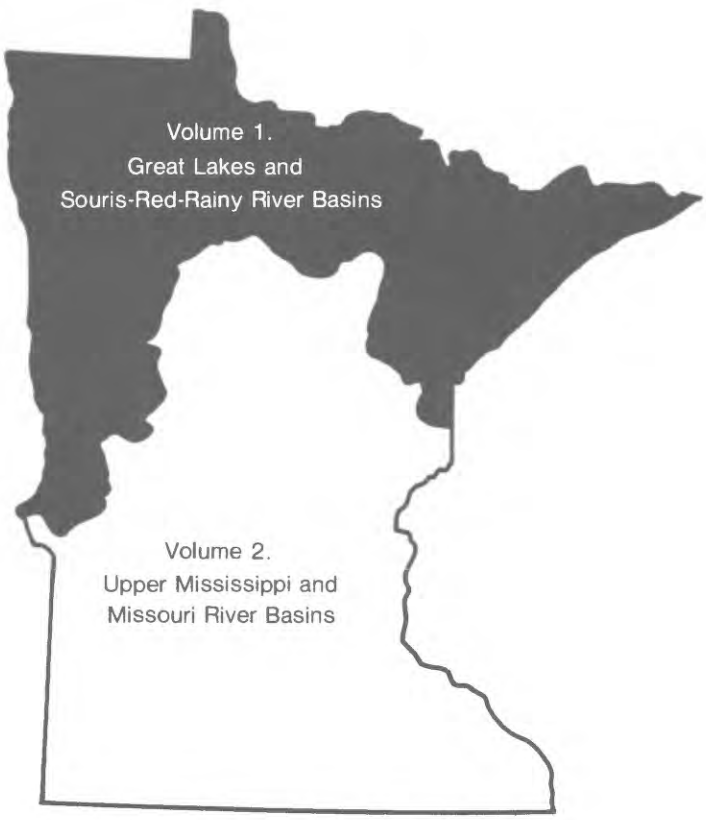
Water Resources Data Minnesota Water Year 1990

Volume 1. Great Lakes and Souris-Red-Rainy River Basins



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MN-90-2
Prepared in cooperation with the Minnesota Department of Natural Resources, Division of Waters; the Minnesota Department of Transportation; and with other State, municipal and Federal agencies

CALENDAR FOR WATER YEAR 1990

1989

OCTOBER

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

NOVEMBER

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

DECEMBER

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

1990

JANUARY

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

FEBRUARY

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

MARCH

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

APRIL

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

MAY

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

JUNE

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

JULY

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

AUGUST

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

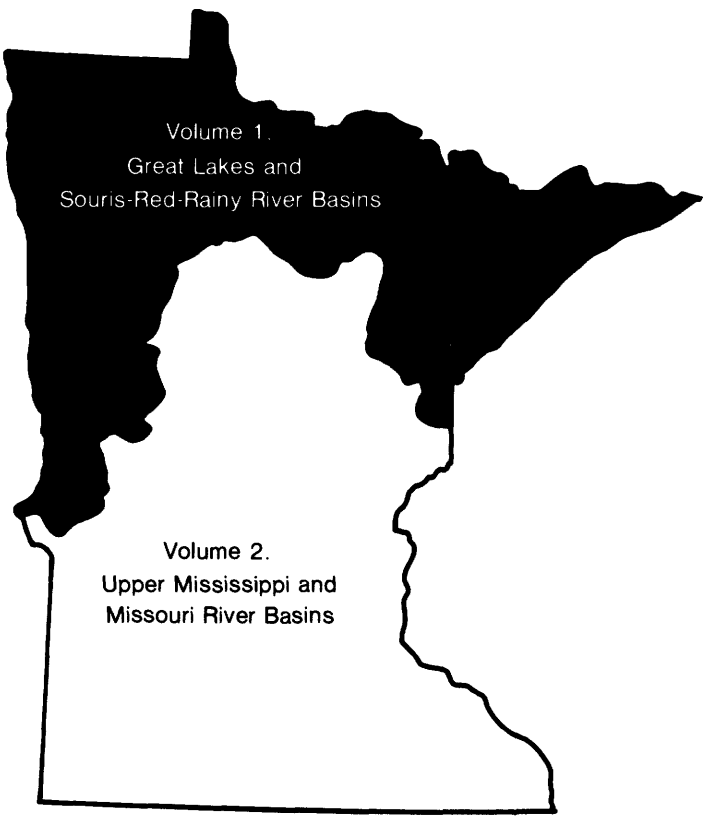
SEPTEMBER

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

Water Resources Data Minnesota Water Year 1990

Volume 1. Great Lakes and Souris-Red-Rainy River Basins

by Kurt T. Gunard, Joseph H. Hess, James L. Zirbel, and Charles E. Cornelius



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MN-90-1
Prepared in cooperation with the Minnesota Department of Natural Resources, Division of Waters; the Minnesota Department of Transportation; and with other State, municipal, and Federal agencies

DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief, Water Resources Division
U.S. Geological Survey
702 Post Office Building
St. Paul, Minnesota 55101

1991

PREFACE

This volume of the annual hydrologic data report of Minnesota is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of streamflow, ground-water levels, and water quality provide the hydrologic information needed by State, local, and Federal agencies, and the private sector for developing and managing our Nation's land and water resources. Hydrologic data for Minnesota are contained in two volumes:

Volume 1. Great Lakes and Souris-Red-Rainy River Basins
Volume 2. Upper Mississippi and Missouri River Basins

This report is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. In addition to the authors, who had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to Geological Survey policy and established guidelines, the following individuals contributed significantly to the preparation of this report:

Lan H. Tornes, Water-Quality Specialist, Minnesota District
Alex Brietkrietz, Ground-Water Network Project Chief, Minnesota District

Most of the data were collected, processed, and tabulated by the following individuals:

St. Paul District Office

Allan D. Arntson
George H. Carlson
Mark R. Have
Joan M. Helms
Rebecca A. Miller
Gregory B. Mitton
George A. Roach
Charles J. Smith
Gregory W. Stratton
Jeff Trionfante
Duane A. Wicklund
Thomas A. Winterstein

Grand Rapids Field Headquarters

Howard D. Braden
William A. Gothard
Gregory R. Melhus

Montevideo Field Headquarters

Roderick L. Johnson

This report was prepared in cooperation with the State of Minnesota and with other agencies under the general supervision of William J. Herb, District Chief, Minnesota.

REPORT DOCUMENTATION PAGE	1. Report No. USGS/WRD/HD-91/293	2.	3. Recipient's Accession No.
4. Title and Subtitle Water Resources for Minnesota, Water Year 1990 Volume 1, Great Lakes and Souris-Red-Rainy River Basins			5. Report May 1991 6.
7. Author(s) Kurt T. Gunard, Joseph H. Hess, James L. Zirbel, and Charles E. Cornelius			8. Performing Organization Rept. No. USGS-WDR-90-1
9. Performing Organization Name and Address U.S. Geological Survey, Water Resources Division 702 Post Office Building St. Paul, Minnesota 55101			10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Geological Survey, Water Resources Division 702 Post Office Building St. Paul, Minnesota 55101			13. Type of Report & Period Covered Annual Oct. 1, 1989 Sept. 30, 1990 14.

15. Supplementary Notes

Prepared in cooperation with the State of Minnesota and with other agencies.

16. Abstract (Limit: 200 words)

Water-resources data for the 1990 water year for Minnesota consist of records of stage, discharge and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 43 gaging stations; stage-only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 13 stream stations; and water levels for 14 observation wells. Also included are 30 high-flow partial-record stations and 6 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data together with the data in Volume 2, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota.

17. Document Analysis a. Descriptors

*Minnesota, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Data collection

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement:	19. Security Class (This Report)	21. No. of Pages
No restriction on distribution. This report may be purchased from: National Technical Information Service Springfield, VA 22161	UNCLASSIFIED	136
	20. Security Class (This Page) UNCLASSIFIED	22. Price

CONTENTS

ILLUSTRATIONS

TABLES

GAGING STATIONS, IN DOWNSTREAM ORDER, FOR WHICH RECORDS ARE PUBLISHED

Note.--Data for partial-record stations and miscellaneous sites for both surface-water quantity and quality are published in separate sections of the data report. See references at the end of this list for page numbers for these sections.

[Letters after station name designates type of data: (d) discharge; (e) gage height, elevation, or contents; (c) chemical, radio-chemical, or pesticides; (b) biological or mictro-biological; (p) physical (water temperature, sediment, or specific conductance)]

SURFACE-WATER STATIONS, IN DOWNSTREAM ORDER--Continued

GROUND-WATER WELLS, BY COUNTY, FOR WHICH RECORDS ARE PUBLISHED

GROUND-WATER LEVELS

COUNTIES WITH QUALITY OF GROUND WATER RECORDS

Survey party at camp on Chain Lakes, ca. 1911

WATER RESOURCES DATA FOR MINNESOTA, 1990

INTRODUCTION

The Water Resources Division of the U.S Geological Survey, in cooperation with State agencies, obtains a large amount of data pertaining to the water resources of Minnesota each water year. These data, accumulated during many years, constitute a valuable data base for developing an improved understanding of the water resources of the State. To make these data readily available to interested parties outside the Geological Survey, the data are published annually in this report series entitled "Water Resources Data - Minnesota."

Water resources data for the 1990 water year for Minnesota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume contains discharge records for 43 gaging stations; stage only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 13 stream stations; and water levels for 14 observation wells. Also included are 30 high-flow partial-record stations and 6 low-flow partial-record stations. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data, together with the data in Volume 2, represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota.

This series of annual reports for Minnesota began with the 1961 water year with a report that contained only data relating to the quantities of surface water. For the 1964 water year, a similar report was introduced that contained only data relating to water quality. Beginning with the 1975 water year, the report was changed to present, in one volume, data on quantities of surface water, quality of surface and ground water, and ground-water levels.

Prior to introduction of this series and for several water years concurrent with it, water-resources data for Minnesota were published in U.S. Geological Survey Water-Supply Papers. Data on stream discharge and stage and on lake or reservoir contents and stage, through September 1960, were published annually under the title "Surface-Water Supply of the United States, Parts 4, 5 and 6A." For the 1961 through 1970 water years, the data were published in two 5-year reports. Data on chemical quality, temperature, and suspended sediment for the 1941 through 1970 water years were published annually under the title "Quality of Surface Waters of the United States," and water levels for the 1935 through 1974 water years were published under the title "Ground-Water Levels in the United States." The above mentioned Water-Supply papers can be consulted in the libraries of the principal cities of the United States and may be purchased from Distribution Branch, Text Products Section, U.S. Geological Survey, 604 Pickett Street, Alexandria, VA 22304.

Publications similar to this report are published annually by the Geological Survey for all States. These official Survey reports have an identification number consisting of the two-letter State abbreviation, the last two digits of the water year, and volume number. For example, this volume is identified as the "U.S. Geological Survey Water-Data Report MN-90-1. For archiving and general distribution, the reports for 1971-1974 water years also are identified as water-data reports. These water-data reports are for sale in paper copy or in microfiche by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

Additional information, including current prices, for ordering specific reports may be obtained from the district chief at the address given on the back of the title page or by telephone (612) 229-2600.

COOPERATION

The U.S. Geological Survey and organizations of the State of Minnesota have had cooperative agreements for the systematic collection of streamflow records since 1909, for ground-water levels since 1948, and for water-quality records since 1952. Organizations that assisted in collecting data through cooperative agreement with the Survey are:

Minnesota Department of Natural Resources, Division of Waters, Ronald N. Nargang, director.

Minnesota Department of Transportation, Leonard W. Levine, commissioner.

Metropolitan Waste Control Commission of the Twin Cities Area, L. Baker-Kent, chairperson.

Beltrami Soil and Water Conservation District, John Cronemiller, chairperson

Elm Creek Conservation Commission, Fred G. Moore, chairperson.

Leech Lake Reservation Business Committee, Daniel Brown, chairperson.

Lower Red River Watershed Management Board, Donald Ogaard, chairman.

Rochester Public Utilities, Robert Pawelski, General Manager.

Assistance in the form of funds or services was given by the U.S. Army Corps of Engineers, in collecting records for 46 gaging stations and 12 water-quality stations published in this report of 2 volumes. Thirteen gaging stations in the Hudson Bay and St. Lawrence River basins were maintained by funds appropriated to the United States Department of State. Eight of these, on water adjacent to the international boundary, 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."

SUMMARY OF HYDROLOGIC CONDITIONS

PRECIPITATION

Precipitation during the 1990 water year ranged from more than 8 in. (inches) below normal (based on record period 1951-80) in small areas of northwestern and north-central Minnesota to more than 8 in. above normal in parts of central, east-central, south-central, and southeastern Minnesota (fig. 1). Normal annual precipitation in Minnesota ranges from 19 in. in the northwest to 32 in. in the southeast. Precipitation during water year 1990 ranged from less than 13 in. in the west and northwest to 44 in. in the east central and southeast.

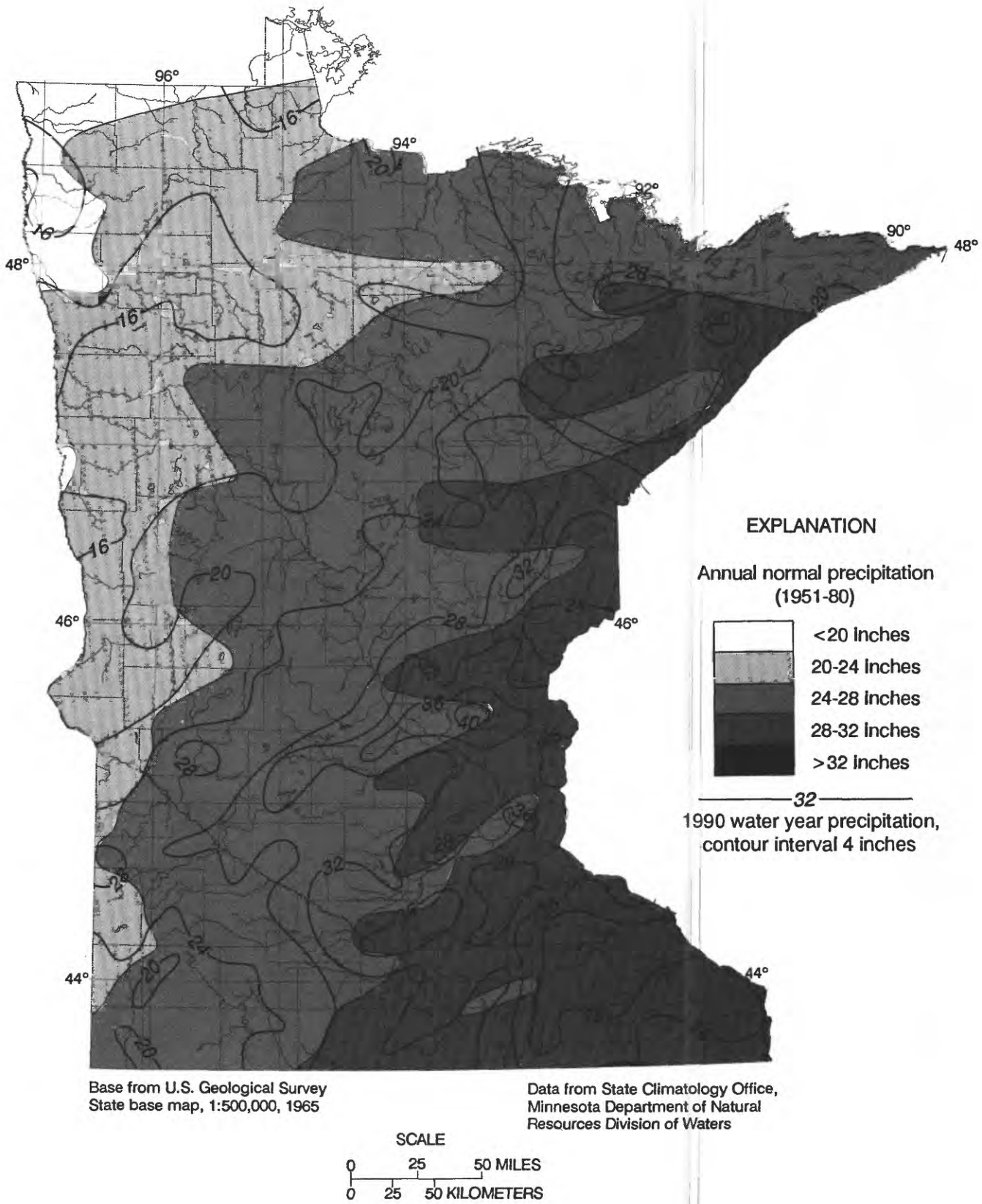


Figure 1.--Precipitation, in inches, during 1990 water year compared to normal annual precipitation in Minnesota.

The water year began with a 4- to 8-in. precipitation deficit in much of southern Minnesota and small areas in northwestern Minnesota, and a 4- to 8-in. precipitation excess in much of north-central and parts of northeastern Minnesota. The following is a summary of precipitation that occurred during water year 1990:

October - below normal statewide.

November - below normal statewide except in the northeast and southwest where it was above normal.

December - below normal statewide.

January - below normal statewide.

February - below normal statewide.

March - above normal statewide.

April - below normal statewide except in the south-central and east where it was above normal.

May - below normal statewide except in the central and south where it was above normal.

June - above normal statewide.

July - below normal in the north and west and above normal in the south.

August - below normal statewide except in the southeast where it was above normal.

September - below normal statewide except in the northeast where it was above normal.

Because of the precipitation pattern and abnormally high temperatures, the south-central and southwest one-third of the State was practically without snow cover at the end of January, and soil moisture was deficient statewide. January, which is normally the coldest month of the year, had temperatures 13 to 18 degrees Fahrenheit above normal statewide. In subsequent months, the amount of soil moisture increased in most of southern and central Minnesota, but by the end of May it was still extremely deficient in the northwest. In June, 9.82 in. of precipitation was recorded at the Minneapolis-St. Paul Airport by the U.S. Weather Service, breaking a 100-year record for precipitation in June. The previous record was 9.0 in. set in 1897 (modern-day record-keeping began in 1891). The total normal precipitation for the 3 months of June, July, and August in this area is only 1.4 in. more than the 9.82 in. that fell in June. In contrast, precipitation in June 1988 measured only 0.22 in. at the Minneapolis-St. Paul Airport -- the lowest precipitation ever recorded since 1891. During the remaining months of the 1990 water year, precipitation was again below normal in much of the State. By the end of the water year, most of northern and western Minnesota had below normal annual precipitation with small areas more than 8 in. below normal. Conversely, most of southern and eastern Minnesota had above normal precipitation with some areas more than 20 in. above normal.

STREAMFLOW

Average annual runoff in Minnesota ranges from 1 in. in the west to 14 in. in the northeast. Annual runoff in water year 1990 ranged from 0.06 in. in a small part of northwestern Minnesota to 12.2 in. in southeastern Minnesota (table 1). This translates to a low of 3 percent of average in northwestern Minnesota to a high of 182 percent of average in southeastern Minnesota. Runoff at almost every streamflow station in the western one-third of Minnesota was considerably less than one-half the long-term average, whereas runoff at stations in the eastern one-third was above one-half the long-term average and runoff at a few stations in southeastern Minnesota was even greater than the long-term average.

In 1990, runoff ranged from below average in most of northwestern Minnesota to near or above average in northeastern Minnesota. Runoff ranged from a low of 3 percent of average in 05076000 Thief River near Thief River Falls in northwestern Minnesota to a high of 113 percent of average in 05129290 Gold Portage outlet from Kabetogama Lake near Ray in northeastern Minnesota along the Canadian border.

In northwestern Minnesota, runoff in the index station Red Lake River at Crookston was 0.48 in.–16 percent of the station's 89-year average (1902-90) of 2.89 in. and was the 6th lowest runoff of record. In the drought years of 1988 and 1989, runoff was the 11th and 23rd lowest, respectively. Hence, the drought continued in northwestern Minnesota for the 3rd consecutive year with increased severity.

In north-central Minnesota, runoff in the index station Little Fork River at Littlefork was 6.37 in.--77 percent of the 67-year average (1912-16, 1929-90) of 8.31 in. Runoff in 1988 and 1989 was 79 and 121 percent of the long-term average, respectively, indicating a much less severe drought in this area than in northwestern Minnesota with a reprieve in 1989.

In northeastern Minnesota, runoff in the index station Baptism River near Beaver Bay was 9.00 in.–55 percent of the 63-year average (1928-90) of 16.3 in. In 1988 and 1989 runoff was 65 and 117 percent of the long-term average, respectively, indicating a pattern similar to the one in north-central Minnesota

Annual and monthly mean discharges for 1990 for the index stations are compared to the median of mean discharges for a 30-year base period in figure 2. Although near-record high flows occurred at several stations published in this volume, no new records were established. However, record low flows occurred at several stations. The most notable was in 05112000 Roseau River below State Ditch No. 51 near Caribou where monthly mean flows for January, February, and September were the lowest for the period of record, which varied from 33 years for January and February to 72 years for September.

WATER QUALITY

The graphs in figure 3 show the comparison of concentrations of dissolved solids in samples collected during the 1990 water year with historical monthly median concentrations collected during the previous years of sampling at four stations sampled for the U.S. Geological Survey's National Stream Accounting Network. Dissolved-solids concentrations during the 1990 water year at the Rainy, Baptism, and St. Louis Rivers were nearly the same as the long-term averages. Deviations from monthly medians probably resulted from minor changes in hydrologic conditions such as dilution by runoff.

Higher-than-average dissolved-solids concentrations in the Red Lake River indicate that little runoff occurred in northwestern Minnesota during the 1990 water year, as discussed in the section on streamflow. The lack of runoff resulted in very little dilution of ground water inflow, which contains a much higher concentration of dissolved solids than does surface runoff.

The graphs in figure 4 show the comparison of nitrite plus nitrate nitrogen concentrations during the 1990 water year with previous median monthly concentrations for the same four stations. Concentrations generally followed normal seasonal patterns with some exceptions. Concentrations in the Red Lake, Rainy, and Baptism Rivers tend to be at or near the detection limit of 0.10 mg/L (milligrams per liter) during most of the open water period. Concentrations in the Red Lake and Baptism Rivers tend to increase during winter, peak during snowmelt runoff, and then return to the detection limit. Concentrations in the Rainy River generally exceed the detection limit only during January and February. Nitrite plus nitrate nitrogen concentrations generally were near average in the St. Louis River through the year, but usually are above the detection limit.

Table 1.--Runoff at streamflow stations in 1990 compared with long-term average for river basins in Minnesota

[Average runoff for station is based on period of record. Maximum and minimum runoff and year of occurrence are shown. mi^2, square miles.]

Station no.	Station name	Drainage area (mi^2)	Runoff (inches)		Maximum runoff		Minimum runoff		Years of record
			1990 Water year	Average	Inches	Water year	Inches	Water year	
04010500	Pigeon River at Middle Falls near Grand Portage	600	8.29	11.41	19.01	1971	3.58	1958	67
04014500	Baptism River near Beaver Bay	140	9.00	16.30	32.50	1972	7.92	1963	63
04015330	Knife River near Two Harbors	85.6	7.28	14.10	23.32	1986	7.01	1977	16
04024000	St. Louis River at Scanlon	3,430	7.83	9.24	16.93	1972	3.74	1924	82
04024098	Deer Creek near Holyoke	7.77	10.74	12.86	33.70	1986	6.38	1980	14
05046000	Otter Tail River below Orwell Dam near Fergus Falls	1,830	1.99	2.37	6.25	1966	.15	1934	60
05050000	Bois de Sioux River near White Rock	1,160	.08	.94	3.85	1986	.004	1977	49
05051500	Red River of the North at Wahpeton	4,010	.97	1.84	5.00	1986	.18	1977	47
05061500	South Branch Buffalo River at Sabin	522	.46	1.47	5.15	1962	.32	1977	40§
05062000	Buffalo River near Dilworth	1,040	.86	1.74	5.76	1975	.33	1934	59
05064000	Wild Rice River at Hendrum	1,600	1.03	2.23	5.79	1975	.25	1977	45§
05069000	Sand Hill River at Climax	426	.89	2.29	6.50	1950	.59	1977	43§
05074500	Red Lake River near Red Lake	1,950	.44	3.35	9.00	1951	.04	1936	57
05076000	Thief River near Thief River Falls	959	.06	2.29	8.60	1966	.02	1939	72§
05078500	Clearwater River at Red Lake Falls	1,370	.95	3.10	8.48	1950	.64	1939	63§
05079000	Red Lake River at Crookston	5,280	.48	2.89	8.05	1950	.22	1934	89
05082500	Red River of the North at Grand Forks	30,100	.40	1.16	3.42	1950	.11	1934	86

Table 1.--Runoff at streamflow stations in 1990 compared with long-term average for river basins in Minnesota--Continued

Station no.	Station name	Drainage area (mi^2)	Runoff (inches)		Maximum runoff		Minimum runoff		Years of record
			1990 Water year	Average	Inches	Water year	Inches	Water year	
05087500	Middle River at Argyle	265	.14	2.00	5.74	1966	.08	1977	39§
05102500	Red River of the North at Emerson	40,200	.34	1.13	4.09	1950	.11	1934	78
05104500	Roseau River below South Fork near Malung	573	.17	3.22	8.18	1950	.17	1990	44
05107500	Roseau River at Ross	1,220	.50	2.86	8.07	1950	.32	1934	62
05112000	Roseau River below State Ditch No. 51 near Caribou	1,570	.51	2.39	5.91	1927	.31	1977	33§
05124480	Kawishiwi River near Ely	253	9.64	11.43	16.80	1971	5.07	1977	24
05127000	Kawishiwi River near Winton	1,229	10.32	11.44	21.73	1950	2.65	1924	70§
05127500	Basswood River near Winton	1,740	10.23	10.93	20.63	1950	4.35	1958	62§
05128000	Namakan River at Outlet of Lac la Croix	5,170	10.07	10.10	19.10	1950	2.53	1924	68
05130500	Sturgeon River near Chisholm	187	7.70	9.00	15.11	1950	4.58	1977	48
05131500	Little Fork River at Littlefork	1,730	6.37	8.31	15.01	1966	2.40	1931	67§
05132000	Big Fork River at Big Falls	1,460	5.18	6.79	12.67	1950	.86	1931	59§
05133500	Rainy River at Manitou Rapids	19,400	7.73	9.01	16.28	1950	4.10	1977	62

§ Noncontinuous period.

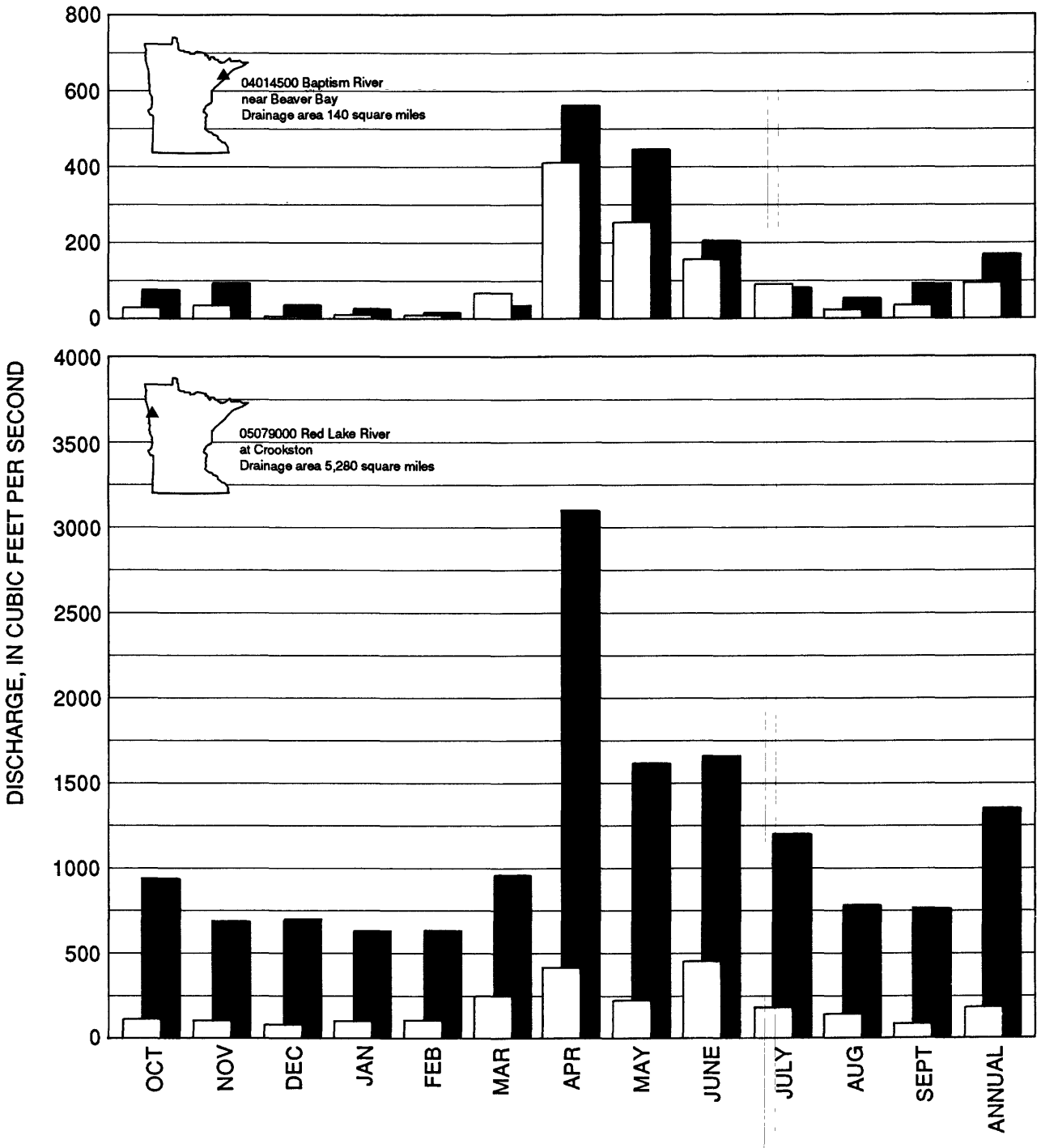
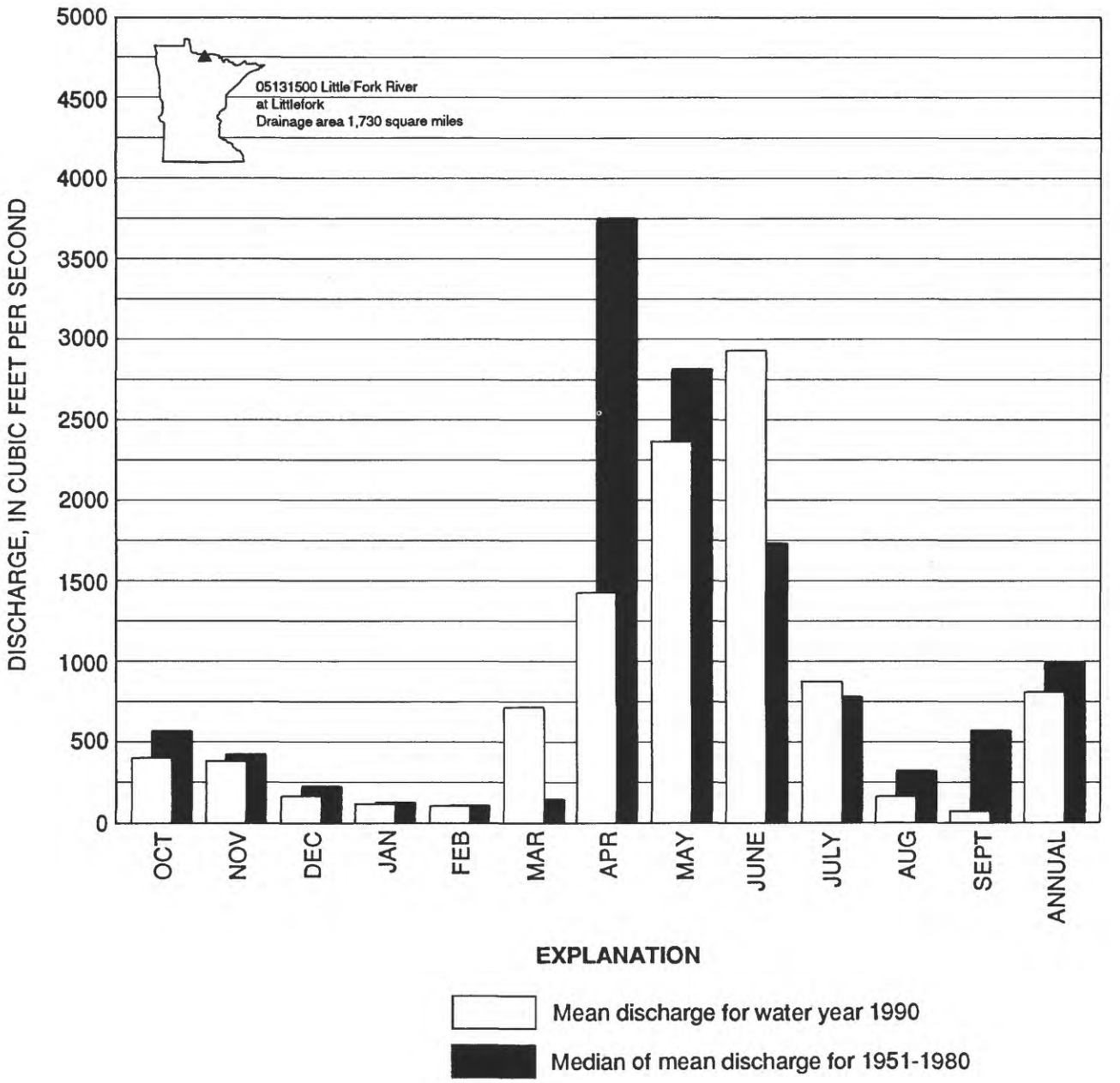


Figure 2.--Comparison of mean discharge for the 1990 water year with median



of mean discharge for 1951-80 at three long-term representative gaging stations.

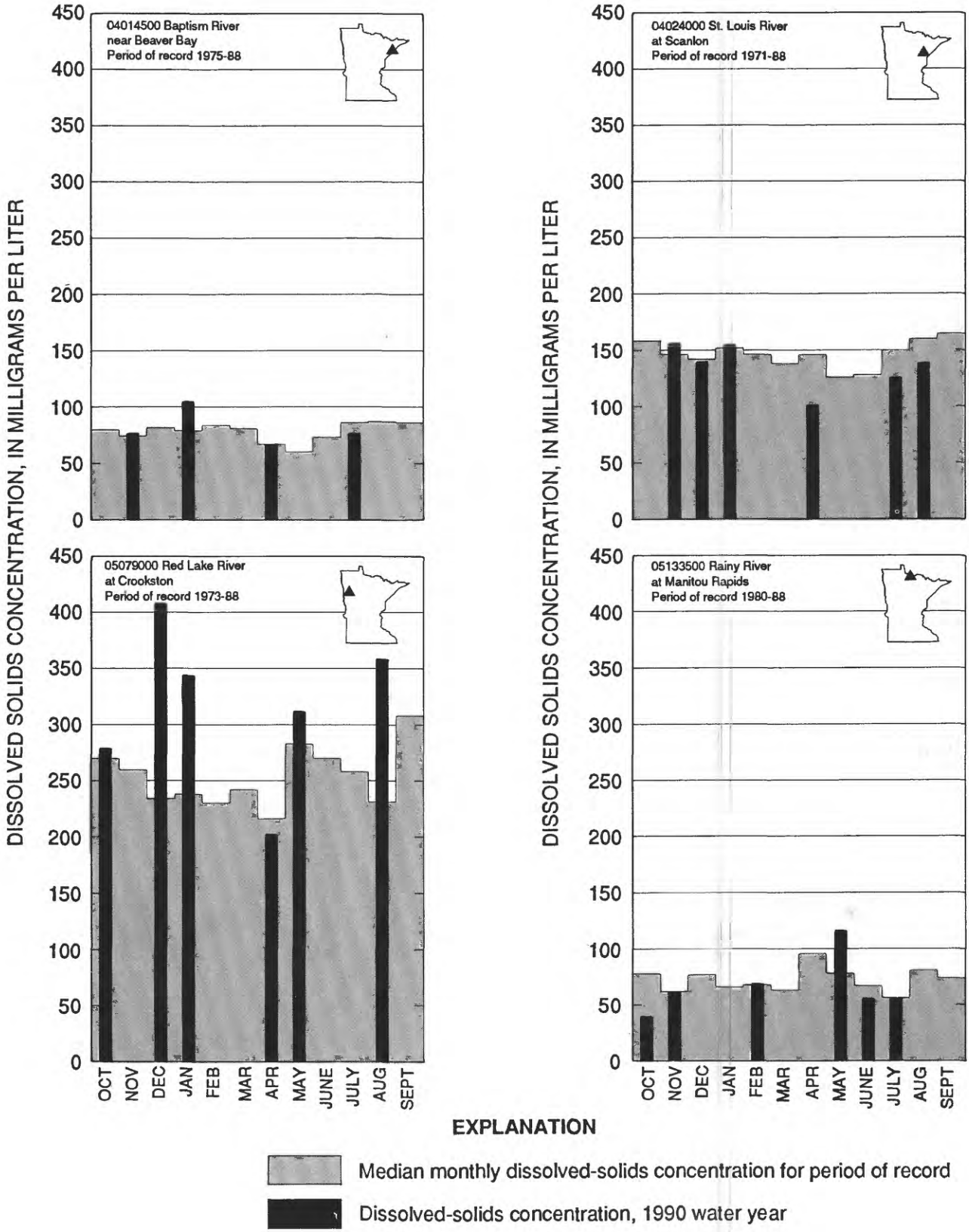


Figure 3.--Comparison of dissolved-solids concentrations in water year 1990 with median for period of record at representative gaging stations.

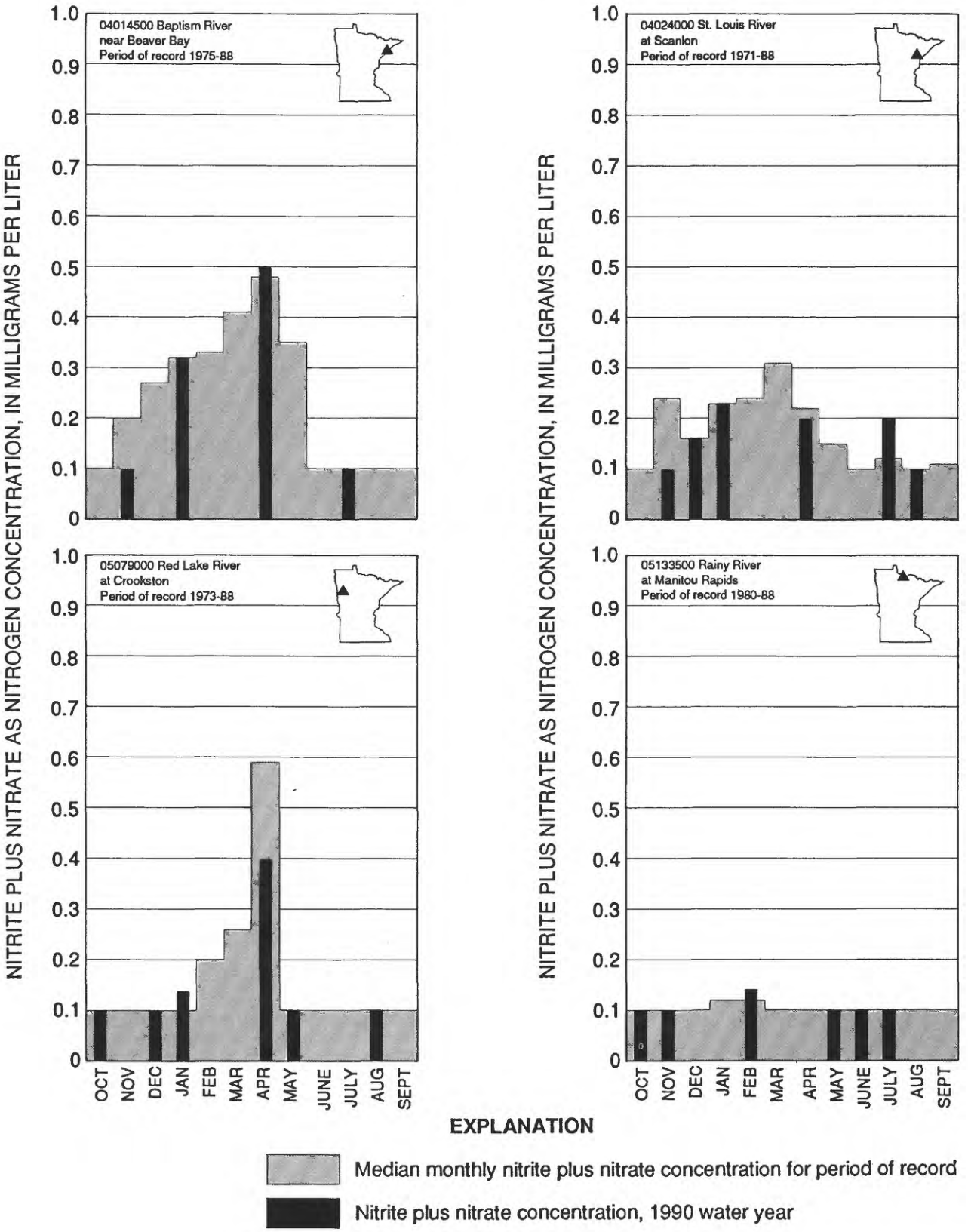


Figure 4.--Comparison of nitrite plus nitrate concentrations in water year 1990 with median for period of record at representative gaging stations.

GROUND-WATER LEVELS

Data from seven wells completed in surficial sand aquifers, six wells completed in buried sand and gravel aquifers and one well completed in the Biwabik Iron-Formation aquifer are presented in this volume.

Wells in Surfical Sand Aquifers

Monthly water levels were below long-term monthly means for the entire water year in a well (463956095352601) completed in a surficial sand aquifer in west-central Minnesota. This well has a 23-year period of record. Bi-monthly measurements in a well (473840093515101) in north-central Minnesota (20-year period of record) indicate that water levels steadily declined from June through the end of the water year. Record low water levels were measured in September. Measurements from a well (465237096383901) near Moorehead, in northwestern Minnesota, were below average monthly values throughout the water year. Water levels in one other well (455700096314001), in west-central Minnesota, had water levels that were lower during March through September 1990 than during that period in 1989. These lower levels probably are related to continued drought conditions in this part of the State. Another well (463854096250701) in northwestern Minnesota had water levels above average throughout the year except for August (fig. 5). A well (474253091574101) in northeastern Minnesota also had above-average monthly water levels for the entire water year except for April coinciding with the above-normal precipitation (fig. 5).

Buried Sand and Gravel Aquifer

Water levels in three of six wells completed in buried sand and gravel aquifers were below average for the year. A record low occurred in one of these wells (465328096391001) in northwestern Minnesota during August (see hydrograph page 116). There has been a decline in water level of 15 feet since 1949 in this well located near the Moorhead city well field. Water levels were higher than monthly averages for most of the year in one well (473102092345001) in northeastern Minnesota.

Bedrock Aquifer

The water level in a well (472638092533601) completed in a bedrock (Biwabik Iron-Formation) aquifer in northeastern Minnesota rose to a record high in September (35-year period of record 1956-90). Record highs have been established each year in this well since 1982. A gradual but steady water-level rise of 11.12 feet has occurred over a period of eight years (see hydrograph on page 118).

SPECIAL NETWORKS AND PROGRAMS

Hydrologic Bench-Mark Network is a network of 57 sites in small drainage basins around the country whose purpose is to provide consistent data on the hydrology, including water quality, and related factors in representative undeveloped watersheds nationwide, and to provide analyses on a continuing basis to compare and contrast conditions observed in basins more obviously affected by the activities of man.

National Stream Quality Accounting Network (NASQAN) is a national data-collection network designed by the U.S. Geological Survey to meet many of the information needs of government agencies and other groups involved in natural or regional water-quality planning and management. The 500 or so sites in NASQAN are generally located at the downstream ends of the hydrologic accounting units designated by the U.S. Geological Survey Office of Water Data Coordination in consultation with the Water Resources Council. The objectives of NASQAN are (1) to obtain information on the quality and quantity of water moving within and from the United States through a systematic and uniform process of data collection, summarization, analysis, and reporting such that the data may be used for, (2) description of the areal variability of water quality in the Nation's rivers through analysis of data from this and other programs, (3) detection of changes or trends with time in the pattern of occurrence of water-quality characteristics, and (4) providing a nationally consistent data base useful for water quality assessment and hydrologic research.

The National Trends Network (NTN) is a 150-station network for sampling atmospheric deposition in the United States. The purpose of the network is to determine the variability, both in location and in time, of the composition of atmospheric deposition, which includes snow, rain, dust particles, and aerosols, and gases. The core from which the NTN was built was the already-existing deposition-monitoring network of the National Atmospheric Deposition Program (NADP).

Radiochemical program is a network of regularly sampled water-quality stations where samples are collected to be analyzed for radioisotopes. The streams that are sampled represent major drainage basins in the conterminous United States.

Tritium network is a network of stations which has been established to provide baseline information on the occurrence of tritium in the Nation's surface waters. In addition to the surface-water stations in the network, tritium data are also obtained at a number of precipitation stations. The purpose of the precipitation stations is to provide an estimate sufficient for hydrologic studies of the tritium input to the United States.

EXPLANATION OF THE RECORDS

The surface-water and ground-water records published in this report are for the 1989 water year that began October 1, 1988, and ended September 30, 1989. A calendar of the water year is provided on the inside of the front cover. The records contain streamflow data, stage and content data for lakes and reservoirs, water-quality data for the surface and ground water, and ground-water-level data. The locations of the stations and wells where the data were collected are shown in figures 7, 8, 9, and 10. The following sections of the introductory text are presented to provide users with a more detailed explanation of how the hydrologic data published in this report were collected, analyzed, computed, and arranged for presentation.

STATION IDENTIFICATION NUMBERS

Each data station, whether streamsite or well, in this report is assigned a unique identification number. This number is unique in that it applies specifically to a given station and to no other. The number usually is assigned when a station is first established and is retained for that station indefinitely. The system used by the U.S. Geological Survey to assign identification numbers for surface-water stations and for ground-water well sites differ, but both are based on geographic location. The "downstream order" system is used for regular surface-water stations and the "latitude-longitude" system is used for wells and, in Minnesota, for surface-water stations where only miscellaneous measurements are made.

Downstream Order System and Station Number

Since October 1, 1950, the order of listing hydrologic-station records in Survey reports is in a downstream direction along the main stream. All stations on a tributary entering upstream from a main-stream station are listed before that station. A station on a tributary that enters between two main-stream sections is listed between them. A similar order is followed by listing stations on first rank, second rank, and other ranks of tributaries. The rank of any tributary on which a station is situated with respect to the stream to which it is immediately tributary is indicated by an indentation in a list of stations in front of the report. Each indention represents one rank. This downstream order and system of indention show which stations are on tributaries between any two stations and the rank of the tributary on which each station is situated.

As an added means of identification, each hydrologic station and partial-record station has been assigned a station number. These are in the same downstream order in this report. In assigning station numbers, no distinction is made between partial-record stations and other stations; therefore, 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 series of numbers to allow for

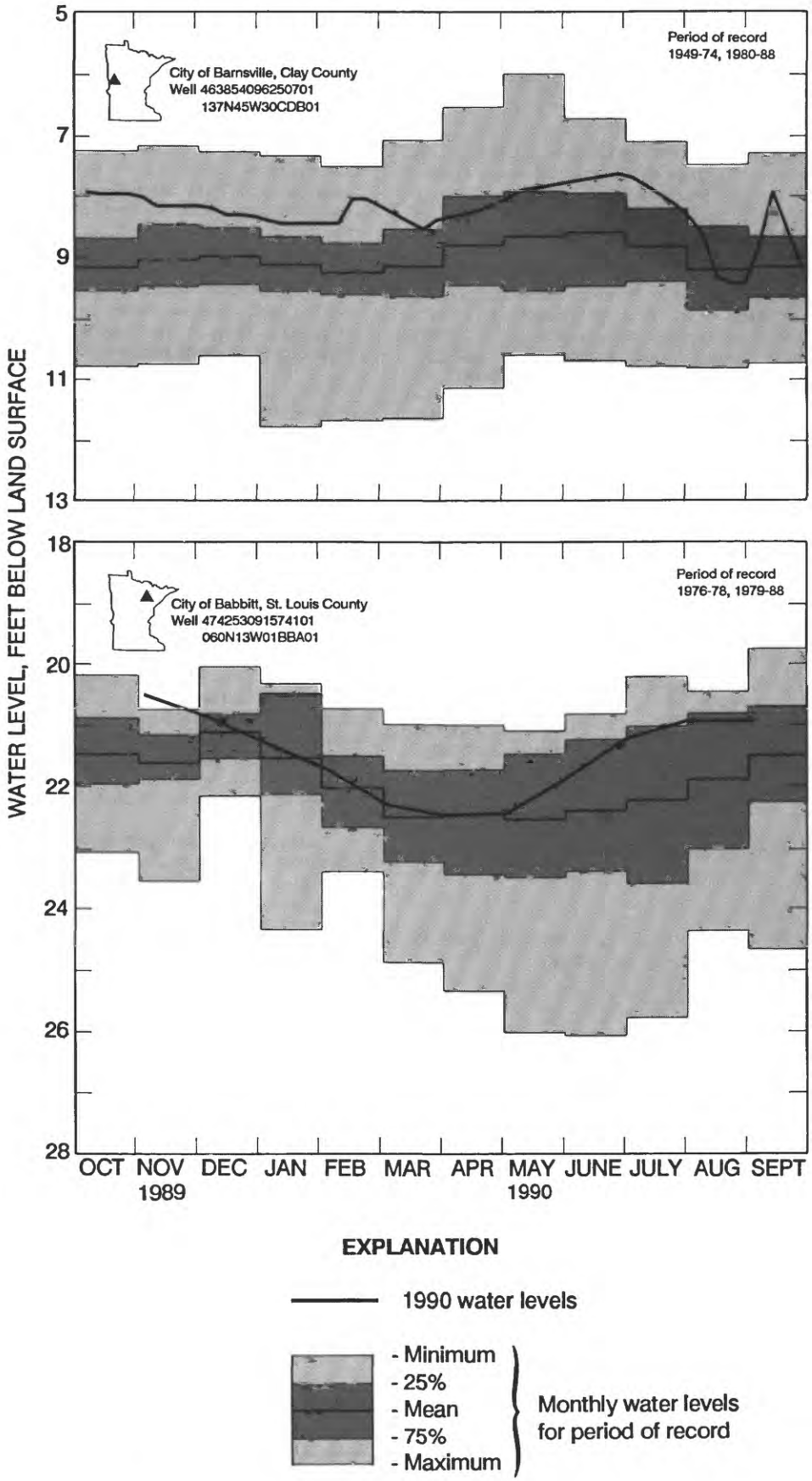


Figure 5.--Relation of water levels during 1990 to long-term levels in two representative wells in surficial sand aquifers.

new stations that may be established; hence, the numbers are not consecutive. The complete 8-digit number for each station such as 05041000, which appears just to the left of the station name, includes the 2-digit part number "05" plus the 6-digit downstream order number "041000."

Latitude-Longitude System for Wells and Miscellaneous Sites

The 8-digit downstream order station numbers are not assigned to wells and miscellaneous sites where only random water-quality samples or discharge measurements are taken.

The well and miscellaneous site numbering system of the U.S. Geological Survey is based on the grid system of latitude and longitude. The system provides the geographic location of the well or miscellaneous site and a unique number for each site. The number consists of 15 digits. The first 6 digits denote the degrees, minutes, and seconds of latitude, the next 7 digits denote degrees, minutes, and seconds of longitude, and the last 2 digits (assigned sequentially) identify the wells or other sites within a 1-second grid. See figure 6. Each well site is also identified by a local well number which consists of township, range, and section numbers, three letters designating 1/4, 1/4, 1/4 section location, and a two-digit sequential number.

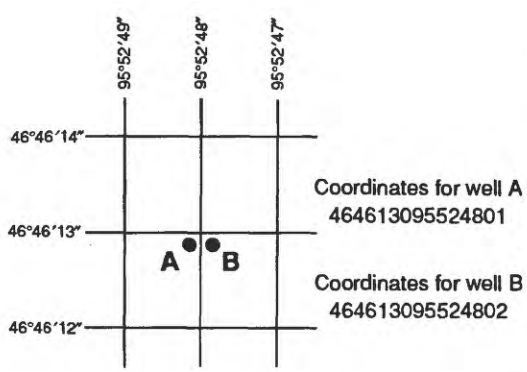


Figure 6.--Example of system for numbering wells and miscellaneous sites.

RECORDS OF STAGE AND WATER DISCHARGE

Records of stage and water discharge may be complete or partial. Complete records of discharge are those obtained using a continuous stage-recording device through which either instantaneous or mean daily discharge may be computed for any time, or any period of time, during the period of record. Complete records of lake or reservoir content, similarly, are those for which stage or content may be computed or estimated with reasonable accuracy for any time, or period of time. They may be obtained using a continuous stage-recording device, but need not be. Because daily mean discharges and end-of-day contents commonly are published for such stations, they are referred to as "daily stations".

By contrast, partial records are obtained through discrete measurements without using a continuous stage-recording device and pertain only to a few flow characteristics, or perhaps only one. The nature of the partial record is indicated by table titles such as "High-flow partial records," or "Low-flow partial records." Records of miscellaneous discharge measurements or of measurements from special studies, such as low-flow seepage studies, may be considered as partial records, but they are presented separately in this report. Location of all complete-record and high-flow partial-record stations for which data are given in this report are shown in figures 7 and 9.

Data Collection and Computation

The data obtained at a complete-record gaging station on a stream or canal consist of a continuous record of stage, individual measurements of discharge throughout a range of stages, and notations regarding factors that may affect the relationships between stage and discharge. These data, together with supplemental information, such as weather records, are used to compute daily discharges. The data obtained at a complete-record gaging station on a lake or reservoir consist of a record of stage and of notations regarding factors that may affect the relationship between stage and lake content. These data are used with stage-area and stage-capacity curves or tables to compute water-surface areas and lake storage.

Continuous records of stage are obtained with analog recorders that trace continuous graphs of stage or with digital recorders that punch stage values on paper tapes at selected time intervals. Measurements of discharge are made with current meters using methods adapted by the Geological Survey as a result of experience accumulated since 1880. These methods are described in standard textbooks, in Water-Supply Paper 2175, and in U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A6.

In computing discharge records, results of individual measurements are plotted against the corresponding stages, and stage-discharge relation curves are then constructed. From these curves, rating tables indicating the approximate discharge for any stage within the range of the measurements are prepared. If it is necessary to define extremes of discharge outside the range of current-meter measurements, the curves are extended using: (1) logarithmic-plotting; (2) velocity-area studies; (3) results of indirect measurements of peak discharge, such as slope-area or contracted-opening measurements, and computations of flow-over-dams or weirs; or (4) step-backwater techniques.

Daily mean discharges are computed by applying the daily mean stages (gage heights) to the stage-discharge curves or tables. 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 the individual discharge measurements and notes of the personnel making the measurements are applied to the gage heights before the discharges are determined from the curves or tables. This shifting-control method also is used if the stage-discharge relation is changed temporarily because of aquatic growth or debris on the control. For some stations, formation of ice in the winter may so obscure the stage-discharge relations that daily mean discharges must be estimated from other information such as temperature and precipitation records, notes of observations, and records for other stations in the same or nearby basins for comparable periods.

At some stream-gaging stations the stage-discharge relation is affected by the 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 computing discharge. 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; at these stations the rate of change in stage is used as a factor in computing discharge.

In computing records of lake or reservoir contents, it is necessary to have available from surveys, curves, or tables defining the relationship of stage and content. The application of stage to the stage-content curves or tables gives the contents from which daily, monthly, or yearly changes then are determined. If the stage-content relationship changes because of deposition of sediment in a lake or

reservoir, periodic resurveys may be necessary to redefine the relationship. Even when this is done, the contents computed may become increasingly in error as time since the last survey increases. Discharge over lake or reservoir spillways are computed from stage-discharge relationships much as other stream discharges are computed.

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 daily discharge or contents. This happens when the recorder stops or otherwise fails to operate properly, intakes are plugged, the float is frozen in the well, or for various other reasons. For such periods, the daily discharges are estimated from the recorded range in stage, previous or following record, discharge measurements, weather records, and comparison with other station records from the same or nearby basins. Likewise, daily contents may be estimated from operator's logs, previous or following record, inflow-outflow studies, and other information. Information explaining how estimated daily-discharge values are identified in station records is included in the next two sections, "Data Presentation" (REMARKS paragraph) and "Identifying Estimated Daily Discharge."

Data Presentation

The records published for each gaging station consist of two parts, the manuscript or station description and the data table for the current water year. The manuscript provides, under various headings, descriptive information, such as station location; period of record; average discharge; historical extremes; record accuracy; and other remarks pertinent to station operation and regulation. The following information as appropriate is provided with each continuous record of discharge or lake content. Comments to follow clarify information presented under the various headings of the station description.

LOCATION.--Information on locations is obtained from the most accurate maps available. The location of the gage with respect to the cultural and physical features in the vicinity and with respect to the reference place mentioned in the station name is given. River mileages, given for only a few stations, were determined by methods given in "River Mileage Measurement," Bulletin 14, Revision of October 1968, prepared by the Water Resources Council or were provided by the U.S. Army Corps of Engineers.

DRAINAGE AREA.--Drainage areas are measured using the most accurate maps available. Because the type of maps available varies from one drainage basin to another, the accuracy of drainage areas likewise varies. Drainage areas are updated as better maps become available.

PERIOD OF RECORD.--This indicates the period for which there are published records for the station or for an equivalent station. An equivalent station is one that was in operation at a time when the present station was not, and whose location was such that records from it can reasonably be considered equivalent with records from the present station.

REVISED RECORDS.--Published records, because of new information, occasionally are found to be incorrect, and revisions are printed in later reports. Listed under this heading are all reports in which revisions have been published for the station and water years to which the revisions apply. If a revision did not include daily, monthly, or annual figures of discharge, that fact is noted after the year dates as follows: "(M)" means that only the instantaneous maximum discharge was revised; "(m)" that only the instantaneous minimum was revised; and "(P)" that only peak discharges were revised. If the drainage area has been revised, the report in which the most recently revised figure was first published is given.

GAGE.--The type of gage in current use, the datum of the current gage referred to National Geodetic Vertical Datum of 1929 (see glossary), and a condensed history of the types, locations, and datum of previous gages are given under this heading.

REMARKS.--All periods of estimated daily-discharge record will either be identified by date in this paragraph of the station description for water-discharge stations or flagged in the daily-discharge table. If a remarks statement is used to identify estimated record, the paragraph will begin with this information presented as the first entry. The paragraph is also used to present information relative to the accuracy of the records, to special methods of computation, to conditions that affect natural flow at the station and, possibly, to other pertinent items. For reservoir stations, information is given on the dam forming the reservoir, the capacity, outlet works and spillway, and purpose and use of the reservoir.

COOPERATION.--Records provided by a cooperating organization or obtained for the Geological Survey by a cooperating organization are identified here.

AVERAGE DISCHARGE.--The discharge value given is the arithmetic mean of the water-year mean discharges. It is computed only for stations having at least 5 water years of complete record, and only water years of complete record are included in the computation. It is not computed for stations where diversions, storage, or other water-use practices cause the value to be meaningless. If water developments significantly altering flow at a station are put into use after the station has been in operation for a period of years, a new average is computed as soon as 5 water years of record have accumulated following the development. The median of yearly mean discharges also is given under this heading for stations having 10 or more water years of record, if the median differs from the average given by more than 10 percent.

