sq mi.

Records available.--June 1913 to September 1917, July 1951 to September 1967.

Gage.--Digital 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 and Oct. 29, 1951 to May 10, 1966, graphic water-stage recorder at present site and datum.

Average discharge.--20 years, 559 cfs.

Extremes.--Maximum discharge during year, 7,670 cfs June 20 (gage height, 8.10 ft); minimum, 32 cfs Sept. 12, 28; minimum gage height, 2.78 ft Sept. 12.
1913-17, 1951-67: Maximum discharge 11,500 cfs April 18, 1965 (gage height, 9.56 ft); minimum, 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 winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in Cfs, water year October 1966 to September 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	71	167	158	114	118	108	3,700	536	183	1,780	95	89
2	66	148	139	117	117	110	4,540	570	182	1,470	160	73
3	97	139	129	117	117	113	5,120	494	161	1,210	162	69
4	120	148	134	117	118	111	5,480	470	186	994	123	72
5	97	153	134	117	119	112	5,440	462	197	841	113	69
6	97	153	140	117	118	115	5,140	454	202	717	103	63
7	97	162	140	117	118	114	4,660	454	199	618	106	62
8	104	153	159	117	118	111	4,030	446	325	555	109	62
9	120	153	153	117	118	107	3,450	383	422	504	92	40
10	134	162	148	117	120	105	2,880	364	622	460	77	42
11	100	162	144	117	121	104	2,470	408	870	422	74	39
12	78	144	140	117	122	100	2,150	424	1,090	364	71	37
13	81	144	138	118	122	97	1,860	436	1,330	308	72	60
14	112	148	136	118	119	95	1,640	456	1,550	266	70	66
15	213	153	138	117	120	95	1,450	444	1,810	245	67	65
16	224	162	135	117	120	95	1,240	428	2,450	257	65	64
17	230	173	139	116	120	97	1,170	406	3,690	233	78	71
18	242	162	138	116	119	100	1,090	388	5,160	208	67	68
19	248	139	147	115	117	104	1,010	373	6,590	189	73	69
20	242	153	146	117	116	106	966	292	7,480	175	64	74
21	248	158	146	119	115	109	976	274	7,600	156	52	63
22	348	173	147	119	114	111	897	263	7,260	152	49	48
23	254	178	138	119	115	115	819	273	6,720	168	59	59
24	218	178	136	120	115	123	780	260	5,980	140	74	41
25	207	196	132	119	115	141	761	254	5,190	111	85	37
26	213	196	128	118	114	171	732	271	4,400	107	163	46
27	207	201	122	117	111	200	685	232	3,700	92	150	36
28	207	173	122	117	110	248	622	220	3,040	96	134	33
29	196	158	122	117	-----	392	586	204	2,540	81	131	37
30	190	178	117	117	-----	1,160	486	179	2,120	72	110	40
31	213	-----	116	118	-----	2,400	-----	175	-----	73	103	-----
TOTAL	5,274	4,867	4,261	3,635	3,286	7,269	66,830	11,293	83,249	13,064	2,951	1,700
MEAN	170	162	137	117	117	234	2,228	364	2,775	421	95.2	56.7
MAX	348	201	159	120	122	2,400	5,480	570	7,600	1,780	163	89
MIN	66	139	116	114	110	95	486	175	161	72	49	33
CFSM	.18	.17	.14	.12	.12	.24	2.33	.38	2.90	.44	.13	.06
IN.	.20	.19	.17	.14	.13	.28	2.59	.44	3.23	.51	.11	.07

CAL YR 1966: TOTAL 262,889

MEAN 720

MAX 6,000

MIN 66

CFSM .75

IN 10.21

WAT YR 1967: TOTAL 207,679

MEAN 569

MAX 7,600

MIN 33

CFSM .59

IN 8.06

ST. CROIX RIVER BASIN

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 1965 to September 1967. Records for January 1949 to July 1965 at site 6.5 miles upstream, published as "near Stacy", 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 year, 508 cfs Apr. 14 (gage height, 6.93 ft); minimum, 14 cfs Oct. 12 (gage height, 2.22 ft).

1965-67: Maximum discharge, that of Apr. 14, 1967; minimum 7.9 cfs Sept. 11, 1965 (gage height, 2.07 ft).

Remarks.--Records good except those for winter months, which are fair. 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. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	16	20	25	22	27	37	210	169	69	211	38	47
2	15	20	25	22	28	37	270	181	49	192	65	44
3	17	22	25	22	30	37	432	174	35	172	49	41
4	20	21	26	22	32	37	493	164	34	158	30	38
5	17	22	26	22	33	37	500	156	37	148	27	37
6	17	22	26	22	34	37	496	148	35	109	33	35
7	16	22	26	22	35	37	493	143	37	87	50	34
8	16	22	26	22	35	37	481	140	48	88	53	33
9	16	22	26	22	35	38	467	132	45	76	45	28
10	16	24	26	22	36	38	462	140	53	75	34	27
11	15	24	26	22	36	38	425	155	71	74	30	26
12	14	24	27	22	36	38	410	164	89	72	29	25
13	14	24	27	22	36	39	392	169	116	66	34	33
14	18	24	28	22	36	39	376	169	120	61	31	32
15	38	23	28	22	36	39	367	166	136	58	28	29
16	36	23	28	22	36	40	358	163	180	60	25	28
17	34	23	28	22	36	40	338	157	208	58	25	27
18	34	23	28	22	36	40	317	151	217	55	31	26
19	34	23	29	22	36	41	293	144	240	52	26	26
20	35	23	29	22	36	42	282	132	314	49	25	26
21	36	23	29	22	36	43	280	124	334	47	21	25
22	37	23	28	23	36	45	266	120	309	49	20	24
23	34	24	28	23	36	46	242	116	280	70	33	23
24	32	24	27	23	36	50	219	109	269	47	32	22
25	30	24	27	24	37	53	202	105	267	40	30	22
26	27	24	26	24	37	53	191	101	256	53	59	20
27	18	25	25	24	37	53	181	94	243	48	59	19
28	18	25	24	25	37	62	171	90	223	45	56	19
29	18	25	23	25	- - - -	101	165	86	203	40	52	18
30	20	25	23	25	- - - -	190	165	81	203	37	50	18
31	21	- - - -	22	26	- - - -	248	- - - -	77	- - - -	35	48	- - - -
Total	729	693	817	704	977	1,712	9,944	4,220	4,720	2,432	1,168	852
Mean	23.5	23.1	26.4	22.7	34.9	55.2	331	136	157	78.4	37.7	28.4
Max	38	25	29	26	37	248	500	181	334	211	65	47
Min	14	20	22	22	27	37	165	77	34	35	20	18
Cfsm	-	-	-	-	-	-	-	-	-	-	-	-
In.	-	-	-	-	-	-	-	-	-	-	-	-
Cal yr1966: Total	28,974		Mean 79.4	Max 357	Min 14	Cfsm -	In. -					
Wtr yr1967: Total	28,968		Mean 79.4	Max 500	Min 14	Cfsm -	In. -					

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 1966 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.--65 years, 4,034 cfs.

Extremes.--Maximum discharge during year, 33,600 cfs Apr. 2 (gage height, 15.64 ft); minimum daily, 1,140 cfs Dec. 3.
1902-67: Maximum discharge, 54,900 cfs May 8, 1950 (gage height, 25.19 ft); minimum daily, 75 cfs July 17, 1910.

Remarks.--Records good except Dec. 28 to Jan. 11, Jan. 29 to Feb. 22, which are fair. Flow regulated by powerplant upstream.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,040	2,730	1,210	2,100	2,350	2,190	26,200	4,540	2,440	7,630	2,270	2,790
2	2,400	2,600	1,840	2,160	2,260	1,870	30,300	5,400	2,930	7,570	2,650	2,420
3	1,960	2,360	1,140	2,180	2,380	2,190	31,500	5,400	2,200	7,060	2,360	2,520
4	2,110	2,750	1,400	2,180	2,060	1,980	30,200	4,850	2,230	5,920	2,300	2,360
5	1,840	1,860	1,770	2,080	2,480	2,280	27,300	5,000	2,470	5,200	2,440	1,770
6	2,410	2,120	2,350	2,060	2,110	2,100	24,500	4,890	2,390	5,140	2,430	2,090
7	2,380	2,630	2,300	1,780	2,400	2,160	22,400	4,450	2,880	4,460	2,740	2,120
8	2,220	2,610	2,600	1,850	2,400	2,120	20,600	4,460	3,580	4,030	2,650	1,990
9	2,420	2,420	2,500	2,140	1,800	2,020	18,300	4,390	4,400	4,240	2,310	2,040
10	2,120	2,280	2,460	1,840	2,240	2,220	16,700	4,530	6,920	3,950	2,470	1,860
11	2,290	2,370	2,300	1,910	2,300	1,830	15,500	4,700	7,020	3,830	1,880	1,640
12	1,810	1,710	2,110	2,340	2,240	2,040	14,200	4,490	7,220	3,630	2,070	1,930
13	2,890	1,370	2,100	1,930	2,320	2,320	13,200	4,960	8,720	3,570	2,220	2,020
14	1,650	2,370	2,270	2,010	2,220	2,260	10,100	4,980	9,820	2,620	2,270	2,280
15	3,340	2,420	1,910	1,840	2,220	2,110	10,000	4,840	12,600	2,760	1,660	2,060
16	3,630	2,980	2,190	2,310	2,120	2,350	10,500	4,650	21,800	2,610	1,880	2,010
17	4,010	2,990	2,180	2,040	2,020	2,100	10,600	4,470	26,300	2,740	1,950	2,340
18	3,740	2,120	2,340	2,270	1,900	2,170	10,800	4,360	27,200	2,860	1,670	2,310
19	3,480	1,770	2,200	2,210	2,080	2,380	11,300	3,740	26,900	2,690	2,090	2,140
20	3,040	1,990	2,300	2,080	2,440	2,300	11,500	3,690	27,300	2,650	2,010	2,280
21	4,100	2,520	2,470	2,010	1,660	1,950	10,800	3,640	28,000	3,140	1,880	2,320
22	3,540	3,390	2,310	2,110	2,240	2,190	9,870	3,520	28,100	1,910	2,040	1,660
23	3,520	2,640	1,810	2,340	2,020	2,290	8,880	3,630	26,700	2,100	1,880	2,490
24	3,880	2,400	2,030	2,380	2,400	2,520	3,100	3,590	23,400	2,490	2,070	2,010
25	3,070	2,620	1,970	2,270	2,130	2,670	7,630	3,340	19,700	2,700	1,680	1,730
26	2,970	2,600	1,800	2,070	2,160	2,970	7,220	3,570	17,300	2,740	2,290	2,160
27	3,170	2,740	2,210	1,940	2,050	3,390	6,580	3,030	14,900	2,150	2,850	1,840
28	2,870	2,660	2,070	2,540	2,240	3,990	5,450	2,680	13,000	1,740	2,860	2,230
29	2,380	1,860	1,860	2,480		5,030	5,590	2,940	12,600	2,000	3,030	1,870
30	2,650	2,060	2,300	2,230	- - - - -	10,500	5,230	2,830	8,880	2,170	2,660	1,730
31	3,090	- - - - -	1,900	2,420	- - - - -	20,000	- - - - -	2,780	- - - - -	2,510	2,570	- - - - -
Total	87,020	71,940	64,200	66,100	61,240	100,490	441,050	128,340	399,900	110,810	70,130	63,010
Mean	2,807	2,398	2,071	2,132	2,187	3,242	14,700	4,140	13,330	3,575	2,262	2,100
Max	4,100	3,390	2,600	2,540	2,480	20,000	31,500	5,400	28,100	7,630	3,030	2,790
Min	1,650	1,370	1,140	1,780	1,660	1,830	5,230	2,680	2,200	1,740	1,660	1,640
Cfsm	.47	.40	.35	.36	.37	.55	2.48	.70	2.25	.60	.38	.35
In.	.55	.45	.40	.41	.38	.63	2.77	.80	2.51	.69	.44	.40
Cal yr 1966: Total	1,828,830		Mean	5,010	Max	27,300	Min	1,140	Cfsm	.84	In.	11.47
Wtr yr 1967: Total	1,664,230		Mean	4,560	Max	31,500	Min	1,140	Cfsm	.77	In.	10.44

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 1967.

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.--39 years, 15,370 cfs.

Extremes.--Maximum discharge during year, 87,800 cfs Apr. 5 (gage height, 84.84 ft); minimum daily, 3,800 cfs Dec. 1; minimum gage height, 74.26 ft Mar. 13.

1928-67: Maximum discharge 228,000 cfs Apr. 18, 1965 (gage height, 93.11 ft); 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. Records of chemical analyses for the water year 1967 are published in Part 2 of this report.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	8030	10000	3800	8100	8600	8000	58300	32300	12500	44300	9060	9190
2	9320	10100	3900	8300	8400	8600	70100	32400	11000	41000	9220	8480
3	7870	10500	4100	8400	8300	8600	77600	32600	10300	38700	8640	8130
4	6260	10600	3900	8700	8600	8500	83400	33400	10800	36700	7720	7520
5	7220	11000	4700	8300	8900	8600	86500	33000	11400	34800	7990	7180
6	8450	11500	6900	8300	8200	8300	86800	31900	11400	32400	8480	7140
7	9740	10900	9220	8500	8300	7700	83400	30800	12400	31200	10000	6830
8	10100	10300	8890	7800	8500	7700	79800	30600	14200	29600	9540	6090
9	9180	9470	8040	6500	9000	8200	77100	29000	13400	27300	7640	5510
10	7420	8960	9520	7500	7800	10400	72900	28400	15000	25800	7500	6630
11	8260	8690	7900	7900	8200	11200	69800	27800	18900	25800	7380	7220
12	9080	8930	3300	7700	7900	10600	67100	27100	22900	25400	6770	7300
13	9240	8670	8100	8500	7300	10300	64400	26800	25200	24300	6730	7060
14	11000	7790	8640	8400	8500	13900	61800	25600	27600	22200	6980	7100
15	12400	8270	8990	8100	8700	16400	53800	25300	29400	19900	7460	7060
16	13800	8480	9220	8200	8500	16200	55800	24400	33600	18600	7260	7060
17	13700	9600	8930	7900	8100	13800	54100	23400	40700	16700	6730	6530
18	13600	9800	9090	7900	8000	15000	51800	22700	49500	15100	6570	7540
19	14200	10300	8830	7300	7900	15600	50000	21500	55700	14000	6590	7020
20	14700	9910	8540	7400	7800	15500	48800	19700	59900	12500	7260	6460
21	14400	9800	8900	7500	7500	14500	48100	19200	62600	12200	6280	6080
22	13500	10000	9000	8000	7700	13600	45800	18900	64400	12400	7100	6550
23	13400	10500	8700	9700	8200	13400	43500	19100	65900	12300	8040	4980
24	12200	10100	8000	9400	8200	16100	41500	17500	65500	11600	7880	6160
25	12400	10200	8100	8300	8200	20600	40000	16400	63000	10500	7500	6910
26	12800	10900	6800	9000	8100	24100	38800	16300	59800	10200	6570	4590
27	12600	10100	7400	8800	7500	27300	37200	16300	57100	10500	8300	4960
28	11800	9580	7900	8500	7600	28200	35500	15300	53200	8860	9220	5580
29	11600	8890	9000	8500		29800	34400	13600	49500	7950	8960	4840
30	11400	5810	8000	8400	- - - -	33600	33700	13000	47000	8630	8730	5400
31	10300	- - - -	8500	8800	- - - -	43500	- - - -	12800	- - - -	8290	8880	- - - -
Total	339,970	289,650	239,810	254,600	228,500	487,800	1,756,900	737,100	1,074,800	649,730	242,980	199,100
Mean	10,970	9,655	7,736	8,213	8,161	15,740	58,560	23,780	35,830	20,960	7,838	6,637
Max	14,700	11,500	9,520	9,700	9,000	43,500	86,800	33,400	65,900	44,300	10,000	9,190
Min	6,260	5,810	3,800	6,500	7,300	7,700	33,700	12,800	10,300	7,950	6,280	4,590
Cfsm	0.245	0.216	0.173	0.183	0.182	0.351	1.31	0.531	0.800	0.468	0.175	0.148
In.	0.28	0.24	0.20	0.21	0.19	0.40	1.46	0.61	0.89	0.54	0.20	0.17
Cal yr 1966: Total	8,032,990		Mean	22,010	Max	74,000	Min	3,800	Cfsm	0.491	In.	6.67
Wtr yr 1967: Total	6,500,940		Mean	17,810	Max	86,800	Min	3,800	Cfsm	0.398	In.	5.40

5-3538. Straight River near Faribault, Minn.

Location.--Lat 44°15'29", long 93°13'51", in W¹/₂SE¹/₄ sec.9, T.109 N., R.20 W., on right bank 15 ft downstream from highway bridge, 2.8 miles upstream from Falls Creek and 3.2 miles southeast of Faribault.

Records available.--October 1965 to September 1967.

Gage.--Water-stage recorder. Altitude of gage is 1,035 ft (from topographic map).

Extremes.--Maximum discharge during year, 3,590 cfs June 16 (gage height, 9.83 ft); minimum daily, 16 cfs Jan. 17-26; minimum gage height, 3.84 ft Nov. 30.

1965-67: Maximum discharge, that of June 16, 1967; minimum daily, that of Jan. 17-26, 1967; minimum gage height, that of Nov. 30, 1967.

Remarks.--Records good except for winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	27	46	30	18	18	25	728	756	69	278	94	67
2	27	43	29	18	18	25	1,900	612	63	236	87	63
3	29	38	28	18	18	26	1,770	436	59	210	82	57
4	32	39	27	18	19	27	1,400	346	59	192	77	55
5	30	40	26	18	19	31	1,110	287	61	179	75	54
6	29	40	25	18	19	42	864	256	59	164	138	50
7	29	39	24	18	20	83	695	232	94	152	220	49
8	29	38	23	17	20	85	580	213	264	518	182	48
9	29	34	23	17	21	86	684	192	549	1,000	149	46
10	30	30	23	17	21	95	651	196	852	924	121	44
11	32	30	23	17	21	105	565	220	1,830	662	104	42
12	38	31	23	17	22	150	495	213	2,960	467	94	40
13	48	33	23	17	22	310	449	252	2,420	354	87	42
14	69	34	23	17	22	410	500	224	1,800	287	82	52
15	135	34	23	17	23	380	640	199	2,180	236	80	43
16	149	35	23	17	23	340	585	182	3,290	206	75	43
17	152	35	23	16	23	300	500	170	3,080	196	71	38
18	126	35	23	16	23	280	431	158	2,340	161	69	38
19	99	34	22	16	23	250	382	146	1,800	152	65	40
20	82	34	22	16	23	230	350	135	1,450	138	65	38
21	71	34	21	16	23	220	359	126	1,190	129	63	35
22	61	34	21	16	23	230	368	118	976	310	67	34
23	55	34	21	16	23	500	336	115	840	364	69	34
24	52	34	21	16	23	1,090	296	110	739	278	75	32
25	50	34	21	16	23	2,120	260	102	640	213	67	32
26	49	33	20	16	23	1,960	236	97	560	173	89	32
27	49	32	20	17	23	1,860	216	89	495	152	97	32
28	49	32	19	17	24	1,700	199	87	431	132	89	32
29	49	31	19	17		1,120	185	85	382	118	77	33
30	48	31	19	17	- - - -	969	292	82	328	110	71	33
31	48	- - - -	18	17	- - - -	870	- - - -	73	- - - -	99	67	- - - -
Total	1,802	1,051	706	524	603	15,919	18,026	6,509	31,860	8,790	2,848	12,78
Mean	58.1	35.0	22.8	16.9	21.5	514	601	210	1,062	284	91.9	42.6
Max	152	46	30	18	24	2,120	1,900	756	3,290	1,000	220	67
Min	27	30	18	16	18	25	185	73	59	99	63	32
Cfsm												
In.												
Cal yr 1966: Total	56,731		Mean	155	Max	1,900	Min	18	Cfsm	In.		
Wtr yr 1967: Total	89,916		Mean	246	Max	3,290	Min	16	Cfsm	In.		

CANNON RIVER BASIN

5-3552. Cannon River at Welch, Minn.

Location.--Lat 44°33'50", long 92°43'55", in NW¼ 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 1967.

Gage.--Digital 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, graphic water-stage recorder at site 0.3 mile upstream at present datum. Oct. 12, 1938 to May 24, 1964, graphic water-stage recorder at same site and datum.

Average discharge.--38 years (1911-13, 1931-67), 480 cfs.

Extremes.--Maximum discharge during year, 10,000 cfs Mar. 25 (gage height, 10.58 ft); minimum daily, 66 cfs Jan. 20-22; minimum gage height, 1.38 ft Jan. 15.

1909-14, 1930-67: Maximum discharge, 36,100 cfs Apr. 8, 1965 (gage height, 14.01 ft); minimum, 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 winter months, which are fair. Records of chemical analyses for the water year 1967 are published in Part 2 of this report. Diurnal fluctuation caused by powerplants above station to Dec. 31, 1966 when the powerplants were shut down.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	92	202	275	118	112	178	2,010	1,320	227	884	348	201
2	82	208	295	102	115	178	3,130	1,660	226	767	341	194
3	154	207	240	96	118	180	4,340	1,360	218	682	333	190
4	169	206	110	96	121	181	3,750	1,120	224	637	303	185
5	164	142	297	93	123	189	3,240	961	241	563	290	181
6	165	81	330	92	126	190	2,840	891	249	394	296	178
7	166	178	350	90	130	191	2,450	840	239	323	332	177
8	93	250	350	88	132	199	2,160	798	141	195	421	175
9	80	253	320	89	134	210	2,470	717	130	515	434	166
10	151	201	151	90	137	228	2,490	678	123	1,400	405	160
11	161	194	98	90	140	270	2,250	663	469	1,590	379	157
12	138	142	262	89	142	500	2,050	657	2,650	1,290	355	153
13	170	82	310	87	144	780	1,870	671	4,010	1,080	336	168
14	202	132	320	82	148	750	1,750	662	3,300	933	321	180
15	172	195	310	78	150	680	1,880	625	2,560	834	307	182
16	114	196	280	74	151	620	1,930	590	2,810	765	295	182
17	285	198	153	71	153	580	1,850	556	3,770	709	320	174
18	327	193	86	70	155	520	1,640	537	3,950	614	260	168
19	325	140	254	67	158	500	1,470	511	3,200	530	224	163
20	318	79	322	66	160	480	1,360	444	2,470	500	218	163
21	313	183	320	66	161	485	1,310	429	2,030	469	247	159
22	152	254	325	66	165	501	1,250	409	1,710	477	205	150
23	100	258	350	67	166	1,700	1,160	388	1,500	649	176	147
24	209	149	216	70	168	5,520	1,090	330	1,340	726	188	140
25	209	194	97	73	170	7,900	989	299	1,210	724	207	136
26	206	146	286	79	171	5,170	865	297	1,110	700	244	136
27	209	82	310	82	173	4,290	819	266	1,130	615	243	132
28	207	184	350	91	177	3,410	774	264	1,040	528	237	132
29	128	254	360	98	-----	2,840	729	273	938	437	230	135
30	82	255	290	104	-----	2,490	656	251	879	385	218	137
31	151	-----	140	105	-----	2,280	-----	238	-----	361	210	-----
TOTAL	5,494	5,438	8,157	2,629	4,100	44,190	56,572	19,705	44,094	21,276	8,923	4,901
MEAN	177	181	263	84.8	146	1,425	1,886	636	1,470	686	288	163
MAX	327	258	360	118	177	7,900	4,340	1,660	4,010	1,590	434	201
MIN	80	79	86	66	112	178	656	238	123	195	176	132
CFSM	.13	.14	.20	.06	.11	1.08	1.43	.48	1.11	.52	.22	.12
IN.	.15	.15	.23	.07	.12	1.25	1.59	.56	1.24	.60	.25	.14
CAL YR 1966: TOTAL 192,361 MEAN 527 MAX 7,250 MIN 79 CFSM .40 IN 5.42												
WAT YR 1967: TOTAL 225,479 MEAN 618 MAX 7,900 MIN 66 CFSM .47 IN 6.35												

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 1967.

Gage.--Digital water-stage recorder. Datum of gage is 949.56 ft above mean sea level, datum of 1929. Prior to July 31, 1962, graphic water-stage recorder at same site and datum.

Average discharge.--15 years, 118 cfs.

Extremes.--Maximum discharge during year, 5,610 cfs Mar. 11 (gage height, 12.45 ft, from floodmark); minimum, 14 cfs Aug. 29, 30; minimum gage height 1.68 ft Aug. 30.

1952-67: Maximum discharge, 19,600 cfs Mar. 1, 1965 (gage height, 19.12 ft, from floodmark); minimum 8.4 cfs Dec. 7, 1955.

Flood of July 21, 1951 reached a stage of about 17.5 ft, from information by sewage plant superintendent. This is the highest known stage outside the period of record since at least 1908.

