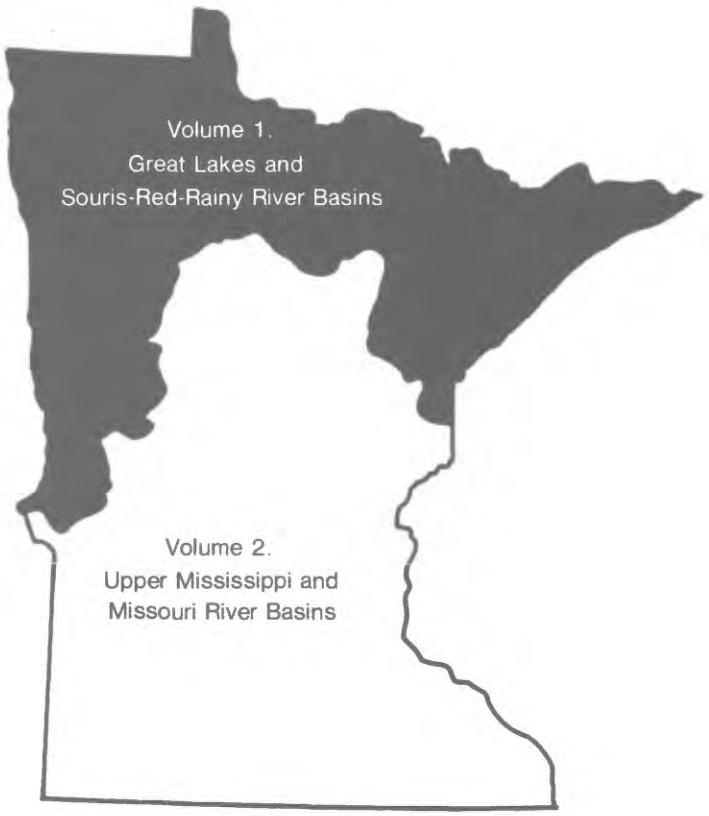
Water Resources Data Minnesota Water Year 1987

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



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MN-87-1
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

CALENDAR FOR WATER YEAR 1987

1986

OCTOBER

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1987

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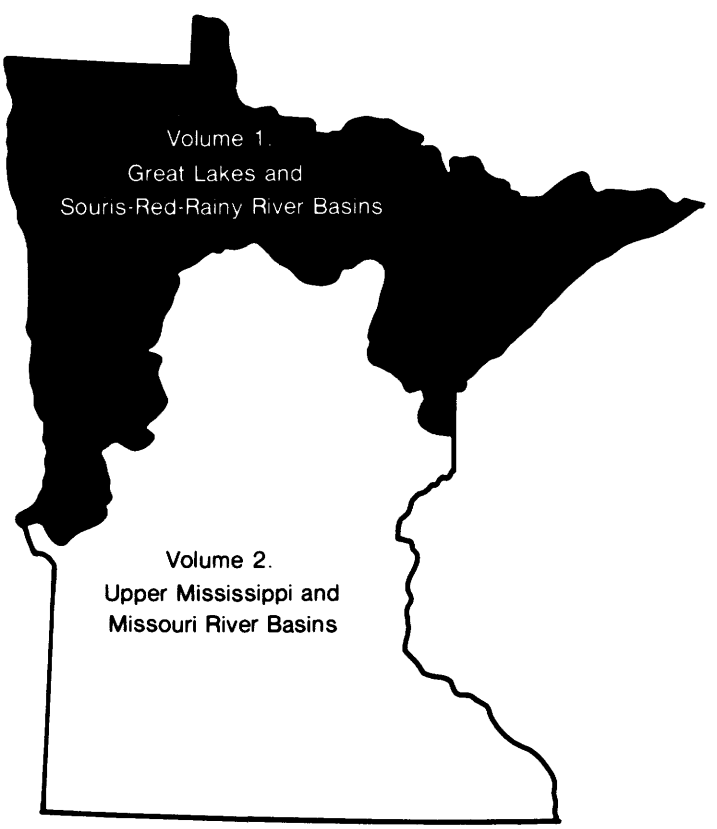
Water Resources Data Minnesota Water Year 1987

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-87-1
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

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District Chief, Water Resources Division
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1989

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:

Mark R. Have, Water-Quality Specialist, Minnesota District
Henry W. Anderson, Jr., Ground-Water Project Chief, Minnesota District

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

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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.

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16. Abstract (Limit: 200 words)

Water-resources data for the 1987 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 45 gaging stations; stage-only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 13 stream stations and 2 partial-record lake stations; and water levels for 15 observation wells. Also included are 34 high-flow partial-record stations and 34 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
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b. Identifiers/Open-Ended Terms

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Note.--Date 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 micro-biological; (p) physical (water temperature, sediment, or specific conductance)]

SURFACE-WATER STATIONS, IN DOWNSTREAM ORDER--Continued

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GROUND-WATER LEVELS

COUNTIES WITH QUALITY OF GROUND-WATER RECORDS

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WATER RESOURCES DATA FOR MINNESOTA, 1987

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 1987 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 45 gaging stations; stage only records for one gaging station; stage and contents for five lakes and reservoirs; water quality for 13 stream stations and two partial-record lake stations; and water levels for 14 observation wells. Also included are 34 high-flow partial-record stations and 34 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-87-1. 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 the data in this report 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, Peter E. Meintsman, chairperson.

Elm Creek Conservation Commission, Gerald E. Butcher, chairperson.

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

Red Lake Reservation Business Committee, Roger Jourdain, chairperson.

Rochester Public Utilities, R. John Miner, General Manager.

White Earth Reservation Business Committee, Darrell Wadena, chairperson.

Assistance in the form of funds or services was given by the Corps of Engineers, U.S. Army, in collecting records for 49 gaging stations and 12 water-quality stations published in this report. 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 1987 water year ranged from 4 in. (inches) above normal in a small area of northern Minnesota to 12 in. below normal in small areas of central and east-central 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 1987 ranged from less than 16 in. in parts of the west, central, and east-central Minnesota to greater than 32 in. in parts of the northeast and southwest.

Precipitation generally was below normal statewide during the first quarter of the water year. However, it was above normal in the south-central and southeastern regions during October, and above normal in the north and west during November. During the second quarter, precipitation was below normal statewide in January and February, but returned to the above-normal range in the west-central, central, and southwest regions in March. During the third quarter, precipitation was considerably below normal statewide, but rose to the above-normal range in the northern 1/3 of the State during May. During the final quarter of the water year, the deluge finally came. In July above normal precipitation occurred over the entire State. Two separate storms with recurrence intervals greater than 100 years occurred within 1 week in the east-central region of the State. More than 1/2 the average annual precipitation of 26 in. fell in 1 month--14.5 in. However, this precipitation pattern was short-lived, and, in August and September, precipitation was again deficient statewide except in the south-central region, where it was above normal during August.

As a result of the precipitation patterns, most of Minnesota experienced below-normal annual precipitation except for a few scattered areas in the north and east-central regions. According to the State Climatology Office, "The winter of 1986-87 was one of the warmest and driest in Minnesota's recorded history." At the close of the 1987 water year, much of Minnesota was 4 to 8 in. below the long-term average for annual precipitation.

A long-term wet cycle of about 10 years appears to have ended with the 1986 water year when the last of several records of precipitation excess were set. In direct contrast, the deficient precipitation in 1987 could be signaling the beginning of a drought period.

STREAMFLOW

Average annual runoff in Minnesota ranges from 1 in. in the west to 14 in. in the northeast. Annual runoff in water year 1987 ranged from 1 in. along the western border to 16.5 in. in northeastern Minnesota (table 1). Runoff varied from as low as 25 percent of average in a small part of the northwest to more than 190 percent of average in a small part of the west. Runoff recorded at considerable number of streams scattered throughout the State was about 50 percent of the long-term average. If streamflow had not been excessive in the beginning of the water year along with saturated soils and high ground-water levels, the runoff recorded at many more streams would have near 50 percent of the long-term average.

In 1987, records for stations in northern Minnesota indicate less than average annual runoff, ranging from 55 percent to 85 percent of annual average long-term runoff. In northwestern Minnesota, runoff in the Roseau River at Ross was only 1.63 in.--55 percent of the 59-year average annual runoff of 2.96 in. and the 17th lowest of record. In contrast, runoff in the previous year was 175 percent of average in the 8th highest for period of record. In north-central Minnesota, runoff in the Little Fork River at Littlefork was 5.89 in. and 71 percent of the 64-year average annual runoff of 8.34 in., considerably less than the 9.89 in. of runoff that occurred in the previous year. In northeastern Minnesota, runoff in the Baptism River near Beaver Bay was 13.95 in. and 85 percent of the 60-year average annual runoff of 16.49 in. This is 5.55 in. less that the 19.50 in. of runoff recorded in the previous year. A comparison of annual and monthly mean discharges for these stations to median discharges for a 30-year base period is shown in figure 2.

No peaks of record were exceeded during water year 1987 at any stations for which records are published in this volume. However, record-breaking monthly runoff volumes occurred at several stations.

WATER QUALITY

Four U.S. Geological Survey National Stream-Quality Accounting Network (NASQAN) stations are used to depict variability in concentrations of dissolved solids and nitrate as nitrogen in the three major basins covered in this volume (figs. 3 and 4): Lake Superior, Rainy River, and Red River of the North basins.

Dissolved-solids concentrations in 1987 were generally lower than average in the Lake Superior basin as evidenced by data for Baptism River near Beaver Bay and St. Louis River at Scanlon. Red Lake River at Crookston in the Red River of the North basin had lower concentrations of dissolved solids in the fall and winter but then had much higher than average concentrations in the last three samples collected in the spring and summer. Dissolved-solids concentrations were generally lower than average except for October and June in the Rainy River at Manitou Rapids.

Nitrate concentrations reported as nitrogen (analyzed for nitrate plus nitrite, but nitrite concentration assumed to be negligible) showed a decreasing trend through April in the Baptism River near Beaver Bay; this is opposite the average trend, which increases through April. The one remaining sample collected in July had a near-average concentration. The nitrate concentrations in the St. Louis River at Scanlon and Rainy River at Manitou Rapids were near the average throughout 1987. Of the six samples collected in the Red Lake River at Crookston, nitrate concentrations were higher than average in March and lower than average in April, but were near average in the other samples collected in November, December, June, and August.

Seventeen ground-water samples were collected in 1987. All constituents had concentrations below any Federal or State limits.

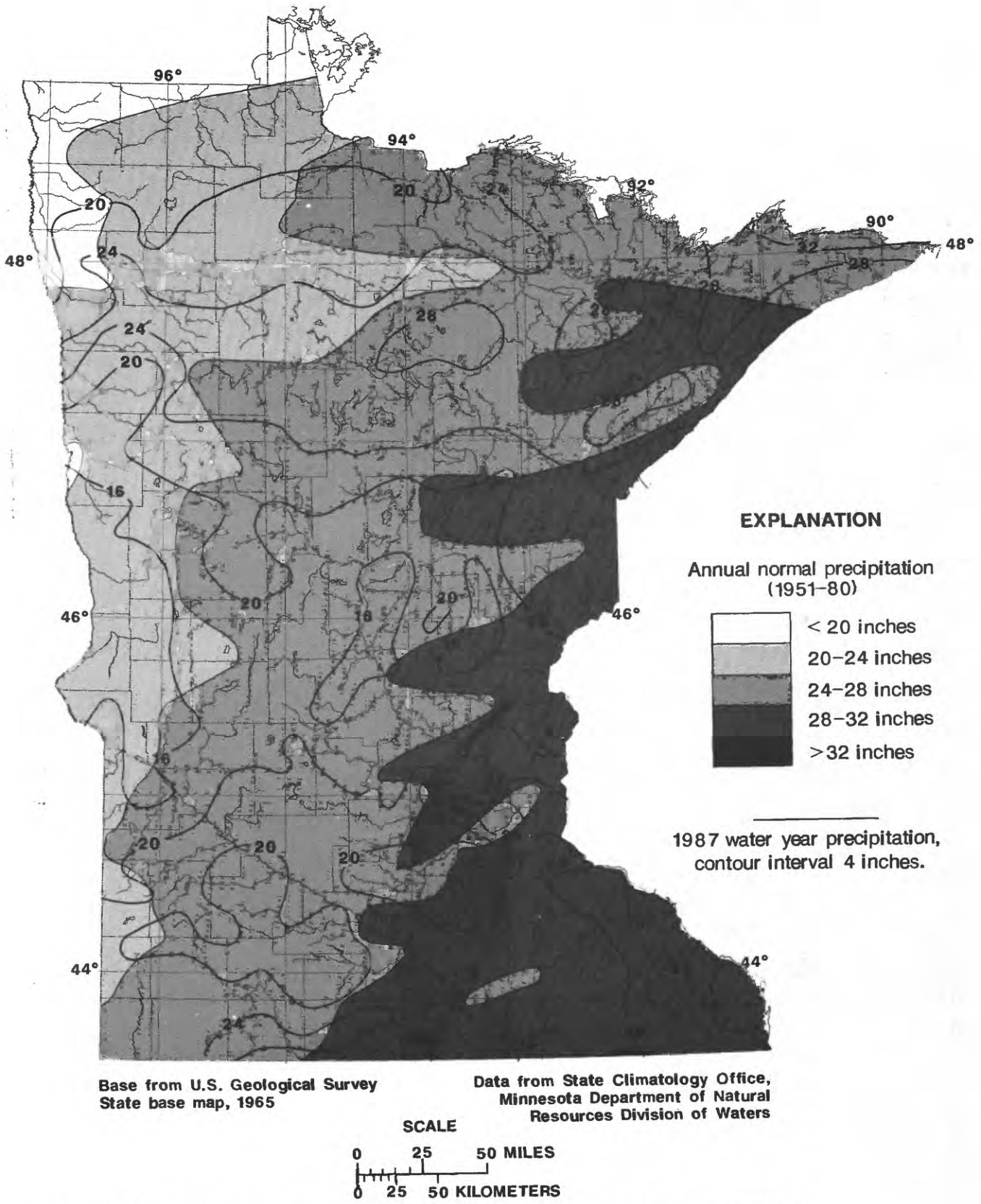


Figure 1.--Precipitation, in inches, during 1987 water year compared to normal annual precipitation for Minnesota