EXTREMES FOR PERIOD OF RECORD.--Extremes may include maximum and minimum stages and maximum and minimum discharges or content. Unless otherwise qualified, the maximum discharge or content is the instantaneous maximum corresponding to the highest stage that occurred. The highest stage may have been obtained from a graphic or digital recorder, a crest-stage gage, or by direct observation of a nonrecording gage. If the maximum stage did not occur on the same day as the maximum discharge or content, it is given separately. Similarly, the minimum is the instantaneous minimum discharge, unless otherwise qualified, and was determined and is reported in the manner as the maximum.

EXTREMES OUTSIDE PERIOD OF RECORD.--Included here is the information concerning major floods or unusually low flows that occurred outside the stated period of record. The information may or may not have been obtained by the U.S. Geological Survey.

EXTREMES FOR THE CURRENT YEAR.--Extremes given here are similar to those for the period of record, except the peak discharge listing which may include secondary peaks. For stations meeting certain criteria, all peak discharges and stages occurring during the water year and greater than a selected base discharge are presented under this heading. The peaks greater than the base discharge, excluding the highest one, are referred to as secondary peaks. Peak discharges are not published for canals, ditches, drains, or streams for which the peaks are subject to substantial control by man. The time of occurrence for peaks is expressed in 24-hour local standard time. For example, 12:30 a.m. is 0030, and 1:30 p.m. is 1330. The minimum for the current water year appears below the table of peak data.

REVISIONS.--If a critical error in published records is discovered, a revision is included in the first report published following discovery of the error.

Although rare, occasionally the records of a discontinued gaging station may need revision. Because, for these stations, there would be no current or, possibly, future station manuscript published to document the revision in a "Revised Records" entry, users of data for these stations who obtained the record from previously published data reports may wish to contact the district office to determine if the published records were ever revised after the station was discontinued. Of course, if the data were obtained by computer

retrieval, the data would be current and there would be no need to check because any published revision of data is always accompanied by revision of the corresponding data in computer storage.

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.

The daily table for stream-gaging stations gives mean discharge for each day and is followed by monthly and yearly summaries. In the monthly summary below the daily table, the line headed "TOTAL" gives the sum of the daily figures. The line headed "MEAN" gives the average flow in cubic feet per second during the month. The lines headed "MAX" and "MIN" give the maximum and minimum daily discharges, respectively, for the month. Discharge for the month also is usually 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 there is extensive regulation or diversion or if the drainage area includes large noncontributing areas. In the yearly summary below the monthly summary, the figures shown are the appropriate discharges for the calendar and water years. At some stations monthly and (or) yearly observed discharges are adjusted for reservoir storage or diversion, or diversions or reservoir contents are given. These figures are identified by a symbol and corresponding footnote.

Data collected at partial-record stations follow the information for continuous-record sites. Data for partial-record discharge 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. The tables of partial-record stations are followed by a listing of discharge measurements made at sites other than continuous-record or partial-record stations. 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.

Identifying Estimated Daily Discharge

Estimated daily-discharge values published in the water-discharge tables of annual State data reports are identified either by flagging individual daily values with the letter symbol "e" and printing a table footnote, "e Estimated", or by listing the dates of the estimated record in the REMARKS paragraph of the station description.

Accuracy of the Records

The accuracy of streamflow records 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 measurements of stage, measurements of discharge, and interpretation of records.

The accuracy attributed to the records is indicated under "REMARKS." "Excellent" means that about 95 percent of the daily discharges are within 5 percent of the true; "good," within 10 percent; and "fair," within 15 percent. Records that do not meet the criteria mentioned, are rated "poor." Different accuracies may be attributed to different parts of a given record.

Daily mean discharges in this report are given to the nearest hundredth of a cubic foot per second for values less than 1 ft^3/s; to the nearest tenth between 1.0 and 10 ft^3/s; to whole numbers between 10 and 1000 ft^3/s; and to 3 significant figures for more than 1000 ft^3/s. The number of significant figures used is based solely on the magnitude of the discharge value. The same rounding rules apply to discharges listed for partial-record stations and miscellaneous sites.

Discharge at many stations, as indicated by the monthly mean, may not reflect natural runoff due to the effects of 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 if adjustments or losses are large in comparison with the observed discharge.

Other Records Available

Information of a more detailed nature than that published for most of the gaging stations such as observations of water temperatures, discharge measurements, gage-height records, and rating tables is on file in the district office. Also most gaging-station records are available in computer-usable form and many statistical analyses have been made.

Information on the availability of unpublished data or statistical analyses may be obtained from the district office.

The National Water Data Exchange, Water Resources Division, U.S. Geological Survey, National Center, Reston, VA 22092, maintains an index of all discharge measurement sites in the State as well as an index of records of discharge collected by other agencies but not published by the Geological Survey. Information on records available at specific sites can be obtained upon request.

RECORDS OF SURFACE-WATER QUALITY

Records of surface water quality ordinarily are obtained at or near stream-gaging stations because interpretation of records of surface-water quality nearly always requires corresponding discharge data. Records of surface-water quality in this report may involve a variety of types of data and measurement frequencies.

Classification of Records

Water-quality data for surface-water sites are grouped into one of three classifications. A continuing-record station is a site where data are collected on a regularly scheduled basis. Frequency may be once or more times daily, weekly, monthly, or quarterly. A partial-record station is a site where limited water-quality data are collected systematically over a period of years. Frequency of sampling is usually less than quarterly. A miscellaneous sampling site is a location other than a continuing or partial-record station, where random samples are collected to give better areal coverage to define water-quality conditions in the river basin.

A careful distinction needs to be made between "continuing records" as used in this report and "continuous recordings," which refers to a continuous graph or a series of discrete values punched at short intervals on a paper tape. Some records of water quality, such as temperature and specific conductance, may be obtained through continuous recordings; however, because of costs, most data are obtained only monthly or less frequently. Locations of stations for which records on the quality of surface water appear in this report are shown in figure 8.

Arrangement of Records

Water-quality records collected at a surface-water daily record station are published immediately following that record, regardless of the frequency of sample collection. Station number and name are the same for both records. Where a surface-water daily record station is not available or where the water quality differs significantly from that at the nearby surface-water station, the continuing water-quality record is published with its own station number and name in the regular downstream-order sequence. Water-quality data for partial-record stations and for miscellaneous sampling sites appear in separate tables following the table of discharge measurements at miscellaneous sites.

Onsite Measurement and Collection

In obtaining water quality data, a major concern needs to be assuring that the data obtained represents the in situ quality of water. To assure this, certain measurements, such as water temperature, pH, and dissolved oxygen need to be made onsite when the samples are taken. To assure that measurements made in the laboratory also represent the in situ water, carefully prescribed procedures need to be followed in collecting the samples, in treating the samples to prevent changes in quality pending analysis, and in shipping the samples to the laboratory. Procedures for onsite measurements and for collecting, treating, and shipping samples are given in publications on "Techniques of Water-Resources Investigations," Book 1, Chap. D2; Book 3, Chap. C2; Book 5 Chap. A1, A3, and A4. All of these references are listed on p. 17 of this report. Also, detailed information on collecting, treating, and shipping samples may be obtained from the Geological Survey district office.

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 through several vertical sections to obtain a representative sample needed for an accurate mean concentration and for use in calculating load. All samples obtained for the National Stream Quality Accounting Network (see definitions) are obtained from at least several verticals. Whether samples are obtained from the centroid of flow or from several verticals, depends on flow conditions and other factors which must be evaluated by the collector.

Chemical-quality data published in this report are considered to be the most representative values available for the stations listed. The values reported represent water-quality conditions at the time of sampling as much as possible, consistent with available sampling techniques and methods of analysis. In the rare case where an apparent inconsistency exists between a reported pH value and the relative abundance of carbon dioxide species (carbonate and bicarbonate), the inconsistency is the result of a slight uptake of carbon dioxide from the air by the sample between measurement of pH in the field and determination of carbonate and bicarbonate in the laboratory.

For chemical-quality stations equipped with digital monitors, the records consist of daily maximum, minimum, and mean values for each constituent measured and are based upon hourly punches beginning at 0100 hours and ending at 2400 hours for the day of record. More detailed records (hourly values) may be obtained from the U.S.G.S. district office whose address is given on the back of the title page of this report.

Water Temperature

Water temperatures are measured at most of the water-quality stations. In addition, water temperatures are taken at time of discharge measurements for water-discharge stations. For stations where water temperatures are taken manually once or twice daily, the water temperatures are taken at about the same time each day. Large streams have a small diurnal temperature change; shallow streams may have a daily range of several degrees and may follow closely the changes in air temperature. Some streams may be affected by waste-heat discharges.

At stations where recording instruments are used, either mean temperatures or maximum and minimum temperatures for each day are published. Water temperatures measured at the time of water-discharge measurements are on file in the district office.

Sediment

Suspended-sediment concentrations are determined from samples collected by using depth-integrating samplers. Samples usually are obtained at several verticals in the cross section, or a single sample may be obtained at a fixed point and a coefficient applied to determine the mean concentration in the cross sections.

During periods of rapidly changing flow or rapidly changing concentration, samples may have been collected more frequently (twice daily or, in some instances, hourly). The published sediment discharges for days of rapidly changing flow or concentration were computed by the subdivided-day method (time-discharge weighted average). Therefore, for those days when the published sediment discharge value differs from the value computed as the product of discharge times mean concentration times 0.0027, the reader can assume that the sediment discharge for that day was computed by the subdivided-day method. For periods when no samples were collected, daily loads of suspended sediment were estimated on the basis of water discharge, sediment concentrations observed immediately before and after the periods, and suspended-sediment loads for other periods of similar discharge.

At other stations, suspended-sediment samples were collected periodically at many 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 and in predicting long-term sediment-discharge characteristics of the stream.

In addition to the records of suspended sediment discharge, records of the periodic measurements of the particle-size distribution of the suspended sediment and bed material are included for some stations.

Laboratory Measurements

Samples for indicator bacteria and specific conductance are analyzed locally. All other samples are analyzed in the Geological Survey laboratories in Arvada, Colo., Doraville, Ga., or Iowa City, Ia. Methods used in analyzing sediment samples and computing sediment records are given in TWRI, Book 5, Chap. C1. Methods used by the Geological Survey laboratories are given in TWRI, Book 1, Chap. D2; Book 3, Chap. C2; Book 5, Chap. A1, A3, and A4.

Data Presentation

For continuing-record stations, information pertinent to the history of station operation is provided in descriptive headings preceding the tabular data. These descriptive headings give details regarding location, drainage area, period of record, type of data available, instrumentation, general remarks, cooperation, and extremes for parameters currently measured daily. Tables of chemical, physical, biological, radiochemical data, and so forth, obtained at a frequency less than daily are presented first. Tables of "daily values" of specific conductance, pH, water temperature, dissolved, and suspended sediment then follow in sequence.

In the descriptive headings, if the location is identical to that of the discharge gaging station, neither the LOCATION nor the DRAINAGE AREA statements are repeated. The following information, when appropriate, is provided with each continuous-record station. Comments that follow clarify information presented under the various headings of the station description.

LOCATION.–See Data Presentation under "Records of stage and Water Discharge"; same comments apply.

DRAINAGE AREA.–See Data Presentation under "Records of stage and Water Discharge"; same comments apply.

PERIOD OF RECORD.--This indicates the periods for which there are published water-quality records for the station. The periods are shown separately for records of parameters measured daily or continuously and those measured less than daily. For those measured daily or continuously, periods of record are given for the parameters individually.

INSTRUMENTATION.--Information on instrumentation is given only if a water-quality monitor, temperature recorder, sediment pumping sampler, or other sampling device is in operation at a station.

REMARKS.--Remarks provide added information pertinent to the collection, analysis, or computation of the records.

COOPERATION.--Records provided by a cooperating organization or obtained for the Geological Survey by a cooperating organization are identified here.

EXTREMES.--Maximums and minimums are given only for parameters measured daily or more frequently. None are given for parameters measured weekly or less frequently, because the true maximums or minimums may not have been sampled. Extremes, when given, are provided for both the period of record and for the current water year.

REVISIONS.--If errors in published water-quality records are discovered after publication, appropriate updates are made to the Water-Quality File in the U.S. Geological Survey's computerized data system, WATSTORE, and subsequently by monthly transfer of update transactions to the U.S. Environmental Protection Agency's STORET system. Because the usual volume of updates makes it impractical to document individual changes in the State data-report series or elsewhere, potential users of U.S. Geological Survey water-quality data are encouraged to obtain all required data from the appropriate computer file to insure the most recent updates.

The surface-water-quality records for partial-record stations and miscellaneous sampling sites are published in separate tables following the table of discharge measurements at miscellaneous sites. No descriptive statements are given for these records. Each station is published with its own station number and name in the regular downstream-order sequence.

Remark Codes

The following remark codes may appear with the water-quality data in this report:

PRINTED OUTPUT	REMARK
E	Estimated value
>	Actual value is known to be greater than the value shown
<	Actual value is known to be less than the value shown
K	Results based on colony count outside the acceptance range (non-ideal colony count)
L	Biological organisms count less than 0.5 percent (organisms may be observed rather than counted)
D	Biological organism count equal to or greater than 15 percent (dominant)
&	Biological organism estimated as dominant

RECORDS OF GROUND-WATER LEVELS

Only water-level data from a national network of observation wells are given in this report. These data are intended to provide a sampling and historical record of water-level changes in the Nation's most important aquifers. Locations of the observation wells in this network in Minnesota are shown in figure 10.

Although, in this report, records of water levels are presented for fewer than 200 wells, records are obtained through cooperative efforts of many Federal, State, and local agencies for several hundred observation wells throughout Minnesota and are placed in computer storage. Each spring, the Minnesota Department of Natural Resources, Division of Waters publishes a report for the previous water year entitled "Observation Well Data Summary, Water Year 19__." This report contains hydrographs of recorder wells, detailed maps showing the location of active observation wells, and other useful items. Information about the availability of the data in the water-level file may be obtained from the District Chief, Minnesota District. (See address on back of front page).

Data Collection and Computation

Measurements of water levels are made in many types of wells under varying conditions, but the methods of measurement are standardized to the extent possible. The equipment and measuring techniques used at each observation well assure that measurements at each well are of consistent accuracy and reliability.

Tables of water-level data are presented by counties arranged in alphabetical order. The prime identification number for a given well is the 15-digit number that appears in the upper left corner of the table. The secondary identification number is the local well number, an alphanumeric number, derived from the township-range location of the well.

Water-level records are obtained from direct measurements with a steel tape or from the graph or punched tape of a water-stage recorder. The water-level measurements in this report are given in feet with reference to land-surface datum (lsd). Land-surface datum is a datum plane that is approximately at land surface at each well. If known, the elevation of the land-surface datum is given in the well description. The height of the measuring point (MP) above or below land-surface datum is given in each well description. Water levels in wells equipped with recording gages are reported for every fifth day and the end of each month (eom).

All water-level measurements are reported to the nearest hundredth of a foot. The error of water-level measurements is normally only a hundredth or a few hundredth of a foot.

Hydrographs showing water-level fluctuations are included for 4 representative wells; 2 in surficial-sand aquifers, 1 in a buried sand aquifer, and 1 in a bedrock aquifer.

Data Presentation

Each well consists of two parts, the station description and the data table of water levels observed during the water year. The description of the well is presented first through use of descriptive headings preceding the tabular data. The comments to follow clarify information presented under the various headings.

LOCATION.--This paragraph follows the well-identification number and reports the latitude and longitude (given in degrees, minutes and seconds); a landline location designation; the hydrologic-unit number; the distance and direction from a geographic point of reference; and the owner's name.

AQUIFER.-- This entry designates by name (if a name exists) and geologic age the aquifer(s) open to the well.

WELL CHARACTERISTICS.--This entry describes the well in terms of depth, diameter, casing depth and/or screened interval, method of construction, use, and includes additional information such as casing breaks, collapsed screen, and other changes since construction.

DATUM.--This entry describes both the measuring point and the land-surface elevation at the well. The measuring point is described physically (such as top of collar, notch in the top of casing, plug in pump base and so on), and in relation to land surface (such as 1.3 ft above land-surface datum). The elevation of the land-surface datum is described in feet above (or below) National Geodetic Vertical Datum of 1929 (NGVD of 1929); it is reported with a precision depending on the method of determination.

REMARKS.--This entry describes factors that may influence the water level in a well or the measurement of the water level. It should identify wells that are also water-quality observation wells, and may be used to acknowledge the assistance of local (non-Survey) observers.

PERIOD OF RECORD.--This entry indicates the period for which there are published records for the well. It reports the month and year of the start of the publication of water-level records by the U.S. Geological Survey and the words "to current year" if the records are to be continued into the following year. Periods for which water-level records are available, but are not published by the Geological Survey, may be noted.

EXTREMES FOR THE PERIOD OF RECORD.--This entry contains the highest and lowest water levels of the period of published record, with respect to land-surface datum, and the dates of their occurrence.

A table of water levels follows the station description for each well. Water levels are reported in feet below land-surface datum and all taped measurements of water level are listed. For wells equipped with recorders, abbreviated tables are published; generally, only water-level lows are listed for every fifth day and at the end of the month (eom). The highest and lowest water levels of the water year and their dates of occurrence are shown on a line below the abbreviated table. Because all values are not published for wells with recorders, the extremes may be values that are not listed in the table. Missing records are indicated by dashes in place of the water level.

RECORDS OF GROUND-WATER QUALITY

Records of ground-water quality in this report differ from other types of records in that for most sampling sites they consist of only one set of measurements for the water year. The quality of ground water ordinarily changes only slowly; therefore, for most general purposes one annual sampling, or only a few samples taken at infrequent intervals during the year, is sufficient. Frequent measurement of the same constituents is not necessary unless one is concerned with a particular problem, such as monitoring for trends in nitrate concentration. In the special cases where the quality of ground water may change more rapidly, more frequent measurements are made to identify the nature of the changes.

Data Collection and Computation

The records of ground-water quality in this report were obtained mostly as a part of special studies in specific areas. Consequently, a number of chemical analyses are presented for some counties but none are presented for others. As a result, the records for this year, by themselves, do not provide a balanced view of ground-water quality statewide. Such a view can be attained only by considering records for this year in context with similar records obtained for these and other counties in earlier years.

Most methods for collecting and analyzing water samples are described in the "U.S. Geological Survey Techniques of Water-Resources Investigation" manuals listed on a following page. The values reported in this report represent water-quality conditions at the time of sampling as much as possible, consistent with available sampling techniques and methods of analysis. All samples were obtained by trained personnel. The wells sampled were pumped long enough to assure that the water collected came directly from the aquifer and had not stood for a long time in the well casing where it would have been exposed to the atmosphere and to the material, possibly metal, comprising the casings.

Data Presentation

The records of ground-water quality are published in a section titled QUALITY OF GROUND WATER immediately following the ground-water-level records. Data for quality of ground water are listed alphabetically by County, and are identified by well number. The prime identification number for wells sampled is the 15-digit number derived from the latitude-longitude locations. No descriptive statements are given for ground-water-quality records; however, the well number, depth of well, date of sampling, and other pertinent data are given in the table containing the chemical analyses of the ground water. The REMARK codes listed for surface-water-quality records are also applicable to ground-water-quality records.

ACCESS TO WATSTORE DATA

The National WATer Data STOrage and REtrieval System (WATSTORE) was established for handling water data collected through the activities of the U.S. Geological Survey and to provide for more effective and efficient means of releasing the data to the public. The system is operated and maintained on the central computer facilities of the Survey at its National Center in Reston, Virginia.

WATSTORE can provide a variety of useful products ranging from simple data tables to complex statistical analyses. A minimal fee, plus the actual computer cost incurred in producing a desired product, is charged to the requester. Information about the availability of specific types of data, the acquisition of data or products, and user charges can be obtained locally from each of the Water Resources Division's district offices (see address given on back of the title page).

General inquiries about WATSTORE may be directed to:

Hydrologist
U.S. Geological Survey
437 National Center
Reston, Virginia 22092

DEFINITION OF TERMS

Terms related to streamflow, water-quality, and other hydrologic data, as used in this report, are defined below. See also table for converting inch-pound units to International System of units (SI) on the inside of back cover.

Acre-foot (AC-FT, acre-ft) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Adenosine triphosphate (ATP) is the primary energy donor in cellular life process. Its central role in living cells makes it an excellent indicator of the presence of living material in water. A measure of ATP, therefore, provides a sensitive and rapid estimate of biomass. ATP is reported in micrograms per liter of the original water sample.

Algae are mostly aquatic single-celled, colonial, or multi-celled plants, containing chlorophyll and lacking roots, stems, and leaves.

Algal growth potential (AGP) is the maximum algal dry weight biomass that can be produced in a natural water sample under standardized laboratory conditions. The growth potential is the algal biomass present at stationary phase and is expressed as milligrams dry weight of algae produced per liter of sample.

Aquifer is a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian means confined and is used to describe a well in which the water level stands above the top of the aquifer tapped by the well. A flowing artesian well is one in which the water level is above the land surface.

Bacteria are microscopic unicellular organisms, typically spherical, rodlike, or spiral and threadlike in shape, often clumped into colonies. Some bacteria cause disease, others perform an essential role in nature in the recycling of materials; for example, by decomposing organic matter into a form available for reuse by plants.

Total coliform bacteria are a particular group of bacteria that are used as indicators of possible sewage pollution. They are characterized as aerobic or facultative anaerobic, gram-negative, nonspore- forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C. In the laboratory these bacteria are defined as the organisms which produce colonies with a golden-green metallic sheet within 24 hours when incubated at 35°C ±1.0°C on M-Endo medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample.

Fecal coliform bacteria are bacteria that are present in the intestine or feces of warmblooded animals. They are often used as indicators of the sanitary quality of the water. In the laboratory they are defined as all organisms which produce blue colonies within 24 hours when incubated at 44.5°C ±0.2°C on M-FC medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample.

Fecal streptococcal bacteria are bacteria also found in the intestine of warmblooded animals. Their presence in water is considered to verify fecal pollution. They are characterized as gram-positive, cocci bacteria which are capable of growth in brain-heart infusion broth. In the laboratory they are defined as all the organisms which produce red or pink colonies within 48 hours at 35°C ±1.0°C on M-FC medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample.

Bed material is the unconsolidated material of which a streambed, lake, pond, reservoir, or estuary bottom is composed.

Biochemical oxygen demand (BOD) is a measure of the quantity of dissolved oxygen, in milligrams per liter, necessary for the decomposition of organic matter by microorganisms, such as bacteria.

Biomass is the amount of living matter present at any given time, expressed as the mass per unit area or volume of habitat.

Ash mass is the mass or amount of residue present after the residue from the dry mass determination has been ashed in a muffle furnace at a temperature of 500°C for 1 hour. The ash mass values of zooplankton and phytoplankton are expressed in grams per cubic meter (g/m^3), and periphyton and benthic organisms in grams per square meter (g/m^2).

Dry mass refers to the weight of residue present after drying in an oven at 60°C for zooplankton and 105°C for periphyton, until the mass remains unchanged. This mass represents the total organic matter, ash and sediment, in the sample. Dry mass values are expressed in the same units as ash mass.

Organic mass or volatile mass of the living substance is the difference between the dry mass and the ash mass, and represents the actual mass of the living matter. The organic mass is expressed in the same units as for ash mass and dry mass.

Wet mass is the mass of living matter plus contained water.

Bottom material: See Bed Material.

Cells/volume refers to the number of cells or any organism which is counted by using a microscope and grid or counting cell. Many planktonic organisms are multicelled and are counted according to the number of contained cells per sample, usually milliliters (mL) or liters (L).

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, approximately 1.9835 acre-feet, or about 646,000 gallons or 2,447 cubic meters.

Chemical oxygen demand (COD) is a measure of the chemically oxidizable material in the water, and furnishes an approximation of the amount of organic and reducing material present. The determined value may correlate with natural water color or with carbonaceous organic pollution from sewage or industrial wastes.

Chlorophyll refers to the green pigments of plants. Chlorophyll a and b are the two most common pigments in plants.

Color unit is produced by one milligram per liter of platinum in the form of the chloroplatinate ion. Color is expressed in units of the platinum-cobalt scale.

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.

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, an artificial structure, or a uniform cross section over a long reach of the channel.

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.

Cubic foot per second (FT^3/s, ft^3/s) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute or 0.02832 cubic meters per second.

Discharge is the volume of water (or more broadly, volume of fluid plus suspended sediment), that passes a given point within a given period of time.

Mean discharge (MEAN) is the arithmetic mean of individual daily mean discharges during a specific period.

Instantaneous discharge is the discharge at a particular instant of time.

Dissolved refers to the amount of substance present in true chemical solution. In practice, however, the term includes all forms of substance that will pass through a 0.45-micrometer membrane filter, and thus may include some very small (colloidal) suspended particles. Analyses are performed on filtered samples.

Dissolved-solids concentration of water is determined either analytically by the "residue-on-evaporation" method, or mathematically by totaling the concentrations of individual constituents reported in a comprehensive chemical analysis. During the analytical determination of dissolved solids, the bicarbonate (generally a major dissolved component of water) is converted to carbonate. Therefore, in the mathematical calculation of dissolved-solids concentration, the bicarbonate value, in milligrams per liter, is multiplied by 0.492 to reflect the change.

Diversity index is a numerical expression of evenness of distribution of aquatic organisms. The formula for diversity index is:

$$\bar{d} = -\sum_{i=1}^{s} \frac{n_i}{n} \log_2 \frac{n_i}{n}$$

Where 'n_i' is the number of individuals per taxon, 'n' is the total number of individuals, and 's' is the total number of taxa in the sample of the community. Diversity index values range from zero, when all the organisms in the sample are the same, to some positive number, when some or all of the organisms in the sample are different.

Drainage area of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains 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.

Drainage basin is a part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Gage height (G.H.) 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.

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Hardness of water is a physical-chemical characteristic that is commonly recognized by the increased quantity of soap required to produce lather. It is attributable to the presence of alkaline earths (principally calcium and magnesium) and is expressed as equivalent calcium carbonate ($CaCO_3$).

Hydrologic unit is a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as delineated by the Office of Water Data Coordination on the State Hydrologic Unit Maps; each hydrologic unit is identified by an 8-digit number.

Metamorphic stage refers to the stage of development that an organism exhibits during its transformation from an immature form to an adult form. This developmental process exists for most insects, and the degree of difference from the immature stage to the adult form varies from relatively slight to pronounced, with many intermediates. Examples of metamorphic stages of insects are egg-larva-adult or egg-nymph-adult.

Methylene blue active substance (MBAS) is a measure of apparent detergents. This determination depends on the formation of a blue color when methylene blue dye reacts with synthetic detergent compounds.

Micrograms per gram (UG/G, ug/g) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (gram) of sediment.

Micrograms per kilogram (MG/KG, mg/kg) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (kilogram) of sediment.

Micrograms per liter (UG/L, ug/L) is a unit expressing the concentration of chemical constituents in solution as mass (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Milligrams per liter (MG/L, mg/L) is a unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represent the mass of solute per unit volume (liter) of water. Concentration of suspended sediment also is expressed in mg/L, and is based on the mass of sediment per liter of water-sediment mixture.

National Geodetic Vertical Datum of 1929 (NGVD) is a geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada. It was formerly called "Sea Level Datum of 1929" or "mean sea level" in this series of reports. Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific Coasts, it does not necessarily represent local mean sea level at any particular place.

National Stream Quality Accounting Network (NASQAN) is a nationwide data-collection network designed by the U.S. Geological Survey to meet many of the information needs of government agencies and other groups involved in natural or regional water-quality planning and management. The 500 or so sites in NASQAN are generally located at the downstream ends of hydrologic accounting units designated by the U.S. Geological Survey Office of Water Data Coordination in consultation with the Water Resources Council. The objectives of NASQAN are (1) to obtain information on the quality and quantity of water moving within and from the United States through a systematic and uniform process of data collection, summarization, analysis, and reporting such that the data may be used for, (2) description of the areal variability of water quality in the Nation's rivers through analysis of data from this and other programs, (3) detection of changes or trends with time in the pattern of occurrence of water-quality characteristics, and (4) providing a nationally consistent data base useful for water-quality assessment and hydrologic research.

The National Trends Network (NTN) is a 150-station network for sampling atmospheric deposition in the United States. The purpose of the network is to determine the variability, both in location and in time, of the composition of atmospheric deposition, which includes snow, rain, dust particles, aerosols, and gases, The core from which the NTN was built was the already-existing deposition-monitoring network of the National Atmospheric Deposition Program (NADP).

Organism is any living entity, such as an insect, phytoplankter, or zooplankter.

Organism count/area refers to the number of organisms collected and enumerated in a sample and adjusted to the number per area habitat, usually square meters (m^2), acres, or hectares. Periphyton, benthic organisms, and macrophytes are expressed in these terms.

Organism count/volume refers to the number of organisms collected and enumerated in a sample and adjusted to the number per sample volume, usually milliliters (mL) or liters (L). Numbers of planktonic organisms can be expressed in these terms.

Total organism count is the total number of organisms collected and enumerated in any particular sample.

Parameter code numbers are unique five-digit code numbers assigned to each parameter placed into storage. These codes are assigned by the Environmental Protection Agency and are also used to identify data exchanged among agencies.

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

Particle size is the diameter, in millimeters (mm), of suspended sediment or bed material determined by either sieve or sedimentation methods. Sedimentation methods (pipet, bottom-withdrawal tube, visual-accumulation tube) determine fall diameter of particles in distilled water (chemically dispersed).

Particle-size classification used in this report agrees with recommendations made by the American Geophysical Union Subcommittee on Sediment Terminology.

The classification is as follows:

Classification	Size (mm)	Method of analysis
Clay	0.00024 - 0.004	Sedimentation
Silt	.004 - .062	Sedimentation
Sand	.062 - 2.0	Sedimentation or sieve
Gravel	2.0 - 64.0	Sieve

The particle-size distributions given in this report are not necessarily representative of all particles in transport in the stream. Most of the organic material is removed and the sample is subjected to mechanical and chemical dispersion before analysis in distilled water.

Percent composition is a unit for expressing the ratio of a particular part of a sample or population to the total sample or population, in terms of types, numbers, mass or volume.

Periphyton is the assemblage of microorganisms attached to and growing upon solid surfaces. While primarily consisting of algae, they also include bacteria, fungi, protozoa, rotifers, and other small organisms. Periphyton is a useful indicator of water quality.

Pesticides are chemical compounds used to control undesirable plants and animals. Major categories of pesticides include insecticides, miticides, fungicides, herbicides, and rodenticides. Insecticides and herbicides, which control insects and plants respectively, are the two categories reported.

Picocurie (PC, pCi) is one trillionth (1×10^{-12}) of the amount of radioactivity represented by a curie (Ci). A curie is the amount of radioactivity that yields 3.7×10^{10} radioactive disintegrations per second. A picocurie yields 2.22 dpm (disintegrations per minute).

Plankton is the community of suspended, floating, or weakly swimming organisms that live in the open water of lakes and rivers.

Phytoplankton is the plant part of the plankton. They are usually microscopic and their movement is subject to the water currents. Phytoplankton growth is dependent upon solar radiation and nutrient substances. Because they are able to incorporate as well as release materials to the surrounding water, the phytoplankton have a profound effect upon the quality of the water. They are the primary food producers in the aquatic environment, and are commonly known as algae.

Blue-green algae are a group of phytoplankton organisms having a blue pigment, in addition to the green pigment called chlorophyll. Blue-green algae often cause nuisance conditions in water.

Diatoms are the unicellular or colonial algae having a siliceous shell. Their concentrations are expressed as number of cells/mL of sample.

Green algae have chlorophyll pigments similar in color to those of higher green plants. Some forms produce algal mats or floating "moss" in lakes. Their concentrations are expressed as number of cells/mL of sample.

Zooplankton is the animal part of the plankton. Zooplankton are capable of extensive movements within the water column, and are often large enough to be seen with the unaided eye. Zooplankton are secondary consumers feeding upon bacteria, phytoplankton, and detritus. Because they are the grazers in the aquatic environment, the zooplankton are a vital part of the aquatic food web. The zooplankton community is dominated by small crustaceans and rotifers.

Polychlorinated biphenyls (PCBs) are industrial chemicals that are mixtures of chlorinated biphenyl compounds having various percentages of chlorine. They are similar in structure to organochlorine insecticides.

Primary productivity is a measure of the rate at which new organic matter is formed and accumulated through photosynthetic and chemosynthetic activity of producer organisms (chiefly green plants). The rate of primary production is estimated by measuring the amount of oxygen released (oxygen method) or the amount of carbon assimilated by the plants (carbon method).

Milligrams of carbon per area or volume per unit time [mg $C/(m^2 \cdot$ time) for periphyton and macrophytes and mg $C/(m^3 \cdot$ time) for phytoplankton] are units for expressing primary productivity. They define the amount of carbon dioxide consumed as measured by radioactive carbon (carbon 14). The carbon 14 method is of greater sensitivity than the oxygen light and dark bottle method, and is preferred for use in unenriched waters. Unit time may be either the hour or day, depending on the incubation period.

Milligrams of oxygen per area or volume per unit time [mg $O_2/(m^2 \cdot$ time) for periphyton and macrophytes and mg $O_2/(m^3 \cdot$ time) for phytoplankton] are the units for expressing primary productivity. They define production and respiration rates as estimated from changes in the measured dissolved oxygen concentration. The oxygen light and dark bottle method is preferred if the rate of primary production is sufficient for accurate measurements to be made within 24 hours. Unit time may be either the hour or day, depending on the incubation period.

Radiochemical program is a network of regularly sampled water-quality stations where samples are collected to be analyzed for radioisotypes. The streams that are sampled represent major drainage basins in the conterminous United States.

Recoverable from bottom material is the amount of a given constituent that is in solution after a representative sample of bottom material has been digested by a method (usually using an acid or mixture of acids) that results in dissolution of only readily soluble substances. Complete dissolution of all bottom material is not achieved by the digestion treatment and thus the determination represents less than the total amount (that is, less than 95 percent) of the constituent in the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

Return period is the average time interval between occurrences of a hydrological event of a given or greater magnitude, usually expressed in years. May also be called recurrence interval.

Runoff in inches (IN, 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.

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 precipitation.

Bed load is the sediment that is transported in a stream by rolling, sliding, or skipping along the bed and very close to it. In this report, bed load is considered to consist of particles in transit within 0.25 ft of the streambed.

Bed load discharge (tons per day) is the quantity of bed load measured by dry weight that moves past a section as bed load in a given time.

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.

Suspended-sediment concentration is the velocity-weighted concentration of suspended sediment in the sampled zone (from the water surface to a point approximately 0.3 ft above the bed) expressed as milligrams of dry sediment per liter of water-sediment mixture (mg/L).

Mean concentration is the time-weighted concentration of suspended sediment passing a stream section during a 24-hour day.

Suspended-sediment discharge (tons/day) is the rate at which dry weight of sediment passes a section of a stream or is the quantity sediment, as measured by dry weight or volume, that passes a section in a given time. It is computed by multiplying discharge times mg/L times 0.0027.

Suspended-sediment load is quantity of suspended sediment passing a section in a specified period.

Total sediment discharge (tons/day) is the sum of the suspended-sediment discharge and the bed-load discharge. It is the total quantity of sediment, as measured by dry weight or volume, that passes a section during a given time.

Total-sediment load or total load is a term which refers to the total sediment (bed load plus suspended-sediment load) that is in transport. It is not synonymous with total-sediment discharge.

7-day 10 year low flow (7 Q_{10}) is the discharge at the 10-year recurrence interval taken from a frequency curve of annual values of the lowest mean discharge for 7 consecutive days (the 7-day low flow).

Sodium-adsorption-ratio (SAR) is the expression of relative activity of sodium ions in exchange reactions within soil and is an index of sodium or alkali hazard to the soil. Waters range in respect to sodium hazard from those which can be used for irrigation on almost all soils to those which are generally unsatisfactory for irrigation.

Solute is any substance derived from the atmosphere, vegetation, soil, or rocks that is dissolved in water.

Specific conductance is a measure of the ability of a water to conduct an electrical current. It is expressed in micromhos per centimeter at 25°C. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in micromhos). This relation is not constant from stream to stream, and it may vary in the same source with changes in the composition of the water.

Stage-discharge relation is the relation between gage height (stage) and volume of water per unit of time, flowing in a channel.

Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as a streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

Substrate is the physical surface upon which an organism lived.

Natural substrates refers to any naturally occurring emersed or submersed solid surface, such as a rock or tree, upon which an organism lived.

Artificial substrate is a device which is purposely placed in a stream or lake for colonization of organisms. The artificial substrate simplifies the community structure by standardizing the substrate from which each sample is taken. Examples of artificial substrates are basket samplers (made of wire cages filled with clean streamside rocks) and miltiplate samplers (made of hardboard) for benthic organism collection, and plexiglass strips for periphyton collection.

Surface area of a lake is that area outlined on the latest USGS topographic map as the boundary of the lake and measured by a planimeter in acres. In localities not covered by topographic maps, the areas are computed from the best maps available at the time planimetered. All areas shown are those for the stage when the planimetered map was made. All areas shown are those for the stage when the planimetered map was made.

Surficial bed material is that part (0.1 to 0.2 ft) of the bed material that is sampled using U.S. Series Bed-Material Samplers.

Suspended (as used in tables of chemical analyses) refers to the amount (concentration) of the total concentration in a water-sediment mixture. The water-sediment mixture is associated with (or sorbed on) that material retained on a 0.45 micrometer filter.

Suspended, recoverable is the amount of a given constituent that is in solution after the part of a representative water-suspended sediment sample that is retained on a 0.45 micrometer filter has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolution of all the particulate matter is not achieved by the digestion treatment and thus the determination represents something less than the "total" amount (that is, less than 95 percent) of the constituent present in the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

Determinations of "suspended, recoverable" constituents are made either by analyzing portions of the material collected on the filter or, more commonly, by difference, based on determinations of (1) dissolved and (2) total recoverable concentrations of the constituent.

Suspended, total is the total amount of a given constituent in the part of a representative water-suspended sediment sample that is retained on a 0.45 um membrane filter. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to determine when the results should be reported as "suspended, total."

Determinations of "suspended, total" constituents are made either by analyzing portions of the material collected on the filter or, more commonly, by difference, based on determinations of (1) dissolved and (2) total concentrations of the constituent.

Taxonomy is the division of biology concerned with the classification and naming of organisms. The classification of organisms is based upon a hierarchical scheme beginning with Kingdom and ending with Species at the base. The higher the classification level, the fewer features the organisms have in common. For example, the taxonomy of a particular mayfly, Hexagenia limbata is the following:

Kingdom.....Animal
Phylum.....Arthropoda
Class.....Insects
Order.....Ephemeroptera
Family.....Ephermeridae
Genus.....Hexageria
Species.....Hexagenia limbata

Thermograph is an instrument that continuously records variations of temperature on a chart. The more general term "temperature recorder" is used in the table headings and refers to any instrument that records temperature whether on a chart, a tape, or any other medium.

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 year.

Tons per acre-foot indicates the dry mass of dissolved solids in 1 acre-foot of water. It is computed by multiplying the concentration in milligrams per liter by 0.00136.

Tons per day is the quantity of substance in solution or suspension that passes a stream section during a 24-hour day.

Total is the total amount of a given constituent in a representative water-suspended sediment sample, regardless of the constituent's physical or chemical form. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent present in both the dissolved and suspended phases of the sample. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total." (Note that the word "total" does double duty here, indicating both that the sample consists of a water-suspended sediment mixture and that the analytical method determines all of the constituent in the sample.)

Total in bottom material is the total amount of a given constituent in a representative sample of bottom material. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total in bottom material."

Total load (tons) is the total quantity of any individual constituent, as measured by dry mass or volume, that is dissolved in a specific amount of water (discharge) during a given time. It is computed by multiplying the total discharge, times the mg/L of the constituent, times the factor 0.0027, times the number of days.

Total recoverable refers to the amount of a given constituent that is in solution after a representative water-suspended sediment sample has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolution of all particulate matter is not achieved by the digestion treatment, and thus the determination represents something less than the "total" amount (that is, less than 95 percent) of the constituent percent in the dissolved and suspended phases of the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

Tritium Network is a network of stations which has been established to provide baseline information on the occurrence of tritium in the Nation's surface waters. In addition to the surface-water stations in the network, tritium data are also obtained at a number of precipitation stations. The purpose of the precipitation stations is to provide an estimate sufficient for hydrologic studies of the tritium input to the United States.

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, 1980, is called the "1980 water year."

WDR is used as an abbreviation for "Water-Data Report" in reference to published reports beginning in 1975.

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.

WRD is used as an abbreviation for "Water-Resources Data" in the REVISED RECORDS paragraph to refer to State annual basic-data reports published before 1975.

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

The U.S. Geological Survey publishes a series of manuals describing procedures for planning and conducting specialized work in water-resources investigations. The material is grouped under major subject headings called books and is further divided into sections and chapters. For example, Section A of Book 3 (Applications of Hydraulics) pertains to surface water. The chapter, the unit of publication, is limited to a narrow field of subject matter. This format permits flexibility in revision and publication as the need arises.

The reports listed below are for sale by the U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, Colorado 80225 (authorized agent of the Superintendent of Documents, Government Printing Office). Prepayment is required. Remittance should be sent by check or money order payable to the U.S. Geological Survey. Prices are not included because they are subject to change. Current prices can be obtained by writing to the above address. When ordering or inquiring about prices for any of these publications, please give the title, book number, chapter number, and "U.S. Geological Survey Techniques of Water-Resources Investigations."

1-D1. *Water temperature--influential factors, field measurement, and data preeentation*, by H. H. Stevens, Jr., J. F. Ficke, and G. F. Smoot: USGS--TWRI Book 1, Chapter D1. 1975. 65 pages.

1-D2. *Guidelines for collection and field analysis of ground-water samples for selected unstable constituents*, by W. W. Wood: USGS--TWRI Book 1, Chapter D2. 1976. 24 pages.

2-D1. *Application of surface geophysics to ground-water investigations*, by A. A. R. Zohdy, G. P. Eaton, and D. R. Mabey: USGS--TWRI Book 2, Chapter D1. 1974. 116 pages.

2-D2. *Application of eeismic-refraction techniques to hydrologic studies*, by F. P. Haeni: USGS--TWRI Book 2, Chapter D2. 1988. 86 pages.

2-E1. *Application of borehole geophysics to water-resources investigations*, by W. S. Keys and L. M. MacCary: USGS--TWRI Book 2, Chapter E1. 1971. 126 pages.

2-F1. *Application of drilling, coring, and sampling techniques to test holes and wells*, by Eugene Shuter and Warren E. Teasdale: USGS--TWRI Book 2, Chapter F1. 1989. 97 pages.

3-A1. *General field and office procedures for indirect discharge measurements*, by M. A. Benson and Tate Dalrymple: USGS--TWRI Book 3, Chapter A1. 1967. 30 pages.

3-A2. *Measurement of peak discharge by the slope-area method*, by Tate Dalrymple and M. A. Benson: USGS--TWRI Book 3, Chapter A2. 1967. 12 pages.

3-A3. *Measurement of peak discharge at culverts by indirect methods*, by G. L. Bodhaine: USGS--TWRI Book 3, Chapter A3. 1968. 60 pages.

3-A4. *Measurement of peak discharge at width contractions by indirect methods*, by H. F. Matthai: USGS--TWRI Book 3, Chapter A4. 1967. 44 pages.

3-A5. *Measurement of peak discharge at dams by indirect methods*, by Harry Hulsing: USGS--TWRI Book 3, Chapter A5. 1967. 29 pages.

3-A6. *General procedure for gaging streams*, by R. W. Carter and Jacob Davidian: USGS--TWRI Book 3, Chapter A6. 1968. 13 pages.

3-A7. *Stage measurements at gaging stations*, by T. J. Buchanan and W. P. Somers: USGS--TWRI Book 3. Chapter A7. 1968. 28 pages.

3-A8. *Discharge measurements at gaging stations*, by T. J. Buchanan and W. P. Somers: USGS--TWRI Book 3, Chapter A8. 1969. 65 pages.

3-A9. *Measurement of time of travel in streams by dye tracing*, by F. A. Kilpatrick and J. F. Wilson, Jr.: USGS--TWRI Book 3, Chapter A9. 1989. 27 pages.

3-A10. *Discharge ratings at gaging stations*, by E. J. Kennedy: USGS--TWRI Book 3, Chapter A10. 1984. 59 pages.

3-A11. *Measurement of discharge by moving-boat method*, by G. F. Smoot and C. E. Novak: USGS--TWRI Book 3, Chapter A11. 1969. 22 pages.

3-A12. *Fluorometric procedures for dye tracing*, by J. F. Wilson, Jr., E. D. Cobb, and F. A. Kilpatrick: USGS--TWRI Book 3, Chapter A12. 1986. 41 pages.

3-A13. *Computation of continuous records of streamflow*, by E. J. Kennedy: USGS--TWRI Book 3, Chapter A13. 1983. 53 pages.

3-A14. *Use of flumes in measuring discharge*, by F. A. Kilpatrick and V. R. Schneider: USGS--TWRI Book 3, Chapter A14. 1983. 46 pages.

3-A15. *Computation of water-surface profiles in open channels*, by Jacob Davidian: USGS--TWRI Book 3, Chapter A15. 1984. 48 pages.

3-A16. *Measurement of discharge using tracers*, by F. A. Kilpatrick and E. D. Cobb: USGS--TWRI Book 3, Chapter A16. 1985. 52 pages.

3-A17. *Acoustic velocity meter systems*, by Antonius Laenen: USGS--TWRI Book 3, Chapter A17. 1985. 38 pages.

3-A18. *Determination of stream reaeration coefficients by use of tracers*, by F. A. Kilpatrick, R. E. Rathbun, N. Yotsukura, G. W. Parker, and L. L. DeLong: USGS--TWRI Book 3, Chapter A18. 1989. 52 pages.

3-A19. *Levels of streamflow gaging stations*, by E. J. Kennedy: USGS--TWRI Book 3, Chapter A19. 1990. 27 pages.

3-B1. *Aquifer-test design, observation, and data analysis*, by R. W. Stallman: USGS--TWRI Book 3, Chapter B1. 1971. 26 pages.

3-B2. *Introduction to ground-water hydraulics, a programmed text for self-instruction*, by G. D. Bennett: USGS--TWRI Book 3, Chapter B2. 1976. 172 pages.

3-B3. *Type curves for selected problems of flow to wells in confined aquifers*, by J. E. Reed: USGS--TWRI Book 3, Chapter B3. 1980. 106 pages.

3-B4. *Regression modeling of ground-water flow*, by Richard L. Cooley and Richard L. Naff: USGS--TWRI Book 3, Chapter B4. 1990. 232 pages.

3-B5. *Definition of boundary and initial conditions in the analysis of saturated ground-water flow systems--An introduction*, by O. L. Franke, T. E. Reilly, and G. D. Bennett: USGS--TWRI Book 3, Chapter B5. 1987. 15 pages.

3-B6. *The principle of superposition and its application in ground-water hydraulics*, by T. E. Reilly, O. L. Franke, and G. D. Bennett: USGS--TWRI Book 3, Chapter B6. 1987. 28 pages.

3-C1. *Fluvial sediment concepts*, by H. P. Guy: USGS--TWRI Book 3, Chapter C1. 1970. 55 pages.

3-C2. *Field methods for measurement of fluvial sediment*, by H. P. Guy and V. W. Norman: USGS--TWRI Book 3, Chapter C2. 1970. 59 pages.

3-C3. *Computation of fluvial-sediment discharge*, by George Porterfield: USGS--TWRI Book 3, Chapter C3. 1972. 66 pages.

4-A1. *Some statistical tools in hydrology*, by H. C. Riggs: USGS--TWRI Book 4, Chapter A1. 1968. 39 pages.

4-A2. *Frequency curves*, by H. C. Riggs: USGS--TWRI Book 4, Chapter A2. 1968. 15 pages.

4-B1. *Low-flow investigations*, by H. C. Riggs: USGS--TWRI Book 4, Chapter B1. 1972. 18 pages.

4-B2. *Storage analyses for water supply*, by H. C. Riggs and C. H. Hardison: USGS--TWRI Book 4, Chapter B2. 1973. 20 pages.

4-B3. *Regional analyses of streamflow characteristics*, by H. C. Riggs: USGS--TWRI Book 4, Chapter B3. 1973. 15 pages.

4-D1. *Computation of rate and volume of stream depletion by wells*, by C. T. Jenkins: USGS-TWRI Book 4, Chapter D1. 1970. 17 pages.

5-A1. *Methods for determination of inorganic substances in water and fluvial sediments*, by M. J. Fishman and L. C. Friedman: USGS--TWRI Book 5, Chapter A1. 1989. 545 pages.

5-A2. *Determination of minor elements in water by emission spectroscopy*, by P. R. Barnett and E. C. Mallory, Jr.: USGS--TWRI Book 5, Chapter A2. 1971. 31 pages.

5-A3. *Methods for the determination of organic substances in water and fluvial sediments*, edited by R. L. Wershaw, M. J. Fishman, R. R. Grabbe, and L. E. Lowe: USGS--TWRI Book 5, Chapter A3. 1987. 80 pages.

5-A4. *Methods for collection and analysis of aquatic biological and microbiological samples*, by L. J. Britton and P. E. Greeson, editors: USGS--TWRI Book 5, Chapter A4. 1989. 363 pages.

5-A5. *Methods for determination of radioactive substances in water and fluvial sediments*, by L. L. Thatcher, V. J. Janzer, and K. W. Edwards: USGS--TWRI Book 5, Chapter A5. 1977. 95 pages.

5-A6. *Quality assurance practices for the chemical and biological analyses of water and fluvial sediments*, by L. C. Friedman and D. E. Erdmann: USGS--TWRI Book 5, Chapter A6. 1982. 181 pages.

5-C1. *Laboratory theory and methods for sediment analysis*, by H. P. Guy: USGS--TWRI Book 5, Chapter C1. 1969. 58 pages.

6-A1. *A modular three-dimensional finite-difference ground-water flow model*, by M. G. McDonald and A. W. Harbaugh: USGS--TWRI Book 6, Chapter A1. 1988. 586 pages.

7-C1. *Finite difference model for aquifer simulation in two dimensions with results of numerical experiments*, by P. C. Trescott, G. F. Pinder, and S. P. Larson: USGS--TWRI Book 7, Chapter C1. 1976. 116 pages.

7-C2. *Computer model of two-dimensional solute transport and dispersion in ground water*, by L. F. Konikow and J. D. Bredehoeft: USGS--TWRI Book 7, Chapter C2. 1978. 90 pages.

7-C3. *A model for simulation of flow in singular and interconnected channels*, by R. W. Schaffrannek, R. A. Baltzer, and D. E. Goldberg: USGS--TWRI Book 7, Chapter C3. 1981. 110 pages.

8-A1. *Methods of measuring water levels in deep wells*, by M. S. Garber and F. C. Koopman: USGS--TWRI Book 8, Chapter A1. 1968. 23 pages.

8-A2. *Installation and service manual for U.S. Geological Survey manometers*, by J. D. Craig: USGS--TWRI Book 8, Chapter A2. 1983. 57 pages.

8-B2. *Calibration and maintenance of vertical-axis type current meters*, by G. F. Smoot and C. E. Novak: USGS--TWRI Book 8, Chapter B2. 1968. 15 pages.

DISCONTINUED GAGING STATIONS

The following continuous-record streamflow or stage stations in Minnesota have been discontinued or converted to partial-record stations. Daily streamflow or stage records were collected and published for the period of record shown for each station.

Station number	Station name	Drainage area (mi^2)	Period of record
	Streams tributary to Lake Superior		
04010000	Pigeon River above mouth of Arrow River, MN	256	1924-27
04011000	Brule River at mouth near Hoveland, MN	248	1911†
04011500	Devil Track River at mouth near Grand Marais, MN	a77	1911†
04012000	Cascade River at mouth near Grand Marais, MN	111	1911†
*04012500	Poplar River at Lutsen, MN	114	1911†, 1912-17, 1928-47, 1952-61
04013000	Cross River at Schroeder, MN	a91	1931-32
04015000	Beaver Creek (Beaver Bay Run) at Beaver Bay, MN	126	1911-14, 1928-31
04015455	South Branch Partridge River near Babbitt, MN	18.5	1977-80
04015475	Partridge River above Colby Lake, at Hoyt Lakes, MN	106	1979-88
04015500	Second Creek near Aurora, MN	29	1955-80
04016000	Partridge River near Aurora, MN	161	1942-82
04016500	St. Louis River near Aurora, MN	290	1942-87
04017000	Embarrass River at Embarrass, MN	93.8	1942-64
04018000	Embarrass River near McKinley, MN	171	1953-62
04018750	St. Louis River at Forbes, MN	713	1965-90
04018900	East Two Rivers near Iron Junction, MN	40.0	1966-79
04019000	West Two Rivers near Iron Junction, MN	65.3	1953-62, 1965-79
04019300	West Swan River near Silica, MN	16.3	1963-79
04019500	East Swan River near Toivola, MN	112	1953-62, 1964-71
04020000	Swan River near Toivola, MN	254	1952-61
04021000	Whiteface River below (at) Meadowlands, MN	453	1909-17
04021530	Stoney Brook at Brookston, MN	97.3	1983-84
04023000	Cloquet River at Independence, MN	a750	1909-17
04023150	Simian Creek near Brookston, MN	-	1983-84
04023500	St. Louis River near Cloquet, MN	a3,400	1903†
04023600	Squaw Creek near Cloquet, MN	-	1983-84
04024015	Otter Creek near Cloquet, MN	-	1983-84
04024090	Elim Creek near Holyoke, MN	1.06	1976-78
04024093	Skunk Creek below Elim Creek near Holyoke, MN	8.83	1976-78
	Red River of the North basin		
05030000	Otter Tail River near Detroit Lakes, MN	270	1937-71
05030500	Otter Tail River at German Church, near Fergus Falls, MN	a1,230	1904-17
05033900	Pelican River at Detroit Lakes, MN	-	1968-71, 1974-75
05034100	Pelican River at Detroit Lake outlet near Detroit Lakes, MN	-	1968-71, 1972-75

"See footnotes at end of table."

DISCONTINUED GAGING STATIONS

Station number	Station name	Drainage area (mi^2)	Period of record
	Red River of the North basin--Continued		
05035100	Long Lake outlet near Detroit Lakes, MN	-	1968-71
05035200	West Branch County Ditch No. 14 near Detroit Lakes, MN	-	1968-71
05035300	East Branch County Ditch No. 14 near Detroit Lakes, MN	-	1968-71
05035500	St. Clair Lake outlet near Detroit Lakes, MN	-	1968-75
05035600	Pelican River at Muskrat Lake outlet near Detroit Lakes, MN	-	1968-75
05037100	Pelican River at Sallie Lake outlet near Detroit Lakes, MN	-	1968-75
05039100	Pelican River at Lake Melissa outlet near Detroit Lakes, MN	-	1968-75
05040000	Pelican River near Detroit Lakes, MN	123	1942-53
05040500	Pelican River near Fergus Falls, MN	482	1909-12, 1942-80
05045500	Otter Tail River (Red River) near Fergus Falls, MN	a1,690	1909-10†
05046500	Otter Tail River near Breckenridge, MN	a2,040	1931-32, 1939-46†
05047000	Mustinka River (head of Bois de Sioux River) near Norcross, MN	-	1940-47
05047500	Mustinka ditch above West Branch Mustinka River (Twelve Mile Creek) near Charlesville, MN	-	1943-55
05048000	Mustinka ditch below West Branch Mustinka River (Twelve Mile Creek) near Charlesville, MN	-	1943-55
05048500	West Branch Mustinka River (Twelve Mile Creek) below Mustinka ditch near Charlesville, MN	-	1943-55
05049000	Mustinka River above (near) Wheaton, MN	834	1915-24, 1930-58
05050500	Bois de Sioux River below Fairmont, ND	a1,540	1919-44
05051000	Rabbit River at Cambell, MN	266	1942-52
05054020	Red River of the North below Fargo, ND	-	1969-78
*05061200	Whiskey Creek at Barnesville, MN	25.3	1964-66
05063000	Wild Rice River near Ada, MN	a1,100	1948-54
*05063500	South Branch Wild Rice River near Borup, MN	254	1944-49
05067000	Marsh River below Ada, MN	-	1948-52
05068000	Sand Hill River at Beltrami, MN	a324	1943-58
05068500	Sand Hill ditch at Beltrami, MN	-	1943-58
05075500	Thief River near Gatske, MN	-	1953-56
05076500	Red Lake River at Thief River Falls, MN	a3,450	1909-18, 1920-30
05077000	Clearwater River near Pinewood, MN	132	1940-45
05077500	Clearwater River near Leonard, MN	153	1934-47
*05077700	Ruffy Brook near Gonvick, MN	45.2	1960-78
05083500	Red River of the North at Oslo, MN	331,200	1936-37, 1941-43, 1945-60, 1973-78
05085500	Snake River at Warren, MN	a175	1945, 1953-56

"See footnotes at end of table."