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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	24	35	28	21	83	35	529	654	56	129	54	46
2	23	33	28	22	60	41	1,450	391	51	122	53	41
3	26	33	25	25	57	41	1,330	200	47	116	49	45
4	28	34	22	26	54	40	782	149	50	109	47	50
5	26	32	27	26	51	43	610	131	51	107	45	55
6	27	29	39	27	48	56	501	118	51	103	76	42
7	27	33	32	29	45	74	416	108	88	92	79	33
8	26	34	44	24	44	73	350	103	100	97	74	33
9	24	35	34	26	45	106	320	96	489	95	59	30
10	24	36	30	26	47	501	285	155	830	93	53	28
11	26	36	25	25	38	2,860	240	175	759	90	49	31
12	37	33	29	26	36	719	215	228	919	82	47	32
13	40	33	28	29	40	431	200	139	738	78	45	59
14	71	36	29	28	47	195	242	116	371	76	46	59
15	85	36	29	22	44	116	270	105	2,500	74	49	43
16	72	36	30	27	50	101	238	91	2,340	73	45	40
17	64	36	30	23	40	103	198	82	1,020	74	43	37
18	59	35	28	24	37	100	159	88	738	72	42	40
19	50	33	31	24	36	98	140	82	550	69	41	38
20	50	31	33	25	37	104	147	82	377	69	39	38
21	45	36	32	25	36	100	137	74	280	74	43	37
22	40	37	30	28	37	311	122	73	238	70	41	34
23	36	37	27	45	37	786	110	71	255	74	38	31
24	38	34	25	341	30	1,600	112	72	242	62	40	29
25	38	36	22	1,330	26	2,490	100	72	232	60	40	31
26	36	34	22	750	27	1,980	98	74	205	59	44	32
27	36	34	23	212	31	2,930	96	67	192	58	163	30
28	36	32	26	116	34	1,060	97	67	178	55	26	31
29	33	32	26	100		814	96	64	153	54	19	31
30	31	32	26	82	-----	762	205	63	145	53	30	31
31	33	-----	24	78	-----	710	-----	61	-----	53	44	-----
Total	1,211	1,023	884	3,612	1,197	19,380	9,795	4,051	14,245	2,492	1,563	1,137
Mean	39.1	34.1	28.5	117	42.8	625	326	131	475	80.4	50.4	37.9
Max	85	37	44	1,330	83	2,930	1,450	654	2,500	129	163	59
Min	23	29	22	21	26	35	96	61	47	53	19	28
Cfsm	0.129	0.112	0.094	0.385	0.141	2.06	1.07	0.431	1.56	0.264	0.166	0.125
In.	0.15	0.13	0.11	0.44	0.15	2.37	1.20	0.50	1.74	0.30	0.19	0.14

Cal yr 1966: Total 37,286 Mean 102 Max 4,460 Min 22 Cfsm 0.336 In. 4.56
 Wtr yr 1967: Total 60,590 Mean 166 Max 2,930 Min 19 Cfsm 0.546 In. 7.41

Peak discharge (base, 1,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
1-25	0700	6.58	1,400	4- 2	1900	7.80	2,070
3-11	0300	12.45	5,610	6-15	2100	11.12	4,880
3-27	0130	11.45	5,310	8-27	0700	6.42	1,310

ZUMBRO RIVER BASIN

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 1967. 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.--45 years (1909-17, 1930-67), 477 cfs.

Extremes.--Maximum discharge during year, 16,600 cfs Mar. 25 (gage height, 21.62 ft); minimum, 44 cfs Dec. 26 (gage height, 6.17 ft).

1909-17, 1929-67: 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 winter months, which are fair. Diurnal fluctuation caused by power-plant above station.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	100	196	210	85	253	655	1,450	417	263	385	306	88
2	74	138	230	80	198	285	2,930	910	237	336	155	116
3	71	137	245	218	442	400	4,860	869	207	409	152	86
4	111	227	170	400	205	200	2,250	852	124	514	207	84
5	194	197	130	210	95	90	1,510	519	242	523	232	121
6	199	90	218	154	76	270	1,230	823	294	397	306	185
7	166	155	166	136	150	160	1,060	411	313	276	370	208
8	112	236	169	73	324	150	991	562	419	534	302	254
9	76	239	175	75	360	225	1,060	261	619	1,590	149	145
10	71	237	120	234	261	410	1,070	157	879	1,110	207	87
11	70	177	78	214	189	1,790	927	158	979	981	436	166
12	72	87	82	141	86	3,880	940	169	2,700	420	191	158
13	72	83	105	363	134	1,950	761	232	2,890	385	194	196
14	95	86	122	140	240	1,330	744	210	1,740	546	235	218
15	248	146	138	74	136	1,030	449	436	2,100	380	214	152
16	378	151	232	74	159	898	403	524	7,720	335	214	118
17	389	154	140	118	167	857	695	152	6,390	448	210	85
18	523	252	74	178	153	856	707	210	3,080	375	197	177
19	365	156	74	184	86	852	691	597	1,930	280	114	225
20	261	79	215	97	108	833	686	263	1,490	271	94	135
21	251	156	173	130	260	814	684	138	1,220	448	90	173
22	168	220	165	82	150	807	407	355	962	239	320	129
23	93	257	210	86	157	1,380	200	306	909	134	492	113
24	113	190	140	320	196	7,150	459	325	721	480	239	90
25	176	203	95	590	188	14,300	717	390	570	311	213	181
26	178	156	62	640	82	8,480	717	350	871	180	158	128
27	190	92	64	540	98	9,060	828	191	1,100	218	111	192
28	196	105	100	230	240	3,890	823	138	1,040	365	329	102
29	156	125	160	120	-----	2,600	477	345	696	158	233	119
30	85	170	175	240	-----	2,140	364	155	642	116	145	125
31	118	-----	201	290	-----	1,760	-----	325	-----	311	95	-----
TOTAL	5,371	4,897	4,638	6,516	5,193	69,502	31,090	11,750	43,347	13,455	6,910	4,356
MEAN	173	163	150	210	185	2,242	1,036	379	1,445	434	223	145
MAX	523	257	245	640	442	14,300	4,860	910	7,720	1,590	492	254
MIN	70	79	62	73	76	90	200	138	124	116	90	84
CFSM	.15	.14	.13	.19	.16	1.98	.92	.34	1.28	.38	.20	.13
IN.	.18	.16	.15	.21	.17	2.29	1.02	.39	1.43	.44	.23	.14

CAL YR 1966: TOTAL 150,047

MEAN 411

MAX 11,200

MIN 62

CFSM .36

IN 4.94

WAT YR 1967: TOTAL 207,025

MEAN 567

MAX 14,300

MIN 62

CFSM .50

IN 6.81

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 1967.

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.--28 years, 27.5 cfs.

Extremes.--Maximum discharge during year, 3,050 cfs Mar. 24 (gage height, 8.02 ft); minimum daily, 9.2 cfs Dec. 1.

1939-67: Maximum discharge, 5,460 cfs Aug. 31, 1947 (gage height, 10.61 ft); minimum, 3.8 cfs Mar. 24, 1940; minimum gage height, 0.23 ft Mar. 12, 1965.

Remarks.--Records poor.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	10	11	9.2	10	21	10	40	60	13	22	12	11
2	11	11	9.8	10	17	10	55	28	13	21	12	11
3	11	11	10	9.4	14	10	76	22	13	20	11	11
4	11	11	10	9.4	13	10	48	20	13	19	11	10
5	11	11	10	9.4	12	10	40	19	13	19	11	10
6	11	11	10	10	12	10	34	18	13	20	12	10
7	11	11	10	9.4	11	10	30	18	16	19	15	10
8	11	11	10	9.4	11	10	27	19	27	19	14	11
9	11	12	10	9.4	11	10	26	18	43	21	14	11
10	11	11	10	9.4	11	12	24	18	42	21	13	11
11	12	11	10	9.6	11	250	22	24	42	20	13	11
12	12	11	10	10	11	130	21	24	51	19	12	11
13	12	11	10	10	11	45	20	20	51	18	12	12
14	55	11	10	10	11	32	21	19	37	19	12	12
15	196	11	10	9.8	11	26	23	18	51	18	15	12
16	32	11	10	9.8	11	20	22	18	70	18	18	11
17	18	11	10	10	11	18	20	17	49	18	14	11
18	15	11	10	10	11	15	19	17	40	17	13	11
19	14	11	10	10	11	14	18	16	36	17	13	11
20	13	11	10	10	11	12	18	16	35	16	12	11
21	13	10	10	12	11	12	18	15	32	16	12	11
22	12	10	10	14	11	12	18	15	30	15	12	11
23	12	11	10	17	11	17	17	15	32	14	12	11
24	12	10	10	82	11	1,460	16	15	34	13	12	11
25	12	10	10	220	10	1,290	16	15	32	14	12	11
26	12	11	10	130	10	1,380	16	14	30	12	13	11
27	12	11	10	92	10	502	15	15	28	12	12	11
28	12	10	10	66	10	128	14	15	26	12	11	11
29	11	11	10	45		79	14	15	24	12	11	11
30	11	10	10	33	-----	71	18	15	25	12	11	11
31	11	-----	10	26	-----	54	-----	13	-----	12	11	-----
Total	618	325	309.0	932.0	327	5,669	766	591	959	525	388	329
Mean	19.9	10.8	9.97	30.1	11.7	183	25.5	19.1	32.0	16.9	12.5	11.0
Max	196	12	10	220	21	1,460	76	60	70	22	18	12
Min	10	10	9.2	9.4	10	10	14	13	13	12	11	10
Cfsm	0.259	0.141	0.130	0.392	0.152	2.38	0.332	0.249	0.417	0.220	0.163	0.143
In.	0.30	0.16	0.15	0.45	0.16	2.75	0.37	0.29	0.46	0.25	0.19	0.16

Cal yr1966: Total 9,360.1 Mean 25.6 Max 1,640 Min 9.2 Cfsm 0.333 In. 4.53
 Wtr yr1967: Total 11,738.0 Mean 32.2 Max 1,460 Min 9.2 Cfsm 0.419 In. 5.68

Peak discharge (base, 400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
10-15	0200	5.00	1,070	3-24	1730	8.02	3,050

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 1967. 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.--39 years, 24,930 cfs.

Extremes.--Maximum discharge during year, 166,000 cfs Apr. 7 (gage height, 16.92 ft); minimum daily, 8,200 cfs Dec. 4; minimum gage height, 4.92 ft Sept. 26.
1928-67: Maximum discharge, 268,000 cfs Apr. 19, 1965 (gage height, 20.77 ft, from floodmark); 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 1967 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	11,900	13,200	12,400	12,900	15,300	16,600	62,600	51,900	20,700	72,700	14,400	16,400
2	11,700	13,100	9,100	12,900	16,700	17,600	80,000	49,800	13,400	70,400	14,900	16,300
3	10,400	17,700	3,400	12,900	16,600	13,800	105,000	49,300	14,200	63,300	17,600	13,900
4	10,400	17,900	3,200	12,900	16,700	13,700	135,000	46,400	15,700	64,700	20,300	13,200
5	10,600	17,900	3,300	13,800	16,800	13,700	157,000	45,800	17,300	62,000	19,100	12,000
6	11,900	17,600	11,400	14,100	16,700	17,000	165,000	46,600	15,800	59,200	15,200	11,500
7	13,300	17,400	11,400	14,200	15,800	17,100	163,000	46,600	15,500	55,900	13,300	11,100
8	15,200	14,500	12,300	14,200	15,800	17,300	154,000	46,500	21,300	52,500	14,800	11,100
9	15,500	14,600	12,900	14,200	15,800	17,200	145,000	45,500	23,400	50,600	15,200	11,100
10	13,500	14,900	13,700	13,700	16,000	17,900	137,000	42,600	25,000	46,900	15,300	10,900
11	12,000	15,100	13,900	12,900	16,100	19,000	129,000	41,900	23,000	42,100	15,400	10,100
12	11,900	15,000	15,200	12,900	16,100	21,200	121,000	42,000	31,500	40,800	15,100	3,700
13	13,700	14,800	15,800	13,500	15,000	22,300	114,000	40,000	40,700	36,400	12,800	3,700
14	17,600	14,800	16,500	13,500	15,700	23,000	108,000	33,700	44,200	33,800	12,000	11,800
15	19,900	14,200	17,100	13,400	15,700	24,500	102,000	43,900	43,100	33,500	10,900	13,500
16	23,800	15,200	17,000	13,500	15,700	23,300	95,400	40,000	52,000	30,000	10,500	14,200
17	25,300	15,700	17,200	13,300	15,600	21,700	89,600	39,200	54,800	26,300	10,500	12,900
18	27,200	16,400	17,200	13,000	15,600	22,000	85,900	37,600	59,300	22,100	12,000	12,800
19	27,600	15,600	16,000	12,000	15,700	24,800	82,300	34,000	62,700	23,600	13,600	12,800
20	27,600	15,000	15,800	12,300	16,800	25,200	78,800	33,100	67,000	23,300	12,100	13,100
21	26,500	14,300	14,600	12,600	15,900	25,400	76,400	33,500	72,900	21,300	11,100	13,100
22	24,200	14,500	14,600	13,200	16,000	25,400	74,400	31,700	73,300	19,900	9,700	12,500
23	22,500	16,900	14,500	14,000	16,000	23,200	71,200	24,800	82,200	20,100	9,400	12,200
24	22,000	17,000	14,000	14,500	16,000	34,300	67,400	25,600	85,200	19,700	11,200	12,000
25	20,200	17,200	13,000	17,400	15,900	54,700	64,200	26,300	86,800	17,400	11,800	9,800
26	19,500	17,300	12,000	17,800	15,800	63,100	62,300	26,500	86,700	16,000	12,700	8,900
27	19,200	17,700	11,400	13,900	15,800	67,000	59,400	27,000	85,600	16,100	13,100	9,000
28	19,600	17,300	12,000	13,700	16,800	65,500	55,200	26,300	83,800	15,600	14,800	8,900
29	20,000	15,500	13,300	13,200		62,100	52,200	24,600	80,600	15,900	14,800	9,100
30	20,000	15,000	13,000	13,000	- - - -	63,600	53,800	21,500	77,100	15,800	14,900	9,400
31	19,500	- - - -	12,900	15,200	- - - -	67,800	- - - -	21,800	- - - -	14,900	15,800	- - - -
Total	564,200	483,300	415,100	444,600	448,400	956,000	2,952,100	1,151,000	1,494,800	1,103,800	429,300	351,000
Mean	18,200	16,110	13,390	14,340	16,010	30,840	98,400	37,130	49,830	35,770	13,850	11,700
Max	27,600	18,200	17,200	18,900	16,800	67,800	165,000	51,900	86,800	72,700	20,300	16,400
Min	10,400	14,200	3,200	12,000	15,000	16,600	52,200	21,500	14,200	14,900	9,400	3,700
Cfsm	0.307	0.272	0.226	0.242	0.270	0.521	1.66	0.627	0.842	0.604	0.234	0.198
In.	0.35	0.30	0.26	0.28	0.28	0.60	1.85	0.72	0.94	0.70	0.27	0.22

Cal yr 1966: Total 11,456,900 Mean 31,390 Max 105,000 Min 8,200 Cfsm 0.530 In. 7.20

Wtr yr 1967: Total 10,798,600 Mean 29,590 Max 165,000 Min 8,200 Cfsm 0.500 In. 6.78

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, 1½ 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 1967. Published as North Branch Root River near Lanesboro, 1910-17.

Gage.--Digital 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. Aug. 2, 1940 to May 19, 1966, graphic water-stage recorder at present site and datum.

Average discharge.--32 years (1911-14, 1915-17, 1940-67), 319 cfs.

Extremes.--Maximum discharge during year, 12,200 cfs Mar. 26 (gage height, 12.37 ft); minimum, 64 cfs Nov. 29 (gage height, 1.07 ft).

1910-17, 1940-67: Maximum discharge, 22,100 cfs Mar. 29, 1962 (gage height, 16.11 ft); maximum gage height, 17.83 ft Mar. 1, 1965, from floodmark, backwater from ice; minimum discharge, 29 cfs Aug. 27, 1949 (gage height, 1.08 ft).

Remarks.--Records good except those for winter months, which are fair. Diurnal fluctuation at times during medium and low flow caused by powerplant above station.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	96	103	112	97	160	130	548	756	135	217	112	98
2	95	102	116	97	150	133	935	437	130	206	116	97
3	95	100	130	97	145	134	1,540	346	128	204	116	94
4	95	105	132	97	140	138	755	293	130	201	116	94
5	95	101	131	97	135	146	512	252	132	193	114	93
6	95	101	120	98	138	156	414	233	135	185	124	93
7	96	102	114	98	138	185	365	223	157	179	164	91
8	97	103	102	98	138	362	337	214	307	179	157	90
9	97	103	99	98	134	365	313	209	2,060	193	135	89
10	95	104	105	98	128	2,070	296	201	1,540	190	124	87
11	94	104	118	98	130	5,660	267	231	1,130	179	120	86
12	101	100	119	98	138	2,570	252	284	1,310	167	114	86
13	112	105	97	98	138	1,100	261	310	1,040	160	112	93
14	164	103	97	98	126	750	252	298	730	152	110	106
15	1,720	102	96	98	126	544	258	255	832	150	135	108
16	403	103	95	99	130	490	261	231	1,690	148	143	103
17	271	102	95	99	128	410	261	214	979	146	116	103
18	211	101	95	99	120	353	261	201	655	143	110	95
19	185	94	95	99	108	362	255	185	517	141	114	93
20	164	101	95	99	104	313	247	174	526	143	110	91
21	149	100	96	102	102	272	244	164	389	185	108	90
22	135	100	97	106	100	250	239	160	372	137	108	87
23	125	101	97	119	100	1,020	231	155	356	135	108	85
24	117	101	97	400	100	4,260	225	157	334	128	106	85
25	114	101	97	3,150	100	4,700	217	152	316	124	106	84
26	111	100	97	2,270	104	5,840	214	146	301	122	108	83
27	109	100	97	1,380	110	7,660	204	141	284	120	112	82
28	108	94	97	389	120	1,970	196	141	267	118	108	82
29	106	99	97	270	-----	1,080	188	143	244	118	105	83
30	105	110	97	205	-----	830	185	143	231	114	103	84
31	105	-----	97	175	-----	710	-----	137	-----	114	99	-----
TOTAL	5,665	3,045	3,229	10,526	3,490	44,963	10,733	7,186	17,357	4,891	3,633	2,735
MEAN	183	102	104	340	125	1,450	358	232	579	158	117	91.2
MAX	1,720	110	132	3,150	160	7,660	1,540	756	2,060	217	164	108
MIN	94	94	95	97	100	130	185	137	128	114	99	82
CFSM	.30	.17	.17	.55	.20	2.36	.58	.38	.94	.26	.19	.15
IN.	.34	.18	.20	.64	.21	2.72	.65	.43	1.05	.30	.22	.17

CAL YR 1966: TOTAL 107,631 MEAN 295 MAX 11,200 MIN 86 CFSM .48 IN 6.51
 WAT YR 1967: TOTAL 117,453 MEAN 322 MAX 7,660 MIN 82 CFSM .52 IN 7.10

Peak discharge (base, 3,500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
10-15	0530	8.02	4,600	3-10	2100	11.64	10,500
1-24	2300	12.36	12,000	3-26	2230	12.35	12,200

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 1967.

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.--25 years, 54.3 cfs.

Extremes.--Maximum discharge during year, 5,170 cfs Mar. 24 (gage height, 8.65 ft, from crest-stage gage); minimum daily, 27 cfs Feb. 20-24; minimum gage height, 0.94 ft Apr. 28, 29.

1942-67: 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, 0.93 ft 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 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	31	32	32	37	33	29	60	61	37	45	34	34
2	31	31	34	36	33	30	66	44	37	44	34	34
3	32	31	35	35	32	30	56	41	37	43	34	34
4	32	31	33	34	31	30	52	40	38	42	34	34
5	32	32	33	33	30	31	50	41	38	42	34	34
6	33	32	34	32	29	31	47	40	38	41	45	34
7	33	32	34	32	28	32	46	40	40	41	39	34
8	33	31	34	33	28	33	44	42	45	41	37	34
9	32	31	34	35	28	31	43	41	134	46	37	34
10	33	31	34	34	28	40	41	46	63	40	36	34
11	33	32	33	33	28	220	41	46	46	40	36	34
12	34	32	32	33	28	95	40	41	45	38	36	34
13	53	32	31	32	28	74	40	42	44	38	36	34
14	78	32	30	32	28	65	40	42	40	38	36	57
15	90	32	30	33	28	55	38	43	368	37	36	40
16	37	32	30	34	28	74	38	41	384	38	36	36
17	35	32	30	37	28	60	37	41	70	37	36	34
18	34	31	30	38	28	44	36	41	58	37	34	34
19	34	32	30	37	28	44	36	41	54	37	35	34
20	33	32	30	36	27	45	38	41	53	39	35	34
21	33	32	30	35	27	41	36	41	53	36	34	34
22	33	32	31	34	27	41	36	41	49	35	34	34
23	33	32	33	34	27	65	34	41	46	36	34	34
24	32	32	36	35	27	2,380	34	40	46	34	34	34
25	32	32	37	145	28	1,320	34	40	47	35	34	34
26	32	32	36	55	28	1,910	34	39	46	35	35	34
27	32	32	35	43	29	480	34	38	46	34	34	35
28	32	31	35	38	29	164	33	39	45	34	34	36
29	32	32	35	36		91	33	39	45	34	34	36
30	32	32	36	35	-----	75	34	39	44	34	34	36
31	32	-----	37	34	-----	65	-----	38	-----	34	33	-----
Total	1,138	952	1,024	1,210	801	7,725	1,231	1,290	2,136	1,185	1,094	1,058
Mean	36.7	31.7	33.0	39.0	28.6	249	41.0	41.6	71.2	38.2	35.3	35.3
Max	90	32	37	145	33	2,380	66	61	384	46	45	57
Min	31	31	30	32	27	29	33	38	37	34	33	34
Cfsm	0.284	0.246	0.256	0.302	0.222	1.93	0.318	0.322	0.552	0.296	0.274	0.274
In.	0.33	0.27	0.30	0.35	0.23	2.23	0.35	0.37	0.62	0.34	0.32	0.31
Cal yr 1966 Total	17,461		Mean	47.8	Max	3,280	Min	30	Cfsm	0.371	In.	5.03
Wtr yr 1967 Total	20,844		Mean	57.1	Max	2,380	Min	27	Cfsm	0.443	In.	6.01

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 1967. 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.--45 years (1909-17, 1930-67), 645 cfs.

Extremes.--Maximum discharge during year 14,200 cfs Mar. 27 (gage height, 11.12 ft); maximum gage height, 13.12 ft Jan. 25 (from floodmark, backwater from ice); minimum daily discharge, 265 cfs Feb. 21 to Mar. 4; minimum gage height observed, 1.00 ft Nov. 29.
1909-17, 1929-67: Maximum discharge, 37,000 cfs Apr. 1, 1952 (gage height, 13.90 ft); maximum gage height, 18.32 ft Mar. 2, 1965 (backwater from ice); minimum discharge, 65 cfs Dec. 26, 1933, Feb. 25, 1935.

Remarks.--Records good except those for winter months, which are fair. Slight diurnal fluctuation at low flows caused by powerplants above station.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	275	327	300	290	750	265	1,470	764	352	607	335	275
2	275	320	305	290	650	265	1,410	922	343	584	335	275
3	280	316	310	290	580	265	1,850	736	339	560	327	280
4	280	312	312	290	530	265	1,770	630	335	555	316	280
5	275	320	320	290	480	268	1,320	569	335	523	316	280
6	275	312	320	290	460	270	1,120	532	339	500	364	280
7	270	316	320	290	430	280	995	510	373	482	373	280
8	270	312	315	290	410	290	907	500	460	478	356	280
9	275	312	310	290	390	310	852	478	3,150	482	343	280
10	275	308	300	290	370	350	798	492	3,430	478	323	280
11	275	308	295	290	350	800	760	542	2,510	464	316	280
12	285	308	295	290	340	3,940	731	555	1,800	451	304	300
13	308	306	295	290	330	3,500	707	588	2,100	433	300	320
14	401	306	295	290	310	3,000	697	602	1,620	424	296	335
15	2,091	306	295	290	300	2,600	678	560	1,440	411	293	323
16	1,360	304	295	290	290	2,200	664	528	4,550	407	312	300
17	857	304	295	290	285	2,000	640	500	2,390	407	308	289
18	688	302	295	290	280	1,700	621	487	1,660	398	293	289
19	593	302	295	290	275	1,500	598	460	1,390	390	289	288
20	528	300	295	290	270	1,400	584	438	1,230	385	286	283
21	487	300	295	295	265	1,200	584	428	1,110	402	282	280
22	451	300	295	295	265	1,080	551	415	1,020	407	286	278
23	424	298	290	310	265	1,100	532	407	933	377	282	275
24	402	298	290	340	265	4,860	514	402	882	364	282	273
25	385	296	290	400	265	10,300	500	398	838	356	282	271
26	373	296	290	3,560	265	6,070	492	390	788	347	282	271
27	360	296	290	1,700	265	13,300	478	381	745	343	282	271
28	352	294	290	1,200	265	5,090	464	377	702	339	282	271
29	343	293	290	1,050		2,420	460	373	668	335	278	273
30	335	293	290	900		1,890	456	368	635	335	275	275
31	331		290	820		1,670		364		331	275	
Total	14,378	9,165	9,262	16,670	10,200	74,448	24,203	15,696	38,467	13,355	9,473	8,535
Mean	464	306	299	538	364	2,402	807	506	1,282	431	306	284
Max	2,090	327	320	3,560	750	13,300	1,850	922	4,550	607	373	335
Min	270	293	290	290	265	265	456	364	335	331	275	271
Cfsm	0.365	0.241	0.235	0.424	0.287	1.89	0.635	0.398	1.01	0.339	0.241	0.224
In.	0.42	0.27	0.27	0.49	0.30	2.18	0.71	0.46	1.13	0.39	0.28	0.25
Cal yr 1966: Total	207,202		Mean 568		Max 12,200	Min 260	Cfsm 0.447	In. 6.07				
Wtr yr 1967: Total	243,852		Mean 668		Max 13,300	Min 265	Cfsm 0.526	In. 7.14				

Peak discharge (base, 5,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
1-25	2100	13.09	7,280	6-9	2200	7.75	5,600
3-11	1900	14.18	5,460	6-16	0800	8.36	6,630
3-27	1700	11.12	14,200				

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 1967.

Gage.--Water-stage recorder. Datum of gage is 680.41 ft above mean sea level, datum of 1929.

Average discharge.--14 years, 123 cfs.

Extremes.--Maximum discharge during year, 5,960 cfs Mar. 11 (gage height, 12.53 ft); minimum 38 cfs Aug. 17 (gage height, 0.85 ft).