Table 1.--Runoff at streamflow stations in 1987 compared with long-term average for river basins in Minnesota

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

Station No.	Station name	Drainage Area (mi^2)	Runoff (inches)		Maximum	
			1987 Water year	Average	Inches	Water year
04010500	Pigeon River at Middle Falls near Grand Portage	600	7.51	11.45	19.01	1971
04014500	Baptism River near Beaver Bay	140	13.95	16.49	32.50	1972
04015330	Knife River near Two Harbors	85.6	11.15	15.15	23.32	1986
04015475	Partridge River above Colby Lake at Hoyt Lake	106	10.74	11.74	14.22	1983
04016500	St. Louis River near Aurora	290	12.73	11.80	20.74	1950
04024000	St. Louis River at Scanlon	3,430	9.79	9.31	16.93	1972
04024098	Dear Creek near Holyoke	7.77	6.67	13.93	33.70	1986
05046000	Otter Tail River below Orwell Dam near Fergus Falls	1,830	3.92	2.40	6.25	1986
05050000	Bois de Sioux River near White Rock	1,160	0.67	0.98	3.85	1986
05051500	Red River of the North at Wahpeton	4,010	2.21	1.88	5.00	1986
05061500	South Branch Buffalo River at Sabin	522	1.07	1.52	5.15	1962
05062000	Buffalo River near Dilworth	1,040	1.69	1.76	5.76	1975
05064000	Wild Rice River at Hendrum	1,600	2.43	2.27	5.79	1975
05069000	Sand Hill River at Climax	426	2.18	2.33	6.50	1950
05074500	Red Lake River near Red Lake	1,950	2.88	3.51	9.00	1951
05076000	Thief River near Thief River Falls	959	1.19	2.36	8.60	1966
05078500	Clearwater River at Red Lake Falls	1,370	2.34	3.18	8.48	1950
05079000	Red Lake River at Crookston	5,280	2.26	2.96	8.05	1950
05082500	Red River of the North at Grand Forks	30,100	1.46	1.19	3.42	1950
05087500	Middle River at Argyle	265	1.15	2.12	5.74	1966
05102500	Red River of the North at Emerson	40,200	1.55	1.16	4.09	1950
05104500	Roseau River below South Fork near Malung	573	0.86	3.41	8.18	1950
05107500	Roseau River at Ross	1,220	1.63	2.96	8.07	1950
05112000	Roseau River below State No. 51 near Caribou	1,570	1.62	2.54	5.91	1927
05124480	Kawishiwi River near Ely	253	8.46	11.43	16.80	1971
05127000	Kawishiwi River near Winton	1,229	9.62	11.44	21.73	1950
05127500	Basswood River near Winton	1,740	9.68	10.93	20.63	1950
05128000	Namakan River at Outlet of Lac la Croix	5,170	8.08	10.07	19.10	1950
05130500	Sturgeon River near Chisholm	187	6.92	9.00	15.11	1950
05131500	Little Fork River at Littlefork	1,730	5.89	8.34	15.01	1966
05132000	Big Fork River at Big Falls	1,460	6.35	6.85	12.67	1950
05133500	Rainy River at Manitou Rapids	19,400	5.62	9.04	16.28	1950

GROUND-WATER LEVELS

Seven wells in the unconfined (water table) aquifer were used to descaribe surficial ground water conditions in the area of the State covered in Volume 1 (fig. 5). These wells are located as follows: two in the northwest, one in the north-central, two in the northeast, and two in west-central Minnesota. Water levels in six wells were normal or above normal for the first half of the water year, and levels in five of these wells were also normal or above normal for the last half of the water year. Levels in the other well, located in north-central Minnesota, were below normal for the second half of the water year. Water levels in the remaining well, located in northwestern Minnesota, were below normal for the entire year. Two wells in west-central Minnesota had record-high levels for the first one-half of the year, but were normal or somewhat above for the remainder of the year. In northeastern Minnesota, record-high levels were recorded at two wells; the levels were at record highs at one well near the beginning and end of the water year and at the other only during the winter months.

Water levels in seven wells completed in confined (artesian) aquifers reflect conditions in buried sand and bedrock aquifers in the area covered in Volume 1 (fig. 6). Levels in four wells located in northeastern Minnesota and one well in northwestern Minnesota were normal or above normal for the entire year, and levels in two wells located in northwestern Minnesota were below normal the entire year. The level in one well in northwestern Minnesota reached a record low for September, and the level in one well in northeastern Minnesota reached a record high each month throughout the water year.

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 1987 water year that began October 1, 1986, and ended September 30, 1987. 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 8, 9, 10, and 11. 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.

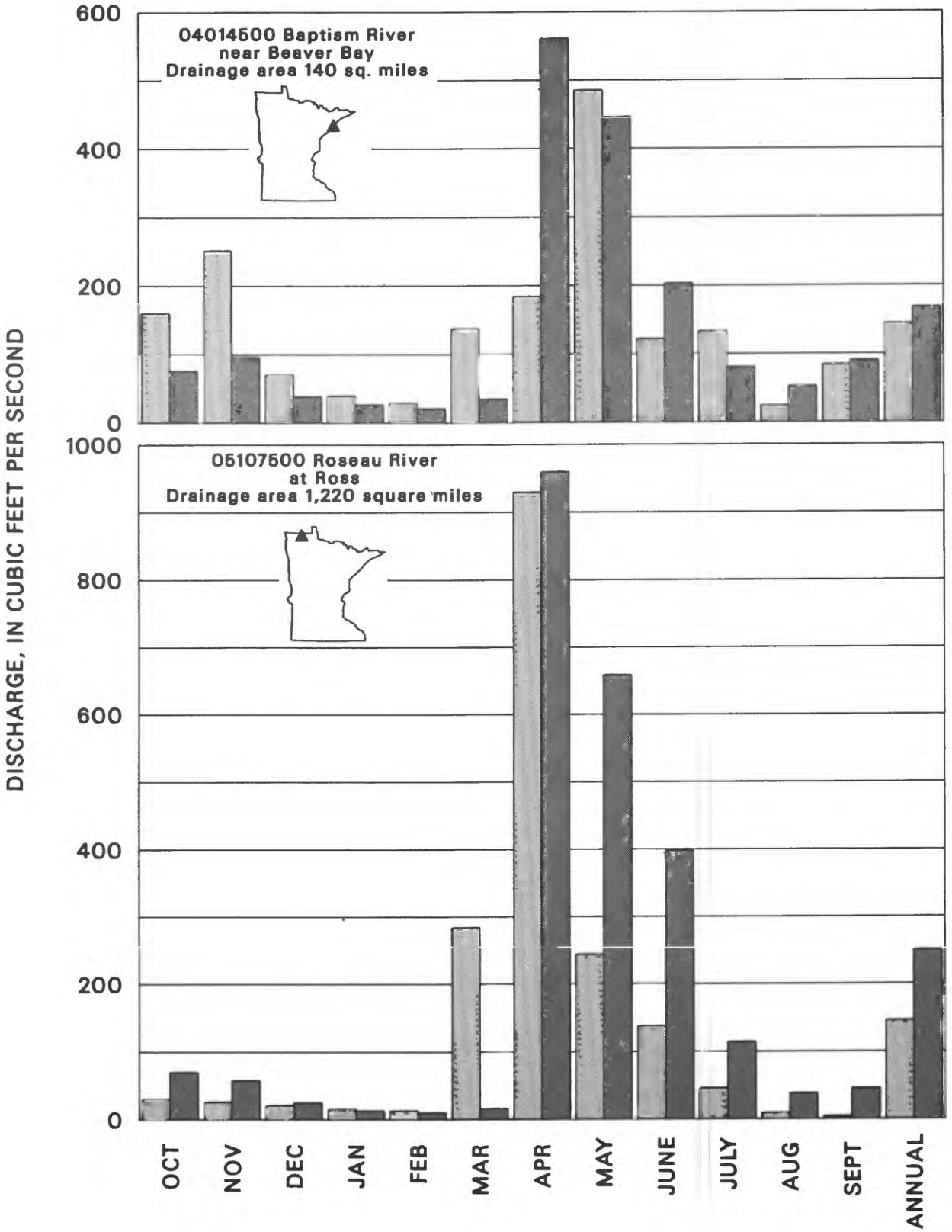
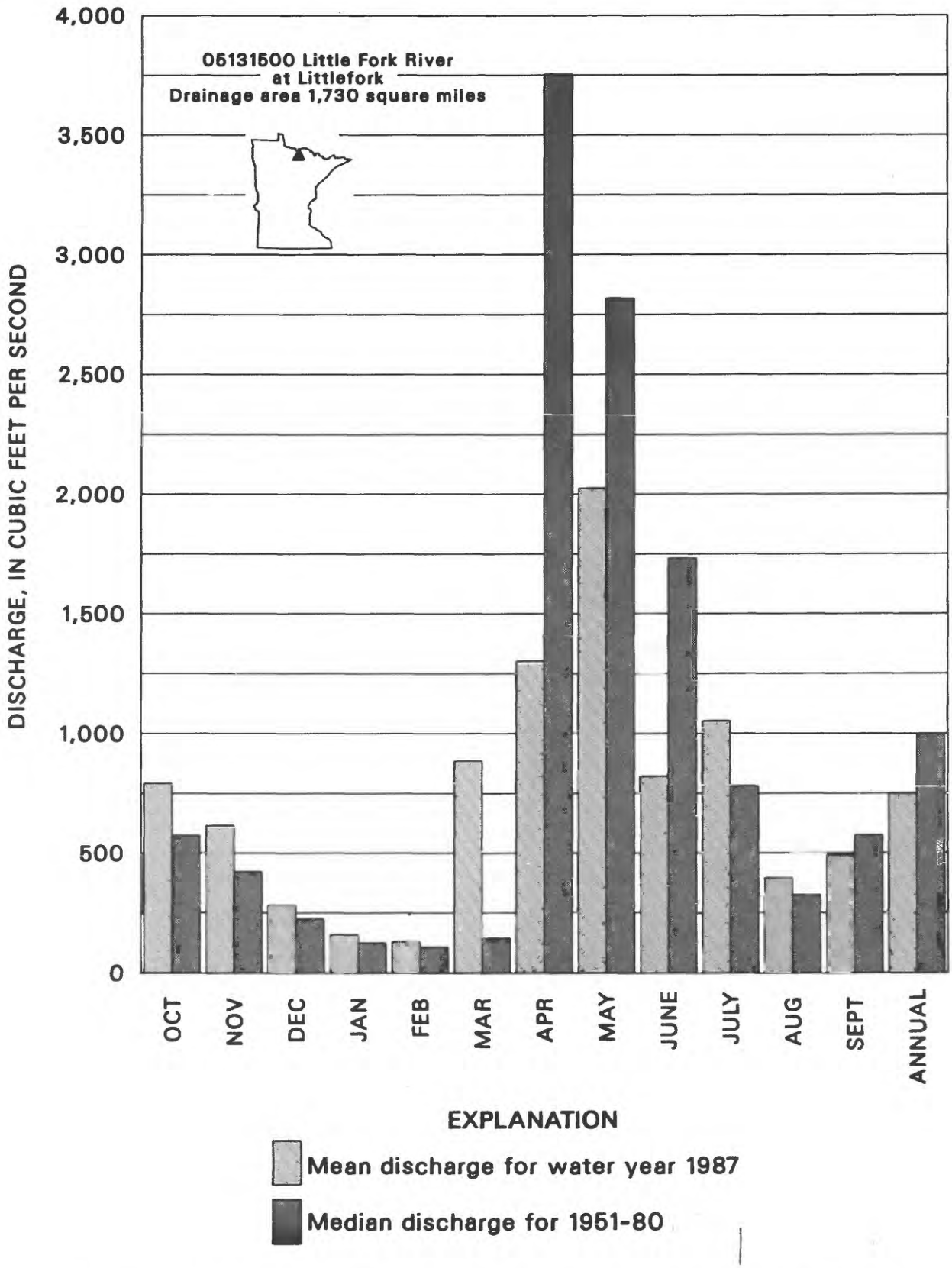


Figure 2.--Comparison of mean discharge for the 1987 water year with median



discharge for 1951–80 at four long-term representative gaging stations.

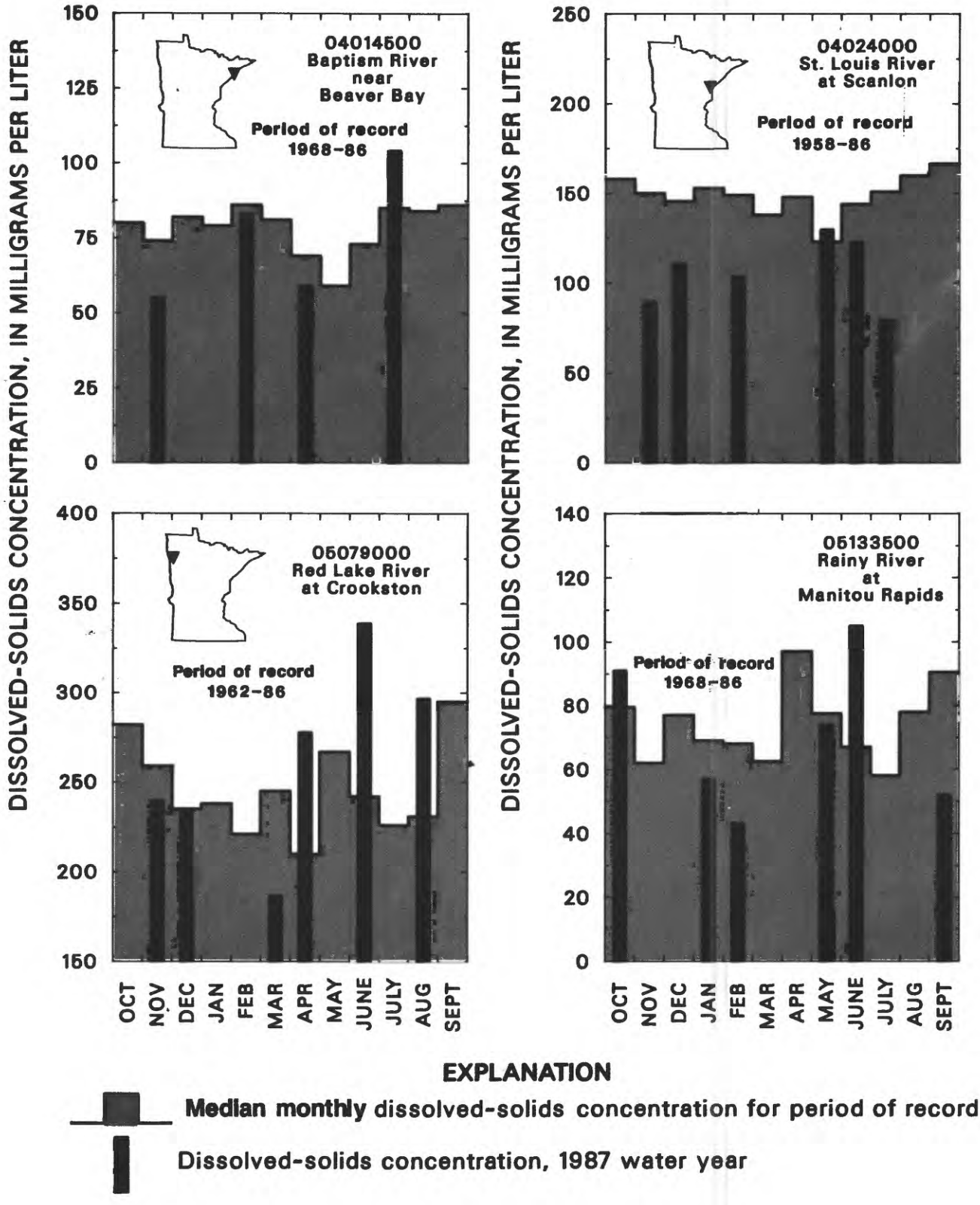


FIGURE 3.--Comparisons between dissolved-solids concentrations.