DISCONTINUED GAGING STATIONS

Station number	Station name	Drainage area (mi^2)	Period of record
	Red River of the North basin--Continued		
05086000	Snake River at Alvarado, MN	309	1945, 1953-56
05086500	Snake River near Argyle, MN	481	1945
05087000	Middle River near Strandquist, MN	-	1953-56
05090500	Tamarac River near Strandquist, MN	-	1953-56
05091000	Tamarac River at Stephen, MN	-	1945
05091500	Tamarac River near Stephen, MN	a320	1945, 1953-55
05092500	Two Rivers (Middle Fork Two Rivers) near Hallock, MN	131	1931-38
05093000	South Branch (South Fork) Two Rivers near Pelan, MN	281	1928-38, 1953-56
05094500	South Branch Two Rivers (Two Rivers) at Hallock, MN	-	1940-47
05095000	Two Rivers (South Branch Two Rivers) at Hallock, MN		1911-14 1929-30 1938-39 1941-43
05095500	Two Rivers below Hallock, MN	644	1945-55
05096000	North Branch (North Fork) Two Rivers near Lancaster, MN	a32	1929-38, 1941-55
05096500	State Ditch 85 near Lancaster, MN	a95	1929-38, 1942-55
05097000	North Branch Two Rivers at Lancaster, MN	209	1941-42, 1953-56
05097500	North Branch Two Rivers near Northcote, MN	386	1941-42, 1945-51
05098000	Two Rivers below North Branch near Hallock, MN	a1,060	1941-43
05103000	Roseau River (at) near Malung, MN	252	1928-46
05104000	South Fork (West Branch) Roseau River near Malung, MN	312	1911-14, 1928-46
05105000	Roseau River at Roseau, MN	-	1940-47
05105500	Roseau River near Roseau, MN	-	1930-60
05106000	Sprague Creek near Sprague, Manitoba	176	1928-81
05107000	Pine Creek near Pine Creek, MN	74.6	1928-53
05108000	Roseau River near Badger, MN	-	1928-69
05108500	Roseau River near Duxby, MN	-	1929-51, 1952-56
05109000	Badger Creek near Badger, MN	a2.2	1929-30, 1931-38
05109500	Roseau River near Haug, MN	-	1932-66
05110000	Roseau River at outlet of State Ditch 69 near Oak Point, MN	-	1939-42
05110500	Roseau River at head of State Ditch 51 near Oak Point, MN	-	1933-42
05111000	Roseau River at Oak Point, MN	-	1933-39, 1941-60
05112500	Roseau River at International boundary, near Caribou, MN	a1,590	1933-69

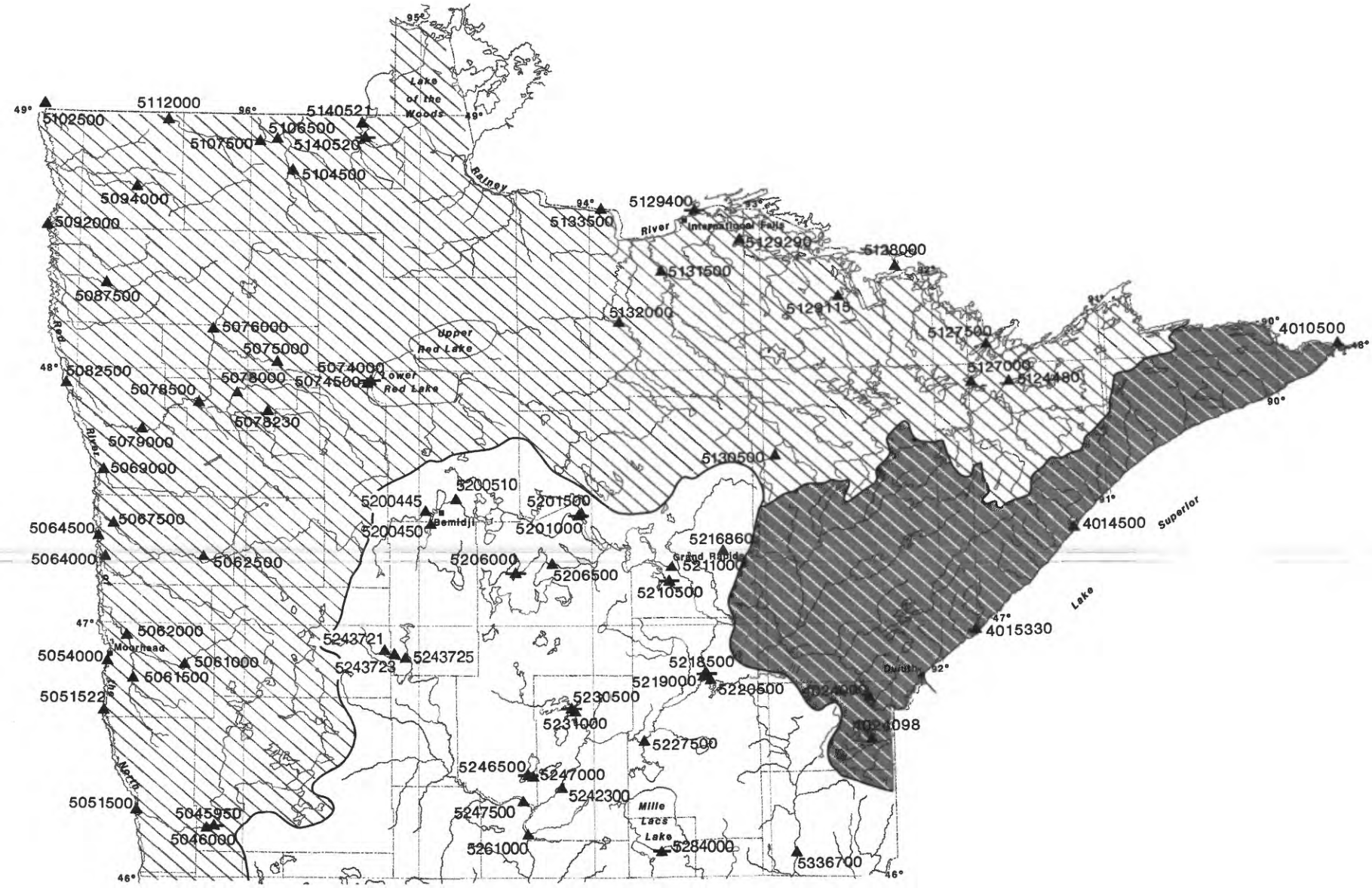
*See footnotes at end of table."

DISCONTINUED GAGING STATIONS

Station number	Station name	Drainage area (mi^2)	Period of record
	Lake of the Woods basin		
05124500	Isabella River near Isabella, MN	341	1953-61, 1976-77
05124990	Filson Creek near Ely, MN	9.66	1974-85
05125000	South Kawishiwi River near Ely, MN	-	1953-61, 1976-78
05125500	Stony River near Isabella, MN	180	1953-64
05125550	Stony River near Babbitt, MN	219	1975-80
05126000	Dunka River near Babbitt, MN	53.4	1951-62, 1975-80
05126210	South Kawishiwi River above White Iron Lake near Ely, MN		1975-78
05126500	Bear Island River near Ely, MN	68.5	1953-62, 1975-77
05127205	Burntside River near Ely, MN	-	1967-78
05127207	Bjorkman's Creek near Ely, MN	1.36	1972-78
05127210	Armstrong Creek near Ely, MN	5.29	1967-78
05127215	Longstorff Creek near Ely, MN	8.84	1967-78
05127219	Shagawa Lake tributary at Ely, MN	1.84	1971-78
05127220	Burgo Creek near Ely, MN	3.04	1967-78
05127230	Shagawa River near Ely, MN	99	1967-78
05128200	Vermilion Lake near Soudan, MN	-	1913-15†, 1941-42†, 1946-87†
05128340	Pike River near Biwabik, MN	-	1977-79
05128500	Pike River near Embarrass, MN	115	1953-64, 1976-79
05129000	Vermilion River below Vermilion Lake near Tower, MN	483	1911-17, 1928-81
05129500	Rainy River at International Falls, MN	14,900	1905-60
05130000	Sturgeon River (Lake) at Side Lake, MN	-	1938-47
05131000	Dark River near Chisholm, MN	50.6	1942-61, 1965-79
05131800	Deer Lake outlet (Deer Lake) near Effie, MN	-	1937-39, 1940-46
05132500	Big Fork River at Laurel, MN	-	1909
05133000	Black River near Loman, MN	-	1909
05134200	Rapid River near Baudette, MN	543	1956-85
05139500	Warroad River near Warroad, MN	162	1946-80
*05140000	Bulldog Run near Warroad, MN	14.2	1946-51, 1966-77
*05140500	East Branch Warroad River near Warroad, MN	102	1946-54, 1966-77

* Presently operated as high-flow partial-record station.
† Stage records only.
a Approximately.

Ramsey River below South Fork Roseau River near
Malung, Minnesota, September 13, 1952


5112000
5102500
5140521
5106500
5107500
5140520
5104500
5094000
5092000
5087500
5076000
5075000
5074000
5082500
5078000
5074500
5078500
5078230
5079000
5069000
5064500
5067500
5064000
5062500
5062000
5054000
Moorhead
5061000
5061500
5051522
5051500
5045950
5046000
5200510
5200445
Bemidji
5200450
5201500
5201000
5206000
5206500
5210500
5216860
Grand Rapids
5211000
5243721
5243725
5243723
5218500
5219000
5220500
5230500
5231000
5227500
5246500
5247000
5242300
5247500
5261000
Mille Lacs Lake
5284000
5336700
5133500
5129400
International Falls
5129290
5128000
5131500
5132000
5129115
5127500
5127000
5124480
4010500
4014500
Superior
Lake
4015330
Duluth
4024000
4024098
5130500
Lake of the Woods
Rainy River
Upper Red Lake
Lower Red Lake
Red River
49°
96°
95°
94°
93°
92°
91°
90°
48°
47°
46°

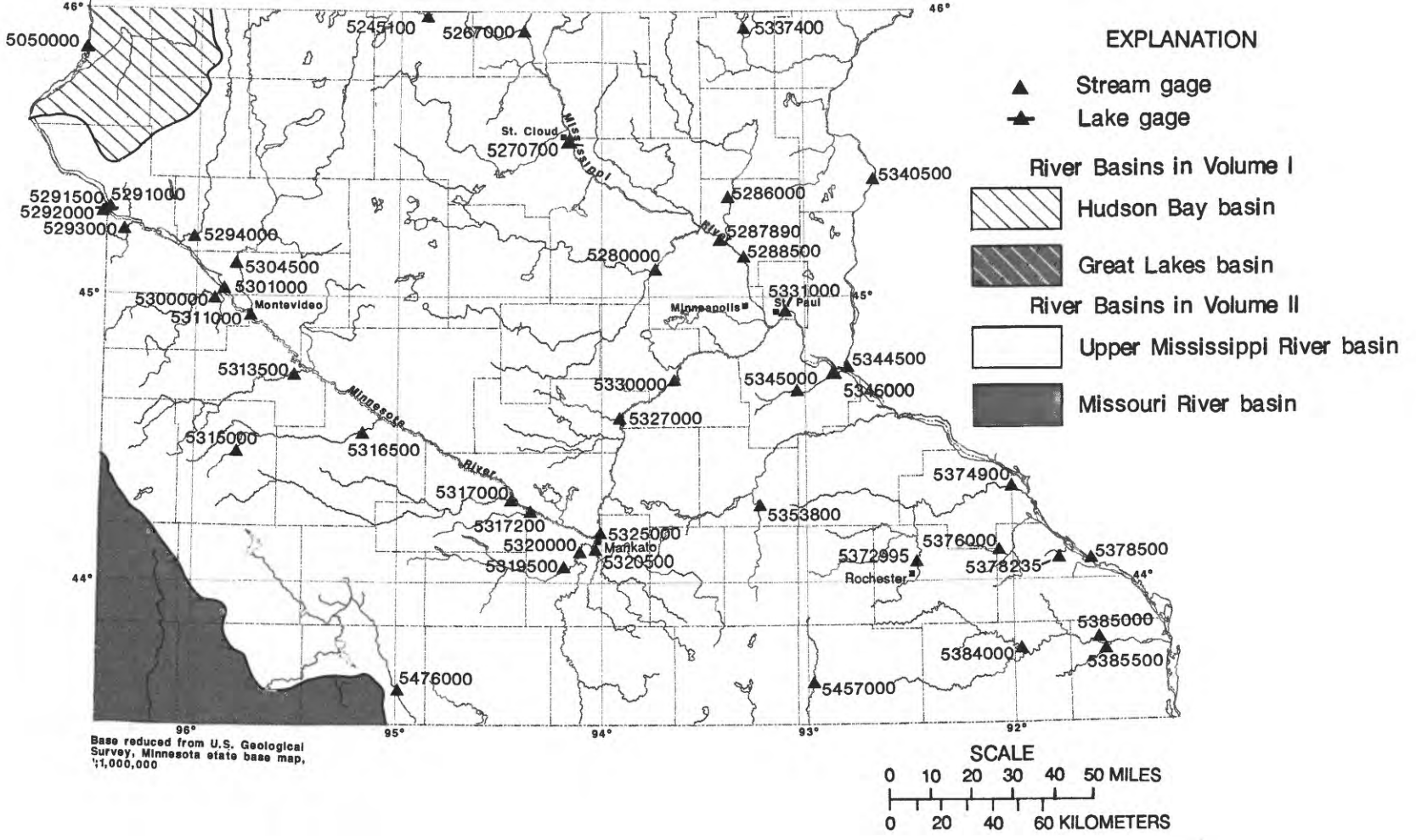
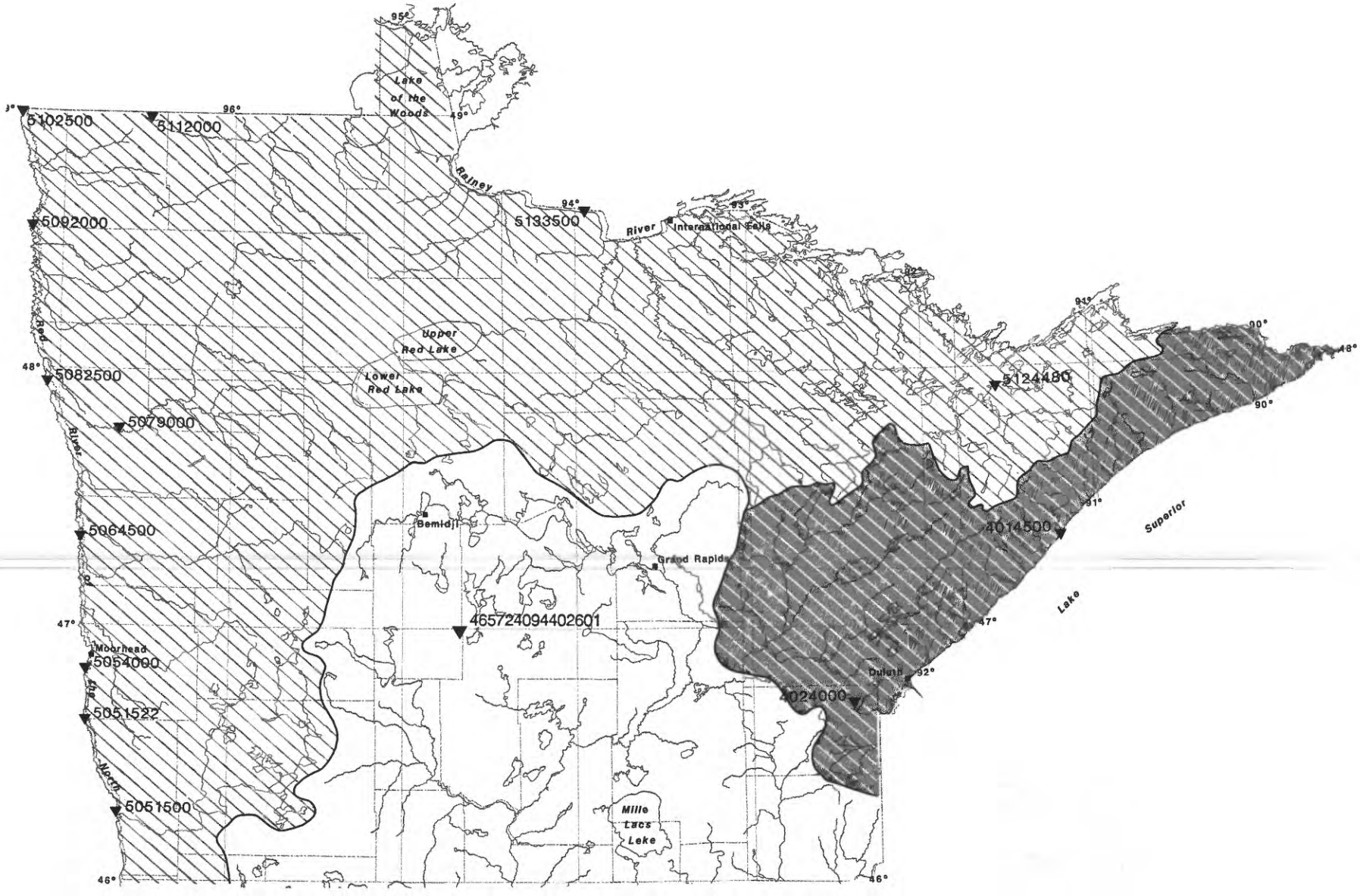


Figure 7.--Location of lake and stream-gaging stations


Lake of the Woods
Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Bemidji
Grand Rapids
Moorhead
Duluth
Superior Lake
Mille Lacs Lake
05102500
05112000
05092000
05133500
05082500
05124480
05079000
05064500
04014500
465724094402601
05054000
04024000
05051522
05051500
95°
96°
94°
93°
92°
91°
90°
48°
47°
46°

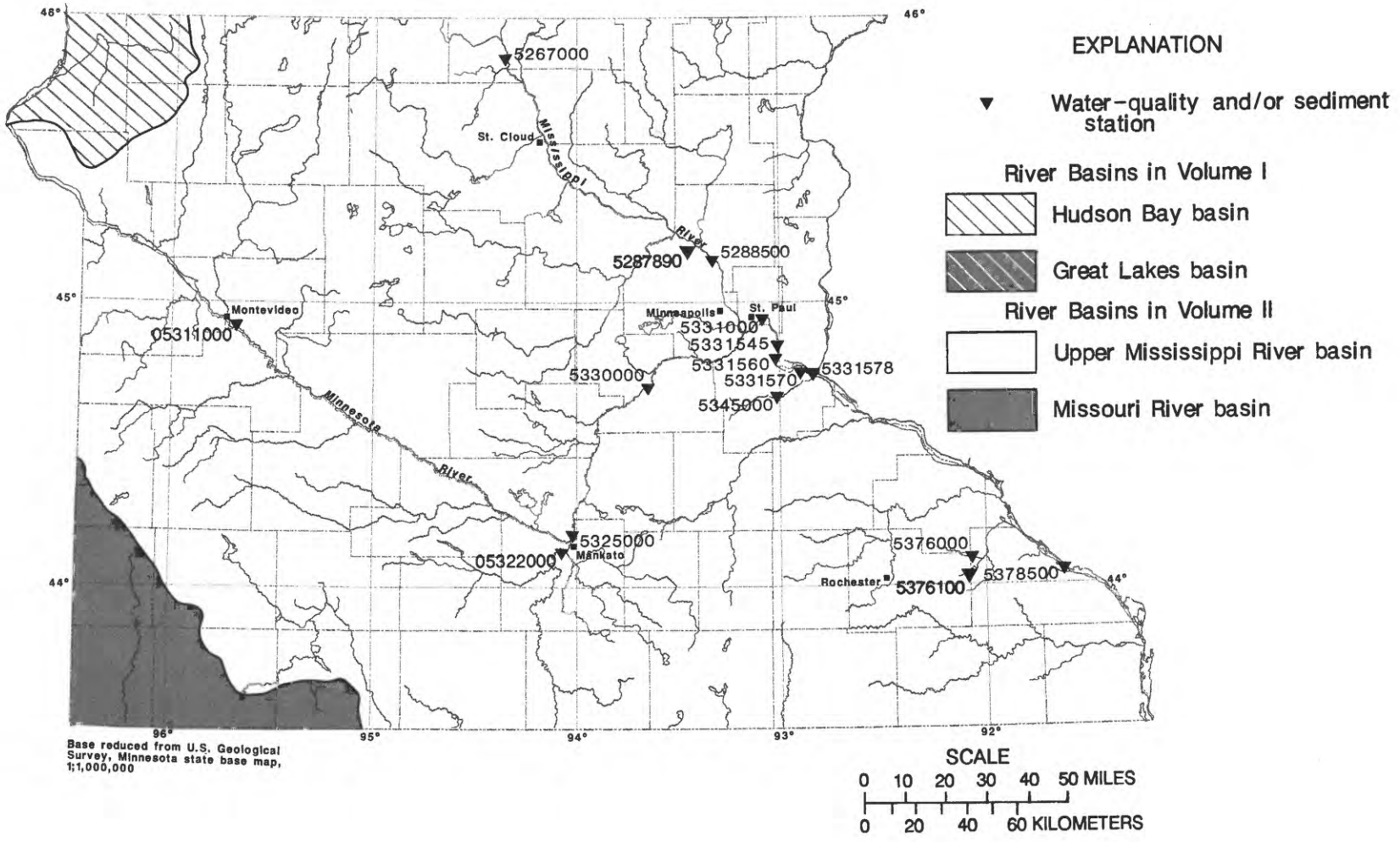


Figure 8.--Location of surface-water-quality stations

STREAMS TRIBUTARY TO LAKE SUPERIOR

04010500 PIGEON RIVER AT MIDDLE FALLS, NEAR GRAND PORTAGE, MN
(International gaging station)

LOCATION.--Lat 48°00'44", long 89°36'58", in SW¼NE¼ sec.24, T.64 N., R.6 E., Cook County, Hydrologic Unit 04010101, on the Grand Portage Indian Reservation, on right bank 400 ft upstream from Middle Falls, 2.5 mi upstream from Grand Portage Port of Entry, 3.5 mi upstream from mouth, and 4.7 mi northeast of city of Grand Portage.
DRAINAGE AREA.--600 mi^2.
PERIOD OF RECORD.--June to October 1921, April to November 1922, March 1923 to current year. 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.
REVISED RECORDS.--WSP 744: 1927-28. WSP 804: 1934(M). WSP 974: Drainage area. WSP 1337: 1924(M), 1925, 1926-28(M), 1931(M), 1938(M), 1941(M), 1945-46(M), 1947, 1948(M), 1950(M).
GAGE.--Water-stage recorder. Datum of gage is 787.58 ft above National Geodetic Vertical Datum of 1929. Prior to Sept. 30, 1940, nonrecording gage at International Bridge, 5.8 mi upstream at datum 102.24 ft higher. Oct. 1, 1940, to Dec. 31, 1975, at present site at datum 2.00 ft higher.
REMARKS.--Records good except those for estimated daily discharges, which are poor. Satellite telemeter at station.
COOPERATION.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.
AVERAGE DISCHARGE.--67 years (water years 1924-90), 504 ft^3/s, 11.41 in/yr.
EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 11,000 ft^3/s, May 5, 1934, gage height, 7.6 ft, site and datum then in use, from rating curve extended above 7,000 ft^3/s; minimum daily, 1.0 ft^3/s, Jan. 15-21, 1977; minimum recorded gage height, 1.24 ft, Jan. 7, 8, 15, 1977, but may have been less during period of no gage-height record, Jan. 16 to Apr. 17, 1977.
EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 3,000 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 29	0030	*3,060	*8.18	No other peak greater than base discharge.			

Minimum discharge, 30 ft^3/s, Dec. 20-25; minimum gage height, 2.09 ft, Nov. 16.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	114	84	e55	e33	e57	e75	e250	2240	465	2100	380	148
2	116	84	e53	e33	e58	e75	e250	1860	474	1570	353	139
3	110	87	e51	e34	e59	e75	e230	1580	565	1170	332	133
4	105	91	e49	e34	e60	e75	e210	1380	610	986	317	126
5	112	91	e47	e35	e61	e75	e200	1250	576	873	305	120
6	119	91	e46	e36	e62	e75	e190	1170	544	790	287	117
7	117	95	e45	e36	e63	e75	e180	1090	539	836	267	112
8	117	123	e44	e37	e64	e75	e170	1040	510	1510	247	107
9	114	154	e43	e37	e70	e75	e160	1040	506	1500	235	102
10	108	161	e41	e38	e75	e75	e155	1010	502	1240	230	99
11	106	156	e39	e38	e75	e77	e155	954	471	1020	223	97
12	112	143	e38	e39	e75	e85	e155	895	880	883	209	105
13	106	e140	e37	e39	e75	e100	e155	837	1600	797	197	103
14	101	e130	e36	e40	e75	e135	e160	858	1350	726	188	128
15	99	e120	e34	e41	e75	e200	e170	1000	1050	667	179	136
16	96	e85	e33	e41	e75	e300	e180	1430	876	620	179	164
17	91	e82	e32	e42	e75	e280	e200	1530	899	595	166	176
18	87	e92	e32	e43	e75	e260	e250	1330	1560	671	163	163
19	84	e96	e32	e44	e75	e240	e300	1160	1560	693	157	153
20	81	e96	e30	e45	e75	e220	e400	1000	1430	624	146	144
21	84	e90	e30	e46	e75	e200	e550	895	1670	569	136	149
22	82	e83	e30	e47	e75	e180	e700	833	1560	556	129	159
23	78	e78	e30	e48	e75	e160	e850	778	1340	591	124	163
24	75	e73	e30	e49	e75	e150	1060	727	1160	710	120	158
25	74	e69	e30	e50	e75	e140	1280	681	1030	681	131	170
26	71	e67	e31	e51	e75	e130	1650	644	993	588	186	156
27	67	e64	e31	e52	e75	e120	1760	612	972	519	226	138
28	66	e61	e31	e53	e75	e120	2890	585	918	491	217	124
29	71	e59	e32	e54	---	e120	2920	553	1510	467	191	115
30	80	e57	e32	e55	---	e130	2580	522	2270	439	172	110
31	81	---	e32	e56	---	e170	---	489	---	410	158	---
TOTAL	2924	2902	1156	1326	1979	4267	20360	31973	30390	25892	6550	4014
MEAN	94.3	96.7	37.3	42.8	70.7	138	679	1031	1013	835	211	134
MAX	119	161	55	56	75	300	2920	2240	2270	2100	380	176
MIN	66	57	30	33	57	75	155	489	465	410	120	97
AC-FT	5800	5760	2290	2630	3930	8460	40380	63420	60280	51360	12990	7960
CFSM	.16	.16	.06	.07	.12	.23	1.13	1.72	1.69	1.39	.35	.22
IN.	.18	.18	.07	.08	.12	.26	1.26	1.98	1.88	1.61	.41	.25

CAL YR 1989 TOTAL 191736 MEAN 525 MAX 3230 MIN 30 AC-FT 380300 CFSM .88 IN. 11.89
WTR YR 1990 TOTAL 133733 MEAN 366 MAX 2920 MIN 30 AC-FT 265300 CFSM .61 IN. 8.29

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN

LOCATION.--Lat 47°20'07", long 91°12'06", in SE¼NE¼ sec.15, T.56 N., R.7 W., Lake County, Hydrologic Unit 04010101, on right bank 400 ft upstream from bridge on U.S. Highway 61, 0.3 mi upstream from mouth, 4 mi northeast of Silver Bay, and 7 mi northeast of city of Beaver Bay.

DRAINAGE AREA.--140 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1927 to current year. Monthly discharge only for some periods, published in WSP 1307.

REVISED RECORDS.--WSP 894: 1939. WSP 1337: 1933-34(M), 1935.

GAGE.--Water-stage recorder. Datum of gage is 613.65 ft above National Geodetic Vertical Datum of 1929 (U.S. Army Corps of Engineers bench mark). Prior to Oct. 5, 1934, nonrecording gage, and Oct. 5, 1934 to Nov. 22, 1978, water-stage recorder at site 370 ft downstream and at datum 3.68 ft lower.

REMARKS.--Records fair except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--63 years, 168 ft^3/s, 16.30 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 10,000 ft^3/s, Sept. 24, 1977, gage height, 8.33 ft site and datum then in use, from highwater mark in well, from rating curve extended above 4,200 ft^3/s on basis of slope-area measurement of peak flow; maximum gage height, 11.06 ft, Apr. 12, 1965, site and datum then in use, from floodmark (backwater from ice); no flow Jan. 14 to Mar. 2, 1977.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 1,300 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 29	0330	*3,300	*10.93	No other peak greater than base discharge.			

Minimum daily discharge, 1.9 ft^3/s, Dec. 28.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25	39	e14	e9.5	e8.0	e8.0	e150	1190	66	186	38	15
2	23	37	e13	e10	e8.0	e8.0	e120	781	64	130	33	13
3	22	30	e12	e10	e8.0	e8.0	e100	564	132	106	27	13
4	19	45	e12	e9.7	e8.0	e8.0	e90	438	153	85	27	13
5	27	47	e11	e9.5	e8.0	e8.0	e83	367	151	70	25	13
6	41	49	e11	e9.3	e8.0	e8.0	e74	310	201	58	19	13
7	39	47	e10	e9.1	e8.0	e8.0	e68	275	170	54	18	13
8	37	56	e9.7	e9.0	e8.0	e8.0	e63	247	178	258	16	12
9	35	70	e9.3	e8.9	e8.0	e8.0	e60	234	273	285	15	12
10	35	73	e9.0	e8.8	e8.0	e8.5	e57	211	234	198	14	12
11	34	67	e8.6	e8.6	e8.0	e10	e54	190	177	144	14	12
12	33	53	e8.3	e8.6	e8.0	e18	e54	174	167	104	14	15
13	68	55	e7.9	e8.6	e8.0	e70	e56	156	150	75	14	20
14	43	54	e7.6	e8.6	e8.0	e100	e58	150	118	59	12	78
15	31	51	e7.3	e8.6	e8.0	e200	e64	156	98	48	12	64
16	25	e45	e7.1	e8.4	e8.0	e170	e72	217	101	42	12	65
17	24	e37	e6.9	e8.4	e8.0	e155	e80	258	139	43	11	58
18	23	e32	e6.7	e8.4	e8.0	e140	e90	234	214	53	11	51
19	23	e28	e6.5	e8.4	e8.0	e120	e110	211	188	50	12	45
20	26	e25	e6.0	e8.4	e8.0	e110	e150	194	186	44	12	39
21	24	e22	e5.5	e8.4	e8.0	e98	e200	165	235	46	12	47
22	23	e21	4.7	e8.4	e8.0	e86	264	150	213	44	9.9	50
23	23	e20	4.4	e8.4	e8.0	e77	416	140	170	37	9.6	47
24	23	e19	4.1	e8.4	e8.0	e71	477	127	127	35	11	39
25	23	e18	2.9	e8.4	e8.0	e66	771	115	99	34	56	36
26	23	e17	2.6	e8.2	e8.0	e61	1010	104	93	51	68	30
27	23	e16	2.3	e8.2	e8.0	e57	1010	96	64	95	50	26
28	23	e16	1.9	e8.2	e8.0	e53	2040	93	84	117	34	22
29	27	e15	2.1	e8.2	---	e50	2570	93	108	87	25	41
30	37	e15	2.5	e8.2	---	e70	1870	85	235	64	19	109
31	39	---	e7.0	e8.2	---	e120	---	73	---	49	17	---
TOTAL	921	1119	223.9	270.0	224.0	1982.5	12281	7798	4608	2751	668.5	1023
MEAN	29.7	37.3	7.22	8.71	8.00	64.0	409	252	154	88.7	21.6	34.1
MAX	68	73	14	10	8.0	200	2570	1190	273	285	68	109
MIN	19	15	1.9	8.2	8.0	8.0	54	73	64	34	9.6	12
AC-FT	1830	2220	444	536	444	3930	24360	15470	9140	5460	1330	2030
CFSM	.21	.27	.05	.06	.06	.46	2.92	1.80	1.10	.63	.15	.24
IN.	.24	.30	.06	.07	.06	.53	3.26	2.07	1.22	.73	.18	.27

CAL YR 1989	TOTAL 62669.8	MEAN 172	MAX 2200	MIN 1.9	AC-FT 124300	CFSM 1.23	IN. 16.65
WTR YR 1990	TOTAL 33869.9	MEAN 92.8	MAX 2570	MIN 1.9	AC-FT 67180	CFSM .66	IN. 9.00

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1968 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
NOV												
01...	1420	39	82	104	--	7.8	3.0	1.2	782	13.8	K9	K9
JAN												
29...	1430	8.2	157	154	7.4	7.6	0.0	1.9	734	13.5	<1	28
APR												
24...	1500	441	63	61	7.6	7.0	9.0	2.1	737	11.0	68	K8
JUL												
17...	1350	43	85	83	7.5	7.7	19.0	0.50	737	8.8	22	130

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
NOV												
01...	12	4.0	3.6	0.40	41	40	0	50	6.0	3.7	0.20	9.8
JAN												
29...	15	5.5	5.5	0.50	54	54	0	66	9.0	6.3	0.20	14
APR												
24...	7.0	2.1	2.0	0.70	15	17	0	18	4.8	2.0	0.20	6.3
JUL												
17...	10	3.1	2.9	0.40	36	35	0	44	3.1	1.5	<0.10	6.8

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
01...	77	<0.010	<0.100	0.030	0.030	0.50	0.020	0.020	0.010	4	88
JAN											
29...	105	<0.010	0.320	0.030	0.030	<0.20	0.030	0.010	<0.010	1	100
APR											
24...	67	0.090	0.500	0.160	0.160	1.7	0.540	0.020	<0.010	12	88
JUL											
17...	77	<0.010	<0.100	0.080	0.050	0.70	<0.010	<0.010	<0.010	4	86

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
NOV											
01...	1420	30	<1	8	<0.5	1.0	<1	<3	<1	200	<1
JAN											
29...	1430	20	<1	11	<0.5	<1.0	<1	<3	<10	160	<10
APR											
24...	1500	90	<1	8	<0.5	<1.0	1	<3	5	300	1
JUL											
17...	1350	50	<1	8	<0.5	<1.0	<1	<3	3	240	<1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
NOV										
01...	<4	4	<0.1	<10	<1	<1	<1.0	35	<6	91
JAN										
29...	<4	3	<0.1	<10	<10	<1	<1.0	48	<6	7
APR										
24...	<4	12	<0.1	<10	1	<1	<1.0	18	<6	5
JUL										
17...	<4	6	<0.1	<10	2	<1	<1.0	31	<6	17

STREAMS TRIBUTARY TO LAKE SUPERIOR

04015330 KNIFE RIVER NEAR TWO HARBORS, MN

LOCATION.--Lat 46°56'49", long 91°47'32", in SW¼NW¼ sec.31, T.52 N., R.11 W., Lake County, Hydrologic Unit 04010102, on right bank 600 ft downstream from bridge on U.S. Highway 61, 0.5 mi upstream from bridge on County Highway 102, in town of Knife River, 0.8 mi upstream from Lake Superior, and 7.8 mi southwest of Two Harbors.

DRAINAGE AREA.--85.6 mi^2.

PERIOD OF RECORD.--Occasional low-flow measurements, water years 1970-71, July 1974 to current year.

GAGE.--Water-stage recorder and crest-stage gage. Elevation of gage is 640 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--Records fair except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--16 years, 88.9 ft^3/s, 14.10 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 7,440 ft^3/s, May 10, 1979, gage height, 11.16 ft; minimum, no flow Dec. 2, 1976 to Mar. 4, 1977.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 800 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 28	1945	1,490	6.03	Aug. 25	0745	1,140	5.55
Apr. 30	0115	*1,580	*6.14				

Minimum daily discharge, 0.10 ft^3/s, Dec. 20-30.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.0	15	e4.4	e.50	e.65	e.90	e110	533	20	89	9.0	9.3
2	8.6	13	e4.0	e.60	e.65	e.90	e90	294	20	50	7.6	7.1
3	8.3	14	e3.7	e.60	e.65	e.90	e80	200	46	35	7.3	5.6
4	8.5	15	e3.4	e.60	e.65	e.90	e70	151	77	25	40	5.4
5	9.0	18	e3.2	e.60	e.65	e.90	e60	123	53	17	43	6.0
6	9.7	29	e3.0	e.60	e.65	e.90	e55	103	48	14	28	228
7	10	25	e2.7	e.60	e.65	e.90	e50	89	38	13	18	112
8	10	26	e2.3	e.60	e.70	e1.0	e45	78	38	20	12	53
9	9.1	30	e2.0	e.60	e.70	e1.2	e43	76	61	30	7.9	44
10	9.3	28	e1.7	e.60	e.70	e1.5	e41	69	46	18	6.0	38
11	10	23	e1.3	e.60	e.70	e5.0	e40	61	35	13	5.5	21
12	10	19	e1.0	e.60	e.70	25	e40	53	53	11	4.3	119
13	9.3	27	e.60	e.60	e.70	e65	e40	47	54	9.3	4.3	86
14	9.0	20	e.40	e.60	e.70	e100	e42	44	37	7.6	3.8	381
15	8.2	17	e.30	e.60	e.70	e150	e44	45	27	7.4	3.1	142
16	7.9	11	e.25	e.60	e.70	e120	e46	55	24	7.1	2.8	86
17	7.7	e11	e.20	e.60	e.70	e100	e48	67	39	7.2	2.5	59
18	7.3	e10	e.15	e.60	e.80	e90	50	59	67	6.5	3.7	42
19	7.7	e9.5	e.13	e.60	e.80	e80	70	51	48	7.5	3.0	42
20	7.6	e9.0	e.10	e.60	e.80	e75	99	44	37	6.2	2.9	35
21	7.9	e8.5	e.10	e.60	e.80	e70	112	40	31	5.8	3.4	43
22	8.1	e8.0	e.10	e.60	e.80	e65	116	37	39	5.3	2.2	47
23	7.5	e7.5	e.10	e.60	e.80	e60	126	36	60	20	2.1	34
24	7.4	e7.0	e.10	e.60	e.80	e55	138	36	46	16	2.5	26
25	7.4	e6.5	e.10	e.60	e.80	e50	262	32	31	12	541	20
26	7.4	e6.0	e.10	e.60	e.80	e45	599	34	35	12	476	18
27	7.1	e5.6	e.10	e.60	e.90	e40	632	45	35	29	147	15
28	7.3	e5.3	e.10	e.65	e.90	e37	1180	37	31	40	62	12
29	10	e5.0	e.10	e.65	---	e37	1110	31	37	28	32	11
30	16	e4.7	e.10	e.65	---	e70	1180	26	203	18	19	15
31	16	---	e.20	e.65	---	e100	---	23	---	12	13	---
TOTAL	278.3	433.6	36.03	18.70	20.55	1449.00	6618	2621	1416	593.9	1514.9	1762.4
MEAN	8.98	14.5	1.16	.60	.73	46.7	221	84.5	47.2	19.2	48.9	58.7
MAX	16	30	4.4	.65	.90	150	1180	533	203	89	541	381
MIN	7.1	4.7	.10	.50	.65	.90	40	23	20	5.3	2.1	5.4
AC-FT	552	860	71	37	41	2870	13130	5200	2810	1180	3000	3500
CFSM	.10	.17	.01	.01	.01	.55	2.56	.99	.55	.22	.57	.69
IN.	.12	.19	.02	.01	.01	.63	2.88	1.14	.62	.26	.66	.77

CAL YR 1989 TOTAL 23304.13 MEAN 63.8 MAX 1080 MIN .10 AC-FT 46220 CFSM .75 IN. 10.13
WTR YR 1990 TOTAL 16762.38 MEAN 45.9 MAX 1180 MIN .10 AC-FT 33250 CFSM .54 IN. 7.28

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024000 ST. LOUIS RIVER AT SCANLON, MN

LOCATION.--Lat 46°42'12", long 92°25'07", in NW¼ sec.30, T.49 N., R.16 W., Carlton County, Hydrologic Unit 04010201, on right bank 25 ft downstream from lower bridge on U.S. Highway 61 at Scanlon, 0.6 mi downstream from Minnesota Power Co. powerplant, 3 mi upstream from Thomson Reservoir, and 3.2 mi upstream from Midway River.

DRAINAGE AREA.--3,430 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--January 1908 to current year. Monthly discharge only for some periods published in WSP 1307. Published as "near Thomson" 1908-50.

REVISED RECORDS.--WSP 1337: 1911-12.

GAGE.--Water-stage recorder. Datum of gage is 1,101.23 ft above National Geodetic Vertical Datum of 1929. Oct. 5, 1909, to Sept. 5, 1914, nonrecording gage 3 mi 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.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Diurnal fluctuation caused by powerplant upstream. Flow regulated by Whiteface Reservoir and Boulder, Island, Rice and Fish Lakes, combined capacity, 332,160 acre-ft; the water-discharge table shows the monthly change in contents (†).

AVERAGE DISCHARGE (UNADJUSTED).--82 years, 2,335 ft^3/s, 9.24 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 37,900 ft^3/s, May 9, 1950; maximum gage height, 15.8 ft, May 9, 1950, from Minnesota Department of Transportation (discharge uncertain); minimum discharge, 54 ft^3/s, July 30, 1980; minimum daily, 88 ft^3/s, Aug. 24, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 19,500 ft^3/s, Sept. 6, gage height, 10.33 ft; minimum daily, 221 ft^3/s, Aug. 17; minimum gage height, 1.92 ft, Aug. 19.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1160	1340	1450	e950	e900	e900	2170	14900	1640	2560	682	413
2	982	1430	1300	e950	e900	e950	2430	14300	1540	2350	606	390
3	983	1560	1060	e950	e900	987	2690	13100	1820	2130	577	319
4	995	1620	1070	e950	e900	977	2900	11900	3420	1930	574	315
5	1230	1740	1410	e950	e900	983	2590	10700	4390	1690	448	380
6	1140	1730	1300	e950	e900	946	2520	9360	4510	1570	487	13300
7	988	1740	932	e900	e900	961	2270	8210	4780	1430	471	12100
8	1060	1800	468	e900	e900	959	2120	7280	4590	1540	361	6690
9	1080	1810	1810	e900	e900	961	1970	6500	4160	1520	416	4500
10	992	1870	1370	e900	e900	938	1730	5690	3930	1640	322	3730
11	983	1900	802	e900	e900	955	1780	5320	3760	1680	511	3020
12	1090	1890	650	e900	e900	1050	1600	4700	3740	1580	386	2640
13	901	1750	1010	e900	e900	1480	1600	4290	3690	1530	359	2170
14	707	1700	e1000	e900	e900	2930	1530	3900	3200	1500	302	2580
15	987	1760	e700	e900	e900	4440	1430	3710	2750	1390	327	2950
16	982	1490	e900	e900	e900	6140	1430	3620	2340	1420	370	2450
17	733	1300	e1000	e900	e900	5860	1360	3510	2250	1440	221	2050
18	659	1150	e1150	e900	e900	4730	1340	3300	2370	1390	230	1940
19	913	1230	e1000	e900	e900	3960	1240	3180	2370	1230	251	1580
20	743	1510	e1100	e900	e900	3440	1320	3010	2280	1300	525	1450
21	658	1550	e1200	e900	e900	3260	1360	2750	2260	1030	345	1420
22	549	1560	e1000	e900	e900	3170	1460	2620	2200	989	332	1380
23	874	1320	e900	e900	e900	2790	1820	2720	2380	944	228	1190
24	682	981	e900	e900	e900	2410	1950	2950	2370	826	367	1280
25	615	1130	e900	e900	e900	1870	2530	2810	2310	798	424	1110
26	557	1510	e900	e900	e900	1550	5740	2640	2340	817	546	980
27	784	1550	e900	e900	e900	1470	8340	2650	2590	889	688	868
28	749	1200	e900	e900	e900	1360	11000	2410	2510	1030	645	833
29	530	933	e900	e900	---	1120	12800	2200	2430	916	401	743
30	1020	1420	e900	e900	---	1270	14600	2030	2910	854	402	714
31	1280	---	e950	e900	---	1580	---	1830	---	770	394	---
TOTAL	27606	45474	31832	28200	25200	66397	99620	168090	87830	42683	13198	75485
MEAN	891	1516	1027	910	900	2142	3321	5422	2928	1377	426	2516
MAX	1280	1900	1810	950	900	6140	14600	14900	4780	2560	688	13300
MIN	530	933	468	900	900	900	1240	1830	1540	770	221	315
†	-42	-594	-662	-544	-522	192	867	1186	524	-16	-145	53
MEAN‡	849	922	365	366	378	2334	4188	6608	3452	1361	281	2569
CFSM‡	.25	.27	.11	.11	.11	.68	1.22	1.93	1.01	.40	.08	.75
IN‡	.29	.30	.12	.12	.11	.78	1.36	2.22	1.12	.46	.09	.84

CAL YR 1989 TOTAL 825980 MEAN 2263 MAX 15900 MIN 331 MEAN‡ 2225 CFSM‡ .65 IN‡ 8.81
WTR YR 1990 TOTAL 711615 MEAN 1950 MAX 14900 MIN 221 MEAN‡ 1977 CFSM‡ .58 IN‡ 7.83

† Change in contents, equivalent in cubic feet per second, in Whiteface Reservoir, and Boulder, Island, Rice and Fish Lakes; records furnished by Minnesota Power Co.
‡ Adjusted for change in reservoir contents.
e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024000 ST. LOUIS RIVER AT SCANLON, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1958-66, 1968 to current year.

REMARKS.--Letter K indicates non-ideal colony count. Letter E indicates estimated value. Samples collected at cableway 0.75 mi downstream from gage.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
NOV												
01...	1130	1280	248	253	8.1	7.6	8.0	2.6	770	10.3	21	--
DEC												
18...	1330	1290	187	201	7.5	7.4	0.5	1.9	736	--	K4	K17
JAN												
23...	1245	898	282	235	7.3	7.5	0.0	2.0	720	10.2	--	53
APR												
16...	1300	1380	150	153	7.5	7.6	1.5	2.6	728	12.8	K15	K7
JUL												
16...	1300	1660	175	165	7.7	7.6	24.0	2.5	728	6.8	37	64
AUG												
20...	1215	568	210	215	8.1	7.8	20.0	3.5	738	6.3	46	E170

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
NOV												
01...	20	15	7.8	1.9	88	86	0	107	31	6.3	0.20	5.8
DEC												
18...	17	11	6.1	1.4	70	69	0	85	22	5.0	0.20	7.8
JAN												
23...	18	14	7.2	1.7	86	78	0	105	28	5.2	0.20	8.9
APR												
16...	13	7.2	5.1	1.9	52	51	0	63	14	5.4	<0.10	6.6
JUL												
16...	15	8.0	5.7	1.3	60	61	0	73	11	5.4	<0.10	6.8
AUG												
20...	20	11	7.8	1.5	78	83	0	95	20	7.9	<0.10	7.4

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
01...	157	<0.010	<0.100	0.020	0.020	0.60	0.020	0.010	<0.010	6	87
DEC											
18...	140	<0.010	0.160	0.080	0.080	0.70	0.010	0.010	0.010	6	52
JAN											
23...	156	<0.010	0.230	0.080	0.070	1.0	0.040	0.020	0.020	2	100
APR											
16...	102	0.020	0.200	0.070	0.060	0.70	0.050	0.030	<0.010	7	98
JUL											
16...	126	<0.010	0.200	0.050	0.050	1.1	0.050	0.020	<0.010	11	91
AUG											
20...	140	<0.010	<0.100	0.060	0.020	0.80	0.040	0.010	<0.010	4	97

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024000 ST. LOUIS RIVER AT SCANLON, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
NOV											
01...	1130	20	<1	16	<0.5	<1.0	<1	<3	1	320	<1
JAN											
23...	1245	20	<1	16	<0.5	<1.0	1	<3	<10	410	<10
APR											
16...	1300	40	<1	16	<0.5	2.0	<1	<3	3	470	1
JUL											
16...	1300	40	1	17	<0.5	2.0	1	<3	11	790	4

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
NOV										
01...	<4	49	<0.1	<10	<1	<1	<1.0	65	<6	<3
JAN										
23...	<4	40	<0.1	<10	<10	<1	<1.0	59	<6	6
APR										
16...	<4	60	<0.1	<10	1	<1	<1.0	41	<6	11
JUL										
16...	<4	45	<0.1	<10	2	<1	<1.0	51	<6	9

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024098 DEER CREEK NEAR HOLYOKE, MN

LOCATION.--Lat 46°31'30", long 92°23'20", in NE¼SE¼ sec.29, T.47 N., R.16 W., Carlton County, Hydrologic Unit 04010301, on left bank 179 ft west of State Highway No. 23, 0.9 mi upstream from mouth and 4.0 mi north of Holyoke.

DRAINAGE AREA.--7.77 mi^2.

PERIOD OF RECORD.--October 1976 to current year.

GAGE.--Water-stage recorder and crest-stage gage. Datum of gage is 786.14 ft above National Geodetic Vertical Datum of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--14 years, 7.36 ft^3/s, 12.86 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,000 ft^3/s, Sept. 3, 1985, gage height, 32.76 ft, from floodmarks, from rating curve extended above 1,000 ft^3/s, on basis of flow through culvert computations; minimum discharge, 0.20 ft^3/s, Aug. 13, 16, 1982, July 12, 1989.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,730 ft^3/s, Sept. 6, gage height, 29.43 ft, from flood marks; minimum discharge, 0.58 ft^3/s, May 13, gage height, 11.15 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.8	2.4	e2.6	e2.3	1.5	e1.2	18	14	1.9	3.8	1.7	e1.4
2	2.0	2.3	e2.5	e2.3	1.4	e1.2	9.8	7.3	2.1	4.7	1.7	e1.2
3	2.0	2.1	e2.4	e2.3	1.4	e1.4	6.3	4.8	5.9	3.2	1.9	e1.2
4	1.8	2.2	e2.4	e2.3	1.4	1.5	8.1	3.5	10	2.6	2.0	e1.2
5	2.0	2.2	e2.5	e2.3	1.5	1.4	5.6	10	4.6	2.4	1.9	e2.7
6	1.9	2.9	e2.4	e2.3	1.5	1.4	3.6	16	3.7	2.4	1.9	e553
7	1.9	2.8	e2.4	e2.5	1.5	1.4	2.9	2.3	2.8	3.5	1.9	e27
8	1.9	2.9	e2.4	e2.8	1.5	e1.5	3.6	3.1	7.4	33	2.1	e14
9	2.0	2.7	e2.4	e2.8	1.5	1.6	3.6	2.1	4.1	6.3	2.7	e8.4
10	2.4	2.6	e2.3	e2.7	1.5	13	3.0	1.6	2.9	2.2	5.1	e7.6
11	2.1	2.7	e2.3	e2.6	1.5	28	2.7	1.4	5.8	1.4	4.6	e5.8
12	2.0	2.5	e2.3	e2.5	1.5	e48	2.3	1.0	6.9	1.2	4.1	e4.8
13	2.0	2.5	e2.3	e2.4	1.5	e37	2.6	.85	5.0	.92	1.9	7.0
14	2.0	2.5	e2.3	e2.4	1.3	e47	3.0	1.5	3.1	.69	1.2	25
15	2.0	2.4	e2.3	e2.4	e1.3	e70	2.7	6.1	2.1	.69	.97	8.2
16	1.9	2.4	e2.3	e2.5	e1.2	32	2.1	4.2	3.2	.73	.93	5.8
17	1.9	2.3	e2.3	e2.5	e1.2	11	1.9	3.8	16	.97	1.0	4.8
18	1.9	e2.3	e2.3	e2.5	1.2	8.2	1.6	5.5	16	1.1	2.8	4.0
19	1.9	e2.6	e2.3	e2.4	1.2	7.4	2.1	1.9	e6.0	.85	2.1	4.2
20	1.9	e2.7	e2.3	e2.3	1.2	6.1	2.8	1.7	e4.8	.81	1.9	3.1
21	1.9	e2.5	e2.3	e2.2	1.4	6.7	2.7	3.2	e3.6	.81	1.4	6.9
22	2.2	e2.4	e2.3	e2.1	e1.3	5.9	3.2	1.5	e3.6	.93	1.3	5.1
23	2.1	e2.4	e2.3	e2.0	e1.2	5.3	2.7	3.8	e3.2	1.1	1.2	3.4
24	2.2	e2.3	e2.3	e2.0	e1.2	4.8	3.8	2.8	e3.0	.84	1.2	2.7
25	2.1	e2.4	e2.3	e1.9	e1.2	3.9	11	5.7	e3.2	6.2	25	2.3
26	2.0	e2.6	e2.3	e1.9	e1.2	3.8	27	2.1	e15	15	31	2.1
27	2.2	e2.4	e2.3	e1.8	e1.2	5.3	18	2.3	8.1	9.7	8.9	1.9
28	2.0	e2.4	e2.3	e1.7	e1.2	5.3	28	1.5	5.6	4.8	4.6	1.7
29	2.7	e2.5	e2.3	e1.7	---	5.8	32	3.5	4.8	2.9	2.8	1.7
30	2.5	e2.8	e2.3	e1.6	---	19	43	3.8	4.5	1.9	e1.9	1.8
31	2.3	---	e2.3	1.6	---	21	---	1.9	---	1.4	e1.5	---
TOTAL	63.5	74.7	72.6	69.6	37.7	407.1	259.7	124.75	168.9	119.04	125.20	720.0
MEAN	2.05	2.49	2.34	2.25	1.35	13.1	8.66	4.02	5.63	3.84	4.04	24.0
MAX	2.7	2.9	2.6	2.8	1.5	70	43	16	16	33	31	553
MIN	1.8	2.1	2.3	1.6	1.2	1.2	1.6	.85	1.9	.69	.93	1.2
AC-FT	126	148	144	138	75	807	515	247	335	236	248	1430
CFSM	.26	.32	.30	.29	.17	1.69	1.11	.52	.72	.49	.52	3.09
IN.	.30	.36	.35	.33	.18	1.95	1.24	.60	.81	.57	.60	3.45

CAL YR 1989 TOTAL 1970.10 MEAN 5.40 MAX 66 MIN .62 AC-FT 3910 CFSM .69 IN. 9.43
WTR YR 1990 TOTAL 2242.79 MEAN 6.14 MAX 553 MIN .69 AC-FT 4450 CFSM .79 IN. 10.74

e Estimated

RED RIVER OF THE NORTH BASIN

05045950 ORWELL LAKE NEAR FERGUS FALLS, MN

LOCATION.--Lat 46°12'55", long 96°10'40", in SW¼ sec.26, T.132 N., R.44 W., Otter Tail County, Hydrologic Unit 09020103, at dam on Otter Tail River at outlet of Orwell Lake, 7 mi southwest of Fergus Falls.

DRAINAGE AREA.--1,830 mi^2, approximately.

PERIOD OF RECORD.--March 1953 to current year. Prior to October 1971, published as Orwell Reservoir.

GAGE.--Water-stage recorder. Datum of gage is adjustment of 1912.

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 is 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 were provided by U.S. Army Corps of Engineers.

EXTREMES FOR PERIOD OF RECORD.--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.

EXTREMES FOR CURRENT YEAR.--Maximum contents, 9,620 acre-ft, May 29, elevation, 1,065.55 ft; minimum, 4,750 acre-ft, Jan. 2, elevation, 1,058.70 ft.

MONTHEND ELEVATION AND CONTENTS, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

Date	Elevation (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	1,064.03	8,320	
Oct. 31	1,064.62	8,830	+510
Nov. 30	1,061.98	6,790	-2,040
Dec. 31	1,058.81	4,820	-1,970
CAL YR 1989			-5,230
Jan. 31	1,060.82	6,030	+1,210
Feb. 28	1,061.64	6,570	+540
Mar. 31	1,064.50	8,720	+2,160
Apr. 30	1,065.43	9,520	+800
May 31	1,065.38	9,470	-50
June 30	1,063.97	8,280	-1,190
July 31	1,063.78	8,140	-140
Aug. 31	1,063.85	8,190	+50
Sept. 30	1,063.80	8,150	-40
WTR YR 1990			-170

RED RIVER OF THE NORTH BASIN

05046000 OTTER TAIL RIVER BELOW ORWELL DAM, NEAR FERGUS FALLS, MN

LOCATION.--Lat 46°12'35", long 96°11'05", in NE¼ sec.34, T.132 N., R.44 W., Otter Tail County, Hydrologic Unit 09020103, on left bank 0.7 mi downstream from Orwell Dam, 6.1 mi downstream from Dayton Hollow Dam, 8 mi southwest of Fergus Falls, and 11.1 mi downstream from Pelican River.

DRAINAGE AREA.--1,830 mi^2, approximately.

PERIOD OF RECORD.--October 1930 to current year. 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.

REVISED RECORDS.--WSP 785: 1934(M). WSP 1208: 1947(M). WSP 1308: 1931(M).

GAGE.--Water-stage recorder. Datum of gage is 1,029.65 ft, adjustment of 1912 (levels by U.S. Army 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 mi upstream at datum 40.30 ft higher.

REMARKS.--Records good. Flow regulated by Orwell Lake (station 05045950) beginning Mar. 21, 1953 and powerplants upstream.

AVERAGE DISCHARGE.--60 years, 320 ft^3/s, 231,800 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 1,710 ft^3/s, June 17, 1953, gage height, 5.60 ft, backwater from aquatic vegetation; minimum, 0.70 ft^3/s, Aug. 5, 1970, gage height, 1.28 ft, result of regulation.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 650 ft^3/s, June 14, gage height, 3.37 ft, result of regulation; minimum discharge, 63 ft^3/s, Oct. 13, result of regulation; minimum gage height, 2.41 ft, Oct. 13, Aug. 18, result of regulation.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	171	96	136	92	e123	145	412	528	566	554	250	197
2	171	107	136	91	e123	136	466	529	566	478	226	197
3	171	118	136	86	e122	138	535	536	566	424	179	200
4	171	118	133	86	e122	138	528	581	560	424	200	230
5	162	118	131	82	e122	145	508	578	560	424	200	238
6	152	118	e130	82	e122	145	468	578	554	424	263	161
7	145	118	e130	82	e122	145	408	515	542	424	299	113
8	145	118	e130	82	153	145	408	414	530	424	273	106
9	145	138	e130	e82	175	145	394	420	536	393	255	107
10	122	155	e130	e83	166	145	383	446	530	339	255	169
11	109	150	e130	e85	166	149	383	489	512	334	255	224
12	110	150	e130	e86	157	225	383	493	501	345	255	225
13	99	150	e130	e87	149	396	367	497	501	361	238	198
14	99	150	e130	e88	150	456	351	501	585	361	228	180
15	99	150	e130	89	150	456	355	506	644	361	178	177
16	99	150	e130	115	e150	455	355	512	639	424	174	177
17	99	e150	e130	e130	e150	450	373	512	633	512	174	143
18	99	e150	e130	e132	e150	450	419	512	591	554	176	124
19	103	e148	e130	e134	e150	380	419	518	572	554	182	123
20	107	145	125	e135	e150	319	419	518	572	472	209	136
21	107	145	110	e137	e150	337	419	518	572	413	224	141
22	107	145	110	139	153	377	417	518	554	413	205	144
23	97	142	110	141	154	354	414	518	542	323	197	143
24	89	141	110	141	150	337	413	518	536	304	253	155
25	89	139	e108	144	151	341	419	524	495	304	294	166
26	90	136	e105	143	e150	336	429	524	472	304	297	166
27	92	136	96	144	e150	339	455	524	472	276	294	147
28	92	136	92	145	e150	355	514	524	530	255	294	136
29	96	136	92	133	---	388	512	560	560	255	294	136
30	96	136	92	124	---	399	517	572	554	255	289	136
31	96	---	92	123	---	407	---	572	---	255	231	---
TOTAL	3629	4089	3734	3443	4080	9133	12843	16055	16547	11943	7341	4895
MEAN	117	136	120	111	146	295	428	518	552	385	237	163
MAX	171	155	136	145	175	456	535	581	644	554	299	238
MIN	89	96	92	82	122	136	351	414	472	255	174	106
AC-FT	7200	8110	7410	6830	8090	18120	25470	31850	32820	23690	14560	9710
CFSM	.06	.07	.07	.06	.08	.16	.23	.28	.30	.21	.13	.09
IN.	.07	.08	.08	.07	.08	.19	.26	.33	.34	.24	.15	.10

CAL YR 1989 TOTAL 104617 MEAN 287 MAX 1170 MIN 53 AC-FT 207500 CFSM .16 IN. 2.13
WTR YR 1990 TOTAL 97732 MEAN 268 MAX 644 MIN 82 AC-FT 193900 CFSM .15 IN. 1.99

e Estimated

RED RIVER OF THE NORTH BASIN

05050000 BOIS DE SIOUX RIVER NEAR WHITE ROCK, SD

LOCATION.--Lat 45°51'45", long 96°34'25", in SW¼SW¼ sec.27, T.128 N., R.47 W., Roberts County, Hydrologic Unit 09020101, on Sisseton Indian Reservation, on left bank just downstream from Big Slough Outlet, 300 ft downstream from White Rock Dam, 4 mi south of White Rock, SD and 5 mi northwest of Wheaton.

DRAINAGE AREA.--1,160 mi^2, approximately.

PERIOD OF RECORD.--October 1941 to current year.

GAGE.--Water-stage recorder. Datum of gage is 960.00 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Jan. 14, 1943, nonrecording 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.

REMARKS.--Records fair. Flow regulated by Lake Traverse-Boise de Sioux Flood Control and Water Conservation project (available capacity for flood control, 137,000 acre-ft).