1953-67: 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 winter months, which are fair.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	75	85	75	92	110	92	179	102	78	93	68	67
2	75	85	79	92	102	92	202	93	79	96	78	65
3	75	86	85	92	96	92	197	92	82	93	69	65
4	76	87	87	92	93	92	167	90	81	91	66	64
5	75	88	87	92	92	92	155	90	81	91	66	64
6	75	82	87	92	92	90	145	91	81	89	76	63
7	75	86	87	92	92	82	136	92	93	87	79	62
8	76	86	87	92	92	80	130	94	160	80	71	61
9	76	87	85	92	92	83	124	91	1150	88	72	60
10	76	88	85	92	92	330	119	102	326	87	68	60
11	76	88	85	92	92	3,050	114	120	199	84	67	60
12	80	88	87	92	92	709	113	104	163	80	66	60
13	99	87	88	92	92	252	115	98	145	79	66	61
14	94	87	88	92	92	194	118	95	128	79	65	65
15	244	87	88	92	92	172	115	94	126	78	64	73
16	148	88	88	92	92	146	104	92	354	76	64	68
17	100	87	88	92	92	126	108	90	150	78	76	64
18	93	87	88	92	92	117	108	88	128	75	68	64
19	89	87	88	92	92	112	102	88	124	74	69	64
20	88	87	88	92	92	108	103	84	119	74	69	65
21	87	89	88	92	92	102	108	86	117	74	70	65
22	86	87	88	92	92	110	102	84	110	72	72	64
23	85	88	88	92	92	203	102	84	108	72	75	64
24	84	88	89	97	92	1,600	97	85	112	68	74	64
25	85	88	91	1,200	92	1,600	96	84	110	68	74	64
26	84	88	92	482	92	1,460	97	83	105	68	72	64
27	84	88	92	262	92	1,770	96	82	104	68	73	66
28	84	88	92	230	92	357	95	84	104	68	72	66
29	83	74	92	191	92	257	95	84	101	68	70	68
30	84	74	92	155	-----	220	101	84	98	65	68	68
31	83	-----	92	122	-----	200	-----	83	-----	67	68	-----
Total	2,794	2,585	2,716	4,855	2,609	13,990	3,643	2,813	4,916	2,430	2,175	1,928
Mean	90.1	86.2	87.6	157	93.2	451	121	90.7	164	78.4	70.2	64.3
Max	244	89	92	1,200	110	3,050	202	120	1,150	96	79	73
Min	75	74	75	92	92	80	95	82	78	65	64	60
Cfsm	0.328	0.313	0.319	0.571	0.339	1.64	0.440	0.330	0.596	0.285	0.255	0.234
In.	0.38	0.35	0.37	0.66	0.35	1.89	0.49	0.38	0.66	0.33	0.29	0.26

Cal yr1966: Total 36,863 Mean 101 Max 2,000 Min 70 Cfsm 0.367 In. 4.99
 Wtr yr1967: Total 47,454 Mean 130 Max 3,050 Min 60 Cfsm 0.473 In. 6.41

Peak discharge (base, 900 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
1-25	Unkn	11.82	1,420	6- 9	1445	10.47	2,000
3-11	0800	12.53	5,960	6-16	0100	7.16	933
3-26	2215	11.72	3,850				

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 1967.

Gage.--Digital 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. October 1914 to May 18, 1964, graphic water-stage recorder at present site and datum.

Average discharge.--28 years, 173 cfs.

Extremes.--Maximum discharge during year, 3,250 cfs June 16 (gage height, 9.33 ft); minimum, 38 cfs Oct. 2; minimum gage height, 2.20 ft Feb. 11.
1909-14, 1944-67: Maximum discharge, 9,530 cfs Mar. 29, 1962; maximum gage height, 18.87 ft Mar. 1, 1965 (from floodmark, backwater from ice); no flow for several days in 1911.

Remarks.--Records good except those for period of backwater from aquatic growth, which are fair.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967

DAY	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.
1	42	90	54	50	62	58	343	206	88	258	61	51
2	40	81	53	51	61	70	1,410	209	86	214	61	49
3	44	79	51	52	61	110	2,200	180	81	190	59	47
4	45	85	51	53	59	185	853	154	79	168	56	48
5	45	77	55	53	59	180	503	138	89	157	54	51
6	44	73	63	54	59	185	389	126	94	146	74	52
7	45	78	62	54	58	190	322	123	526	136	68	52
8	44	81	66	49	58	175	274	124	966	155	69	53
9	44	79	62	50	59	183	266	116	2,350	165	64	50
10	46	78	55	50	60	781	260	153	2,790	169	60	46
11	48	77	52	50	55	2,410	234	254	2,140	178	56	48
12	134	66	54	51	57	1,530	214	270	1,720	146	53	48
13	181	72	55	52	57	717	211	217	1,390	126	51	74
14	259	71	55	51	61	395	231	188	1,150	115	52	65
15	739	76	56	49	58	296	280	165	1,410	102	53	52
16	684	75	56	50	61	240	260	147	2,910	97	52	48
17	416	76	57	50	60	220	236	135	1,960	97	55	46
18	277	71	56	50	60	195	209	132	1,030	93	62	48
19	217	62	59	50	58	179	189	126	680	88	52	47
20	180	68	59	47	60	158	188	112	510	85	48	47
21	157	70	59	46	59	145	203	111	417	80	50	47
22	142	70	52	47	57	194	192	109	347	76	57	45
23	123	72	54	56	58	588	167	118	296	73	59	44
24	116	69	50	130	59	1,170	154	115	290	72	59	40
25	109	69	48	119	57	2,020	142	116	272	70	56	43
26	105	69	46	87	52	1,680	138	115	248	68	67	45
27	103	71	46	75	55	2,400	131	101	250	66	54	43
28	101	58	51	68	56	1,090	123	99	784	64	54	42
29	91	60	49	64	-----	571	118	103	541	61	55	43
30	86	58	49	65	-----	454	153	96	339	59	52	42
31	90	-----	49	65	-----	421	-----	92	-----	61	50	-----
TOTAL	4,797	2,181	1,684	1,838	1,636	19,190	10,593	4,450	25,833	3,635	1,773	1,456
MEAN	155	72.7	54.3	59.3	58.4	619	353	144	861	117	57.2	48.5
MAX	739	90	66	130	62	2,410	2,200	270	2,910	258	74	74
MIN	40	58	46	46	52	58	118	92	79	59	48	40
CFSM	.36	.17	.13	.14	.14	1.46	.83	.34	2.03	.28	.13	.11
IN.	.42	.19	.15	.16	.14	1.68	.93	.39	2.26	.32	.16	.13
CAL YR 1966: TOTAL 58,682 MEAN 161 MAX 3,140 MIN 38 CFSM .38 IN 5.14												
WAT YR 1967: TOTAL 79,066 MEAN 217 MAX 2,910 MIN 40 CFSM .51 IN 6.92												

Peak discharge (base, 1,400 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
3-11	2030	8.37	2,670	6-9	1730	9.14	3,130
3-27	0215	8.45	2,720	6-16	0915	9.33	3,250
4-3	0400	8.52	2,760				

Note.--Backwater from aquatic vegetation, Oct. 1-14, Sept. 3-30.

5-4760. West Fork Des Moines River at Jackson, Minn.

Location.--Lat 43°37'10", long 94°59'10", in SE 1/4 sec. 24, T.102 N., R.35 W., on right bank in storage room of city powerplant in Jackson.

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

Records available.--May 1909 to December 1913, August 1930 to September 1967 (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. Oct. 27, 1942 to Dec. 15, 1965, water-stage recorder 200 ft downstream at same datum.

Average discharge.--32 years (1935-67), 267 cfs.

Extremes.--Maximum discharge during year, 1,250 cfs Apr. 3 (gage height, 7.74 ft); minimum, 4.4 cfs Sept. 24 (gage height, 2.86 ft).
1909-13, 1930-67: Maximum discharge 9,530 cfs Apr. 9, 1965; maximum gage height, 18.62 ft Apr. 6, 1965, (from floodmark, backwater from ice); no flow at times.

Remarks.--Records good except those for winter months, which are fair. Regulation at times by Yankton, Long, Shetek, and Heron Lakes.

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	24	56	35	22	17	27	334	261	82	850	130	34
2	20	43	35	22	17	57	872	307	80	840	120	31
3	19	39	36	22	16	140	1,220	271	78	814	108	28
4	19	40	36	23	16	370	1,080	237	83	700	96	31
5	23	46	38	25	16	380	957	237	91	626	84	29
6	18	46	36	18	16	360	947	249	84	574	80	28
7	17	51	37	18	16	340	981	249	138	524	75	29
8	16	66	38	19	16	320	1,000	230	135	499	70	26
9	16	45	37	21	15	300	998	205	130	768	66	22
10	13	24	37	23	15	420	1,010	189	118	847	62	20
11	16	44	39	20	14	490	900	187	128	805	58	17
12	17	41	42	18	13	480	798	181	193	725	54	17
13	12	44	38	18	13	420	748	185	305	649	51	20
14	18	46	35	18	13	360	722	189	500	580	48	22
15	62	50	33	18	13	340	689	173	620	531	54	18
16	84	56	33	18	12	320	640	159	770	490	45	17
17	89	47	35	18	12	310	613	159	860	444	44	16
18	92	42	37	18	12	301	567	153	670	395	43	13
19	86	37	39	16	12	300	483	145	534	378	40	12
20	74	44	36	15	12	330	453	131	538	351	38	12
21	65	60	35	16	12	320	450	121	540	329	35	9.7
22	65	57	31	17	12	320	435	111	545	305	39	9.2
23	62	55	27	18	12	310	395	109	560	290	35	11
24	58	53	24	26	12	350	342	108	630	254	42	6.4
25	62	52	21	25	12	480	321	102	715	235	37	13
26	55	51	20	25	13	460	316	97	831	215	64	9.7
27	54	45	17	23	14	406	310	93	890	200	65	9.7
28	55	37	18	22	18	356	299	90	900	184	47	14
29	55	32	18	21		332	281	87	880	170	42	9.2
30	51	34	20	19	-----	324	242	89	860	155	37	10
31	54	-----	21	18	-----	342	-----	87	-----	147	34	-----
Total	1,371	1,383	984	620	391	10,365	19,403	5,191	13,488	14,874	1,843	543.9
Mean	44.2	46.1	31.7	20.0	14.0	334	647	167	450	480	59.5	18.1
Max	92	66	42	26	18	490	1,220	307	900	850	130	34
Min	12	24	17	15	12	27	242	87	78	147	34	6.4
Cfsm	0.036	0.038	0.026	0.016	0.011	0.274	0.530	0.137	0.369	0.393	0.049	0.015
In.	0.04	0.04	0.03	0.02	0.01	0.32	0.59	0.16	0.41	0.45	0.06	0.02

Cal yr 1966 Total 56,891.5 Mean 156 Max 1,100 Min 1.8 Cfsm 0.128 In. 1.73
Wtr yr 1967: Total 70,456.9 Mean 193 Max 1,220 Min 6.4 Cfsm 0.158 In. 2.15

Peak discharge (base, 500 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
4- 3	1530	7.74	1,250	6-27	Unkwn	Unkwn	about 940
6-17	Unkwn	Unkwn	about 910	7- 9	2200	6.78	940

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 stations are usable in low-flow or flood-flow 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 1967

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Measurements	
					Date	Discharge (cfs)
Crow Wing River basin						
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 ^a , 1942, 1956-67	10-24-66 11-21-66 12-19-66 1-20-67 2-20-67 3-20-67 4-28-67 5-22-67 6-19-67 8-4-67 8-21-67	23.6 23.1 26.0 35.7 23.8 30.5 53.9 47.9 46.1 32.8 20.9

^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	Little Devil 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.	7.49	1961-67	4-17-67	22.43	390
4-0113.9	Little Devil Track River tributary near Grand Marais, Minn.	SE¼SE¼ sec.4, T.61 N., R.1 E., at culvert on County Highway 55, 0.2 mile above mouth, and 2.8 miles north of Grand Marais.	0.47	1966-67	4-17-67	16.41	40
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	1964-67	4-17-67	10.37	125
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	1961-67	4-17-67	15.70	1,080
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	1960-67	6-12-67	8.81	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	1960-67	4-9-67	a7.78	45
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	1966-67	6-12-67	4.66	(/)
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	1960-67	6-12-67	10.77	138
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	1964-67	6-13-67	23.00	276
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	1964-67	6-13-67	15.55	(/)
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	1960-67	6-13-67	16.76	242
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.	.42	1960-67	3-31-67	7.80	8.1
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	1959-67	3-30-67	6.38	48
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.	4.94	1961-65, 1967	6-14-67	19.29	678
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.	.20	1961-67	6-14-67	13.14	27
4-0242	South Fork Nemadji River near Holyoke, Minn.	SE¼SE¼ sec.6, T.46 N., R.16 W., at culvert on State Highway 23, 1.7 miles below Clear Creek, and 2.0 miles northwest of Holyoke.	19.4	1961-67	6-14-67	14.78	1,210

/ Discharge not determined.

a Affected by shifting control.

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.	NW¼ sec.22, T.125 N., R.46 W., at culverts on county highway, 4.1 miles north of Graceville.	-	1964-67	6-14-67	8.46	(/)
5-0477	West Branch Mustinka River tributary near Graceville, Minn.	NE¼ NW¼ sec.28, T.125 N., R.45 W., at culvert on county highway, 0.6 mile northeast of Graceville.	-	1964-67	6-14-67	8.06	49
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.	-	1965-67	6-14-67	8.48	730
5-0608	Buffalo River near Callaway, Minn.	SW¼ SW¼ sec.17, T.141 N., R.41 W., at culvert on U.S. Highway 59, 2.7 miles north of Callaway.	49.9	1960-67	5-1-67	12.85	324
5-0612	Whisky Creek at Barnesville, Minn.	SE¼ SW¼ sec.20, T.137 N., R.45 W., at culvert on State Highway 34, 0.7 mile above Blue Eagle Lake, and 1.0 mile northeast of Barnesville.	25.3	1961-64 1965-66 1967	6-14-67	4.90	(/)
5-0614	Hay Creek above Downer, Minn.	NW¼ NW¼ sec.30, T.138 N., R.45 W., at culvert on county road, 3.1 miles east of Downer.	5.81	1961-67	6-14-67	6.26	12
5-0622.8	Wild Rice River tributary near Bagley, Minn.	SW¼ NW¼ sec.21, T.146 N., R.37 W., at culvert on State Highway 92, 5.0 miles south of Bagley.	3.34	1961-67	4-17-67	9.72	68
5-0624.7	Marsh River tributary near Mahnommen, Minn.	SE¼ SW¼ sec.36, T.145 N., R.43 W., at culvert on State Highway 31, a quarter mile above mouth, and 5¼ miles west of Mahnommen.	6.57	1961-67	3-29-67	10.37	110
5-0627	Wild Rice River tributary near Twin Valley, Minn.	SW¼ SE¼ sec.12, T.144 N., R.45 W., at culvert on State Highway 31, 1½ miles above mouth, and 4½ miles northwest of Twin Valley.	2.25	1961-67	3-29-67	12.07	79
5-0628	Coon Creek near Twin Valley, Minn.	NE¼ NE¼ 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	1962-67	4-17-67	10.77	267
5-0632	South Branch Wild Rice River near Ogema, Minn.	SE¼ SE¼ sec.11, T.142 N., R.42 W., at culvert on county highway, 2 miles northwest of Ogema.	6.50	1963-67	3-29-67	8.48	72
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	1960-67	4-1-67	14.71	89
5-0737.5	South Branch Cormorant River tributary near Blackduck, Minn.	NW¼ NW¼ 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	1960-67	4-1-67	14.00	61
5-0738	Perry Creek near Shooks, Minn.	NW¼ SW¼ sec.30, T.151 N., R.30 W., at culvert on State Highway 72, 5 miles west of Shooks.	2.41	1960-67	3-29-67	b7.58	31
5-0766	Red Lake River tributary near Thief River Falls, Minn.	SW¼ SE¼ 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.	-	1962-67	3-30-67	b9.67	115
5-0781	Lost River at Gonvick, Minn.	NE¼ NE¼ 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	1960-67	3-30-67	b9.58	202
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	1960-67	4-21-64 3-31-67	8.04 b12.85	c21 109
5-0782	Lost River tributary at Clearbrook, Minn.	SW¼ NW¼ 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	1960-67	3-30-67	14.47	123
5-0784	Clearwater River tributary near Plummer, Minn.	SE¼ SE¼ sec.22, T.151 N., R.43 W., at culvert on county highway, 1½ miles above mouth, and 5½ miles southwest of Plummer.	1.17	1961-67	3-30-67	7.93	71

/ Discharge not determined.

* Operated as a continuous-record gaging station.

b Backwater from ice.

c 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)	Dis-charge (cfs)
Lake of the Woods basin							
5-1283	Pike River near Gilbert, Minn.	NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec.22, T.58 N., R.17 W., at culvert on State Highway 135, 1.1 miles west of Gilbert.	-	1966-67	3-31-67	7.17	(/)
5-1287	Pike River tributary near Wahlsten, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ 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.	-	1961-67	4-17-67	6.57	31
5-1297.1	Johnson Creek near Britt, Minn.	NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.28, T.60 N., R.18 W., at culvert adjacent to U.S. Highway 53, 0.6 mile below Sand Lake, and 5.9 miles west of Britt.	-	1961-64, 1966-67	3-28-67	8.03	17
5-1303	Boriin Creek near Chisholm, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ 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	1959-67	3-31-67	b12.63	140
Split Hand Creek basin							
5-2150	Smith Creek near Hill City, Minn.	SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.13, T.53 N., R.26 W., at culvert on U.S. Highway 169, 6 $\frac{1}{2}$ miles north of Hill City.	5.06	1961-67	5-14-61 5-23-62 5-28-63 5-6-64 6-2-65 8-7-66 4-10-67	5.15 6.02 4.45 6.28 5.70 5.67 5.48	60 238 30 282 150 140 105
Swan River basin							
5-2167	O'Brien Creek near Nashauk, Minn.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec.33, T.57 N., R.22 W., at culvert on U.S. Highway 169, 1.5 miles east of Nashauk, and 3.0 miles above Welcome Creek.	-	1959-67	3-31-67	b9.57	120
5-2169.8	Swan River tributary at Warba, Minn.	NW $\frac{1}{4}$ 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	1961-67	3-31-67	b5.68	29
Bluff Creek basin							
5-2177	Bluff Creek near Jacobson, Minn.	SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.8, T.52 N., R.23 W., at culvert on State Highway 34, 1 $\frac{1}{4}$ miles west of Jacobson.	2.95	1961-67	3-31-67	b8.15	31
Crow Wing River basin							
5-2441	Kitten Creek near Sebeke, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.15, T.137 N., R.35 W., at culvert on county highway, 3 $\frac{1}{4}$ miles above mouth, and 3 $\frac{1}{4}$ miles north of Sebeke.	9.34	1961-67	4-3-66 3-30-67	10.36 10.63	143 200
5-2442	Cat River near Nimrod, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.36, T.137 N., R.34 W., at bridge on State Highway 227, 2 $\frac{1}{2}$ miles west of Nimrod, and 3 miles above mouth.	44.3	1961-67	4-24-61 5-23-62 6-1-63 5-6-64 4-14-65 4-1-67	6.56 7.52 5.47 6.38 8.93 6.84	217 316 125 200 488 244
Platte River basin							
5-2678	Big Mink Creek tributary near Lastrup, Minn.	NW $\frac{1}{4}$ SW $\frac{1}{4}$ 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.	-	1961-67	5-23-62 3-15-63 4-13-64 4-12-65 3-15-66 3-30-67	9.27 b8.80 8.57 10.42 b10.47 10.08	14 3.3 5.8 27 21 23
5-2679	Hillman Creek near Pierz, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ 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	1964-67	3-31-67	13.93	620

/ Discharge not determined.
b 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)	Dis-charge (cfs)
Sauk River basin							
5-2703	Sauk River tributary at Spring Hill, Minn.	SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.27, T.124 N., R.33 W., at culvert on State Highway 4, 1.0 mile east of Spring Hill, and 2.7 miles above mouth.	6.42	1960-67	8-27-60 4-14-61 7-19-62 3-23-63 4-6-64 4-11-65 6-21-66 3-30-67	10.27 b12.33 10.87 b11.26 b10.08 b12.60 11.64 12.20	116 157 160 8.5 75 268 225 277
5-2703.1	Sauk River tributary near St. Martin, Minn.	SE $\frac{1}{4}$ sec.19, T.124 N., R.32 W., at culvert on county highway, $\frac{1}{4}$ miles northwest of St. Martin.	.23	1960, 1962-67	3-30-67	b10.24	12
Johnson Creek basin							
5-2718	Johnson Creek tributary at Luxemburg, Minn.	NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.30, T.123 N., R.28 W., at culverts on State Highway 15, 0.8 mile south of Luxemburg.	2.77	1965-67	8-29-64 4-12-65 3-11-66 3-30-67	7.24 9.43 b8.55 7.54	29 125 23 39
5-2720	Johnson Creek tributary near St. Augusta, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ 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.	-	1964-67	6-14-67	7.45	88
5-2723	Johnson Creek near St. Augusta, Minn.	NW $\frac{1}{4}$ SW $\frac{1}{4}$ 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.	-	1964-67	3-31-67	13.51	358
Otsego Creek basin							
5-2737	Otsego Creek near Otsego, Minn.	SW $\frac{1}{4}$ NE $\frac{1}{4}$ 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.	-	1964-67	3-30-67	8.36	263
Elk River basin							
5-2742	Stony Brook tributary near Foley, Minn.	NW $\frac{1}{4}$ sec.2, T.36 N., R.29 W., at culvert on State Highway 25, a quarter mile above mouth, and $1\frac{1}{2}$ miles south of Foley.	3.11	1960-67	3-30-67	8.80	55
Crow River basin							
5-2761	North Fork Crow River tributary near Paynesville, Minn.	NW $\frac{1}{4}$ sec.12, T.122 N., R.33 W., at culvert on county highway, 1 mile above mouth, and 3 miles west of Paynesville.	.58	1960-67	3-30-67	17.35	21
5-2783.5	Fountain Creek near Montrose, Minn.	NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.22, T.118 N., R.26 W., at culvert on County Highway 30, 3.3 miles southwest of Montrose.	6.73	1962-67	5-23-62 6-10-63 5-6-64 4-9-65 3-4-66 3-30-67	7.42 5.40 5.46 b8.14 b7.20 6.61	109 32 33 95 38 73
5-2787	Otter Creek near Lester Prairie, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ 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.	-	1961-67	3-30-67	b8.86	195
5-2787.5	Otter Creek tributary near Lester Prairie, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ 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.	-	1962-67	6-19-67	8.10	23
5-2788.5	Buffalo Creek tributary near Brown-ton, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ 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 Brown-ton.	9.45	1961-67	4-2-67	13.88	39
5-2790.3	South Fork Crow River tributary near Mayer, Minn.	NW $\frac{1}{4}$ NE $\frac{1}{4}$ 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.	-	1962-67	3-29-67	6.54	(/)
5-2803	School Lake Creek tributary near St. Michael, Minn.	NW $\frac{1}{4}$ SE $\frac{1}{4}$ 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	1964-67	5-6-64 3-4-66 3-30-67	7.34 b11.03 11.05	9.1 47 166

/ Discharge not determined.
b 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)	Dis-charge (cfs)
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.	-	1961-67	3-31-67	b9.21	8.7
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 6½ miles south of Onamia.	7.21	1960-67	6-14-67	15.79	162
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 7½ miles south of Onamia.	1.84	1960-67	6-14-67	13.85	405
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	1961-67	3-30-67	b7.18	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 ¾ miles above mouth.	3.4	1960-67	6-18-67	11.00	(f)
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 ¾ miles west of Montevideo.	0.54	1960-67	6-14-67	7.27	2.0
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	1962-67	6-16-67	7.08	(f)
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	1962-67	3-26-67	b10.89	(f)
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 2¼ miles north of Montevideo.	16.3	1959-67	6-14-67	15.14	197
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	1960-67	6-15-67	14.17	(f)
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	1960-67	3-10-67	7.86	6.8
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	1960-67	4-13-60 7-1-61 4-10-62 7-26-63 4-13-64 5-23-65 3-10-66 3-10-67	14.56 14.30 b16.79 14.76 b14.78 15.15 b15.76 b15.14	111 93 247 124 92 153 91 20
5-3138	Chetomba Creek tributary near Blomkest, Minn.	SW¼SW¼ sec.35, T.118 N., R.35 W., at culvert on U.S. Highway 71, 2¼ miles northwest of Blomkest.	.79	1959-67	7-8-67	9.70	57
5-3149	Redwood River at Ruthon, Minn.	NW¼NW¼ sec.11, T.108 N., R.44 W., at culvert on State Highway 23, 0.1 mile northeast of Ruthon.	5.90	1959-67	7-4-62 6-7-67	16.09 14.86	472 338
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 1965-67	6-15-67	6.58	47
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	1959-67	6-26-67	7.53	352
5-3166.9	Spring Creek tributary near Sleepy Eye, Minn.	NW¼ sec.25, T.111 N., R.33 W., at culvert on county highway, 0.1 mile above mouth, and 7½ miles north of Sleepy Eye.	-	1966-67	7-8-67	5.45	(f)
5-3167	Spring Creek near Sleepy Eye, Minn.	NE¼SE¼ sec.24, T.111 N., R.33 W., at culvert on county highway, ¾ miles above mouth, and 7½ miles north of Sleepy Eye.	30.0	1959-67	4-2-67	11.45	203

(f) Discharge not determined.