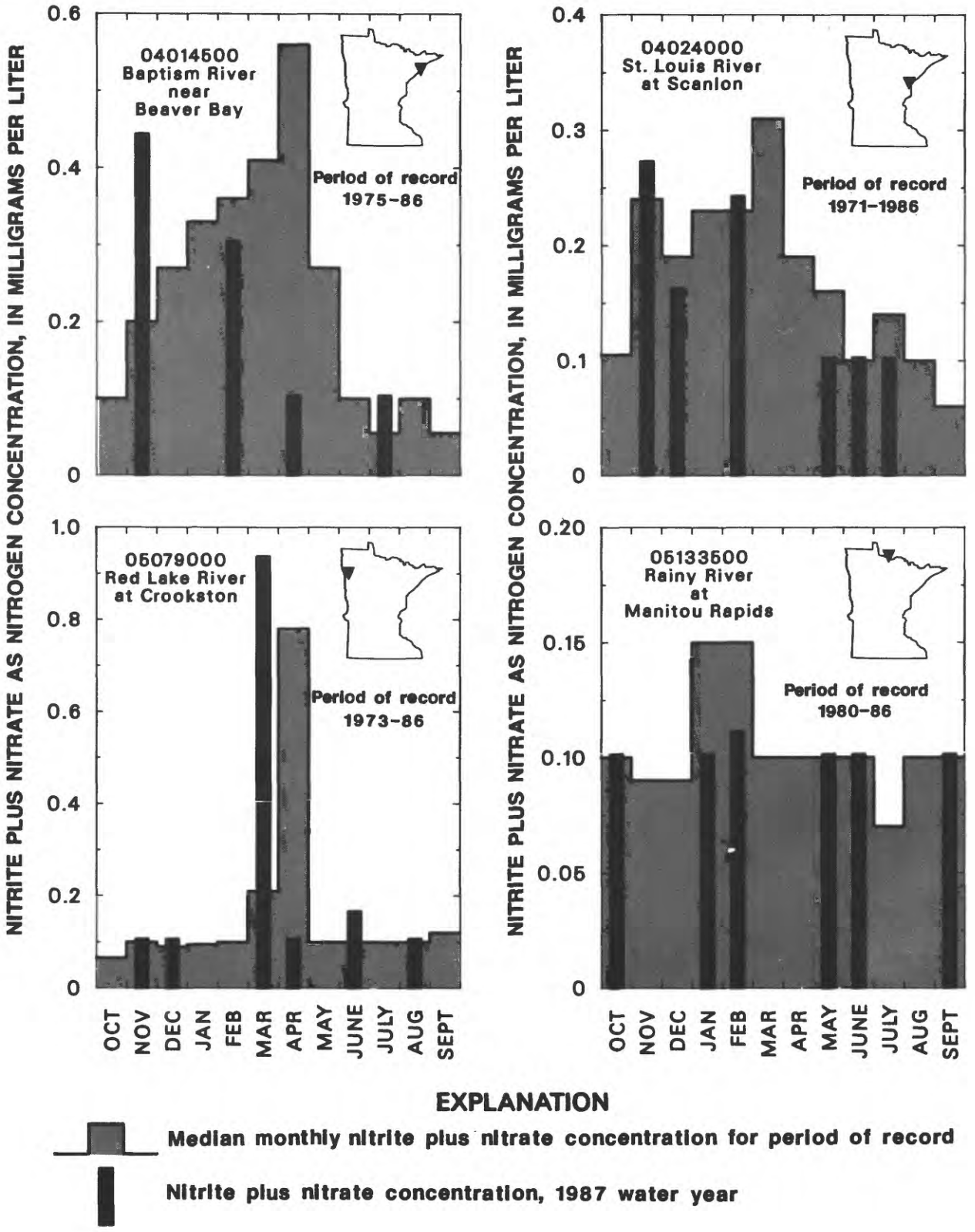


FIGURE 4.--Comparisons between nitrite plus nitrate concentrations.

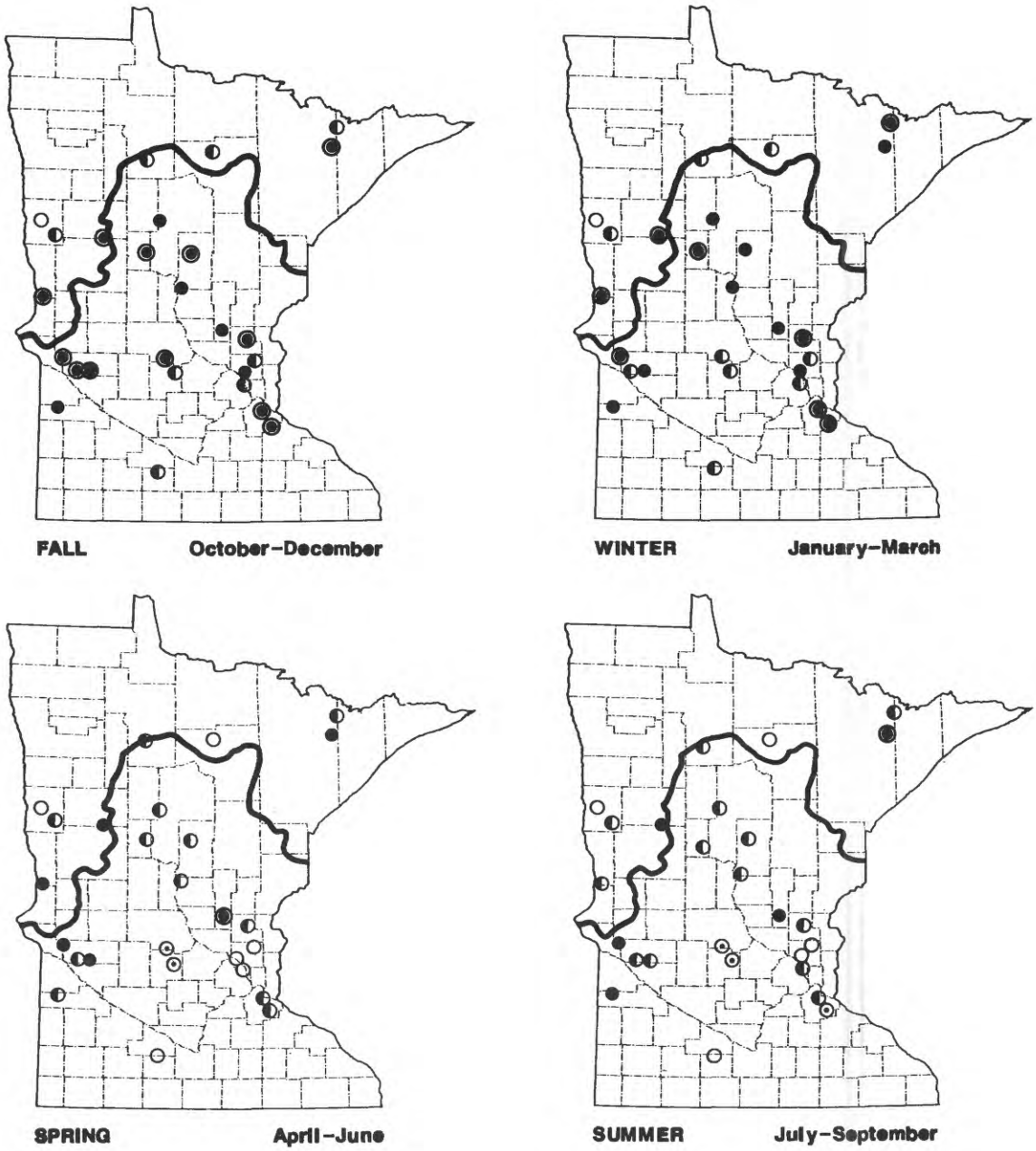
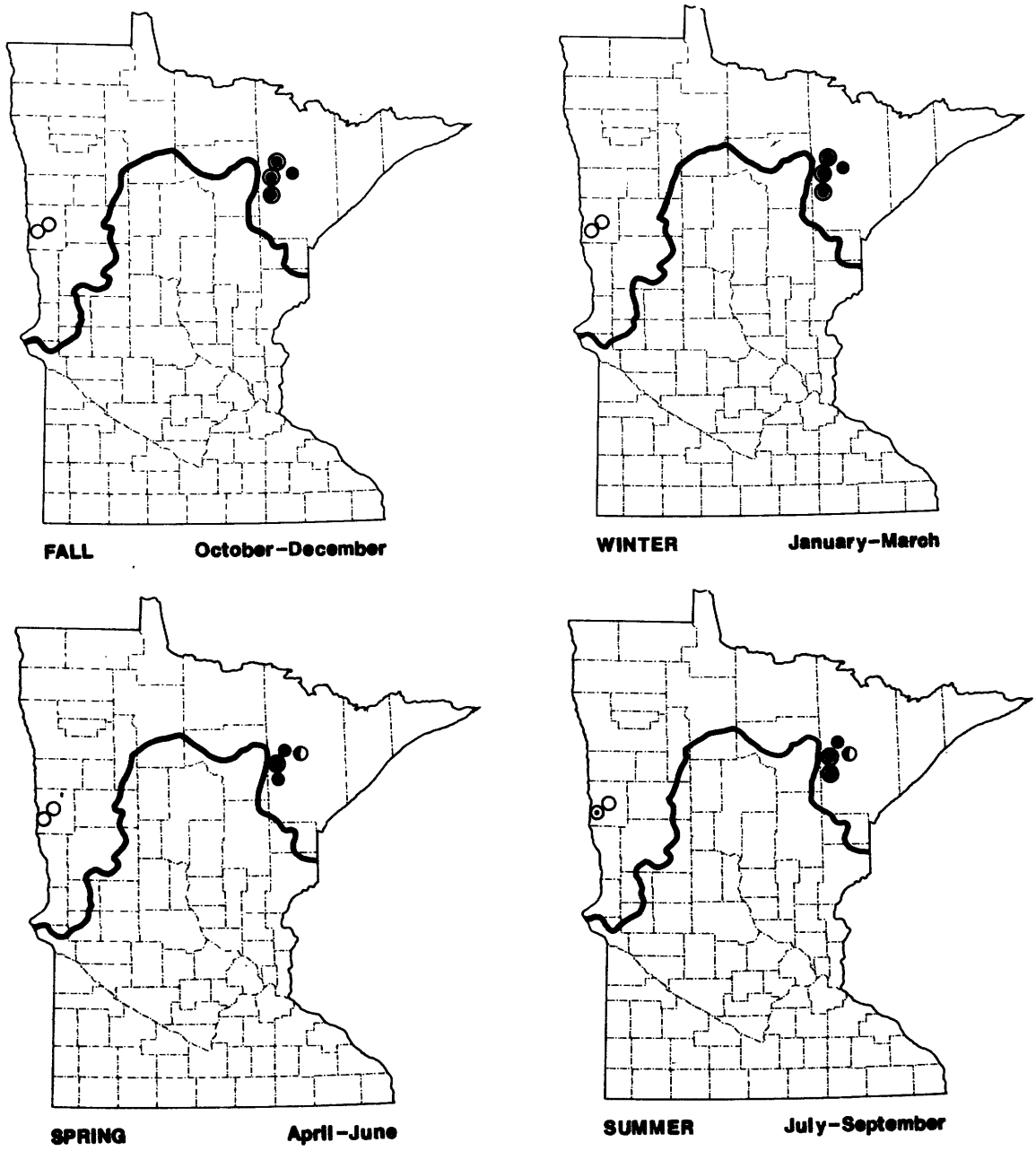


FIGURE 5.--Relation of seasonal water-table levels to long-term normal levels.



EXPLANATION

- ● New record monthly high
- ● Above normal – Water levels are within the highest 25 percent of record for the season
- ◐ Normal – Water levels are within the middle 50 percent of record for the season
- ○ Below normal – Water levels are within the lowest 25 percent of record for the season
- ◎ New record monthly low
- ——— Boundary between Volume I and II

FIGURE 6.--Relation of seasonal water levels in confined aquifers to long-term mean levels.

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 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 7 below. 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.