AVERAGE DISCHARGE.--49 years, 80.4 ft^3/s, 58,250 acre-ft/yr; median of yearly mean discharges, 53 ft^3/s, 38,400 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,770 ft^3/s, occurred during period Apr. 19-21, 1969, gage height, 15.07 ft, from floodmark; no flow at times in most years.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 89 ft^3/s, Mar. 13, gage height, 4.85 ft, due to regulation; no flow on many days.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	81	.21	e13	.00	.00	.00	3.0	31	7.1	9.6	.02	1.2
2	78	.17	e13	.00	.00	.00	3.0	29	8.1	9.2	.02	.94
3	77	.14	e13	.00	.00	.00	2.7	25	8.4	7.7	.00	.88
4	59	.17	e13	.00	.00	.00	3.0	22	8.5	5.7	.00	.84
5	12	.21	e13	.00	.00	e.05	2.7	17	8.8	4.3	.00	.81
6	1.5	.21	e13	.00	.00	e.70	3.0	13	7.9	3.4	.00	.74
7	.51	.24	e12	.00	.00	e2.8	3.0	11	7.4	2.7	.00	.93
8	.36	.24	e12	.00	.00	e6.1	2.9	9.6	7.6	2.2	.00	1.2
9	.31	11	e12	.00	.00	e7.2	2.6	8.1	6.1	1.6	.00	1.9
10	.24	17	e11	.00	.00	e9.8	2.4	6.8	5.2	1.4	.00	1.9
11	.21	18	e11	.00	.00	40	2.8	5.9	4.3	2.2	.00	1.7
12	.17	17	e10	.00	.00	58	3.1	5.4	5.1	2.7	.00	1.3
13	.12	18	e10	.00	.00	77	3.0	4.4	3.8	2.1	.00	.99
14	.12	18	e9.8	.00	.00	61	3.1	6.0	3.8	1.4	.00	.93
15	.12	17	e9.6	.00	.00	65	4.6	6.3	5.2	.99	.00	.90
16	.12	e17	e9.4	.00	.00	56	3.4	7.6	10	.88	.00	.79
17	.10	e17	e9.2	.00	.00	45	2.7	7.7	11	.88	.00	.75
18	.07	e18	e7.2	.00	.00	48	3.9	6.7	9.7	.80	.00	.81
19	.05	e18	e2.0	.00	.00	35	6.3	8.3	12	.82	.00	.75
20	.07	18	e.50	.00	.00	30	1.6	11	13	.80	.00	.85
21	.10	17	e.08	.00	.00	27	2.4	12	10	.75	.00	.88
22	.10	e16	e.02	.00	.00	27	4.3	12	9.5	.69	.00	1.1
23	.12	e15	.00	.00	.00	22	4.9	11	8.4	.62	.02	1.2
24	.10	e15	.00	.00	.00	15	4.5	9.3	7.3	.63	.02	1.2
25	.10	e14	.00	.00	.00	16	9.4	8.7	6.9	.55	.02	1.1
26	.10	e12	.00	.00	.00	9.4	15	8.4	8.9	.45	.02	1.1
27	.10	e12	.00	.00	.00	6.4	20	8.6	9.3	.33	.05	1.1
28	.10	e12	.00	.00	.00	4.7	25	8.0	12	.21	.07	1.0
29	.10	e12	.00	.00	---	4.3	30	7.5	12	.10	.05	.98
30	.19	e13	.00	.00	---	3.6	31	6.9	10	.05	.62	.89
31	.26	---	.00	.00	---	2.9	---	6.7	---	.02	1.4	---
TOTAL	312.44	343.59	203.80	0.00	0.00	679.95	209.3	340.9	247.3	65.77	2.31	31.66
MEAN	10.1	11.5	6.57	.000	.000	21.9	6.98	11.0	8.24	2.12	.075	1.06
MAX	81	18	13	.00	.00	77	31	31	13	9.6	1.4	1.9
MIN	.05	.14	.00	.00	.00	.00	1.6	4.4	3.8	.02	.00	.74
AC-FT	620	682	404	.00	.00	1350	415	676	491	130	4.6	63
CFSM	.01	.01	.01	.00	.00	.02	.01	.01	.01	.00	.00	.00
IN.	.01	.01	.01	.00	.00	.02	.01	.01	.01	.00	.00	.00

CAL YR 1989 TOTAL 33761.04 MEAN 92.5 MAX 689 MIN .00 AC-FT 66970 CFSM .08 IN. 1.08
WTR YR 1990 TOTAL 2437.02 MEAN 6.68 MAX 81 MIN .00 AC-FT 4830 CFSM .01 IN. .08

e Estimated

RED RIVER OF THE NORTH BASIN

05051300 BOIS DE SIOUX RIVER NEAR DORAN, MN

LOCATION.--Lat 46°09'08", long 96°34'44", in NE¼NE¼ sec.21, T.131 N., R.47 W., Wilkin County, Hydrologic Unit 09020101, on right bank, 10 ft downstream from bridge on County Highway 6, 3 miles downstream from Rabbit River, 4.3 mi southwest of Doran.

DRAINAGE AREA.--1,880 mi^2, approximately

PERIOD OF RECORD.--October 1989 to current year.

GAGE.--Water-stage recorder. Datum of gage is 943.90 ft above National Geodetic Vertical Datum of 1929 (elevation data obtained from Wilkin County Highway Engineer).

REMARKS.--Records fair. Flow regulated by Lake Traverse-Boise de Sioux Flood Control and Water Conservation project near White Rock, SD.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 96 ft^3/s, Mar. 16, gage height, 9.75 ft, due to regulation at White Rock Dam (backwater from ice); no flow on many days.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e96	.08	e14	e1.6	.00	.00	48	21	12	12	.00	.00
2	e90	.08	e14	e1.5	.00	.00	42	21	12	11	.00	.00
3	e80	.08	e14	e1.4	.00	.00	37	21	13	10	.00	.00
4	e77	.15	e14	e1.3	.00	.00	31	20	13	9.8	.00	.00
5	e74	.71	e14	e.09	.00	.00	24	18	14	10	.00	.00
6	e64	1.1	e14	e.03	.00	.00	19	18	14	11	.00	.00
7	e52	1.5	e13	.00	.00	.00	15	15	14	9.7	.00	.00
8	e30	1.5	e13	.00	.00	.00	13	13	13	9.0	.00	.00
9	e15	1.6	e13	.00	.00	.00	9.9	10	13	8.4	.00	.00
10	e11	2.0	e12	.00	.00	.00	7.4	8.8	13	7.3	.00	.00
11	e8.6	2.0	e11	.00	.00	e.01	6.2	7.5	13	7.2	.00	.00
12	6.0	1.7	e11	.00	.00	e7.8	5.2	6.7	12	7.6	.00	.00
13	5.0	2.7	e11	.00	.00	e39	5.2	6.8	11	6.1	.00	.00
14	4.6	7.0	e11	.00	.00	e64	5.0	7.9	10	4.2	.00	.00
15	3.3	9.9	e10	.00	.00	e73	3.5	8.1	12	2.6	.00	.00
16	2.0	e12	e10	.00	.00	e85	3.2	7.4	13	1.6	.00	.00
17	1.4	e13	e9.8	.00	.00	e73	3.3	7.1	12	1.4	.00	.00
18	1.2	e14	e9.5	.00	.00	e50	3.2	6.6	11	1.2	.00	.00
19	.72	e15	e8.8	.00	.00	e43	3.7	7.1	12	1.1	.00	.00
20	.75	e17	e8.0	.00	.00	e35	3.7	9.4	13	.87	.00	.00
21	.65	e17	e5.0	.00	.00	e28	3.9	9.9	13	.87	.00	.00
22	.62	e17	e3.7	.00	.00	e22	4.3	9.8	12	.63	.00	.00
23	.60	e17	e3.2	.00	.00	e18	6.0	11	12	.38	.00	.00
24	.51	e16	e2.4	.00	.00	e17	7.6	12	12	.38	.00	.00
25	.42	e15	e2.3	.00	.00	e17	7.5	13	13	.30	.00	.00
26	.22	e15	e2.2	.00	.00	e19	10	13	12	.38	.00	.00
27	.15	e14	e2.0	.00	.00	22	9.4	12	15	.30	.00	.00
28	.08	e14	e1.9	.00	.00	26	10	12	14	.08	.00	.00
29	.08	e14	e1.8	.00	---	36	14	11	13	.00	.00	.00
30	.08	e14	e1.7	.00	---	58	18	11	12	.00	.00	.00
31	.08	---	e1.6	.00	---	58	---	12	---	.00	.00	---
TOTAL	626.06	256.10	262.9	5.92	0.00	790.81	379.2	367.1	378	135.39	0.00	0.00
MEAN	20.2	8.54	8.48	.19	.000	25.5	12.6	11.8	12.6	4.37	.000	.000
MAX	96	17	14	1.6	.00	85	48	21	15	12	.00	.00
MIN	.08	.08	1.6	.00	.00	.00	3.2	6.6	10	.00	.00	.00
AC-FT	1240	508	521	12	.00	1570	752	728	750	269	.00	.00
CFSM	.01	.00	.00	.00	.00	.01	.01	.01	.01	.00	.00	.00
IN.	.01	.01	.01	.00	.00	.02	.01	.01	.01	.00	.00	.00

WTR YR 1990 TOTAL 3201.48 MEAN 8.77 MAX 96 MIN .00 AC-FT 6350 CFSM .00 IN. .06

e Estimated

RED RIVER OF THE NORTH BASIN

05051500 RED RIVER OF THE NORTH AT WAHPETON, ND

LOCATION.--Lat 46°15'55", long 96°35'40", in NE¼ sec.8, T.132 N., R.47 W., Richland County, Hydrologic Unit 09020104, 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 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1942 to October 1942, March 1943 to current year. Gage-height records collected in this vicinity since 1917 are contained in reports of the U.S. Weather Bureau.

GAGE.--Water-stage recorder and concrete and wooden dam. Datum of gage is 942.97 ft above National Geodetic Vertical Datum of 1929. Prior to Aug. 6, 1943, U.S. Weather Bureau nonrecording gage 800 ft upstream, converted to present datum. Aug. 6, 1943, to Oct. 27, 1950, nonrecording gage at present site and datum.

REMARKS.--Estimated daily discharges: Nov. 19 to Mar. 9 and Mar. 14-29. Records good except those for periods of estimated daily discharges, which are fair. Flow regulated by Orwell Reservoir, capacity, 14,100 acre-ft at elevation 1,070 ft above National Geodetic Vertical Datum of 1929, adjustment of 1912; Lake Traverse, capacity, 137,000 acre-ft, available for flood control; numerous other controlled lakes and ponds, and several powerplants.

AVERAGE DISCHARGE.--47 years (1944-90), 543 ft^3/s, 393,400 acre-ft/yr; median of yearly mean discharges, 480 ft^3/s, 348,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,200 ft^3/s, Apr. 10, 1969, gage height, 16.34 ft; maximum gage height, 17.95 ft, Apr. 5, 1989; minimum daily, 1.7 ft^3/s, Aug. 28 to Sept. 5, 9, 10, 1976.

EXTREMES OUTSIDE PERIOD OF RECORD.--A stage of 17.0 ft, discharge, 10,500 ft^3/s, occurred in the spring of 1897 and has not been exceeded since.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, about 900 ft^3/s, Mar. 18, gage height, 5.72 ft, backwater from ice; minimum daily, 61 ft^3/s, Nov. 3.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	303	83	e160	e98	e107	e210	493	563	514	542	248	261
2	303	80	e125	e98	e107	e220	474	578	521	539	240	204
3	296	61	e106	e98	e107	e230	500	575	532	496	228	193
4	290	123	e147	e99	e120	e240	549	581	539	427	175	193
5	288	115	e160	e99	e130	e250	548	612	526	416	179	215
6	277	106	e150	e99	e140	e260	522	613	522	418	185	243
7	256	104	e117	e100	e150	e270	483	605	521	415	220	205
8	233	104	e116	e100	e160	e289	415	536	510	423	277	128
9	221	105	e114	e102	e170	e315	399	432	499	421	275	94
10	213	116	e113	e104	e180	335	382	421	496	399	251	87
11	183	141	e112	e105	e190	361	362	446	492	367	247	110
12	134	144	e111	e106	e188	456	350	485	481	335	252	190
13	128	142	e110	e107	e185	491	326	489	459	330	252	203
14	120	145	e109	e108	e180	e570	334	505	456	341	236	198
15	110	151	e108	e109	e178	e640	312	502	519	341	227	167
16	107	80	e107	e110	e175	e720	310	498	604	343	186	163
17	109	90	e106	e111	e170	e800	315	494	608	386	158	162
18	109	94	e105	e120	e170	e880	331	501	607	465	175	154
19	110	e130	e103	e130	e170	e850	374	503	599	515	169	123
20	115	e140	e101	e140	e180	e800	395	503	569	537	168	114
21	123	e192	e100	e150	e190	e740	399	496	562	506	180	117
22	98	e180	e99	e160	e200	e640	401	493	559	433	197	121
23	96	e158	e98	e170	e198	e560	405	497	552	416	239	122
24	95	e145	e97	e169	e190	e520	404	496	532	372	229	122
25	87	e147	e96	e169	e180	e500	406	494	533	312	229	129
26	79	e160	e96	e169	e189	e495	435	496	529	310	334	145
27	76	e170	e96	e169	e198	e460	449	499	493	308	319	147
28	81	e180	e96	e169	e200	e451	495	499	481	292	301	141
29	79	e172	e96	e150	---	e445	553	490	496	254	296	125
30	79	e170	e97	e120	---	457	557	491	537	249	294	121
31	80	---	e98	e110	---	488	---	515	---	250	291	---
TOTAL	4878	3928	3449	3848	4702	14943	12678	15908	15848	12158	7257	4697
MEAN	157	131	111	124	168	482	423	513	528	392	234	157
MAX	303	192	160	170	200	880	557	613	608	542	334	261
MIN	76	61	96	98	107	210	310	421	456	249	158	87
AC-FT	9680	7790	6840	7630	9330	29640	25150	31550	31430	24120	14390	9320

CAL YR 1989 TOTAL 204353 MEAN 560 MAX 8310 MIN 31 AC-FT 405300
WTR YR 1990 TOTAL 104294 MEAN 286 MAX 880 MIN 61 AC-FT 206900

e Estimated

05051500 RED RIVER OF THE NORTH AT WAHPETON, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DISCHARGE, INST. CUBIC FEET PER SECOND (00061)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE AIR (DEG C) (00020)	TEMPERATURE WATER (DEG C) (00010)	HARDNESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM ADSORPTION RATIO (00931)
OCT												
18...	1030	109	542	--	3.0	5.5	--	--	--	--	--	--
NOV												
30...	1110	170	700	--	0.5	0.5	--	--	--	--	--	--
JAN												
17...	1540	111	664	--	-3.5	0.5	--	--	--	--	--	--
APR												
04...	1215	551	585	8.1	8.0	11.0	220	40	28	11	10	0.3
MAY												
02...	1815	582	460	--	18.5	12.0	--	--	--	--	--	--
JUN												
06...	0820	526	458	--	12.5	15.0	--	--	--	--	--	--
JUL												
10...	0950	409	485	--	23.0	24.0	--	--	--	--	--	--
AUG												
22...	0715	187	410	8.1	17.5	20.0	200	34	28	9.0	9	0.3
SEP												
25...	1620	131	450	--	17.5	18.0	--	--	--	--	--	--

DATE	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	BICARBONATE, FET-LAB (MG/L AS HCO3) (95440)	CARBONATE, FET-LAB (MG/L AS CO3) (95445)	ALKALINITY LAB (MG/L AS CACO3) (90410)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)
APR											
04...	6.3	250	0	210	27	14	0.10	15	259	267	0.35
AUG											
22...	2.5	240	0	199	17	11	0.10	11	251	232	0.34

DATE	SOLIDS, DISSOLVED (TONS PER DAY) (70302)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BORON, DISSOLVED (UG/L AS B) (01020)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)
APR											
04...	385	2	50	30	<1	13	30	0.1	1	<1	220
AUG											
22...	127	3	60	20	1	13	10	0.1	<1	<1	220

RED RIVER OF THE NORTH BASIN

05051522 RED RIVER OF THE NORTH AT HICKSON, ND

LOCATION.--Lat 46°39'35", long 96°47'44", in SW¼ sec.19, T.137 N., R.48 W., Clay County, MN, Hydrologic Unit 09020104, on right bank 60 ft downstream from bridge on township road, and 1 mi southeast of Hickson, ND.

DRAINAGE AREA.--4,300 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1975 to current year.

GAGE.--Water-stage recorder and concrete control. Datum of gage is 877.06 ft above National Geodetic Vertical Datum of 1929.

REMARKS.--Estimated daily discharges: Nov. 20 to Jan. 6, Jan. 31 to Feb. 4, and Feb. 12-26. Records good except those for periods of estimated daily discharges, which are fair. Flow regulated by Orwell Reservoir, capacity, 14,100 acre-ft at elevation 1,070 ft above National Geodetic Vertical Datum of 1929, adjustment of 1912; Lake Traverse, capacity, 137,000 acre-ft, available for flood control, numerous other controlled lakes and ponds, and several powerplants.

AVERAGE DISCHARGE.--15 years, 593 ft^3/s, 429,600 acre-ft/yr; median of yearly mean discharges, 530 ft^3/s, 38,400 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 12,900 ft^3/s, Apr. 7, 1989, gage height, 35.81 ft; no flow Oct. 26, 1976, to Jan. 9, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 857 ft^3/s, Apr. 2, gage height, 11.26 ft; minimum daily discharge, 70 ft^3/s, Dec. 23, 24.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	184	90	e139	e80	e100	166	716	567	527	534	259	306
2	228	92	e150	e81	e96	165	829	574	590	566	257	296
3	290	91	e160	e83	e100	161	804	586	573	572	261	257
4	301	82	e150	e84	e120	161	702	591	571	561	256	211
5	297	98	e131	e86	120	149	676	580	577	504	238	202
6	294	119	e121	e90	115	133	562	589	579	452	201	202
7	290	134	e110	90	116	131	521	605	566	441	197	226
8	277	124	e107	84	118	131	503	606	559	445	199	246
9	253	120	e104	77	121	136	439	583	560	445	230	203
10	230	120	e101	83	117	141	382	499	542	445	281	145
11	205	117	e98	85	119	151	360	428	523	458	280	112
12	196	127	e96	82	e135	187	343	420	517	439	260	97
13	181	145	e93	84	e120	226	333	453	508	392	257	112
14	158	158	e90	87	e115	307	316	480	492	360	260	168
15	140	161	e88	76	e110	364	312	489	481	356	256	186
16	129	116	e85	84	e105	387	306	497	490	363	242	187
17	117	91	e82	88	e102	456	300	499	567	369	230	167
18	116	113	e80	88	e106	543	300	498	623	377	201	166
19	117	109	e78	88	e110	628	307	498	639	420	179	174
20	114	e150	e76	107	e130	653	339	507	642	480	180	166
21	115	e160	e73	131	e140	638	384	515	616	530	176	138
22	116	e150	e71	138	e130	610	405	517	594	548	180	122
23	125	e140	e70	140	e120	560	412	512	592	509	201	123
24	122	e130	e70	142	e110	508	412	508	588	457	223	127
25	116	e140	e71	143	e120	449	408	507	577	432	247	130
26	116	e150	e72	145	e130	349	404	509	566	381	256	130
27	106	e160	e74	145	141	360	405	505	582	341	270	128
28	93	e150	e75	142	152	494	436	506	563	333	328	139
29	88	e140	e76	141	---	538	465	507	532	327	325	142
30	90	e120	e78	130	---	555	525	504	512	300	310	143
31	88	---	e79	e110	---	613	---	503	---	267	305	---
TOTAL	5292	3797	2948	3214	3318	11050	13606	16142	16848	13404	7545	5151
MEAN	171	127	95.1	104	118	356	454	521	562	432	243	172
MAX	301	161	160	145	152	653	829	606	642	572	328	306
MIN	88	82	70	76	96	131	300	420	481	267	176	97
AC-FT	10500	7530	5850	6370	6580	21920	26990	32020	33420	26590	14970	10220

CAL YR 1989 TOTAL 227983 MEAN 625 MAX 12000 MIN 40 AC-FT 452200
WTR YR 1990 TOTAL 102315 MEAN 280 MAX 829 MIN 70 AC-FT 202900

e Estimated

RED RIVER OF THE NORTH BASIN

05051522 RED RIVER OF THE NORTH AT HICKSON, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1976 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
18...	1555	117	550	--	9.0	6.0	--	--	--	--	--	--
JAN												
17...	1300	88	875	--	-2.5	0.0	--	--	--	--	--	--
APR												
11...	1430	359	545	8.5	2.0	7.5	230	43	29	15	12	0.4
25...	1000	408	540	--	15.0	18.0	--	--	--	--	--	--
JUN												
06...	1415	577	590	--	15.5	19.5	--	--	--	--	--	--
JUL												
09...	1530	445	505	--	29.5	28.0	--	--	--	--	--	--
AUG												
23...	0930	215	430	8.3	21.5	22.5	210	36	30	10	9	0.3
SEP												
26...	1205	130	652	--	23.0	11.0	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
11...	6.8	230	0	190	51	15	0.10	13	302	287	0.41
AUG											
23...	3.1	260	0	213	25	11	0.10	12	245	255	0.33

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
11...	293	2	70	250	1	18	50	0.1	1	<1	230
AUG											
23...	142	4	60	20	<1	14	10	<0.1	1	<1	200

RED RIVER OF THE NORTH BASIN

05054000 RED RIVER OF THE NORTH AT FARGO, ND

LOCATION.--Lat 46°51'40", long 96°47'00", in NW¼NE¼ sec.18, T.139 N., R.48 W., Cass County, Hydrologic Unit 09020104, at waterplant on 4th St. S. in Fargo, 25 mi upstream from mouth of Sheyenne River, and at mi 453.
DRAINAGE AREA.--6,800 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--May 1901 to current year. Published as "at Moorhead, Minn." 1901. Monthly discharge only for some periods, published in WSP 1308.
REVISED RECORDS.--WSP 1308: 1902-4, 1906-7, 1910-14, 1916, 1918, 1924. WSP 1388: 1905-6, 1917-20(M), 1935(M), 1938-39(M), 1943.
GAGE.--Water-stage recorder and concrete control. Datum of gage is 861.8 ft above National Geodetic Vertical Datum of 1929. Oct. 1, 1960, to Sept. 30, 1962, water-stage recorder at present site at datum 5.6 ft higher. See WSP 1728 or 1913 for history of changes prior to Oct. 1, 1960.
REMARKS.--Estimated daily discharges: Nov. 27-29 and Dec. 3 to Mar. 31. Records good except those for periods of estimated daily discharges, which are fair. Flow regulated by Orwell Reservoir, capacity, 14,100 acre-ft at elevation 1,070 ft above National Geodetic Vertical Datum of 1929, 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 diversions to cities of Fargo and Moorhead and from Sheyenne River.
AVERAGE DISCHARGE (UNADJUSTED).--89 years, 575 ft^3/s, 416,600 acre-ft/yr; median of yearly mean discharges, 449 ft^3/s, 325,300 acre-ft/yr.
EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 25,300 ft^3/s, Apr. 15, 1969, gage height, 37.34 ft; no flow for many days in each year for period 1932-41, Sept. 30, Oct. 1-2, 1970, Oct. 10-19, 1976.
EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Apr. 7, 1897, reached a stage of 39.1 ft present datum, discharge, 25,000 ft^3/s at site 1.5 mi downstream.
EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,220 ft^3/s, June 2, gage height, 15.40 ft; minimum daily discharge, 67 ft^3/s, Jan. 20.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	191	99	134	e80	e117	e180	713	544	537	484	227	303
2	197	97	129	e80	e115	e165	743	568	877	511	230	297
3	243	98	e130	e75	e115	e160	824	583	875	529	228	286
4	284	101	e140	e72	e120	e150	808	595	749	527	225	235
5	293	87	e135	e72	e120	e155	750	597	660	511	227	211
6	294	89	e122	e85	e130	e145	731	595	623	454	204	200
7	292	106	e120	e100	e140	e130	676	618	591	416	176	235
8	291	122	e119	e100	e135	e124	629	646	568	406	170	223
9	279	119	e117	e96	e135	e131	568	631	560	401	170	229
10	270	116	e115	e100	e132	e135	489	598	549	391	208	193
11	249	113	e115	e95	e135	e150	452	510	527	417	245	143
12	224	113	e114	e90	e150	e217	425	465	532	418	253	108
13	201	118	e112	e85	e150	e217	403	482	508	383	243	90
14	188	133	e110	e78	e145	e280	385	512	493	346	242	105
15	169	142	e110	e72	e145	e270	366	512	506	323	239	155
16	157	133	e100	e70	e142	e275	357	520	479	322	235	179
17	149	110	e90	e69	e140	e285	345	526	491	323	222	181
18	142	95	e85	e69	e165	e300	330	526	566	329	238	205
19	138	104	e80	e69	e165	e400	328	527	698	343	195	181
20	135	108	e75	e67	e180	e550	339	534	703	384	177	179
21	137	134	e70	e82	e195	e610	361	534	664	448	175	165
22	139	169	e70	e100	e180	e600	396	559	619	492	171	142
23	140	183	e70	e120	e175	e565	409	536	586	494	184	135
24	149	172	e75	e120	e160	e520	408	522	575	450	192	130
25	143	161	e75	e120	e158	e490	410	518	564	412	220	128
26	132	155	e82	e125	e165	e430	404	546	543	386	273	124
27	122	e155	e89	e127	e160	e380	412	533	596	340	259	117
28	117	e153	e95	e125	e160	e413	471	526	558	307	277	117
29	108	e152	e85	e122	---	e470	463	525	527	290	311	131
30	105	150	e82	e120	---	e540	481	528	495	281	307	135
31	102	---	e82	e120	---	e600	---	528	---	254	301	---
TOTAL	5780	3787	3127	2905	4129	10037	14876	16944	17819	12372	7024	5262
MEAN	186	126	101	93.7	147	324	496	547	594	399	227	175
MAX	294	183	140	127	195	610	824	646	877	529	311	303
MIN	102	87	70	67	115	124	328	465	479	254	170	90
AC-FT	11460	7510	6200	5760	8190	19910	29510	33610	35340	24540	13930	10440
(+)	1168	1058	1105	1061	985	1076	1083	1254	1239	1442	1719	1379
MEAN*	205	144	119	111	165	342	514	567	615	424	255	198
AC-FT*	12630	8570	7300	6820	9180	20990	30590	34860	36580	26070	15650	11820

		OBSERVED						ADJUSTED		
CAL YR 1989	TOTAL 301138	MEAN 825	MAX 18600	MIN 22	AC-FT 597300		MEAN	831	AC-FT	602,100
WTR YR 1990	TOTAL 104062	MEAN 285	MAX 877	MIN 67	AC-FT 206400		MEAN	305	AC-FT	221,000

\+ - Diversions in acre-feet to cities of Fargo and Moorhead.
e - Estimated
* - Adjusted for diversions to cities of Fargo and Moorhead.

RED RIVER OF THE NORTH BASIN

05054000 RED RIVER OF THE NORTH AT FARGO, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1956 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
12...	1005	227	905	--	13.5	9.0	--	--	--	--	--	--
NOV												
30...	1700	150	615	--	1.0	0.5	--	--	--	--	--	--
JAN												
17...	0925	69	850	--	-3.5	0.5	--	--	--	--	--	--
MAR												
08...	1045	123	710	--	1.0	0.5	--	--	--	--	--	--
28...	0930	403	545	--	5.0	0.5	--	--	--	--	--	--
APR												
11...	1145	464	510	8.6	2.0	6.0	230	44	28	14	12	0.4
24...	1635	405	485	--	29.0	6.5	--	--	--	--	--	--
JUN												
07...	0910	600	510	--	19.5	15.5	--	--	--	--	--	--
JUL												
09...	1235	407	451	--	28.0	26.5	--	--	--	--	--	--
AUG												
17...	1020	222	500	8.5	29.5	28.5	230	41	31	16	13	0.5
SEP												
26...	1430	136	625	--	22.0	18.5	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
11...	7.1	250	0	200	45	16	0.10	14	312	292	0.42
AUG											
17...	3.2	260	0	214	47	14	0.10	13	317	294	0.43

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
11...	391	2	60	220	<1	17	40	0.1	1	1	240
AUG											
17...	190	5	90	20	1	20	<10	0.1	<1	<1	270

RED RIVER OF THE NORTH BASIN

05061000 BUFFALO RIVER NEAR HAWLEY, MN

LOCATION.--Lat 46°51'00", long 96°19'45", in NW¼SE¼ sec.14, T.139 N., R.45 W., Clay County, Hydrologic Unit 09020106, near left downstream end of bridge on farm lane, 2 mi southwest of Hawley.

DRAINAGE AREA.--322 mi^2.

PERIOD OF RECORD.--March 1945 to current year, WY 1981 (annual maximum only), March 1982 to September 1985 (no winter records).

REVISED RECORDS.--WSP 1308: 1945-46(M), 1948(M).

GAGE.--Water-stage recorder. Datum of gage is 1,111.91 ft above National Geodetic Vertical Datum of 1929. Prior to Jan. 29, 1953, nonrecording gage at bridge 1,800 ft upstream at datum 3.17 ft lower.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--40 years (water years 1945-80, 1986-90), 71.9 ft^3/s, 52,090 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,050 ft^3/s, July 1, 1975, gage height, 9.76 ft; minimum, 2.8 ft^3/s, Aug. 26, 1977; minimum gage height, 2.55 ft, Sept. 5, 1961.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known, about 11.3 ft, present datum, spring of 1921, from information by local resident.

EXTREMES FOR CURRENT YEAR:--Maximum discharge, 562 ft^3/s, Mar. 31, gage height, 7.18 ft, from highwater mark; minimum discharge, 6.9 ft^3/s, Aug. 8, gage height, 2.98 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	22	23	e25	e14	e16	e30	494	109	48	32	8.8	9.2
2	21	22	e23	e14	e16	e36	379	103	49	28	8.3	9.7
3	25	21	e22	e14	e16	e32	300	98	50	27	8.0	9.2
4	24	21	e21	e14	e16	e34	244	93	54	25	7.8	8.9
5	24	e21	e21	e14	e17	e30	181	89	56	21	8.0	8.3
6	23	e22	e19	e14	e17	e24	101	81	50	18	8.6	8.2
7	23	e23	e18	e14	e18	e24	109	78	46	18	7.7	11
8	23	e24	e17	e15	e19	e20	123	72	42	29	7.3	9.9
9	22	e24	e17	e15	e19	e30	104	64	40	35	7.6	9.8
10	20	e24	e17	e15	e18	e46	95	56	40	36	8.4	10
11	20	e24	e17	e15	e19	e60	82	54	41	36	9.9	9.7
12	22	e24	e17	e16	e20	e52	72	51	49	33	15	9.4
13	24	e24	e17	e16	e18	e51	69	50	61	31	12	10
14	23	e24	e16	e16	e20	e120	69	59	59	28	11	11
15	23	e24	e15	e16	e20	e145	66	67	59	23	15	10
16	29	e24	e15	e16	e20	e177	62	63	55	21	12	9.2
17	22	e24	e15	e16	e20	e120	59	61	54	19	9.6	9.3
18	22	e24	e15	e16	e20	e90	56	60	50	16	8.6	12
19	22	e24	e15	e16	e21	e96	55	56	51	15	8.8	11
20	22	e24	e15	e16	e23	e75	56	55	52	14	9.5	11
21	23	e25	e15	e17	e25	72	55	53	64	13	9.2	11
22	23	e25	e15	e17	e27	69	56	50	68	14	9.5	12
23	22	e26	e15	e18	e27	e75	59	45	63	14	17	11
24	24	e26	e14	e18	e22	e80	63	43	58	12	13	11
25	25	e28	e14	e18	e26	e72	72	42	53	11	12	9.8
26	26	e28	e14	e18	e24	71	78	42	46	11	14	9.2
27	26	e28	e14	e18	e23	67	78	46	42	12	12	8.5
28	27	e28	e14	e18	e23	92	85	67	40	12	11	7.7
29	25	e27	e14	e17	---	153	108	69	38	11	9.7	8.3
30	25	e26	e14	e17	---	292	114	62	34	10	9.0	9.2
31	24	---	e14	e16	---	507	---	53	---	8.9	8.9	---
TOTAL	726	732	514	494	570	2842	3544	1991	1512	633.9	317.2	294.5
MEAN	23.4	24.4	16.6	15.9	20.4	91.7	118	64.2	50.4	20.4	10.2	9.82
MAX	29	28	25	18	27	507	494	109	68	36	17	12
MIN	20	21	14	14	16	20	55	42	34	8.9	7.3	7.7
AC-FT	1440	1450	1020	980	1130	5640	7030	3950	3000	1260	629	584
CFSM	.07	.08	.05	.05	.06	.28	.37	.20	.16	.06	.03	.03
IN.	.08	.08	.06	.06	.07	.33	.41	.23	.17	.07	.04	.03

CAL YR 1989 TOTAL 25685.5 MEAN 70.4 MAX 1410 MIN 8.0 AC-FT 50950 CFSM .22 IN. 2.97
WTR YR 1990 TOTAL 14170.6 MEAN 38.8 MAX 507 MIN 7.3 AC-FT 28110 CFSM .12 IN. 1.64

e Estimated

RED RIVER OF THE NORTH BASIN

05061500 SOUTH BRANCH BUFFALO RIVER AT SABIN, MN

LOCATION.--Lat 46°46'20", long 96°37'40", in SW¼SW¼ sec.9, T.138 N., R.47 W., Clay County, Hydrologic Unit 09020106, near center of span on downstream side of highway bridge, 0.3 mi downstream from Stony Creek and 1 mi east of Sabin.

DRAINAGE AREA.--522 mi^2.

PERIOD OF RECORD.--March 1945 to current year, WY 1981 (annual maximum only), March 1982 to September 1985 (no winter records).

REVISED RECORDS.--WSP 1308: 1949(M).

GAGE.--Nonrecording gage and crest-stage gage. Datum of gage is 902.39 ft above National Geodetic Vertical Datum of 1929 (levels by Soil Conservation Service). Prior to Aug. 17, 1948, nonrecording gage at site 1 mi downstream at different datum.

REMARKS.--Records fair.

AVERAGE DISCHARGE.--40 years (water years 1945-80, 1986-90), 56.5 ft^3/s, 40,930 acre-ft/yr; median of yearly mean discharges, 41 ft^3/s, 29,700 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 8,500 ft^3/s, July 2, 1975, gage height, 19.90 ft; no flow on many days in most years.

EXTREMES FOR CURRENT PERIOD.--Maximum discharge, 178 ft^3/s, Apr. 1, gage height, 9.22 ft (backwater from ice); maximum gage height; 10.02 ft, Mar. 16 (backwater from ice); no flow on many days.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e9.4	6.4	e5.8	e.40	e4.2	e7.0	e177	72	29	18	2.9	.00
2	e9.3	e6.6	e5.5	e.68	e3.9	e8.0	e174	79	98	18	2.8	.00
3	9.3	e6.8	e5.3	e1.1	e3.4	e8.5	140	75	109	18	2.6	.00
4	9.4	e7.0	e5.2	e1.3	e3.3	e9.0	113	65	96	17	2.3	.00
5	9.8	7.0	e5.1	e1.7	e3.2	e9.5	90	58	75	15	1.1	.00
6	9.5	7.0	e5.0	e2.2	e3.1	e9.5	70	53	63	14	.38	.00
7	9.6	8.0	e4.9	e2.7	e3.4	e10	60	47	55	13	.21	.00
8	9.6	9.4	e4.8	e3.5	e3.8	e10	65	41	47	12	.04	.00
9	9.3	e10	e4.6	e4.0	e4.3	e11	75	37	38	9.9	.00	.00
10	8.8	e10	e4.0	e4.2	e4.3	e12	70	33	32	8.4	.00	.00
11	9.2	9.9	e3.4	e4.3	e4.4	e18	60	31	28	7.5	.00	.00
12	10	9.9	e2.9	e4.4	e4.5	e25	54	30	24	6.4	.00	.00
13	9.8	10	e2.3	e4.5	e4.1	e32	49	28	21	5.4	.00	.00
14	9.7	e10	e1.8	e4.6	e3.8	e36	44	28	18	4.5	.00	.00
15	9.3	e9.8	e1.6	e4.8	e4.0	e55	40	27	17	3.7	.00	.00
16	9.3	e9.4	e1.4	e4.9	e3.6	e85	36	26	17	3.2	.00	.00
17	8.3	e9.4	e1.2	e5.0	e3.2	e80	32	27	17	2.9	.00	.00
18	8.8	e9.3	e.94	e5.0	e3.0	e65	30	29	16	2.7	.00	.07
19	9.2	e9.2	e.94	e5.1	e2.9	e42	28	32	17	2.3	.00	.80
20	8.1	e9.2	e.60	e5.3	e3.2	e45	27	37	21	1.8	.00	.83
21	7.4	e9.0	e.50	e5.4	e6.3	e40	27	39	21	1.4	.00	.88
22	11	e9.0	e.50	e5.4	e6.5	e35	27	40	19	1.1	.00	.35
23	8.9	e8.8	e.48	e5.4	e7.0	e40	28	41	18	.94	.00	.06
24	6.1	e8.8	e.46	e5.4	e7.5	e36	31	40	18	.91	.00	.68
25	4.9	e8.8	e.44	e5.4	e7.0	e38	32	45	19	1.0	.00	.66
26	4.8	e8.8	e.41	e5.6	e6.5	e38	34	50	20	1.5	.00	.82
27	5.8	e8.8	e.37	e5.6	e6.0	e45	34	47	21	2.0	.00	.92
28	6.3	e8.8	e.33	e5.6	e6.0	e57	42	41	21	2.5	.00	1.0
29	8.8	e7.3	e.30	e5.6	---	e71	52	40	19	2.9	.00	1.1
30	8.7	e6.4	e.30	e4.7	---	e107	63	40	18	2.9	.00	1.3
31	6.1	---	e.33	e4.6	---	e153	---	34	---	2.9	.00	---
TOTAL	264.5	258.8	71.70	128.38	126.4	1237.5	1804	1312	1032	203.75	12.33	9.47
MEAN	8.53	8.63	2.31	4.14	4.51	39.9	60.1	42.3	34.4	6.57	.40	.32
MAX	11	10	5.8	5.6	7.5	153	177	79	109	18	2.9	1.3
MIN	4.8	6.4	.30	.40	2.9	7.0	27	26	16	.91	.00	.00
AC-FT	525	513	142	255	251	2450	3580	2600	2050	404	24	19
CFSM	.02	.02	.00	.01	.01	.08	.12	.08	.07	.01	.00	.00
IN.	.02	.02	.01	.01	.01	.09	.13	.09	.07	.01	.00	.00

CAL YR 1989 TOTAL 23445.42 MEAN 64.2 MAX 3740 MIN .00 AC-FT 46500 CFSM .12 IN. 1.67
WTR YR 1990 TOTAL 6460.83 MEAN 17.7 MAX 177 MIN .00 AC-FT 12820 CFSM .03 IN. .46

e Estimated

RED RIVER OF THE NORTH BASIN

05062000 BUFFALO RIVER NEAR DILWORTH, MN

LOCATION.--Lat 46°57'40", long 96°39'40", in SW¼SE¼ sec.6, T.140 N., R.47 W., Clay County, Hydrologic Unit 09020106, on left bank 4.5 mi southeast of Kragnes, 6.5 mi northeast of Dilworth, and 9 mi downstream from South Branch.

DRAINAGE AREA.--1,040 mi^2, approximately.

PERIOD OF RECORD.--March 1931 to current year. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 1308: 1931(M).

GAGE.--Water-stage recorder. Datum of gage is 878.31 ft above National Geodetic Vertical Datum of 1929 (levels by U.S Army Corps of Engineers). Prior to Apr. 5, 1937, nonrecording gage at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--59 years, 133 ft^3/s, 96,360 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 13,600 ft^3/s, July 2, 1975, gage height, 27.10 ft; no flow at times in 1936.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 600 ft^3/s, Apr. 3, gage height, 12.40 ft (backwater from ice); minimum discharge, 7.2 ft^3/s, Aug. 10, gage height, 2.47 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	50	e30	e35	e16	e23	e27	e350	236	82	71	12	9.3
2	41	e31	e32	e16	e23	e27	e490	246	330	65	12	9.1
3	36	e29	e30	e16	e23	e28	e565	249	410	61	11	10
4	34	e28	e29	e16	e24	e29	e525	246	331	56	10	10
5	35	e32	e29	e16	e26	e30	e400	231	250	52	10	10
6	37	e30	e28	e17	e27	e32	e335	213	202	49	9.3	11
7	38	e29	e26	e18	e27	e34	e320	196	169	47	9.0	11
8	38	e28	e19	e19	e27	e39	246	179	140	46	8.8	11
9	38	e29	e18	e19	e26	e43	227	162	119	46	7.9	12
10	38	e30	e18	e19	e26	e47	227	147	102	50	7.3	12
11	38	e31	e18	e19	e24	e51	220	131	89	51	7.7	12
12	37	e32	e18	e19	e24	e54	201	118	87	54	7.5	9.8
13	35	e31	e18	e19	e23	e80	179	109	85	53	8.8	9.0
14	34	e30	e17	e19	e21	e115	162	108	84	48	12	8.9
15	34	e30	e17	e19	e22	e130	152	117	95	44	12	10
16	35	e30	e17	e20	e22	e150	142	121	99	41	12	10
17	35	e30	e17	e21	e22	e175	133	127	101	36	11	10
18	37	e30	e16	e21	e22	e215	123	127	97	33	13	12
19	39	e32	e16	e21	e21	e230	113	124	98	30	13	12
20	36	e33	e16	e22	e19	e220	106	120	105	27	12	13
21	34	e34	e16	e23	e20	e180	103	117	117	25	11	13
22	34	e34	e16	e24	e22	e145	102	114	110	24	9.4	13
23	34	e34	e16	e24	e23	e125	103	113	113	21	10	13
24	35	e35	e16	e24	e24	e105	104	108	116	19	12	13
25	40	e36	e16	e24	e24	e90	108	96	109	17	16	13
26	40	e38	e16	e24	e25	e100	116	89	99	16	16	12
27	37	e38	e16	e24	e26	e110	134	87	92	16	14	10
28	34	e38	e16	e23	e26	e110	151	89	87	15	14	10
29	31	e37	e16	e23	---	e130	179	89	80	14	12	9.5
30	30	e37	e16	e23	---	e185	207	95	75	13	11	9.6
31	30	---	e16	e23	---	e250	---	93	---	13	10	---
TOTAL	1124	966	610	631	662	3286	6523	4397	4073	1153	341.7	328.2
MEAN	36.3	32.2	19.7	20.4	23.6	106	217	142	136	37.2	11.0	10.9
MAX	50	38	35	24	27	250	565	249	410	71	16	13
MIN	30	28	16	16	19	27	102	87	75	13	7.3	8.9
AC-FT	2230	1920	1210	1250	1310	6520	12940	8720	8080	2290	678	651
CFSM	.03	.03	.02	.02	.02	.10	.21	.14	.13	.04	.01	.01
IN.	.04	.03	.02	.02	.02	.12	.23	.16	.15	.04	.01	.01

CAL YR 1989 TOTAL 55965.6 MEAN 153 MAX 5260 MIN 9.4 AC-FT 111000 CFSM .15 IN. 2.00
WTR YR 1990 TOTAL 24094.9 MEAN 66.0 MAX 565 MIN 7.3 AC-FT 47790 CFSM .06 IN. .86

e Estimated

RED RIVER OF THE NORTH BASIN

05062500 WILD RICE RIVER AT TWIN VALLEY, MN

LOCATION.--Lat 47°16'00", long 96°14'40", in NW¼NE¼ sec.27, T.144 N., R.44., Norman County, Hydrologic Unit 09020108, on left bank 100 ft upstream from highway bridge, 0.8 mi northeast of Twin Valley, and 2 mi upstream from small tributary.

DRAINAGE AREA.--888 mi ^{2}.

PERIOD OF RECORD.--June 1909 to September 1917, July 1930 to September 1983, October 1989 to September 1990. Monthly discharge only for some periods, published in WSP 1308. October 1983 to September 1989, annual maximums only.

REVISED RECORDS.--WSP 955: 1941. WSP 1308: 1915(M), 1917(M).

GAGE.--Water-stage recorder. Datum of gage is 1,008.16 ft above National Geodetic Vertical Datum of 1929 (U.S. Army Corps of Engineers bench mark). June 1909 to September 1917, nonrecording gage at site 0.2 mi downstream at different datum. July 23, 1930, to Nov. 24, 1934, nonrecording gage at highway bridge 100 ft downstream from present site at present datum. Nov. 25, 1934, to Aug. 2, 1950, water-stage recorder 80 ft upstream from present site at present datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow slightly regulated by Rice Lake and many other small lakes above station. Satellite telemeter at station.

AVERAGE DISCHARGE.--62 years, 171 ft^3/s, 123,900 acre-ft/yr; median of yearly mean discharge, 154 ft^3/s, 112,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,200 ft^3/s, July 22, 1909, gage height, 20.0 ft, site and datum then in use, from rating curve extended above 3,300 ft^3/s; minimum, 0.5 ft^3/s, Nov. 4, 1939.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,090 ft^3/s, Apr. 3, gage height, 6.31 ft; minimum, 3.5 ft^3/s, Aug. 22, 23; minimum gage height, 0.95 ft, Sept. 2.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.0	54	e28	e12	e22	e25	727	241	150	119	e24	4.6
2	9.9	46	e27	e12	e22	e26	704	241	151	119	e23	4.6
3	8.6	53	e26	e12	e22	e28	677	240	162	108	e21	4.4
4	9.4	42	e24	e12	e22	e29	584	237	184	99	e20	4.3
5	9.9	50	e23	e12	e22	e31	471	226	227	92	e19	e6.0
6	12	51	e22	e12	e22	e33	392	218	210	86	e18	e6.5
7	12	50	e21	e12	e22	e36	362	203	200	81	e17	e7.0
8	13	55	e20	e12	e22	e40	362	186	198	77	e16	e7.0
9	15	51	e19	e12	e22	e45	425	179	177	74	e15	e7.0
10	19	48	e18	e13	e22	e50	392	171	174	72	e14	e6.5
11	25	48	e18	e14	e22	e60	313	192	178	72	e13	e6.0
12	25	42	e17	e15	e22	e80	267	209	170	66	e12	e5.0
13	25	40	e17	e16	e23	e150	237	210	166	61	e11	4.2
14	50	39	e15	e18	e23	e250	230	236	174	55	e10	4.4
15	60	56	e14	e20	e23	e250	224	244	170	52	e9.0	4.4
16	60	42	e13	e20	e23	e230	210	252	150	52	e8.0	5.0
17	57	36	e12	e20	e23	e220	196	272	137	e49	9.7	4.9
18	57	e30	e12	e21	e23	e200	186	298	134	e47	7.7	5.5
19	56	e27	e12	e21	e23	e190	179	318	151	e45	6.4	5.5
20	57	e24	e12	e21	e23	e180	181	299	179	e44	5.2	5.9
21	59	e23	e12	e21	e23	e170	183	273	205	e42	4.3	6.0
22	59	e22	e12	e21	e23	e160	180	262	232	e40	3.6	5.6
23	62	e23	e12	e21	e23	e150	183	246	210	e38	6.7	5.3
24	60	e28	e12	e21	e23	e150	187	231	197	e36	7.6	4.9
25	59	e33	e12	e21	e23	e140	176	222	189	e34	7.3	5.4
26	59	e34	e12	e21	e24	e140	174	207	170	e33	8.6	5.3
27	60	e33	e12	e21	e24	e140	176	199	156	e31	9.5	5.1
28	56	e32	e12	e21	e24	e190	200	203	141	e30	7.6	5.4
29	56	e31	e12	e21	---	e400	212	192	130	e29	8.6	4.9
30	57	e30	e12	e21	---	e620	231	168	123	e27	5.4	5.0
31	55	---	e12	e21	---	e700	---	155	---	e25	5.1	---
TOTAL	1231.8	1173	502	538	635	5113	9221	7030	5195	1835	353.3	161.6
MEAN	39.7	39.1	16.2	17.4	22.7	165	307	227	173	59.2	11.4	5.39
MAX	62	56	28	21	24	700	727	318	232	119	24	7.0
MIN	8.6	22	12	12	22	25	174	155	123	25	3.6	4.2
AC-FT	2440	2330	996	1070	1260	10140	18290	13940	10300	3640	701	321
CFSM	.04	.04	.02	.02	.03	.19	.35	.26	.20	.07	.01	.01
IN.	.05	.05	.02	.02	.03	.21	.39	.29	.22	.08	.01	.01

WTR YR 1990 TOTAL 32988.7 MEAN 90.4 MAX 727 MIN 3.6 AC-FT 65430 CFSM .10 IN. 1.38

e Estimated

RED RIVER OF THE NORTH BASIN

05064000 WILD RICE RIVER AT HENDRUM, MN

LOCATION.--Lat 47°16'05", long 96°47'50", in SE¼SE¼ sec.19, T.144 N., R.48 W., Norman County, Hydrologic Unit 09020108, on right bank 30 ft downstream from highway bridge, 0.5 mi east of Hendrum and 4 mi upstream from mouth.

DRAINAGE AREA.--1,600 mi^2, approximately.

PERIOD OF RECORD.--March 1944 to September 1984 and May 1985 to current year. Operated as a high-flow partial-record station October 1984 to April 1985.

REVISED RECORDS.--WSP 1728: 1958.

GAGE.--Water-stage recorder. Datum of gage is 836.75 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers). Prior to July 18, 1989, nonrecording gage at same site and datum.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Large part of high flow diverted into Marsh River basin at overflow section 3.5 mi east of Ada. Another diversion into the Marsh River basin formed in 1947, 1.5 mi southeast of Ada and diverted water at all stages 1947-51, after which it was closed except for a small regulated flow diverted for abatement of pollution from Ada sewage plant effluent. Amount of diversion not known.

AVERAGE DISCHARGE.--45 years, (Water Years 1945-84, 1986-90), 263 ft^3/s, 190,500 acre-ft/yr; median of yearly mean discharges, 225 ft^3/s, 163,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,350 ft^3/s, Apr. 10, 1978, gage height, 31.42 ft; maximum gage height, 32.30 ft, Apr. 21, 1979, backwater from Red River of the North; no flow some days in 1948-49.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,100 ft^3/s, Apr. 1, gage height, 14.26 ft (backwater from ice); minimum, 2.0 ft^3/s, Sept. 28, 29; minimum gage height, 1.36 ft, Sept. 5.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	12	65	e34	e12	e19	e22	e1080	e350	195	158	25	3.6
2	11	76	e32	e12	e19	e23	e1060	e350	366	146	25	3.5
3	11	63	e30	e12	e19	e24	e1040	e350	762	142	28	3.2
4	11	62	e28	e12	e19	e26	e950	341	489	134	23	3.0
5	14	79	e26	e12	e19	e28	e840	e330	374	118	21	3.1
6	17	76	e25	e12	e19	e30	e760	e310	340	106	19	4.7
7	17	66	e24	e12	e19	e33	e690	299	328	98	18	3.8
8	17	68	e22	e12	e19	e35	e660	e285	283	94	18	5.3
9	22	68	e21	e12	e19	e39	e640	e250	268	87	19	5.2
10	21	72	e20	e12	e19	e43	652	e240	251	82	17	5.2
11	21	70	e18	e12	e19	e49	625	226	228	80	13	4.5
12	22	66	e17	e13	e19	e60	525	e235	252	81	12	3.6
13	22	57	e16	e14	e19	e80	444	e250	240	76	13	3.2
14	22	61	e15	e18	e19	e120	402	260	220	68	11	2.5
15	23	e55	e14	e19	e19	e220	349	e285	236	63	10	3.3
16	39	e49	e14	e19	e20	e220	317	e310	243	58	9.3	3.5
17	64	e44	e13	e19	e20	e210	293	e335	218	56	7.2	2.5
18	66	e43	e12	e19	e20	e195	268	347	197	53	12	2.4
19	64	e49	e12	e19	e20	e180	249	e390	195	51	9.4	3.3
20	62	e51	e12	e19	e20	e165	240	e420	210	49	5.9	7.6
21	64	e51	e12	e19	e20	e160	e240	409	250	48	5.2	5.1
22	66	e50	e12	e19	e20	e150	e240	e380	284	47	4.3	4.2
23	65	e50	e12	e19	e20	e140	245	345	313	46	4.2	3.7
24	68	e48	e12	e19	e20	e135	e240	325	305	43	4.7	3.9
25	71	e47	e12	e19	e21	e130	e235	299	276	40	5.7	3.6
26	70	e45	e12	e19	e21	e130	e230	282	258	38	6.9	3.4
27	70	e42	e12	e19	e21	e140	224	270	240	37	8.6	3.1
28	68	e40	e12	e19	e21	e150	e260	252	218	34	7.3	2.2
29	66	e38	e12	e19	---	e200	e310	250	193	35	8.6	5.0
30	65	e36	e12	e19	---	e400	344	243	174	32	6.4	5.5
31	64	---	e12	e19	---	e800	---	219	---	28	4.2	---
TOTAL	1295	1687	537	500	549	4337	14652	9437	8406	2228	381.9	116.7
MEAN	41.8	56.2	17.3	16.1	19.6	140	488	304	280	71.9	12.3	3.89
MAX	71	79	34	19	21	800	1080	420	762	158	28	7.6
MIN	11	36	12	12	19	22	224	219	174	28	4.2	2.2
AC-FT	2570	3350	1070	992	1090	8600	29060	18720	16670	4420	757	231
CFSM	.03	.04	.01	.01	.01	.09	.31	.19	.18	.04	.01	.00
IN.	.03	.04	.01	.01	.01	.10	.34	.22	.20	.05	.01	.00

CAL YR 1989 TOTAL 109247.5 MEAN 299 MAX 5450 MIN 8.1 AC-FT 216700 CFSM .19 IN. 2.54
WTR YR 1990 TOTAL 44126.6 MEAN 121 MAX 1080 MIN 2.2 AC-FT 87530 CFSM .08 IN. 1.03

e Estimated

RED RIVER OF THE NORTH BASIN

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN
(National stream quality accounting network station and radiochemical program station)

LOCATION.--Lat 47°21'10", long 96°50'50", on line between secs.24 and 25, T.145 N., R.49 W., Traill County, Hydrologic Unit 09020107, on left bank on upstream side of highway bridge, 0.5 mi west of Halstad, 2.5 mi downstream from Wild Rice River, and at mile 375.2.

DRAINAGE AREA.--21,800 mi^2, approximately, including 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1936 to June 1937 (no winter records), April 1942 to September 1960 (spring and summer months only), May 1961 to current year.

REVISED RECORDS.--WSP 1388: 1936, 1950. WSP 1728: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 826.65 ft above National Geodetic Vertical Datum of 1929. Prior to July 17, 1961, nonrecording gage at same site and datum.

REMARKS.--Estimated daily discharges: Oct. 26 to Nov. 2 and Nov. 15 to Apr. 9. Records good except those for periods of estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--29 years (1961-90), 1,750 ft^3/s, 1,275,000 acre-ft/yr; median of yearly mean discharges, 1,760 ft^3/s, 1,280,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 42,000 ft^3/s, Apr. 22, 1979, gage height, 39.00 ft; minimum observed, 5.4 ft^3/s, Oct. 8, 9, 12-14, 1936.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in 1897 reached a stage of about 38.5 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,880 ft^3/s, Apr. 10, gage height, 8.55 ft; maximum gage height, 12.59 ft, Apr. 4, backwater from ice; minimum daily discharge, 100 ft^3/s, Dec. 22.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	396	e292	e200	e108	e120	e190	e900	1190	892	1060	322	348
2	339	e287	e180	e107	e115	e195	e990	1230	1350	968	303	312
3	303	284	e170	e106	e115	e200	e1100	1290	2160	926	296	297
4	280	285	e160	e105	e125	e195	e1270	1320	2580	923	293	295
5	282	309	e160	e105	e125	e185	e1450	1320	2360	902	289	300
6	313	314	e155	e105	e135	e190	e1750	1300	2000	871	276	292
7	336	289	e150	e105	e145	e185	e2000	1260	1730	828	268	291
8	339	276	e148	e110	e155	e185	e2300	1230	1570	765	254	281
9	339	283	e145	e110	e155	e185	e2400	1200	1450	696	235	301
10	342	320	e140	e120	e155	e195	2440	1180	1380	672	215	306
11	335	345	e135	e118	e160	e200	1790	1140	1360	666	207	295
12	327	345	e132	e115	e170	e205	1570	1070	1430	653	223	276
13	315	334	e130	e115	e168	e215	1420	1000	1550	655	257	241
14	302	332	e128	e120	e164	e250	1290	955	1510	652	278	204
15	288	e320	e125	e120	e162	e300	1200	966	1340	623	276	176
16	274	e300	e122	e118	e160	e320	1070	1030	1210	570	270	167
17	276	e290	e120	e118	e160	e290	984	1060	1140	520	267	183
18	283	e280	e120	e117	e160	e270	915	1080	1060	482	283	223
19	271	e290	e118	e117	e160	e280	858	1110	1030	472	284	247
20	264	e310	e110	e117	e180	e300	832	1130	1140	478	283	272
21	263	e290	e105	e120	e200	e320	811	1140	1550	482	264	286
22	267	e280	e100	e125	e195	e322	806	1110	1680	505	237	258
23	275	e270	e102	e130	e190	e330	825	1080	1630	547	225	247
24	289	e260	e105	e128	e180	e370	850	1090	1500	580	225	229
25	303	e250	e108	e125	e180	e410	865	1070	1360	581	232	214
26	e316	e250	e109	e130	e180	e470	873	1030	1270	547	242	207
27	e312	e230	e110	e130	e180	e520	875	1010	1190	500	258	204
28	e308	e220	e110	e135	e190	e600	922	1010	1150	459	302	223
29	e312	e210	e110	e140	---	e660	993	985	1160	408	309	244
30	e305	e200	e110	e130	---	e730	1130	956	1140	368	308	262
31	e298	---	e109	e120	---	e800	---	922	---	340	345	---
TOTAL	9452	8545	4026	3669	4484	10067	37479	34464	43872	19699	8326	7681
MEAN	305	285	130	118	160	325	1249	1112	1462	835	269	256
MAX	396	345	200	140	200	800	2440	1320	2580	1060	345	348
MIN	263	200	100	105	115	185	806	922	892	340	207	167
AC-FT	18750	16950	7990	7280	8890	19970	74340	68360	87020	39070	16510	15240

CAL YR 1989 TOTAL 647491 MEAN 1774 MAX 25600 MIN 100 AC-FT 1284000
WTR YR 1990 TOTAL 191764 MEAN 525 MAX 2580 MIN 100 AC-FT 380400

e Estimated

RED RIVER OF THE NORTH BASIN

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN--CONTINUED
(National stream quality accounting network station and radiochemical program station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1961-67, 1972 to current year.