(f) Operated as a continuous-record gaging station.

b 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)	Dis-charge (cfs)
Minnesota River basin--continued							
5-3168	Cottonwood River tributary near Balaton, Minn.	NW $\frac{1}{4}$ sec.19, T.109 N., R.42 W., at culvert on U.S. Highway 14, 4 $\frac{1}{4}$ miles west of Balaton.	0.50	1959-67	6-7-67	5.37	20
5-3168.5	Meadow Creek tributary near Marshall, Minn.	E $\frac{1}{2}$ sec.34, T.111 N., R.41 W., at culvert on U.S. Highway 59, 1 $\frac{1}{4}$ miles above mouth, and 4 $\frac{1}{2}$ miles south of Marshall.	-	1961-67	4-30-67	14.63	(/)
5-3169	Dry Creek near Jeffers, Minn.	NE $\frac{1}{4}$ sec.31, T.108 N., R.36 W., at culvert on County Highway 10, 4 $\frac{1}{2}$ miles north of Jeffers.	3.24	1961-67	4-2-67	8.39	332
5-3169.2	Cottonwood River tributary near Sanborn, Minn.	NW $\frac{1}{4}$ sec.12, T.108 N., R.36 W., at culvert on U.S. Highway 71, 2.4 miles south of Sanborn.	-	1966-67	4-2-67	4.43	(/)
5-3178.5	Foster Creek near Alden, Minn.	NE $\frac{1}{4}$ sec.9, T.102 N., R.23 W., at culvert on U.S. Highway 16, 1.2 miles southwest of Alden.	-	1959-67	5-30-59 5-21-60 7-21-61 10-10-61 7-18-63 9-20-64 4-7-65 3-31-66 6-11-67	d4.55 d6.37 d7.55 5.83 d5.21 4.42 6.99 6.23 7.27	13 112 175 86 24 13 185 108 152
5-3181	East Branch Blue Earth River tributary near Blue Earth, Minn.	W $\frac{1}{2}$ SE $\frac{1}{4}$ sec.24, T.102 N., R.27 W., at culvert on County Highway 13, a quarter mile above mouth, and 4 $\frac{1}{4}$ miles east of Blue Earth.	-	1960-67	6-8-67	e5.29	130
5-3183	North Fork Watonwan River near Delft, Minn.	E $\frac{1}{2}$ sec.11, T.106 N., R.36 W., at culvert on U.S. Highway 71, 1 $\frac{1}{4}$ miles northwest of Delft.	13.1	1960-67	4-2-67	15.33	55
5-3202	Le Sueur River tributary near Mankato, Minn.	SE $\frac{1}{4}$ SW $\frac{1}{4}$ 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	1959-67	4-2-67	19.96	14
5-3203	Cobb River tributary near Mapleton, Minn.	SW $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1959-67	6-15-67	17.92	252
5-3204	Maple River tributary near Mapleton, Minn.	SW $\frac{1}{4}$ sec.1, T.105 N., R.27 W., at culvert on State Highway 30, 1 mile above mouth, and 3 $\frac{1}{4}$ miles west of Mapleton.	5.75	1959-67	6-8-67	19.67	260
5-3204.4	Maple River tributary near Amboy, Minn.	NW $\frac{1}{4}$ sec.19, T.105 N., R.27 W., at culvert on State Highway 30, 1 $\frac{1}{2}$ miles east of Amboy.	13.8	1959-67	6-15-67	17.85	(/)
5-3251	Minnesota River tributary near North Mankato, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ 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.	0.21	1961-67	5-18-61 5-23-62 - 9-7-64 4-6-65 2-9-66 4-30-67	8.08 5.56 (f) 4.13 b5.43 4.81 10.28	154 61 <25 23 43 39 g792
5-3301.5	Sand Creek tributary near Montgomery, Minn.	NE $\frac{1}{4}$ sec.18, T.111 N., R.22 W., at culvert on State Highway 21, 3 $\frac{1}{2}$ miles east of Montgomery.	0.29	1961-67	4-2-67	8.86	29
5-3302	Rice Lake tributary near Montgomery, Minn.	N $\frac{1}{2}$ sec.13, T.111 N., R.23 W., at culvert on State Highway 21, 1 $\frac{1}{4}$ miles above Rice Lake, and 2 $\frac{1}{2}$ miles east of Montgomery.	2.49	1960-67	3-24-67	b8.16	67
5-3303	Sand Creek near New Prague, Minn.	NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.1, T.112 N., R.23 W., at culvert on State Highway 13 and 19, 1.9 miles east of New Prague.	65	1960-67	4-3-67	10.85	294
5-3305.5	Raven Stream tributary near New Prague, Minn.	NW $\frac{1}{4}$ sec.28, T.113 N., R.23 W., at culvert on county road, 1.6 miles above mouth, and 2.3 miles northwest of New Prague.	23	1960-67	6-16-67	12.26	249
5-3306	Sand Creek tributary near Jordan, Minn.	NW $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1960-67	3-24-67	14.35	(/)

/ Discharge not determined.

< Less than.

b Backwater from ice.

d Backwater from aquatic growth.

e Backwater from debris.

f Peak stage did not reach bottom of gage.

g Estimated.

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)	Dis-charge (cfs)
St. Croix River basin							
5-3363	Moose River tributary at Moose Lake, Minn.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ 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.	-	1960-67	6-14-67	12.11	208
5-3365.5	Wolf Creek tributary near Sandstone, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ 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.	-	1960-67	6-19-67	17.43	104
5-3366	Kettle River tributary at Sandstone, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.4, T.42 N., R.20 W., at culvert on U.S. Highway 61 at Sandstone, and 0.2 mile above mouth.	-	1960-67	6-14-67	7.99	(/)
5-3382	Mission Creek near Hinckley, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.25, T.41 N., R.21 W., at culvert on U.S. Highway 23, 1.2 miles south of Hinckley.	-	1960-67	3-31-67	14.15	(/)
Vermillion River basin							
5-3459	Vermillion River tributary near Hastings, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ 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	1960-67	12-28-59 3-25-61 4-3-62 3-15-63 3-13-64 3-24-67	b15.44 15.62 b18.50 15.51 b15.59 b21.21	8.0 20 37 15 6.2 228
Cannon River basin							
5-3527	Turtle Creek tributary near Pratt, Minn.	NW $\frac{1}{4}$ sec.8, T.106 N., R.19 W., at culvert on U.S. Highway 218, 1 mile above mouth, and 1 $\frac{1}{2}$ miles southeast of Pratt.	-	1960-67	6-15-67	16.93	79
5-3528	Turtle Creek tributary near Steele Center, Minn.	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.11, T.106 N., R.20 W., at culvert on township road, 1 $\frac{1}{2}$ miles above mouth, and 1 $\frac{1}{2}$ miles northeast of Steele Center.	-	1960-67	3-4-66 6-12-67	6.32 7.04	84 114
5-3551	Little Cannon River tributary near Kenyon, Minn.	SE $\frac{1}{4}$ 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	1960-67	3-24-67	b15.08	186
5-3551.5	Pine Creek near Cannon Falls, Minn.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1960-67	3-27-60 3-20-61 3-16-63 3-24-67	1.70 1.65 1.41 5.03	c40 c36 c21 428
5-3551.8	Cannon River tributary near Miesville, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.9, T.113 N., R.17 W., at culvert on State Highway 50, 2.9 miles west of Miesville.	.086	1960-67	4-2-67	13.72	(/)
5-3552.3	Cannon River tributary near Welch, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ 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.	-	1960-67	4-2-67	8.38	15
Zumbro River basin							
5-3733.5	Zumbro River tributary near South Troy, Minn.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1962-67	6-17-62 3-16-63 3-13-64 4-8-65 3-4-66 6-15-67 6-12-67	7.65 b8.01 b7.21 7.90 b8.36 10.75 13.39	16 9.5 3.6 21 12 84 1,120
5-3737	North Fork Zumbro River tributary near Wanamingo, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.32, T.110 N., R.17 W., at culvert on County Highway 1, 3 $\frac{1}{2}$ miles above mouth, and 4 $\frac{1}{2}$ miles southwest of Wanamingo.	9.36	1960-67	6-12-67	13.39	1,120
5-3739	Trout Brook tributary near Goodhue, Minn.	SE $\frac{1}{4}$ 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	1960-67	3-24-67	b8.74	(/)
5-3744	Long Creek near Potsdam, Minn.	At quarter corner on north line of sec. 8, T.108 N., R.12 W., at culvert on county highway, 2.6 miles northeast of Potsdam.	-	1966-67	6-15-67	19.75	(/)

/ Discharge not determined.
b Backwater from ice.
c 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)
East Indian Creek basin							
5-3758	East Indian Creek tributary No. 1 near Weaver, Minn.	NW $\frac{1}{4}$ SE $\frac{1}{4}$ 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.	0.21	1962-67	5-16-65 8-7-66 10-15-66	10.34 10.65 11.01	26 31 37
Garvin Brook basin							
5-3782.9	Straight Valley Creek near Altura, Minn.	SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.3, T.107 N., R.9 W., at culvert on State Highway 248, 2.4 miles above mouth, and 3.1 miles northeast of Altura.	-	1966-67	3-26-67	12.09	(/)
5-3783	Straight Valley Creek near Rollingstone, Minn.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1959-67	3-24-67	14.48	(/)
Jethro Creek basin							
5-3791	Jethro Creek at Homer, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.32, T.107 N., R.6 W., at culvert on U.S. Highway 61, 0.1 mile above mouth, and 0.1 mile northwest of Homer.	-	1966-67	6-15-67	13.04	(/)
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	1958, 1959-64, 1965-67	3-26-67	7.87	86
5-3837	Mill Creek tributary near Chatfield, Minn.	SW $\frac{1}{4}$ NW $\frac{1}{4}$ 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	1959-67	4-15-61 3-28-62 9-18-63 9-7-64 3-3-66 6-8-67	13.74 13.57 12.54 12.09 13.14 15.92	435 405 235 141 271 780
5-3837.2	Mill Creek near Chatfield, Minn.	SE $\frac{1}{4}$ NW $\frac{1}{4}$ 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	1962-67	3-26-67	13.98	(/)
5-3838.5	Bear Creek near Grand Meadow, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.14, T.103 N., R.15 W., at bridge on county highway, 1 $\frac{1}{2}$ miles northwest of Grand Meadow, and 4 miles above North Fork Bear Creek.	13.6	1962-67	3-24-67	19.35	485
5-3841	Trout Creek tributary near Lanesboro, Minn.	SW $\frac{1}{4}$ 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	1959-67	6-9-67	17.60	550
5-3841.5	Root River tributary near Whalan, Minn.	SW $\frac{1}{4}$ sec.17, T.103 N., R.9 W., at culvert on private road, 1 $\frac{1}{2}$ miles southwest of Whalan.	.30	1959-67	6-9-67	9.82	169
5-3842	Whalan Creek near Whalan, Minn.	SE $\frac{1}{4}$ sec.21, T.103 N., R.9 W., at bridge on county highway, 1 $\frac{1}{2}$ miles southeast of Whalan, and 2 $\frac{1}{2}$ miles above mouth.	7.85	1959-67	6-25-59 3-25-61 3-28-62 9-19-65 6-9-67	16.52 16.83 16.95 18.57 20.96	c510 c562 c581 868 2,460
5-3843	Big Springs Creek near Arendahl, Minn.	NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.7, T.104 N., R.9 W., at culvert on State Highway 250, 2.0 miles west of Arendahl.	.14	1959-67	6-9-67	10.05	32
5-3844	Pine Creek near Arendahl, Minn.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1959-67	3-26-67	13.53	1,290
Iowa River basin							
5-4570.8	Rose Creek tributary near Dexter, Minn.	SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec.22, T.103 N., R.16 W., at culvert on county highway, 1 $\frac{1}{2}$ miles above mouth, and 2 $\frac{1}{2}$ miles southwest of Dexter.	1.20	1962-67	8-31-62 5-10-63 5-16-64 7-9-65 3-31-66 3-24-67	9.07 7.70 7.10 10.31 9.08 8.31	121 56 21 201 122 86

/ Discharge not determined.

* Operated as a continuous-record gaging station.

b Backwater from ice.

c 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)	Dis-charge (cfs)
Iowa River basin--continued							
5-4589.5	Shell Rock River tributary near Albert Lea, Minn.	SW $\frac{1}{4}$ SE $\frac{1}{4}$ 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.	-	1960-67	6-8-67	18.97	(\neq)
Des Moines River basin							
5-4747.5	Beaver Creek tributary near Slayton, Minn.	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.17, T.106 N., R.41 W., at culvert on State Highway 30, 2 $\frac{1}{4}$ miles west of Slayton, and 2 $\frac{1}{4}$ miles above mouth.	2.67	1961-67	4-2-67	16.74	50
5-4747.6	Beaver Creek tributary above Slayton, Minn.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec.17, T.106 N., R.41 W., at culvert on State Highway 30, three-quarter mile above mouth, and 1 $\frac{1}{2}$ miles west of Slayton.	.97	1961-67	4-2-67	17.07	(\neq)
5-4754	Warren Lake tributary near Windom, Minn.	SE $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1960-67	6-16-67	5.19	40
5-4758	West Fork Des Moines River tributary near Jackson, Minn.	NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.27, T.103 N., R.35 W., at culvert on county highway, three-quarter mile above mouth, and 5 $\frac{1}{2}$ miles north of Jackson.	1.42	1960-67	6-15-67	14.82	52
5-4759	West Fork Des Moines River tributary near Lakefield, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.32, T.103 N., R.35 W., at culvert on County Highway 19, 1 $\frac{1}{2}$ miles above mouth, and 5 $\frac{1}{2}$ miles east of Lakefield.	4.52	1960-67	6-15-67	6.50	92
5-4760.1	Nelson Creek at Jackson, Minn.	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.25, T.102 N., R.35 W., in flume spillway at intersection of U.S. Highways 16 and 71, at south edge of Jackson.	6.8	1959, 1964-67	5-6-64 4-5-65 3-14-66 6-15-67 6-15-67	13.22 >15.39 <17.48 16.06 14.03 10.38	166 g670 600 412 763
5-4761	Story Brook near Petersburg, Minn.	SW $\frac{1}{4}$ NW $\frac{1}{4}$ 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.	-	1960-67	6-15-67	10.38	763
5-4769	East Fork Des Moines River tributary near Dunnell, Minn.	SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.2, T.101 N., R.33 W., at bridge on State Highway 4, a half mile above mouth, and 1 $\frac{1}{2}$ miles north of Dunnell.	7.88	1960-67	4-2-67	11.38	111
Big Sioux River basin							
6-4829.5	Mound Creek near Hardwick, Minn.	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.15, T.104 N., R.45 W., at culvert on county highway, 2 $\frac{1}{4}$ miles northwest of Hardwick.	2.77	1959-67	4-2-67	8.35	43
6-4829.6	Mound Creek tributary at Hardwick, Minn.	SE $\frac{1}{4}$ sec.34, T.104 N., R.45 W., at culvert on U.S. Highway 75, a half mile above mouth, and 1 mile southwest of Hardwick.	.23	1959-67	6-19-67	6.47	(\neq)
6-4830.5	Rock River tributary near Luverne, Minn.	NE $\frac{1}{4}$ sec.10, T.101 N., R.45 W., at culvert on U.S. Highway 75, 5.8 miles south of Luverne.	.20	1959-67	6-19-67	13.38	(\neq)
6-4832	North Branch Kanaranzi Creek tributary near Lismore, Minn.	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.31, T.104 N., R.42 W., at culvert on county highway adjacent to State Highway 91, 60 ft above mouth, and 1 $\frac{1}{2}$ miles northeast of Lismore.	.18	1959-67	6-15-67	18.85	128
6-4832.1	North Branch Kanaranzi Creek tributary near Wilmont, Minn.	SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.15, T.103 N., R.42 W., at culvert on County Highway 15, 3 $\frac{1}{2}$ miles southwest of Wilmont and 3 $\frac{1}{2}$ miles above mouth.	-	1966-67	4-2-67	5.49	(\neq)
Little Sioux River basin							
6-6035.2	Little Sioux River tributary near Spafford, Minn.	NW $\frac{1}{4}$ NE $\frac{1}{4}$ 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	1959-67	6-15-67	6.93	42
6-6035.3	Little Sioux River near Spafford, Minn.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ 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.	-	1962-67	6-15-67	8.52	(\neq)

\neq Discharge not determined.

> Greater than.

< Less than.

a Affected by shifting control.

b Backwater from ice.

g Estimated.

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 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Red River of the North basin						
Wild Rice River	Red River of the North	On line between secs.16 and 21, T.145 N., R.37 W., at bridge on County Highway 36, 4 miles north of Zerkel, Minn.	-	-	9-18-67	1.79
Wild Rice River	Red River of the North	On line between secs.28 and 29, T.145 N., R.37 W., at bridge on State Highway 92, ¼ mile below Hier Creek and 3 miles north of Zerkel, Minn.	-	-	9-18-67	1.58
Wild Rice River Tributary	Wild Rice River	On line between secs.6 and 7, T.144 N., R.37 W., at culvert on State Highway 31, 1½ miles west of Zerkel, Minn.	-	-	9-19-67	.65
Buckboard Creek	Lower Rice Lake	On line between secs.2 and 11, T.144 N., R.38 W., at culvert on State Highway 31, 4 miles west of Zerkel, Minn.	-	-	9-19-67	1.04
Wild Rice River	Red River of the North	SE¼ sec.8, T.145 N., R.38 W., at bridge on County Highway 35, 1 mile downstream from outlet of Lower Rice Lake and 4½ miles northeast of Roy Lake, Minn.	-	-	9-19-67	.16
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.	-	1964-66	7-21-67 9-19-67	50.4 9.95
Twin Lake Creek	Wild Rice River	On line between sec.3, T.144 N., R.40 W., and sec.34, T.145 N., R.40 W., at culvert on State Highway 31, 4 miles east and 1 mile south of Beaulieu, Minn.	-	-	11-4-66 9-20-67	*5.59 1.35
Twin Lake Creek	Wild Rice River	NW¼ sec.34, T.145 N., R.40 W., at bridge on county road, 3½ miles east of Beaulieu, Minn.	-	-	11-4-66 9-20-67	*5.58 1.03
White Earth River	Wild Rice River	SW¼ sec.20, T.144 N., R.41 W., at culvert on county road, 6½ miles north of Waubun, Minn.	-	-	9-20-67	.54
White Earth River	Wild Rice River	On line between secs.6 and 1, T.144 N., R.41 and 42 W., at bridge on county road, about 1 mile above Wild Rice River and 1½ miles east of Mahnomen, Minn.	-	1964-66	7-21-67 9-20-67	19.2 a.06
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 River and ½ mile east of Mahnomen, Minn.	-	1964-66	7-21-66 9-20-67	124 13.7
Wild Rice River	Red River of the North	On line between secs.14 and 23, T.144 N., R.43 W., at bridge on County Highway 29, at Faith, Minn.	-	-	9-20-67	13.1
Spring Creek	Wild Rice River	NW¼ sec.30, T.144 N., R.42 W., at bridge on county road, 5½ miles southwest of Mahnomen, Minn.	-	-	11-4-66 9-20-67	*.95 .41
Wild Rice River Tributary	Wild Rice River	On line between secs.22 and 27, T.144 N., R.43 W., at culvert on County Highway 173, 2 miles southwest of Faith, Minn.	-	-	9-20-67	.31
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.	-	1964-66	7-21-67	.66

* Base flow.
a Estimated.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Red River of the North basin--continued						
Marsh Creek	Wild Rice River	Near intersection of secs.16, 17, 20 and 21, T.144 N., R.43 W., at bridge on County Highway 29, 5 miles northeast of Twin Valley, Minn.	-	-	11-4-66	*.27
Wild Rice River Tributary	Wild Rice River	On line between secs.5 and 6, T.143 N., R.43 W., at bridge on County Highway 36, ¾ mile south of Fossum, Minn.	-	-	9-19-67	.77
Wild Rice River Tributary	Wild Rice River	SW¼ sec.16, T.144 N., R.44 W., at foot-bridge in park at Heiberg, ¼ mile above mouth, and 1½ miles northwest of Twin Valley, Minn.	-	1964-66	7-21-67 9-19-67	.06 a.1
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, 1965-66	3-29-67 3-30-67	949 1,930
South Branch Wild Rice River Tributary	South Branch Wild Rice River	On line between secs.26 and 27, T.142 N., R.42 W., at culvert on County Highway 13, 2½ miles southwest of Ogema, Minn.	-	-	9-18-67	.70
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.	-	1964-66	7-21-67 9-18-67	.31 .36
South Branch Wild Rice River	Wild Rice River	On line between secs.23 and 26, T.142 N., R.44 W., at bridge on county road, 1¼ miles northeast of Ulen, Minn.	-	-	9-18-67	.09
South Branch Wild Rice River Tributary	South Branch Wild Rice River	NW¼NW¼ sec.20, T.142 N., R.44 W., at culvert on County Highway 42, 2½ miles northwest of Ulen, Minn.	-	-	9-18-67	.12
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.	-	1959-66	3-29-67 9-19-67	489 2.54
South Branch Wild Rice River	Wild Rice River	NW¼ sec.24, T.143 N., R.47 W., at highway bridge half a mile downstream from channel fork, 3½ miles upstream from Wild Rice River, and 3¾ miles northwest of Borup.	254	1944-49 4 1966	9-19-67	1.70
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.	-	1959-66	9-19-67	1.40
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 State Highway 31, and 3 miles east of Ada, Minn.	-	1945-51	3-29-67 3-30-67	21.9 67.9
Sandhill River	Red River of the North	N½ sec.10, T.147 N., R.41 W., at bridge on county road, 5½ miles west of Fosston, Minn.	-	-	11-1-66 9-20-67	*1.89 .81
Sandhill River Tributary	Sandhill River	On line between secs.3 and 10, T.147 N., R.41 W., at bridge on County Highway 31, 4 miles south of McIntosh, Minn.	-	-	11-1-66	*.45
Sandhill River	Red River of the North	On line between secs.26 and 27, T.147 N., R.42 W., at bridge on U.S. Highway 59, 1½ miles south of Winger, Minn.	-	-	11-1-66	*2.50
Sandhill River	Red River of the North	NE¼NE¼ sec.32, T.147 N., R.43 W., at bridge on county road, 8¼ miles west of Winger, Minn.	-	-	11-1-66	*2.44

* Base flow.

≠ Operated as a continuous-record gaging station.

a Estimated.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Red River of the North basin--continued						
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.	-	1964-66	11-2-66 7-21-67 9-21-67	*11.7 12.7 6.54
Maple Creek	Sandhill River	On line between secs.4 and 5, T.147 N., R.44 W., at bridge on State Highway 32, 2½ miles north of Fertile, Minn.	-	-	11-2-66	*.53
Sandhill Ditch	Sandhill River	NW¼ sec.28, T.147 N., R.45 W., at entrance to Sandhill Ditch, 5½ miles west of Fertile, Minn.	-	-	11-1-66 9-21-67	*16.8 13.1
Maple Creek Diversion	Sandhill Ditch	NW¼ sec.21, T.147 N., R.45 W., at culvert on County Highway 1, 6½ miles east of Beltrami, Minn.	-	-	11-1-66 9-21-67	*1.88 2.42
Sandhill Ditch	Sandhill River	SE¼NW¼ sec.21, T.147 N., R.46 W., at bridge on State Highway 9, at Beltrami, Minn.	-	1943-58	11-1-66 9-21-67	*20.6 14.6
Tamarack River	Upper Red Lake	Sec.8, T.154 N., R.30 W., at Washkish, Minn.	-	1961, 1964-66	7-20-67	*116
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.	-	1964-66	7-20-67	*2.80
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.	-	1964-66	7-20-67	*4.78
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.	-	1964-66	7-20-67	0
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.	-	1964-66	7-20-67	*9.20
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.	-	1964-66	7-20-67	*8.94
Clearwater River Diversion	Clearwater River	SW¼ sec.9, T.150 N., R.37 W., at bridge on Indian Service Road, 19 miles west of Red Lake, Minn.	-	-	11-3-66	*8.39
Poplar River	Lost 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, 1964-66	7-21-67	*3.20
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.	-	1964-66	7-21-67	0
Two Rivers	Red River of the North	SE¼SE¼ sec.12, T.161 N., R.49 W., at bridge on County Highway 3, at east edge of Hallock, and a quarter of a mile downstream from South Branch.	625	1911-14, 1929-30, 1941-43	4-1-67	991
Roseau River	Red River of the North	SW¼ sec.13, T.162 N., R.40 W., at bridge on State Highway 11, at Roseau, Minn.	-	1911-14, 1943	4-1-67	2,890

* Base flow.

/ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Lake of the Woods basin						
Isabella River	South Kawish-iwi River	NW¼NE¼ sec.6, T.61 N., R.9 W., 200 ft upstream from Bald Eagle Lake, half a mile upstream from Snake River, and 14½ miles northwest of Isabella, Minn.	341	1953-61	5-11-67 9-27-67	884 104
South Kawishiwi River	Kawishiwi River	NE¼SW¼ sec.23, T.62 N., R.11 W., 5 miles upstream from Birch Lake, and 9 miles southeast of Ely, Minn.	-	1952-61	5-19-67 9-28-67	1,090 116
Stony River	South Kawish-iwi River	NW¼NW¼ sec.17, T.60 N., R.10 W., 275 ft downstream from Slate Lake and bridge on State Highway 1, 11 miles upstream from Birch Lake, and 12¼ miles north-west of Isabella, Minn.	180	1953-65	5-19-67 9-27-67	260 61.5
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, 1958-66	4-4-67	128
Big Fork River	Rainy River	Sec.12, T.149 N., R.47 W., at bridge on County Highway 29, at Dora Lake, Minn.	-	1965-66	10-13-66 2-3-67 4-12-67 5-5-67 6-5-67 6-30-67 7-31-67 9-25-67	272 *94.6 461 658 432 155 120 *118
County Ditch No. 6	Warroad River	SW¼SE¼ sec.31, T.162 N., R.36 W., at bridge at mouth, 1 mile southwest of Warroad, Minn.	-	-	4-1-67	18.7
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.	-	1964-65	9-5-67	*1.41
Mississippi River	Gulf of Mexico	N½ sec.13, T.155 N., R.26 W., at dam at outlet of Pokegama Lake, 3½ miles northwest of Grand Rapids, Minn.	3,265	1929-30, 1944-45, 1948-55, 1957-66	1-31-67 6-29-67	1,770 1,180
Mississippi River	Gulf of Mexico	S½ sec.35, T.125 N., R.28 W., at bridge on State Highway 152, at St. Cloud, Minn.	-	-	4-4-67	25,800
Elk River basin						
Battle Brook	St. Francis River	NW¼SW¼ sec.31, T.35 N., R.26 W., at dam at outlet of Elk Lake, 2.7 miles north-west of Zimmerman, Minn.	-	1965-66	10-7-66 11-4-66 12-8-66 1-5-67 2-10-67 3-8-67 3-24-67 3-28-67 3-31-67 4-25-67 5-16-67 6-13-67 7-19-67 8-8-67 9-21-67	9.70 *9.40 11.5 *9.31 *9.38 *9.27 10.7 13.3 41.7 16.9 10.6 25.1 10.7 *9.60 *9.58
Elk River	Mississippi River	SW¼ sec.33, T.33 N., R.26 W., at bridge on County Highway 12, 1 mile above mouth, at Elk River, Minn.	-	-	3-30-67	1,540
Mississippi River main stem						
Mississippi River	Gulf of Mexico	SE¼ sec.34, T.33 N., R.26 W., on left bank in town of Elk River, and at mile 884.6 above Ohio River.	14,500	1915-56 1966	10-11-66 4-4-67	4,780 29,000

* Base flow.