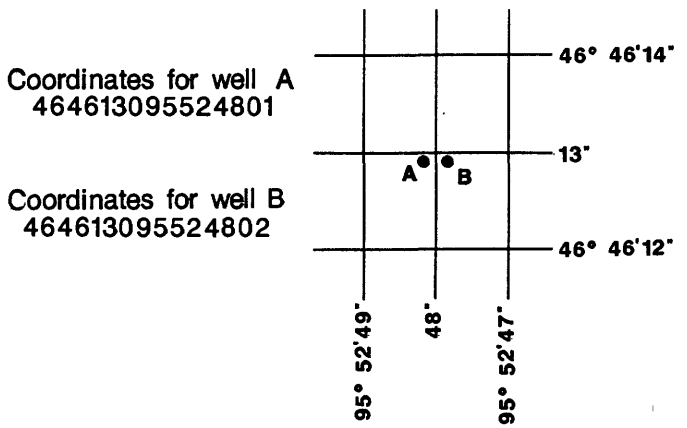


Figure 7.--Example of system for numbering wells and miscellaneous sites

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 8 and 10.

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 10.

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 11.

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 entitles "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, pressure gage or from the graph or punched tape of a water-level 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 hundredths of a foot.

Hydrographs showing water-level fluctuations are included for 13 representative wells; 1 bedrock, 7 surficial-sand, and 5 buried-sand wells.

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 purposed 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.

Date Collection and Computation

The records of ground-water quality in this report were obtained mostly as 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:

Chief 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 bicatbonate 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 milliters (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 (C1). 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 quantity and intensity of 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 of 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 of 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 um membrane 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 anslytical 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.

PUBLICATIONS ON TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS

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 presentation,* 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-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.

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 and dispersion in streams by dye tracing,* by E. F. Hubbard, F. A. Kilpatrick, L. A. Martens, and J. F. Wilson, Jr.: USGS--TWRI Book 3, Chapter A9. 1982. 44 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-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-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 programed 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.

PUBLICATIONS ON TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS--Continued

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. W. Skougstad and others, editors: USGS--TWRI Book 5, Chapter A1. 1979. 626 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 analysis of organic substances in water* by D. F. Goerlitz and Eugene Brown: USGS--TWRI Book 5, Chapter A3. 1972. 40 pages.

5-A4. *Methods for collection and analysis of aquatic biological and microbiological samples* edited by P. E. Greeson, T. A. Ehlke, G. A. Irwin, B. W. Lium, and K. V. Slack: USGS--TWRI Book 5, Chapter A4. 1977. 332 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 sedments,* 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.

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
04015500	Second Creek near Aurora, MN	29	1955-80
04016000	Partridge River near Aurora, MN	161	1942-82
04017000	Embarrass River at Embarrass, MN	93.8	1942-64
04018000	Embarrass River near McKinley, MN	171	1953-62
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
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

"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		
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
05062500	Wild Rice River at Twin Valley, MN	888	1909-17 1930-83
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
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

"See footnotes at end of table."

DISCONTINUED GAGING STATIONS

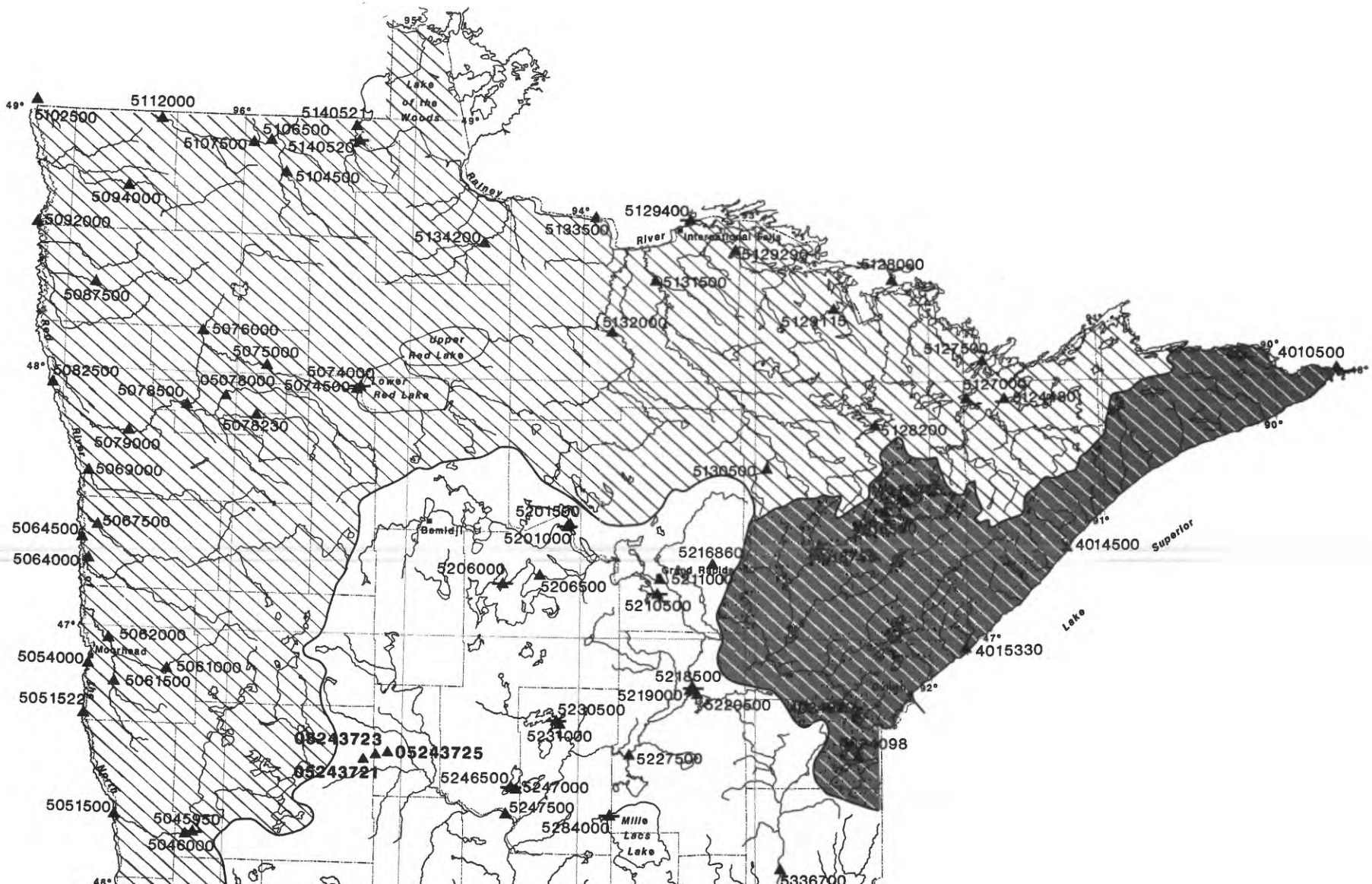
Station number	Station name	Drainage area (mi^2)	Period of record
	Red River of the North basin--Continued		
05091000	Tamarac River at Stephen, MN	-	1945
05091500	Tamarac River near Stephen, MN	a320	1945, 1953-55
05092500	Two Rivers (Middle Fork Two Rivers) near Hallock, MN	131	1931-38
05093000	South 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
	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

*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--Continued		
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
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.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5284000
Mille Lacs Lake
5336700
4010500
4014500
Superior
Lake
4015330
Lake of the Woods
Rainy
River
Upper Red Lake
Lower Red Lake
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Rivers
North
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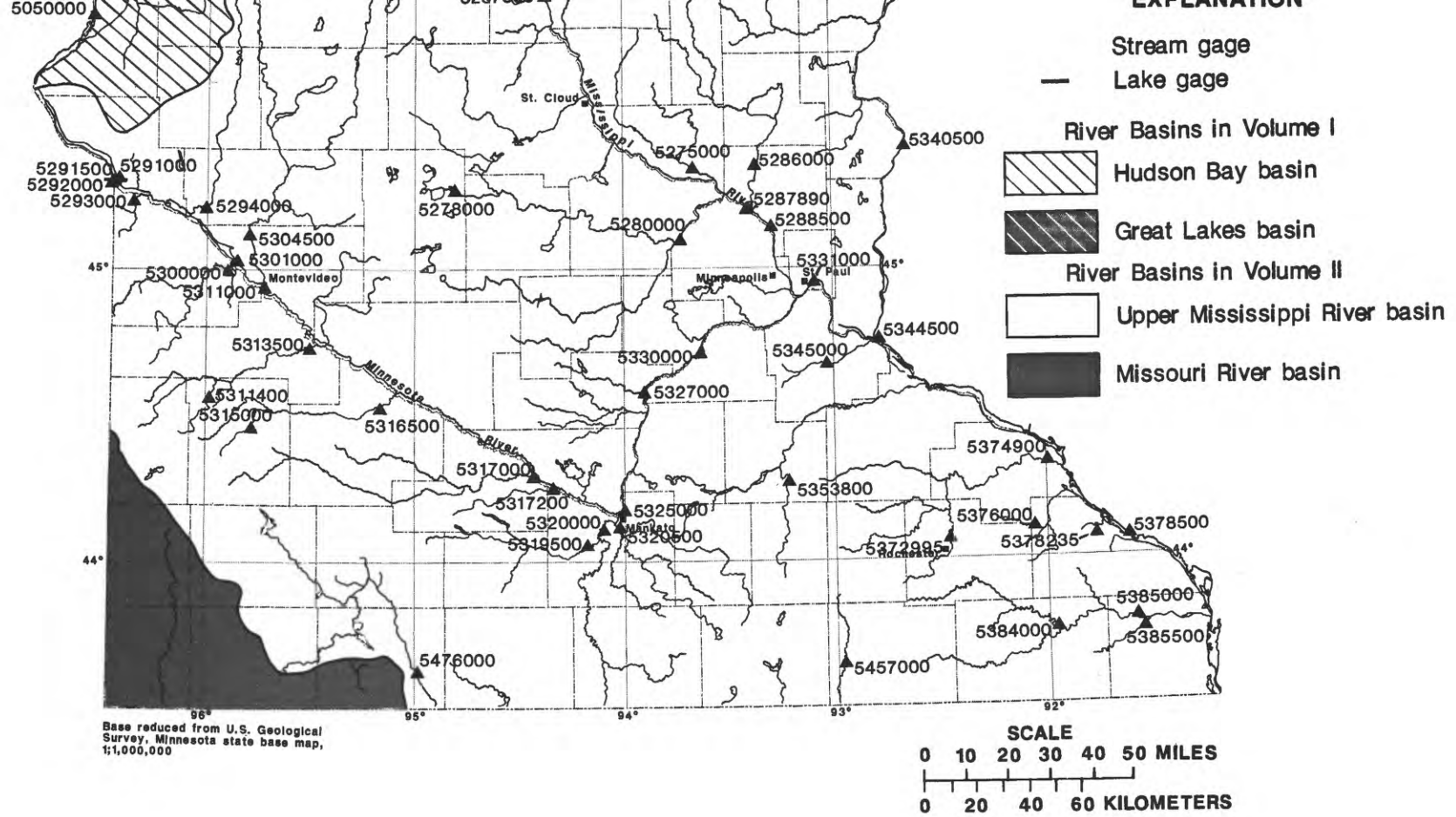
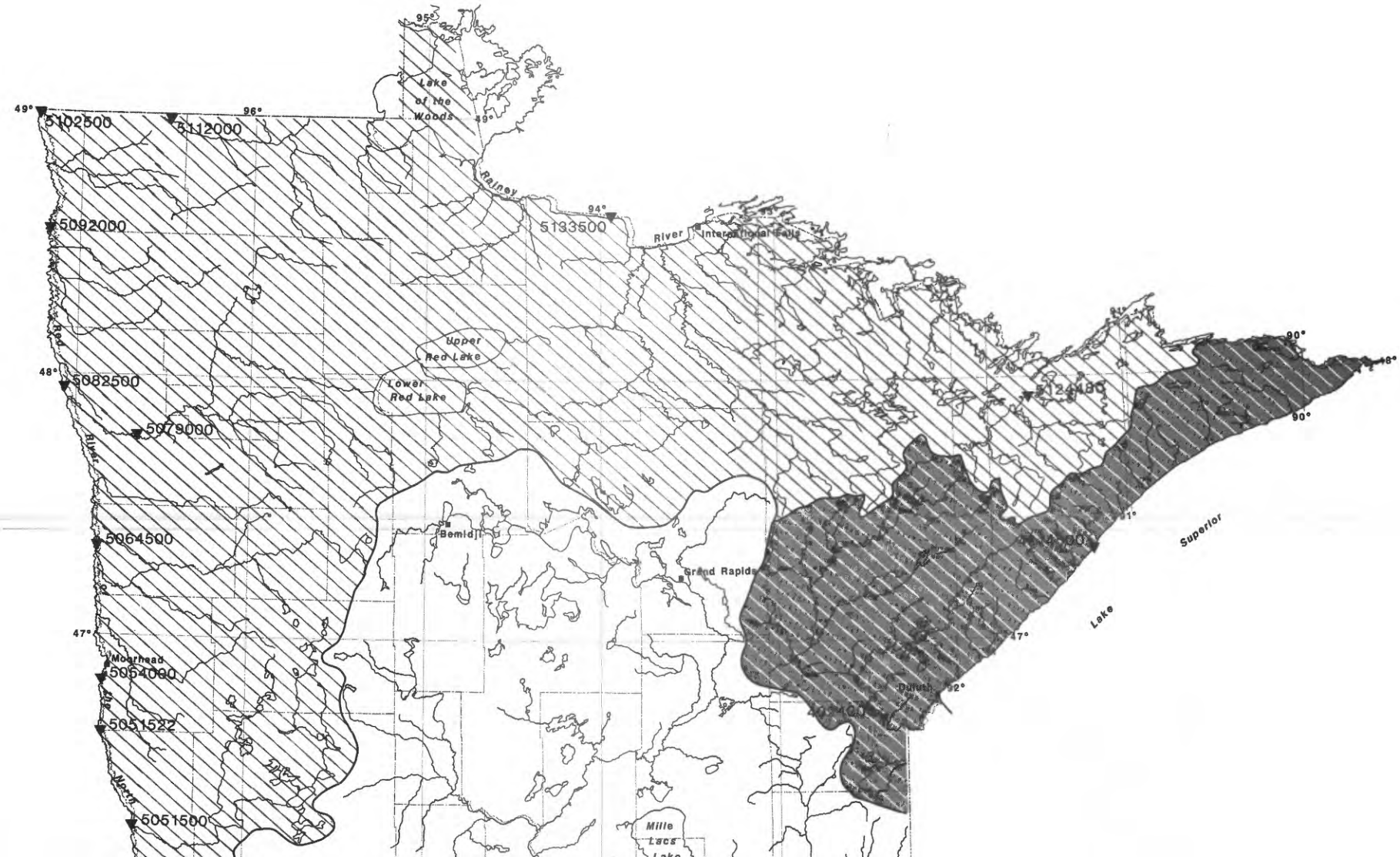