REMARKS.--Additional radiation and radionuclide data were not available at printing. These data will be available from files at the Bismarck District office.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DISCHARGE, INST. CUBIC FEET PER SECOND (00061)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE AIR (DEG C) (00020)	TEMPERATURE WATER (DEG C) (00010)	TURBIDITY (NTU) (00076)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)	COLIFORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT											
20...	1405	262	805	8.6	15.0	6.0	3.4	12.0	97	5	20
DEC											
19...	1220	119	1120	7.8	-25.0	0.0	3.5	11.8	--	--	--
JAN											
19...	1130	117	1230	--	-1.0	0.5	--	--	--	--	--
APR											
11...	1325	1780	522	8.3	2.5	2.5	89	10.5	77	K9	200
MAY											
31...	1055	926	--	8.3	25.5	22.0	60	7.9	--	K9	K50
JUL											
23...	1030	610	600	8.2	28.0	27.0	100	7.2	91	K63	K49
SEP											
06...	1035	293	570	--	22.5	22.0	--	--	--	--	--
28...	1055	223	700	--	10.5	12.5	--	--	--	--	--

DATE	HARDNESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM ADSORPTION RATIO (00931)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY LAB (MG/L AS CACO3) (90410)	ALKALINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	BICARBONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	CARBONATE WATER DIS IT FIELD MG/L AS CO3 (00452)
OCT											
20...	350	71	42	41	20	1	9.1	249	251	282	12
DEC											
19...	480	96	58	55	20	1	10	350	355	433	0
APR											
11...	230	51	24	15	12	0.4	6.6	185	189	222	5
MAY											
31...	270	56	32	22	15	0.6	6.1	238	240	283	5
JUL											
23...	240	49	29	26	18	0.7	8.0	230	213	260	0

DATE	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)	SOLIDS, DISSOLVED (TONS PER DAY) (70302)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	NITROGEN, NITRITE DISSOLVED (MG/L AS N) (00613)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)
OCT											
20...	180	29	0.20	8.5	537	534	0.73	380	0.350	0.030	0.380
DEC											
19...	190	34	0.30	14	695	674	0.95	223	--	<0.010	0.490
APR											
11...	42	13	<0.10	13	321	281	0.44	1540	0.390	0.010	0.400
MAY											
31...	73	16	<0.10	5.6	379	362	0.52	948	1.47	0.030	1.50
JUL											
23...	61	22	0.30	15	364	339	0.50	600	0.390	0.010	0.400

RED RIVER OF THE NORTH BASIN

05067500 MARSH RIVER NEAR SHELLY, MN

LOCATION.--Lat 47°24'45", long 96°45'50", in NE¼NW¼ sec.3, T.145 N., R.48 W., Norman County, Hydrologic Unit 09020107, near center of span on downstream truss of bridge, 3.8 mi southeast of Shelly and 10 mi upstream from mouth.

DRAINAGE AREA.--151 mi^2.

PERIOD OF RECORD.--March 1944 to September 1983 and April 1985 to current year (no winter records since 1989). Monthly discharge only for March 1944, published in WSP 1308. Operated as a high-flow partial-record station October 1983 to March 1985.

GAGE.--Water-stage recorder. Datum of gage is 841.14 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct.1, 1965, nonrecording gage at datum 3.0 ft higher. Oct. 1, 1965, to May 17, 1989, nonrecording gage at present site and datum.

REMARKS.--Records fair. Large part of high flow of Wild Rice River diverted into Marsh River basin at overflow section 4.6 mi east of Ada. Another diversion from Wild Rice River basin formed in 1947, 1.5 mi southeast of Ada and diverted water at all stages 1947-51, after which it was closed except for a small regulated flow diverted for abatement of pollution from Ada sewage plant effluent.

AVERAGE DISCHARGE.--43 years (water years 1945-83, 1986-89), 63.3 ft^3/s, 45,860 acre-ft/yr; median of yearly mean discharges, 46 ft^3/s, 33,300 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,880 ft^3/s, Apr. 19, 1979, gage height, 23.36 ft, from floodmark; no flow for many days most years.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 254 ft^3/s, June 2, gage height, 6.65 ft; no flow for many days.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	---	---	---	---	---	182	4.5	.94	2.6	.00	.00
2	.00	---	---	---	---	---	191	4.5	191	2.0	.00	.00
3	.00	---	---	---	---	---	155	3.6	156	1.5	.00	.00
4	.00	---	---	---	---	---	112	3.0	110	1.4	.00	.00
5	.00	---	---	---	---	---	59	2.4	93	33	.00	.00
6	.00	---	---	---	---	---	29	2.7	63	37	.00	.00
7	.00	---	---	---	---	---	26	2.8	42	25	.00	.00
8	.00	---	---	---	---	---	18	2.0	28	17	.00	.00
9	.00	---	---	---	---	---	15	4.1	20	9.9	.00	.00
10	.00	---	---	---	---	---	13	3.1	14	6.4	.00	.00
11	.00	---	---	---	---	---	9.3	1.4	11	5.6	.00	.00
12	.00	---	---	---	---	---	6.3	.83	9.5	4.3	.00	.00
13	.00	---	---	---	---	---	5.5	.57	7.9	3.2	.00	.00
14	.00	---	---	---	---	---	4.0	.52	7.7	2.2	.00	.00
15	.00	---	---	---	---	---	2.6	.41	6.2	1.5	.00	.00
16	.00	---	---	---	---	---	1.9	.37	5.0	1.3	.00	.00
17	.00	---	---	---	---	---	1.4	.52	3.7	1.2	.00	.00
18	.00	---	---	---	---	---	1.2	.62	2.6	.98	.00	.00
19	.00	---	---	---	---	---	.95	.76	3.4	.81	.00	.00
20	.00	---	---	---	---	---	.78	1.8	8.8	.71	.00	.00
21	30	---	---	---	---	---	.63	1.6	18	.54	.00	.00
22	48	---	---	---	---	---	.61	1.5	28	.43	.00	.00
23	29	---	---	---	---	---	.62	1.3	25	.32	.00	.00
24	15	---	---	---	---	---	.51	1.1	19	.24	.00	.00
25	e6.0	---	---	---	---	---	.41	.95	15	.18	.00	.00
26	e3.0	---	---	---	---	---	.49	.85	11	.15	.00	.00
27	e2.0	---	---	---	---	---	.49	38	7.7	.12	.00	.00
28	e1.5	---	---	---	---	---	.97	16	5.7	.06	.00	.00
29	e1.1	---	---	---	---	---	1.1	5.1	4.5	.00	.00	.00
30	e.90	---	---	---	---	---	2.8	2.6	3.4	.00	.00	.00
31	e.70	---	---	---	---	---	---	1.3	---	.00	.00	---
TOTAL	137.20	---	---	---	---	---	842.56	110.80	921.04	159.64	0.00	0.00
MEAN	4.43	---	---	---	---	---	28.1	3.57	30.7	5.15	.000	.000
MAX	48	---	---	---	---	---	191	38	191	37	.00	.00
MIN	.00	---	---	---	---	---	.41	.37	.94	.00	.00	.00
AC-FT	272	---	---	---	---	---	1670	220	1830	317	.00	.00
CFSM	.03	---	---	---	---	---	.19	.02	.20	.03	.00	.00
IN.	.03	---	---	---	---	---	.21	.03	.23	.04	.00	.00

e Estimated

RED RIVER OF THE NORTH BASIN

05069000 SAND HILL RIVER AT CLIMAX, MN

LOCATION.--Lat 47°36'43", long 96°48'52", in NE¼NE¼ sec.30, T.148 N., R.48 W., Polk County, Hydrologic Unit 09020301, on left bank 25 ft upstream from bridge on U.S. Highway 75 in Climax and 3.7 mi upstream from mouth.

DRAINAGE AREA.--426 mi^2.

PERIOD OF RECORD.--March 1943 to September 1984, June 1985 to current year (winter records incomplete prior to 1947). Monthly discharge only for some periods, published in WSP 1308 and 1728. October 1984 to May 1985, operated as a high-flow partial-record station.

REVISED RECORDS.--WSP 1388: 1943(M), 1944, 1947(M). WSP 1728: 1951(M), 1960 (Average discharge).

GAGE.--Water stage recorder. Datum of gage is 820.10 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct. 1, 1966, nonrecording gage at site 3.2 mi upstream at datum 12.78 ft higher. Oct. 1, 1966, to Sept 5, 1989, nonrecording gage at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--43 years (water years 1947-84, 1986-90), 71.7 ft^3/s, 51,950 acre-ft/yr; median of yearly mean discharges, 53 ft^3/s, 38,400 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,560 ft^3/s, Apr. 14, 1965, gage height, 17.81 ft, site and datum then in use; maximum gage height, 32.79 ft, Apr. 23, 1979, from floodmark (backwater from Red River of the North); minimum daily discharge, 1.0 ft^3/s, Jan. 17, 18, 1962.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 405 ft^3/s, June 2, gage height, 7.52 ft; minimum, 4.8 ft^3/s, Sept. 15; minimum gage height, 3.93 ft, Aug. 11, Sept. 2.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	15	13	e11	e6.0	e11	e13	e170	63	27	23	9.5	6.7
2	15	12	e10	e6.0	e11	e14	e190	63	236	22	8.5	5.8
3	15	9.7	e10	e6.0	e11	e15	e200	62	210	22	9.0	5.6
4	16	11	e9.5	e6.0	e11	e16	e190	58	147	20	8.1	6.5
5	17	17	e9.0	e6.0	e11	e17	e180	53	104	18	7.4	6.6
6	19	17	e8.5	e6.0	e11	e18	e160	48	78	17	7.7	7.7
7	17	15	e8.0	e6.0	e11	e20	e140	44	63	17	8.0	9.3
8	15	17	e8.0	e6.5	e11	e22	e120	41	55	20	6.8	9.9
9	16	15	e7.5	e6.5	e11	e24	e105	38	53	27	6.7	9.5
10	15	18	e7.5	e6.5	e11	e26	e95	37	55	26	6.5	8.7
11	15	17	e7.0	e7.0	e11	e30	e88	35	53	22	6.0	8.4
12	16	15	e7.0	e7.0	e11	e35	e80	34	49	21	7.6	8.0
13	15	15	e7.0	e7.5	e11	e45	e75	33	45	20	8.5	7.8
14	16	15	e6.5	e8.0	e11	e60	e70	41	38	18	9.5	7.0
15	16	16	e6.5	e9.0	e11	e80	e66	38	33	17	8.4	5.5
16	14	11	e6.5	e10	e11	e100	e63	33	31	15	7.5	6.4
17	14	12	e6.0	e10	e11	e120	60	32	31	15	6.9	7.1
18	14	12	e6.0	e10	e11	e120	58	39	29	14	6.3	8.1
19	14	17	e6.0	e10	e11	e120	53	38	31	14	6.3	8.9
20	15	16	e6.0	e10	e11	e115	47	36	42	14	6.3	9.2
21	14	16	e6.0	e10	e12	e110	44	37	60	15	7.1	8.9
22	14	16	e6.0	e10	e12	e100	41	36	51	15	6.8	8.0
23	14	16	e6.0	e10	e12	e90	42	35	47	15	6.3	8.2
24	15	e15	e6.0	e10	e12	e80	42	34	41	14	6.3	8.2
25	15	e15	e6.0	e10	e12	e70	40	32	33	14	12	8.1
26	15	e14	e6.0	e11	e12	e60	40	31	29	14	11	8.1
27	14	e14	e6.0	e11	e12	e50	39	30	26	12	11	7.2
28	13	e13	e6.0	e11	e12	e50	47	30	24	11	11	6.6
29	13	e13	e6.0	e11	---	e60	55	29	23	11	9.7	7.4
30	13	e12	e6.0	e11	---	e70	58	29	23	10	9.1	8.6
31	13	---	e6.0	e11	---	e100	---	28	---	9.0	7.9	---
TOTAL	462	434.7	219.5	266.0	316	1850	2658	1217	1767	522.0	249.7	232.0
MEAN	14.9	14.5	7.08	8.58	11.3	59.7	88.6	39.3	58.9	16.8	8.05	7.73
MAX	19	18	11	11	12	120	200	63	236	27	12	9.9
MIN	13	9.7	6.0	6.0	11	13	39	28	23	9.0	6.0	5.5
AC-FT	916	862	435	528	627	3670	5270	2410	3500	1040	495	460
CFSM	.03	.03	.02	.02	.03	.14	.21	.09	.14	.04	.02	.02
IN.	.04	.04	.02	.02	.03	.16	.23	.11	.15	.05	.02	.02

CAL YR 1989 TOTAL 30984.2 MEAN 84.9 MAX 2400 MIN 6.0 AC-FT 61460 CFSM .20 IN. 2.71
WTR YR 1990 TOTAL 10193.9 MEAN 27.9 MAX 236 MIN 5.5 AC-FT 20220 CFSM .07 IN. .89

e Estimated

RED RIVER OF THE NORTH BASIN

05074000 LOWER RED LAKE NEAR RED LAKE, MN

LOCATION.--Lat 47°57'27", long 95°16'34", in SW¼NW¼ sec.28, T.152 N., R.36 W., Clearwater County, Hydrologic Unit 09020302, on Red Lake Indian Reservation, on left bank just upstream from dam at outlet, 13 mi northwest of city of Red Lake.

DRAINAGE AREA.--1,950 mi^2, approximately.

PERIOD OF RECORD.--June 1930 to November 1932 and May 1933 to current year. Published as "Red Lake at Redby" prior to May 1933 and as "Red Lake near Red Lake" May 1933 to September 1940. 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 Natural Resources (fragmentary).

GAGE.--Water-stage recorder. Datum of gage is 1,100.00 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers); gage readings have been reduced to elevations based on adjustment of 1912. May 1933 to Sept. 6, 1934, nonrecording gage and Sept. 7, 1934 to Sept. 30, 1986, recording gage at same site at datum 69.00 ft higher. Nonrecording gages at Waskish and Redby.

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

EXTREMES FOR PERIOD OF RECORD.--Maximum elevation, 1,178.53 ft, June 25, 1950; minimum recorded, 1,169.80 ft, Nov. 20, 1936.

EXTREMES FOR CURRENT YEAR.--Maximum elevation, 1,174.09 ft, July 17; maximum daily, 1,173.94 ft, June 27; minimum, 1,172.43 ft, Sept. 21; minimum daily, 1,172.64 ft, Sept. 21.

MONTHEND ELEVATION, IN FEET, OCTOBER 1989 TO SEPTEMBER 1990

Oct. 31	1,173.24	Feb. 28	1,173.23	June 30	1,173.90
Nov. 30	1,173.13	Mar. 31	1,173.39	July 31	1,173.45
Dec. 31	1,173.15	Apr. 30	1,173.28	Aug. 31	1,173.12
Jan. 31	1,173.21	May 31	1,173.50	Sept. 30	1,172.77

NOTE.--Mean daily gage heights are available.

RED RIVER OF THE NORTH BASIN

05074500 RED LAKE RIVER NEAR RED LAKE, MN

LOCATION.--Lat 47°57'27", long 95°16'35", in SW¼NW¼ sec.28, T.152 N., R.36 W., Clearwater County, Hydrologic Unit 09020302, on Red Lake Indian Reservation, on left bank 50 ft downstream from dam at outlet of Lower Red Lake and 13 mi northwest of village of Red Lake.

DRAINAGE AREA.--1,950 mi^2, approximately.

PERIOD OF RECORD.--May 1933 to current year. Monthly discharge only for May 1933, published in WSP 1308.

GAGE.--Water-stage recorder. Datum of gage is 1,100.00 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Sept. 7, 1934, nonrecording gage at site 50 ft upstream at datum 69.00 ft higher. Sept. 7, 1934, to Nov. 26, 1951, water-stage recorder at present site at datum 69.00 ft higher. Nov. 27, 1951 to Sept. 30, 1986, water-stage recorder at present site at datum 67.00 ft higher.

REMARKS.--Records poor. Flow completely regulated by outlet dam on Lower Red Lake.

AVERAGE DISCHARGE.--57 years, 481 ft^3/s, 348,500 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,600 ft^3/s, June 25, 1950, gage height, 78.19 ft, affected by seiches and backwater from aquatic vegetation, present datum, from rating curve extended above 1,400 ft^3/s; no flow at times.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 72 ft^3/s, part or all of each day July 3-11; maximum gage height, 70.22 ft, Feb. 21, July 10; minimum daily discharge, 58 ft^3/s, Sept. 30.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	64	e62	e62	e62	e62	e63	64	65	64	70	66	62
2	64	e62	e62	e62	e62	e63	64	66	64	70	66	62
3	64	e62	e62	e62	e62	e63	64	66	64	71	66	62
4	64	e62	e62	e62	e62	e63	64	66	64	72	66	62
5	64	e62	e62	e62	e62	e63	64	66	65	72	65	62
6	64	e62	e62	e62	e62	e63	64	66	65	72	65	62
7	64	62	e62	e62	e62	e63	64	66	65	72	65	62
8	64	e62	e62	e62	e62	e63	65	66	66	72	65	62
9	64	62	e62	e62	e62	e63	66	66	66	72	64	62
10	64	62	e62	e62	e62	e63	64	66	66	72	64	61
11	64	e62	e62	e62	e62	e63	64	65	66	72	64	60
12	64	e62	e62	e62	e62	e63	65	66	66	70	64	60
13	63	e62	e62	e62	e62	e63	65	66	66	68	64	60
14	63	e62	e62	e62	e62	e63	65	66	66	68	64	60
15	63	e62	e62	e62	e62	e64	65	66	66	68	64	60
16	63	e62	e62	e62	e63	e64	64	66	66	68	64	60
17	62	e62	e62	e62	e63	e64	65	64	66	68	64	60
18	62	e62	e62	e62	e63	e64	66	65	67	68	62	60
19	62	e62	e62	e62	e63	e64	66	66	68	68	62	60
20	62	e62	e62	e62	e63	e64	66	66	68	68	62	60
21	62	e62	e62	e62	e63	e64	66	66	68	68	62	60
22	62	e62	e62	e62	e63	e64	66	66	68	68	62	60
23	62	e62	e62	e62	e63	e64	66	66	68	68	62	60
24	62	e62	e62	e62	e63	e64	66	65	68	68	62	60
25	62	e62	e62	e62	e63	e64	66	65	69	67	62	60
26	62	e62	e62	e62	e63	64	66	64	70	66	62	60
27	62	e62	e62	e62	e63	64	66	64	70	66	62	60
28	62	e62	e62	e62	e63	64	66	64	70	66	62	60
29	62	e62	e62	e62	---	64	66	64	70	66	62	59
30	62	e62	e62	e62	---	64	65	64	70	66	62	58
31	62	---	e62	e62	---	64	---	64	---	66	62	---
TOTAL	1950	1860	1922	1922	1749	1970	1953	2027	2005	2136	1968	1816
MEAN	62.9	62.0	62.0	62.0	62.5	63.5	65.1	65.4	66.8	68.9	63.5	60.5
MAX	64	62	62	62	63	64	66	66	70	72	66	62
MIN	62	62	62	62	62	63	64	64	64	66	62	58
AC-FT	3870	3690	3810	3810	3470	3910	3870	4020	3980	4240	3900	3600
CFSM	.03	.03	.03	.03	.03	.03	.03	.03	.03	.04	.03	.03
IN.	.04	.04	.04	.04	.03	.04	.04	.04	.04	.04	.04	.03

CAL YR 1989 TOTAL 22644 MEAN 62.0 MAX 71 MIN 56 AC-FT 44910 CFSM .03 IN. .43
WTR YR 1990 TOTAL 23278 MEAN 63.8 MAX 72 MIN 58 AC-FT 46170 CFSM .03 IN. .44

e Estimated

RED RIVER OF THE NORTH BASIN

05075000 RED LAKE RIVER AT HIGH LANDING, NEAR GOODRIDGE, MN

LOCATION.--Lat 48°02'34", long 95°48'28", in NW¼NW¼ sec.28, T.153 N., R.40 W., Pennington County, Hydrologic Unit 09020303, on left bank 50 ft upstream from highway bridge at High Landing, 7 mi south of Goodridge and 33 mi upstream from Thief River.

DRAINAGE AREA.--2,300 mi^2, approximately.
PERIOD OF RECORD.--September 1929 to current year. Prior to October 1930, published as "at Kratka".

GAGE.--Water-stage recorder. Datum of gage is 1,141.57 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). See WSP 1308 or 1738 for history of changes prior to Oct. 1, 1949.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Flow regulated by outlet dam on Lower Red Lake.

AVERAGE DISCHARGE.--61 years, 543 ft^3/s, 393,400 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,060 ft^3/s, July 7, 1975, gage height, 13.39 ft; maximum gage height, 13.44 ft, July 3, 1975; no flow during infrequent periods in 1931-34, 1936-37.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 150 ft^3/s, Mar. 13, gage height, 5.65 ft (backwater from ice); maximum gage height, 5.65 ft, Mar. 13, 14 (backwater from ice); minimum daily discharge, 35 ft^3/s, Nov. 18.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	57	61	e65	e63	e62	e66	e100	72	77	e85	78	72
2	58	57	e65	e63	e61	e66	e98	73	79	e84	79	72
3	58	59	e65	e63	e61	e66	e95	74	82	e83	77	72
4	60	e68	e65	e63	e61	e67	e92	73	84	e82	75	72
5	61	e70	e65	e63	e61	e68	e88	73	83	e81	75	71
6	60	e66	e64	e63	e61	e69	e85	73	81	e80	75	71
7	60	e64	e62	e63	e61	e70	e82	73	82	e79	75	71
8	60	e64	e62	e63	e61	e72	e80	73	82	e79	74	71
9	60	e64	e62	e63	e62	e75	e76	73	82	e79	74	71
10	60	e64	e62	e63	e63	e83	e72	74	83	e79	74	71
11	61	e58	e62	e63	e64	e95	e68	74	84	e79	74	70
12	61	e40	e62	e63	e64	e125	e70	74	85	e79	74	67
13	61	e68	e62	e63	e64	e145	e72	74	85	e79	74	70
14	61	e80	e62	e63	e65	e140	e72	75	85	e79	74	71
15	61	e70	e62	e63	e65	e125	e73	75	86	e79	73	66
16	61	e37	e62	e63	e66	e110	e73	75	86	e78	73	63
17	61	e37	e62	e63	e66	e100	e73	74	87	e78	73	63
18	61	e35	e62	e63	e66	e95	e73	74	87	e78	73	65
19	61	e60	e62	e63	e66	e90	e73	76	88	e78	74	68
20	61	e72	e62	e63	e66	e90	e73	75	93	e78	73	63
21	61	e80	e62	e63	e66	e90	73	75	101	e78	73	63
22	61	e73	e62	e63	e66	e92	e74	75	108	e78	72	60
23	61	e69	e62	e63	e66	e94	e74	76	106	e78	72	60
24	61	e67	e62	e63	e66	e92	e74	76	100	e78	73	60
25	61	e65	e62	e63	e66	e90	74	76	98	e78	73	58
26	61	e65	e62	e62	e66	e89	74	76	96	e78	73	58
27	61	e65	e62	e62	e66	e88	75	76	95	e78	73	60
28	61	e65	e62	e62	e66	e87	81	76	e92	e78	73	61
29	61	e65	e63	e62	---	e87	81	77	e89	e78	72	61
30	61	e65	e63	e62	---	e87	81	77	e87	e78	72	62
31	61	---	e63	e62	---	e90	---	77	---	e78	72	---
TOTAL	1875	1873	1942	1947	1794	2803	2349	2314	2653	2454	2289	1983
MEAN	60.5	62.4	62.6	62.8	64.1	90.4	78.3	74.6	88.4	79.2	73.8	66.1
MAX	61	80	65	63	66	145	100	77	108	85	79	72
MIN	57	35	62	62	61	66	68	72	77	78	72	58
AC-FT	3720	3720	3850	3860	3560	5560	4660	4590	5260	4870	4540	3930
CFSM	.03	.03	.03	.03	.03	.04	.03	.03	.04	.03	.03	.03
IN.	.03	.03	.03	.03	.03	.05	.04	.04	.04	.04	.04	.03

CAL YR 1989 TOTAL 33293 MEAN 91.2 MAX 500 MIN 35 AC-FT 66040 CFSM .04 IN. .54
WTR YR 1990 TOTAL 26276 MEAN 72.0 MAX 145 MIN 35 AC-FT 52120 CFSM .03 IN. .42

e Estimated

RED RIVER OF THE NORTH BASIN

05076000 THIEF RIVER NEAR THIEF RIVER FALLS, MN

LOCATION.--Lat 48°11'06", long 96°10'11", in NW¼SW¼ sec.3, T.154 N., R.43 W., Marshall County, Hydrologic Unit 09020304, on right bank, 0.2 mi upstream from highway bridge, 5 mi north of Thief River Falls, 7 mi upstream from mouth, and 9 mi downstream from Mud Lake National Wildlife Refuge.

DRAINAGE AREA.--959 mi^2.

PERIOD OF RECORD.--July 1909 to September 1917, April 1920 to September 1921, October 1922 to September 1924, October 1928 to September 1981, March 1982 to current year. Monthly discharge only for some periods, annual maximums for water years 1919, 1922, 1925, 1926, published in WSP 1308. October 1981 to February 1982, operated as a high-flow partial-record station.

REVISED RECORDS.--WSP 925: Drainage area. WSP 1308: 1917(M), 1924(M), 1929(M), 1931-33(M), 1935(M), 1937(M).

GAGE.--Water-stage recorder and control of grouted boulders. Datum of gage is 1,112.33 ft above National Geodetic Vertical Datum of 1929 (levels by Minnesota Department of Transportation). Prior to May 4, 1939, nonrecording gages at same site and datum.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Some regulation by Thief and Mud Lakes.

AVERAGE DISCHARGE.--72 years (water years 1910-17, 1921, 1923-24, 1929-81, 1983-90), 162 ft^3/s, 117,400 acre-ft/yr; median of yearly mean discharges, 107 ft^3/s, 77,500 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,610 ft^3/s, May 13, 1950, gage height, 17.38 ft; no flow at times in some years.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 150 ft^3/s, Apr. 1, gage height, 6.11 ft (backwater from ice); maximum gage height, 7.08 ft, Mar. 13 (backwater from ice); no flow Oct. 1 to Nov. 30, Dec. 6 to Mar. 11, Aug. 1 and Aug. 6 to Sept. 30.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.00	e.20	.00	.00	.00	e100	2.6	.50	9.8	.00	.00
2	.00	.00	e.30	.00	.00	.00	e80	2.5	2.1	8.0	.08	.00
3	.00	.00	e.10	.00	.00	.00	e50	2.9	3.8	6.5	.09	.00
4	.00	.00	e.04	.00	.00	.00	e35	2.9	3.8	5.5	.05	.00
5	.00	.00	e.02	.00	.00	.00	e25	2.9	4.8	4.6	.02	.00
6	.00	.00	.00	.00	.00	.00	e20	2.5	12	3.8	.00	.00
7	.00	.00	.00	.00	.00	.00	e15	2.4	9.5	5.0	.00	.00
8	.00	.00	.00	.00	.00	.00	e13	2.1	8.9	8.6	.00	.00
9	.00	.00	.00	.00	.00	.00	e11	1.8	7.7	7.4	.00	.00
10	.00	.00	.00	.00	.00	.00	e10	1.5	7.1	5.9	.00	.00
11	.00	.00	.00	.00	.00	.00	e9.0	1.4	6.7	4.5	.00	.00
12	.00	.00	.00	.00	.00	e1.0	e8.0	1.4	7.5	3.2	.00	.00
13	.00	.00	.00	.00	.00	e40	e7.2	1.5	8.2	2.3	.00	.00
14	.00	.00	.00	.00	.00	e60	e6.5	1.6	7.3	1.6	.00	.00
15	.00	.00	.00	.00	.00	e70	e6.0	1.4	6.5	1.2	.00	.00
16	.00	.00	.00	.00	.00	e80	e5.5	1.5	6.8	.96	.00	.00
17	.00	.00	.00	.00	.00	e80	e5.0	1.6	8.4	1.3	.00	.00
18	.00	.00	.00	.00	.00	e60	4.1	1.4	11	1.3	.00	.00
19	.00	.00	.00	.00	.00	e45	3.2	1.2	23	1.1	.00	.00
20	.00	.00	.00	.00	.00	e35	3.0	1.2	24	.88	.00	.00
21	.00	.00	.00	.00	.00	e25	2.7	1.4	23	.62	.00	.00
22	.00	.00	.00	.00	.00	e20	2.2	2.0	21	.51	.00	.00
23	.00	.00	.00	.00	.00	e21	1.7	2.4	20	.44	.00	.00
24	.00	.00	.00	.00	.00	e23	1.4	2.5	22	.34	.00	.00
25	.00	.00	.00	.00	.00	e15	1.8	2.1	21	.27	.00	.00
26	.00	.00	.00	.00	.00	e12	1.7	2.1	20	.26	.00	.00
27	.00	.00	.00	.00	.00	e10	1.8	1.9	18	.19	.00	.00
28	.00	.00	.00	.00	.00	e9.0	2.0	1.5	16	.15	.00	.00
29	.00	.00	.00	.00	---	e11	2.1	1.1	14	.11	.00	.00
30	.00	.00	.00	.00	---	e25	2.5	.83	12	.07	.00	.00
31	.00	---	.00	.00	---	e50	---	.63	---	.03	.00	---
TOTAL	0.00	0.00	0.66	0.00	0.00	692.00	436.4	56.76	356.60	86.43	0.24	0.00
MEAN	.000	.000	.021	.000	.000	22.3	14.5	1.83	11.9	2.79	.008	.000
MAX	.00	.00	.30	.00	.00	80	100	2.9	24	9.8	.09	.00
MIN	.00	.00	.00	.00	.00	.00	1.4	.63	.50	.03	.00	.00
AC-FT	.00	.00	1.3	.00	.00	1370	866	113	707	171	.5	.00
CFSM	.00	.00	.00	.00	.00	.02	.02	.00	.01	.00	.00	.00
IN.	.00	.00	.00	.00	.00	.03	.02	.00	.01	.00	.00	.00

CAL YR 1989 TOTAL 36712.59 MEAN 101 MAX 2150 MIN .00 AC-FT 72820 CFSM .10 IN. 1.42
WTR YR 1990 TOTAL 1629.09 MEAN 4.46 MAX 100 MIN .00 AC-FT 3230 CFSM .00 IN. .06

e Estimated

RED RIVER OF THE NORTH BASIN

05078000 CLEARWATER RIVER AT PLUMMER, MN

LOCATION.--Lat 47°55'24", long 96°02'46", in SE¼SW¼ sec. 4, T.151 N., R.42 W., Red Lake County, Hydrologic Unit 09020305, on right bank 200 ft downstream from Soo Line Railroad bridge, 300 ft downstream from bridge on U.S. Highway 59, 0.9 mi northwest of railroad depot in Plummer, and 8 mi upstream from Hill River.

DRAINAGE AREA.--512 mi^2.

PERIOD OF RECORD.--April 1939 to September 1979, March 1982 to current year. Annual maximums only, October 1979 to February 1982.

GAGE.--Water-stage recorder. Datum of gage is 1,099.12 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Nov. 10, 1939, nonrecording gage at site 100 ft upstream at same datum.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Since 1968, undetermined amounts of water diverted for the flooding of wild rice paddies upstream.

AVERAGE DISCHARGE.--48 years (water years 1940-79, 1983-90), 173 ft^3/s, 125,300 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,940 ft^3/s, Apr. 25, 1979, gage height, 12.31 ft; maximum gage height, 12.37 ft, Apr. 18, 1979 (backwater from ice); minimum discharge, 2.5 ft^3/s, May 16, 17, 1977, gage height, 1.71 ft.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 500 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Mar. 13	1100	(a)	*6.79	No peak greater than base discharge.			
June 22	0700	*393	4.67				

(a) Backwater from ice.

Minimum discharge, 9.2 ft^3/s, Nov. 12, gage height, 2.35 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	40	37	e30	e25	e36	e36	e60	68	29	139	130	29
2	40	29	e30	e26	e36	e36	e50	51	41	124	119	26
3	38	20	e30	e27	e36	e36	e47	34	71	117	113	23
4	32	29	e29	e28	e38	e36	e44	28	145	119	121	23
5	35	55	e29	e28	e39	e36	e40	28	193	98	139	21
6	34	66	e28	e29	e39	e36	e38	58	168	78	118	20
7	53	60	e28	e30	e39	e35	e36	61	150	73	95	18
8	45	59	e27	e31	e39	e35	e35	47	130	67	86	19
9	40	29	e27	e32	e34	e37	e34	42	124	71	89	21
10	46	16	e26	e33	e25	e43	e33	47	120	75	97	20
11	51	27	e25	e33	e25	e57	e28	43	129	75	97	20
12	48	12	e24	e34	e25	e66	e35	36	154	70	101	21
13	42	15	e23	e34	e25	e78	e40	34	151	70	81	20
14	39	15	e22	e35	e25	e60	e43	47	131	77	73	25
15	35	e40	e22	e35	e37	e45	e47	51	122	83	73	20
16	36	e35	e22	e36	e37	e36	e51	81	100	77	70	29
17	51	e26	e22	e36	e37	e34	e56	94	109	72	59	30
18	56	e20	e22	e36	e37	e36	e60	95	104	77	49	39
19	40	e25	e22	e36	e37	e31	e63	128	107	87	39	35
20	34	e30	e22	e36	e37	e15	e64	135	204	89	30	32
21	31	e30	e22	e36	e37	e21	66	132	328	89	31	32
22	28	e25	e22	e36	e37	e50	56	123	384	116	30	29
23	25	e20	e22	e36	e37	e47	43	113	356	124	25	30
24	34	e23	e22	e36	e37	e45	38	100	318	107	27	30
25	22	e25	e22	e36	e37	e42	34	88	279	97	32	30
26	31	e27	e22	e36	e37	e40	24	90	244	111	40	22
27	46	e30	e22	e36	e37	e38	20	108	224	130	37	27
28	30	e31	e22	e36	e37	e36	22	91	208	127	52	28
29	51	e31	e23	e36	---	e35	44	79	185	122	50	31
30	47	e31	e23	e36	---	e40	57	62	161	103	40	29
31	28	---	e24	e36	---	e47	---	40	---	102	34	---
TOTAL	1208	918	756	1036	979	1265	1308	2234	5169	2966	2177	779
MEAN	39.0	30.6	24.4	33.4	35.0	40.8	43.6	72.1	172	95.7	70.2	26.0
MAX	56	66	30	36	39	78	66	135	384	139	139	39
MIN	22	12	22	25	25	15	20	28	29	67	25	18
AC-FT	2400	1820	1500	2050	1940	2510	2590	4430	10250	5880	4320	1550
CFSM	.08	.06	.05	.07	.07	.08	.09	.14	.34	.19	.14	.05
IN.	.09	.07	.05	.08	.07	.09	.10	.16	.38	.22	.16	.06

CAL YR 1989 TOTAL 38743 MEAN 106 MAX 1100 MIN 12 AC-FT 76850 CFSM .21 IN. 2.81
WTR YR 1990 TOTAL 20795 MEAN 57.0 MAX 384 MIN 12 AC-FT 41250 CFSM .11 IN. 1.51

e Estimated

RED RIVER OF THE NORTH BASIN

05078230 LOST RIVER AT OKLEE, MN

LOCATION.--Lat 47°50'35", long 95°51'30", in SE¼NE¼ sec.2, T.150 N., R.41 W., Red Lake County, Hydrologic Unit 09020305, on downstream side of bridge on State Highway 222 at northwest edge of Oklee, 12 mi upstream from mouth.

DRAINAGE AREA.--266 mi^2.

PERIOD OF RECORD.--April 1960 to September 1981, February 1982 to current year. Monthly and daily figures for April 1960, to June 1960, published in WSP 2113.

GAGE.--Water-stage recorder. Datum of gage is 1,126.94 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Sept. 9, 1960, reference points at same site at datum 8.00 ft higher. Sept. 9, 1960, to Sept. 30, 1964, nonrecording gage at same site at datum 8.00 ft higher. Oct. 1, 1964, to Sept. 30, 1981, and Feb. 24, 1982, to Sept. 6, 1989, nonrecording gage at same site and datum.

REMARKS.--Records poor.

AVERAGE DISCHARGE.--29 years, 70.8 ft^3/s, 51,290 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,210 ft^3/s, Apr. 11, 1969, gage height, 14.91 ft, from floodmark; maximum gage height, 16.72 ft, present datum, May 24, 1962; no flow Feb. 16 to Mar. 21, 1963, Feb. 15 to Mar. 2, 1964, Jan. 6 to Mar. 11, 1977, Aug.30 to Sept. 30, 1990.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known since at least 1897, 18.39 ft, present datum, Apr. 21, 1950, from floodmarks, discharge, 2,790 ft^3/s.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 134 ft^3/s, Jun. 21, 22, gage height, 5.89 ft; maximum gage height, 6.66 ft, Mar. 14 (backwater from ice); no flow Aug. 30 to Sept. 30.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.0	3.1	6.9	e2.7	e2.7	e3.3	e110	41	16	33	4.8	.00
2	5.0	2.8	6.3	e2.7	e2.7	e3.4	e100	32	19	25	4.2	.00
3	4.2	2.7	5.9	e2.7	e2.7	e3.5	e90	25	39	20	3.2	.00
4	3.6	3.4	5.4	e2.7	e2.7	e3.6	e80	22	85	18	5.0	.00
5	3.6	3.7	6.2	e2.7	e2.8	e3.8	e70	21	59	19	19	.00
6	3.6	4.1	e7.0	e2.7	e2.8	e4.0	e65	18	45	25	34	.00
7	3.4	4.9	e7.0	e2.7	e2.8	e4.2	e60	15	32	31	34	.00
8	3.3	7.1	e7.0	e2.7	e2.8	e4.5	e55	9.4	22	23	34	.00
9	3.3	7.4	e7.0	e2.7	e2.8	e5.0	e50	15	22	18	34	.00
10	3.5	14	e7.0	e2.7	e2.8	e5.5	e47	19	27	19	25	.00
11	3.9	16	e7.0	e2.7	e2.8	e6.5	e44	14	36	22	17	.00
12	4.3	13	e6.0	e2.7	e2.8	e15	e42	12	36	19	15	.00
13	4.1	17	e5.5	e2.7	e2.9	e50	e40	18	34	26	12	.00
14	3.8	18	e5.0	e2.7	e2.9	e80	e35	21	36	33	10	.00
15	3.3	16	e4.5	e2.7	e2.9	e70	e33	27	31	29	9.6	.00
16	3.2	10	e4.0	e2.7	e2.9	e65	30	28	28	31	8.7	.00
17	3.8	13	e3.7	e2.7	e2.9	e60	24	38	27	30	7.7	.00
18	4.0	14	e3.5	e2.7	e2.9	e55	24	49	30	26	6.5	.00
19	3.6	13	e3.3	e2.7	e2.9	e50	25	52	28	26	4.1	.00
20	3.3	14	e3.2	e2.7	e3.0	e45	29	49	84	21	2.2	.00
21	3.3	14	e3.1	e2.7	e3.0	e45	28	36	131	16	1.4	.00
22	3.5	12	e3.1	e2.7	e3.0	e54	27	27	133	14	.79	.00
23	3.6	12	e3.0	e2.7	e3.1	e70	32	26	128	11	.61	.00
24	3.6	11	e3.0	e2.7	e3.1	e60	31	22	112	8.4	.41	.00
25	3.7	10	e2.9	e2.7	e3.1	e55	31	24	93	6.6	.36	.00
26	3.8	9.6	e2.8	e2.7	e3.2	e52	31	22	81	5.6	.50	.00
27	3.9	9.2	e2.8	e2.7	e3.2	e50	30	18	69	4.9	.43	.00
28	4.6	8.6	e2.7	e2.7	e3.2	e52	33	18	58	4.7	.22	.00
29	4.5	7.4	e2.7	e2.7	---	e60	53	16	49	4.8	.01	.00
30	4.3	10	e2.7	e2.7	---	e80	53	16	40	4.8	.00	.00
31	3.8	---	e2.7	e2.7	---	e120	---	16	---	4.7	.00	---
TOTAL	118.4	301.0	142.9	83.7	81.4	1235.3	1402	766.4	1630	579.5	294.73	0.00
MEAN	3.82	10.0	4.61	2.70	2.91	39.8	46.7	24.7	54.3	18.7	9.51	.000
MAX	5.0	18	7.0	2.7	3.2	120	110	52	133	33	34	.00
MIN	3.2	2.7	2.7	2.7	2.7	3.3	24	9.4	16	4.7	.00	.00
AC-FT	235	597	283	166	161	2450	2780	1520	3230	1150	585	.00
CFSM	.01	.04	.02	.01	.01	.15	.18	.09	.20	.07	.04	.00
IN.	.02	.04	.02	.01	.01	.17	.20	.11	.23	.08	.04	.00

CAL YR 1989 TOTAL 17731.40 MEAN 48.6 MAX 900 MIN .85 AC-FT 35170 CFSM .18 IN. 2.48
WTR YR 1990 TOTAL 6635.33 MEAN 18.2 MAX 133 MIN .00 AC-FT 13160 CFSM .07 IN. .93

e Estimated

RED RIVER OF THE NORTH BASIN

05078500 CLEARWATER RIVER AT RED LAKE FALLS, MN

LOCATION.--Lat 47°53'15", long 96°16'25", in NW¼NE¼ sec.22, T.151 N., R.44 W., Red Lake County, Hydrologic Unit 09020305, on left bank 40 ft downstream from Great Northern Railroad bridge in Red Lake Falls, 1.4 mi upstream from mouth, and 3 mi downstream from Badger Creek.

DRAINAGE AREA.--1,370 mi^2, approximately.

PERIOD OF RECORD.--June 1909 to September 1917, October 1934 to September 1981, March 1982 to current year. Monthly discharge only for October, November, 1934, published in WSP 1308. October 1981 to February 1982, operated as a high-flow partial-record station.

REVISED RECORDS.--WSP 355: 1911-12. WSP 1438: 1910-11, 1917(M). WDR MN-84-1:1983.

GAGE.--Water-stage recorder. Datum of gage is 949.49 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Sept. 12, 1911, nonrecording gage at site 0.5 mi upstream, and Sept. 12, 1911, to Sept. 30, 1917, nonrecording gage at site 40 ft upstream at different datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--63 years (1910-17, 1935-81, 1983-90), 313 ft^3/s, 226,800 acre-ft/yr; median of yearly mean discharges, 280 ft^3/s, 203,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 10,300 ft^3/s, Apr. 25, 1979, gage height, 12.38 ft; maximum gage height, 15.85 ft, Mar. 6, 1983, from high-water mark (backwater from ice); no flow Sept. 15, 1936, Sept. 14, 1939, Aug. 19-22, 1940.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 652 ft^3/s, June 22, gage height, 3.77 ft; maximum gage height, 5.20 ft, Apr. 3, from highwater mark (backwater from ice); minimum discharge, 12 ft^3/s, Nov. 7, Sept. 10, 11; minimum gage height, 1.50 ft, Nov. 7.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	48	33	e33	e26	e42	e45	e500	184	78	222	93	34
2	47	21	e33	e27	e42	e46	e450	184	90	200	124	30
3	50	21	e32	e28	e42	e47	e400	160	150	183	111	25
4	49	25	e31	e28	e43	e48	e360	132	264	164	104	21
5	49	24	e30	e29	e43	e49	e330	118	415	161	110	20
6	46	23	e30	e30	e44	e50	e300	101	373	139	127	19
7	46	39	e29	e31	e44	e52	e270	122	316	121	108	18
8	50	59	e28	e32	e44	e54	e250	119	272	119	88	16
9	57	58	e27	e33	e44	e56	e230	102	234	104	84	15
10	51	49	e26	e33	e44	e60	e215	90	215	100	86	13
11	48	39	e24	e34	e36	e68	e196	95	227	102	100	16
12	52	27	e23	e34	e35	e84	e190	89	246	97	105	19
13	54	48	e23	e35	e35	e120	e190	75	252	92	105	21
14	50	39	e23	e35	e35	e200	e185	70	213	90	83	24
15	49	43	e23	e35	e35	e200	e180	86	188	93	70	26
16	45	30	e23	e35	e35	e180	e175	95	169	96	68	25
17	42	e45	e23	e36	e35	e170	e170	139	151	89	67	25
18	46	e40	e23	e36	e45	e160	e165	149	156	79	63	29
19	55	e35	e23	e37	e45	e140	e160	172	180	79	48	32
20	58	e33	e23	e38	e45	e130	e160	202	285	91	43	37
21	44	e34	e23	e39	e45	e120	162	204	528	98	35	36
22	44	e38	e23	e40	e45	e110	150	198	632	94	28	33
23	39	e40	e23	e40	e45	e130	151	183	606	118	34	31
24	36	e35	e23	e40	e45	e150	145	165	551	123	31	30
25	36	e30	e23	e40	e45	e120	141	149	484	106	26	29
26	39	e28	e23	e41	e45	e110	132	135	432	96	31	29
27	30	e30	e23	e41	e45	e110	123	148	361	106	38	28
28	29	e31	e24	e41	e45	e110	126	145	322	127	37	28
29	34	e32	e24	e41	---	e110	139	128	291	122	37	28
30	29	e33	e25	e41	---	e115	169	115	252	115	48	28
31	38	---	e25	e41	---	e130	---	98	---	99	43	---
TOTAL	1390	1062	789	1097	1173	3274	6514	4152	8933	3625	2175	765
MEAN	44.8	35.4	25.5	35.4	41.9	106	217	134	298	117	70.2	25.5
MAX	58	59	33	41	45	200	500	204	632	222	127	37
MIN	29	21	23	26	35	45	123	70	78	79	26	13
AC-FT	2760	2110	1560	2180	2330	6490	12920	8240	17720	7190	4310	1520
CFSM	.03	.03	.02	.03	.03	.08	.16	.10	.22	.09	.05	.02
IN.	.04	.03	.02	.03	.03	.09	.18	.11	.24	.10	.06	.02

CAL YR 1989 TOTAL 79668 MEAN 218 MAX 2400 MIN 21 AC-FT 158000 CFSM .16 IN. 2.16
WTR YR 1990 TOTAL 34949 MEAN 95.8 MAX 632 MIN 13 AC-FT 69320 CFSM .07 IN. .95

e Estimated

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN

LOCATION.--Lat 47°46'32", long 96°36'33", in SW¼SW¼ sec.30, T.150 N., R.46 W., Polk County, Hydrologic Unit 09020303, on right bank 100 ft upstream from Sargent Street bridge in Crookston, 0.3 mi downstream from Interstate Power Co.'s dam, 0.6 mi downstream from bridge on U.S. Highway 75, and 53 mi upstream from mouth.

DRAINAGE AREA.--5,280 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--May 1901 to current year. 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.

REVISED RECORDS.--WSP 1115: 1906, 1915-16, 1919-20, 1922, 1925, 1927, 1929. WSP 1308: 1916(M), 1919(M), 1928(M), 1930(M). See also PERIOD OF RECORD.

GAGE.--Water-stage recorder. Datum of gage is 832.72 ft above National Geodetic Vertical Datum of 1929. May 18, 1901, to June 30, 1909, nonrecording gage at bridge 300 ft upstream at same datum. July 1, 1909, to Sept. 25, 1911, nonrecording gage, Sept. 26, 1911, to Sept. 30, 1919, water-stage recorder, Oct. 1, 1919, to Sept. 30, 1930, nonrecording gage, at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Diurnal fluctuation prior to 1975 caused by powerplant 1,000 ft upstream. Runoff from 1,950 mi^2 in the headwaters of Red Lake River is completely controlled by dam at outlet of Lower Red Lake. Flow partially affected by occasional regulation at Thief and Mud Lakes in Thief River basin (see station 05076000).

AVERAGE DISCHARGE.--89 years, 1,125 ft^3/s, 815,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 28,400 ft^3/s, Apr. 12, 1969, gage height, 27.33 ft; no flow for part of July 13, 1960 (caused by regulation of powerplant upstream).

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 916 ft^3/s, June 23, gage height, 4.60 ft; maximum gage height, 7.60 ft, Apr. 2, from highwater mark (backwater from ice); minimum discharge, 61 ft^3/s, Nov. 16, gage height, 2.50 ft, result of freeze up.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	121	90	e94	e90	e100	e108	e400	280	165	350	148	112
2	140	98	e94	e90	e100	e110	e840	293	232	309	143	91
3	119	77	e94	e90	e100	e110	e750	255	215	277	167	106
4	112	95	e94	e90	e100	e115	e700	252	284	231	174	103
5	115	111	e92	e95	e100	e115	e650	228	429	219	159	84
6	118	121	e89	e95	e100	e120	e600	212	556	231	184	73
7	117	107	e85	e95	e100	e123	e560	191	500	191	192	73
8	122	101	e81	e95	e100	e130	e540	205	461	173	166	72
9	124	126	e77	e95	e100	e135	e520	202	413	169	163	72
10	139	126	e75	e95	e100	e140	e517	200	355	182	137	84
11	133	119	e70	e95	e105	e160	e490	182	317	151	141	80
12	125	89	e70	e95	e105	e190	e450	179	350	150	166	75
13	124	84	e70	e95	e105	e240	e425	176	368	145	186	67
14	130	82	e70	e95	e105	e330	e405	157	377	140	175	68
15	128	111	e70	e95	e105	e410	e380	146	343	135	142	72
16	124	69	e70	e95	e105	e460	e360	158	300	152	126	76
17	117	e70	e70	e95	e105	e420	e350	183	295	172	122	90
18	110	e71	e70	e95	e105	e400	e335	225	261	146	123	88
19	104	e73	e70	e95	e105	e370	e320	239	335	134	123	82
20	115	e86	e70	e95	e105	e340	e305	254	427	131	126	101
21	122	e110	e70	e95	e105	e310	e290	290	602	132	115	97
22	115	e106	e70	e100	e105	e280	e275	293	840	143	101	91
23	110	e102	e70	e100	e105	e290	e265	290	898	162	95	72
24	106	e100	e70	e100	e105	e330	250	273	809	161	95	88
25	101	e98	e70	e100	e105	e350	247	250	740	169	112	88
26	100	e96	e73	e100	e105	e280	236	230	653	161	119	71
27	96	e96	e77	e100	e105	e270	236	210	584	149	124	65
28	100	e95	e81	e100	e107	e260	273	209	494	149	133	92
29	99	e94	e85	e100	---	e260	233	218	441	185	161	83
30	105	e94	e88	e100	---	e270	262	199	424	195	99	70
31	96	---	e90	e100	---	e290	---	182	---	181	81	---
TOTAL	3587	2899	2419	2975	2892	7716	12464	6861	13468	5575	4298	2486
MEAN	116	96.6	78.0	96.0	103	249	415	221	449	180	139	82.9
MAX	140	128	94	100	107	460	840	293	898	350	192	112
MIN	96	69	70	90	100	108	233	146	165	131	81	65
AC-FT	7110	5750	4800	5900	5740	15300	24720	13610	26710	11060	8530	4930
CFSM	.02	.02	.01	.02	.02	.05	.08	.04	.09	.03	.03	.02
IN.	.03	.02	.02	.02	.02	.05	.09	.05	.09	.04	.03	.02

CAL YR 1989 TOTAL 193539 MEAN 530 MAX 8650 MIN 69 AC-FT 383900 CFSM .10 IN. 1.36
WTR YR 1990 TOTAL 67640 MEAN 185 MAX 898 MIN 65 AC-FT 134200 CFSM .04 IN. .48

e Estimated

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1962, 1974-76, 1979 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT												
24...	1600	106	500	501	8.4	8.3	8.0	4.5	772	12.1	K9	20
DEC												
12...	1500	63	562	649	8.0	8.0	0.0	3.8	736	14.0	270	74
JAN												
17...	1430	95	595	584	7.8	7.8	0.0	2.5	738	9.1	K5	420
APR												
10...	1630	517	295	323	8.1	7.9	0.0	70	747	13.9	K2	40
MAY												
22...	1400	287	480	489	8.3	8.5	15.0	3.4	737	8.4	K14	35
AUG												
21...	1420	124	550	515	8.6	8.5	23.0	3.0	742	7.1	35	55

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
OCT												
24...	55	24	15	5.1	219	214	6	255	40	11	0.20	3.3
DEC												
12...	80	33	13	5.1	305	308	0	372	47	7.5	0.20	11
JAN												
17...	73	30	9.5	4.3	279	294	0	340	23	5.0	0.20	18
APR												
10...	38	14	4.4	5.1	128	127	0	156	26	5.0	<0.10	9.2
MAY												
22...	62	26	9.1	4.1	209	207	0	255	58	8.8	0.20	2.3
AUG												
21...	59	30	10	5.3	192	204	6	222	70	8.1	0.40	2.9

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
24...	279	<0.010	<0.100	0.030	0.020	0.70	0.030	0.010	<0.010	41	88
DEC											
12...	409	<0.010	<0.100	0.040	0.040	0.60	0.020	<0.010	<0.010	136	43
JAN											
17...	345	<0.010	0.140	0.290	0.290	1.4	0.040	0.040	0.040	68	85
APR											
10...	203	<0.010	0.400	0.080	0.080	1.0	0.080	0.040	0.020	12	92
MAY											
22...	313	<0.010	<0.100	0.040	0.040	0.80	0.040	0.030	0.020	12	77
AUG											
21...	359	<0.010	<0.100	0.020	0.020	1.9	0.080	0.040	0.010	9	96

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
24...	1600	<10	2	54	<0.5	<1.0	<1	<3	2	8	<1
JAN											
17...	1430	<10	<1	88	<0.5	1.0	1	<3	<10	18	<10
APR											
10...	1630	10	1	42	<0.5	<1.0	1	<3	3	57	<1
AUG											
21...	1420	<10	3	64	<0.5	<1.0	1	<3	16	10	3

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
24...	16	7	<0.1	<10	1	<1	<1.0	140	<6	<3
JAN										
17...	15	61	<0.1	<10	<10	<1	3.0	170	<6	<3
APR										
10...	8	38	<0.1	<10	1	<1	<1.0	84	<6	<3
AUG										
21...	19	6	<0.1	<10	2	<1	<1.0	170	<6	24

RED RIVER OF THE NORTH BASIN

05082500 RED RIVER OF THE NORTH AT GRAND FORKS, ND

LOCATION.--Lat 47°55'38", long 97°01'34", in sec.2, T.151 N., R.50 W., Grand Forks County, Hydrologic Unit 09020301, on the right bank, 200 ft upstream from the DeMers Avenue bridge, 0.4 mi downstream from Red Lake River, and at mile 293.8.

DRAINAGE AREA.--30,100 mi^2, approximately, including 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1882 to current year. Prior to January 1904 monthly discharge only, published in WSP 1308.

REVISED RECORDS.--WSP 855: 1936(M). WSP 1115: 1942. WSP 1175: 1897(M). WSP 1388: 1904, 1914-15, 1917-19, 1921-22, 1927, 1950. WSP 1728: Drainage area. WRD-ND-81-1: 1882, 1897 (M).

GAGE.--Water-stage recorder. Datum of gage is 779.00 ft above National Geodetic Vertical Datum of 1929. Oct. 1, 1983, to Sept. 30, 1986, datum of gage was 780.00 ft at same site. Apr. 14, 1965, to Sept. 30, 1983, water-stage recorder 1.9 mi downstream at a datum of 778.35 ft. Nov. 3, 1933, to Apr. 13, 1965, water-stage recorder 0.3 mi upstream at 778.35 ft datum. See WSP 1728 or 1913 for history of changes prior to Nov. 3, 1933.

REMARKS.--Estimated daily discharges: Dec. 20 to Mar. 12. Records good except those for period of estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--86 years (water year 1905-90), 2,581 ft^3/s, 1,870,000 acre-ft/yr; median of yearly mean discharge, 2,270 ft^3/s, 1,645,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, about 85,000 ft^3/s, Apr. 10, 1897, gage height, 50.2 ft, site and datum then in use, from rating curve extended above 54,000 ft^3/s; minimum, 1.8 ft^3/s, Sept. 2, 1977, caused by unusual regulation during repair of dam at Grand Forks.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,040 ft^3/s, Apr. 5, gage height, 17.56 ft; minimum daily, 110 ft^3/s, Dec. 24.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	607	439	446	e143	e265	e332	2160	1490	1220	1680	608	447
2	617	425	439	e147	e256	e323	3270	1560	1330	1590	570	468
3	595	400	433	e151	e265	e323	4310	1630	2040	1430	534	461
4	559	402	413	e155	e273	e323	4880	1660	2770	1300	503	403
5	500	424	412	e155	e273	e340	4860	1700	3190	1240	514	415
6	469	462	400	e159	e273	e350	4590	1700	3170	1210	519	411
7	500	482	383	e163	e273	e376	4240	1690	2900	1180	491	419
8	525	487	391	e159	e273	e385	3910	1650	2560	1200	482	395
9	544	474	370	e163	e256	e412	3820	1590	2290	1120	477	375
10	577	464	351	e159	e239	e440	3910	1570	2090	1020	443	375
11	548	457	336	e163	e231	e477	3490	1550	1920	953	428	383
12	570	508	299	e163	e231	e594	2900	1540	1820	926	402	385
13	560	513	269	e168	e223	611	2570	1480	1830	889	406	362
14	545	517	239	e168	e231	754	2460	1410	1920	870	416	354
15	505	451	218	e152	e231	1060	2280	1350	1970	857	484	284
16	506	301	203	e152	e223	1780	2040	1270	1840	861	474	268
17	465	277	200	e168	e207	2300	1710	1310	1680	831	431	231
18	458	349	194	e176	e215	2130	1560	1370	1580	785	436	265
19	466	396	163	e192	e223	1790	1400	1420	1550	740	433	288
20	452	437	e144	e200	e239	1580	1340	1490	1440	705	448	331
21	440	482	e130	e207	e248	1440	1310	1540	1560	689	450	335
22	427	511	e116	e215	e239	1410	1270	1580	2010	701	432	374
23	427	483	e116	e223	e239	1480	1240	1580	2510	707	395	422
24	465	447	e110	e223	e256	1550	1190	1560	2640	741	362	375
25	471	423	e115	e231	e344	1590	1200	1530	2530	776	383	354
26	486	426	e120	e240	e350	1520	1170	1520	2310	805	405	330
27	464	453	e124	e248	e323	1440	1160	1480	2120	791	393	311
28	436	472	e135	e248	e332	1450	1250	1440	1980	744	377	295
29	440	470	e139	e265	---	1470	1390	1320	1820	685	414	276
30	448	446	e143	e256	---	1470	1400	1310	1740	662	459	310
31	439	---	e143	e276	---	1580	---	1260	---	642	460	---
TOTAL	15511	13278	7694	5888	7231	33080	74280	46550	62330	29330	14029	10702
MEAN	500	443	248	190	258	1067	2476	1502	2078	946	453	357
MAX	617	517	446	276	350	2300	4880	1700	3190	1680	608	468
MIN	427	277	110	143	207	323	1160	1260	1220	642	362	231
AC-FT	30770	26340	15260	11680	14340	65610	147300	92330	123600	58180	27830	21230

CAL YR 1989 TOTAL 959808 MEAN 2630 MAX 39500 MIN 110 AC-FT 1904000
WTR YR 1990 TOTAL 319903 MEAN 876 MAX 4880 MIN 110 AC-FT 634500

e Estimated

RED RIVER OF THE NORTH BASIN

05082500 RED RIVER OF THE NORTH AT GRAND FORKS, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1949, 1956 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
27...	1610	444	500	--	5.0	4.0	--	--	--	--	--	--
DEC												
27...	1550	130	985	--	-2.0	0.0	--	--	--	--	--	--
JAN												
26...	1125	240	1040	--	3.0	1.0	--	--	--	--	--	--
FEB												
27...	1500	312	865	--	0.0	0.5	--	--	--	--	--	--
APR												
13...	1150	2560	462	8.2	7.5	1.0	210	48	22	14	12	0.4
17...	1600	1640	495	--	10.0	3.5	--	--	--	--	--	--
23...	1725	1270	510	--	28.0	14.0	--	--	--	--	--	--
MAY												
29...	1445	1350	565	--	27.0	19.0	--	--	--	--	--	--
JUN												
25...	1440	2490	575	--	32.0	24.0	--	--	--	--	--	--
JUL												
27...	1520	794	608	--	30.5	26.0	--	--	--	--	--	--
AUG												
30...	1230	458	625	8.5	29.5	24.5	260	52	32	22	15	0.6
SEP												
28...	1430	293	623	--	15.0	15.5	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
13...	6.7	210	0	170	64	13	0.10	13	279	283	0.38
AUG											
30...	4.5	200	24	210	70	20	0.20	8.1	364	334	0.50

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
13...	1930	2	50	60	<1	16	20	0.1	2	1	250
AUG											
30...	450	5	90	20	<1	22	10	0.1	4	<1	280

RED RIVER OF THE NORTH BASIN

05087500 MIDDLE RIVER AT ARGYLE, MN

LOCATION.--Lat 48°20'25", long 96°48'58", in NE¼NW¼ sec.15, T.156 N., R.48 W., Marshall County, Hydrologic Unit 09020309, on left bank 30 ft upstream of bridge on County Highway 4 in Argyle and 14 mi upstream from mouth.