 \neq Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Crow River basin						
South Fork Crow River	Crow River	On line between secs.6 and 7, T.116 N., R.29 W., at bridge on State Highway 22, at south edge of Hutchinson, Minn.	-	-	3-29-67 3-31-67	692 718
South Fork Crow River	Crow River	SE $\frac{1}{4}$ sec.11, T.118 N., R.25 W., at bridge in Delano, Minn.	-	1962-63, 1966	3-28-67 3-31-67 4-5-67	797 2,990 3,200
Rum River basin						
Rum River	Mississippi River	SE $\frac{1}{4}$ SE $\frac{1}{4}$ 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, 1965	3-30-67 3-31-67	696 1,510
Rum River	Mississippi River	W $\frac{1}{2}$ sec.30, T.35 N., R.23 W., at bridge on County Highway 5, 0.8 mile west of Isanti, Minn.	-	1958-60, 1962,1965	3-30-67 3-31-67	959 2,250
Bassett Creek basin						
Bassett Creek	Mississippi River	W $\frac{1}{2}$ sec.28, T.118 N., R.21 W., at bridge on County Highway 66 in Golden Valley, Minn., and $\frac{1}{4}$ mile west of underpass on State Highway 100.	-	1964-66	10-14-66 11-7-66 3-24-67 4-18-67 5-12-67 6-15-67 7-7-67 8-7-67 9-13-67	7.75 *1.74 49.0 41.6 10.6 28.3 *22.7 22.1 19.0
North Fork Bassett Creek	Bassett Creek	NW $\frac{1}{4}$ sec.21, T.118 N., R.21 W., at culvert on 34th Ave. North at Crystal, Minn., and $\frac{1}{4}$ mile above mouth.	-	1964-66	10-14-66 11-7-66 4-18-67 5-12-67 6-15-67 7-7-67 8-7-67 9-13-67	.84 *.04 1.02 .79 11.6 *.92 5.10 1.90
South Fork Bassett Creek	Bassett Creek	Near center of W $\frac{1}{2}$ sec.19, T.29 N., R.24 W., at culvert on Olsen Highway, Golden Valley, Minn., and $\frac{1}{4}$ mile east of State Highway 100.	-	1964-66	10-14-66 11-7-66 3-13-67 4-18-67 5-12-67 6-15-67 7-7-67 8-7-67 9-13-67	2.65 *1.47 2.67 2.21 2.14 12.8 *2.02 5.35 6.62
Bassett Creek	Mississippi River	SE $\frac{1}{4}$ sec.20, T.29 N., R.24 W., at Fruen Mill, Minneapolis, Minn., and 700 feet downstream from Glenwood Ave.	-	1952, 1954-55, 1963-66	10-14-66 11-7-66 3-24-67 4-18-67 5-12-67 6-15-67 7-7-67 8-7-67 9-13-67	11.2 *3.20 81.0 44.6 .07 78.7 *29.2 39.5 20.0
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At lower St. Anthony Falls lock and dam at Minneapolis, Minn., and 10 miles upstream from Minnesota River.	-	-	4-6-67 4-10-67 4-25-67	37,900 32,600 20,200
Mississippi River	Gulf of Mexico	At Washington Ave. and Dartmouth Ave. bridges in Minneapolis, Minn., and 9 miles upstream from Minnesota River.	-	1912, 1953-54, 1957, 1963-66	4-6-67 4-10-67 4-25-67	39,900 31,400 20,000
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, 1938-39, 1941, 1945-50, 1954, 1959, 1961-66	10-12-66 6-6-67 8-21-67 9-29-67 9-29-67	4,440 7,050 3,460 2,260 2,220

* Base flow.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Minnesota River basin						
Minnesota River	Mississippi River	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.29, T.121 N., R.45 W., at highway bridge, 0.6 mile southwest of Odessa, Minn., and 5.0 miles upstream from Yellow Bank River.	1,340	1909-12 7 1944-63 7	8-2-67	40.0
Lac qui Parle River	Minnesota River	On line between secs.27 and 34, T.117 N., R.34 W., at bridge on County Highway 56, 2 miles southeast of Dawson, Minn., and 2 $\frac{1}{4}$ miles upstream from West Branch Lac qui Parle River.	-	-	3-28-67	170
W. Br. Lac qui Parle River	Lac qui Parle River	Near center of sec.17, T.117 N., R.44 W., at bridge on U.S. Highway 75, 7 miles west of Dawson, Minn.	-	1966	3-28-67	268
Chippewa River Diversion	Minnesota River	SE $\frac{1}{4}$ sec.16, T.118 N., R.14 W., at weir at bridge on county highway, 1 mile north of Watson, Minn.	-	1943-58, 1960-66	10-26-66 11-17-66 12-13-66 1-27-67 3-1-67 3-23-67 3-30-67 4-25-67 5-17-67 6-22-67 7-18-67 9-8-67	0 0 0 0 0 0 2,010 110 0 194 0 0
Chippewa River	Minnesota River	NW $\frac{1}{4}$ sec.22, T.118 N., R.41 W., below diversion channel, at culvert and spillway, at bridge on county highway, 1 mile northeast of Watson, Minn.	-	1943-58, 1960-61	3-30-67 4-25-67 6-22-67	877 711 778
Chetomba Creek	Hawk Creek	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.9, T.116 N., R.33 W., at bridge on county highway, 1 mile east and 2 miles south of Maynard, Minn.	200	1949-51 7 1966	10-11-66 11-10-66 5-10-67 5-18-67 6-22-67 6-26-67 7-18-67 9-3-67 9-4-67	0 0 a.05 .05 .91 0 0 0 0
Redwood River	Minnesota River	On line between secs.25 and 36, T.110 N., R.43 W., at bridge on county highway, 1 $\frac{1}{4}$ miles southwest of Russell, Minn.	-	1966	10-11-66 11-10-66 5-11-67 6-26-67 7-18-67 8-11-67 9-8-67	*.39 .76 5.48 110 28.6 *.49 *.08
Coon Creek	Redwood River	On line between secs.23 and 24, T.110 N., R.43 W., at bridge on county highway, 1 mile west of Russell, Minn.	-	1966	10-11-66 11-10-66 5-11-67 6-26-67 7-18-67 8-11-67 9-8-67	0 0 4.11 12.9 3.84 *.15 0
Beaver Creek	Minnesota River	NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.22, T.113 N., R.35 W., at bridge on county highway in Beaver Falls, Minn.	-	1966	10-11-66 11-9-66 5-10-67 6-22-67 7-13-67 8-10-67 9-7-67	*4.96 7.99 17.7 282 62.7 11.8 *7.94
Little Rock Creek	Minnesota River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.30, T.111 N., R.31 W., at bridge on County Highway 21, 10 miles southeast of Fairfax, Minn.	-	1966	10-10-66 11-9-66 5-10-67 6-21-67 7-13-67 8-10-67 9-7-67	0 5.12 8.55 112 30.1 0 *1.56

* Base flow.

≠ Operated as a continuous-record gaging station.

Less than.

a Estimated.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Minnesota River basin--continued						
Cottonwood River	Minnesota River	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.8, T.109 N., R.37 W., 2 $\frac{1}{2}$ miles northwest of Lamberton, Minn.	-	-	10-13-66 5-13-67 6-29-67 7-20-67 8-16-67 9-11-67	*.35 44.1 169 *20.5 *.85 *.15
Cottonwood River	Minnesota River	On line between secs.21 and 22, T.109 N., R.33 W., at bridge on county highway, $\frac{1}{4}$ mile north of Leavenworth, Minn.	-	-	10-13-66 5-11-67 6-29-67 7-20-67 8-16-67 9-11-67	*5.36 122 350 *64.5 *8.35 *5.66
Sleepy Eye Creek	Cottonwood River	On line between secs.8 and 9, T.109 N., R.33 W., at bridge on county highway, 1 $\frac{1}{4}$ miles southeast of Cobden, Minn.	-	1966	10-13-66 5-14-67 6-29-67 7-20-67 8-16-67 9-11-67	*5.58 29.5 71.4 *15.0 *7.19 *9.17
Little Cottonwood River	Minnesota River	Near center of sec.17, T.109 N., R.29 W., at bridge on State Highway 68, $\frac{1}{2}$ mile south of Courtland, Minn.	-	1966	10-10-66 11-8-66 5-11-67 6-20-67 7-13-67 8-8-67 9-5-67	*5.63 *17.3 74.5 77.3 71.4 9.71 *10.1
Swan Lake Outlet	Minnesota River	On line between secs.27 and 28, T.109 N., R.28 W., at culvert on county highway, 4 $\frac{1}{2}$ miles south of Nicollet, Minn.	-	1966	10-10-66 11-8-66 5-14-67 6-20-67 7-11-67 8-8-67 9-5-67	*.60 *6.13 a.6 31.9 20.8 1.15 *4.74
Minnesota River	Mississippi River	E $\frac{1}{2}$ sec.33, T.109 N., R.28 W., at highway bridge, a quarter of a mile northeast of Judson, Minn., and 11 miles upstream from Blue Earth River.	11,200	1938-50 \neq	3-27-67	4,460
Blue Earth River	Minnesota River	SE $\frac{1}{4}$ sec.14, T.108 N., R.27 W., at bridge on U.S. Highway 169 at LeHillier, $\frac{3}{4}$ mile upstream from mouth, and 2 miles west of Mankato, Minn.	-	-	3-29-67	4,200
Judicial Ditch 1A	South Branch Rush River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.19, T.111 N., R.28 W., at bridge on County Highway 4, 1,000 ft upstream from County Ditch No. 9, 9 $\frac{1}{2}$ miles above mouth, and 2 miles west of New Sweden, Minn.	-	-	10-7-63 11-4-63 12-9-63 2-24-64 3-30-64 5-22-64 6-18-64 7-15-64 8-10-64 9-13-64 10-12-64 11-6-64 12-7-64 1-8-65 4-8-65 5-1-65 5-29-65 9-20-65 12-22-65 2-16-66 3-15-66 4-18-66 5-23-66 6-20-66 7-11-66 8-15-66 9-13-66 10-10-66 11-8-66	*.78 *1.93 *.02 *.32 1.24 24.6 6.57 2.58 .16 7.54 1.66 1.64 *.06 *.01 1,170 39.3 32.1 6.32 12.8 *6.79 36.0 33.9 20.6 3.23 4.24 20.1 1.20 *.36 *8.73

* Base flow.

 \neq Operated as a continuous-record gaging station.

a Estimated.

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Minnesota River basin--continued						
Judicial Ditch 1A--continued					12-5-66 1-10-67 2-14-67 3-22-67 3-30-67 4-4-67 4-16-67 5-14-67 6-7-67 7-28-67 9-6-67	*2.30 *.87 *.65 22.7 113 231 46.3 20.1 14.1 *3.76 *.65
Chaska Creek	Minnesota River	NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec.8, T.115 N., R.23 W., at bridge on U.S. Highway 212 in Chaska, Minn., and 1 mile upstream from mouth.	-	-	3-24-67	160
East Chaska Creek	Minnesota River	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.4, T.115 N., R.23 W., at bridge on U.S. Highway 212 at Chaska, Minn., and 1 mile upstream from mouth.	-	-	3-24-67	130
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At Hastings, Minn.	37,100	1929, 1931-39, 1945-48, 1950, 1953-57, 1959-66	4-6-67 5-1-67	57,700 24,700
St. Croix River basin						
Crooked Creek	St. Croix River	NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec.30, T.41 N., R.17 W., at bridge on State Highway 48, 2 $\frac{1}{2}$ miles above mouth, and 19 miles east of Hinckley, Minn.	-	1966	10-3-66 5-9-67 7-21-67 8-16-67 9-7-67 9-26-67	13.2 *54.2 *13.6 *8.76 *9.95 *9.38
Sand Creek	St. Croix River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.13, T.40 N., R.18 W., at bridge on St. Croix State Park Road, 2 $\frac{1}{2}$ miles above mouth, and 13 miles southeast of Hinckley, Minn.	-	1966	10-3-66 5-9-67 7-21-67 8-16-67 9-7-67 9-26-67	17.2 *71.6 *19.5 *11.6 *10.5 *12.2
Kettle River	St. Croix River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.16, T.45 N., R.20 W., at bridge on County Highway 46, 2 $\frac{1}{2}$ miles west of Sturgeon Lake, Minn.	-	1965-66	10-4-66 5-10-67 7-19-67 8-14-67 9-6-67 9-26-67	30.0 243 *20.1 *4.85 *4.91 *6.04
Moose River	Kettle River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.14, T.45 N., R.20 W., at bridge on County Highway 46 at Sturgeon Lake, Minn., and 1 $\frac{1}{2}$ miles above mouth.	-	1965-66	10-4-66 5-10-67 7-20-67 8-18-67 9-6-67 9-25-67	22.8 153 *36.2 *16.4 *17.8 *15.7
Kettle River	St. Croix River	SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.26, T.43 N., R.20 W., at bridge on State Highway 23, about 1 $\frac{1}{2}$ miles northeast of Sandstone, Minn.	-	1966	10-4-66 5-10-67 8-15-67 9-7-67	144 685 *82.0 *108
Kettle River	St. Croix River	NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.26, T.41 N., R.20 W., at bridge on State Highway 48, 4 $\frac{1}{2}$ miles east of Hinckley, Minn.	-	1966	3-31-67 4-4-67 6-16-67	6,810 5,290 11,500
Knife River	Snake River	SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec.27, T.40 N., R.24 W., at bridge on County Highway 77, 2 $\frac{1}{2}$ miles north of Mora, Minn.	-	1966	10-5-66 5-11-67 7-24-67 8-11-67 9-6-67 9-27-67	4.94 55.2 *8.72 *1.00 *1.85 *2.10

* Base flow.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
St. Croix River basin--continued						
Snake River	St. Croix River	SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec.14, T.39 N., R.24 W., at bridge on State Highways 23 and 65, at Mora, Minn.	-	1966	5-11-67 7-24-67 8-11-67 9-6-67 9-27-67	229 *48.9 *18.0 *32.4 *40.6
Groundhouse River	Snake River	SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.12, T.38 N., R.24 W., at bridge on county highway at Brunswick, Minn., and 2 miles above mouth.	-	1966	10-5-66 5-11-67 7-24-67 8-11-67 9-6-67 9-27-67	7.55 46.0 *12.0 *6.74 *6.76 *6.82
Rock Creek	St. Croix River	NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.7, T.37 N., R.20 W., at bridge on County Highway 3, 4 $\frac{1}{2}$ miles northeast of Rush City, Minn.	-	-	8-16-67 9-5-67 9-27-67	*1.62 *1.78 *1.65
Rush Creek	St. Croix River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.31, T.37 N., R.20 W., at bridge on County Highway 56, 3 $\frac{1}{2}$ miles southeast of Rush City, Minn.	-	-	8-16-67 9-5-67 9-27-67	*15.1 *13.0 *6.99
North Branch Sunrise River	Sunrise River	On line between secs.18 and 19, T.35 N., R.20 W., at bridge on State Highway 95, 4 miles east of North Branch, Minn.	-	-	8-16-67 9-6-67 9-27-67	*22.8 *27.4 *23.1
Mississippi River main stem						
St. Croix River	Mississippi River	At Prescott, Wis.	7,650	1939, 1946-48, 1950, 1953-57, 1959-66	4-6-67 5-1-67	28,000 5,070
Vermillion River basin						
Vermillion River	Mississippi River	SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec.33, T.115 N., R.17 W., at highway bridge in Hastings, 0.7 mile upstream from mill dam, and 3 miles upstream from Vermillion Slough.	195	1942-47, 1966	3-25-67 6-16-67	2,690 318
Cannon River basin						
Straight River	Cannon River	SE $\frac{1}{4}$ sec.9, T.107 N., R.20 W., at bridge on West Bridge Street in Owatonna, Minn.	-	1966	10-24-66 11-22-66 4-18-67 5-16-67 6-27-67 7-18-67 8-22-67 9-27-67	*23.4 *19.8 140 73.8 207 64.8 23.5 *11.0
Crane Creek	Straight River	SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.20, T.108 N., R.20 W., at culvert on service road, 1 mile north-west of Clinton Falls, Minn.	-	1965-66	10-24-66 11-22-66 12-12-66 1-20-67 2-22-67 3-20-67 4-18-67 5-15-67 6-27-67 7-24-67 8-21-67 9-27-67	*2.19 *2.10 *.94 *.86 *.38 36.4 150 55.0 125 112 26.2 *1.93
Cannon River	Mississippi River	SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.30, T.110 N., R.20 W., at mill dam above bridge on State Highway 3, in Faribault, Minn.	-	1965-66	10-21-66 11-21-66 12-12-66 1-19-67 2-21-67 3-20-67 3-24-67 4-17-67 5-15-67 6-26-67 7-18-67 8-21-67 9-27-67	*43.6 *57.0 *30.0 *9.36 34.5 67.6 188 530 171 136 159 28.9 *14.0

* Base flow.

/ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Cannon River basin--continued						
Prairie Creek	Cannon River	On line between secs.21 and 28, T.112 N., R.18 W., at bridge on State Highway 19, 4½ miles southwest of Cannon Falls, Minn.		1966	10-21-66 4-24-67 5-19-67 7-7-67 7-25-67 8-29-67 9-27-67	*8.37 19.8 *13.0 10.6 8.97 7.03 *6.39
Little Cannon River	Cannon River	SW¼ sec.25, T.112 N., R.18 W., at bridge on county highway, 2½ miles south of Cannon Falls, Minn.	-	1966	10-21-66 4-24-67 5-19-67 7-7-67 7-25-67 8-29-67 9-27-67	*14.5 29.2 *23.2 21.0 14.4 12.6 *10.7
Belle Creek	Cannon River	SE¼ sec.4, T.112 N., R.16 W., at bridge on county highway, 2 miles north of Vasa, Minn.	-	1966	11-7-66 11-25-66 5-5-67 5-22-67 7-7-67 7-25-67 8-29-67 9-27-67	*7.31 *7.94 15.8 *9.88 10.1 6.99 7.29 *5.39
Zumbro River basin						
North Branch Middle Fork Zumbro River	Middle Fork Zumbro River	W½ sec.32, T.109 N., R.15 W., at bridge on Main Street in Pine Island, Minn., and ¼ mile upstream from Middle Fork Zumbro River.	-	-	3-11-67 3-24-67	1/9 1,630
Cascade Creek	South Fork Zumbro River	NW¼NW¼ sec.4, T.106 N., R.14 W., at bridge on County Highway 34, 2½ miles west of Rochester, Minn.	-	-	6-16-67	126
Cascade Creek	South Fork Zumbro River	SW¼ sec.34, T.107 N., R.14 W., at bridge on 16th Ave. N.W., in Rochester, Minn.	-	-	3-24-67	550
Cascade Creek	South Fork Zumbro River	SE¼NW¼ sec.35, T.107 N., R.14 W., at bridge on 7th Street N.W., in Rochester, Minn.	-	1965	6-16-67	358
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At lock and dam No. 5, near Whitman, Minn.	58,800	1935-36, 1938, 1941, 1945, 1946, 1965	11-1-66 11-4-66	22,000 19,200
Burns Valley Creek basin						
Burns Valley Creek	Mississippi River	SE¼ sec.35, T.107 N., R.7 W., at bridge on County Highway 17, at southeast edge of Winona, Minn.	-	-	3-11-67	9.84
Pleasant Valley Creek basin						
Pleasant Valley Creek	Mississippi River	On line between sec.36, T.107 N., R.7 W., and sec.1, T.106 N., R.7 W., at bridge on County Highway 15, at southeast edge of Winona, Minn.	-	-	3-11-67 3-24-67	8.17 91.8
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At lock and dam No. 7, near Dreshbach, Minn.	-	1966	11-2-66	17,700
Mississippi River	Gulf of Mexico	At La Crosse, Wis.	62,800	1929-55, 1965	4-8-67 4-12-67	178,000 147,000

* Base flow.

≠ Operated as a continuous-record gaging station.

Discharge measurements made at miscellaneous sites during water year 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Root River basin						
South Branch Root River	Root River	SE $\frac{1}{4}$ sec.6, T.102 N., R.10 W., at bridge on County Highway 17, at south edge of Preston, Minn.	-	1965	3-12-67	334
South Branch Root River	Root River	NE $\frac{1}{4}$ sec.13, T.103 N., R.10 W., at bridge on road to ball park, in Lanesboro, Minn.	-	1915, 1939-42, 1965	3-12-67 6-29-67	657 143
Root River	Mississippi River	SE $\frac{1}{4}$ 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, 1965	3-12-67 3-23-67	3,850 1,040
Root River	Mississippi River	NE $\frac{1}{4}$ sec.32, T.104 N., R.4 W., at bridge on U.S. Highway 16, at Hokah, Minn.	-	-	1-26-67	4,030
Mississippi River main stem						
Mississippi River	Gulf of Mexico	At lock and dam No. 8, near Genoa, Wis.	-	1966	11-3-66	16,700
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, $3\frac{1}{4}$ miles northeast of Dundee, Minn.	-	1963-66	10-13-66 11-11-66 12-6-66 1-11-67 2-16-67 3-28-67 4-15-67 5-12-67 6-28-67 7-19-67 8-15-67 9-12-67	*.18 4.64 5.00 *1.78 *1.29 127 94.3 22.2 416 100 *.67 1.26

* Base flow.

LOW-FLOW INVESTIGATIONS

Low-flow investigations in the St. Croix River Basin

On September 5-7, 1967, a series of discharge measurements were made on many of the tributaries to the St. Croix River to study base-flow yields from various parts of the basin.

There was no rain for the 9 days preceding this period and measurements should represent base flow.

Discharge measurements made in St. Croix River basin, Minn., Sept. 5-7, 1967

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Upper Tamarack River	St. Croix River	NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.25, T.42 N., R.16 W., at bridge on County Highway 25, 1 mile east of Markville, Minn.			9-7-67	3.94
Lower Tamarack River	St. Croix River	On line between secs.21 and 28, T.42 N., R.17 W., at bridge on County Highway 41, 2 miles south of Duxburg, Minn.			9-7-67	1.99
McDermott Creek	Lower Tamarack River	On line between secs.22 and 27, T.42 N., R.17 W., at bridge on County Highway 41, 2 $\frac{1}{2}$ miles southeast of Duxburg, Minn.			9-7-67	0.99
Hay Creek	Lower Tamarack River	SE $\frac{1}{4}$ sec.30, T.42 N., R.16 W., at bridge on County Highway 73, 4 miles west of Markville, Minn.			9-7-67	2.58
Lower Tamarack River	St. Croix River	SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.32, T.42 N., R.16 W., at bridge on county highway, 3 miles southeast of Markville, Minn.			9-7-67	7.93
Crooked Creek	St. Croix River	NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec.30, T.41 N., R.17 W., at bridge on State Highway 48, 2 $\frac{1}{2}$ miles above mouth, and 19 miles east of Hinckley, Minn.		1966	*9-7-67	9.95
Sand Creek	St. Croix River	On line between secs.11 and 14, T.42 N., R.19 W., at bridge on County Highway 30, 7 miles east of Sandstone, Minn.			9-7-67	4.89
Little Sand Creek	Sand Creek	SE $\frac{1}{4}$ sec.31, T.41 N., R.18 W., at bridge on county highway, 14 miles southeast of Hinckley, Minn.			9-6-67	1.71
Sand Creek	St. Croix River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.13, T.40 N., R.18 W., at bridge on St. Croix State Park Road, 2 $\frac{1}{2}$ miles above mouth, and 13 miles southeast of Hinckley, Minn.		1966	*9-7-67	10.5
Clover Creek	Sand Creek	SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec.19, T.40 N., R.18 W., below Clayton Dam in St. Croix State Park, 15 miles southeast of Hinckley, Minn.			9-7-67	2.90
Bear Creek	St. Croix River	NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec.21, T.40 N., R.19 W., at bridge on St. Croix State Park Road, 12 miles southeast of Hinckley, Minn.			9-6-67	3.39
West Branch River	Kettle River	On line between secs.19 and 20, T.47 N., R.20 W., at bridge on State Highway 73, 3 $\frac{1}{2}$ miles northwest of Kettle River, Minn.			9-5-67	1.07
Kettle River	St. Croix River	On line between sec.5, T.46 N., R.20 W., and sec.32, T.47 N., R.20 W., at bridge on State Highway 73, 1 $\frac{1}{2}$ miles northwest of Kettle River, Minn.			9-5-67	1.51
Split Rock River	Kettle River	On line between secs.29 and 30, T.46 N., R.20 W., at bridge on county highway, 3 miles southwest of Kettle River, Minn.			9-6-67	1.16
Kettle River	St. Croix River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.16, T.45 N., R.20 W., at bridge on County Highway 46, 2 $\frac{1}{2}$ miles west of Sturgeon Lake, Minn.			*9-6-67	4.91
Birch Creek	Kettle River	On line between secs.20 and 21, T.45 N., R.20 W., $\frac{1}{4}$ mile north of County Highway 52, 3.0 miles southwest of Sturgeon Lake, Minn.			9-6-67	0.97

* 1967 water year measurements other than those shown are listed under miscellaneous measurements.