Figure 8.--Location of lake and stream-gaging stations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Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Bemidji
Grand Rapids
Moorhead
Duluth
Superior Lake
Warroad River
Mille Lacs Lake
5102500
5112000
5092000
5082500
5079000
5064500
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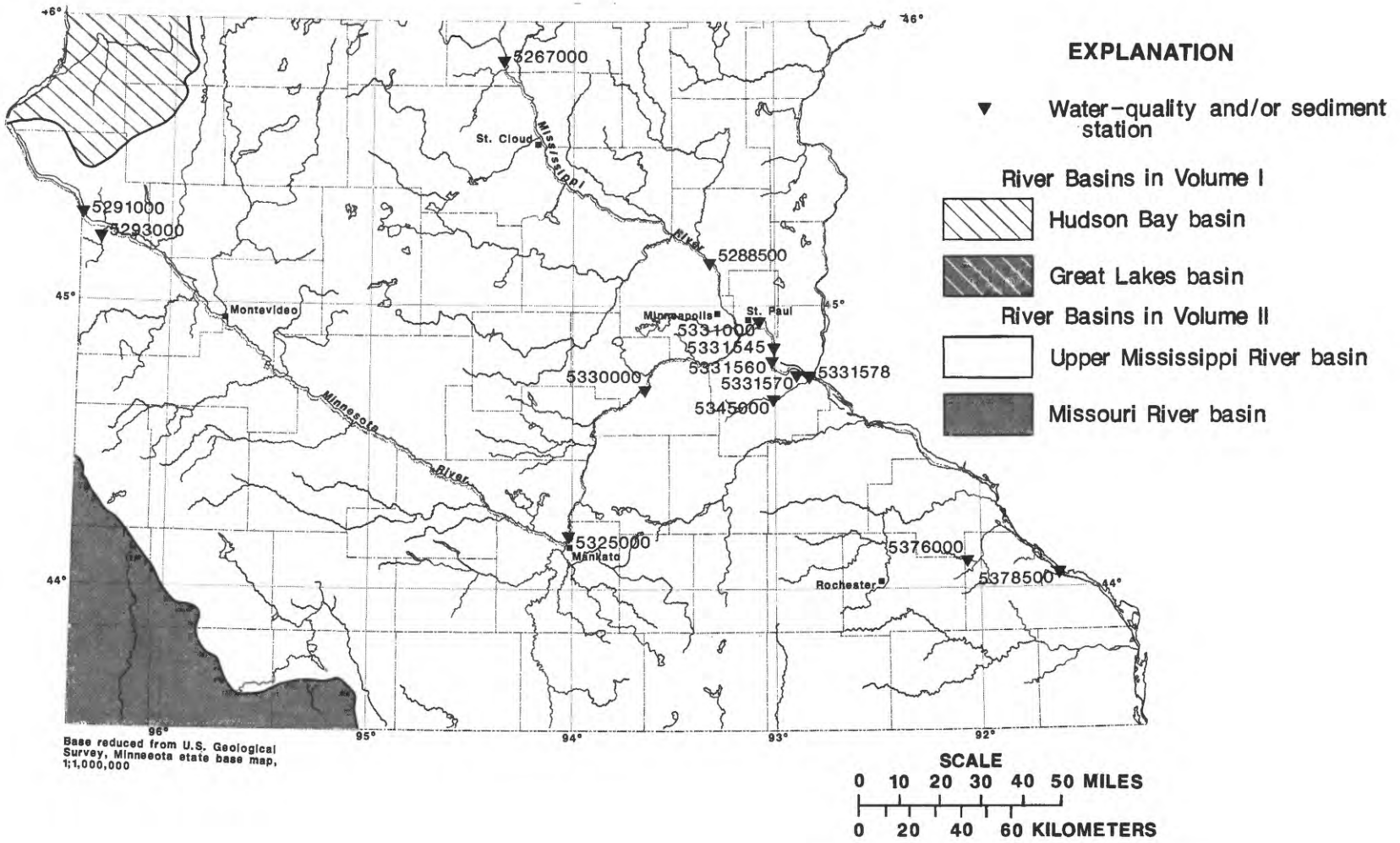


Figure 9.--Location of surface-water-quality stations

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 Nov. 8 to Apr. 10, which are fair. 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.--64 years (water years 1924-87), 506 ft^3/s, 11.45 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)
Nov. 8	2200	Ice jam	*7.90	No peak greater than base discharge			
Aug. 13	2000	*2,000	7.02				

Minimum discharge, 70 ft^3/s, July 17, gage height, 2.49 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	305	163	e270	e185	e130	e100	e280	236	467	94	453	501
2	270	157	e265	e180	e150	e100	e270	211	532	92	948	470
3	242	157	e260	e180	e150	e100	e260	193	539	89	801	438
4	220	161	e255	e175	e140	e105	e250	177	469	84	584	409
5	207	184	e250	e175	e125	e110	e270	168	424	78	450	401
6	193	172	e248	e170	e120	e120	e320	159	384	78	368	584
7	191	193	e245	e170	e115	e150	e450	149	352	78	317	766
8	191	e500	e240	e165	e110	e200	e550	147	331	77	283	749
9	180	e1100	e238	e160	e105	e230	e650	141	313	78	256	831
10	170	e900	e235	e160	e105	e220	e700	129	291	76	233	804
11	167	e700	e230	e155	e102	e200	736	127	272	75	217	814
12	191	e580	e228	e150	e100	e180	677	116	266	74	902	715
13	218	e520	e225	e150	e100	e160	620	117	254	74	1960	727
14	255	e480	e222	e145	e100	e150	577	121	240	74	1650	773
15	332	e450	e220	e140	e100	e145	547	120	218	77	1200	682
16	362	e430	e216	e140	e100	e140	518	125	211	76	1160	605
17	353	e410	e215	e135	e100	e140	503	231	199	71	1060	554
18	317	e395	e214	e135	e100	e140	487	731	187	83	885	515
19	281	e380	e213	e130	e100	e140	470	847	174	160	907	644
20	262	e365	e210	e130	e100	e150	464	762	167	309	826	1410
21	248	e350	e208	e125	e100	e170	449	636	157	292	725	1430
22	235	e335	e206	e125	e100	e200	436	1250	147	233	714	1180
23	225	e320	e204	e120	e100	e250	397	1430	139	201	712	979
24	230	e315	e200	e120	e100	e300	361	1030	134	269	666	833
25	204	e310	e199	e120	e100	e350	336	787	129	326	608	730
26	191	e300	e198	e120	e100	e400	312	673	125	275	569	656
27	182	e295	e196	e120	e100	e360	298	621	123	224	549	608
28	178	e290	e194	e120	e100	e330	282	572	121	187	537	568
29	170	e285	e192	e120	---	e310	283	522	113	173	516	540
30	165	e280	e190	e120	---	e300	248	476	102	171	511	521
31	170	---	e188	e120	---	e290	---	477	---	149	513	---
TOTAL	7105	11477	6874	4460	3052	6240	13001	13481	7580	4397	22080	21437
MEAN	229	383	222	144	109	201	433	435	253	142	712	715
MAX	362	1100	270	185	150	400	736	1430	539	326	1960	1430
MIN	165	157	188	120	100	100	248	116	102	71	217	401
AC-FT	14090	22760	13630	8850	6050	12380	25790	26740	15030	8720	43800	42520
CFSM	.38	.64	.37	.24	.18	.34	.72	.72	.42	.24	1.19	1.19
IN.	.44	.71	.43	.28	.19	.39	.81	.84	.47	.27	1.37	1.33

CAL YR 1986 TOTAL 190232 MEAN 521 MAX 5120 MIN 128 AC-FT 377300 CFSM .87 IN. 11.79
WTR YR 1987 TOTAL 121184 MEAN 332 MAX 1960 MIN 71 AC-FT 240400 CFSM .55 IN. 7.51

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 good except those for Nov. 9-12, 20 to Mar. 23, which are poor.

AVERAGE DISCHARGE.--60 years, 170 ft^3/s, 16.49 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)
Nov. 8	1630	1,830	9.67	May 22	1830	*2,260	*10.08
May 18	0630	1,760	9.59				

Minimum discharge, 14 ft^3/s, part or all of Aug. 12, 24-26; minimum gage height, 5.54 ft, Aug. 25, 26.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	246	93	e98	e49	e29	e27	131	81	491	19	33	24
2	211	87	e96	e49	e29	e27	110	76	413	26	38	22
3	188	95	e94	e48	e29	e27	106	68	371	35	37	20
4	168	95	e92	e47	e29	e27	117	62	280	27	37	21
5	154	95	e90	e47	e29	e27	153	58	220	21	34	35
6	145	176	e88	e46	e28	e30	204	51	176	20	30	109
7	159	363	e86	e45	e28	e35	273	50	153	22	25	80
8	229	1560	e84	e44	e28	e70	311	45	137	23	21	89
9	187	e950	e82	e43	e28	e100	345	44	120	22	19	84
10	153	e500	e80	e43	e28	e120	356	39	100	20	17	79
11	154	e400	e78	e42	e28	e110	327	38	153	58	16	82
12	222	e300	e76	e41	e28	e100	288	34	161	80	16	75
13	235	251	e73	e40	e28	e90	256	33	130	59	19	68
14	213	256	e70	e40	e28	e80	232	39	102	44	17	63
15	213	235	e68	e39	e28	e70	212	39	84	43	28	55
16	203	232	e67	e39	e27	e60	202	49	69	38	36	46
17	185	199	e66	e38	e27	e56	189	581	54	34	34	39
18	165	164	e64	e37	e27	e56	184	1620	46	264	29	40
19	153	157	e62	e37	e27	e56	171	1490	40	785	30	78
20	146	e150	e61	e36	e27	e60	165	1090	35	680	27	269
21	139	e140	e60	e35	e27	e75	158	934	31	526	24	285
22	128	e135	e59	e35	e27	e100	144	1920	29	399	21	216
23	122	e130	e58	e34	e27	e150	130	1820	30	264	17	157
24	115	e125	e57	e34	e27	369	116	1080	49	203	15	120
25	111	e120	e56	e33	e27	698	114	705	39	127	14	90
26	107	e115	e55	e32	e27	491	119	577	33	88	15	70
27	104	e110	e54	e32	e27	339	113	498	30	64	19	61
28	102	e107	e53	e31	e27	273	104	457	27	45	19	53
29	102	e104	e52	e31	---	210	94	383	24	37	17	46
30	100	e100	e51	e30	---	175	85	415	20	32	28	42
31	96	---	e50	e30	---	142	---	661	---	28	28	---
TOTAL	4955	7544	2180	1207	776	4250	5509	15037	3647	4133	760	2518
MEAN	160	251	70.3	38.9	27.7	137	184	485	122	133	24.5	83.9
MAX	246	1560	98	49	29	698	356	1920	491	785	38	285
MIN	96	87	50	30	27	27	85	33	20	19	14	20
AC-FT	9830	14960	4320	2390	1540	8430	10930	29830	7230	8200	1510	4990
CFSM	1.14	1.80	.50	.28	.20	.98	1.31	3.46	.87	.95	.18	.60
IN.	1.32	2.00	.58	.32	.21	1.13	1.46	4.00	.97	1.10	.20	.67

CAL YR 1986 TOTAL 72216 MEAN 198 MAX 1860 MIN 25 AC-FT 143200 CFSM 1.41 IN. 19.19
WTR YR 1987 TOTAL 52516 MEAN 144 MAX 1920 MIN 14 AC-FT 104200 CFSM 1.03 IN. 13.95

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 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 AIR (DEG C) (00020)	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)
NOV												
13...	0945	249	55	56	7.2	7.2	-3.0	2.0	1.3	759	14.4	K16
FEB												
03...	1300	29	75	104	7.3	7.5	3.0	0.0	1.4	744	11.2	K2
APR												
29...	1500	90	66	73	7.8	8.2	16.0	13.0	1.2	743	7.6	K7
JUL												
22...	1230	401	60	67	7.7	8.1	32.0	20.5	1.9	745	8.6	110

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 WATER DISSOLV FLD. AS CACO3 (MG/L) (39086)	CAR-BONATE WATER DISSOLV FIELD AS CO3 (MG/L) (00452)	BICAR-BONATE WATER DISSOLV FIELD AS HCO3 (MG/L) (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)
NOV											
13...	48	7.1	2.4	2.0	0.7	21	0	26	13	1.5	0.2
FEB											
03...	K9	12	3.8	3.3	0.3	40	0	49	15	2.6	0.2
APR											
29...	--	7.3	3.1	3.7	0.5	26	0	31	12	2.0	0.2
JUL											
22...	K660	8.8	2.9	2.3	0.4	25	0	30	14	2.1	0.3

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	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)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
13...	12	54	0.44	<0.01	0.60	0.01	0.01	<0.01	4	2.7	75
FEB											
03...	16	82	0.30	0.02	0.80	<0.01	0.01	<0.01	3	0.23	93
APR											
29...	6.1	58	<0.10	0.02	1.1	0.03	0.01	0.01	2	0.49	100
JUL											
22...	9.4	103	<0.10	<0.01	1.2	0.02	0.02	<0.01	6	6.5	98

DATE	TIME	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)
NOV											
13...	0945	130	<1	10	<0.5	1	<1	<3	4	330	<5
FEB											
03...	1300	60	<1	8	<0.5	<1	<1	<3	1	280	<5
APR											
29...	1500	60	<1	11	<0.5	3	<1	<3	2	260	<5
JUL											
22...	1230	150	<1	12	<0.5	3	<1	<3	2	410	<5

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
NOV										
13...	<4	6	0.1	<10	<1	<1	<1	21	<6	23
FEB										
03...	<4	<1	<0.1	<10	<1	<1	<1	32	<6	10
APR										
29...	200	36	<0.1	<10	<1	<1	<1	23	<6	11
JUL										
22...	12	7	0.1	<10	1	<1	<1	39	<6	<3