DRAINAGE AREA.--265 mi^2.

PERIOD OF RECORD.--March to September 1945, October 1950 to September 1981, February 1982 to current year. Monthly discharge only for some periods, published in WSP 1728. October 1981 to January 1982, operated as a high-flow partial-record station.

GAGE.--Water-stage recorder. Datum of gage is 828.53 ft above National Geodetic Vertical Datum of 1929. Prior to Nov. 8, 1951, nonrecording gage and Nov. 8, 1951, to Sept. 18, 1952, water-stage recorder at site 800 ft downstream at datum 1.0 ft higher. Sept. 19, 1952, to June 28, 1982, recording gage at site 800 feet downstream at present datum. June 29, 1982, to Sept. 20, 1983, nonrecording gage at present site and datum.

REMARKS.--Records fair except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--39 years (water years 1951-81, 1983-90), 39.1 ft^3/s, 28,330 acre-ft/yr; median of yearly mean discharges, 25 ft^3/s, 18,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,260 ft^3/s, July 3, 1975, gage height, 16.59 ft present datum, site then in use; no flow at times in most years.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of April 1950 reached a stage of 15.25 ft present datum, site then in use, from floodmarks, discharge, 2,790 ft^3/s.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 60 ft^3/s, Apr. 4, gage height, 4.86 ft (backwater from ice); maximum gage height, 5.16 ft, Mar. 19 (backwater from ice); no flow for many days.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.00	e.00	e.00	e.00	e.00	e20	3.7	1.3	11	.06	.00
2	.00	.00	e.00	e.00	e.00	e.00	e30	3.4	3.0	9.8	.08	.00
3	.00	e.00	e.00	e.00	e.00	e.00	e45	4.4	3.3	7.9	.05	.00
4	.00	e.01	e.00	e.00	e.00	e.00	e50	4.6	2.9	7.2	.02	.00
5	.00	e.03	e.00	e.00	e.00	e.00	e36	4.3	2.5	5.8	.01	.00
6	.00	e.04	e.00	e.00	e.00	e.00	e29	3.8	1.5	5.2	.00	.00
7	.00	e.04	e.00	e.00	e.00	e.00	e22	4.2	1.0	4.8	.00	.00
8	.00	e.04	e.00	e.00	e.00	e.03	e20	3.8	1.8	5.5	.00	.00
9	.00	e.04	e.00	e.00	e.00	e.06	e17	3.3	1.6	3.5	.00	.00
10	.00	e.04	e.00	e.00	e.00	e.10	e14	3.7	1.4	2.4	.00	.00
11	.00	e.04	e.00	e.00	e.00	e.25	e12	2.9	2.9	1.9	.00	.00
12	.00	e.03	e.00	e.00	e.00	e.75	e10	2.3	3.9	.98	.00	.00
13	.00	e.03	e.00	e.00	e.00	e2.0	e9.0	2.3	3.4	.32	.00	.00
14	.00	e.03	e.00	e.00	e.00	e4.0	e8.0	2.0	3.4	.30	.00	.00
15	.00	e.03	e.00	e.00	e.00	e15	e7.2	1.4	3.4	.30	.00	.00
16	.00	e.03	e.00	e.00	e.00	e25	e6.6	1.4	3.6	.28	.00	.00
17	.00	e.02	e.00	e.00	e.00	e30	e6.2	1.7	3.3	.29	.00	.00
18	.00	e.02	e.00	e.00	e.00	e30	e5.6	1.6	3.0	.26	.00	.00
19	.00	e.01	e.00	e.00	e.00	e30	e5.2	1.5	3.3	.25	.00	.00
20	.00	e.00	e.00	e.00	e.00	e25	4.8	1.3	3.4	.24	.00	.00
21	.00	e.00	e.00	e.00	e.00	e20	4.7	1.3	2.7	.22	.00	.00
22	.00	e.00	e.00	e.00	e.00	e17	4.6	2.9	2.5	.20	.00	.00
23	.00	e.00	e.00	e.00	e.00	e14	4.1	3.0	3.2	.17	.00	.00
24	.00	e.00	e.00	e.00	e.00	e12	3.9	3.0	2.7	.15	.02	.00
25	.00	e.00	e.00	e.00	e.00	e11	5.3	3.0	4.6	.13	.10	.00
26	.00	e.00	e.00	e.00	e.00	e10	4.5	2.6	14	.12	.11	.00
27	.00	e.00	e.00	e.00	e.00	e9.0	3.6	2.6	15	.11	.07	.00
28	.00	e.00	e.00	e.00	e.00	e9.0	4.2	2.6	14	.10	.03	.00
29	.00	e.00	e.00	e.00	---	e9.0	3.6	2.7	14	.08	.00	.00
30	.00	e.00	e.00	e.00	---	e10	3.1	2.2	14	.07	.00	.00
31	.00	---	e.00	e.00	---	e15	---	1.5	---	.07	.00	---
TOTAL	0.00	0.48	0.00	0.00	0.00	298.19	399.2	85.0	140.6	69.64	0.55	0.00
MEAN	.000	.016	.000	.000	.000	9.62	13.3	2.74	4.69	2.25	.018	.000
MAX	.00	.04	.00	.00	.00	30	50	4.6	15	11	.11	.00
MIN	.00	.00	.00	.00	.00	.00	3.1	1.3	1.0	.07	.00	.00
AC-FT	.00	1.0	.00	.00	.00	591	792	169	279	138	1.1	.00
CFSM	.00	.00	.00	.00	.00	.04	.05	.01	.02	.01	.00	.00
IN.	.00	.00	.00	.00	.00	.04	.06	.01	.02	.01	.00	.00

CAL YR 1989 TOTAL 8753.62 MEAN 24.0 MAX 1400 MIN .00 AC-FT 17360 CFSM .09 IN. 1.23
WTR YR 1990 TOTAL 993.66 MEAN 2.72 MAX 50 MIN .00 AC-FT 1970 CFSM .01 IN. .14

e Estimated

RED RIVER OF THE NORTH BASIN

05092000 RED RIVER OF THE NORTH AT DRAYTON, ND

LOCATION.--Lat 48°34'20", long 97°08'50", in SE¼ sec.24, T.159 N., R.51 W., Pembina County, Hydrologic Unit 09020311, on downstream end of east pier of interstate highway bridge, 1.5 mi northeast of Drayton, and at mile 206.7.

DRAINAGE AREA.--34,800 mi^2, approximately, includes 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1936 to June 1937, April 1941 to current year (fragmentary prior to April 1949).

REVISED RECORDS.--WSP 1388: 1949-50. WSP 1728: Drainage area.

GAGE.--Water-stage recorder and concrete control. Datum of gage is 755.00 ft above National Geodetic Vertical Datum of 1929 (Minnesota highway benchmark). Prior to Nov. 30, 1954, nonrecording gage at site 1.5 mi upstream at datum 1.59 ft higher.

REMARKS.--Estimated daily discharges: Nov. 26 to Feb. 27. Records good. Some regulation by reservoirs on tributaries.

AVERAGE DISCHARGE.--41 years (water years 1950-90), 3,746 ft^3/s, 2,714,000 acre-ft/yr; median of yearly mean discharges, 2,930 ft^3/s, 2,123,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 92,900 ft^3/s, Apr. 28, 1979, gage height, 43.66 ft; minimum observed, 7.7 ft^3/s, Oct. 16, 1936, gage height, 1.75 ft, former site and datum.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of April 1897 reached a stage of about 41 ft, at site and datum in use prior to Nov. 30, 1954.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,080 ft^3/s, Apr. 7, gage height, 15.54 ft; minimum daily discharge, 110 ft^3/s, Dec. 29-31.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	411	446	e460	e125	e250	291	2170	1460	1350	1860	731	396
2	495	460	e460	e125	e260	300	2230	1460	1310	1770	683	438
3	529	455	e445	e125	e260	302	2650	1510	1370	1700	626	432
4	521	459	e445	e125	e270	307	4010	1590	1530	1620	568	410
5	502	464	e440	e130	e270	311	4300	1650	1980	1520	535	446
6	480	461	e435	e138	e260	323	4600	1700	2520	1410	473	403
7	473	433	e420	e138	e260	338	5000	1710	2790	1340	435	410
8	432	436	e410	e148	e270	371	5000	1710	2790	1360	421	391
9	410	484	e400	e156	e270	372	4860	1680	2660	1340	408	390
10	461	493	e395	e161	e280	370	4650	1650	2430	1310	397	395
11	461	482	e390	e165	e270	376	4580	1600	2240	1240	416	364
12	504	487	e380	e166	e270	426	4370	1580	2060	1150	421	352
13	513	474	e360	e170	e260	462	4230	1530	1940	1070	395	344
14	516	477	e345	e170	e240	539	3880	1510	1850	1030	350	362
15	521	474	e330	e170	e230	629	3730	1480	1840	990	360	341
16	528	437	e290	e170	e230	670	2650	1410	1870	975	344	356
17	512	399	e265	e170	e230	742	2360	1350	1890	957	356	333
18	507	408	e240	e170	e230	1130	2150	1360	1850	974	436	295
19	483	412	e230	e170	e230	1880	1920	1360	1740	986	464	284
20	449	408	e220	e170	e220	2350	1770	1380	1660	952	418	285
21	450	414	e200	e175	e220	2460	1630	1410	1620	847	401	294
22	444	431	e160	e175	e220	2330	1540	1470	1580	807	394	318
23	464	436	e110	e190	e230	2110	1470	1500	1640	768	383	372
24	475	467	e150	e199	e240	1950	1400	1530	1930	749	387	372
25	458	475	e140	e202	e250	1910	1380	1540	2230	746	420	404
26	472	e480	e140	e215	e257	1910	1350	1540	2370	778	386	408
27	465	e460	e130	e218	e280	1910	1350	1510	2340	818	374	364
28	431	e435	e120	e230	293	1880	1390	1480	2210	838	375	339
29	448	e430	e110	e240	---	1860	1410	1450	2090	841	379	317
30	448	e450	e110	e250	---	1860	1420	1400	1980	838	372	317
31	443	---	e110	e250	---	1950	---	1380	---	788	368	---
TOTAL	14706	13527	8840	5406	7050	34619	85450	46890	59660	34372	13476	10932
MEAN	474	451	285	174	252	1117	2848	1513	1989	1109	435	364
MAX	529	493	460	250	293	2460	5000	1710	2790	1860	731	446
MIN	410	399	110	125	220	291	1350	1350	1310	746	344	284
AC-FT	29170	26830	17530	10720	13980	68670	169500	93010	118300	68180	26730	21680

CAL YR 1989 TOTAL 1077204 MEAN 2951 MAX 41800 MIN 110 AC-FT 2137000
WTR YR 1990 TOTAL 334928 MEAN 918 MAX 5000 MIN 110 AC-FT 664300

e Estimated

RED RIVER OF THE NORTH BASIN

05092000 RED RIVER OF THE NORTH AT DRAYTON, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972 to current year.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
05...	1200	512	610	--	5.0	6.5	--	--	--	--	--	--
NOV												
06...	1200	485	980	--	6.0	2.0	--	--	--	--	--	--
DEC												
29...	1200	111	1050	--	-16.0	0.0	--	--	--	--	--	--
FEB												
26...	1110	259	1010	--	1.0	0.5	--	--	--	--	--	--
APR												
16...	1230	2520	740	7.8	1.5	3.5	230	52	24	48	30	1
20...	1320	1740	705	--	21.0	7.0	--	--	--	--	--	--
MAY												
11...	1430	1570	900	--	14.5	14.0	--	--	--	--	--	--
JUN												
20...	1405	1640	560	--	21.0	22.0	--	--	--	--	--	--
JUL												
23...	1250	766	985	8.6	29.0	25.0	330	68	38	79	34	2
SEP												
07...	1550	418	800	--	26.5	24.0	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
16...	9.1	200	0	160	89	67	0.20	13	408	399	0.55
JUL											
23...	9.8	320	0	258	120	110	0.20	16	624	597	0.85

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
16...	2780	2	100	140	1	29	30	0.1	4	1	350
JUL											
23...	1290	8	170	60	<1	46	10	0.2	3	<1	460

RED RIVER OF THE NORTH BASIN

05094000 SOUTH BRANCH TWO RIVERS AT LAKE BRONSON, MN

LOCATION.--Lat 48°43'50", long 96°39'50", in SW¼SW¼ sec.30, T.161 N., R.46 W., Kittson County, Hydrologic Unit 09020312, on left bank 70 ft upstream from culvert on U.S. Highway 59 at Lake Bronson and 3.4 mi downstream from dam at outlet of Bronson Lake.

DRAINAGE AREA.--444 mi^2.

PERIOD OF RECORD.--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 1981, April 1985 to current year. Monthly discharge only for some periods, published in WSP 1308. October 1981 to March 1985, annual maximums only. Published as South Fork Two Rivers at Bronson prior to 1941.

REVISED RECORDS.--WSP 1308: 1929(M), 1931(M), 1936(M), 1944(M), 1947(M).

GAGE.--Water-stage recorder. Datum of gage is 928.53 ft above National Geodetic Vertical Datum of 1929 (Minnesota Department of Transportation bench mark). Prior to Nov. 23, 1953, nonrecording gage at bridge 100 ft downstream at datum 2.00 ft higher. Nov 23, 1953, to Oct. 5, 1963, water-stage recorder at same site at datum 2.00 ft higher.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow partly regulated since 1937 by Bronson Lake, usable capacity, 3,700 acre-ft.

AVERAGE DISCHARGE.--45 years (water years 1929-36, 1942, 1943, 1946, 1947, 1954-81, 1986-90), 84.6 ft^3/s, 61,290 acre-ft/yr; median of yearly mean discharges, 51 ft^3/s, 36,900 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,410 ft^3/s, Apr. 5, 1966, gage height, 18.23 ft; no flow at times in 1937, 1941, 1960, 1973.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 784 ft^3/s, Apr. 1, gage height, 7.10 ft, from highwater mark; maximum gage height, 9.14 ft, Mar. 16 (backwater from ice); minimum discharge, 0.04 ft^3/s, Sept. 17; minimum gage height, 3.15 ft, July 24, 25, 26.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.32	.28	.45	e.31	e.48	e.20	e650	9.6	e.54	1.5	.22	16
2	.33	.23	.45	e.31	e.47	e.20	e300	10	e1.0	2.4	.60	15
3	.38	.22	e.45	e.31	e.45	e.20	e150	e10	e4.0	17	.52	14
4	.49	.37	e.45	e.31	e.43	e.20	e120	e9.5	e6.4	15	.39	14
5	.47	.49	e.45	e.31	e.41	e.20	e70	e9.0	e6.4	13	.33	16
6	.25	.39	e.45	e.30	e.39	e.20	e17	e8.4	e6.0	14	.45	16
7	.33	.39	e.45	e.30	e.36	e.20	52	e7.6	e4.6	14	.45	1.6
8	.41	.43	e.45	e.30	e.34	e.20	49	e6.5	e4.4	22	.28	.18
9	.59	.45	e.45	e.30	e.32	e.50	46	e5.2	e4.3	24	.20	.12
10	.67	.39	e.45	e.30	e.30	e1.0	40	e4.3	e4.3	21	.16	.10
11	.62	.34	e.44	e.30	e.29	e5.0	36	e3.4	e4.2	22	13	.09
12	.59	.35	e.43	e.30	e.28	e10	36	e2.8	e4.1	22	113	.08
13	.59	.39	e.42	e.30	e.27	e30	34	e2.5	e3.9	21	100	.07
14	.66	.43	e.41	e.30	e.26	e200	34	e2.2	e3.8	19	14	.06
15	.80	.42	e.39	e.30	e.25	e450	24	e2.0	e3.8	17	14	.05
16	.71	.40	e.37	e.29	e.25	e600	12	e1.8	e3.7	17	47	.05
17	29	.39	e.35	e.29	e.24	e400	13	e1.6	e3.7	14	72	.05
18	95	.39	e.33	e.29	e.24	e220	13	e1.5	e3.6	7.4	63	.08
19	100	.39	e.33	e.29	e.23	e190	13	e1.3	7.9	2.1	87	.12
20	115	.33	e.32	e.29	e.23	e190	13	e1.2	24	.42	84	.13
21	101	.39	e.32	e.29	e.22	e150	13	e1.0	33	.21	78	.12
22	61	.39	e.32	e.29	e.22	e130	14	e.95	16	.15	26	.12
23	38	.39	e.31	e.30	e.21	e115	15	e.87	16	.14	16	.12
24	38	.39	e.31	e.31	e.21	e115	13	e.81	15	.14	13	.11
25	27	.39	e.31	e.33	e.21	e145	1.5	e.76	12	.13	13	.10
26	16	.33	e.31	e.35	e.20	e145	.36	e.70	1.7	.14	12	.11
27	12	.39	e.31	e.37	e.20	e84	.79	e.66	.58	25	12	.11
28	9.9	.39	e.31	e.39	e.20	e20	4.7	e.62	.34	2.3	12	.13
29	9.9	.45	e.31	e.42	---	e70	7.9	e.58	.46	.68	14	.16
30	7.5	.45	e.31	e.45	---	e120	9.4	e.54	1.1	.33	17	.17
31	.70	---	e.31	e.48	---	e200	---	e.50	---	.20	14	---
TOTAL	668.21	11.43	11.72	9.98	8.16	3592.10	1801.65	108.39	200.82	315.24	837.60	95.03
MEAN	21.6	.38	.38	.32	.29	116	60.1	3.50	6.69	10.2	27.0	3.17
MAX	115	.49	.45	.48	.48	600	650	10	33	25	113	16
MIN	.25	.22	.31	.29	.20	.20	.36	.50	.34	.13	.16	.05
AC-FT	1330	23	23	20	16	7120	3570	215	398	625	1660	188
CFSM	.05	.00	.00	.00	.00	.26	.14	.01	.02	.02	.06	.01
IN.	.06	.00	.00	.00	.00	.30	.15	.01	.02	.03	.07	.01

CAL YR 1989 TOTAL 16783.76 MEAN 46.0 MAX 1860 MIN .10 AC-FT 33290 CFSM .10 IN. 1.41
WTR YR 1990 TOTAL 7660.33 MEAN 21.0 MAX 650 MIN .05 AC-FT 15190 CFSM .05 IN. .64

e Estimated

RED RIVER OF THE NORTH BASIN

05102500 RED RIVER OF THE NORTH AT EMERSON, MAN
(National stream-quality accounting network station)
(International gaging station)

LOCATION.--Lat 49°00'30", long 97°12'40", in sec.2, T.1, R.2 E., Hydrologic Unit 09020311, on right bank 1,500 ft downstream from Canadian National Railway bridge in Emerson, 0.8 mi downstream from international boundary, 3.6 mi downstream from Pembina River, and at mile 154.3.

DRAINAGE AREA.--40,200 mi^2, approximately, includes 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--March to November 1902 (gage heights only), May 1912 to September 1929 (monthly discharge only, published in WSP 1308), October 1929 to current year.

GAGE.--Water-stage recorder. Datum of gage is Geodetic Survey of Canada Datum of 1929. See WSP 1728 or 1913 for history of changes prior to Apr. 10, 1953.

COOPERATION.--This station is one of the international gaging stations maintained by Canada under agreement with the United States. Records provided by Water Survey of Canada.

AVERAGE DISCHARGE.--78 years (water years 1913-90), 3,350 ft^3/s, 2,427,000 acre-ft/yr; median of yearly mean discharges, 2,870 ft^3/s, 2,080,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 95,500 ft^3/s, May 13, 1950, gage height, 90.89 ft; maximum gage height, 91.19 ft, May 1, 1979; minimum observed discharge, 0.9 ft^3/s, Feb. 6-8, 1937.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,510 ft^3/s, Apr. 10, gage height, 760.90 ft; minimum daily, 138 ft^3/s, Jan. 2.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	417	367	e353	e144	e232	e262	e3460	1640	1440	2160	727	374
2	424	357	e348	e138	e236	e264	e3920	1650	1470	2030	724	374
3	445	350	e341	e152	e243	e267	e4060	1670	1480	1960	671	395
4	505	395	e344	e159	e254	e271	e4520	1710	1490	1840	618	427
5	526	438	e343	e157	e265	e276	e4550	1800	1600	1740	565	424
6	523	392	e338	e156	e272	e282	e4730	1850	1960	1680	523	431
7	501	364	e332	e153	e276	e288	e4980	1890	2460	1630	487	434
8	487	350	e326	e148	e279	e294	e5230	1900	2840	1540	452	420
9	463	340	e320	e150	e279	e306	e5370	1890	2950	1510	438	417
10	431	371	e308	e152	e278	e322	e5470	1870	2880	1500	420	403
11	424	410	e293	e160	e276	e328	e5330	1830	2700	1450	410	395
12	438	371	e282	e164	e273	e360	e5190	1780	2500	1360	410	392
13	448	388	e276	e169	e270	e438	e5160	1750	2320	1260	413	367
14	463	395	e270	e170	e266	e455	e4980	1700	2200	1150	413	352
15	470	388	e263	e166	e255	e519	e4630	1660	2250	1070	388	346
16	459	378	e256	e164	e244	e674	e4310	1620	2230	1010	364	347
17	456	388	e252	e167	e240	e734	e3710	1550	2190	978	378	340
18	463	392	e246	e171	e250	e996	e3250	1520	2140	953	371	352
19	452	371	e236	e169	e261	e1330	2850	1500	2090	943	388	328
20	431	381	e223	e167	e265	e1790	2420	1480	2010	936	445	293
21	420	385	e204	e167	e264	e2310	2190	1490	1960	879	470	284
22	456	e374	e192	e168	e263	e2680	2020	1510	2010	830	463	280
23	484	e364	e193	e174	e266	e2730	1900	1560	1980	773	455	282
24	480	e360	e202	e183	e266	e2580	1800	1610	1970	731	452	317
25	470	e364	e202	e191	e262	e2380	1730	1630	2110	703	445	353
26	448	e364	e193	e199	e260	e2160	1660	1630	2350	689	452	374
27	424	e364	e187	e207	e258	e2010	1610	1620	2500	692	452	395
28	431	e367	e177	e212	e258	e1900	1620	1600	2520	710	431	388
29	399	e367	e171	e219	---	e1860	1640	1570	2430	731	406	360
30	378	e357	e167	e223	---	e2000	1650	1530	2300	745	392	329
31	374	---	e160	e228	---	e2500	---	1480	---	749	385	---
TOTAL	13990	11252	7998	5347	7311	35566	105940	51490	65330	36932	14408	10973
MEAN	451	375	258	172	261	1147	3531	1661	2178	1191	465	366
MAX	526	438	353	228	279	2730	5470	1900	2950	2160	727	434
MIN	374	340	160	138	232	262	1610	1480	1440	689	364	280
AC-FT	27750	22320	15860	10610	14500	70550	210100	102100	129600	73250	28580	21760

CAL YR 1989 TOTAL 1082833 MEAN 2967 MAX 42400 MIN 160 AC-FT 2148000
WTR YR 1990 TOTAL 366537 MEAN 1004 MAX 5470 MIN 138 AC-FT 727000

e Estimated

RED RIVER OF THE NORTH BASIN

05102500 RED RIVER AT EMERSON, MANITOBA--CONTINUED
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1978 to current year.

PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: October 1977 to current year.
WATER TEMPERATURE: October 1977 to current year.

REMARKS.--Records of daily mean values of water temperature and specific conductance are furnished by Water Survey of Canada.

EXTREMES FOR PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: Maximum daily mean, 2,180 microsiemens, Dec. 8, 1989; minimum daily mean, 259 microsiemens, Apr. 14, 1989.

WATER TEMPERATURES: Maximum daily mean, 26.7°C, Aug. 16, 1988; minimum daily mean, 0.0°C, on many days during winter months.

EXTREMES FOR CURRENT YEAR.--
SPECIFIC CONDUCTANCE: Maximum daily mean, 1,460 microsiemens, Dec. 3, 26-28; minimum daily mean, 432 microsiemens, Apr. 3.

WATER TEMPERATURES: Maximum daily mean, 24.9°C, July 3; minimum daily mean, 0.0°C, on many days during winter months.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DISCHARGE, INST. CUBIC FEET PER SECOND (00061)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE AIR (DEG C) (00020)	TEMPERATURE WATER (DEG C) (00010)	TURBIDITY (NTU) (00076)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML) (31625)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT											
06...	1200	--	760	8.5	4.5	7.5	32	10.2	85	K75	130
NOV											
07...	1150	--	920	8.6	4.0	2.5	11	9.4	70	K7	K23
APR											
17...	1000	3730	705	8.0	2.5	3.0	87	15.5	113	K4	710
MAY											
31...	1000	--	830	8.6	22.0	21.0	84	8.3	92	K12	K15
JUL											
17...	1150	--	882	8.5	23.0	25.5	59	6.6	82	K10	K20

DATE	HARDNESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM ADSORPTION RATIO (00931)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY LAB (MG/L AS CACO3) (90410)	ALKALINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	BICARBONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	CARBONATE WATER DIS IT FIELD MG/L AS CO3 (00452)
OCT											
06...	260	58	29	52	29	1	7.8	189	191	227	0
NOV											
07...	330	68	40	68	30	2	10	226	271	326	2
APR											
17...	200	47	21	44	31	1	7.2	144	152	185	0
MAY											
31...	300	66	33	49	26	1	6.9	236	177	182	17
JUL											
17...	310	69	34	64	30	2	9.8	238	223	252	10

DATE	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)	SOLIDS, DISSOLVED (TONS PER DAY) (70302)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	NITROGEN, NITRITE DISSOLVED (MG/L AS N) (00613)
OCT										
06...	100	59	0.20	15	438	436	0.60	--	--	<0.010
NOV										
07...	140	90	0.30	2.9	576	582	0.78	--	--	<0.010
APR										
17...	76	62	0.20	12	393	365	0.53	3960	0.880	0.020
MAY										
31...	100	57	0.20	2.5	466	423	0.63	--	0.180	0.020
JUL										
17...	100	86	0.20	16	542	515	0.74	--	--	<0.010

RED RIVER OF THE NORTH BASIN

05104500 ROSEAU RIVER BELOW SOUTH FORK NEAR MALUNG, MN

LOCATION.--Lat 48°47'30", long 95°44'40", in NW¼SW¼ sec.6, T.161 N., R.39 W., Roseau County, Hydrologic Unit 09020314, on left bank 0.3 mi downstream from South Fork and 1.5 mi northwest of Malung.

DRAINAGE AREA.--573 mi^2.

PERIOD OF RECORD.--October 1946 to current year.

REVISED RECORDS.--WSP 2113: 1948, 1950, 1951, 1956(M), 1957(M), 1962(M).

GAGE.--Water-stage recorder and concrete control. Datum of gage is 1,029.67 ft, adjustment of 1912.

REMARKS.--Records poor. Some flow bypasses the gaging station through a natural overflow channel 0.8 mi upstream and returns to river 0.5 mi downstream. Overflow begins at stage of about 13.0 ft, discharge, 1,800 ft^3/s. These records include any flow in the overflow channel.

AVERAGE DISCHARGE.--44 years, 136 ft^3/s, 98,530 acre-ft/yr; median of yearly mean discharges, 110 ft^3/s, 79,700 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,750 ft^3/s, July 18, 1968, gage height, 22.32 ft; maximum gage height, 23.37 ft, Apr. 3, 1966 (backwater from ice); no flow for part of Jan. 15, 1952 (caused by construction of concrete control), July 23 to Sept. 8, 1961, Dec. 22 to Mar. 10, 1977, Sept. 9-11, 1980, Aug. 10 to Sept. 18, 1988, Jan. 16 to Feb. 2, 24-27, and Mar. 4-8, 1990.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 78 ft^3/s, Apr. 1, gage height, 5.49 ft; maximum gage height, 6.51 ft, Mar. 16 (backwater from ice); no flow Jan. 16 to Feb. 2, 24-27, and Mar. 4-8.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.07	e1.0	e.39	e.05	e.00	e.01	70	16	4.3	16	.70	.08
2	.07	e1.1	e.36	e.04	e.00	e.01	54	15	9.2	15	.71	.08
3	.07	e1.2	e.34	e.04	e.01	e.01	48	14	17	15	.79	.08
4	.07	e1.3	e.32	e.03	e.01	e.00	35	15	36	13	.68	.07
5	.09	e1.5	e.30	e.03	e.01	e.00	26	14	33	13	.54	.06
6	.10	e1.8	e.28	e.03	e.01	e.00	25	13	30	11	.41	.06
7	.10	e2.1	e.26	e.03	e.01	e.00	20	12	37	10	.34	.06
8	.05	e2.2	e.24	e.03	e.02	e.00	18	12	41	9.7	.29	.05
9	.05	e2.2	e.22	e.03	e.02	e.01	17	11	37	45	.25	.04
10	.06	e2.2	e.20	e.03	e.02	e.02	18	9.8	30	58	.23	e.04
11	.04	e2.1	e.19	e.03	e.02	e.03	16	9.0	27	40	.23	.03
12	.03	e2.1	e.18	e.03	e.02	e.10	16	8.3	23	29	.22	.03
13	.03	e2.0	e.17	e.02	e.02	e.70	14	7.5	21	22	.21	.03
14	.02	e1.9	e.16	e.02	e.02	e5.0	14	7.1	19	17	.20	.03
15	.04	e1.8	e.15	e.01	e.02	e30	14	6.9	14	13	.20	.03
16	.06	e1.6	e.14	e.00	e.02	e60	12	6.9	9.9	10	.20	.03
17	.08	e1.4	e.13	e.00	e.02	e50	12	7.5	11	9.1	.21	.03
18	.10	e1.3	e.12	e.00	e.02	e40	11	7.3	23	7.7	.21	.04
19	.13	e1.2	e.11	e.00	e.02	e30	12	7.8	27	7.4	.20	.04
20	.24	e1.1	e.10	e.00	e.02	e25	13	7.1	33	6.8	.19	.04
21	.33	e.95	e.10	e.00	e.02	e20	15	8.5	48	5.7	.18	.05
22	.51	e.65	e.09	e.00	e.02	e16	15	6.9	55	4.6	.17	.04
23	.48	e.75	e.08	e.00	e.01	e14	15	6.3	57	4.0	.16	.04
24	.54	e.68	e.08	e.00	e.00	e12	15	5.9	55	3.3	.14	.04
25	1.1	e.62	e.07	e.00	e.00	e10	17	5.5	47	2.9	.12	.04
26	1.3	e.57	e.07	e.00	e.00	e7.5	17	4.9	41	2.4	.11	.04
27	.99	e.53	e.06	e.00	e.00	e6.5	16	4.3	31	2.1	.13	.03
28	.87	e.49	e.06	e.00	e.01	e5.6	17	5.1	25	2.0	.13	.03
29	.87	e.46	e.06	e.00	---	e6.5	18	6.2	21	1.5	.12	.03
30	.87	e.42	e.05	e.00	---	e13	17	5.9	19	1.2	.11	.03
31	.93	---	e.05	e.00	---	62	---	5.3	---	.86	.10	---
TOTAL	10.29	39.42	5.13	0.45	0.37	413.99	627	272.0	881.4	398.26	8.48	1.32
MEAN	.33	1.31	.17	.015	.013	13.4	20.9	8.77	29.4	12.8	.27	.044
MAX	1.3	2.2	.39	.05	.02	62	70	16	57	58	.79	.08
MIN	.02	.42	.05	.00	.00	.00	11	4.3	4.3	.86	.10	.03
AC-FT	20	78	10	.9	.7	821	1240	540	1750	790	17	2.6
CFSM	.00	.00	.00	.00	.00	.02	.04	.02	.05	.02	.00	.00
IN.	.00	.00	.00	.00	.00	.03	.04	.02	.06	.03	.00	.00

CAL YR 1989 TOTAL 19592.05 MEAN 53.7 MAX 1540 MIN .02 AC-FT 38860 CFSM .09 IN. 1.27
WTR YR 1990 TOTAL 2658.11 MEAN 7.28 MAX 70 MIN .00 AC-FT 5270 CFSM .01 IN. .17

e Estimated

RED RIVER OF THE NORTH BASIN

05106500 ROSEAU RIVER AT ROSEAU LAKE, MN

LOCATION.--Lat 48°54'22", long 95°49'55", in SW¼SW¼ sec.28, T.163 N., R.40 W., Roseau County, Hydrologic Unit 09020314, at downstream side of bridge on County Road 123 at Roseau Lake, 3.5 mi upstream from Pine Creek, 3.8 mi downstream from Sprague Creek, and 7 mi northwest of Roseau.

PERIOD OF RECORD.--November 1939 to current year (incomplete).

GAGE.--Water-stage recorder. Datum of gage is 1,018.59 ft, adjustment of 1928 (levels by Geodetic Survey of Canada); gage readings have been reduced to elevations, adjustment of 1928. Prior to Aug. 26, 1970, and Oct. 18, 1979 to Sept. 30, 1980, nonrecording gage at same site and datum.

EXTREMES FOR PERIOD OF RECORD.--Maximum elevation observed, 1,036.86 ft, May 13, 1950; minimum observed, 1,019.75 ft, Aug. 16, 1941.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in July 1919 reached an elevation of about 1,034 ft.

EXTREMES FOR CURRENT YEAR.--Maximum elevation recorded, 1,026.31 ft, Apr. 1; minimum observed, 1,020.27 ft, Sept. 11, but may have been lower during period of no gage-height record.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	26.23	22.58	---	---	---	---
2	---	---	---	---	---	---	26.09	22.61	---	---	---	---
3	21.46	---	---	---	---	---	25.84	22.57	22.37	22.39	---	---
4	---	---	---	---	---	---	25.40	22.74	22.79	22.58	---	---
5	---	---	---	---	---	---	24.82	22.79	23.06	22.62	---	---
6	---	---	---	---	---	---	---	22.74	23.03	22.56	---	---
7	---	---	---	---	21.40	---	23.43	22.64	22.83	22.64	---	---
8	---	---	---	---	---	---	22.86	22.51	22.77	22.90	---	---
9	---	---	---	---	---	---	22.49	22.43	22.92	23.10	---	---
10	---	---	---	---	---	---	---	22.34	23.02	23.26	---	---
11	---	---	---	---	---	---	---	22.31	22.87	23.44	---	20.27
12	---	---	---	---	---	---	22.17	---	22.73	23.33	---	---
13	---	---	---	---	---	---	---	---	22.60	23.06	---	---
14	---	21.79	---	---	---	---	---	---	22.49	22.76	---	---
15	---	---	---	---	---	---	---	---	22.34	22.49	---	---
16	---	---	---	---	---	---	---	---	---	22.31	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	22.19	---	---	---
20	---	---	---	---	---	---	---	---	22.48	---	---	---
21	---	---	---	---	---	---	---	---	22.91	---	---	---
22	---	---	---	---	---	---	---	---	23.43	---	---	---
23	---	---	---	---	---	---	---	---	23.55	---	---	---
24	---	---	---	---	---	---	---	---	23.46	---	---	---
25	---	---	---	---	---	---	---	---	23.25	---	---	---
26	---	---	---	---	---	---	22.35	---	22.98	---	---	---
27	---	---	---	---	---	23.41	22.38	---	22.72	---	---	---
28	---	---	---	---	---	23.36	22.38	---	22.46	---	---	---
29	---	---	---	---	---	23.36	22.46	---	---	---	---	---
30	---	---	---	---	---	23.78	22.57	---	---	---	---	---
31	---	---	---	---	---	25.25	---	---	---	20.79	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---
MAX	---	---	---	---	---	---	---	---	---	---	---	---
MIN	---	---	---	---	---	---	---	---	---	---	---	---

NOTE: Add 1,000 ft to obtain elevations in adjustment of 1928. Gage height below intake elevation of 1,022.29 ft (gage height, 22.29 ft) Oct. 1 to Nov. 14, Apr. 10-25, May 12 to June 2, 16-18, June 29 to July 2, July 17 to Sept. 30. No winter record.

RED RIVER OF THE NORTH BASIN

05107500 ROSEAU RIVER AT ROSS, MN

LOCATION.--Lat 48°54'37", long 95°55'18", in NE¼SE¼ sec.27, T.163 N., R.41 W., Roseau County, Hydrologic Unit 09020314, on left bank 300 ft downstream from highway bridge, 0.2 mi north of Ross, and 2.3 mi downstream from Pine Creek.

DRAINAGE AREA.--1,220 mi^2, approximately.

PERIOD OF RECORD.--July 1928 to current year.

REVISED RECORDS.--WSP 1055: 1945. WSP 1175: Drainage area. WSP 1308: 1936(M). WSP 1508: 1948-49(P).

GAGE.--Water-stage recorder. Datum of gage is 1,018.44 ft, adjustment of 1928 (levels by Geodetic Survey of Canada). Prior to Mar. 13, 1929, nonrecording gage at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. High flow affected by natural storage in Roseau Lake.

AVERAGE DISCHARGE.--62 years, 257 ft^3/s, 186,200 acre-ft/yr; median of yearly mean discharges, 229 ft^3/s, 166,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 6,560 ft^3/s, May 12, 1950, gage height, 18.25 ft; no flow Aug. 29, 30, 1961, Jan. 3 to Mar. 3, 1977, Aug. 23-25, 1977 and Aug. 3, 1980.

EXTREMES OUTSIDE PERIOD OF RECORD.--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.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 310 ft^3/s, Apr. 1, gage height, 7.15 ft (backwater from ice); maximum gage height, 7.21 ft, Mar. 16 (backwater from ice); minimum discharge, 0.02 ft^3/s, Sept. 12; minimum gage height, 0.83 ft, Aug. 26, 27.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.9	e7.5	e2.2	e.29	e.45	e.45	e300	139	37	84	5.5	.23
2	4.1	e7.5	e2.0	e.28	e.45	e.45	e260	140	42	70	5.3	.33
3	4.5	e7.5	e1.9	e.28	e.45	e.45	e220	134	78	94	4.5	.55
4	4.7	e7.7	e1.8	e.28	e.45	e.45	e180	148	150	145	4.0	.32
5	4.8	e8.0	e1.7	e.28	e.45	e.45	e150	155	181	157	3.6	.21
6	4.6	e8.5	e1.6	e.28	e.45	e.45	e120	150	183	159	3.4	.16
7	4.7	e9.0	e1.5	e.28	e.45	e.45	e110	140	166	170	3.1	.16
8	4.8	e10	e1.4	e.28	e.45	e.45	e100	128	157	193	2.8	.16
9	4.8	e11	e1.3	e.28	e.45	e.50	e90	122	169	214	2.6	.17
10	5.1	e11	e1.3	e.28	e.45	e.60	e80	114	179	228	2.4	.14
11	5.0	e11	e1.2	e.28	e.45	e.80	e75	105	169	245	2.2	.10
12	5.2	e11	e1.1	e.28	e.45	e2.0	e71	97	153	238	2.0	.04
13	5.4	e11	e1.0	e.28	e.45	e10	e70	87	141	217	1.9	.07
14	5.2	e11	e.95	e.29	e.45	e50	e70	83	130	193	1.7	.10
15	6.7	e10	e.90	e.30	e.45	e150	e70	80	118	170	1.4	.10
16	5.2	e9.0	e.85	e.40	e.45	e250	e70	80	103	147	1.7	.10
17	4.9	e8.0	e.80	e.45	e.45	e250	70	89	89	123	1.4	.13
18	5.1	e7.0	e.75	e.45	e.45	e200	70	103	89	104	1.1	.42
19	7.2	e6.0	e.70	e.45	e.45	e150	74	106	99	87	1.0	.49
20	9.1	e5.5	e.65	e.45	e.45	e120	81	100	123	68	.90	.41
21	8.4	e5.0	e.60	e.45	e.45	e95	88	94	165	53	.62	.58
22	11	e4.5	e.55	e.45	e.45	e75	89	88	213	42	.53	.58
23	12	e4.2	e.50	e.45	e.45	e65	82	86	233	33	.49	.63
24	13	e3.9	e.46	e.45	e.45	e55	82	81	228	25	.45	.54
25	11	e3.6	e.42	e.45	e.45	e50	90	73	211	21	.36	.55
26	10	e3.3	e.40	e.45	e.45	e45	109	65	189	22	.26	.80
27	7.6	e3.0	e.38	e.45	e.45	e41	121	61	166	20	.27	.95
28	8.9	e2.8	e.37	e.45	e.45	e40	119	57	144	15	.30	.85
29	8.7	e2.6	e.35	e.45	---	e40	126	53	119	10	.29	.84
30	8.0	e2.4	e.33	e.45	---	e50	138	47	102	7.4	.24	.79
31	7.2	---	e.31	e.45	---	e150	---	41	---	6.3	.28	---
TOTAL	210.8	212.5	30.27	11.39	12.60	1893.50	3375	3046	4326	3360.7	56.59	11.50
MEAN	6.80	7.08	.98	.37	.45	61.1	112	98.3	144	108	1.83	.38
MAX	13	11	2.2	.45	.45	250	300	155	233	245	5.5	.95
MIN	3.9	2.4	.31	.28	.45	.45	70	41	37	6.3	.24	.04
AC-FT	418	421	60	23	25	3760	6690	6040	8580	6670	112	23
CFSM	.01	.01	.00	.00	.00	.05	.09	.08	.12	.09	.00	.00
IN.	.01	.01	.00	.00	.00	.06	.10	.09	.13	.10	.00	.00

CAL YR 1989 TOTAL 62575.07 MEAN 171 MAX 1550 MIN .31 AC-FT 124100 CFSM .14 IN. 1.91
WTR YR 1990 TOTAL 16546.85 MEAN 45.3 MAX 300 MIN .04 AC-FT 32820 CFSM .04 IN. .50

e Estimated

RED RIVER OF THE NORTH BASIN

05112000 ROSEAU RIVER BELOW STATE DITCH 51, NEAR CARIBOU, MN
(International gaging station)

LOCATION.--Lat 48°58'54", long 96°27'46", in SE¼SW¼ sec.34, T.164 N., R.45 W., Kittson County, Hydrologic Unit 09020314, on left bank 400 ft downstream from State ditch 51 (known locally as Caribou cutoff ditch) and 0.6 mi west of Caribou.

DRAINAGE AREA.--1,570 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April to October 1917, April 1920 to current year (no winter records in water years 1931, 1932, 1934-36, 1938-40, 1944-72). 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.

REVISED RECORDS.--WSP 1308: 1938(M). WSP 1508: 1917(M), 1920, 1932(M), 1934-35(M). WSP 1913: 1954(M).

GAGE.--Water-stage recorder. Datum of gage is 1,002.14 ft, 1928 datum, (levels by Geodetic Survey of Canada). Prior to Apr. 1, 1929, nonrecording gage at site at Caribou 0.6 mi upstream at datum 0.95 ft lower.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Satellite telemeter at station. Occasionally, at high stages, there is some natural diversion of flow above station to headwaters of Two Rivers.

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

AVERAGE DISCHARGE.--33 years (water years 1921-30, 1933, 1937, 1941-43, 1973-90), 276 ft^3/s, 200,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,080 ft^3/s, May 19, 1950, gage height, 11.81 ft; no flow Aug. 13, 1936, Sept 15-17, 1990.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of 1916 is reported to have reached a stage of about 15.5 ft at former site.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 400 ft^3/s, Apr. 3, gage height, 6.40 ft (backwater from ice); no flow Sept. 15-17.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.7	5.7	4.6	.15	e.10	e.10	e300	130	80	132	17	e1.1
2	6.4	4.6	5.2	.11	e.10	e.10	e350	135	60	111	18	e1.0
3	5.7	4.1	5.1	.10	e.10	e.10	e390	138	69	121	15	e.86
4	5.1	4.5	5.1	e.10	e.10	e.10	e390	141	73	111	e14	e.76
5	5.2	6.1	4.7	e.10	e.10	e.10	e375	150	110	130	e12	e.68
6	5.0	8.0	4.8	e.10	e.10	e.10	e330	157	153	182	e10	e.60
7	4.4	8.6	4.0	e.10	e.10	e.10	e290	155	165	241	e8.5	e.54
8	4.5	11	3.5	e.10	e.10	e.10	e260	143	171	273	e7.5	.44
9	5.9	9.4	2.9	e.10	e.10	e.12	e200	134	165	290	e6.5	.34
10	5.6	9.5	2.4	e.10	e.10	e.15	e170	127	160	303	e5.8	.21
11	5.7	9.8	2.0	e.10	e.10	e.20	e140	117	166	301	e5.3	.15
12	5.3	8.3	1.8	e.10	e.10	e.50	e125	111	167	293	e4.9	.11
13	4.5	12	1.5	e.10	e.10	e2.0	e110	104	153	280	e4.5	.08
14	4.8	12	1.2	e.10	e.10	e9.0	102	96	137	257	e4.2	.02
15	6.2	12	1.1	e.10	e.10	e40	95	88	125	237	e3.9	.00
16	5.5	10	.97	e.10	e.10	e60	88	88	113	201	e3.7	.00
17	5.7	8.4	.75	e.10	e.10	e100	82	94	102	151	e3.5	.00
18	5.1	9.3	.65	e.10	e.10	e200	76	108	91	112	e3.2	.10
19	5.3	9.2	.60	e.10	e.10	e280	73	112	86	91	e3.0	.15
20	5.1	10	.56	e.10	e.10	e300	76	109	92	76	e2.7	.15
21	4.4	11	.52	e.10	e.10	e300	78	104	115	65	e2.5	.22
22	6.1	9.9	.45	e.10	e.15	e290	83	100	142	54	e2.3	.21
23	6.6	9.0	.39	e.10	e.20	e280	86	96	206	46	e2.2	.16
24	6.9	7.8	.35	e.10	e.20	e250	83	91	249	39	e2.0	.19
25	8.8	7.1	.32	e.10	e.15	e210	83	87	253	34	e1.9	.18
26	8.8	7.2	.30	e.10	e.10	e180	86	79	243	30	e1.8	.15
27	8.8	7.2	.25	e.10	e.10	e160	98	73	226	27	e1.7	.14
28	10	6.5	.23	e.10	e.10	e160	114	149	205	25	e1.5	.13
29	12	5.5	.20	e.10	---	e160	118	253	181	22	e1.4	.14
30	8.5	4.7	.17	e.10	---	e160	120	266	158	20	e1.3	.16
31	6.7	---	.15	e.10	---	e200	---	199	---	19	e1.2	---
TOTAL	195.3	248.4	56.76	3.16	3.10	3342.77	4971	3934	4416	4274	173.0	8.97
MEAN	6.30	8.28	1.83	.10	.11	108	166	127	147	138	5.58	.30
MAX	12	12	5.2	.15	.20	300	390	266	253	303	18	1.1
MIN	4.4	4.1	.15	.10	.10	.10	73	73	60	19	1.2	.00
AC-FT	387	493	113	6.3	6.1	6630	9860	7800	8760	8480	343	18
CFSM	.00	.01	.00	.00	.00	.07	.11	.08	.09	.09	.00	.00
IN.	.00	.01	.00	.00	.00	.08	.12	.09	.10	.10	.00	.00

CAL YR 1989 TOTAL 69182.70 MEAN 190 MAX 1340 MIN .15 AC-FT 137200 CFSM .12 IN. 1.64
WTR YR 1990 TOTAL 21626.46 MEAN 59.3 MAX 390 MIN .00 AC-FT 42900 CFSM .04 IN. .51
e Estimated

RED RIVER OF THE NORTH BASIN

05112000 ROSEAU RIVER BELOW STATE DITCH 51 NR CARIBOU, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT												
03...	1030	5.7	380	402	8.0	7.9	5.5	2.3	778	9.4	K16	61
JAN												
03...	1100	0.08	1010	1060	7.4	7.6	0.5	2.5	729	3.3	K5	41
MAY												
02...	1100	144	350	343	8.3	8.3	6.5	5.2	732	11.8	46	66
JUL												
31...	1400	18	355	371	8.2	8.4	23.0	10	736	8.9	29	170

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
OCT												
03...	51	22	8.0	2.7	197	199	0	240	13	4.4	0.10	9.4
JAN												
03...	130	54	35	5.5	514	520	0	627	62	26	0.30	27
MAY												
02...	42	17	5.6	3.5	158	160	0	193	14	6.5	0.10	4.5
JUL												
31...	48	21	6.6	1.3	187	193	0	228	8.8	4.4	<0.10	7.8

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
03...	255	<0.010	<0.100	0.040	0.020	1.4	0.040	0.020	<0.010	8	94
JAN											
03...	696	<0.010	<0.100	0.250	0.250	1.5	0.060	0.040	0.040	97	69
MAY											
02...	231	<0.010	<0.100	0.030	0.020	0.90	0.050	0.020	<0.010	9	84
JUL											
31...	257	<0.010	<0.100	0.040	0.020	1.4	0.080	0.050	0.030	14	94

RED RIVER OF THE NORTH BASIN

05112000 ROSEAU RIVER BELOW STATE DITCH 51 NR CARIBOU, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
03...	1030	10	2	38	<0.5	<1.0	1	<3	4	54	1
JAN											
03...	1100	10	2	110	<0.5	<1.0	10	<3	<10	49	10
MAY											
02...	1100	<10	1	36	<0.5	<1.0	<1	<3	4	53	<1
JUL											
31...	1400	<10	<2	38	<0.5	<1.0	2	<3	9	28	1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
03...	10	16	<0.1	<10	1	<1	<1.0	110	<6	18
JAN										
03...	29	740	0.2	10	<10	<1	1.0	360	<6	9
MAY										
02...	8	10	<0.1	<10	1	<1	<1.0	86	<6	5
JUL										
31...	11	39	<0.1	<10	2	<2	<1.0	100	<6	5

LAKE OF THE WOODS BASIN

05124480 KAWISHIWI RIVER NEAR ELY, MN

(Hydrologic bench-mark station)

LOCATION.--Lat 47°55'22", long 91°32'06", in SE¼SE¼ sec.24, T.63 N., R.10 W., Lake County, Hydrologic Unit 09030001, in Superior National Forest, on left bank upstream from rapids, 2 mi upstream from South Kawishiwi River, 2.2 mi southwest of Fernberg Lookout Tower and 14 mi east of Ely.

DRAINAGE AREA.--253 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--June 1966 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,450 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--No estimated daily discharges. Records good.

AVERAGE DISCHARGE.--24 years, 213 ft^3/s, 11.43 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 1,720 ft^3/s, Apr. 24, 1976, gage height, 5.92 ft; minimum, 4.5 ft^3/s, Jan. 30 to Feb. 2, 1977, gage height, 2.14 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,260 ft^3/s, May 2, gage height, 5.54 ft; minimum, 31 ft^3/s, Oct. 29, Mar. 11, gage height, 2.74 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	46	35	33	34	38	35	71	1170	399	332	198	66
2	50	36	33	34	38	35	81	1230	394	330	189	63
3	48	35	33	34	38	35	81	1240	383	332	183	60
4	46	35	33	34	38	34	85	1230	367	327	176	59
5	47	35	33	34	38	34	87	1220	360	316	165	56
6	47	35	33	34	38	33	87	1210	349	308	158	55
7	45	35	33	35	38	33	88	1200	336	309	152	55
8	44	36	33	35	38	32	89	1190	330	365	146	52
9	43	36	33	35	38	32	98	1170	325	396	142	51
10	44	38	33	35	37	32	103	1130	314	410	137	49
11	44	38	33	36	37	32	105	1090	303	418	134	46
12	43	37	33	37	37	37	107	1050	297	416	130	48
13	42	36	33	37	37	41	110	998	289	408	124	47
14	41	36	33	37	37	44	114	970	278	394	117	50
15	40	36	33	36	37	51	118	936	264	379	113	51
16	39	36	33	36	38	58	122	910	251	362	108	51
17	38	35	33	36	38	59	124	877	261	352	105	48
18	37	35	33	36	38	58	126	841	279	340	102	46
19	36	34	33	35	38	58	133	804	278	326	95	45
20	35	35	33	35	37	58	139	770	300	311	91	43
21	34	34	33	35	37	58	148	731	321	301	88	42
22	34	34	33	36	36	59	158	693	329	296	85	41
23	33	33	33	36	36	59	203	658	332	299	84	40
24	33	33	33	37	36	59	259	622	331	282	85	39
25	33	33	34	37	36	59	317	588	327	268	86	38
26	33	33	34	37	36	59	387	555	329	256	83	37
27	32	33	34	37	36	58	473	525	320	247	82	36
28	32	33	33	38	36	57	633	496	314	239	79	35
29	34	33	34	38	---	58	844	469	318	230	77	35
30	36	33	34	38	---	60	1050	444	327	217	73	36
31	35	---	34	38	---	62	---	420	---	207	70	---
TOTAL	1224	1046	1029	1112	1042	1479	6540	27437	9605	9973	3657	1420
MEAN	39.5	34.9	33.2	35.9	37.2	47.7	218	885	320	322	118	47.3
MAX	50	38	34	38	38	62	1050	1240	399	418	198	66
MIN	32	33	33	34	36	32	71	420	251	207	70	35
AC-FT	2430	2070	2040	2210	2070	2930	12970	54420	19050	19780	7250	2820
CFSM	.16	.14	.13	.14	.15	.19	.86	3.50	1.27	1.27	.47	.19
IN.	.18	.15	.15	.16	.15	.22	.96	4.03	1.41	1.47	.54	.21

CAL YR 1989 TOTAL 66838 MEAN 183 MAX 1080 MIN 32 AC-FT 132600 CFSM .72 IN. 9.83
WTR YR 1990 TOTAL 65564 MEAN 180 MAX 1240 MIN 32 AC-FT 130000 CFSM .71 IN. 9.64

LAKE OF THE WOODS BASIN

05124480 KAWISHIWI RIVER NEAR ELY, MN--Continued
(Hydrologic bench-mark station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1966 to current year.

REMARKS.--Letter K indicates non-ideal colony count. Because of low concentrations and laboratory methods, some of the sulfate values may have a positive bias.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
NOV												
02...	1015	34	26	30	6.1	7.4	5.0	1.0	760	12.0	K3	K4
FEB												
07...	1030	37	33	36	6.8	7.5	0.0	0.60	720	12.4	<1	K5
APR												
26...	1045	373	30	30	6.8	6.7	8.0	1.2	714	10.9	K3	28
AUG												
29...	1015	78	25	35	6.8	7.3	22.0	1.6	719	8.1	K6	>200

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
NOV												
02...	2.9	1.4	1.0	0.30	10	10	0	13	2.0	0.50	<0.10	3.8
FEB												
07...	3.3	1.5	1.1	0.40	10	11	0	12	3.0	0.50	0.10	4.1
APR												
26...	3.1	1.3	0.90	0.30	9	9.0	0	11	2.6	0.30	0.10	4.0
AUG												
29...	3.4	1.5	1.1	0.40	9	12	0	11	2.1	0.70	<0.10	2.9

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
02...	32	<0.010	<0.100	<0.010	<0.010	0.50	0.010	<0.010	<0.010	2	83
FEB											
07...	48	<0.010	<0.100	0.010	0.010	0.40	0.010	<0.010	<0.010	1	88
APR											
26...	41	0.010	0.300	0.020	0.020	0.40	0.020	<0.010	<0.010	4	58
AUG											
29...	32	<0.010	<0.100	0.030	0.030	0.70	<0.010	<0.010	<0.010	5	95

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
NOV											
02...	1015	30	1	8	<0.5	<1.0	10	<3	1	180	<1
FEB											
07...	1030	40	<1	8	<0.5	<1.0	<5	<3	<10	220	<10
APR											
26...	1045	50	<1	8	<0.5	<1.0	1	<3	3	200	1
AUG											
29...	1015	20	<1	8	<0.5	<1.0	1	<3	6	120	2

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
NOV										
02...	<4	3	<0.1	<10	<1	<1	<1.0	12	<6	7
FEB										
07...	<4	6	<0.1	<10	<10	<1	<1.0	13	<6	<3
APR										
26...	<4	13	<0.1	<10	<1	<1	<1.0	12	<6	<3
AUG										
29...	<4	3	<0.1	<10	1	<1	<1.0	12	<6	11

RADIOCHEMICAL, ANALYSES, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	GROSS ALPHA, DISSOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DISSOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DISSOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)	RADIUM 226, DISSOLVED, RADON METHOD (PCI/L) (09511)	URANIUM NATURAL DISSOLVED (UG/L AS U) (22703)
NOV									
02...	1015	1.4	<0.4	2.4	0.4	1.9	0.4	0.06	0.04

LAKE OF THE WOODS BASIN

05127000 KAWISHIWI RIVER NEAR WINTON, MN

LOCATION.--Lat 47°56'05", long 91°45'50", in NE¼NW¼ sec.20, T.63 N., R.11 W., Lake County, Hydrologic Unit 09030001, Superior National Forest, at powerplant of Minnesota Power Co., just upstream from Fall Lake, and 1.8 mi east of Winton.

DRAINAGE AREA.--1,229 mi^2.

PERIOD OF RECORD.--June 1905 to June 1907, October 1912 to September 1919 (fragmentary), September 1923 to current year. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WDR MN-77-1: Drainage area.

REMARKS.--No estimated daily discharges. 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 Co., under general supervision of Geological Survey, in connection with a Federal Power Commission project.

AVERAGE DISCHARGE (unadjusted).--71 years (water years 1906, 1916-17, 1919, 1924-90), 1,035 ft^3/s, 11.44 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum daily discharge, 16,000 ft^3/s, May 18, 1950; no flow at times.

EXTREMES FOR CURRENT YEAR.--Maximum daily discharge, 6,660 ft^3/s, May 5-7; no flow for several days, and Sept. 3.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	374	375	451	400	221	466	880	4560	1480	2960	958	.00
2	374	373	243	429	213	480	931	5810	1390	2940	958	.00
3	375	384	252	424	.00	480	954	6180	1390	2610	907	.00
4	375	363	474	449	31	480	954	6430	1540	2230	882	183
5	375	.00	454	542	217	480	954	6660	1630	2150	881	132
6	375	376	343	.00	249	480	953	6660	1870	1920	820	.00
7	375	193	398	.00	266	480	953	6660	1950	1790	758	.00
8	375	355	349	396	230	480	952	6480	1820	2000	512	.00
9	375	407	226	390	267	480	951	6240	1810	2620	397	.00
10	375	435	226	388	265	480	951	5520	1810	3090	398	66
11	375	408	414	390	267	480	950	4970	1380	3030	398	83
12	375	.00	427	390	266	480	950	4580	966	2890	398	84
13	375	452	429	.00	261	480	950	4300	923	2580	398	83
14	375	449	423	.00	266	480	949	4350	960	2280	398	117
15	375	451	433	404	267	480	949	4080	1000	2280	398	.00
16	375	455	194	295	265	480	643	3760	1100	2140	398	.00
17	375	472	.00	211	266	480	476	3630	1330	2080	296	100
18	375	469	425	213	271	480	420	3510	1860	1950	.00	100
19	375	451	429	201	267	480	395	3510	1960	1700	.00	101
20	375	452	422	.00	292	480	395	3200	2080	1280	284	110
21	375	331	423	.00	420	480	396	2850	2670	958	399	99
22	375	437	420	216	443	480	396	2440	2880	959	340	.00
23	375	273	.00	217	443	480	396	2130	2760	960	.00	.00
24	498	561	.00	273	443	480	402	2060	2410	961	.00	100
25	410	446	435	222	443	481	425	1890	2420	961	.00	117
26	505	447	428	213	442	481	723	1830	2760	961	.00	116
27	371	451	424	.00	442	481	874	1830	2760	960	272	101
28	360	447	424	.00	442	599	874	1830	2800	959	400	94
29	.00	450	.00	217	---	882	875	1830	2790	959	399	.00
30	376	450	.00	217	---	881	3050	1740	3160	958	399	.00
31	368	---	.00	210	---	880	---	1620	---	959	331	---
TOTAL	11511.00	11613.00	9566.00	7307.00	8165.00	16191	24921	123140	57659	57075	12979.00	1786.00
MEAN	371	387	309	236	292	522	831	3972	1922	1841	419	59.5
MAX	505	561	474	542	443	882	3050	6660	3160	3090	958	183
MIN	.00	.00	.00	.00	.00	466	395	1620	923	958	.00	.00
†	-22	-3	-91	-27	-134	-92	538	-50	-22	-51	-94	24
MEAN‡	349	384	218	209	158	430	1369	3922	1900	1790	325	83.5
CFSM‡	.28	.31	.18	.17	.13	.35	1.11	3.19	1.55	1.46	.26	.07
IN‡	.33	.35	.20	.20	.13	.40	1.24	3.68	1.73	1.68	.30	.08

CAL YR 1989 TOTAL 364,284 MEAN 998 MAX 4,760 MIN .0 MEAN‡ 989 CFSM‡ .80 IN‡ 10.92
WTR YR 1990 TOTAL 341,913 MEAN 937 MAX 6,660 MIN .0 MEAN‡ 934 CFSM‡ .76 IN‡ 10.32

† Change in contents, equivalent in cubic feet per second, in Camp Six, Bald Eagle, Gabbro, Little Gabbro, Birch, White Iron, Farm, South Farm, and Garden Lakes
‡ Adjusted for change in reservoir content.