Discharge measurements made in St. Croix River basin, Minn., Sept. 5-7, 1967--continued

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Moose River	Kettle River	NE $\frac{1}{4}$ sec.1, T.46 N., R.19 W., at bridge on U.S. Highway 61, at Barnum, Minn.			9-6-67	3.96
Moose River	Kettle River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.14, T.45 N., R.20 W., at bridge on County Highway 46, at Sturgeon Lake, Minn., and 1 $\frac{1}{2}$ miles above mouth.		1965-66	*9-6-67	17.8
Willow River	Kettle River	NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.29, T.45 N., R.18 W., at bridge on County Highway 46, 3 miles northwest of Kerrick, Minn.			9-6-67	2.64
Hay Creek	Willow River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.30, T.45 N., R.18 W., at bridge on County Highway 46, 4 $\frac{1}{2}$ miles northwest of Kerrick, Minn.			9-7-67	0.13
Little Willow River	Willow River	On line between secs.1 and 12, T.44 N., R.19 W., at bridge on county highway, 3 miles northwest of Bruno, Minn.			9-6-67	1.08
Willow River	Kettle River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.2, T.44 N., R.20 W., at bridge on County Highway 41, at Willow River, Minn.			9-6-67	17.5
Pine River	Kettle River	On line between secs.22 and 27, T.44 N., R.21 W., at bridge on County Highway 50, 6 miles northwest of Rutledge, Minn.			9-7-67	6.50
Bremen Creek	Pine River	Near center of sec.22, T.44 N., R.21 W., at bridge on county highway, 7 miles northwest of Rutledge, Minn.			9-7-67	1.23
Pine River	Kettle River	On line between secs.33 and 34, T.44 N., R.20 W., at bridge on U.S. Highway 61, at Rutledge, Minn.			9-7-67	13.8
Kettle River	St. Croix River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.22, T.42 N., R.20 W., at gaging station at Sandstone Federal Correctional Institution, 1 $\frac{1}{2}$ miles south of Sandstone, Minn.			9-7-67	108
South Branch Grindstone River	Grindstone River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.23, T.41 N., R.21 W., at bridge on county highway, 2 miles northwest of Hinckley, Minn.			9-7-67	0.23
North Branch Grindstone River	Grindstone River	On line between secs.14 and 15, T.41 N., R.21 W., at bridge on county highway, 2 $\frac{1}{2}$ miles northwest of Hinckley, Minn.			9-7-67	5.65
Grindstone River	Kettle River	On line between secs.21 and 28, T.41 N., R.20 W., at bridge on State Highway 48, 3 miles east of Hinckley, Minn.			9-7-67	6.59
Kettle River	St. Croix River	On line between secs.23 and 26, T.41 N., R.20 W., at bridge on County Highway 48, 5 miles east of Hinckley, Minn.			9-7-67	124
Snake River	St. Croix River	On line between secs.32 and 33, T.45 N., R.23 W., at bridge on State Highway 65, $\frac{1}{2}$ mile north of Pliny, Minn.			9-5-67	0.14
Snake River	St. Croix River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.15, T.43 N., R.23 W., at bridge on State Highway 18, 2 miles southeast of McGrath, Minn.			9-5-67	1.09
Cowan Brook	Snake River	On line between secs.34 and 35, T.43 N., R.23 W., on County Highway 23, 4 $\frac{1}{2}$ miles northeast of Woodland, Minn.			9-5-67	0
Hay Creek	Snake River	SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.8, T.42 N., R.23 W., at bridge on State Highways 27 and 65, 1 mile north of Woodland, Minn.			9-5-67	0

* 1967 water year measurements other than those shown are listed under miscellaneous measurements.

Discharge measurements made in St. Croix River basin, Minn., Sept. 5-7, 1967--continued

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Chelsey Brook	Snake River	On line between secs.12 and 13, T.42 N., R.23 W., at bridge on county highway, 5 miles northeast of Woodland, Minn.			9-5-67	0.89
Snake River	St. Croix River	On line between secs.15 and 22, T.41 N., R.23 W., at bridge on County Highway 3, $\frac{1}{2}$ miles east of bridge over Snowshoe Brook, $3\frac{1}{2}$ miles southeast of Warman, Minn.			9-5-67	14.1
Snowshoe Brook	Snake River	On line between secs.15 and 22, T.41 N., R.23 W., at bridge on County Highway 3, 3 miles southeast of Warman, Minn.			9-5-67	0.65
Knife River	Snake River	On Kanabec-Mille Lacs County line, between sec.7, T.41 N., R.24 W., and sec.12, T.41 N., R.25 W., at bridge on State Highway 47, 7 miles west of Warman, Minn.			9-6-67	1.64
Knife River	St. Croix River	SE $\frac{1}{4}$ sec.27, T.40 N., R.24 W., at bridge on County Highway 77, $2\frac{1}{2}$ miles north of Mora, Minn.		1966	*9-6-67	1.85
Snake River	St. Croix River	SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec.14, T.39 N., R.24 W., at bridge on State Highways 23 and 65, at Mora, Minn.		1966	*9-6-67	32.4
Little Ann River	Ann River	On line between secs.23 and 26, T.40 N., R.25 W., at bridge on County Highway 26, 7 miles northwest of Mora, Minn.			9-6-67	0.09
Ann River	Snake River	SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.21, T.39 N., R.24 W., at bridge on State Highway 23, $2\frac{1}{2}$ miles southwest of Mora, Minn.			9-6-67	3.19
Ann River	Snake River	SE $\frac{1}{4}$ sec.28, T.39 N., R.24 W., at bridge on County Highway 14, $3\frac{1}{2}$ miles southwest of Mora, Minn.			9-6-67	3.83
South Fork Groundhouse River	Groundhouse River	On line between secs.12 and 13, T.38 N., R.25 W., at bridge on county highway, 3 miles southeast of Ogilvie, Minn.			9-6-67	2.24
Groundhouse River	Snake River	On line between secs.1 and 12, T.38 N., R.25 W., at bridge on county highway, 2 miles south of Ogilvie, Minn.			9-6-67	1.55
Groundhouse River	Snake River	SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.12, T.38 N., R.24 W., at bridge on county highway, at Brunswick, Minn., and 2 miles above mouth.			*9-6-67	6.76
Mud Creek	Snake River	At intersection of secs.25, 26, 35, and 36, T.40 N., R.23 W., at bridge on State Highway 23, $\frac{1}{2}$ mile northeast of Quamba, Minn.			9-6-67	0.09
Mud Creek	Snake River	NE $\frac{1}{4}$ sec.2, T.38 N., R.23 W., at bridge on County Highway 5, $1\frac{1}{2}$ miles north of Grasston, Minn.			9-7-67	1.35
Snake River	St. Croix River	SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec.12, T.38 N., R.23 W., at bridge on State Highway 70, $\frac{1}{2}$ mile south of Grasston, Minn.			9-7-67	64.1
Pokegama Creek	Snake River	NE $\frac{1}{4}$ sec.14, T.39 N., R.22 W., at bridge on County Highway 11, $4\frac{1}{2}$ miles northwest of Pine City, Minn.			9-7-67	0
Mission Creek	Snake River	NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.31, T.39 N., R.21 W., at bridge on County Highway 53, $2\frac{1}{2}$ miles west of Pine City, Minn.			9-7-67	0
Rock Creek	St. Croix River	NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec.7, T.37 N., R.20 W., at bridge on County Highway 3, $4\frac{1}{2}$ miles northeast of Rush City, Minn.			*9-5-67	1.78

* 1967 water year measurements other than those shown are listed under miscellaneous measurements.

Discharge measurements made in St. Croix River basin, Minn., Sept. 5-7, 1967--continued

Stream	Tributary to	Location	Drainage area (sq mi)	Measured previously (water years)	Measurements	
					Date	Discharge (cfs)
Rush Creek	St. Croix River	NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.31, T.37 N., R.20 W., at bridge on County Highway 56, 3 $\frac{1}{2}$ miles southeast of Rush City, Minn.			*9-5-67	13.0
Goose Creek	St. Croix River	NE $\frac{1}{4}$ sec.14, T.36 N., R.21 W., at bridge on County Highway 57, 2 $\frac{1}{2}$ miles northeast of Harris, Minn.			9-5-67	5.59
Sunrise River	St. Croix River	SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec.22, T.33 N., R.21 W., at bridge on State Highway 98, 2 miles east of Wyoming Minn.			9-6-67	2.68
West Branch Sunrise River	Sunrise River	N $\frac{1}{2}$ sec.32, T.34 N., R.21 W., at bridge on Interstate Highway 35 (under construction), at Stacy, Minn.			9-6-67	11.1
North Branch Sunrise River	Sunrise River	On line between secs.18 and 19, T.35 N., R.20 W., at bridge on State Highway 95, 4 miles east of North Branch, Minn.			*9-6-67	27.4
Sunrise River	St. Croix River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.4, T.35 N., R.20 W., at bridge on County Highway 9, at Sunrise, Minn.			-5-67	82.6
Valley Branch	St. Croix River	NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec.14, T.28 N., R.20 W., at bridge on State Highway 95, at Afton, Minn.			9-6-6	9.62

* 1967 water year

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

WATER RESOURCES DATA
FOR
MINNESOTA
1967

Part 2 Water Quality Records

Prepared in cooperation with
Minnesota Department of Conservation, Division of Waters,
Soils, and Minerals

Copies of this report may be obtained from
District Chief, Water Resources Division
U.S. Geological Survey
1002 Post Office Building
St. Paul, Minnesota 55101

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t, water temperature; s, sediment]*

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WATER RESOURCES DATA FOR MINNESOTA, 1967

Part 2. Water Quality Records

INTRODUCTION

Water-resources investigations of the U.S. Geological Survey include the collection of water quality data on the chemical and physical characteristics of surface- and ground-water supplies of the Nation. These data for the 1967 water year for the quality of surface waters in Minnesota are presented in this report. Data for a few water quality stations in bordering States are also included. The data were collected by the Water Resources Division of the U.S. Geological Survey under the direction of Charles R. Collier, District Chief.

Water quality information is presented for chemical quality, fluvial sediment, and water temperatures. The chemical quality includes concentrations of individual dissolved constituents and certain properties or characteristics such as hardness, sodium-adsorption-ratio, specific conductance, and pH. Fluvial-sediment information is given for particle-size distribution of suspended sediment and bed material. Water-temperature data represent once-daily observations except for stations where a continuous temperature recorder furnishes information from which daily minimums and maximums are obtained.

The Geological Survey has published the annual series of water-supply papers, "Quality of Surface Waters of the United States," from 1941 through 1963 which contained the chemical quality, temperature, and suspended-sediment data of the water. Each volume covered an area whose boundaries coincided with those of certain natural drainage areas. The records for Minnesota are contained in Parts 4, 5, and 6 of the water-supply paper series. (See table, p. 189.) These publications are available in most public libraries. Beginning with the 1964 water year, water quality records for surface water obtained by the Geological Survey were published in a new series of annual releases on a state boundary basis. This report is primarily for local and immediate use, and its distribution is limited. The records will be published in Geological Survey water-supply papers.

COOPERATION

Most of the records for Minnesota were obtained as a part of a cooperative program with the Minnesota Department of Conservation, Division of Waters, Soils, and Minerals, Eugene R. Gere, 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 U.S. Department of the Interior for development of the Missouri River basin.

DEFINITION OF TERMS AND ABBREVIATIONS

The terms and abbreviations of water quality and hydrologic data that are not defined in Part 1 of this report are as follows:

Discharge, in its simplest concept, means outflow; therefore, the use of this term is not restricted as to course or location. In this report it represents the total fluids measured in the stream.

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 at the time of sampling is reported instead of the daily mean, the heading of the discharge column is "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 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 solution in terms of the interreacting values of the electrically charged particles, or ions. 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})....	.02283
Fluoride (F^{-1}).....	.05264	Sulfate (SO_4^{-2}).....	.02082
Hydrogen (H^{+1}).....	.99209	Zinc (Zn^{+2}).....	.03060

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 agrees closely with recommendations made by the American Geophysical Union Subcommittee on sediment terminology (Lane and others, 1947, p. 937). The classification is as follows:

Clay:	Smaller than 0.004 mm.
Silt:	Between 0.004 and 0.062 mm.
Sand:	Between 0.062 and 2.0 mm.
Gravel:	Between 2.0 and 64.0 mm.

The particle-size distributions given in this report are not necessarily representative of the particle sizes of sediment in transport in the natural stream. Most of the organic matter is removed, and the sample is subjected to mechanical and chemical dispersion before analysis of the silt and clay.

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 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; 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 that originates mostly from disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material such as humus. The quantity, 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 quantity 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 is 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 dissolved-solids content in the water. The following general relations are applicable:

Specific conductance $\times (0.65 \pm 0.05) = \text{ppm dissolved solids}$;

$$\frac{\text{Specific conductance}}{100} = \frac{\text{total epm}}{2}$$

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.

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." 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 that continuously and automatically records, on a chart, the water temperature of a stream. "Temperature recorder" is the term used to indicate the location of the thermograph.

Time-weighted average is computed by multiplying the number of days in the sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the products by the total number of days. A time-weighted average represents the composition of water that would be contained in a vessel or reservoir that had received equal quantities of water from the stream each day for the water year.

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.

Weighted average is used in this report to indicate discharge-weighted average. It is computed by multiplying the discharge for a sampling period by the concentrations of individual constituents for the corresponding period 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 water 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 2 digits followed by a hyphen and a 6-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 6-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 5-3310 for a station whose complete identification number is 05-3310.00.

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 190 shows the locations of the water quality sampling stations.

Solutes

Data for daily chemical-quality sites include the average chemical characteristics of water for "composite periods" of about one month or less and the annual discharge-weighted average chemical characteristics of the water. The methods of collecting and compositing water samples for determining the kinds and concentrations of solutes are described by Rainwater and Thatcher (1960). One sample can define adequately the water quality at a given time if the mixture of solutes throughout the stream cross section is homogeneous. However, the concentration of solutes at different locations in the cross section may vary widely with different rates of water discharge depending on the source of material and the turbulence and mixing of the stream. Some streams must be sampled at several verticals across the channel to determine accurately the solute load. The daily chemical-quality data in this report generally represent equal-volume composites for 2- to 3-day periods; the composite periods are selected on the basis of specific conductance of the daily samples and fluctuation of water discharge.

At sites where water quality data were collected less frequently than daily, the data may represent conditions only at the time of sampling. For such sites, however, observations obtained over a period of years show relations that are useful in predicting the long-term water quality characteristics.

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 not reflect normal variations in water temperature. Most large streams have a small diurnal variation in water temperature; small, 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.

Sediment

Suspended-sediment samples were collected periodically with depth-integrating cable-suspended or hand samplers at several verticals in the stream cross section. Although data collected periodically may represent conditions only at the time of observations, such data are useful in establishing seasonal relations between quality and streamflow in predicting long-term sediment-discharge characteristics of the stream.

In addition to the records of the quantities of suspended sediment, records of periodic measurements of the particle-size distribution of the suspended sediment and the bed material are included.

WATER-SUPPLY PAPERS

The following table shows the annual series of water-supply papers that give information on quality of surface waters in Minnesota. Data 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, 1941-65

Water year	Parts 1-14	Parts 1-4	Parts 3-4	Parts 5-6	Water year	Parts 1-14	Parts 1-4	Parts 3-4	Parts 5-6
1941	942	-----	-----	-----	1954	-----	1350	-----	1351
1942	950	-----	-----	-----	1955	-----	1400	-----	1401
1943	970	-----	-----	-----	1956	-----	1450	-----	1451
1944	1022	-----	-----	-----	1957	-----	1520	-----	1521
1945	1030	-----	-----	-----	1958	-----	1571	-----	1572
1946	1050	-----	-----	-----	1959	-----	-----	1642	1643
1947	1102	-----	-----	-----	1960	-----	-----	1742	1743
1948	-----	1132	-----	1132	1961	-----	-----	1882	1883
1949	-----	1162	-----	1162	1962	-----	-----	1942	1943
1950	-----	1186	-----	1187	1963	-----	-----	1948	1949
1951	-----	1197	-----	1198	1964	-----	-----	A1955	A1956
1952	-----	1250	-----	1251	1965	-----	-----	A1962	A1963
1953	-----	1290	-----	1291					

A In preparation.

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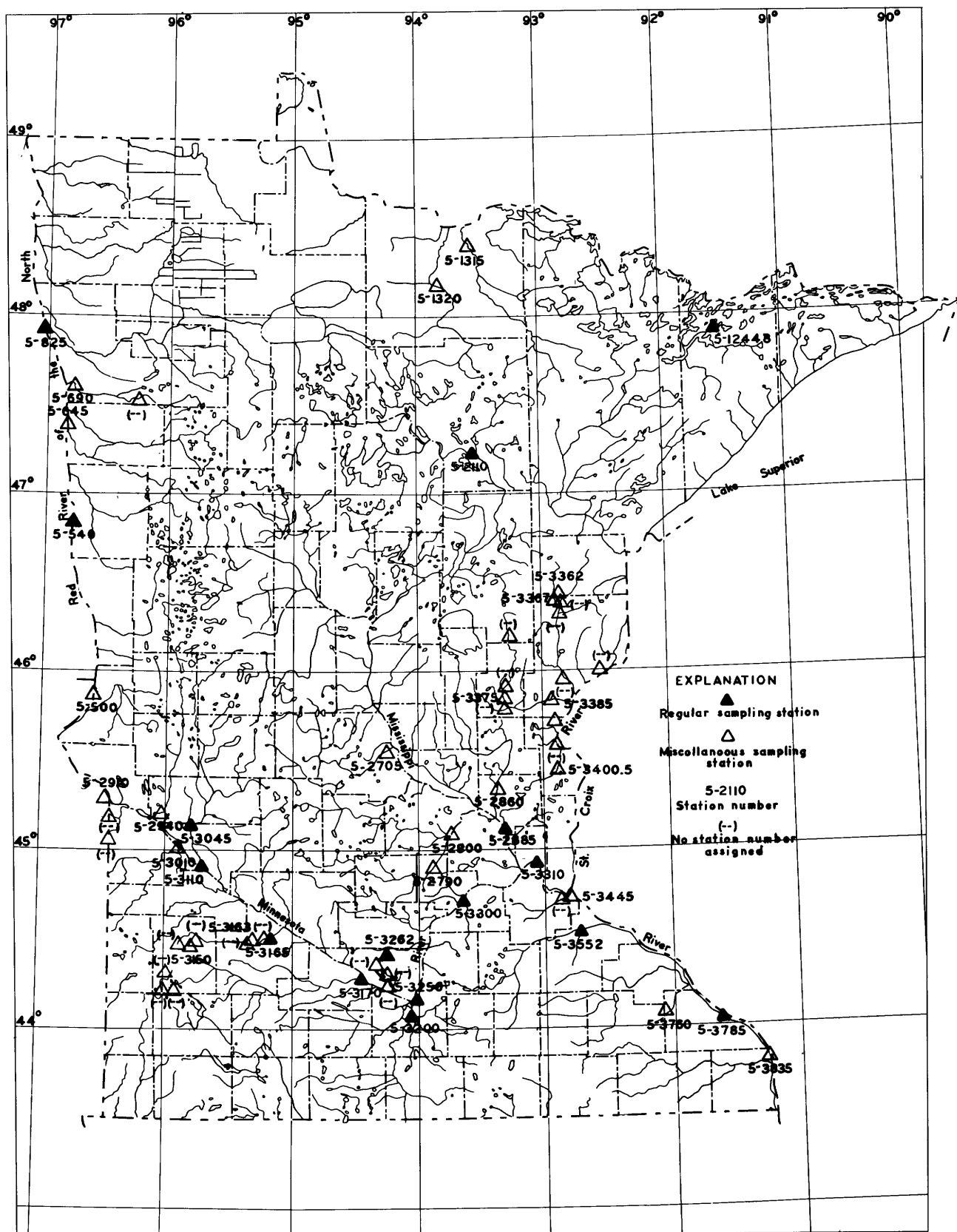


Figure 1.-- Map showing location of water-quality stations in Minnesota.

WATER QUALITY RECORDS

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

RED RIVER OF THE NORTH BASIN

5-0540. RED RIVER OF THE NORTH AT FARGO, N. DAK.

LOCATION.--Lat 46°51'40", long 96°47'00", 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 1967.

Water temperatures: October 1955 to September 1967.

EXTREMES, 1966-67.--Dissolved solids: Maximum, 460 ppm Apr. 18-24; minimum, 126 ppm Mar. 25-26.

Hardness: Maximum, 312 ppm June 25 to July 24; minimum, 126 ppm Mar. 25-26.

Specific conductance: Maximum daily, 745 micromhos July 15; minimum daily, 249 micromhos Mar. 26.

Water temperatures: Maximum, 79°F July 27; minimum, 35°F on many days during December to March.

EXTREMES, 1955-67.--Dissolved solids (1955-58, 1959-67): 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 1966 to September 1967

Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Carbonyl (CO ₂)	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 (micro-mhos at 25°C)	pH
															Parts per million	Tons per acre-foot	Tons per day	Calcium, Magnesium	Non-carbonate			
Oct. 1-16, 1966...	412	--	--	--	--	10	--	250	0	26	--	--	--	--	256	0.35	285	220	15	0.3	438	7.7
Oct. 17.....	475	11	0.02	35	30	8.5	3.9	232	6	24	4.8	0.3	0.2	0.06	241	.33	309	209	8	.3	419	8.3
Oct. 18-31.....	531	--	--	--	--	15	--	250	0	58	--	--	--	--	320	.44	459	245	40	.4	510	7.9
Nov. 1-30.....	476	--	--	--	--	18	--	268	0	63	--	--	--	--	323	.44	415	250	30	.5	534	8.2
Dec. 1-.....	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Jan. 20, 1967...	449	--	--	--	--	13	--	283	0	34	--	--	--	--	289	.39	350	245	13	.4	496	7.9
Jan. 21.....	390	14	--	44	31	10	4.9	277	0	26	5.6	.3	.2	.03	308	.42	324	236	8	.3	474	7.7
Jan. 22-Feb. 28...	394	--	--	--	--	9.8	--	286	0	27	--	--	--	--	282	.38	300	248	13	.3	496	7.6
Mar. 1-24.....	448	--	--	--	--	17	--	277	0	49	--	--	--	--	300	.41	363	248	21	.5	509	7.5
Mar. 25-26.....	1000	--	--	--	--	17	--	130	0	45	--	--	--	--	196	.27	529	126	19	.7	327	7.5
Mar. 27-29.....	2400	--	--	--	--	9.8	--	164	0	41	--	--	--	--	213	.29	1380	156	21	.3	354	7.4
Mar. 30-Apr. 2....	3818	--	--	--	--	9.6	--	150	0	66	--	--	--	--	243	.33	2500	175	52	.3	391	7.4
Apr. 3.....	2150	13	.07	46	22	14	8.9	170	0	88	4.9	.2	4.0	.05	293	.40	1700	206	67	.4	451	7.3
Apr. 4-17.....	1466	--	--	--	--	19	--	209	0	102	--	--	--	--	349	.47	1380	249	78	.5	542	7.4
Apr. 18-24.....	3444	--	--	--	--	28	--	191	0	188	--	--	--	--	460	.63	4280	309	152	.7	677	7.3
Apr. 25-May 8....	2054	--	--	--	--	33	--	229	0	166	--	--	--	--	458	.62	2540	308	120	.8	693	7.4
May 9-31.....	1430	--	--	--	--	23	--	254	0	119	--	--	--	--	393	.53	1520	292	84	.6	617	7.5
June 1-14.....	1102	--	--	--	--	16	--	255	0	47	--	--	--	--	289	.39	860	237	28	.5	478	7.9
June 15-17.....	3743	--	--	--	--	18	--	199	0	80	--	--	--	--	302	.41	3050	217	54	.5	478	8.0
June 18-21.....	5165	--	--	--	--	14	--	144	0	86	--	--	--	--	265	.36	3700	184	66	.4	404	7.8
June 22-24.....	2250	--	--	--	--	18	--	200	0	117	--	--	--	--	370	.50	2250	252	88	.5	549	7.9
June 25-July 24...	1379	--	--	--	--	22	--	259	0	133	--	--	--	--	439	.60	1630	312	99	.5	659	7.5
July 25.....	905	19	.00	58	39	34	7.6	264	0	147	8.0	.3	.3	.13	432	.61	1100	305	88	.8	694	7.9
July 26-Aug. 10...	473	--	--	--	--	29	--	274	0	120	--	--	--	--	452	.59	552	308	83	.7	664	7.7
Aug. 11-31.....	204	--	--	--	--	18	--	267	0	61	--	--	--	--	326	.44	180	263	44	.5	534	7.2
Sept. 1-15.....	98.5	--	--	--	--	14	--	257	0	48	--	--	--	--	291	.40	77.3	244	33	.4	489	7.5

RED RIVER OF THE NORTH BASIN--Continued

5-0540. RED RIVER OF THE NORTH AT FARGO, N. DAK.--Continued

Chemical analyses, in parts per million, water year October 1966 to September 1967--Continued

Date of collection	Mean discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO 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 (micro-mhos at 25°C)	pH
														Parts per million	Tons per acre-foot	Tons per day	Calcium, magnesium	Non-carbonate			
Sept. 16-25, 1967.	39.2	--	--	--	--	14	--	254	0	55	--	--	--	297	0.40	31.3	248	40	0.4	498	7.6
Sept. 26-30.....	140	--	--	--	--	15	--	261	0	51	--	--	--	297	.40	112	251	37	.4	502	7.7
Weighted average	--	--	--	--	--	19	--	232	--	97	--	--	--	353	0.48	839	259	69	0.5	554	7.5
Time-weighted average.....	881	--	--	--	--	17	--	257	--	71	--	--	--	331	--	--	258	47	0.5	537	7.6
Tons per day....	--	--	--	--	--	46	--	551	--	231	--	--	--	--	--	--	--	--	--	--	--