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.--13 years, 95.5 ft^3/s, 15.15 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)
Nov. 8	1015	1,500	5.43	May 22	1115	1,080	5.47
Mar. 24	--	850	Ice Jam	Sept. 19	1645	1,080	5.47
May 18	0745	*2,450	*7.13				

Minimum discharge, 3.4 ft^3/s, June 29, 30, gage height, 2.47 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	126	46	e28	e17	e11	e10	62	41	100	4.3	12	7.6
2	119	40	e27	e17	e11	e10	48	38	65	5.3	14	6.9
3	147	42	e27	e17	e11	e10	51	33	44	7.7	13	6.2
4	132	40	e26	e16	e10	e10	57	29	33	6.8	11	6.1
5	125	41	e25	e16	e10	e10	71	26	27	5.2	9.2	8.8
6	113	56	e25	e16	e10	e11	86	24	23	5.6	8.0	70
7	112	343	e24	e16	e10	e15	103	21	20	7.1	6.9	44
8	230	773	e24	e15	e10	e30	116	17	18	6.6	6.2	89
9	152	e300	e23	e15	e10	e50	124	16	16	5.5	5.3	50
10	121	e100	e23	e15	e10	e60	126	14	14	4.4	4.9	34
11	113	e70	e23	e15	e10	e55	116	14	45	4.7	4.5	39
12	229	e60	e22	e14	e10	e50	103	12	53	19	23	38
13	219	e52	e22	e14	e10	e45	90	12	32	16	41	29
14	174	e49	e22	e14	e10	e40	83	15	22	9.8	21	23
15	154	e46	e22	e14	e10	e35	78	16	18	7.9	16	18
16	132	e45	e21	e13	e10	e30	75	12	15	6.9	18	15
17	113	e44	e21	e13	e10	e28	71	113	13	6.0	15	12
18	97	e42	e21	e13	e10	e27	68	1890	11	178	12	19
19	86	e40	e20	e13	e10	e30	64	1260	10	690	11	686
20	81	e39	e20	e13	e10	e35	58	712	8.6	353	11	725
21	78	e37	e20	e12	e10	e50	55	504	7.5	189	11	382
22	74	e36	e20	e12	e10	e80	48	989	7.0	92	11	188
23	69	e35	e19	e12	e10	e200	41	671	6.8	50	9.4	109
24	66	e34	e19	e12	e10	e250	36	344	9.1	30	8.2	68
25	61	e33	e19	e12	e10	e300	87	204	8.3	20	7.5	45
26	59	e32	e19	e12	e10	e250	124	163	5.6	14	7.3	34
27	57	e31	e18	e12	e10	e200	128	151	4.4	11	7.6	27
28	54	e30	e18	e11	e10	e150	83	124	4.1	8.1	7.8	23
29	53	e29	e18	e11	---	e110	61	114	3.7	6.8	7.5	20
30	51	e28	e18	e11	---	89	49	98	3.9	5.9	7.1	18
31	49	---	e17	e11	---	83	---	224	---	4.7	7.2	---
TOTAL	3446	2593	671	424	283	2353	2362	7901	648.0	1781.3	354.6	2840.6
MEAN	111	86.4	21.6	13.7	10.1	75.9	78.7	255	21.6	57.5	11.4	94.7
MAX	230	773	28	17	11	300	128	1890	100	690	41	725
MIN	49	28	17	11	10	10	36	12	3.7	4.3	4.5	6.1
AC-FT	6840	5140	1330	841	561	4670	4690	15670	1290	3530	703	5630
CFSM	1.30	1.01	.25	.16	.12	.89	.92	2.98	.25	.67	.13	1.11
IN.	1.50	1.13	.29	.18	.12	1.02	1.03	3.43	.28	.77	.15	1.23

CAL YR 1986 TOTAL 52869 MEAN 145 MAX 1420 MIN 11 AC-FT 104900 CFSM 1.69 IN. 22.98
WTR YR 1987 TOTAL 25657.5 MEAN 70.3 MAX 1890 MIN 3.7 AC-FT 50890 CFSM .82 IN. 11.15

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04015475 PARTRIDGE RIVER ABOVE COLBY LAKE, AT HOYT LAKES, MN

LOCATION.--Lat 47°31'38", long 92°7'21", in SW¼NE¼ sec.9, T.58 N., R.14 W., St. Louis County, Hydrologic Unit 04010201, in Superior National Forest, 10 ft upstream from bridge on County Highway 110, 1 mi east of Hoyt Lakes.

DRAINAGE AREA.--106 mi^2 of which 6.0 mi^2 is noncontributing.

PERIOD OF RECORD.--October 1978 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,455 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--Records good except those for Nov. 9 to Feb. 20, Mar. 28, 29, which are fair.

AVERAGE DISCHARGE.--9 years, 91.6 ft^3/s, 11.74 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,020 ft^3/s, Apr. 22, 1979, gage height, 10.89 ft; minimum, 0.88 ft^3/s, Feb. 15, 1981, gage height, 4.81 ft.

EXTREMES OUTSIDE PERIOD OF RECORD.--A discharge of 0.50 ft^3/s was measured Aug. 23, 1976.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 892 ft^3/s, May 24, gage height, 9.01 ft; minimum discharge, 7.7 ft^3/s, June 24, 25, gage height, 5.14 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	115	44	e34	e15	e9.8	8.1	73	55	155	24	119	16
2	102	42	e33	e14	e9.8	8.2	60	50	154	21	107	16
3	94	42	e32	e14	e9.6	8.3	50	46	156	20	91	14
4	87	39	e31	e14	e9.6	8.4	44	41	139	18	76	14
5	84	38	e29	e14	e9.4	8.4	42	37	117	16	59	15
6	80	46	e28	e13	e9.4	9.8	46	34	98	16	48	20
7	74	62	e27	e13	e9.3	18	58	32	82	17	41	51
8	82	132	e26	e13	e9.2	28	73	28	69	33	33	81
9	93	e130	e26	e13	e9.2	34	88	26	59	45	26	81
10	97	e120	e25	e13	e9.1	38	104	25	50	45	21	80
11	94	e116	e24	e12	e9.1	38	117	22	47	41	17	96
12	98	e106	e24	e12	e9.0	32	123	21	47	43	17	101
13	106	e94	e23	e12	e9.0	27	123	19	46	70	19	93
14	110	e86	e22	e12	e9.0	24	122	18	41	104	22	79
15	112	e81	e21	e12	e8.9	21	117	17	34	108	20	67
16	112	e72	e21	e12	e8.9	20	111	17	28	91	18	57
17	112	e66	e20	e11	e8.8	19	111	52	23	85	17	48
18	109	e62	e19	e11	e8.8	18	108	272	20	243	17	45
19	99	e59	e19	e11	e8.8	18	105	464	17	443	18	53
20	88	e56	e19	e11	e8.8	21	101	593	15	625	18	79
21	76	e52	e18	e11	8.7	27	101	684	12	779	16	105
22	70	e49	e18	e11	8.5	36	97	744	10	866	16	110
23	65	e47	e18	e11	8.4	58	92	814	8.7	829	17	100
24	63	e45	e17	e11	8.4	92	83	874	8.0	746	16	84
25	63	e43	e17	e10	8.4	142	79	830	15	657	14	69
26	59	e42	e16	e10	8.2	191	73	705	55	566	14	59
27	53	e40	e16	e10	8.0	209	69	561	68	452	12	51
28	50	e39	e16	e10	8.0	e180	65	413	57	331	11	44
29	48	e37	e15	e10	---	e140	64	299	42	239	11	41
30	47	e36	e15	e10	---	123	58	223	32	178	12	37
31	44	---	e15	e10	---	91	---	177	---	140	14	---
TOTAL	2586	1923	684	366	250.1	1696.2	2557	8193	1704.7	7891	957	1806
MEAN	83.4	64.1	22.1	11.8	8.93	54.7	85.2	264	56.8	255	30.9	60.2
MAX	115	132	34	15	9.8	209	123	874	156	866	119	110
MIN	44	36	15	10	8.0	8.1	42	17	8.0	16	11	14
AC-FT	5130	3810	1360	726	496	3360	5070	16250	3380	15650	1900	3580
CFSM	.79	.60	.21	.11	.08	.52	.80	2.49	.54	2.40	.29	.57
IN.	.91	.67	.24	.13	.09	.60	.90	2.88	.60	2.77	.34	.63

CAL YR 1986 TOTAL 33582.5 MEAN 92.0 MAX 628 MIN 6.5 AC-FT 66610 CFSM .87 IN. 11.79
WTR YR 1987 TOTAL 30614.0 MEAN 83.9 MAX 874 MIN 8.0 AC-FT 60720 CFSM .79 IN. 10.74

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04016500 ST. LOUIS RIVER NEAR AURORA, MN

LOCATION.--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 highway bridge, 0.8 mi downstream from Partridge River and 1.5 mi south of Aurora.

DRAINAGE AREA.--290 mi^2 of which 13.3 mi^2 is noncontributing.

PERIOD OF RECORD.--August 1942 to September 1987 (discontinued as a continuous-record station; converted to a high-flow partial-record station).

REVISED RECORDS.--WSP 1337: 1950. WDR MN-77-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 1,371.24 ft above National Geodetic Vertical Datum of 1929. Prior to Aug. 26, 1944, nonrecording gage at same site and datum.

REMARKS.--Records good except those for Nov. 9 to Mar. 26, which are poor. Flow regulated at times by storage in off-channel Partridge Reservoir, formerly known as Whitewater Lake. Reservoir formed from lake by levees around marsh areas and natural outlet. Available capacity 20,000 acre-ft between elevations 1,410 ft, natural lake level, and 1,440 ft. Storage in reservoir obtained from Colby Lake during periods of high flow; release from storage returned to Colby Lake to maintain lake elevation during diversion for iron-ore processing. Diversion began Feb.7, 1956. Some seepage losses from reservoir enter above station. Flow also affected by mining activities in Second Creek basin.

AVERAGE DISCHARGE (adjusted for storage and diversion).--45 years, 252 ft^3/s, 11.80 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,380 ft^3/s, May 14, 1950, gage height, 8.37 ft; minimum daily, 4.0 ft^3/s, Jan. 29 to Feb. 10, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,870 ft^3/s, May 23, gage height, 4.82 ft; minimum daily, 68 ft^3/s, Mar. 3; minimum gage height, 1.21 ft, Aug. 29 and Sept. 2.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	389	145	e160	e86	e100	e70	156	121	751	91	516	73
2	358	146	e155	e86	e100	e70	134	120	729	96	449	70
3	331	147	e150	e80	e95	e68	119	119	654	93	389	76
4	314	145	e145	e80	e90	e70	112	113	584	88	339	78
5	291	148	e140	e80	e87	e70	113	106	512	85	301	76
6	280	175	e135	e80	e81	e70	119	100	453	119	266	79
7	274	229	e130	e80	e81	e80	130	93	399	103	237	89
8	281	467	e125	e80	e81	e90	146	88	354	103	214	116
9	288	e480	e122	e75	e75	e80	167	86	314	98	190	129
10	287	e470	e120	e75	e75	e80	185	80	279	96	171	160
11	291	e440	e118	e75	e75	e90	197	76	271	105	157	200
12	292	e410	e116	e75	e75	e100	212	74	248	112	163	199
13	297	e380	e114	e75	e73	e110	222	77	225	113	148	200
14	303	e350	e112	e75	e72	e95	227	77	201	123	134	192
15	305	e320	e110	e75	e70	e90	222	80	179	147	129	179
16	300	e300	e108	e75	e70	e84	219	90	160	156	127	164
17	293	e280	e106	e75	e70	e80	216	252	144	167	121	153
18	284	e270	e106	e75	e71	e78	212	683	133	623	115	156
19	276	e255	e104	e80	e73	e77	206	958	123	1160	113	170
20	263	e245	e102	e80	e76	e76	198	1050	113	1490	102	202
21	254	e230	e98	e80	e76	e76	194	1200	104	1550	98	220
22	239	e225	e96	e80	e70	e76	191	1670	99	1750	92	234
23	228	e215	e96	e85	e70	e90	182	1840	94	1780	85	230
24	197	e205	e92	e85	e70	e120	173	1840	87	1650	81	213
25	172	e195	e92	e89	e70	e170	170	1770	82	1480	79	193
26	166	e185	e92	e89	e70	e260	162	1650	82	1330	84	180
27	160	e180	e92	e94	e70	344	153	1500	84	1190	86	169
28	155	e175	e86	e94	e70	315	142	1310	93	1010	80	160
29	152	e170	e86	e100	---	262	130	1130	97	850	76	154
30	149	e165	e86	e100	---	214	122	983	93	705	85	146
31	149	---	e86	e100	---	179	---	851	---	604	76	---
TOTAL	8018	7747	3480	2558	2156	3734	5131	20187	7741	19067	5303	4660
MEAN	259	258	112	82.5	77.0	120	171	651	258	615	171	155
MAX	389	480	160	100	100	344	227	1840	751	1780	516	234
MIN	149	145	86	75	70	68	112	74	82	85	76	70
$	+34.9	+25.0	+25.4	+10.1	+11.2	+40.4	+42.3	+37.9	+17.9	+22.2	+16.7	+26.7
MEAN¥	294	283	138	92.6	88.2	161	213	689	276	637	188	182
CFSM¥	1.01	0.98	0.48	0.32	0.30	0.56	0.73	2.38	0.95	2.20	0.65	0.63
IN¥	1.17	1.09	0.55	0.37	0.32	0.64	0.82	2.74	1.06	2.53	0.75	0.70

CAL YR 1986 TOTAL 104072 MEAN 285 MAX 1490 MIN 45 MEAN ¥ 305 CFSM ¥ 1.05 IN ¥ 14.26
WTR YR 1987 TOTAL 89782 MEAN 246 MAX 1840 MIN 68 MEAN ¥ 272 CFSM ¥ 0.94 IN ¥ 12.73

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

¥ Adjusted for change in contents and diversion.