LAKE OF THE WOODS BASIN

05127500 BASSWOOD RIVER NEAR WINTON, MN

(International gaging station)

LOCATION.--Lat 48°04'57", long 91°39'09", in SE¼SE¼ sec.30, T.65 N., R.10 W., Lake County, Hydrologic Unit 09030001, in Superior National Forest, on island in Jackfish Bay of Basswood Lake, used to determine discharge at outlet [lat 48°06'21", long 91°38'51", in sec.19, T.65 N., R.10 W., on international boundary 14 mi northeast of Winton].

DRAINAGE AREA.--1,740 mi^2, approximately (above outlet of Basswood Lake).

PERIOD OF RECORD.--March to June 1924, September 1925 to March 1928, January 1930 to current year. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 955: Drainage area. WSP 1145: 1935, 1937.

GAGE.--Water-stage recorder. Datum of gage is 1,296.80 ft, 1928 datum, (levels by Geodetic Survey of Canada). Prior to Oct. 27, 1938, nonrecording gages at several sites in vicinity of gage, at datum 3.0 ft higher. Oct. 28, 1938, to Sept. 30, 1966, water-stage recorder at datum 3.0 ft higher.

REMARKS.--No estimated daily discharges. Records good. Satellite telemeter at station. Some regulation by powerplant on Kawishiwi River at Winton, and by many lakes located upstream from station.

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

AVERAGE DISCHARGE.--62 years (water years 1926, 1927, 1931-90), 1,401 ft^3/s, 10.93 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 15,600 ft^3/s, May 24, 1950, gage height 9.94 ft, present datum; minimum, 55 ft^3/s, Nov. 18, 1976, gage height, 1.67 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 6,210 ft^3/s, May 11, gage height, 6.54 ft; minimum, 226 ft^3/s, Sept. 29, gage height, 2.30 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	590	459	439	404	351	385	719	2320	3070	3610	1740	485
2	604	456	439	398	350	386	773	2730	3060	3660	1680	477
3	594	452	443	390	350	391	805	3240	2990	3720	1630	458
4	581	447	441	389	347	394	828	3790	2890	3680	1580	436
5	586	453	438	391	341	399	851	4330	2820	3620	1520	421
6	571	449	437	394	338	402	870	4830	2750	3530	1470	407
7	557	449	439	391	333	406	889	5300	2730	3450	1420	391
8	551	447	441	386	331	409	904	5640	2720	3450	1370	372
9	547	441	446	382	331	412	947	5930	2700	3400	1320	355
10	546	441	443	383	332	417	971	6090	2680	3390	1280	339
11	540	430	440	383	332	423	982	6170	2650	3420	1220	330
12	527	438	436	388	333	465	995	6130	2590	3440	1170	335
13	524	434	436	391	331	488	1010	6060	2490	3440	1110	326
14	516	431	440	390	333	505	1020	5980	2390	3430	1040	321
15	516	426	441	383	333	548	1030	5880	2290	3370	1000	321
16	502	420	441	381	342	585	1040	5800	2200	3310	956	317
17	494	420	441	380	346	597	1040	5660	2210	3270	931	307
18	483	420	436	378	348	609	1030	5550	2230	3180	901	294
19	479	425	434	376	349	618	1010	5410	2280	3080	843	284
20	471	413	429	373	351	624	996	5240	2480	2970	781	280
21	467	427	429	371	349	629	986	5070	2660	2860	737	276
22	464	426	429	367	350	634	974	4860	2830	2730	706	271
23	460	424	429	365	353	634	1100	4650	2980	2610	684	261
24	460	430	429	364	355	639	1150	4430	3090	2480	666	255
25	460	424	429	360	360	631	1200	4210	3170	2360	650	248
26	464	431	429	359	368	633	1260	4010	3270	2260	626	244
27	466	432	425	359	372	631	1370	3820	3320	2160	595	236
28	455	432	417	359	379	631	1580	3650	3370	2060	556	232
29	476	434	417	354	---	633	1830	3480	3450	1980	534	234
30	478	435	417	345	---	648	2070	3330	3550	1890	518	237
31	464	---	411	348	---	671	---	3200	---	1810	509	---
TOTAL	15893	13046	13441	11682	9688	16477	32230	146790	83910	93620	31743	9750
MEAN	513	435	434	377	346	532	1074	4735	2797	3020	1024	325
MAX	604	459	446	404	379	671	2070	6170	3550	3720	1740	485
MIN	455	413	411	345	331	385	719	2320	2200	1810	509	232
AC-FT	31520	25880	26660	23170	19220	32680	63930	291200	166400	185700	62960	19340
CFSM	.29	.25	.25	.22	.20	.31	.62	2.72	1.61	1.74	.59	.19
IN.	.34	.28	.29	.25	.21	.35	.69	3.14	1.79	2.00	.68	.21

CAL YR 1989 TOTAL 503982 MEAN 1381 MAX 5250 MIN 411 AC-FT 999600 CFSM .79 IN. 10.77
WTR YR 1990 TOTAL 478270 MEAN 1310 MAX 6170 MIN 232 AC-FT 948600 CFSM .75 IN. 10.23

LAKE OF THE WOODS BASIN

05128000 NAMAKAN RIVER AT OUTLET OF LAC LA CROIX, ONTARIO

(International gaging station)

LOCATION.--Lat 48°21'14", long 92°13'01", at Campbell's Camp, on Lac La Croix Lake, used to determine discharge at outlet [Lat 48°23'00", long 92°10'40", 2.5 mi east of Campbell's Camp].

DRAINAGE AREA.--5,170 mi^2.

PERIOD OF RECORD.--September 1921 to January 1922, April 1922 to current year, in reports of Geological Survey. Monthly discharge only for some periods, published in WSP 1308. August 1921 to current year, in reports of Water Survey of Canada.

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

REMARKS.--Records good. Satellite telemeter at station.

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

AVERAGE DISCHARGE.--68 years (water years 1923-90), 3,847 ft^3/s, 10.10 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 28,200 ft^3/s, May 31 to June 2, 1950, elevation, 1,193.30 ft; minimum, 535 ft^3/s at times in February, March and April 1924, elevation, 1,181.50 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 12,700 ft^3/s, part or all of each day May 18-22; maximum elevation, 1,188.32 ft, May 19; minimum discharge, 1,100 ft^3/s, Mar. 9, elevation, 1,182.27 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2030	1760	1450	1290	1220	1150	e1550	5720	10400	8930	6780	2970
2	2040	1750	1440	1290	1220	1140	e1570	6360	10200	9080	6570	2930
3	2040	1740	1440	1280	1230	1140	e1590	6960	9960	9220	6460	2850
4	2040	1730	1440	1270	1230	1140	e1610	7520	9780	9220	6360	2770
5	2060	1710	1430	1260	1210	1130	1660	8020	9640	9320	6180	2710
6	2030	1670	1420	1250	1210	1130	1680	8480	9360	9360	6040	2660
7	2040	1690	1410	1250	1210	1120	1700	9040	9250	9500	5860	2590
8	2050	1690	1400	1260	1210	1120	1710	9430	9080	9500	5690	2510
9	2040	1670	1400	1250	1210	1110	1750	9890	8860	9500	5510	2440
10	2040	1660	1400	1240	1200	1110	1780	10300	8790	9530	5330	2380
11	2030	1580	1390	1240	1200	1120	1790	10700	8620	9530	5160	2350
12	2010	1650	1390	1240	1200	1160	1800	11100	8330	9500	5010	2410
13	2030	1660	1390	1250	1180	1190	1820	11400	8160	9390	4840	2340
14	2010	1640	1390	1250	1180	1200	1840	11900	7980	9320	4660	2260
15	2020	1640	1380	1240	1180	1250	1860	12100	7880	9180	4590	2220
16	1990	1600	1380	1230	1190	1300	1890	12400	7730	9040	4450	2190
17	1980	1590	1370	1240	1180	1330	1910	12400	7660	9010	4380	2140
18	1960	1590	1370	1240	1190	1340	1940	12600	7520	8860	4270	2080
19	1940	1580	1360	1230	1180	1370	1970	12700	7560	8790	4130	2010
20	1930	1520	1280	1230	1190	1380	2000	12700	7700	8650	3990	1990
21	1910	1540	1260	1230	1180	1390	2050	12700	7730	8510	3880	1920
22	1900	1540	1260	1230	1170	1390	2110	12600	7800	8400	3780	1900
23	1880	1540	1260	1230	1170	1410	2260	12500	7910	8260	3710	1850
24	1880	1540	1280	1230	1160	1420	2400	12400	8020	8120	3670	1820
25	1870	1520	1300	1230	1150	1430	2560	12200	8120	7980	3570	1780
26	1860	1500	1300	1230	1160	1440	2830	12000	8260	7840	3510	1750
27	1830	1490	1300	1230	1160	1470	3230	11800	8400	7660	3410	1700
28	1810	1470	1300	1230	1160	e1480	3740	11500	8550	7520	3300	1680
29	1800	1460	1300	1230	---	e1500	4410	11300	8690	7310	3230	1660
30	1800	1450	1300	1210	---	e1520	5090	11000	8830	7130	3160	1640
31	1780	---	1300	1210	---	e1540	---	10700	---	6960	3090	---
TOTAL	60630	48170	42090	38520	33330	39920	66100	332420	256770	270120	144570	66500
MEAN	1956	1606	1358	1243	1190	1288	2203	10720	8559	8714	4664	2217
MAX	2060	1760	1450	1290	1230	1540	5090	12700	10400	9530	6780	2970
MIN	1780	1450	1260	1210	1150	1110	1550	5720	7520	6960	3090	1640
AC-FT	120300	95550	83490	76400	66110	79180	131100	659400	509300	535800	286800	131900
CFSM	.38	.31	.26	.24	.23	.25	.43	2.07	1.66	1.69	.90	.43
IN.	.44	.35	.30	.28	.24	.29	.48	2.39	1.85	1.94	1.04	.48

CAL YR 1989 TOTAL 1491390 MEAN 4086 MAX 10700 MIN 1260 AC-FT 2958000 CFSM .79 IN. 10.73
WTR YR 1990 TOTAL 1399140 MEAN 3833 MAX 12700 MIN 1110 AC-FT 2775000 CFSM .74 IN. 10.07

e Estimated

LAKE OF THE WOODS BASIN

05129115 VERMILION RIVER NEAR CRANE LAKE, MN

LOCATION.--Lat 48°15'53", long 92°33'57", in NE¼NE¼ sec. 30, T.67 N., R.17 W., St. Louis County, Hydrologic Unit 09030002, in Superior National Forest, on left bank 350 ft downstream from bridge on Forest Route 491, 3.5 mi upstream from mouth, and 3.5 mi west of village of Crane Lake.

PERIOD OF RECORD.--August 1979 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,180 ft above National Geodectic Vertical Datum of 1929, from topographic map.

REMARKS.--Records good.

AVERAGE DISCHARGE.--11 years, 639 ft^3/s, 463,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,360 ft^3/s, Apr. 25, 1985, gage height, 15.20 ft; minimum, 38 ft^3/s, Aug. 13, 14, 1980, gage height, 3.68 ft.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of April 1979 reached a stage of 15.15 ft, from high-water mark, discharge, about 4,600 ft^3/s.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,530 ft^3/s, May 1, gage height, 12.29 ft, from graph based on gage readings; minimum, 76 ft^3/s, Sept. 29, gage height, 4.22 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	263	209	176	131	136	146	601	e2520	1060	1570	663	226
2	264	212	171	131	138	148	608	2510	1050	1520	640	214
3	253	213	166	131	144	142	605	2410	1360	1490	634	209
4	259	216	164	130	148	138	605	2300	1630	1440	659	200
5	279	228	164	127	149	135	593	2200	1680	1370	618	189
6	281	233	162	125	149	133	577	2120	1720	1320	593	181
7	273	233	155	126	146	132	554	2010	1710	1310	573	173
8	273	249	152	127	146	133	542	1960	1670	1330	552	168
9	287	266	154	128	146	134	574	1890	1620	1440	526	160
10	313	275	154	127	143	136	595	1830	1570	1470	495	150
11	310	279	151	127	140	137	594	1790	1510	1450	470	144
12	309	258	148	128	141	160	587	1730	1460	1420	453	140
13	297	257	145	124	142	203	582	1670	1400	1370	438	135
14	293	255	143	122	130	252	638	1670	1330	1320	419	128
15	290	250	142	125	128	397	670	1650	1260	1260	398	123
16	279	246	141	124	137	646	671	1660	1210	1210	384	117
17	269	240	142	124	144	672	652	1680	1190	1170	383	113
18	266	229	140	126	149	677	652	1690	1200	1130	403	111
19	261	224	138	124	149	672	726	1670	1230	1080	389	108
20	259	223	134	124	147	660	842	1650	1550	1030	362	102
21	252	217	129	126	154	636	897	1600	1890	985	338	103
22	245	210	127	127	157	604	920	1550	2070	944	317	98
23	238	205	128	128	155	545	1140	1500	2140	912	308	95
24	230	201	130	130	147	497	1430	1450	2110	880	304	91
25	230	200	131	131	133	457	1530	1400	2020	848	305	89
26	230	197	133	131	134	422	1730	1350	1910	824	288	87
27	232	194	131	133	145	395	1910	1300	1810	805	273	82
28	224	188	130	134	144	400	2130	1250	1740	789	261	79
29	218	182	131	137	---	404	e2360	1200	1680	767	249	78
30	215	179	130	138	---	404	e2470	1160	1620	725	239	83
31	211	---	130	133	---	479	---	1100	---	694	232	---
TOTAL	8103	6768	4472	3979	4021	11096	28985	53470	47400	35873	13166	3976
MEAN	261	226	144	128	144	358	966	1725	1580	1157	425	133
MAX	313	279	176	138	157	677	2470	2520	2140	1570	663	226
MIN	211	179	127	122	128	132	542	1100	1050	694	232	78
AC-FT	16070	13420	8870	7890	7980	22010	57490	106100	94020	71150	26110	7890

CAL YR 1989 TOTAL 238033 MEAN 652 MAX 2760 MIN 127 AC-FT 472100
WTR YR 1990 TOTAL 221309 MEAN 606 MAX 2520 MIN 78 AC-FT 439000

e Estimated

LAKE OF THE WOODS BASIN

05129290 GOLD PORTAGE OUTLET FROM KABETOGAMA LAKE NEAR RAY, MN

LOCATION.--Lat 48°31'28", long 93°04'29", in SW¼NE¼ sec.30, T.70 N., R.21 W., St. Louis County, Hydrologic Unit 09030003, on right bank in bay at head of Gold Portage Outlet from Kabetogama Lake, 9.8 mi northeast of Ray.

PERIOD OF RECORD.--October 1982 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,100 ft, adjustment of 1912 (U.S. Army Corps of Engineers bench mark), water surface transfer.

REMARKS.--Records good. Flow completely regulated by outlet dam on Namakan Lake.

AVERAGE DISCHARGE.--8 years, 243 ft^3/s, 176,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 897 ft^3/s, Sept. 21, 1988, gage height, 19.23 ft; no flow from approximately the middle of January to the first of May each year; minimum gage height, 10.27 ft, Apr. 3, 5, 1989.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 726 ft^3/s, July 7, gage height, 18.52 ft; no flow Feb. 27 to Apr. 28; minimum gage height recorded, 12.14 ft, Apr. 1.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	424	338	186	80	17	.00	.00	e15	359	668	581	603
2	402	333	175	79	17	.00	.00	20	365	681	571	619
3	406	347	177	75	17	.00	.00	37	365	682	573	624
4	415	347	174	69	16	.00	e.00	56	378	660	573	602
5	419	328	168	66	14	.00	e.00	77	393	677	574	600
6	389	326	159	66	14	.00	e.00	95	383	697	574	587
7	404	336	156	65	13	.00	e.00	123	393	701	569	587
8	410	326	156	63	11	.00	e.00	135	403	678	560	578
9	411	304	152	56	11	.00	e.00	149	402	666	542	563
10	414	306	145	57	9.2	.00	e.00	164	414	663	538	554
11	408	269	141	51	8.8	.00	e.00	183	428	648	538	562
12	395	295	138	50	8.6	.00	e.00	200	421	636	537	587
13	406	289	133	49	6.3	.00	e.00	220	406	633	533	583
14	399	282	131	48	5.9	.00	e.00	244	400	633	522	554
15	402	268	127	44	5.2	.00	e.00	272	407	622	530	545
16	394	254	125	43	4.5	.00	e.00	280	412	611	535	544
17	390	249	121	40	4.2	.00	e.00	276	409	611	540	544
18	386	244	116	38	3.7	.00	e.00	300	406	592	547	532
19	386	246	112	37	3.0	.00	e.00	323	435	592	548	512
20	382	220	108	34	2.6	.00	e.00	334	462	592	544	516
21	381	232	104	34	2.1	.00	e.00	342	492	591	557	490
22	384	226	103	31	1.2	.00	e.00	353	537	593	570	479
23	379	219	102	31	.68	.00	e.00	360	574	592	583	475
24	378	220	101	29	.31	.00	e.00	367	609	599	595	473
25	381	213	97	27	.17	.00	e.00	370	637	607	607	461
26	383	210	94	27	.11	.00	e.00	373	644	617	617	459
27	379	202	93	24	.00	.00	e.00	376	659	615	623	441
28	364	196	91	23	.00	.00	e.00	376	661	610	615	434
29	355	194	86	23	---	.00	e1.0	373	658	591	621	433
30	353	189	85	19	---	.00	e5.0	367	655	586	625	432
31	349	---	83	19	---	.00	---	364	---	579	629	---
TOTAL	12128	8008	3939	1397	196.57	0.00	6.00	7524	14167	19523	17671	15973
MEAN	391	267	127	45.1	7.02	.000	.20	243	472	630	570	532
MAX	424	347	186	80	17	.00	5.0	376	661	701	629	624
MIN	349	189	83	19	.00	.00	.00	15	359	579	522	432
AC-FT	24060	15880	7810	2770	390	.00	12	14920	28100	38720	35050	31680

CAL YR 1989 TOTAL 95828.96 MEAN 263 MAX 695 MIN .00 AC-FT 190100
WTR YR 1990 TOTAL 100532.57 MEAN 275 MAX 701 MIN .00 AC-FT 199400

e Estimated

LAKE OF THE WOODS BASIN

05129400 RAINY LAKE NEAR FORT FRANCES, ONTARIO
(International gaging station)

LOCATION.--Lat 48°38'30", long 93°20'00", at Five Mile dock, approximately 5 mi northeast of city of Fort Frances.

PERIOD OF RECORD.--January 1910 to September 1917 and October 1934 to current year, in reports of Geological Survey. August 1911 to current year, in reports of Water Survey of 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 National Geodetic Vertical Datum of 1929 (United States and Canadian Boundary Survey). January 1910 to December 1949, nonrecording gage 3 mi northeast at Ranier, Minn., at same datum. January 1950 to October 1964, water-stage recorder on Government dock at Pither's Point at Fort Frances, and supplementary gage in town pumping station, 0.5 mi south, used during winter months, at same datum.

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

EXTREMES FOR PERIOD OF RECORD.--Maximum elevation observed, 1,112.97 ft, July 5, 1950; minimum observed, 1,101.26 ft, Apr. 17, 1923, Apr. 2, 1930.

EXTREMES FOR CURRENT YEAR.--Maximum elevation, 1,108.17 ft, June 25, maximum daily elevation, 1,108.09 ft, July 3; minimum, 1,105.59 ft, Apr. 5; minimum daily, 1,105.61 ft, Apr. 5.

MONTHEND ELEVATION, IN FEET NGVD, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

Oct. 31 ..... 1,107.69	Feb. 28 ..... 1,108.00	June 30 ..... 1,108.05
Nov. 30 ..... 1,107.41	Mar. 31 ..... 1,105.66	July 31 ..... 1,107.75
Dec. 31 ..... 1,107.07	Apr. 30 ..... 1,106.30	Aug. 31 ..... 1,107.46
Jan. 31 ..... 1,106.56	May 31 ..... 1,107.27	Sept. 30 ..... 1,107.29

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

LAKE OF THE WOODS BASIN

05130500 STURGEON RIVER NEAR CHISHOLM, MN

LOCATION.--Lat 47°40'25", long 92°54'00", in NE¼NW¼ sec.20, T.60 N., R.20 W., St. Louis County, Hydrologic Unit 09030005, on left bank 1,000 ft upstream from highway bridge, 0.6 mi downstream from East Branch Sturgeon River, and 11.5 mi north of Chisholm.

DRAINAGE AREA.--187 mi^2.

PERIOD OF RECORD.--August 1942 to current year.

REVISED RECORDS.--WSP 1438: 1946.

GAGE.--Water-stage recorder. Datum of gage is 1,305.7 ft above National Geodetic Vertical Datum of 1929. Prior to Aug. 24, 1944, nonrecording gage at site 1,000 ft downstream at different datum. Aug. 25, 1944, to Sept. 30, 1975, at present site at datum 1.00 ft higher.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--48 years, 124 ft^3/s, 9.00 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,630 ft^3/s, May 7, 1950, gage height, 7.41 ft, present datum, from rating curve extended above 1,600 ft^3/s, on basis of slope-area measurement of peak flow; minimum daily, 2.5 ft^3/s, July 30, 1988.

EXTREMES FOR CURRENT YEAR.--Peak discharge greater than base of 500 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage Height (ft)
Apr. 29	0400	863	4.61	June 5	1300	*1,010	*4.87

Minimum, 14 ft^3/s, Sept. 10, gage height, 1.34 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	72	81	e48	e25	e23	e23	e200	664	98	143	40	19
2	82	82	e46	e25	e23	e23	e230	572	190	128	38	19
3	85	81	e44	e25	e23	e23	e220	494	540	122	38	18
4	90	81	e42	e25	e23	e23	e210	431	814	111	36	18
5	100	82	e41	e25	e23	e23	e200	373	985	97	35	17
6	99	81	e40	e25	e23	e23	e185	326	885	88	33	17
7	94	88	e38	e25	e23	e23	e170	290	685	84	31	16
8	93	97	e37	e25	e23	e23	162	264	530	161	29	16
9	94	101	e35	e25	e23	e23	157	245	418	156	27	16
10	98	103	e34	e25	e23	e23	153	230	332	141	24	16
11	98	101	e33	e25	e23	e23	148	215	271	119	23	17
12	96	99	e32	e25	e23	e30	142	202	226	100	22	17
13	93	92	e30	e25	e23	e50	132	189	199	86	21	19
14	90	89	e29	e25	e23	e80	133	188	178	76	21	27
15	84	84	e28	e25	e23	e150	137	191	153	66	20	27
16	82	e81	e27	e25	e23	e250	134	195	139	60	20	28
17	82	e79	e27	e25	e23	e300	130	202	143	55	19	26
18	78	e76	e26	e25	e23	e300	126	200	160	52	18	26
19	75	e73	e25	e25	e23	e270	131	191	162	48	17	25
20	80	e71	e25	e25	e23	e240	141	181	209	44	17	24
21	83	e68	e24	e24	e23	e210	159	168	234	40	16	24
22	76	e66	e23	e24	e23	e180	187	168	245	41	16	24
23	72	e64	e22	e24	e23	e160	216	175	241	39	17	24
24	71	e62	e22	e24	e23	e140	233	166	216	35	20	24
25	71	e60	e22	e24	e23	e130	250	159	193	33	39	23
26	76	e58	e22	e24	e23	e120	312	153	193	34	58	22
27	101	e56	e22	e24	e23	e120	430	143	177	38	38	20
28	85	e54	e23	e24	e23	e120	710	132	170	38	27	19
29	82	e52	e24	e24	---	e120	814	126	164	46	23	20
30	84	e50	e24	e24	---	e125	756	120	167	44	20	20
31	81	---	e24	e23	---	e140	---	111	---	42	20	---
TOTAL	2647	2312	939	763	644	3488	7308	7464	9317	2367	823	628
MEAN	85.4	77.1	30.3	24.6	23.0	113	244	241	311	76.4	26.5	20.9
MAX	101	103	48	25	23	300	814	664	985	161	58	28
MIN	71	50	22	23	23	23	126	111	98	33	16	16
AC-FT	5250	4590	1860	1510	1280	6920	14500	14800	18480	4690	1630	1250
CFSM	.46	.41	.16	.13	.12	.60	1.30	1.29	1.66	.41	.14	.11
IN.	.53	.46	.19	.15	.13	.69	1.45	1.48	1.85	.47	.16	.12

CAL YR 1989 TOTAL 46432 MEAN 127 MAX 1060 MIN 18 AC-FT 92100 CFSM .68 IN. 9.24
WTR YR 1990 TOTAL 38700 MEAN 106 MAX 985 MIN 16 AC-FT 76760 CFSM .57 IN. 7.70

e Estimated

LAKE OF THE WOODS BASIN

05131500 LITTLE FORK RIVER AT LITTLEFORK, MN

LOCATION.--Lat 48°23'45", long 93°32'57", in NE¼SE¼ sec.9, T.68 N., R.25 W., Koochiching County, Hydrologic Unit 09030005, on right bank at town of Littlefork, 0.9 mi upstream from bridge on State Highway 217, 2.8 mi upstream from Beaver Creek, and 19 mi upstream from mouth.

DRAINAGE AREA.--1,730 mi^2, approximately.

PERIOD OF RECORD.--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 current year.

REVISED RECORDS.--WSP 955: Drainage area. WSP 1508: 1913, 1916, 1928-32, 1934. WRD MN-74: 1963.

GAGE.--Water-stage recorder. Datum of gage is 1,083.59 ft above National Geodetic Vertical Datum of 1929. June 23, 1909, to Mar. 4, 1917, nonrecording gage and July 21, 1937, to Oct. 23, 1979, water-stage recorder at site 1.2 mi downstream at datum 10.53 ft lower; Mar. 5 to Sept. 30, 1917, and June 22, 1928, to July 20, 1937, nonrecording gage at site 1.18 mi downstream at datum 10.53 ft lower.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--67 years (water years 1912-16, 1929-90), 1,059 ft^3/s, 8.31 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discherge, 25,000 ft^3/s, Apr. 18, 1916, May 11, 1950, gage height, 37.00 ft, site and datum then in use; minimum observed, 21 ft^3/s, Aug. 26, 27, 1936.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,480 ft^3/s, June 6, 7, gage height, 8.26 ft; minimum, 57 ft^3/s, Sept. 18, gage height, 1.77 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	358	362	e250	e120	e105	e100	e1100	4990	936	1680	313	112
2	345	363	e240	e120	e105	e100	e1350	5060	906	1510	319	98
3	321	366	e230	e120	e105	e100	e1500	4900	1940	1350	284	86
4	329	371	e230	e120	e105	e100	e1600	4580	3280	1210	286	80
5	338	380	e220	e120	e105	e100	e1400	4160	4420	1050	264	74
6	367	390	e220	e120	e105	e100	e1300	3730	5280	890	249	71
7	416	398	e210	e120	e105	e100	e1200	3310	5400	822	236	68
8	458	412	e210	e120	e105	e100	e1100	2970	5070	795	227	65
9	469	438	e200	e120	e105	e100	e1050	2700	4580	1160	216	66
10	481	465	e190	e120	e105	e100	e1000	2430	3960	2060	195	67
11	508	496	e180	e115	e105	e105	e960	2230	3280	2160	181	65
12	529	494	e175	e115	e105	e110	e940	2010	2700	1810	173	65
13	527	488	e170	e115	e105	e120	e930	1810	2200	1460	168	65
14	523	518	e165	e115	e105	e200	922	1750	1840	1190	156	66
15	512	500	e160	e115	e105	e450	904	1820	1550	970	145	67
16	492	e400	e150	e115	e105	e1000	896	1790	1340	799	132	64
17	463	e350	e145	e115	e105	e2500	893	1780	1220	696	123	60
18	434	e350	e140	e115	e105	e2300	831	1800	1190	618	118	59
19	414	e370	e135	e115	e105	e2000	781	1810	1210	557	128	64
20	403	e390	e135	e115	e105	e1800	786	1770	2020	497	134	72
21	394	e430	e130	e110	e105	e1600	862	1670	4490	465	115	80
22	376	e380	e125	e110	e105	e1400	946	1560	5030	430	100	81
23	363	e340	e125	e110	e105	e1200	1070	1550	4750	386	92	75
24	368	e320	e125	e110	e105	e1050	1360	1630	4300	370	88	73
25	383	e300	e120	e110	e105	e950	1630	1670	3650	356	89	71
26	355	e290	e120	e110	e105	e800	1980	1590	2990	337	92	68
27	345	e280	e120	e110	e105	e750	2310	1480	2470	317	83	64
28	339	e270	e120	e110	e105	e700	2900	1340	2120	303	79	64
29	334	e260	e120	e110	---	e650	3760	1220	1950	297	77	64
30	335	e250	e120	e110	---	e700	4600	1140	1850	308	83	64
31	352	---	e120	e110	---	e800	---	1040	---	311	107	---
TOTAL	12631	11421	5100	3560	2940	22185	42861	73290	87922	27164	5052	2138
MEAN	407	381	165	115	105	716	1429	2364	2931	876	163	71.3
MAX	529	518	250	120	105	2500	4600	5060	5400	2160	319	112
MIN	321	250	120	110	105	100	781	1040	906	297	77	59
AC-FT	25050	22650	10120	7060	5830	44000	85010	145400	174400	53880	10020	4240
CFSM	.24	.22	.10	.07	.06	.41	.83	1.37	1.69	.51	.09	.04
IN.	.27	.25	.11	.08	.06	.48	.92	1.58	1.89	.58	.11	.05

CAL YR 1989 TOTAL 418152 MEAN 1146 MAX 12000 MIN 96 AC-FT 829400 CFSM .66 IN. 8.99
WTR YR 1990 TOTAL 296264 MEAN 812 MAX 5400 MIN 59 AC-FT 587600 CFSM .47 IN. 6.37

e Estimated

LAKE OF THE WOODS BASIN

05132000 BIG FORK RIVER AT BIG FALLS, MN

LOCATION.--Lat 48°11'45", long 93°48'25", in SW¼SE¼ sec.35, T.155 N., R.25 W., Koochiching County, Hydrologic Unit 09030006, on left bank at village of Big Falls, 700 ft downstream from falls, 0.3 mi downstream from bridge on U.S. Highway 71, and 4.8 mi upstream from Sturgeon River.

DRAINAGE AREA.--1,460 mi^2, approximately.

PERIOD OF RECORD.--August to November 1909, April to November 1910. April 1911 to September 1912 (gage heights and discharge measurements only). June 1928 to September 1979. October 1979 to September 1982, annual maximums only. October 1982 to current year.

REVISED RECORDS.--WSP 1308: 1935(M).

GAGE.--Water-stage recorder. Datum of gage is 1,144.71 ft above National Geodetic Vertical Datum of 1929. Prior to June 10, 1911, nonrecording gage at railroad bridge about 0.4 mi upstream at different datum. June 10, 1911, to Sept. 30, 1912, and June 22, 1928, to Dec. 17, 1937, nonrecording gage at site 200 ft upstream at same datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Prior to 1971, a powerplant, located 0.3 mi upstream, caused some diurnal fluctuation at low flows.

AVERAGE DISCHARGE.--59 years (water years 1929-79, 1983-90), 730 ft^3/s, 6.79 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 14,800 ft^3/s, May 8, 9, 1950; maximum gage height, 17.08 ft, May 8, 1950; minimum discharge recorded, 7 ft^3/s, Aug. 7, 1939.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 3,740 ft^3/s, June 23, gage height, 7.56 ft; minimum, 91 ft^3/s, Aug. 22, 23, gage height, 2.86 ft.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	527	558	e340	e160	e150	e140	e600	1990	681	1370	203	110
2	527	545	e330	e160	e150	e140	e850	1960	666	1410	195	108
3	521	533	e310	e160	e150	e140	e850	1870	962	1350	193	106
4	533	531	e300	e160	e150	e140	e850	1750	1720	1140	187	103
5	564	533	e290	e160	e150	e140	e800	1620	2280	925	170	102
6	570	528	e280	e155	e145	e140	e750	1510	2580	771	159	104
7	576	540	e270	e155	e145	e140	e700	1430	2540	683	153	103
8	576	565	e260	e155	e145	e140	e660	1360	2300	703	146	105
9	589	589	e250	e155	e145	e140	e630	1290	1950	828	139	104
10	601	612	e240	e155	e145	e140	e610	1200	1590	931	132	105
11	607	614	e230	e155	e145	e140	e590	1150	1320	858	126	105
12	631	565	e220	e155	e145	e150	e570	1130	1140	753	120	107
13	633	501	e215	e155	e145	e200	e560	1030	984	653	114	110
14	624	448	e210	e155	e145	e300	e550	1090	857	573	109	113
15	622	527	e205	e155	e145	e700	e540	1280	752	498	107	115
16	607	524	e200	e150	e145	e1000	e530	1320	675	439	103	120
17	582	437	e195	e150	e145	e1200	e520	1320	620	394	102	121
18	582	451	e190	e150	e145	e1300	e520	1300	643	365	103	123
19	565	589	e190	e150	e145	e1100	e520	1270	715	334	104	129
20	551	e500	e185	e150	e145	e1000	551	1190	1950	311	100	131
21	551	e480	e185	e150	e140	e900	559	1090	2880	293	95	133
22	551	e460	e180	e150	e140	e800	589	1050	3490	279	94	135
23	551	e450	e175	e150	e140	e700	630	1140	3680	267	93	137
24	546	e430	e175	e150	e140	e600	724	1250	3210	257	95	137
25	545	e420	e170	e150	e140	e550	899	1240	2580	241	95	136
26	546	e400	e170	e150	e140	e500	1160	1160	2110	232	97	137
27	545	e390	e165	e150	e140	e450	1720	1070	1710	218	99	132
28	539	e380	e165	e150	e140	e420	1870	973	1480	210	106	129
29	541	e360	e160	e150	---	e400	1970	889	1440	220	112	127
30	553	e350	e160	e150	---	e400	2000	802	1360	218	114	129
31	558	---	e160	e150	---	e400	---	729	---	208	113	---
TOTAL	17614	14810	6775	4750	4045	14610	24872	39453	50865	17932	3878	3556
MEAN	568	494	219	153	144	471	829	1273	1695	578	125	119
MAX	633	614	340	160	150	1300	2000	1990	3680	1410	203	137
MIN	521	350	160	150	140	140	520	729	620	208	93	102
AC-FT	34940	29380	13440	9420	8020	28980	49330	78260	100900	35570	7690	7050
CFSM	.39	.34	.15	.10	.10	.32	.57	.87	1.16	.40	.09	.08
IN.	.45	.38	.17	.12	.10	.37	.63	1.01	1.30	.46	.10	.09

CAL YR 1989 TOTAL 326788 MEAN 895 MAX 5500 MIN 137 AC-FT 648200 CFSM .61 IN. 8.33
WTR YR 1990 TOTAL 203160 MEAN 557 MAX 3680 MIN 93 AC-FT 403000 CFSM .38 IN. 5.18

e Estimated

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN

(International gaging station)

LOCATION.--Lat 48°38'04", long 93°54'47", in NW¼SE¼ sec.36, T.160 N., R.26 W., Koochiching County, Hydrologic Unit 09030004, on left bank at Manitou Rapids, 4 mi west of Indus.

DRAINAGE AREA.--19,400 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--July 1928 to current year. 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 U.S. Army Corps of Engineers Published as "near Birchdale" 1932-34.

GAGE.--Water-stage recorder. Datum of gage is 1,062.48 ft above National Geodetic Vertical Datum of 1929. Prior to Nov. 10, 1934, nonrecording gage at site near Birchdale, 7 mi. downstream at different datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Satellite telemeter at station. Diurnal fluctuation caused by powerplant at International Falls. Some regulation at low and medium flows by Rainy and Namakan Lakes.

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

AVERAGE DISCHARGE.--62 years, 12,870 ft^3/s, 9.01 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 71,600 ft^3/s, May 12, 1950, gage height, 21.04 ft; minimum daily, 928 ft^3/s, Dec. 26, 1929.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 37,300 ft^3/s, June 8, gage height, 13.76 ft; minimum daily, 3,000 ft^3/s, Dec. 26; minimum gage height, 2.13 ft, Sept. 4.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6700	6710	e6500	e5000	e5800	e5600	11100	12500	16700	27500	11900	5780
2	6730	6730	e6500	e4500	e5800	e5800	11300	13100	16100	27100	12000	5840
3	6690	6770	e6500	e5000	e5800	e6500	11700	13700	17300	28700	12100	5830
4	6640	6710	e6500	e5400	e5800	e7000	12100	13500	20200	30400	12100	4630
5	6570	6730	e6500	e5400	e5800	e7000	12000	13100	24500	30500	12100	4770
6	6570	6790	e6500	e5400	e5800	e7000	10000	12700	31900	30000	12000	5230
7	6800	6790	e6500	e5400	e5800	e7000	9050	12200	36600	29400	12000	5340
8	6840	6830	e6500	e5400	e5800	e7000	8700	11600	37200	29100	12000	5340
9	6900	6900	e6500	e5400	e5800	e7000	8500	12400	36600	28900	11900	5340
10	6980	6990	e6500	e5400	e5800	e6500	8280	12600	35600	29400	10900	5350
11	6950	7060	e6000	e5400	e5800	e5300	8230	14400	34200	29800	10600	5010
12	6980	7420	e6000	e5600	e5800	e5300	8220	16500	32900	29600	10600	4730
13	7080	7310	e6000	e5800	e5600	e5300	8240	17100	32000	28800	10700	4630
14	7040	7410	e5500	e5800	e5600	e5300	8010	17000	30900	26100	10700	4670
15	7020	7410	e5500	e5800	e5600	e6000	7360	17100	29200	24600	10600	4670
16	7020	7200	e5500	e5800	e5600	e7000	5060	21200	27200	23600	10200	4740
17	6980	7120	e5500	e5800	e5600	e9000	5730	25700	26400	20700	9960	4720
18	6950	e7000	e5500	e5800	e5600	e12000	7530	27100	26100	19500	9940	4670
19	6910	e6500	e5500	e5800	e5600	e12000	8100	27400	23800	19200	9900	4680
20	6870	e6500	e5500	e5800	e5600	e11000	8130	27400	24100	17000	9790	4700
21	6840	e6500	e5500	e5800	e5600	e10500	7820	27300	27500	15800	8660	4740
22	6800	e6500	e5500	e5800	e5600	e11000	7690	27100	30600	15500	6460	4850
23	6770	e6500	e5500	e5800	e5600	e12000	7700	27100	31900	15400	5200	4820
24	6770	e6500	e5500	e5800	e5600	e12000	7410	27400	31700	13400	4930	4740
25	6760	e6500	e4500	e5800	e5600	e11500	7590	27600	30400	12000	4880	5140
26	6780	e6500	e3000	e5800	e5600	e11000	8030	27600	28700	11700	4850	5440
27	6740	e6500	e4000	e5800	e5600	e11000	8680	27300	27000	11600	4840	5170
28	6680	e6500	e5500	e5800	e5600	e11000	9520	26600	25900	11500	4830	5120
29	6670	e6500	e5500	e5800	---	11000	10600	25900	25200	11500	5270	5120
30	6690	e6500	e5500	e5800	---	10900	11600	23700	25400	11500	5670	5140
31	6670	---	e5500	e5800	---	11000	---	19100	---	11500	5770	---
TOTAL	211390	203880	177000	173500	159200	267500	264000	625000	843800	671300	283350	150950
MEAN	6819	6796	5710	5597	5686	8629	8800	20160	28130	21650	9140	5032
MAX	7060	7420	6500	5800	5800	12000	12100	27600	37200	30500	12100	5840
MIN	6570	6500	3000	4500	5600	5300	5060	11600	16100	11500	4830	4630
AC-FT	419300	404400	351100	344100	315800	530600	523600	1240000	1674000	1332000	562000	299400
CFSM	.35	.35	.29	.29	.29	.44	.45	1.04	1.45	1.12	.47	.26
IN.	.41	.39	.34	.33	.31	.51	.51	1.20	1.62	1.29	.54	.29

CAL YR 1989 TOTAL 4913040 MEAN 13460 MAX 38400 MIN 3000 AC-FT 9745000 CFSM .69 IN. 9.42
WTR YR 1990 TOTAL 4030870 MEAN 11040 MAX 37200 MIN 3000 AC-FT 7995000 CFSM .57 IN. 7.73

e Estimated

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN--Continued
(National stream-quality network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1968-70, 1978 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	DIS-CHARGE, IN CUBIC FEET PER SECOND (00060)	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)
OCT												
02...	1100	--	6720	100	94	7.4	7.7	12.0	3.5	768	--	110
NOV												
13...	1300	--	7130	102	79	6.9	7.3	1.0	1.8	762	13.3	330
FEB												
06...	0945	5800	--	75	90	7.1	7.5	0.0	1.2	731	11.8	180
MAY												
01...	1030	--	13100	150	143	7.7	7.9	5.0	26	729	10.7	K20
JUN												
18...	1200	--	26300	85	65	7.1	7.7	17.5	1.5	731	9.1	98
JUL												
30...	1300	--	11500	68	71	7.3	7.7	22.0	25	738	7.6	K140

DATE	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)
OCT												
02...	K30	11	2.9	4.9	0.80	31	31	0	38	5.0	5.4	0.10
NOV												
13...	79	7.9	2.3	5.1	0.90	28	25	0	34	6.0	4.4	<0.10
FEB												
06...	70	8.9	2.5	4.6	0.80	31	27	0	38	6.0	5.3	0.10
MAY												
01...	K42	15	6.0	3.2	1.9	61	60	0	74	6.6	2.8	0.10
JUN												
18...	260	7.4	2.3	2.3	0.70	21	23	0	26	3.4	2.8	<0.10
JUL												
30...	340	7.3	2.2	3.9	0.80	22	23	0	27	4.2	4.3	<0.10

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT												
02...	1.8	40	<0.010	<0.100	0.030	0.030	0.70	0.030	<0.010	<0.010	8	98
NOV												
13...	2.2	62	<0.010	<0.100	0.020	0.020	0.70	0.030	0.020	0.010	8	61
FEB												
06...	3.9	69	0.010	0.140	0.040	0.040	0.50	0.030	0.020	0.010	2	100
MAY												
01...	5.3	117	0.010	0.100	0.100	0.100	0.90	0.070	0.040	0.010	128	99
JUN												
18...	2.6	56	<0.010	<0.100	0.080	0.020	0.90	0.030	0.030	<0.010	24	29
JUL												
30...	2.7	56	<0.010	<0.100	0.020	0.020	0.50	0.030	0.030	<0.010	11	87

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN--Continued

QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
02...	1100	20	<1	15	<0.5	<1.0	<1	<3	2	96	1
FEB											
06...	0945	30	<1	15	<0.5	<1.0	<5	<3	<10	85	<10
MAY											
01...	1030	<10	<1	26	<0.5	5.0	<1	<3	3	300	1
JUL											
30...	1300	70	<1	13	<0.5	<1.0	1	<3	4	82	<1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
02...	<4	6	<0.1	<10	1	<1	<1.0	28	<6	7
FEB										
06...	<4	8	<0.1	<10	<10	<1	<1.0	27	<6	7
MAY										
01...	9	27	0.1	<10	2	<1	<1.0	39	<6	89
JUL										
30...	<4	6	<0.1	<10	1	<2	<1.0	22	<6	4

LAKE OF THE WOODS BASIN

05140520 LAKE OF THE WOODS AT WARROAD, MN

(International gaging station)

LOCATION.--Lat 48°54'15", long 95°18'57", in SW¼SE¼ sec.29, T.163 N., R.36 W., Roseau County, Hydrologic Unit 09030009, on left bank of Warroad River in Warroad, 300 ft downstream from Canadian National railroad bridge, 1,000 ft downstream from bridge on State Highway 11, and 4,000 ft upstream from mouth of Warroad River.

DRAINAGE AREA.--27,200 mi^2.

PERIOD OF RECORD.--April to September 1978 (monthend elevations only), October 1978 to current year. Records collected prior to April 1978 are in reports of the Water Survey of Canada.

GAGE.--Water-stage recorder. Datum of gage is 1,000.00 ft, Lake of the Woods datum.

REMARKS.--Runoff conditions of the Warroad River can affect water levels obtained at this station. Water level subject to fluctuation caused by change in direction and velocity of wind and seiches.

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

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 62.38 ft, July 15, 1989; maximum daily, 61.84 ft, Sept. 12, 1978; minimum gage height recorded, 55.94 ft, Sept. 4, 1980; minimum daily recorded, 56.52 ft, Apr. 15, 1981.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 60.94 ft, July 17; maximum daily, 60.72 ft, July 11; minimum, 57.57 ft, Oct. 27; minimum daily, 57.89 ft, Mar. 9.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59.42	59.01	58.70	58.41	58.14	57.91	58.11	58.08	59.00	60.26	59.97	59.49
2	59.38	59.02	58.68	58.41	58.15	57.90	58.13	58.21	59.67	60.34	59.94	59.56
3	59.20	58.87	58.72	58.38	58.14	57.93	58.14	58.29	59.78	60.44	60.08	59.41
4	59.17	58.90	58.69	58.37	58.12	57.95	58.11	58.30	59.25	60.32	60.13	59.56
5	59.16	58.91	58.65	58.37	58.09	57.94	58.12	58.31	59.07	60.54	60.04	59.40
6	59.19	58.88	58.64	58.36	58.10	57.94	58.12	58.19	59.16	60.49	59.96	59.52
7	59.27	58.88	58.65	58.34	58.09	57.93	58.13	58.56	59.20	60.44	59.90	59.52
8	59.24	58.87	58.67	58.32	58.07	57.93	58.15	58.32	59.35	60.52	59.86	59.25
9	59.06	58.95	58.65	58.33	58.04	57.89	58.16	58.51	59.47	60.50	60.02	59.42
10	59.15	58.73	58.64	58.32	58.05	57.90	58.13	58.36	59.55	60.60	60.01	59.32
11	59.06	58.55	58.63	58.27	58.07	57.94	58.13	58.26	59.51	60.72	59.96	59.22
12	59.00	58.87	58.65	58.28	58.04	57.94	58.13	58.37	59.63	60.57	59.95	59.53
13	59.27	58.93	58.61	58.33	58.01	57.92	58.13	58.57	59.67	60.47	59.67	59.27
14	59.20	58.90	58.60	58.29	58.01	57.95	58.13	58.49	59.80	60.44	59.86	59.26
15	59.39	58.93	58.57	58.26	58.02	57.97	58.14	58.48	59.85	60.45	59.85	59.35
16	59.24	58.83	58.58	58.27	58.02	57.98	58.11	58.50	59.85	60.44	59.80	59.31
17	59.18	58.81	58.56	58.24	58.03	57.98	58.10	58.42	59.98	60.44	60.21	59.06
18	59.10	58.76	58.56	58.24	57.98	58.00	58.12	58.57	59.90	60.39	60.22	59.03
19	58.93	58.75	58.54	58.23	57.98	58.02	58.11	58.65	59.97	60.44	59.95	59.13
20	59.09	58.79	58.53	58.23	57.99	58.04	58.12	58.67	59.94	60.45	59.80	59.13
21	59.10	58.82	58.53	58.21	57.96	58.04	58.11	58.66	60.04	60.43	59.74	58.86
22	59.06	58.74	58.53	58.19	57.97	58.01	58.14	58.75	60.19	60.41	59.70	59.30
23	59.08	58.77	58.53	58.24	57.97	58.03	58.15	58.84	60.18	60.36	59.65	58.98
24	59.10	58.80	58.53	58.18	57.93	58.03	58.13	58.88	60.14	60.30	59.72	58.90
25	59.06	58.74	58.53	58.21	57.97	58.04	58.12	58.95	60.17	60.34	59.69	59.07
26	59.04	58.78	58.52	58.22	57.96	58.07	58.13	58.91	60.27	60.33	59.78	59.05
27	58.48	58.74	58.49	58.15	57.93	58.09	58.43	58.88	60.27	60.30	59.65	59.08
28	58.97	58.73	58.48	58.21	57.95	58.09	58.28	59.15	60.30	60.16	59.61	59.12
29	59.09	58.70	58.46	58.19	---	58.10	58.06	59.09	60.31	60.29	59.52	59.14
30	59.07	58.71	58.45	58.13	---	58.09	57.93	59.01	60.35	60.23	59.58	59.00
31	59.17	---	58.41	58.16	---	58.09	---	58.95	---	60.02	59.48	---
MEAN	59.13	58.82	58.58	58.27	58.03	57.99	58.13	58.59	59.79	60.40	59.85	59.24
MAX	59.42	59.02	58.72	58.41	58.15	58.10	58.43	59.15	60.35	60.72	60.22	59.56
MIN	58.48	58.55	58.41	58.13	57.93	57.89	57.93	58.08	59.00	60.02	59.48	58.86

CAL YR 1989 MEAN 59.78 MAX 61.72 MIN 58.41
WTR YR 1990 MEAN 58.91 MAX 60.72 MIN 57.89

LAKE OF THE WOODS BASIN

05140521 LAKE OF THE WOODS AT SPRINGSTEEL ISLAND NEAR WARROAD, MN

LOCATION.--Lat 48°56'45", long 95°18'24", in SW¼SW¼ sec.9, T.163 N., R.36 W., Roseau County, Hydrologic Unit 09030009, at Springsteel Resort on Springsteel Island, 2.8 mi north of Warroad.

DRAINAGE AREA.--27,200 mi^2.

PERIOD OF RECORD.--June 1985 to current year.

GAGE.--Water-stage recorder. Datum at gage is 1,000.00 ft, Lake of the Woods datum.

REMARKS.--Satellite telemeter at station. Water level subject to fluctuation caused by changes in direction and velocity of wind and seiches.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 62.24 ft, July 5, 1989; maximum daily, 61.81 ft, July 6, 7, 1985; minimum, 57.42 ft, Mar. 17, 18, 19, 20, 22, 25, 1988; minimum daily, 57.43 ft, Mar. 18, 19, 20, 1988.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 60.88 ft, July 7; maximum daily, 60.72 ft, July 11; minimum, 57.65 ft, Apr. 30; minimum daily, 57.89 ft, Mar. 9, 10.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59.44	59.01	58.68	58.40	58.09	57.90	58.09	58.06	59.01	60.31	59.99	59.52
2	59.35	59.01	58.65	58.39	58.11	57.90	58.10	58.18	---	60.36	59.98	59.61
3	59.21	58.92	58.69	58.37	58.08	57.91	58.12	58.20	---	60.45	60.11	59.49
4	59.20	58.95	58.69	58.37	58.09	57.93	58.10	58.22	---	60.34	60.13	59.58
5	59.18	58.92	58.64	58.37	58.06	57.93	58.10	58.26	---	60.53	60.07	59.46
6	59.16	58.91	58.62	58.34	58.08	57.93	58.10	58.22	---	60.51	60.00	59.56
7	59.28	58.93	58.62	58.34	58.08	57.91	58.11	58.49	---	60.47	59.95	59.57
8	59.27	58.89	58.64	58.32	58.06	57.91	58.12	58.32	---	60.54	59.91	59.33
9	59.10	58.95	58.64	58.31	58.04	57.89	58.14	58.39	---	60.52	60.01	59.46
10	59.21	58.79	58.60	58.32	58.02	57.89	58.13	58.34	---	60.61	60.00	59.37
11	59.11	58.58	58.59	58.27	58.04	57.92	58.13	58.28	---	60.72	59.98	59.27
12	59.05	58.91	58.59	58.26	58.00	57.94	58.13	58.35	---	60.60	59.94	59.52
13	59.28	58.95	58.57	58.30	57.97	57.93	58.14	58.47	---	60.52	59.73	59.29
14	59.22	58.93	58.56	58.26	57.99	57.95	58.14	58.42	---	60.49	59.85	59.25
15	59.37	58.90	58.54	58.24	58.00	57.98	58.13	58.44	---	60.48	59.87	59.28
16	59.27	58.81	58.55	58.26	58.00	58.00	58.11	58.48	---	60.40	59.83	59.31
17	59.21	58.81	58.53	58.23	58.00	57.99	58.11	58.33	---	60.34	60.16	59.13
18	59.13	58.74	58.53	58.21	57.97	57.99	58.11	58.52	---	60.36	60.18	59.06
19	58.99	58.76	58.50	58.22	57.97	58.02	58.11	58.63	59.80	60.41	59.94	59.14
20	59.13	58.75	58.47	58.21	57.98	58.06	58.12	58.62	59.85	60.44	59.81	59.15
21	59.15	58.82	58.45	58.20	57.95	58.06	58.13	58.66	59.97	60.42	59.78	58.81
22	59.12	58.74	58.47	58.18	57.96	58.02	58.16	58.71	60.11	60.41	59.73	59.16
23	59.13	58.76	58.49	58.25	57.95	58.04	58.17	58.78	60.12	60.38	59.69	59.02
24	59.15	58.80	58.47	58.19	57.92	58.05	58.14	58.84	60.13	60.32	59.75	58.93
25	59.13	58.75	58.44	58.20	57.94	58.06	58.15	58.89	60.19	60.35	59.74	59.08
26	59.11	58.77	58.45	58.22	57.94	58.08	58.11	58.87	60.29	60.34	59.81	59.07
27	58.68	58.73	58.44	58.14	57.92	58.10	58.31	58.86	60.30	60.32	59.71	59.07
28	58.99	58.70	58.45	58.17	57.94	58.11	58.23	59.08	60.34	60.20	59.66	59.10
29	59.10	58.68	58.42	58.16	---	58.11	58.05	59.05	60.34	60.30	59.58	59.14
30	59.08	58.70	58.42	58.09	---	58.12	57.91	59.00	60.36	60.23	59.64	59.04
31	59.15	---	58.39	58.12	---	58.10	---	58.97	---	60.04	59.54	---
MEAN	59.16	58.83	58.54	58.26	58.01	57.99	58.12	58.55	---	60.41	59.87	59.26
MAX	59.44	59.01	58.69	58.40	58.11	58.12	58.31	59.08	---	60.72	60.18	59.61
MIN	58.68	58.58	58.39	58.09	57.92	57.89	57.91	58.06	---	60.04	59.54	58.81

PARTIAL-RECORD STATIONS

Making discharge measurement at West Swan River near Silica, Minnesota, April 16, 1963.

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

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 at low-flow partial-record stations and the second is a table of annual maximum stage and discharge at crest-stage stations.

Low-flow partial-record stations

Measurements of streamflow in the area covered by this report made at low-flow partial-record stations are given in the following table. 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 when continuous records are available, will give a picture of the low-flow potentiality of a 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 1990

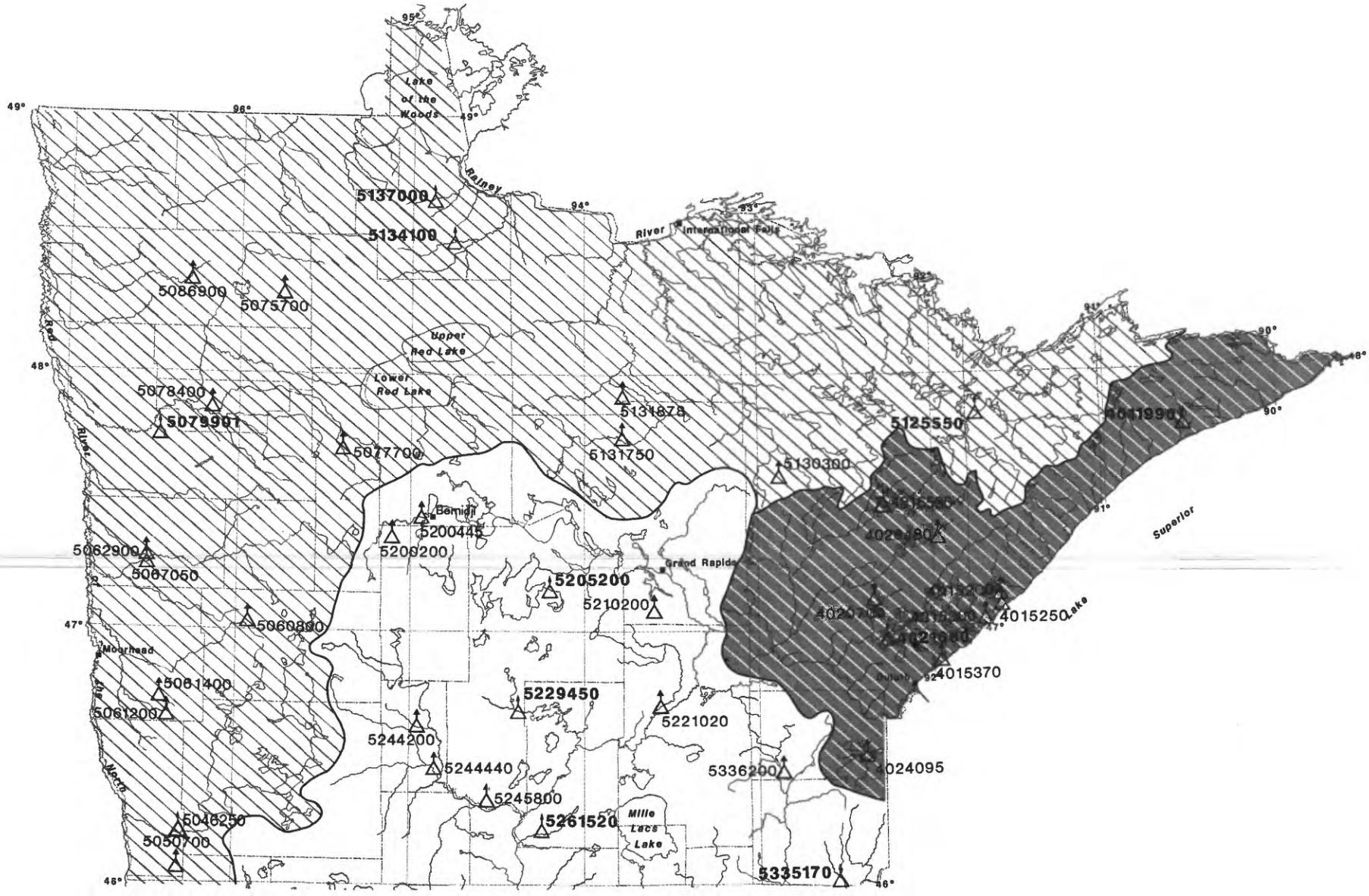
Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Lake of the Woods basin				
05129380	Rat Root River near Littlefork, MN	Lat 48°24'35", long 93°21'55", in SW¼NE¼ sec.1, T.68 N., R.24 W., Koochiching County, Hydrologic Unit 09030003, at bridge on County Road 5, 7 miles southwest of Ericsburg, 9 miles east of Littlefork.	89.6	1970-73, 1975-76, 1980, 1990	9-26-90	0
05129390	East Branch Rat Root River near Ray, MN	Lat 48°26'32", long 93°11'58", in NW¼NW¼ sec.29, T.69 N., R.22 W., Koochiching County, Hydrologic Unit 09030003, at bridge on County Highway 3, 2 miles north of Ray.	63.9	1970-73, 1975-76, 1980, 1990	9-26-90	0
05131760	Rice River near Bigfork, MN	Lat 47°40'28", long 93°39'17", in NE¼NW¼ sec.16, T.60 N., R.26 W., Itasca County, Hydrologic Unit 09030006, at bridge on County Highway 254, 5 miles south of Bigfork.	82.8	1969-72, 1975-76, 1980, 1990	9-27-90	9.34
05131770	Gale Brook near Bigfork, MN	Lat 47°43'22", long 93°39'26", in NE¼NW¼ sec.4, T.60 N., R.26 W., Itasca County, Hydrologic Unit 09030006, at culvert on County Highway 7, 1.5 miles south of Bigfork.	27.8	1969-72, 1975-76, 1980, 1990	9-27-90	.01
05131900	Caldwell Brook at Caldwell Road near Effie, MN	Lat 47°57'15", long 93°52'54", in NW¼SW¼ sec.29, T.152 N., R.25 W., Koochiching County, Hydrologic Unit 09030006, at bridge on Caldwell Road, 12 miles northwest of Effie.	122	1969-72, 1975-76, 1980, 1990	9-26-90	.35
05132200	Sturgeon River near Big Falls, MN	Lat 48°12'57", long 93°55'54", in NE¼SE¼ sec.26, T.155 N., R.26 W., Koochiching County, Hydrologic Unit 09030006, at bridge on County Highway 30, 6.2 miles northwest of Big Falls.	a280	1970-72, 1975-76, 1980, 1990	9-26-90	.04

a Approximately

HIGH-FLOW PARTIAL-RECORD STATIONS

Roseau River near Haug, Minnesota, April 14, 1932

Snake River at Mora, Minnesota, July 24, 1972.