Additional determinations, in parts per million

Date of collection	Manganese (Mn)	Orthophosphate as PO ₄
Oct. 17, 1966.....	0.00	0.22
Apr. 3, 1967.....	.10	.62
July 25.....	.00	--

RED RIVER OF THE NORTH BASIN--Continued

5-0540. RED RIVER OF THE NORTH AT FARGO, N. DAK.--Continued

Specific conductance (micromhos at 25°C), water year October 1966 to September 1967												
Day	October	November	December	January	February	March	April	May	June	July	August	September
1.....	432	580	474	473	486	500	406	676	515	596	698	507
2.....	434	573	508	485	484	498	424	679	509	596	670	488
3.....	430	548	514	476	486	502	451	680	502	641	650	486
4.....	427	542	515	472	486	506	457	698	494	721	644	476
5.....	432	549	546	471	484	506	457	698	485	697	606	470
6.....	434	545	566	466	486	498	468	674	472	699	575	471
7.....	436	480	520	467	485	495	465	690	471	693	574	486
8.....	434	486	539	476	487	488	467	684	466	688	567	486
9.....	427	516	543	480	487	482	453	673	466	685	566	485
10.....	417	497	553	477	487	476	456	679	460	672	555	482
11.....	417	504	520	485	486	476	483	655	456	662	564	480
12.....	423	556	490	478	482	483	530	633	459	658	548	480
13.....	422	569	481	473	479	479	668	647	472	653	540	484
14.....	419	568	488	471	481	474	665	648	468	653	541	484
15.....	418	558	483	484	480	468	636	639	408	745	553	488
16.....	415	560	480	474	487	468	611	641	630	681	553	486
17.....	419	553	512	464	484	471	633	638	384	587	544	484
18.....	407	512	489	469	484	471	712	637	373	612	540	484
19.....	403	501	484	474	484	488	728	634	398	637	536	486
20.....	400	555	474	465	485	683	678	612	408	661	551	490
21.....	420	485	469	474	484	705	631	603	427	696	551	492
22.....	426	493	470	467	484	531	649	592	503	713	532	504
23.....	443	513	471	469	487	491	653	582	551	716	523	501
24.....	470	475	466	475	487	469	695	579	599	728	513	504
25.....	472	496	468	499	490	444	676	576	620	694	500	502
26.....	496	552	479	502	492	249	700	573	594	710	492	498
27.....	575	481	490	477	494	426	700	563	603	716	488	492
28.....	607	481	459	480	494	342	686	563	614	707	484	492
29.....	578	485	482	476	--	322	704	549	604	700	483	491
30.....	587	501	520	474	--	355	702	527	596	696	491	501
31.....	585	--	473	476	--	370	--	522	--	693	494	--
Average	455	523	497	475	485	471	588	627	500	677	552	488

RED RIVER OF THE NORTH BASIN--Continued

5-0540. RED RIVER OF THE NORTH AT FARGO, N. DAK.--Continued

Temperature (°F) of water, water year October 1966 to September 1967

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	58	56	56	55	55	54	55	56	57	55	53	54	54	54	53	51	50	48	47	47	47	47	47	45	45	45	47	46	46	48	45	50
November	43	41	40	39	40	40	37	36	37	36	36	36	36	36	36	36	36	36	36	37	37	36	36	37	36	36	36	36	36	36	36	37
December	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	35
January	36	37	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	36	35	35	35	35	35	36	36	35	35	35
February	35	35	35	36	36	35	35	35	35	35	36	36	36	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
March	35	35	35	35	35	35	35	35	35	36	36	36	36	37	36	35	35	37	36	37	37	37	36	35	35	36	36	36	36	36	37	35
April	56	37	39	43	44	44	43	45	46	45	45	47	47	46	48	48	49	49	49	49	48	48	46	46	46	46	47	48	49	50	49	46
May	49	48	48	48	47	50	50	51	52	52	51	51	53	53	53	55	56	58	59	59	59	59	60	62	65	65	66	67	67	67	67	56
June	65	65	66	66	68	69	68	67	67	65	67	66	66	67	67	67	70	68	70	70	70	70	68	67	66	68	69	70	71	71	67	67
July	70	71	69	68	68	68	70	70	70	72	73	73	71	71	71	71	73	74	76	78	78	78	77	78	78	79	78	78	78	78	78	73
August	78	77	75	73	73	73	74	74	72	71	71	72	72	73	74	74	75	74	74	74	73	71	71	73	73	73	73	71	70	69	68	72
September	68	67	67	66	67	68	69	69	68	65	65	65	65	64	64	64	64	65	65	65	65	65	62	62	62	62	59	57	57	57	57	64

RED RIVER OF THE NORTH BASIN--Continued

5-0825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.--Continued

Temperature (°F) of water, water year October 1966 to September 1967

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	55	54	54	51	49	47	48	48	49	49	49	48	48	48	46	44	43	43	41	41	41	41	40	40	40	40	40	40	40	40	39	45
November	37	36	34	34	34	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
December	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
January	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
February	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
March	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
April	33	34	33	34	35	35	35	38	40	40	41	42	43	43	43	44	43	41	42	43	42	40	41	40	40	40	41	42	43	42	42	39
May	42	39	37	38	39	40	43	45	46	47	46	47	48	49	52	55	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	51
June	64	64	65	65	65	64	64	64	65	64	64	64	64	64	64	64	64	67	68	69	69	68	67	67	65	65	66	66	66	66	66	65
July	70	70	68	67	66	67	68	69	70	71	72	71	70	69	70	70	71	72	73	75	76	76	75	75	74	75	75	75	74	74	74	71
August	75	75	74	72	74	73	74	70	69	68	68	68	70	72	74	76	75	72	72	71	70	69	69	69	69	69	69	69	67	67	67	70
September	66	66	66	66	66	67	68	67	66	65	64	64	62	63	62	62	62	63	63	64	63	63	63	63	60	59	57	55	53	53	53	62

RED RIVER OF THE NORTH BASIN--Continued

5-0825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.--Continued

Additional analyses, in parts per million, water year October 1966 to September 1967

Date of collection	Discharge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Carbonylate (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 (micro-mhos at 25°C)	Color or pH
															Parts per million	Tons per acre-foot	Tons per day	Calcium, magnesium	Non-carbonate			
Oct. 14, 1966..	1800	2.4	0.04	46	21	12	4.7	231	0	30	6.2	0.2	0.2	0.01	0.36	1280	202	12	0.4	426	7.6	5
Oct. 27.....	2120	5.1	.02	47	23	12	3.8	244	0	34	7.2	.2	.2	.02	.38	1590	213	13	.4	442	7.5	4
Nov. 28.....	1960	4.0	.01	54	26	13	3.7	264	0	45	7.0	.2	.2	.03	.319	1690	241	24	.4	489	7.7	11
Dec. 30.....	1750	5.1	.00	54	22	13	3.7	256	0	33	6.2	.2	1.1	.02	.42	1470	227	17	.4	471	7.4	5

Additional determinations, in parts per million

Date of collection	Discharge (cfs)	Aluminum (Al)	Cadmium (Cd)	Cobalt (Co)	Copper (Cu)	Detergents (MBAS)	Dissolved oxygen	Lead (Pb)	Lithium (Li)	Manganese (Mn)	Nickel (Ni)	Orthophosphate as PO ₄	Strontium (Sr)	Total chromium (Cr)	Zinc (Zn)
Oct. 14, 1966....	1800	0.2	0.00	0.00	0.00			0.00	0.04	0.04	0.01	0.35	0.22	0.00	0.00
Oct. 27.....	2120	.2	.00	.00	.00			.00	.02	.04	.01	.72	.24	.00	.00
Nov. 28.....	1960	.1	.00	.00	.00			.00	.03	.02	.01	.28	.26	.00	.00
Dec. 30.....	1750	.1	.00	.00	.00	0.1	8.2	.00	.01	.08	.01	1.4	.22	.00	.00
Apr. 2, 1967.....	A25200	--	--	--	--			--	--	.04	--	.60	--	--	--
July 23.....	A2730	--	--	--	--			--	--	.00	--	--	--	--	--

A Daily mean discharge.

RED RIVER OF THE NORTH BASIN--Continued

5-0825. RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.--Continued

Specific conductance (micromhos at 25°C), water year October 1966 to September 1967

Day	October	November	December	January	February	March	April	May	June	July	August	September
1.....	430	447	552	466	444	442	395	641	574	555	569	444
2.....	425	439	536	455	442	444	359	615	561	556	549	445
3.....	422	449	514	451	442	443	372	598	558	556	535	436
4.....	425	460	558	454	444	446	392	585	548	553	537	436
5.....	425	458	518	453	442	447	394	577	546	552	529	450
6.....	423	460	548	453	450	447	427	571	546	539	526	468
7.....	423	469	563	464	446	447	443	577	547	525	528	457
8.....	419	490	515	460	440	450	437	587	530	522	523	419
9.....	413	508	499	458	442	456	451	599	511	538	518	428
10.....	414	524	498	458	438	461	453	599	511	569	518	428
11.....	418	524	529	454	442	470	451	594	541	564	512	412
12.....	418	529	515	448	440	473	467	614	513	571	504	392
13.....	416	564	525	448	445	498	471	608	566	572	504	382
14.....	416	541	584	446	443	512	482	588	558	571	492	375
15.....	415	537	531	448	445	519	497	584	551	571	490	371
16.....	418	519	508	455	445	514	528	580	540	576	479	365
17.....	425	507	499	454	445	508	556	582	542	572	482	366
18.....	418	492	514	454	444	506	565	586	560	574	467	365
19.....	419	477	501	452	442	500	594	589	551	566	454	374
20.....	411	501	496	453	440	500	585	599	563	567	460	371
21.....	417	521	484	451	442	491	560	610	445	611	442	371
22.....	417	526	483	445	442	464	548	622	458	582	436	369
23.....	428	513	485	443	442	474	525	621	476	545	436	359
24.....	420	501	482	442	445	469	513	614	480	533	435	379
25.....	424	501	487	442	445	464	544	615	497	541	428	372
26.....	422	483	480	446	448	472	584	613	525	546	427	370
27.....	439	488	480	454	449	469	598	604	548	552	436	384
28.....	444	483	491	454	446	510	603	593	551	568	436	390
29.....	438	493	464	451	--	537	616	589	555	570	432	384
30.....	440	490	452	446	--	537	629	580	562	570	446	388
31.....	439	--	438	447	--	408	--	577	--	566	453	--
Average	423	496	507	451	443	475	501	597	533	560	483	398

LAKE OF THE WOODS BASIN

5-1244.8. KAWISHIWI RIVER NEAR ELY, MINN.
(Hydrologic bench-mark station)

LOCATION.--Lat 47°55'22", long 91°32'06", temperature recorder at gaging station on left bank, 2 miles upstream from South Kawishiwi River, 2.2 miles southwest of Fernberg Lookout Tower, and 14 miles east of Ely, Lake County.
RECORDS AVAILABLE.--Water temperatures: July 1966 to September 1967.
EXTREMES, 1966-67.--Water temperatures: Maximum, 71°F on several days during July; minimum, freezing point on many days during January to March.
EXTREMES, July 1966 to September 1967.--Water temperatures: Maximum, 76°F July 24, 25, 1966; minimum, freezing point on many days during winter months.

Chemical analyses, in parts per million, water year October 1966 to September 1967

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) (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 (micro-mhos at 25°C)	pH	Color	
																	Calcium	Non-carbonate					
Oct. 18, 1966	30.9	4.7	0.2	0.12	0.04	2.9	1.4	1.0	0.5	14	0	3.5	0.7	0.0	0.5	0.00	37	13	1	0.1	32	6.8	25
Jan. 19, 1967	39.9	3.5	.4	.13	.02	4.8	1.1	1.1	.5	13	0	5.5	.8	.1	.3	.03	35	16	5	.1	35	7.0	32
Apr. 25.....	934	1.4	.4	.14	.06	3.2	1.4	1.2	.7	15	0	4.5	.6	.1	.0	.02	28	14	1	.1	31	6.7	32
Aug. 2.....	119	3.8	.1	.10	.00	3.2	1.3	1.2	.4	13	0	5.8	.3	.0	.4	.00	33	13	2	.1	38	6.8	29
Aug. 31.....	72.9	3.3	.8	.14	.12	3.0	1.1	1.1	.2	11	0	3.5	.4	.0	.4	.02	38	12	3	.1	33	6.5	37

LAKE OF THE WOODS BASIN--Continued

5-1244.8. KAWISHIWI RIVER NEAR ELY, MINN.--Continued

Temperature (°F) of water, water year October 1966 to September 1967
 (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	55	54	54	54	52	52	53	54	54	53	51	50	50	49	49	46	46	45	44	44	44	44	44	43	43	43	42	42	42	42	42	47
	54	54	54	52	52	52	52	52	53	51	50	49	49	49	46	45	45	44	44	44	44	43	43	43	42	42	42	42	42	42	41	47
November	41	40	40	40	39	39	39	39	39	39	39	39	39	39	39	39	38	38	38	38	37	37	37	37	37	37	37	36	36	36	38	38
	40	40	40	39	39	39	39	39	39	39	39	39	39	39	39	38	38	38	38	37	37	37	37	37	37	37	36	36	36	36	38	
December	36	36	35	35	35	35	35	35	34	34	34	34	34	34	35	35	36	34	34	34	34	33	33	33	33	33	33	33	33	33	34	34
	36	35	35	35	35	35	35	34	34	34	34	34	34	34	34	34	34	34	34	33	33	33	33	33	33	33	33	33	33	33	33	33
January	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	33	33	33	33	33	33	33	32	32
	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	33	33	33	33	33	33	33	32	32
February	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32
	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32
March	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32	32
	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32	32
April	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
May	33	33	33	33	33	33	33	33	33	33	33	33	33	33	36	36	36	36	36	36	36	36	37	39	42	42	42	42	43	43	43	36
	33	33	33	33	33	33	33	33	33	33	33	33	33	33	35	35	35	35	35	35	35	36	36	39	42	42	42	42	42	43	43	36
June	43	43	43	43	43	44	44	44	44	44	44	45	47	48	48	48	48	49	50	51	51	52	53	54	55	56	57	59	59	59	60	49
	43	43	43	43	43	43	44	44	44	44	44	45	46	46	48	48	48	49	50	50	51	51	52	53	54	55	56	57	59	59	59	48
July	63	64	65	64	64	66	65	65	65	65	64	64	64	64	64	64	64	64	65	65	65	65	65	65	65	65	65	62	63	63	64	64
	60	63	64	64	63	64	65	65	65	64	64	64	64	64	64	64	64	64	64	65	65	65	65	65	65	65	65	62	62	63	63	63
August	63	63	63	63	63	63	63	63	64	64	64	64	64	64	64	64	64	65	66	66	67	69	71	71	71	71	71	71	71	70	70	66
	63	63	63	63	63	63	63	63	63	64	64	64	64	64	64	64	64	64	65	66	66	67	69	71	71	71	71	71	71	70	70	66
September	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
October	70	70	70	70	70	70	70	70	70	70	70	69	69	68	68	68	68	68	68	68	68	68	67	67	67	66	64	64	63	62	61	67
	70	70	70	70	70	70	70	70	70	70	70	69	68	68	68	68	68	68	68	68	68	68	67	67	66	64	63	62	61	61	61	67

5-3262. JUDICIAL DITCH NO. 1-A NEAR NEW SWEDEN, MINN.

LOCATION.--Lat 44°24'40", long 94°15'02", at bridge on Nicollet County Highway No. 4, 1,000 feet upstream from County Ditch No. 9, 9.5 miles upstream from mouth, and 3 miles west of New Sweden, Nicollet County.

RECORDS AVAILABLE.--Chemical analyses: April to September 1967 (discontinued).

Chemical analyses, in parts per million, April to September 1967

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)	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 (micro-mhos at 25°C)	Color or pH
Apr. 14, 1967	A38					138	38	8.3	4.0		183	15		41		699	501	0.2	899	
Apr. 23.....	A22					149	37	8.2	3.6		188	16		48		711	523	.2	942	
May 1.....	A235					109	20	8.7	4.1		127	16		56		529	555	.2	676	
May 7.....	A32					152	42	8.7	4.1		201	10		51		753	553	.2	982	
May 16.....	A22					140	46	9.9	3.2		188	17		44		740	537	.2	959	
May 23.....	A9.2					122	47	11	3.6		177	19		36		694	498	.2	905	
May 30.....	A6.5					114	49	13	3.4		173	19		26		669	486	.3	898	
June 4.....	A13.2					110	42	11	4.2		178	16		22		630	446	.2	834	
June 7.....	A14.6					123	43	12	3.2		141	18		22		674	484	.2	885	
June 11.....	A43					100	44	9.8	3.1		138	14		40		573	430	.2	806	
June 17.....	A105					125	46	10	2.9		144	15		36		651	501	.2	916	
June 24.....	A28					125	46	10	2.9		142	13		23		624	501	.2	902	
July 2.....	A19					128	46	11	3.4		157	16		1.0		638	508	.2	934	
July 11.....	A62					105	42	8.0	4.0		158	12		39		581	434	.2	791	
July 16.....	A62					138	46	10	3.6		160	14		25		667	534	.2	934	
July 24.....	A5.8					108	50	18	6.8		178	18		11		619	475	.4	897	
July 28.....	3.76					120	52	14	3.8		181	14		12		650	514	.3	932	
Sept. 6.....	.65	5.8	0.1	0.11	0.17	86	52	23	5.5	308	0	30	0.4	.2	0.06	586	428	.5	867	8.1

A Estimated.

Periodic determinations of suspended-sediment discharge, water year October 1966 to September 1967
(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 tem- per- ature (° F)	Sam- pling point	Discharge (cfs)	Sediment concen- tration (ppm)	Sediment discharge (tons per day)	Suspended sediment										Method of analysis
							Percent finer than size indicated, in millimeters										
							0.002	0.004	0.008	0.016	0.031	0.062	0.125	0.250	0.500	1.000	
Mar. 30, 1967.....	1400	40		113	407	124											
Apr. 4.....	1100	42		231	246	153											
Apr. 8.....	1045	--		62	244	41											
Apr. 14.....	1445	--		39	429	45											
Apr. 19.....	1400	--		33	334	30											
Apr. 23.....	1915	--		22	285	17											
May 1.....	1745	--		232	339	212											
May 2.....	0830	--		232	436	273											
May 7.....	1500	--		33	347	31											
May 14.....	1320	58		20	287	15											
May 16.....	1930	--		21	258	15											
May 21.....	1530	--		12	239	7.7											
May 23.....	1845	--		9.8	256	6.8											
May 30.....	1830	--		7.0	204	3.9											

MISSISSIPPI RIVER MAIN STEM

5-3310. MISSISSIPPI RIVER AT ST. PAUL, MINN.

LOCATION.--Lat 44°56'40", long 93°05'20", 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 1967.

EXTREMES, 1966-67.--Water temperatures: Maximum, 84°F July 22; minimum, freezing point on many days during December to March.

EXTREMES, 1956-67.--Water temperatures: Maximum, 87°F July 24-28, 1964; minimum, freezing point on many days during winter months.

REMARKS.--Recorder stopped July 31 to Aug. 21.

Temperature (°F) of water, water year October 1966 to September 1967 (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	62	61	60	60	59	58	57	58	58	58	57	57	56	56	54	53	53	52	52	51	51	51	51	51	50	48	48	48	48	47	47	53	
Minimum	60	60	59	58	58	56	56	57	58	57	57	55	54	53	51	50	49	48	49	47	48	48	47	46	44	45	45	45	44	43	41	51	
November																																	
Maximum	46	45	45	44	43	42	43	43	42	42	43	42	42	42	38	42	42	42	40	39	40	39	39	39	39	39	39	39	39	40	41	41	
Minimum	41	41	40	39	38	37	39	38	38	38	37	37	36	35	37	37	37	36	35	33	33	34	35	36	36	36	36	36	35	34	36	36	
December																																	
Maximum	39	39	39	38	38	37	37	37	37	36	35	36	36	36	36	35	35	36	36	36	36	35	35	35	35	35	35	34	33	33	34	35	
Minimum	34	35	34	32	34	32	32	33	33	32	32	32	32	32	34	32	33	35	32	32	34	33	32	34	35	32	32	32	32	32	32	32	
January																																	
Maximum	33	33	33	33	34	34	34	34	34	33	33	33	33	34	34	34	34	34	34	34	34	32	32	32	32	32	32	33	33	32	32	33	
Minimum	32	32	32	32	32	32	32	33	32	32	32	32	32	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	
February																																	
Maximum	32	32	32	32	32	32	32	32	32	32	32	32	32	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	32	
Minimum	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	
March																																	
Maximum	33	33	34	35	36	36	37	38	38	38	39	40	40	40	40	41	42	41	42	43	44	44	44	45	46	45	45	43	42	43	40	42	40
Minimum	32	32	33	34	35	34	34	34	34	38	37	39	36	38	37	38	38	38	40	40	40	42	42	43	42	42	39	39	38	39	39	40	37
April																																	
Maximum	41	41	41	41	41	43	43	43	44	44	45	46	46	47	47	47	47	48	48	49	49	49	49	49	49	49	50	51	51	53	51	46	
Minimum	40	41	41	41	41	41	43	43	43	44	44	45	46	46	47	47	47	47	48	48	49	49	49	49	49	49	49	50	51	51	51	45	
May																																	
Maximum	53	53	53	52	52	53	53	54	56	56	56	57	57	58	59	61	63	64	64	64	63	64	65	66	68	69	69	68	70	70	70	60	
Minimum	52	53	52	52	52	52	53	53	54	56	55	56	56	57	58	59	60	62	62	62	62	62	62	63	63	66	66	66	66	68	68	59	
June																																	
Maximum	70	72	73	73	74	74	74	73	72	72	72	72	75	77	78	79	80	80	77	78	78	78	79	79	79	79	79	78	79	80	80	76	
Minimum	68	69	70	71	72	72	72	71	71	71	71	71	72	75	77	77	77	77	76	77	77	78	78	79	79	79	78	77	78	77	78	74	
July																																	
Maximum	80	80	78	79	78	77	77	77	78	79	80	80	79	79	78	77	77	79	80	81	81	84	83	83	82	82	80	80	80	80	79	79	
Minimum	80	78	78	78	77	77	77	77	77	77	79	79	78	78	76	76	75	76	76	78	79	80	80	79	81	80	80	79	80	79	80	78	
August																																	
Maximum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Minimum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
September																																	
Maximum	70	70	70	69	69	69	69	70	70	69	69	69	68	67	67	67	67	68	67	69	69	69	68	67	65	65	64	63	62	61	--	67	
Minimum	70	70	69	68	68	67	68	68	69	69	69	68	67	67	66	67	67	66	67	67	67	67	67	67	65	64	63	62	61	--	66		

Chemical analyses, in parts per million, water year October 1966 to September 1967

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 (micro-mhos at 25°C)	Color or pH	
																		Calcium, magnesium	Non-carbonate				
PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS																							
RED RIVER OF THE NORTH BASIN																							
5-0500. BOIS DE SIOUX RIVER NEAR WHITE ROCK, S. DAK. (lat 45°51'45", long 96°34'25")																							
Nov. 15, 1966	0.4	22	0.4	0.04	0.10	142	94	59	17	476	0	440	24	0.6	4.8	0.24	A1040	740			1450	8.1	33
5-0645. RED RIVER OF THE NORTH AT HALSTAD (lat 47°21'10", long 96°50'50")																							
Apr. 2, 1967.	B10400	11		0.07	0.10	45	17	13	7.2	167	0	65	7.4	0.1	5.2	0.06	267	183	46	0.4	413	8.0	
SANDHILL RIVER AT FERTILE (lat 47°31'50", long 96°15'50")																							
Nov. 2, 1966.	11.7	25	0.2	0.06	0.06	102	41	15	4.5	438	0	89	5.4	0.3	0.1	0.09	507	424	65	0.3	789	7.9	15
5-0690. SANDHILL RIVER AT CLIMAX (lat 47°36'43", long 96°48'52")																							
Nov. 1, 1966.	28.3	21	0.2	0.02	0.00	84	37	19	4.1	378	0	69	15	0.3	0.1	0.07	445	360	50	0.4	706	8.2	20
LAKE OF THE WOODS BASIN																							
5-1315. LITTLE FORK RIVER AT LITTLE FORK (lat 48°24', long 93°34')																							
Sept. 28, 1967.....	57.4	5.6	0.6	0.10	0.02	36	11	6.0	1.7	158	0	15	1.6	0.2	0.4	0.04	190	135	5	0.2	275	7.6	33
5-1320. BIG FORK RIVER AT BIG FALLS (lat 48°12', long 93°48')																							
Sept. 28, 1967.....	119	4.5	0.6	0.07	0.09	38	12	4.4	1.7	175	0	8.8	1.8	0.2	0.3	0.03	191	144	0	0.2	282	7.9	17
MISSISSIPPI RIVER MAIN STEM																							
5-2110. MISSISSIPPI RIVER AT GRAND RAPIDS (lat 47°13'56", long 93°31'48")																							
Oct. 10, 1966	1980	7.4	0.2	0.03	0.06	33	14	5.0	1.8	172	0	5.5	1.8	0.1	0.4	0.00	162	140	0	0.2	278	7.6	8
Jan. 13, 1967	1690	6.6	--	--	--	38	16	6.6	2.5	200	0	8.0	1.6	.2	.1	.02	178	161	0	.2	330	8.0	7
Apr. 13.....	2190	1.4	.3	.14	.08	28	8.2	3.3	.4	124	0	7.2	1.8	.2	.4	.02	122	104	2	.1	206	7.5	25
SAUK RIVER BASIN																							
5-2705. SAUK RIVER NEAR ST. CLOUD (lat 45°33'35", long 94°14'00")																							
Sept. 22, 1967.....	76.0	3.7	0.1	0.02	0.01	41	22	8.0	4.8	219	0	28	7.5	0.3	0.7	0.04	241	192	12	0.3	409	8.0	8

A Calculated from determined constituents.