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04018750 ST. LOUIS RIVER AT FORBES, MN

LOCATION.--Lat 47°21'48", long 92°35'56", in NE¼SE¼ sec.3, T.56 N., R.18 W., St. Louis County, Hydrologic Unit 04010201, on right bank at downstream side of highway bridge, 1.8 mi downstream from Eveleth Taconite Company dam, 0.6 mi south of Forbes, 1.8 mi upstream from Elbow Creek.

DRAINAGE AREA.--713 mi^2.

PERIOD OF RECORD.--August 1964 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,293.11 ft above National Geodetic Vertical Datum of 1929. Prior to Oct. 28, 1964, nonrecording gage at same site and datum.

REMARKS.--Records good except those for Nov. 11 to Mar. 22, which are poor. Natural flow of stream affected by continually changing iron-mining activities that include diversions for iron-ore processing, regulation of storage reservoirs and tailing ponds, and mine pit dewatering. There is some regulation at medium and low flows by Eveleth Taconite Company dam 1.8 mi upstream.

AVERAGE DISCHARGE.--23 years, 570 ft^3/s, 10.86 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 6,200 ft^3/s, Apr. 25, 1979, gage height, 17.71 ft; minimum daily, 8.0 ft^3/s, Sept. 11, 1984, gage height 5.05 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 4,020 ft^3/s, May 24, gage height, 14.38 ft; mimimum daily, 140 ft^3/s, Feb. 20 to Mar. 5; minimum gage height, 5.12 ft, July 7.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1210	411	e500	e225	e200	e140	745	359	2040	195	1020	192
2	1130	391	e485	e220	e200	e140	580	343	1950	245	883	186
3	1050	379	e470	e220	e200	e140	591	327	1820	231	762	187
4	968	393	e455	e220	e190	e140	509	308	1640	231	642	189
5	908	399	e440	e220	e190	e140	490	280	1470	217	578	199
6	835	456	e425	e210	e190	e145	475	300	1310	217	514	197
7	784	644	e415	e210	e180	e170	473	272	1180	200	472	198
8	760	1040	e400	e200	e180	e200	483	257	790	234	419	218
9	734	1370	e390	e200	e170	e270	520	259	1160	209	374	255
10	706	1360	e380	e190	e170	e320	585	249	825	200	337	271
11	698	e1270	e365	e190	e170	e320	550	227	782	208	306	310
12	708	e1180	e355	e190	e160	e310	616	225	744	229	315	350
13	701	e1110	e342	e180	e160	e300	657	219	677	243	338	348
14	692	e1040	e338	e180	e160	e280	591	227	610	233	283	345
15	690	e1000	e326	e180	e150	e270	719	225	535	235	299	339
16	689	e950	e320	e180	e150	e260	709	224	481	256	281	324
17	666	e900	e312	e180	e150	e260	658	587	461	282	267	308
18	642	e870	e302	e180	e150	e260	630	1720	338	627	253	297
19	609	e830	e294	e180	e150	e280	610	2380	372	1460	248	308
20	539	e790	e288	e180	e140	e300	591	2470	334	2000	240	352
21	618	e750	e282	e190	e140	e340	574	2860	309	2170	227	388
22	552	e710	e276	e190	e140	e400	550	3540	265	2460	218	400
23	583	e680	e270	e190	e140	591	531	3860	288	2610	209	402
24	513	e650	e264	e190	e140	883	505	3990	266	2700	196	398
25	499	e630	e258	e190	e140	1020	483	4000	250	2670	190	380
26	454	e600	e252	e200	e140	1140	486	3850	235	2490	200	347
27	440	e580	e248	e200	e140	1220	472	3600	228	2240	285	335
28	432	e560	e244	e200	e140	1170	429	3310	219	1970	206	318
29	455	e540	e240	e200	---	1030	415	3000	191	1700	194	311
30	429	e520	e236	e200	---	917	389	2660	232	1430	200	308
31	435	---	e230	e200	---	787	---	2320	---	1190	202	---
TOTAL	21129	23003	10402	6085	4530	14143	16616	48448	22002	31582	11158	8960
MEAN	682	767	336	196	162	456	554	1563	733	1019	360	299
MAX	1210	1370	500	225	200	1220	745	4000	2040	2700	1020	402
MIN	429	379	230	180	140	140	389	219	191	195	190	186
AC-FT	41910	45630	20630	12070	8990	28050	32960	96100	43640	62640	22130	17770
CFSM	.96	1.08	.47	.28	.23	.64	.78	2.19	1.03	1.43	.50	.42
IN.	1.10	1.20	.54	.32	.24	.74	.87	2.53	1.15	1.65	.58	.47

CAL YR 1986 TOTAL 268139.0 MEAN 735 MAX 3400 MIN 5.0 AC-FT 531900 CFSM 1.03 IN. 13.99
WTR YR 1987 TOTAL 218058 MEAN 597 MAX 4000 MIN 140 AC-FT 432500 CFSM .84 IN. 11.38

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 Dec. 3 to Mar. 7, 11-13, 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).--79 years, 2,351 ft^3/s, 9.31 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, 17,700 ft^3/s, May 23, gage height, 9.86 ft; minimum daily, 553 ft^3/s, May 15; minimum gage height, 2.24 ft, June. 24.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6370	2240	2500	e2000	e1900	e1600	2660	1340	6390	606	2330	1030
2	5890	2280	2340	e2000	e1900	e1600	2060	1190	5700	790	2070	1070
3	5420	2500	e2300	e2000	e1900	e1600	1970	1210	5250	723	1940	1010
4	4900	2200	e2000	e2000	e1900	e1600	1760	1150	4540	781	1750	947
5	4360	2240	e1900	e2000	e1900	e1600	1670	1030	3860	760	1580	1080
6	3730	2310	e1900	e2000	e1800	e1600	1670	960	3370	758	1460	1290
7	3400	2830	e2200	e2000	e1800	e1800	1500	945	2960	675	1310	1280
8	3120	4600	e2200	e1900	e1800	2590	1680	818	2500	755	1200	1370
9	2930	6570	e2000	e1900	e1800	2460	1790	811	2280	689	1050	1430
10	2610	6500	e1700	e1900	e1800	2030	1960	695	1900	748	956	1690
11	2640	5200	e1800	e1900	e1800	e2000	2020	742	2040	787	942	2010
12	2760	3890	e1700	e1900	e1800	e1800	2160	613	2000	700	1160	1880
13	2960	4040	e1700	e1900	e1800	e1700	2110	658	1920	693	1160	1910
14	3180	3470	e2000	e1900	e1800	1590	2240	682	1680	775	1200	1750
15	3190	3690	e3000	e1800	e1800	1520	2070	553	1420	775	1290	1530
16	3200	3720	e2500	e1400	e1800	1350	2140	596	1280	763	1230	1450
17	3130	3640	e2300	e1500	e1800	1280	2150	703	1090	765	1390	1220
18	3070	3230	e2100	e1700	e1800	1370	2120	2830	1010	2060	1350	1170
19	2880	2930	e2000	e1800	e1800	1330	2140	10100	887	8650	849	1310
20	2780	2260	e2000	e1600	e1800	1410	2090	11300	744	10800	965	1670
21	2640	2870	e2000	e1300	e1800	1590	2080	11100	763	10700	959	1930
22	2610	2940	e2000	e1500	e1700	1810	1910	13500	606	10200	935	2070
23	2590	3030	e2000	e1500	e1700	2210	1930	16800	639	9690	837	1920
24	2450	2760	e2000	e1200	e1700	3370	1710	17100	689	9290	940	1910
25	2350	2810	e2000	e1200	e1600	4540	1660	15600	608	8830	840	1680
26	2310	2920	e2000	e1900	e1600	5210	1610	13600	752	8250	807	1510
27	2260	2780	e2000	e1900	e1600	5180	1830	11700	781	7480	755	1520
28	2140	2730	e2000	e1900	e1600	4740	1590	10100	770	6120	839	1380
29	2230	2610	e2000	e1900	---	4110	1530	8630	752	4670	796	1220
30	1940	2490	e2000	e1900	---	3510	1410	7730	735	3570	1130	1270
31	2300	---	e2000	e1900	---	3100	---	7100	---	2830	1050	---
TOTAL	98340	98280	64140	55200	49800	73200	57220	171886	59916	115683	37070	44507
MEAN	3172	3276	2069	1781	1779	2361	1907	5545	1997	3732	1196	1484
MAX	6370	6570	3000	2000	1900	5210	2660	17100	6390	10800	2330	2070
MIN	1940	2200	1700	1200	1600	1280	1410	553	606	606	755	947
§	-157	-168	-930	-1084	-930	+80	+545	+1637	+253	+153	-86	-124
MEAN ¥	3015	3108	1139	697	849	2441	2452	7182	2250	3885	1110	1360
CFSM ¥	.88	.91	.33	.20	.25	.71	.71	2.09	.66	1.13	.32	.40
IN ¥	1.01	1.01	.38	.23	.26	.82	.80	2.41	.73	1.31	.37	.44

CAL YR 1986 TOTAL 1390650 MEAN 3810 MAX 21100 MIN 1120 MEAN ¥ 3830 CFSM ¥ 1.12 IN ¥ 15.16
WTR YR 1987 TOTAL 925242 MEAN 2535 MAX 17100 MIN 553 MEAN ¥ 2472 CFSM ¥ .72 IN ¥ 9.79

§ 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. Samples collected at cableway 0.75 mi (1.21 km) downstream from gage.

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 AIR (DEG C) (00020)	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)
NOV												
12...	1115	3340	110	115	7.4	7.7	3.0	2.0	5.3	741	12.6	160
DEC												
10...	1230	1960	140	142	7.3	7.5	-12.0	0.0	2.1	730	12.3	K4
FEB												
18...	1100	1790	75	141	7.0	7.4	-1.0	0.5	2.6	736	10.8	K6
MAY												
18...	1210	1860	180	197	8.0	8.3	12.0	13.5	2.8	734	9.8	34
JUN												
22...	1300	782	133	174	7.8	8.0	32.0	24.5	4.1	731	6.7	K11
JUL												
21...	1400	11200	98	102	7.6	7.6	33.0	21.0	9.5	737	8.4	180

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 WATER DISSOLV FLD. AS CACO3 (MG/L) (39086)	CAR-BONATE WATER DISSOLV FIELD AS CO3 (MG/L) (00452)	BICAR-BONATE WATER DISSOLV FIELD AS HCO3 (MG/L) (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)
NOV											
12...	K520	12	6.0	3.4	1.4	44	0	54	19	3.8	0.1
DEC											
10...	K13	13	9.0	5.0	1.0	58	0	71	21	4.8	0.2
FEB											
18...	K40	15	6.8	3.7	0.9	58	0	71	12	3.1	0.1
MAY											
18...	98	18	9.3	5.8	1.2	74	0	90	10	5.0	0.3
JUN											
22...	64	16	8.5	6.2	1.1	62	0	76	19	5.2	0.2
JUL											
21...	320	12	5.2	2.8	1.3	34	0	41	15	3.1	0.1

STREAMS TRIBUTARY TO LAKE SUPERIOR

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

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	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)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
12...	9.2	88	0.27	0.05	0.20	0.04	0.02	<0.01	13	117	93
DEC											
10...	9.9	109	0.16	0.06	0.70	0.03	0.02	0.01	6	32	100
FEB											
18...	11	102	0.24	0.04	0.70	0.02	<0.01	<0.01	4	19	69
MAY											
18...	3.9	128	<0.10	0.02	1.0	0.03	0.02	<0.01	8	40	100
JUN											
22...	6.5	121	<0.10	0.06	0.50	0.04	0.04	<0.01	7	15	100
JUL											
21...	7.6	78	<0.10	0.04	1.9	0.50	0.39	0.02	49	1480	98

DATE	TIME	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)
NOV											
12...	1115	80	<1	17	<0.5	1	<1	<3	2	460	<5
FEB											
18...	1100	30	<1	16	<0.5	<1	<1	<3	2	600	<5
MAY											
18...	1210	20	<1	19	<0.5	<1	<1	<3	2	310	<5
JUL											
21...	1400	260	<1	24	<0.5	3	<1	<3	3	920	<5

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
NOV										
12...	<4	49	0.1	<10	<1	<1	<1	35	<6	7
FEB										
18...	<4	25	<0.1	<10	1	<1	<1	41	<6	7
MAY										
18...	5	8	<0.1	<10	<1	<1	<1	56	<6	10
JUL										
21...	<4	78	<0.1	<10	1	1	<1	35	<6	7