Lake of the Woods
Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Bemidji
Grand Rapids
Moorhead
Superior Lake
Mille Lacs Lake
5137000
5134100
5086900
5075700
5078400
5079901
5077700
5131878
6131750
5125550
5130300
5200445
5209200
5205200
5210200
5060890
5062900
5067060
5061400
5061200
5229450
5221020
5244200
5244440
5245800
5261520
5336200
5046250
5050700
5335170
4015250
4015370
4024095

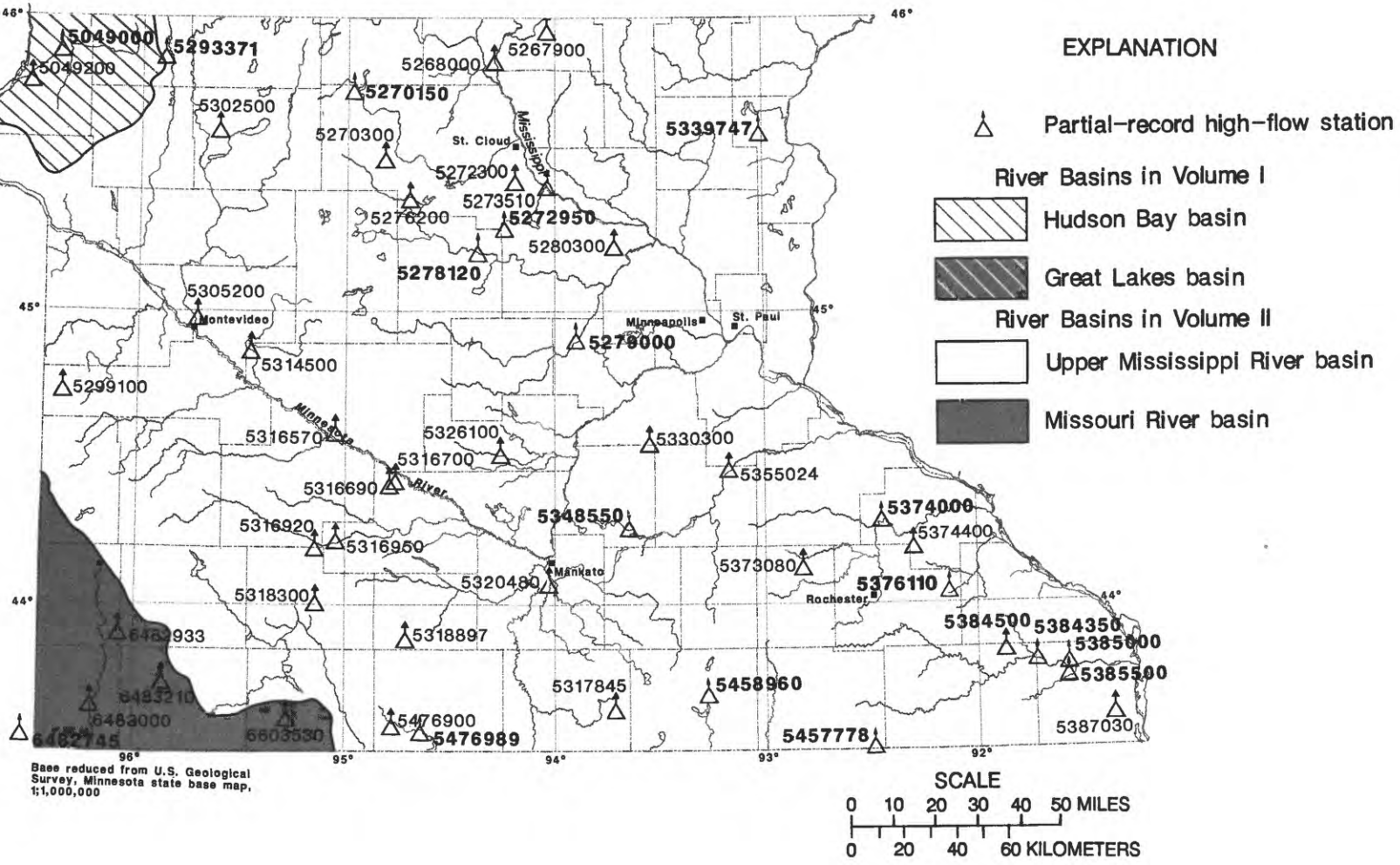


Figure 9.--Location of high-flow partial-record stations

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

High-flow partial-record stations

The following table contains annual maximum discharge for high-flow stations. A high-flow partial-record station is equipped with a crest-stage gage, 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, and discharge measurements may have been made for purposes of establishing the stage-discharge relation, but these are 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 high-flow partial-record stations during water year 1990

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Annual maximum Date	Gage height (feet)	Discharge (ft^3/s)
		Streams tributary to Lake Superior					
04011990	Cascade River near Grand Marais, MN	Lat 47°47'24", long 90°31'35", in SE¼ sec.1, T.61 N., R.2 W., Cook County, Hydrologic Unit 04010101, at bridge on Forest Road 45, 6.6 miles upstream from mouth, 9.5 miles west of Grand Marais.	-	1985-90	4-29-90	11.95	1,210
04015200	Encampment River tributary at Silver Creek, MN	Lat 47°07'01", long 91°36'04", in NE¼SE¼ sec.33, T.54 N., R.10 W., Lake County, Hydrologic Unit 04010102, at culvert on County Highway 3, 0.3 mile north of Silver Creek, 1.4 miles upstream from mouth, 7.2 miles northeast of Two Harbors.	.96	1960-90	4-28-90	a7.40	42
04015250	Silver Creek tributary near Two Harbors, MN	Lat 47°04'40", long 91°36'49", in SW¼NE¼ sec.16, T.53 N., R.10 W., Lake County, Hydrologic Unit 04010102, at culvert on County Highway 3, 1.0 mile upstream from mouth, 4.5 miles northeast of Two Harbors.	3.72	1965-90	8-25-90	2.90	104
04015300	Little Stewart River near Two Harbors, MN	Lat 47°03'52", long 91°40'03", in SE¼NE¼ sec.24, T.53 N., R.11 W., Lake County, Hydrologic Unit 04010102, at culvert on County Highway 2, 2.0 miles upstream from mouth, 2.7 miles north of Two Harbors.	5.54	1960-90	4-28-90	a9.46	94
04015370	Talmadge River at Duluth, MN	Lat 46°53'20", long 91°55'21", in SE¼NE¼ sec.24, T.51 N., R.13 W., St. Louis County, Hydrologic Unit 04010102, at culvert on U.S. Highway 61, 0.6 mile upstream from mouth, 0.5 mile northeast of Duluth city limits.	5.79	1964-90	4-29-90	a13.56	126
04016500	St. Louis River near Aurora, MN	Lat 47°29'30", long 92°14'20", in NW¼SW¼ sec.22, T.58 N., R.15 W., St. Louis County, Hydrologic Unit 04010201, on left bank at upstream side of County Highway 100 bridge, 0.8 mile downstream from Partridge River and 1.5 mile south of Aurora.	290	1942-87# 1988-90	5-1-90	4.91	1,930
04020480	North Branch Whiteface River near Fairbanks, MN	Lat 47°22'20", long 91°56'28", in NW¼NW¼ sec.1, T.56 N., R.13 W., St. Louis County, Hydrologic Unit 04010201, on right downstream wing wall of double box culvert on County Highway 16, 2 miles upstream from the mouth of Jenkins Creek, 0.7 mile west of Fairbanks.	17.1	1979-90	4-30-90	12.50	228
04020700	Bug Creek at Shaw, MN	Lat 47°06'40", long 92°21'03", in SW¼SE¼ sec.34, T.54 N., R.16 W., St. Louis County, Hydrologic Unit 04010201, at left bank on downstream side of culverts on County Road 15 at Shaw, 7.5 miles upstream from mouth.	24.0	1979-90	4-30-90	14.08	348

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1990--Continued

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Annual maximum Date	Gage height (feet)	Discharge (ft^3/s)
		Streams tributary to Lake Superior--Continued					
04021690	Cloquet River near Toimi, MN	Lat 47°21'00", long 91°39'30", in NE¼SW¼ sec.7, T.56 N., R.10 W., Lake County, Hydrologic Unit 04010202, at bridge on County Highway 2, 5.8 miles southeast of Toimi, 23 miles north of Two Harbors.	-	1986-90	4-30-90	7.51	570
04024095	Nemadji River near Holyoke, MN	Lat 46°31'04", long 92°23'22", in NE¼NE¼ sec.32, T.47 N., R.16 W., Carlton County, Hydrologic Unit 04010301, at bridge on State Highway 23, 3.5 miles north of Holyoke, 7 miles south of Wrenshall.	118	1972-90	9-6-90	15.83	3,600
		Red River of the North basin					
05046250	Ottertail River near Foxhome, MN	Lat 46°12'48", long 96°18'24", in SW¼SW¼ sec.26, T.132 N., R.45 W., Wilkin County, Hydrologic Unit 09020103, at bridge on County Road 19, 4 miles south of Foxhome, 10.8 miles below Orwell Dam.	-	1990	6-14-90	bc14.4	d690
05049000	Mustinka River above Wheaton, MN	Lat 45°49'15", long 96°29'25", in SW¼ sec.8, T.127 N., R.46 W., Traverse County, Hydrologic Unit 09020102, at bridge on U.S. Highway 75, one mile upstream from Chicago, Milwaukee and St. Paul railroad bridge, 0.5 mile north of Wheaton, about 8 miles above Lake Traverse.	834	1915-24#, 1930-58#, 1985-90	4-4-90	e3.83	130
05049200	Eighteenmile Creek near Wheaton, MN	Lat 45°47'18", long 96°31'52", in NW¼NW¼ sec.25, T.127 N., R.47 W., Traverse County, Hydrologic Unit 09020102, at culvert on County Highway 7, 1.4 miles upstream from mouth, 2.0 miles southwest of Wheaton.	68.5	1965-90,	3-12-90	e5.33	23
05050700	Rabbit River near Nashua, MN	Lat 46°04'30", long 96°18'24", in SE¼NE¼ sec.15, T.130 N., R.45 W., Wilkin County, Hydrologic Unit 09020101, at bridge on County Road 19, 2.6 miles north of Nashua, 4.8 miles upstream from mouth of South Fork Rabbit River.	56.1	1979-90	3-13-90	c	d5
05060800	Buffalo River near Callaway, MN	Lat 47°01'17", long 95°54'43", in SW¼SW¼ sec.17, T.141 N., R.41 W., Becker County, Hydrologic Unit 09020106, at culvert on U.S. Highway 59, 2.7 miles north of Callaway.	94.5	1960-90	4-1-90	e14.11	255
05061200	Whiskey Creek at Barnesville, MN	Lat 46°39'35", long 96°23'54", in SE¼SW¼ sec.20, T.137 N., R.45 W., Clay County, Hydrologic Unit 09020106, at culvert on State Highway 34, 0.7 mile upstream from Blue Eagle Lake, 1.0 mile northeast of Barnesville.	25.3	1961-64, 1965-66#, 1967-90	3-30-90	4.43	118

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1990--Continued

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Annual maximum Date	Gage height (feet)	Discharge (ft^3/s)
		Red River of the North basin--Continued					
05061400	Spring Creek above Downer, MN	Lat 46°44'37", long 96°25'12", in NW¼NW¼ sec.30, T.138 N., R.45 W., Clay County, Hydrologic Unit 09020106, at culvert on county road, 3.1 miles east of Downer.	5.81	1961-90	3-30-90	6.05	13
05062900	Wild Rice River above Ada, MN	Lat 47°17'29", long 96°26'09", in SE¼NE¼ sec.13, T.144 N., R.46 W., Norman County, Hydrologic Unit 09020108, at bridge on County Highway 24, 3.2 miles southeast of Ada.	-	1985-90	4-1-90	e17.98	906
05067050	Marsh River Ditch near Ada, MN	Lat 47°17'46", long 96°26'09", in NE¼NE¼ sec.13, T.144 N., R.46 W., Norman County, Hydrologic Unit 09020108, at bridge on County Highway 24, 3.5 miles southeast of Ada.	-	1985-90	-	-	0
05075700	Mud River near Grygla, MN	Lat 48°19'31", long 95°44'35", in NE¼NE¼ sec.23, T.156 N., R.40 W., Hydrologic Unit 09020304, Marshall County, at bridge on State Highway 89, 6 miles west of Grygla.	170	1979-90	4-16-90	e11.39	90
05077700	Ruffy Brook near Gonvick, MN	Lat 47°44'50", long 95°24'45", in SE¼SE¼ sec.5, T.149 N., R.37 W., Clearwater County, Hydrologic Unit 09020305, at culvert on County Highway 17, 4.0 miles upstream from mouth, 4.8 miles east of Gonvick.	45.2	1960-78#, 1979-85, 1986,# 1987-90	6-20-90	c	d30
05078400	Clearwater River tributary near Plummer, MN	Lat 47°52'34", long 96°08'35", in SE¼SE¼ sec.22, T.151 N., R.43 W., Red Lake County, Hydrologic Unit 09020305, at culvert on County Highway 1, 1.2 miles upstream from mouth, 5.3 miles southwest of Plummer.	6.51	1961-90	3-13-90	e12.19	5
05079901	Burnham Creek near Crookston, MN	Lat 47°43'59", long 96°39'52", in SE¼SW¼ sec.10, T.149 N., R.47 W., Polk County, Hydrologic Unit 09020303, at triple box culvert on U.S. Highway 75, 0.75 mile northeast of Girard, 3 miles southwest of Crookston, 7 miles above mouth.	d111	1986-90	3-31-90	a11.09	55
05086900	Middle River near Newfolden, MN	Lat 48°22'04", long 96°16'47", in NE¼NE¼ sec.3, T.156 N., R.44 W., Marshall County, Hydrologic Unit 09020309, at bridge on township road, 2.0 miles northeast of Newfolden.	91.1	1979-90	3-14-90	a12.80	46
		Lake of the Woods basin					
05125550	Stony River near Babbitt, MN	Lat 47°41'36", long 91°45'38", in SW¼SW¼ sec.8, T.60 N., R.11 W., Lake County, Hydrologic Unit 09030001, in Superior National Forest, at bridge on Forest Road 424, 4.7 miles upstream from mouth, 8.5 miles southeast of Babbitt.	219	1975-80#, 1986-90	4-30-90	7.21	1,370

"See footnotes at end of the table."

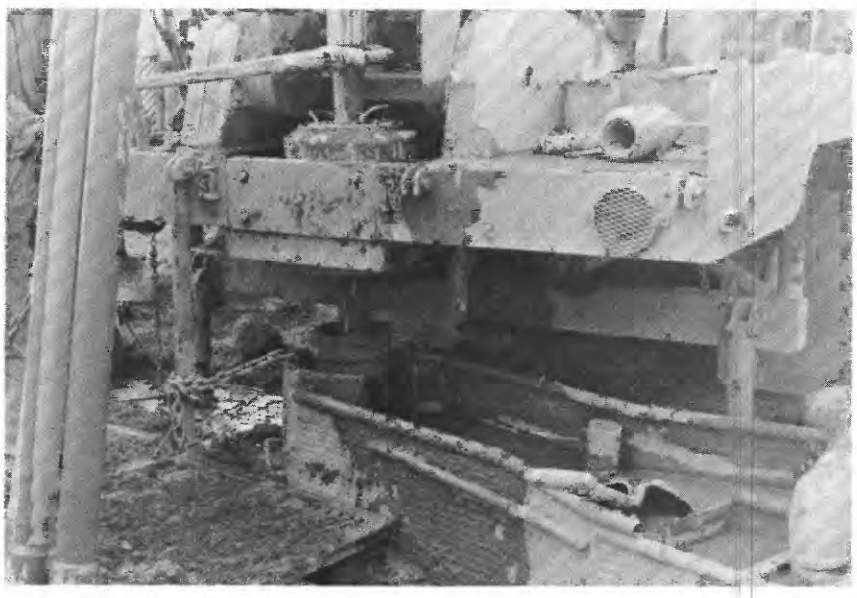
DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1990--Continued

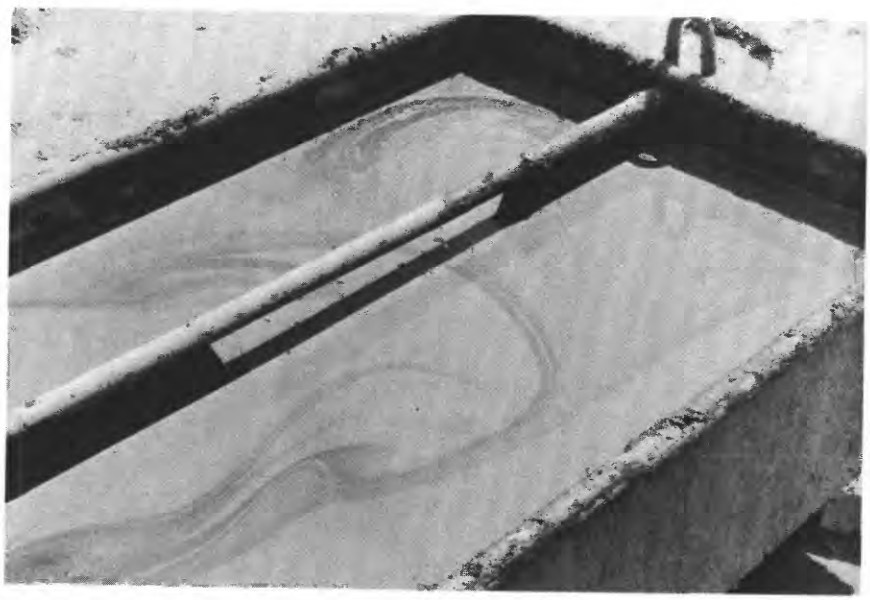
Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Annual maximum Gage height (feet)	Annual maximum Discharge (ft^3/s)
		Lake of the Woods basin--Continued				
05130300	Boriin Creek near Chisholm, MN	Lat 47°36'14", long 92°51'58", in SE¼SE¼ sec.9, T.59 N., R.20 W., St. Louis County, Hydrologic Unit 09030005, at culvert on State Highway 73, 1.3 miles upstream from mouth, 7.8 miles north of Chisholm.	13.7	1959-90	6-3-90	12.51	215
05131750	Big Fork River near Bigfork, MN	Lat 47°44'56", long 93°46'31", in SW¼NE¼ sec.27, T.61 N., R.27 W., Itasca County, Hydrologic Unit 09030006, at bridge on State Highway 6, 5.5 miles west of Bigfork.	602	1973-90	6-21-90	11.25	930
05131878	Bowerman Brook near Craigville, MN	Lat 47°55'29", long 93°45'34", in NE¼NW¼ sec.26, T.63 N., R.27 W., Koochiching County, Hydrologic Unit 09030006, at culvert on State Highway 6, 2.4 miles upstream from mouth, 7.0 miles west of Craigville.	25.0	1979-90	6-21-90	a12.76	210
05134100	North Branch Rapid River near Baudette, MN	Lat 48°31'56", long 94°38'50", in NW¼SW¼ sec.4, T.158 N., R.31 W., Lake of the Woods County, Hydrologic Unit 09030007, at bridge on County Highway 1, 12.7 miles southwest of Baudette.	b180	1986-90	-	c<4.5	d50
05137000	Winter Road River near Baudette, MN	Lat 48°42'39", long 94°41'52", in NW¼NE¼ sec.1, T.160 N., R.32 W., Lake of the Woods County, Hydrologic Unit 09030008, at bridge on State Highway 11, 4.5 miles west of Baudette, 1.8 miles east of Pitt, 5 miles upstream of mouth.	145	1986-90	3-16-90	e7.65	25

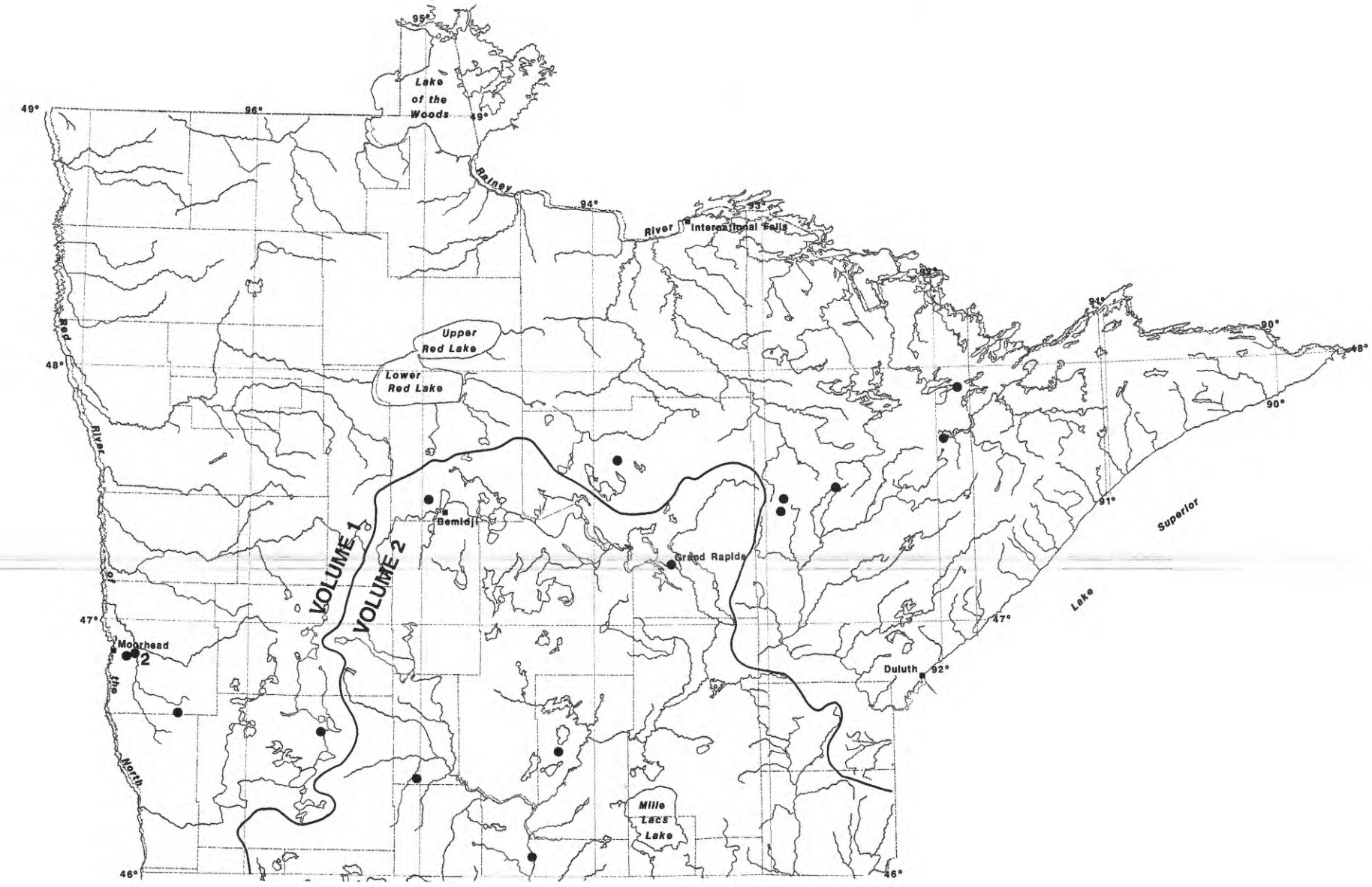
< Less than, peak stage unknown, discharge estimated.
Operated as a continuous-record gaging station.
a Not annual maximum gage height.
b Approximate.
c Peak stage did not reach bottom of gage.
d Discharge estimated.
e Backwater from ice, discharge estimated.

Yellow Medicine River watershed
May 1967



Yellow Medicine River watershed
May 1967




Lake of the Woods
Rainy River
International Falls
Red River
Upper Red Lake
Lower Red Lake
Bemidji
Grand Rapids
VOLUME 1
VOLUME 2
Moorhead
Duluth
Superior Lake
Mille Lacs Lake
95°
96°
49°
94°
93°
92°
91°
90°
48°
47°
46°

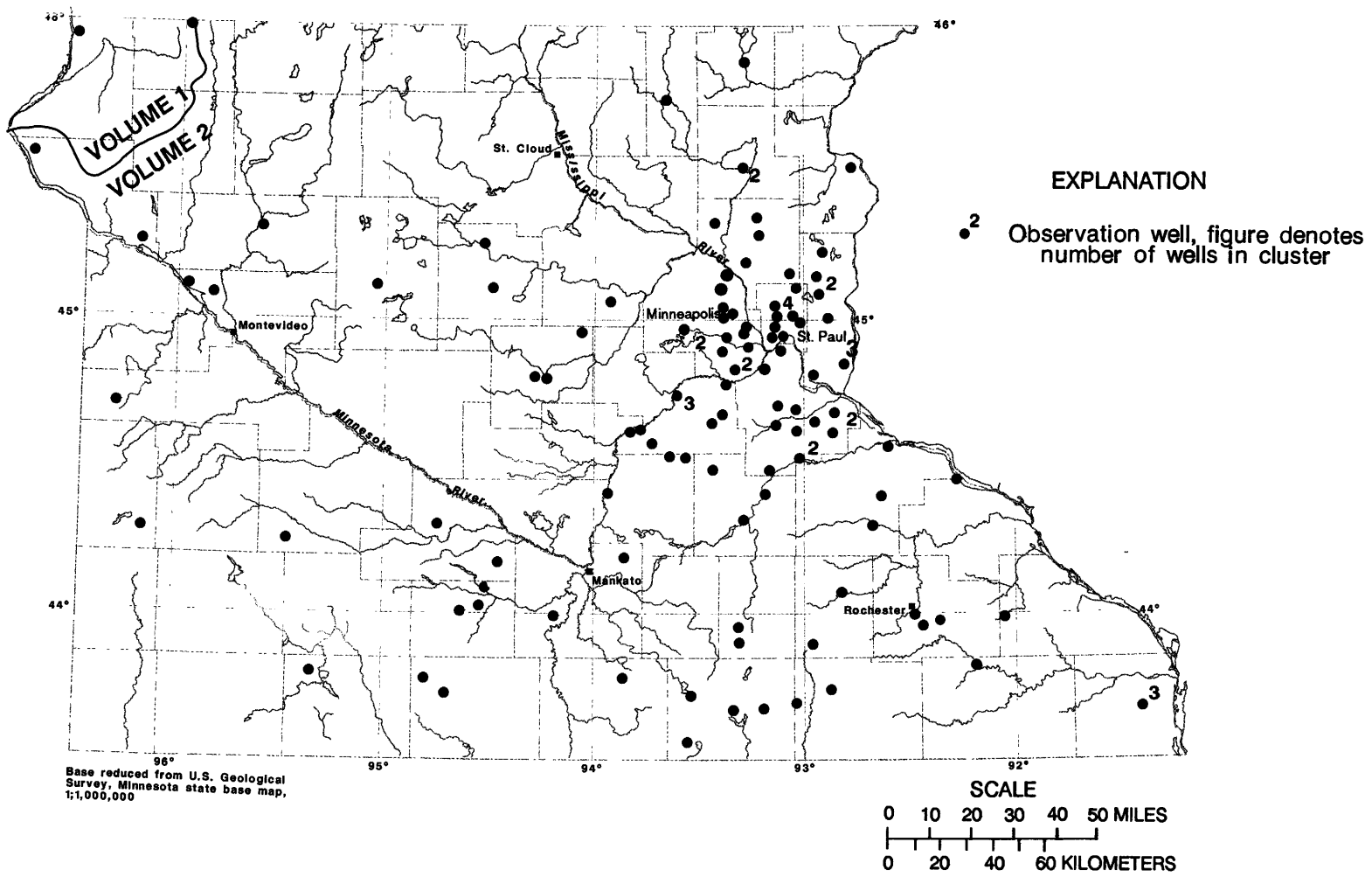


Figure 10.--Location of ground-water wells

CLAY COUNTY

463854096250701. Local number, 137N45W30CDB01.
LOCATION.--Lat 46°38'54", long 96°25'07", in NW¼SE¼SW¼ sec.30, T.137 N., R.45 W., Hydrologic Unit 09020106, in Barnesville.
Owner: City of Barnesville, well 3.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused water-table well, diameter 10 in., depth 73 ft.
DATUM.--Altitude of land-surface datum is 1,022 ft. Measuring point: Top of casing, 1.50 ft above land-surface datum.
PERIOD OF RECORD.--January 1949 to January 1975, May 1980 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.86 ft below land-surface datum, June 9, 1962; lowest, 11.86 ft below land-surface datum, June 3, 1970.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 06	7.87	DEC 08	8.14	JAN 26	8.40	APR 06	8.30	JUL 13	7.80	SEP 07	8.80
13	7.90	15	8.25	FEB 02	8.40	20	8.20	27	8.10	14	7.90
20	7.90	22	8.25	09	8.40	27	8.10	AUG 03	8.30	28	9.10
27	7.90	29	8.28	16	8.00	MAY 04	8.00	10	8.60		
NOV 03	7.95	JAN 05	8.35	23	8.00	11	7.87	17	9.30		
10	8.10	12	8.40	MAR 23	8.50	JUN 29	7.60	24	9.40		
DEC 01	8.10	19	8.40	30	8.35	JUL 06	7.66	31	9.40		

465237096383901. Local number, 139N47W05CDC01.
LOCATION.--Lat 46°52'37", long 96°38'39", in SW¼SE¼SW¼ sec.5, T.139 N., R.47 W., Hydrologic Unit 09020104, 2.4 mi east of Dilworth.
Owner: City of Moorhead, MS-1.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled observation water-table well, diameter 8 in., depth 131 ft, slotted 91 to 107 ft.
DATUM.--Land-surface datum is 916.7 ft National Geodetic Vertical Datum of 1929. Measuring point: Top of recorder floor, 3.60 ft above land-surface datum.
REMARKS.--Water level affected by pumping from nearby wells.
PERIOD OF RECORD.--January 1947 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 12.19 ft below land-surface datum, July 15, 1947; lowest, 32.94 ft below land-surface datum, Aug. 24, 1988.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATAUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

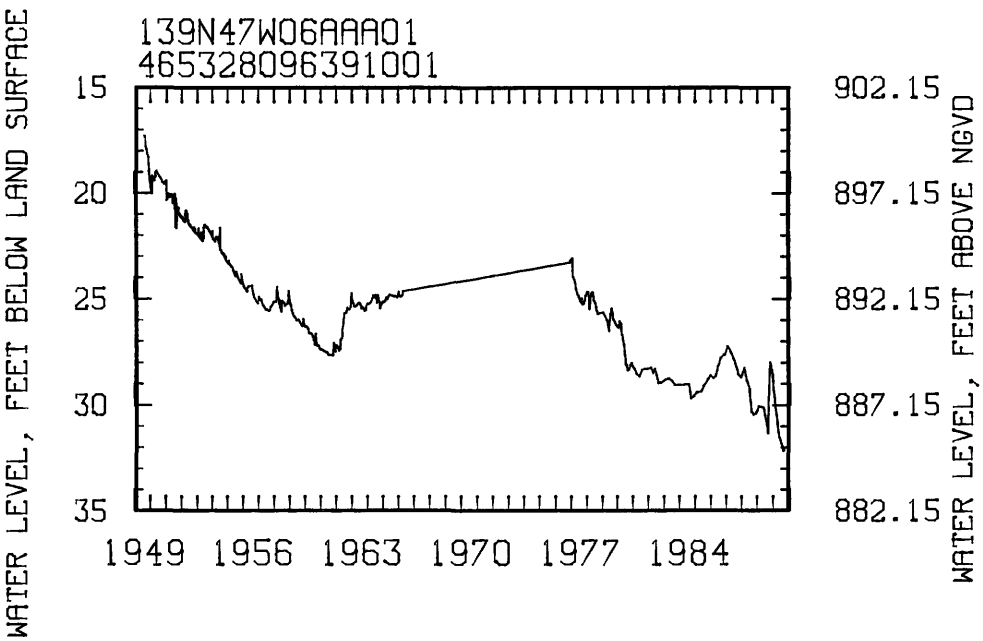
DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 25	30.56	DEC 05	31.86	FEB 05	31.44	APR 05	31.12	JUN 05	30.94	AUG 05	32.00
NOV 05	31.36	10	31.84	10	31.24	10	30.84	10	31.02	10	32.28
10	31.46	15	31.78	15	31.32	15	30.92	15	31.10	15	32.42
15	31.56	20	31.78	20	31.32	20	30.68	20	31.14	20	32.56
20	31.68	25	31.84	25	31.30	25	30.76	25	31.16	25	32.46
25	31.74	31	32.00	28	31.40	30	30.60	30	31.18	31	32.44
30	31.80	JAN 05	31.94	MAR 05	31.34	MAY 05	30.54	JUL 05	31.22	SEP 05	32.42
		10	31.86	10	31.30	10	30.62	10	31.22	10	32.46
		15	31.84	15	31.36	15	30.72	15	31.10	15	32.46
		20	31.84	20	31.44	20	30.84	20	31.46	20	32.44
		25	31.70	25	31.46	25	30.66	25	31.68	25	32.38
		31	31.68	31	31.32	31	30.84	31	31.86	30	32.38

465328096391001. Local number, 139N47W06AAA01.
LOCATION.--Lat 46°53'27", long 96°39'08", in NE¼NE¼NE¼ sec.6, T.139 N., R.47 W., Hydrologic Unit 09020104, 2.7 mi northeast of Dilworth.
Owner: U.S. Geological Survey, M-80.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled observation artesian well, diameter 3 in., depth 103 ft, casing slotted near bottom.
DATUM.--Altitude of land-surface datum is 915 ft. Measuring point: Top of casing, 2.50 ft above land-surface datum.
REMARKS.--Water level affected by pumping.
PERIOD OF RECORD.--July 1949 to April 1966, November 1976 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 16.94 ft below land-surface datum, July 16, 1949; lowest, 32.08 ft below land-surface datum, Aug. 28, 1990.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 26	27.87	JAN 03	28.75	MAR 22	30.18	MAY 30	31.45	AUG 28	32.08

CLAY COUNTY--Continued



465231096415801. Local number, 139N48W11ABA01.
LOCATION.--Lat 46°52'31", long 96°41'58", in NE¼NW¼NE¼ sec.11, T.139 N., R.48 W., Hydrologic Unit 09020104, at Dilworth.
Owner: City of Dilworth.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 8 in., depth 152 ft.
DATUM.--Altitude of land-surface datum is 908 ft. Measuring point: Top of recorder platform, 2.40 ft above land-surface datum.
REMARKS.--Water level affected by pumping.
PERIOD OF RECORD.--May 1965 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 101.33 ft below land-surface datum, Dec. 29, 1965; lowest, 131.24 ft below land-surface datum, July 18, 1985.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 26	118.97	JAN 03	122.58	MAR 22	122.88	MAY 30	124.67	AUG 28	127.95

GRANT COUNTY

455927095575505. Local number, 129N42W16ABB05.
LOCATION.--Lat 45°59'27", long 95°57'55", in NW¼NW¼NE¼ sec.16, T.129 N., R.42 W., Hydrologic Unit 09020102, in city of Elbow Lake.
Owner: City of Elbow Lake, well 5.
AQUIFER.--Buried sand of Pleistocene age.
WELL CHARACTERISTICS.--Drilled public-supply artesian well, diameter 12 in., depth 215 ft, screened 190 to 215 ft.
DATUM.--Altitude of land-surface datum is 1,220 ft. Measuring point: Top breather pipe, 1.80 abaove land-surface datum.
PERIOD OF RECORD.--October 1989 to September 1990.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 74.10 ft below land-surface datum, Apr. 30, 1990; lowest, 76.50 ft below land-surface datum, Nov. 1, 1989.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 23	74.18	FEB 01	74.30	APR 30	74.10
NOV 01	76.50	MAR 01	74.20	MAY 29	74.40
DEC 01	75.30	30	74.20	JUN 29	74.30
28	74.10			JUL 31	74.60
				SEP 04	74.80

GROUND-WATER LEVELS

ITASCA COUNTY

473840093515101. Local number, 148N25W08DDD01.
LOCATION.--Lat 47°38'40", long 93°51'51", in SE¼SE¼SE¼ sec.8, T.148 N., R.25 W., Hydrologic Unit 09030006, at Spring Lake.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in., depth 10 ft, screened 8 to 10 ft.
DATUM.--Altitude of land-surface datum is 1,350 ft. Measuring point: Top of casing, 3.40 ft above land-surface datum.
PERIOD OF RECORD.--September 1970 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 4.40 ft below land-surface datum, July 13, 1979; lowest, 7.68 ft below land-surface datum, Sep. 6, 1990.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 10	6.32	APR 30	6.04	JUL 24	6.87	SEP 06	7.68
NOV 20	6.54	JUN 13	6.39				

OTTER TAIL COUNTY

463956095352601. Local number, 137N39W22ACD01.
LOCATION.--Lat 46°39'56", long 95°35'26", in SE¼SW¼NE¼ sec.22, T.137 N., R.39 W., Hydrologic Unit 09020103, 4.5 mi north of Perham.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 2 in., depth 24 ft, screened 21 to 24 ft.
DATUM.--Altitude of land-surface datum is 1,370 ft. Measuring point: Top of casing, 0.50 ft above land-surface datum.
PERIOD OF RECORD.--December 1967 to current year.
EXTREMES FOR PERIOD OF RECORD.--Higheest water level, 6.84 ft below land-surface datum, Aug. 12, 1985; lowest, 11.41 ft below land-surface datum, Mar. 10, 15, 1977.

WATER LEVEL, IN FEET ABOVE LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

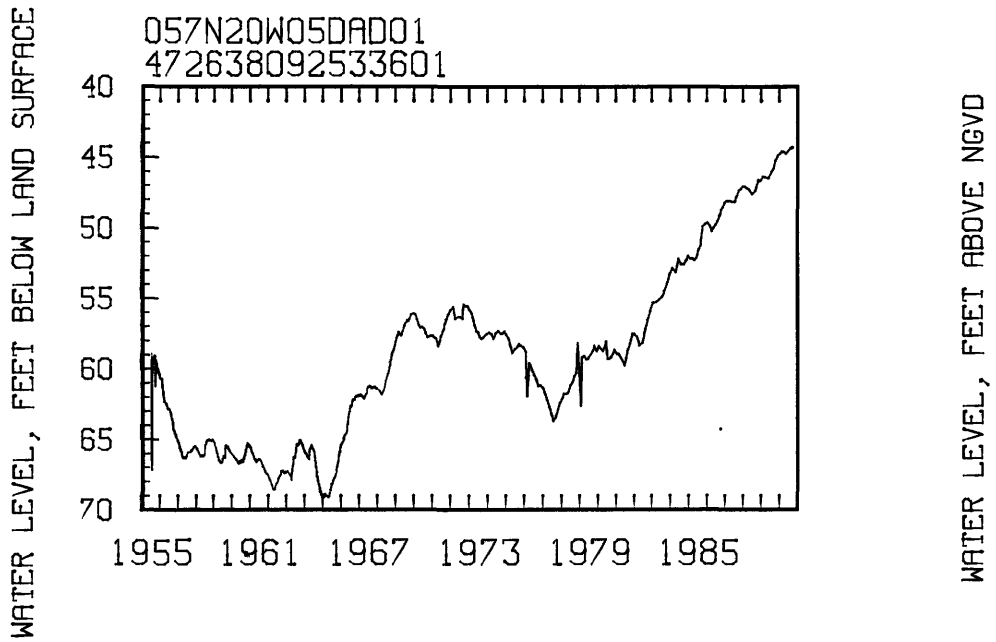
DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 20	8.90	DEC 20	9.81	FEB 26	10.16	APR 20	9.62	JUN 20	9.36	AUG 19	9.99
NOV 19	9.54	JAN 20	9.97	MAR 20	9.72	MAY 21	9.47	JUL 20	9.67	SEP 18	9.92

ST. LOUIS COUNTY

472638092533601. Local number, 057N20W05DAD01.
LOCATION.--Lat 47°26'38", long 92°53'36", in SE¼NE¼SE¼ sec.5, T.57 N., R.20 W., Hydrologic Unit 04010201, 2.5 mi east of Hibbing.
Owner: Burlington Northern, Inc.
AQUIFER.--Biwabik Iron Formation of Middle Precambrian Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 12 in., depth 430 ft, cased to 315 ft.
DATUM.--Altitude of land-surface datum is 1,470 ft. Measuring point: Top of platform, 1.20 ft above land-surface datum.
PERIOD OF RECORD.--August 1955 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 44.17 ft below land-surface datum, Sept. 4, 1990; lowest, 69.07 ft below land-surface datum, Jan. 15, 1965.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
NOV 21	44.74	FEB 09	44.46	MAY 03	44.67	SEP 04	44.17
JAN 05	44.58	MAR 21	44.53	JUL 27	44.24		



472230092561001. Local number, 057N20W31DBC01.
LOCATION.--Lat 47°22'30", long 92°56'10", in SW¼NW¼SE¼ sec.31, T.57 N., R.20 W., Hydrologic Unit 04010201, 1.4 mi south of Hibbing.
Owner: Mesaba County Club.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused artesian and water-table well, diameter 18 in., depth 92 ft screened 82 to 92 ft.
DATUM.--Altitude of land-surface datum is 1,391 ft. Measuring point: Hole east side of pump base, 3.00 ft above land-surface datum.
REMARKS.--Water level affected by pumping.
PERIOD OF RECORD.--February 1958 to March 1965, July 1979 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.85 ft below land-surface datum, July 26, 1985; lowest, 15.05 ft below land-surface datum, June 30, 1980.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 29	2.80	DEC 08	2.60	JAN 27	2.44	AUG 21	2.02

473102092345001. Local number, 058N18W12CCC01.
LOCATION.--Lat 47°31'02", long 92°34'50, in SW¼SW¼SW¼ sec.12, T.58 N., R.18 W., Hydrologic Unit 04010201, 1 mi west of Virginia.
Owner: U.S. Steel Corp.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled observation artesian well, diameter 6 in., depth 97 ft, slotted casing between 67 to 97 ft.
DATUM.--Land-surface datum is 1,427.5 ft National Geodetic Vertical Datum of 1929. Measuring point: Edge of vent pipe, 1.90 ft above land-surface datum.
PERIOD OF RECORD.--December 1954 to July 1964 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 10.64 ft below land-surface datum, July 20, 1957; lowest, 17.47 ft below land-surface datum, Apr. 2, 1964.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 13	13.17	JAN 05	14.04	MAR 21	13.18	JUN 21	12.71	SEP 04	13.65
NOV 21	13.45	FEB 08	14.41	MAY 03	12.43	JUL 26	13.02		

473011092524301. Local number, 058N20W16DBC01.
LOCATION.--Lat 47°30'11", long 92°52'43", in SW¼NW¼SE¼ sec.16, T.58 N., R.20 W., Hydrologic Unit 04010201, in Chisholm.
Owner: City of Chisholm.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 12 in. depth 40 ft, screened 30 to 40 ft.
DATUM.--Altitude of land-surface datum is 1,500 ft. Measuring point: Top of wood platform, 1.70 ft above land-surface datum.
REMARKS.--Water level affected by pumping. Water-level subject to freezing during winter months.
PERIOD OF RECORD.--August 1953 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 0.23 ft below land-surface datum, May 10, 1954; lowest, 15.60 ft below land-surface datum, Mar. 23-24, 1957.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
NOV 21	3.11	JUN 21	1.47	JUL 27	2.72	SEP 04	4.08
MAY 03	1.82						

474253091574101. Local number, 060N13W01BBA01.
LOCATION.--Lat 47°42'53", long 91°57'41", in NE¼NW¼NW¼ sec.1, T.60 N., R.13 W., Hydrologic Unit 09030001, at Babbitt water tower.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 2 in., depth 30 ft, screened 27 to 30 ft.
DATUM.--Altitude of land-surface datum is 1,485 ft. Measuring point: Top of 3 in pipe, 4.00 ft above land-surface datum.
PERIOD OF RECORD.--October 1975 to June 1978, July 1979 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 19.79 ft below land-surface datum, Sept. 6, 1989; lowest, 26.03 ft below land-surface datum, June 14, 1977.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
NOV 03	20.46	JAN 02	21.25	MAR 05	22.29	MAY 03	22.42	JUL 02	21.21	SEP 04	20.92
DEC 05	20.83	FEB 01	21.67	APR 03	22.46	JUN 01	21.88	AUG 01	20.92		

475502091494601. Local number, 063N12W26ABB01.
LOCATION.--Lat 47°55'02", long 91°49'46", NW¼NW¼NE¼ sec.26, T.63 N., R.12 W., Hydrologic Unit 09030001, at Ely.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in., depth 9 ft, screened 7 to 9 ft.
DATUM.--Altitude of land-surface datum is 1,342 ft. Measuring point: Top of casing, 4.00 ft above land-surface datum.
PERIOD OF RECORD.--October 1970 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.53 ft below land-surface datum, May 14, 1986; lowest, 6.87 ft below land-surface datum, Sept. 27, 1976.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
NOV 02	3.77	FEB 07	5.25	APR 25	2.05	JUL 18	2.79
DEC 26	4.98	MAR 14	4.63	JUN 11	2.85	AUG 29	4.98

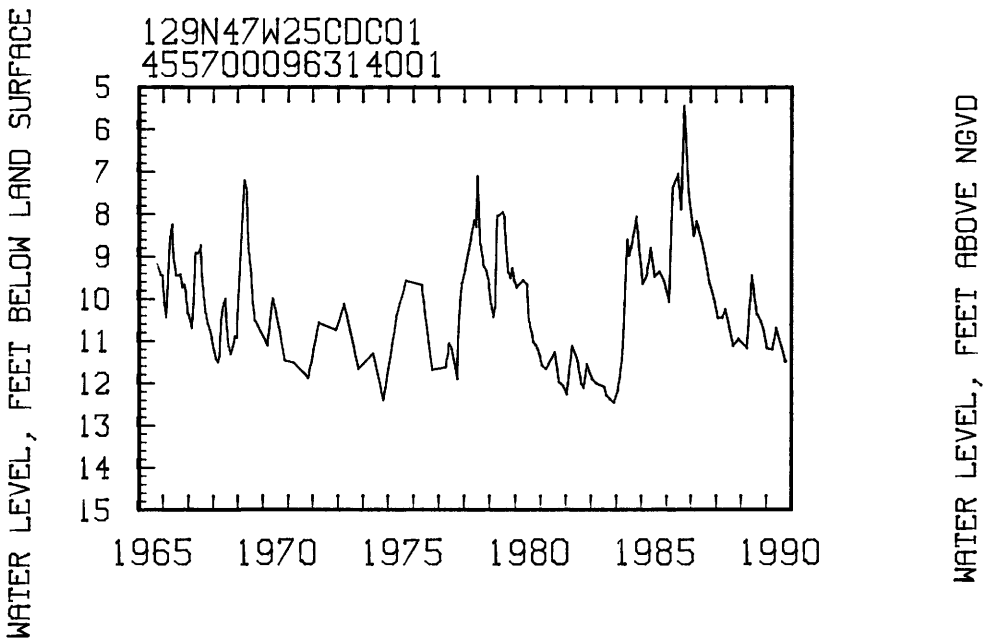
GROUND-WATER LEVELS

TRAVERSE COUNTY

455700096314001. Local number, 129N47W25CDC01.
LOCATION.--Lat 45°57'00", long 93°31'40", in SW¼SE¼SW¼ sec.25, T.129 N., R.47 W., Hydrologic Unit 09020101, 9 mi north of Wheaton.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in., depth 39 ft, open end.
DATUM.--Altitude of land-surface datum is 1,010 ft. Measuring point: Top of casing, 2.00 ft above land-surface datum.
PERIOD OF RECORD.--October 1965 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 5.39 ft below land-surface datum, Sept. 23, 1986; lowest, 12.42 ft below land-surface datum, Dec. 2, 1983.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
OCT 06	10.49	JAN 04	11.13	MAY 18	10.65	SEP 27	11.45
NOV 13	10.68	MAR 22	11.17				



QUALITY OF GROUND WATER

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

CLEARWATER COUNTY

STATION NUMBER	LOCAL IDENTIFIER	GEOLOGIC UNIT	DATE	TIME	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET) (72019)	DEPTH OF WELL, TOTAL (FEET) (72008)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
473107095240300	147N37W29CC-BAGLEY CITY	112DMDF	08-24-90	1415	--	170.00	--
473332095284000	147N38W22BA-MARTINE	112DMDF	08-24-90	1559	25.89	152.00	1490
473924095161100	148N36W09BBB HENRY LINDOM	112DMDF	08-24-90	1210	--	212.00	1450

STATION NUMBER	SPECIFIC CONDUCTANCE LAB (US/CM) (90095)	PH (STANDARD UNITS) (00400)	PH LAB (STANDARD UNITS) (00403)	TEMPERATURE WATER (DEG C) (00010)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY LAB (MG/L AS CACO3) (90410)	SULFATE DISSOLVED (MG/L AS SO4) (00945)
473107095240300	--	7.8	--	11.0	--	--	--	--	--	--
473332095284000	548	7.8	7.6	11.0	79	24	9.2	2.2	154	<1.0
473924095161100	691	7.7	7.6	9.5	78	40	15	5.1	281	5.9

STATION NUMBER	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN,AMMONIA + ORGANIC DIS. (MG/L AS N) (00623)	PHOSPHORUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS ORTHO, DISSOLVED (MG/L AS P) (00671)
473107095240300	--	--	--	--	<0.100	0.590	0.70	0.009	0.009
473332095284000	2.7	0.20	20	311	<0.100	0.430	0.60	0.022	0.022
473924095161100	3.0	0.20	21	362	<0.100	0.460	0.60	0.006	--

STATION NUMBER	DATE	TIME	BENZENE TOTAL (UG/L) (34030)	BROMOFORM TOTAL (UG/L) (32104)	CHLORODIBROMOMETHANE TOTAL (UG/L) (32105)	CHLOROFORM TOTAL (UG/L) (32106)	CARBONTETRACHLORIDE TOTAL (UG/L) (32102)	CHLOROBENZENE TOTAL (UG/L) (34301)	CHLOROETHANE TOTAL (UG/L) (34311)	DICHLOROBROMOMETHANE TOTAL (UG/L) (32101)
473107095240300	08-24-90	1415	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
473332095284000	08-24-90	1559	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
473924095161100	08-24-90	1210	--	--	--	--	--	--	--	--

STATION NUMBER	2-CHLOROETHYLVINYLETHER TOTAL (UG/L) (34576)	CIS 1,3-DICHLOROPROPENE TOTAL (UG/L) (34704)	1,3-DICHLOROBENZENE TOTAL (UG/L) (34566)	1,4-DICHLOROBENZENE TOTAL (UG/L) (34571)	DICHLORODIFLUOROMETHANE TOTAL (UG/L) (34668)	1,3-DICHLOROPROPENE TOTAL (UG/L) (34561)	1,1-DICHLOROETHANE TOTAL (UG/L) (34496)	1,1-DICHLOROETHYLENE TOTAL (UG/L) (34501)	1,2-DICHLOROBENZENE TOTAL (UG/L) (34536)	1,2-DICHLOROPROPANE TOTAL (UG/L) (34541)
473107095240300	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
473332095284000	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
473924095161100	--	--	--	--	--	--	--	--	--	--

QUALITY OF GROUND WATER

WATER QUALITY DATA, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990

CLEARWATER COUNTY--Continued

STATION NUMBER	1,2-DIBROMO ETHANE WATER WHOLE TOTAL (UG/L) (77651)	ETHYL-BENZENE TOTAL (UG/L) (34371)	METHYL-BROMIDE TOTAL (UG/L) (34413)	METHYL-CHLO-RIDE TOTAL (UG/L) (34418)	METHYL-ENE CHLO-RIDE TOTAL (UG/L) (34423)	PHENOLS TOTAL (UG/L) (32730)	STYRENE TOTAL (UG/L) (77128)	1,1,2,2 TETRA-CHLORO-ETHANE TOTAL (UG/L) (34516)	TETRA-CHLORO-ETHYL-ENE TOTAL (UG/L) (34475)
473107095240300	<3.0	<3.0	<3.0	<3.0	<3.0	2	<3.0	<3.0	<3.0
473332095284000	<3.0	<3.0	<3.0	<3.0	<3.0	1	<3.0	<3.0	<3.0
473924095161100	--	--	--	--	--	1	--	--	--

STATION NUMBER	1,1,2-TRI-CHLORO-ETHANE TOTAL (UG/L) (34511)	TRI-CHLORO-FLUORO-METHANE TOTAL (UG/L) (34488)	1,1,1-TRI-CHLORO-ETHANE TOTAL (UG/L) (34506)	1,2-TRANSDI CHLORO-ETHENE TOTAL (UG/L) (34546)	TRANS-1,3-DI-CHLORO-PROPENE TOTAL (UG/L) (34699)	TRI-CHLORO-ETHYL-ENE TOTAL (UG/L) (39180)	TOLUENE TOTAL (UG/L) (34010)	VINYL CHLO-RIDE TOTAL (UG/L) (39175)	XYLENE TOTAL WATER WHOLE TOT REC (UG/L) (81551)
473107095240300	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<1.0	<3.0
473332095284000	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<1.0	<3.0
473924095161100	--	--	--	--	--	--	--	--	--

ITASCA COUNTY

STATION NUMBER	LOCAL IDENT-I-FIER	GEO-LOGIC UNIT	DATE	TIME	DEPTH OF WELL, TOTAL (FEET) (72008)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)
473448093573001	47N26W03BDDB LC17-BERQUI	112DSMO	08-30-90	1030	84.00	1330	540	519	7.6
473623094040601	48N27W26CAAA LC18-FOSS	112DSMO	08-30-90	1200	110.00	1380	650	647	7.7

STATION NUMBER	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	ALKA-LINITY WAT WH TOT FET FIELD MG/L AS CACO3 (00410)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
473448093573001	7.5	9.0	74	23	2.6	1.9	288	280	2.6	3.6
473623094040601	7.5	10.0	92	30	8.1	3.9	372	362	<1.0	3.5

STATION NUMBER	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	CARBON, ORGANIC DIS-SOLVED (MG/L AS C) (00681)
473448093573001	0.20	23	<0.100	0.190	0.010	0.010	10	2400	150	3.1
473623094040601	0.40	27	<0.100	0.370	0.010	0.010	40	1500	160	2.5

Pigeon River at High Falls near Grand Portage,
Minnesota, ca. 1912

INDEX

INDEX

INDEX

INDEX

☆U.S. GOVERNMENT PRINTING OFFICE: 1991-556-655

October 1, 1978

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM UNITS (SI)

The following factors may be used to convert the inch-pound units published herein to the International System of Units (SI).

Multiply inch-pound units	By	To obtain SI units
	Length	
inches (in)	2.54×10^{1}	millimeters (mm)
	2.54×10^{-2}	meters (m)
feet (ft)	3.048×10^{-1}	meters (m)
miles (mi)	1.609×10^{0}	kilometers (km)
	Area	
acres	4.047×10^{3}	square meters (m^2)
	4.047×10^{-1}	square hectometers (hm^2)
	4.047×10^{-3}	square kilometers (km^2)
square miles (mi^2)	2.590×10^{0}	square kilometers (km^2)
	Volume	
gallons (gal)	3.785×10^{0}	liters (L)
	3.785×10^{0}	cubic decimeters (dm^3)
	3.785×10^{-3}	cubic meters (m^3)
million gallons	3.785×10^{3}	cubic meters (m^3)
	3.785×10^{-3}	cubic hectometers (hm^3)
cubic feet (ft^3)	2.832×10^{1}	cubic decimeters (dm^3)
	2.832×10^{-2}	cubic meters (m^3)
cfs-days	2.447×10^{3}	cubic meters (m^3)
	2.447×10^{-3}	cubic hectometers (hm^3)
acre-feet (acre-ft)	1.233×10^{3}	cubic meters (m^3)
	1.233×10^{-3}	cubic hectometers (hm^3)
	1.233×10^{-6}	cubic kilometers (km^3)
	Flow	
cubic feet per second (ft^3/s)	2.832×10^{1}	liters per second (L/s)
	2.832×10^{1}	cubic decimeters per second (dm^3/s)
	2.832×10^{-2}	cubic meters per second (m^3/s)
gallons per minute (gal/min)	6.309×10^{-2}	liters per second (L/s)
	6.309×10^{-2}	cubic decimeters per second (dm^3/s)
	6.309×10^{-5}	cubic meters per second (m^3/s)
million gallons per day	4.381×10^{1}	cubic decimeters per second (dm^3/s)
	4.381×10^{-2}	cubic meters per second (m^3/s)
	Mass	
tons (short)	9.072×10^{-1}	megagrams (Mg) or metric tons

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT 413

U.S. DEPARTMENT OF THE INTERIOR
Geological Survey
702 Post Office Building
St. Paul, MN 55101

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

SPECIAL 4TH CLASS BOOK RATE