Chemical analyses, in parts per million, water year October 1966 to September 1967--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 (micro-mhos at 25°C)	Col- or pH
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PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

CROW RIVER BASIN

5-2790. SOUTH FORK CROW RIVER NEAR MAYER (lat 44°54'20", long 93°53'05")

Mar. 31, 1967	2870	12				38	13	4.2	7.8	114	0	42	9.0	0.1	19	0.04	243	148	55	0.1	327	7.5	44
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5-2800. CROW RIVER AT ROCKFORD (lat 45°05'15", long 93°44'00")

Sept. 28, 1967.....	53.5	16	0.1	0.01	0.06	78	37	34	6.0	367	0	67	31	0.4	1.2	0.10	460	346	45	0.8	746	7.9	12
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RUM RIVER BASIN

5-2860. RUM RIVER NEAR ST. FRANCIS (lat 45°19'40", long 93°22'20")

Apr. 1, 1967.	2480	11				18	6.3	2.1	4.3	81	0	11	3.0	0.0	3.4	0.04	134	71	4	0.1	159	7.4	33
Sept. 20.....	242	9.6	0.0	0.02	0.05	37	13	4.9	1.8	173	0	10	3.8	.2	.1	.02	173	146	4	.2	292	7.8	8

MISSISSIPPI RIVER MAIN STEM

5-2885. MISSISSIPPI RIVER NEAR ANOKA (lat 45°07'36", long 93°17'48")

Apr. 26, 1967	18700	7.4	0.5	0.46	0.12	33	14	4.9	4.7	148	0	27	5.3	0.3	1.2	0.08	215	141	20	0.2	289	7.6	120
July 18.....	5950	10	.1	.05	.00	50	17	6.1	2.5	208	0	28	5.3	.2	.5	.02	239	195	24	.2	388	8.0	20

MINNESOTA RIVER BASIN

5-2910. WHETSTONE RIVER NEAR BIG STONE CITY, S. DAK. (lat 45°17'32", long 96°29'14")

Oct. 18, 1966	11.0	18	0.2	0.03	0.16	114	47	30	7.3	338	0	236	18	0.2	0.6	0.22	680	479			972	7.9	10
Jan. 12, 1967	5.9	24	.2	.03	.29	174	70	53	7.3	462	0	395	23	.3	4.1	.17	A979	721			1400	7.4	6
Mar. 30.....	234	13	.3	.50	.43	66	21	13	7.2	168	0	137	5.8	.2	.8	.08	370	252			542	7.8	25
July 6.....	11	21	--	.08	.14	129	59	46	9.0	343	0	335	16	.2	1.0	.18	837	564			1130	7.9	--
Sept. 13.....	2.0	17	--	.09	.13	102	54	46	8.2	345	0	260	29	.4	.1	.19	721	476			1040	7.7	--

SOUTH FORK YELLOW BANK RIVER NEAR SOUTH DAKOTA-MINNESOTA STATE LINE (lat 45°03', long 96°27')

Oct. 18, 1966	3.1	20	0.2	0.06	0.22	108	41	9.1	7.7	319	0	188	1.8	0.2	0.3	0.04	572	438			811	7.8	16
Mar. 31, 1967	65.8	16	.2	.05	.27	70	28	6.6	6.1	192	0	133	3.9	.2	2.2	.05	387	288			555	7.8	25

NORTH FORK YELLOW BANK RIVER NEAR SOUTH DAKOTA-MINNESOTA STATE LINE (lat 45°12', long 96°28')

Oct. 18, 1966	1.7	17	0.2	0.05	0.16	88	38	14	7.5	290	0	152	9.6	0.2	0.2	0.07	504	376			748	7.7	10
Jan. 12, 1967	1.6	23	.2	.02	.02	137	52	21	5.8	402	0	259	8.2	.4	2.0	.08	789	556			1040	7.5	4
Mar. 31.....	143	15	.2	.03	.18	63	24	7.5	6.3	182	0	124	4.0	.1	1.4	.06	359	258			528	7.8	23

A Calculated from determined constituents.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1966 to September 1967--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)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids (residue at 180°C)	Hardness as CaCO ₃	Cal-cium, mag-nesium	Non-car-bon-ate	Sodium ad-sorp-tion ratio	Specific conductance (micro-mhos at 25°C)	Col-or	pH
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PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

MINNESOTA RIVER BASIN--Continued

5-2940. POMME DE TERRE RIVER AT APPLETON (lat 45°12'10", long 96°01'20")

Mar. 29, 1967	843	13				43	26	8.1	8.0	190	0	69	4.4	0.1	3.5	0.07	296	212	56	0.2	439	8.1	32
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5-3010. MINNESOTA RIVER NEAR LAC QUI PARLE (lat 45°01'17", long 95°52'05")

Mar. 30, 1967	2840	12				48	26	11	7.8	176	0	100	6.1	0.1	4.5	0.08	329	228	84	0.3	486	7.7	18
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5-3045. CHIPPEWA RIVER NEAR MILAN (lat 45°06'39", long 95°47'57")

Nov. 17, 1966	80.8	16	0.2	0.03	0.24	104	48	16	4.9	396	0	157	7.5	0.3	0.1	0.09	567	459	134	0.3	852	8.2	7
Mar. 1, 1967	34.2	25	.2	.02	.42	96	61	24	8.0	428	0	164	12	.2	4.3	.12	640	491	140	.5	936	8.2	4
Mar. 30, 1967	2810	12	--	--	--	43	16	16	4.4	156	0	54	4.8	.1	7.4	.05	254	175	47	.1	374	7.7	45
June 22, 1967	943	25	.2	.15	.10	68	34	12	5.7	290	0	103	3.6	.3	.2	.10	422	310	72	.3	626	7.5	35
July 18, 1967	233	14	.4	.11	.09	65	40	14	5.9	309	0	110	4.6	.3	.0	.10	441	326	73	.3	669	7.7	20

5-3110. MINNESOTA RIVER AT MONTEVIDEO (lat 44°56'00", long 95°44'00")

Nov. 17, 1966	112	20	0.3	0.02	0.20	78	57	27	6.2	278	6	225	12	0.3	1.9	0.13	598	430	192	0.6	858	8.3	9
Mar. 1, 1967	171	32	.2	.03	.95	115	94	47	13	436	0	373	19	.4	7.0	.28	992	672	314	.8	1290	8.1	17
May 17, 1967	985	9.8	.3	.11	.10	84	44	23	8.2	260	0	207	8.1	.1	.9	.14	561	389	176	.5	790	7.9	12
June 20, 1967	2520	18	.2	.14	.08	70	32	20	8.1	199	0	181	4.6	.2	.1	.12	469	306	143	.5	676	7.6	20
July 17, 1967	416	22	.2	.19	.15	88	45	23	8.1	302	0	188	6.2	.3	2.1	.13	578	404	156	.5	817	7.4	10

REDWOOD RIVER NEAR FLORENCE (lat 44°13'33", long 96°00'00")

Aug. 9, 1967	C0.5	19				100	39	12	9.5	414	0	85	9.6	0.5	5.5	0.15	513	410	70	0.3	781	7.9	45
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COON CREEK AT RUSSELL (lat 44°19'22", long 95°58'42")

Aug. 9, 1967		16	1.4	0.90	0.93	128	52	11	9.2	335	0	263	6.4	0.5	3.0	0.13	694	534	259	0.2	936	7.9	25
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REDWOOD RIVER NEAR BURCHARD (lat 44°20'22", long 95°55'26")

Aug. 9, 1967	C1.5	18				128	54	23	7.6	336	0	306	9.0	0.4	0.1	0.16	763	542	266	0.4	1040	7.9	20
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5-3150. REDWOOD RIVER AT MARSHALL (lat 44°27'05", long 95°47'13")

Aug. 10, 1967	B3.9	19				148	64	38	9.1	313	0	398	20	0.4	0.6	0.11	915	632	375	0.7	1210	7.9	17
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B Daily mean discharge.

C Estimated.

Chemical analyses, in parts per million, water year October 1966 to September 1967--Continued

Date of collection	Discharge (cfs)	Silica (SiO ₂) (Al)	Aluminum (Al)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃) (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 (micro-mhos at 25°C)	Col- or pH
																	Calcium	Non-carbonate			

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

MINNESOTA RIVER BASIN--Continued

REDWOOD RIVER NEAR GREEN VALLEY (lat 44°29'12", long 95°45'58")

Aug. 10, 1967	C4.0	16				162	68	59	8.4	320	0	450	42	0.4	0.1	0.14	963	684	422	1.0	1340	7.9	22
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THREEMILE CREEK NEAR GHENT (lat 44°27'48", long 95°53'50")

Aug. 10, 1967		18	1.0	0.00	0.37	205	83	48	7.4	232	0	720	2.4	0.2	0.0	0.30	A1200	853	663	0.7	1540	7.7	5
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REDWOOD RIVER NEAR MARSHALL (lat 44°29'35", long 95°21'00")

Aug. 10, 1967	C7.5	20				132	54	44	8.0	328	0	356	25	0.4	0.5	0.18	847	552	283	0.8	1130	7.4	17
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5-3163. CLEAR CREEK AT SEAFORTH (lat 44°28'48", long 95°19'22")

Aug. 11, 1967		16	1.6	0.09	0.40	128	98	59	7.2	336	0	550	7.0	0.3	1.7	0.18	A1030	722	446	1.0	1410	7.9	12
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REDWOOD RIVER ABOVE RAMSEY CREEK, NEAR REDWOOD FALLS (lat 44°32'57", long 95°07'21")

Aug. 11, 1967	C11	17	0.1	0.01	0.01	112	62	43	7.5	301	0	334	21	0.3	1.6	0.24	801	534	287	0.8	1090	7.9	15
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5-3165. REDWOOD RIVER NEAR REDWOOD FALLS (lat 44°31'25", long 95°10'20")

Oct. 11, 1966	11.5	18	0.2	0.02	0.18	128	68	82	9.2	286	0	442	58	0.4	0.6	0.20	948	598	363	1.5	1370	7.8	4
Mar. 1, 1967	4.1	21	.3	.05	.28	104	43	20	6.9	311	12	180	8.9	.2	7.8	.12	585	438	163	.4	841	8.4	8
July 14, 1967	179	20	.2	.03	.08	150	70	39	7.2	306	0	454	13	.5	6.1	.17	995	662	411	.7	1270	7.7	10

5-3170. COTTONWOOD RIVER NEAR NEW ULM (lat 44°17'40", long 94°26'40")

Oct. 10, 1966	21.4	16	0.1	0.01	0.09	78	42	33	5.5	302	0	158	19	0.2	2.8	0.12	521	366	118	0.7	793	7.8	7
Feb. 14, 1967	22.3	20	.3	.04	.48	98	46	55	6.1	310	0	188	68	.2	7.5	.18	672	435	181	1.1	1020	8.2	7
July 13, 1967	214	23	.2	.04	.05	132	57	24	4.8	298	0	345	7.4	.5	5.8	.12	814	564	320	.4	1070	7.3	10

SWAN LAKE AT WIDE NARROWS, NEAR NICOLLET (lat 44°18'43", long 94°14'58")

July 28, 1967						28	28		7.5	16		9.2	.6	8	0.1	0.1	269	185		0.2	400		
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A Calculated from determined constituents.

C Estimated.

Chemical analyses, in parts per million, water year October 1966 to September 1967--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) (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 (micro-mhos at 25°C)	Col- or pH

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

MINNESOTA RIVER BASIN--Continued

SWAN LAKE NEAR NICOLLET (lat 44°19'25", long 94°14'17")

June 7, 1967.						39	24	5.9	12		11	7.4		0.4		265	197		0.2	416	
July 28, 1967.						28	28	7.2	17		14	7.8		.2		258	185		.2	402	

SWAN LAKE OUTLET NEAR NICOLLET (lat 44°12'45", long 94°11'25")

July 28, 1967						31	28	7.5	16		8.8	5.6		0.3		267	192		0.2	418	
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SWAN LAKE OUTLET AT HIGHWAY 14, NEAR NICOLLET (lat 44°16'21", long 94°13'49")

June 7, 1967.						37	23	5.8	14		14	7.1		0.4		278	187		0.2	400	
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5-3200. BLUE EARTH RIVER NEAR RAPIDAN (lat 44°05'44", long 94°06'33")

Oct. 18, 1966	551	19	0.2	0.05	0.18	86	36	28	5.6	288	0	145	17	0.3	5.9	0.10	497	362	126	0.6	756	7.9
Feb. 28, 1967	60.8	23	.2	.05	1.4	118	45	50	5.5	406	9	184	29	.3	8.2	.17	700	481	133	1.0	1030	8.3
July 12, 1967	1530	25	.2	.03	.07	90	30	13	3.1	289	0	114	11	.5	17	.06	479	348	111	.3	706	7.8

5-3250. MINNESOTA RIVER AT MANKATO (lat 44°10'10", long 94°00'15")

Oct. 18, 1966	1930	20	0.3	0.03	0.00	79	41	21	7.1	278	0	156	13	0.3	11	0.10	507	366	138	0.5	752	7.6
Feb. 17, 1967	308	24	.3	.07	.68	82	59	39	7.6	277	12	246	20	.2	5.2	.18	666	446	199	.8	938	8.5
July 11, 1967	7220	23	.2	.05	.08	92	40	18	6.8	284	0	173	8.6	.4	12	.10	546	394	161	.4	785	7.3

COUNTY DITCH NO. 20 NEAR NEW SWEDEN (lat 44°21'38", long 94°20'34")

June 7, 1967.						99	36	7.2	4.7		84	19		4.1		504	395		0.2	727	
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COUNTY DITCH NO. 32-A NEAR NEW SWEDEN (lat 44°23'27", long 94°17'27")

June 7, 1967.						132	54	9.2	2.8		217	15		22		686	554		0.2	959	
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TRIBUTARY TO COUNTY DITCH NO. 32-A NEAR NEW SWEDEN (lat 44°23'51", long 94°18'41")

June 7, 1967.						114	39	6.6	2.6		115	12		16		562	446		0.1	827	
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COUNTY DITCH NO. 40-A NEAR NEW SWEDEN (lat 44°24'36", long 94°16'51")

June 7, 1967.						124	41	24	4.0		142	30		22		635	477		0.5	921	
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Chemical analyses, in parts per million, water year October 1966 to September 1967--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 (micro-mhos at 25°C)	pH	Color
																		Calcium, magnesium	Non-carbonate				

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

MINNESOTA RIVER BASIN--Continued

5-3300. MINNESOTA RIVER NEAR JORDAN (lat 44°41'35", long 93°38'30")
(Formerly published as Minnesota River near Carver)

Oct. 17, 1966	1650	18	0.3	0.05	0.03	75	39	26	6.3	290	0	133	18	0.3	5.4	0.11	481	346	108	0.6	737	7.6	12
Feb. 21, 1967	494	23	.2	.06	.98	78	70	45	6.7	416	0	176	38	.2	6.8	.16	690	483	142	.9	1030	8.1	5
July 10.....	10400	23	.2	.08	.00	72	30	12	5.5	244	0	110	11	.4	18	.07	427	303	103	.3	634	7.9	18

ST. CROIX RIVER BASIN

CROOKED CREEK NEAR HINCKLEY (lat 46°00'41", long 92°31'46")

Sept. 7, 1967	10.0	14	0.1	0.16	0.01	25	11	3.7	1.0	126	0	6.8	1.7	0.1	0.2	0.02	136	108	4	0.2	207	8.0	12
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SAND CREEK AT ST. CROIX STATE PARK, NEAR HINCKLEY (lat 45°57'05", long 92°50'25")

Sept. 7, 1967	10.5	14	0.1	0.49	0.06	17	6.4	3.4	0.9	82	0	6.2	3.1	0.1	0.2	0.02	105	69	1	0.2	146	7.8	11
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5-3362. GLAISBY BROOK NEAR KETTLE RIVER (lat 46°27'19", long 92°51'34")

Sept. 5, 1967	0.3	15	0.1	0.04	0.05	42	16	6.0	0.9	220	0	3.5	2.8	0.1	0.2	0.01	197	171	0	0.2	337	7.9	4
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KETTLE RIVER NEAR STURGEON LAKE (lat 46°23'24", long 92°52'56")

Sept. 6, 1967	4.9	4.0	0.1	0.06	0.04	32	13	4.4	1.5	162	0	8.8	2.7	0.2	0.4	0.02	167	133	0	0.2	260	8.1	38
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MOOSE RIVER AT STURGEON LAKE (lat 46°22'58", long 92°50'25")

Sept. 6, 1967	17.8	9.8	0.0	0.08	0.05	22	6.1	2.8	1.0	95	0	7.8	2.0	0.1	0.2	0.01	112	80	2	0.1	166	8.0	17
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WILLOW RIVER AT WILLOW RIVER (lat 46°19'25", long 92°50'56")

Sept. 6, 1967	17.5	11	0.0	0.30	0.07	19	6.1	3.6	0.9	90	0	5.2	3.0	0.1	0.1	0.01	109	72	0	0.2	157	7.7	10
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5-3367. KETTLE RIVER BELOW SANDSTONE (lat 46°23'24", long 92°52'56")

Sept. 7, 1967	108	12	0.0	0.43	0.13	24	8.5	6.0	1.2	110	0	5.8	8.0	0.1	0.2	0.02	125	95	4	0.3	205		14
Sept. 25.....	102	13	.4	.44	.12	24	8.1	7.0	1.4	113	0	3.0	6.6	.1	.1	.03	146	93	0	.3	208	7.6	4

SNAKE RIVER NEAR MC GRATH (lat 46°13'05", long 93°14'25")

Sept. 5, 1967	1.1	5.3	0.6	0.12	0.15	24	8.5	4.5	1.1	116	0	7.2	5.2	0.1	0.5	0.06	135	95	0	0.2	200	7.4	45
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MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1966 to September 1967--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) (CO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃) (B)	Dissolved solids (residue at 180°C)	Hardness as CaCO ₃		Sodium adsorption ratio	Specific conductance (microhmhos at 25°C)	pH	Col- or
																Calcium, magnesium	Non-carbonate				

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

ST. CROIX RIVER BASIN--Continued

KNIFE RIVER NEAR MORA (lat 45°55'05", long 93°18'30")

Sept. 6, 1967	1.8	8.4	0.4	0.07	0.20	31	9.8	3.5	1.8	148	0	6.0	2.2	0.1	0.1	0.03	147	118	0	0.1	237	7.9	22
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5-3375. SNAKE RIVER AT MORA (lat 45°51'50", long 93°17'50")

Sept. 6, 1967	32.4	8.0	0.4	0.00	0.10	38	12	5.5	1.8	188	0	6.5	0.4	0.2	0.4	0.03	176	144	0	0.2	299	7.6	17
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GROUNDHOUSE RIVER AT BRUNSWICK (lat 45°47'25", long 93°16'30")

Sept. 6, 1967	6.8	12	0.4	0.00	0.08	37	11	5.0	1.7	176	0	7.0	3.0	0.2	0.0	0.02	165	138	0	0.2	285	7.9	17
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5-3385. SNAKE RIVER NEAR PINE CITY (lat 45°50'30", long 92°56'00")

Sept. 7, 1967	B62.0	5.2	0.4	0.07	0.08	29	8.8	3.9	1.9	135	0	7.0	2.6	0.1	0.6	0.04	145	108	0	0.2	222	7.7	45
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ROCK CREEK NEAR RUSH CITY (lat 45°42'58", long 92°53'11")

Sept. 5, 1967	1.8	12	0.1	0.05	0.04	56	28	7.3	3.0	314	0	17	6.7	0.2	0.1	0.04	303	254	0	0.2	501	8.2	14
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RUSH CREEK NEAR RUSH CITY (lat 45°35'19", long 92°53'55")

Sept. 5, 1967	13.0	6.7	0.1	0.05	0.01	40	19	6.0	3.4	213	0	9.5	5.7	0.2	0.6	0.03	209	178	3	0.2	349	8.0	15
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5-3400.5. SUNRISE RIVER NEAR LINDSTROM (lat 45°27'00", long 92°53'10")

Sept. 6, 1967	35.0	6.6	0.1	0.06	0.07	42	12	3.4	1.3	185	0	6.2	2.8	0.1	0.4	0.01	184	154	2	0.1	294	7.5	25
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NORTH BRANCH SUNRISE RIVER NEAR NORTH BRANCH (lat 45°30'48", long 92°53'33")

Sept. 6, 1967	27.4	19	0.0	0.03	0.06	44	12	4.0	1.1	183	0	12	2.9	0.1	3.3	0.00	190	160	9	0.1	313	8.0	7
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MISSISSIPPI RIVER MAIN STEM

5-3445. MISSISSIPPI RIVER AT PRESCOTT, WIS. (lat 44°44'45", long 92°48'00")

Apr. 6, 1967.	86000	10				17	6.2	2.3	2.3	80	0	6.5	2.3	0.0	2.4	0.02	104	68	2	0.1	140	7.4	17
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B Daily mean discharge.

MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Chemical analyses, in parts per million, water year October 1966 to September 1967--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 (micro-mhos at 25°C)	pH	Col- or
																		Calcium, magnesium	Non-carbonate				

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS--Continued

VERMILLION RIVER BASIN

5-3460. VERMILLION RIVER AT HASTINGS (lat 44°43', long 92°52')

Mar. 25, 1967	2690	3.4				13	5.2	1.4	5.3	34	0	16	4.1	0.0	10	0.03	87	54	26		125	7.2	22
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CANNON RIVER BASIN

5-3552. CANNON RIVER AT WELCH (lat 44°33' 50", long 92°43' 55")

Mar. 25, 1967	6890	7.1				35	9.4	3.6	6.1	122	0	20	7.2	0.1	13	0.23	188	126	26	0.1	285	7.9	28
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WHITEWATER RIVER BASIN

5-3760. NORTH FORK WHITEWATER RIVER NEAR ELBA (lat 44°05' 30", long 92°03' 57")

Aug. 21, 1967	14.8	15	0.0	0.08	0.13	65	25	2.7	1.2	304	0	14	2.2	0.2	3.8	0.00	276	265	16		478	8.0	3
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MISSISSIPPI RIVER MAIN STEM

5-3785. MISSISSIPPI RIVER AT WINONA (lat 44°03' 20", long 91°38' 15")

Nov. 29, 1966	17100	9.1	0.3	0.12	0.00	37	14	8.8	2.1	164	0	20	8.0	0.2	1.6	0.06	195	150	16	0.3	320	7.4	22
Apr. 7, 1967	162000	11	--	--	--	30	14	6.3	4.3	132	0	25	7.5	.5	7.9	.04	197	132	24	.2	289	8.1	18
May 2,	52600	9.1	.3	.09	.10	35	14	5.5	3.1	144	0	33	6.4	.1	3.1	.04	213	147	29	.2	309	7.8	35
Aug. 24,	13000	15	.1	.16	.07	41	15	7.8	2.6	172	0	36	7.7	.4	.5	.07	233	164	23	.3	351	8.0	28

5-3835. MISSISSIPPI RIVER AT LA CROSSE, WIS. (lat 43°48' 45", long 91°15' 25")

Apr. 8, 1967.	17800	10				31	10	5.4	3.7	123	0	22	6.2	0.1	6.1	0.03	178	121	20	0.2	268	7.7	21
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MISCELLANEOUS ANALYSES OF LAKES AND STREAMS IN MINNESOTA--Continued

Periodic determinations of suspended-sediment discharge, water year October 1966 to September 1967
(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)

2, pipet, 5, sieve, v, visual accumulation tube, w, in distilled water																	
Date of collection	Time (24 hour)	Water tem- per- ature (° F)	Sam- pling point	Discharge (cfs)	Sediment concen- tration (ppm)	Sediment discharge (tons per day)	Suspended sediment								Method of analysis		
							Percent finer than size indicated, in millimeters										
							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

MINNESOTA RIVER BASIN

5-2910. WHETSTONE RIVER NEAR BIG STONE CITY, S. DAK. (lat 45°17'32", long 96°29'14")

Oct. 18, 1966.....	0930	42		11.0	202	6.0												
Jan. 12, 1967.....	1450	32		5.9	10	T												
Mar. 30.....	1730	54		234	76	48												

SOUTH FORK YELLOW BANK RIVER NEAR SOUTH DAKOTA-MINNESOTA STATE LINE (lat 45°03', long 96°27')

Oct. 18, 1966.....	1000	42		3.1	41	T												
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NORTH FORK YELLOW BANK RIVER NEAR SOUTH DAKOTA-MINNESOTA STATE LINE (lat 45°12', long 96°28')

Oct. 18, 1966.....	1000	42		1.7	37	T												
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T Less than 0.50 ton.

210

Particle-size analyses of bed material, water year October 1966 to September 1967

(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)

		x, pipet, y, sieve, v, visual accumulation (moes, n), in distance (meters)													
Date of collection	Time (24 hour)	Water tem- per- ature (°F)	Sam- pling point	Discharge (cfs)	Sediment concen- tration (ppm)	Sediment discharge (tons per day)	Bed material								Method of analysis
							Percent finer than size indicated, in millimeters								
							0.062	0.125	0.250	0.500	1.000	2.000	4.000	8.000		16.00	32.00	64.00

PART 5. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

MINNESOTA RIVER BASIN

5-2910. WHETSTONE RIVER NEAR BIG STONE CITY, S. DAK. (lat 45°17'32", long 96°29'14")

Oct. 18, 1966.....	0930		10	11.0			14	27	60	86	95	98	100					SV
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SOUTH FORK YELLOW BANK RIVER NEAR SOUTH DAKOTA-MINNESOTA STATE LINE (lat 45°03', long 96°27')

Oct. 18, 1966.....	1000		10	3.1			8	12	16	22	35	56	88	99	100			SV
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NORTH FORK YELLOW BANK RIVER NEAR SOUTH DAKOTA-MINNESOTA STATE LINE (lat 45°12', long 96°28')

Oct. 18, 1966.....	1000		10	1.7			10	14	14	25	35	46	61	77	100			SV
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