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. 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.--11 years, 7.97 ft^3/s, 13.93 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.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 96 ft^3/s, Nov. 8, gage height, 13.27 ft; minimum discharge, 0.95 ft^3/s, Aug. 10, gage height, 11.18 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.8	3.0	e1.8	e1.8	e2.1	2.6	5.1	2.7	3.6	2.0	2.0	1.7
2	5.3	e2.9	e1.8	e1.8	e2.1	2.5	5.2	2.6	3.5	2.7	2.1	1.8
3	5.0	e2.7	e1.8	e1.8	e2.1	2.5	4.7	2.4	2.6	2.1	2.3	1.9
4	4.6	2.6	1.7	e1.8	e2.1	3.2	4.3	2.1	2.4	2.0	2.0	1.9
5	4.2	2.8	e1.7	e1.8	e2.1	6.1	5.3	2.2	2.2	2.0	1.7	2.1
6	3.9	3.4	e1.7	e1.8	e2.1	27	5.5	2.7	2.2	2.2	1.7	2.6
7	3.9	7.4	e1.8	e1.8	e2.2	29	4.9	2.8	2.2	2.1	1.7	1.8
8	4.2	44	e1.9	e1.7	e2.2	15	4.6	2.8	2.2	2.7	1.7	1.8
9	3.8	12	e2.0	e1.7	e2.3	7.0	5.8	2.7	2.1	2.2	1.7	1.9
10	3.6	5.4	2.4	e1.8	e2.4	8.3	6.4	2.7	2.1	2.0	1.6	1.9
11	7.3	3.3	e2.4	e1.9	e2.4	4.0	4.9	2.7	5.4	2.8	1.7	2.1
12	28	2.9	e2.4	e1.9	e2.5	3.8	5.1	2.8	3.2	2.7	5.0	1.9
13	14	e2.8	e2.4	e2.0	e2.6	3.6	5.5	2.6	2.5	2.1	3.1	1.9
14	11	e2.6	e2.3	e2.0	e2.6	3.6	5.0	2.9	2.2	2.0	1.7	2.0
15	9.2	e2.5	e2.3	e2.0	e2.6	3.8	4.5	2.6	2.1	2.0	2.0	1.9
16	6.8	e2.3	e2.3	e2.0	e2.6	3.9	4.5	2.7	2.0	2.0	2.8	2.0
17	5.5	e2.3	e2.3	e2.0	2.6	4.2	4.5	4.6	2.0	2.0	2.2	2.1
18	5.5	2.2	e2.2	e2.0	2.6	4.6	4.4	16	2.0	6.0	2.0	2.4
19	4.9	2.2	e2.2	e2.0	2.5	4.7	3.9	24	1.9	19	1.9	3.0
20	4.1	e2.1	e2.2	e2.0	2.5	8.6	4.3	10	1.9	4.2	1.8	3.5
21	3.9	e2.1	e2.1	e2.0	2.5	6.7	4.0	14	2.0	3.7	1.9	3.7
22	3.8	e2.1	e2.1	e2.0	2.9	7.4	3.8	39	2.0	2.9	2.0	2.7
23	3.6	e2.0	e2.1	e2.0	2.8	13	3.5	17	2.0	2.4	1.8	2.0
24	3.6	e2.0	e2.0	e2.0	2.4	13	3.0	8.4	2.0	3.7	1.9	1.9
25	3.3	e2.0	e2.0	e2.0	2.4	13	3.0	5.5	1.9	2.9	1.9	1.9
26	3.3	e1.9	e2.0	e2.0	2.5	10	2.9	4.7	1.9	2.2	2.1	1.9
27	3.1	e1.9	e1.9	e2.0	2.7	8.8	3.3	4.2	2.1	1.9	2.0	1.9
28	3.1	e1.9	e1.9	e2.0	2.4	7.4	3.2	5.9	2.0	2.4	1.8	1.9
29	3.0	e1.8	e1.9	e2.0	---	5.9	2.5	13	2.0	2.1	1.7	1.9
30	3.0	e1.8	e1.9	e2.0	---	5.7	2.4	13	2.0	1.9	2.5	1.8
31	3.2	---	e1.8	e2.0	---	5.2	---	5.5	---	1.9	2.0	---
TOTAL	177.5	130.9	63.3	59.6	67.8	244.1	130.0	226.8	70.2	94.8	64.3	63.8
MEAN	5.73	4.36	2.04	1.92	2.42	7.87	4.33	7.32	2.34	3.06	2.07	2.13
MAX	28	44	2.4	2.0	2.9	29	6.4	39	5.4	19	5.0	3.7
MIN	3.0	1.8	1.7	1.7	2.1	2.5	2.4	2.1	1.9	1.9	1.6	1.7
AC-FT	352	260	126	118	134	484	258	450	139	188	128	127
CFSM	.74	.56	.26	.25	.31	1.01	.56	.94	.30	.39	.27	.27
IN.	.85	.63	.30	.29	.32	1.17	.62	1.09	.34	.45	.31	.31

CAL YR 1986 TOTAL 6918.3 MEAN 19.0 MAX 416 MIN 1.7 AC-FT 13720 CFSM 2.44 IN. 33.12
WTR YR 1987 TOTAL 1393.1 MEAN 3.82 MAX 44 MIN 1.6 AC-FT 2760 CFSM .49 IN. 6.67

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, 12,860 acre-ft, Oct. 1, elevation, 1,068.86 ft; minimum, 670 acre-ft, July 14, elevation, 1,047.82 ft.

MONTHEND ELEVATION AND CONTENTS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

Date	Elevation (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30, 1986	1,069.13	13,130	
Oct. 31	1,068.14	12,140	-990
Nov. 30	1,067.85	11,850	-290
Dec. 31	1,067.62	11,620	-230
CAL YR 1986			5,740
Jan. 31, 1987	1,068.22	12,220	600
Feb. 28	1,064.65	8,850	-3,370
Mar. 31	1,063.65	8,040	-810
Apr. 30	1,067.83	11,830	3,790
May 31	1,068.42	12,420	590
June 30	1,067.00	11,000	-1,420
July 31	1,063.65	8,040	-2,960
Aug. 31	1,067.56	11,560	3,520
Sept. 30	1,067.96	11,960	400
WTR YR 1987			-1,170

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 except those for Nov. 11 to Dec. 11, which are fair. Flow regulated by Orwell Lake (station 05045950) beginning Mar. 21, 1953 and powerplants upstream.

AVERAGE DISCHARGE.--57 years, 324 ft^3/s, 234,700 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, 1,050 ft^3/s, June 30, gage height, 3.97 ft, result of regulation; minimum, 8.1 ft^3/s, July 14, gage height, 1.86 ft, result of regulation.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	911	844	e730	668	566	560	645	588	604	1000	65	110
2	905	838	e730	667	614	560	610	554	604	959	65	113
3	860	819	e730	665	648	558	598	554	533	906	71	135
4	824	792	e730	662	645	554	609	559	484	849	71	150
5	818	792	e730	629	645	554	610	564	484	785	73	150
6	767	792	e730	585	638	557	610	566	484	720	73	150
7	704	792	e730	585	633	618	574	572	484	662	73	150
8	727	804	e700	586	633	666	523	545	484	602	73	172
9	743	805	e690	589	630	760	533	522	484	537	76	185
10	773	803	e690	591	627	817	542	518	484	423	160	198
11	792	e790	e630	591	627	808	546	471	484	364	220	200
12	792	e790	578	591	622	795	553	443	432	356	220	200
13	792	e785	548	591	615	660	558	445	399	378	220	199
14	771	e775	546	591	613	560	564	446	403	118	220	195
15	737	e760	548	644	610	560	577	446	415	86	220	200
16	722	e760	602	650	610	556	584	445	424	79	220	200
17	722	e760	679	591	607	554	588	446	438	96	220	207
18	723	e760	747	591	602	554	591	450	445	99	226	207
19	729	e755	779	588	591	554	591	450	435	103	200	206
20	730	e750	779	555	590	569	595	450	429	110	182	204
21	735	e750	777	501	585	591	596	452	429	110	182	180
22	741	e750	773	501	585	594	593	498	413	76	182	165
23	747	e745	771	524	579	656	644	528	403	60	182	166
24	752	e745	766	578	576	716	684	526	408	63	314	166
25	754	e740	766	572	568	773	693	529	408	60	424	170
26	759	e740	764	518	566	798	698	572	408	63	355	171
27	775	e735	760	489	563	792	661	604	405	63	123	171
28	795	e735	760	489	560	788	633	607	403	65	110	174
29	812	e735	758	494	---	788	631	603	491	65	110	171
30	837	e730	702	540	---	721	628	604	831	65	110	171
31	842	---	668	567	---	648	---	604	---	65	111	---
TOTAL	24091	23171	21891	17983	16948	20239	18062	16161	14032	9987	5151	5236
MEAN	777	772	706	580	605	653	602	521	468	322	166	175
MAX	911	844	779	668	648	817	698	607	831	1000	424	207
MIN	704	730	546	489	560	554	523	443	399	60	65	110
AC-FT	47780	45960	43420	35670	33620	40140	35830	32060	27830	19810	10220	10390
CFSM	.42	.42	.39	.32	.33	.36	.33	.28	.26	.18	.09	.10
IN.	.49	.47	.44	.37	.34	.41	.37	.33	.29	.20	.10	.11

CAL YR 1986 TOTAL 310365 MEAN 850 MAX 1600 MIN 66 AC-FT 615600 CFSM .46 IN. 6.31
WTR YR 1987 TOTAL 192952 MEAN 529 MAX 1000 MIN 60 AC-FT 382700 CFSM .29 IN. 3.92

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, and 5 mi northwest of Wheaton, MN.

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.--Estimated daily discharges: Nov. 8 to Mar. 13. 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.--46 years, 83.4 ft^3/s, 60,420 acre-ft/yr; median of yearly mean discharges, 54 ft^3/s, 39,100 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, 530 ft^3/s, Oct. 9, gage height, 7.71 ft, due to regulation; maximum gage height, 7.80 ft, Oct. 7, due to regulation; no flow on several days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	255	243	e42	e45	e27	e24	30	104	8.6	.24	.38	.00
2	258	238	e42	e45	e27	e24	26	102	8.2	.17	.24	.02
3	356	164	e41	e44	e27	e24	26	99	4.5	.12	.10	.17
4	405	104	e41	e44	e26	e26	26	99	6.1	.14	.00	.33
5	432	105	e41	e43	e26	e30	25	83	5.4	.17	.00	.21
6	457	106	e40	e43	e25	e37	24	69	4.3	.12	.00	.05
7	487	104	e40	e43	e25	e39	25	38	2.6	.12	5.4	.02
8	511	e82	e40	e43	e24	e50	28	18	1.2	.07	.48	.02
9	527	e82	e40	e43	e24	e52	32	14	2.0	.12	.29	.00
10	499	e80	e39	e43	e24	e51	35	13	4.3	.17	.12	.02
11	464	e92	e39	e41	e24	e40	35	7.1	4.3	.12	.21	.21
12	454	e83	e38	e40	e24	e29	40	4.5	3.0	.02	.00	.31
13	446	e78	e38	e39	e24	e27	37	3.3	2.9	.01	.00	.21
14	440	e74	e38	e38	e24	25	43	5.2	1.5	.01	.02	.21
15	428	e72	e38	e36	e24	25	47	14	2.0	6.1	.00	.12
16	420	e71	e38	e35	e24	25	48	14	2.7	20	.10	.14
17	371	e70	e39	e34	e24	23	52	5.3	2.5	.19	.12	.17
18	342	e70	e41	e33	e24	24	58	13	.93	.19	.05	.17
19	339	e68	e44	e32	e24	25	58	14	.90	.19	.02	.19
20	334	e66	e48	e32	e24	26	50	12	.95	.17	.02	.17
21	329	e61	e52	e31	e24	27	50	9.7	.90	.17	.02	.12
22	323	e58	e54	e31	e24	27	57	11	.86	.02	.02	.10
23	290	e56	e57	e30	e24	27	56	14	.60	.17	.00	.07
24	267	e54	e58	e29	e24	41	124	12	.43	.10	.02	.02
25	265	e52	e56	e29	e24	46	177	11	.31	.07	.21	.02
26	262	e51	e54	e29	e24	39	177	16	3.6	.02	.26	.02
27	261	e48	e52	e29	e24	35	177	18	.24	.00	.05	.02
28	259	e46	e51	e28	e24	41	147	18	.17	.00	.00	.02
29	255	e45	e49	e28	---	38	108	11	.14	.00	.02	.02
30	249	e43	e48	e28	---	30	104	10	.17	.00	.19	.00
31	253	---	e46	e28	---	28	---	11	---	8.8	.05	---
TOTAL	11238	2566	1384	1116	687	1005	1922	873.1	76.30	37.79	8.39	3.15
MEAN	363	85.5	44.6	36.0	24.5	32.4	64.1	28.2	2.54	1.22	.27	.10
MAX	527	243	58	45	27	52	177	104	8.6	20	5.4	.33
MIN	249	43	38	28	24	23	24	3.3	.14	.00	.00	.00
AC-FT	22290	5090	2750	2210	1360	1990	3810	1730	151	75	17	6.2
CFSM	.31	.07	.04	.03	.02	.03	.06	.02	.00	.00	.00	.00
IN.	.36	.08	.04	.04	.02	.03	.06	.03	.00	.00	.00	.00

CAL YR 1986 TOTAL 134737.9 MEAN 369 MAX 1390 MIN 3.3 AC-FT 267300 CFSM .32 IN. 4.32
WTR YR 1987 TOTAL 20916.73 MEAN 57.3 MAX 527 MIN .00 AC-FT 41490 CFSM .05 IN. .67

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 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. 9 to Mar 18. Records good except those for period with ice effect, Nov. 9 to Mar. 18, 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.--44 years (1943-87), 556 ft^3/s, 402,800 acre-ft/yr; median of yearly mean discharges, 497 ft^3/s, 360,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,200 ft^3/s, Apr. 10, 1969, gage height, 16.34 ft; 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, 1,770 ft^3/s, Oct. 1, gage height, 7.46 ft; maximum observed gage height, 7.95 ft, Mar. 8; minimum daily, 54 ft^3/s, Aug. 10.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1740	988	898	719	646	711	831	743	630	637	78	133
2	1670	987	825	649	643	647	802	715	624	816	77	133
3	1620	977	776	687	659	576	780	669	619	890	76	132
4	1610	914	864	750	711	800	744	653	599	872	74	144
5	1570	816	771	741	702	853	733	656	535	838	79	193
6	1540	797	838	732	710	1120	727	655	517	792	83	189
7	1500	804	840	646	717	1330	724	640	514	734	75	180
8	1420	817	914	604	715	1610	681	620	517	680	61	180
9	1390	706	981	592	698	1380	653	580	522	639	55	188
10	1390	848	743	549	724	1150	655	563	519	582	54	207
11	1360	795	649	590	722	1600	665	553	514	525	117	217
12	1320	971	732	670	730	1010	666	526	511	422	236	225
13	1310	1030	678	689	731	772	669	486	481	387	250	226
14	1290	1030	641	675	703	690	673	489	429	394	259	218
15	1270	1150	688	584	698	580	672	486	429	296	258	214
16	1230	1170	703	467	688	590	674	481	437	145	258	214
17	1190	1130	723	603	691	616	679	490	479	118	258	211
18	1130	1050	786	632	659	641	677	509	478	122	257	214
19	1090	960	862	639	676	698	670	502	489	136	257	233
20	1070	930	906	607	666	725	665	511	488	174	248	222
21	1060	968	900	594	655	745	674	541	474	168	223	216
22	1050	973	899	518	653	749	672	543	468	156	223	199
23	1040	966	904	446	653	821	674	549	447	157	223	171
24	1010	912	900	507	650	982	704	578	435	115	220	166
25	975	968	886	630	655	1570	789	593	432	84	293	164
26	964	973	869	638	670	1700	883	609	431	76	446	164
27	958	957	876	604	697	1350	883	612	431	76	445	163
28	956	987	862	556	718	998	871	646	429	73	229	163
29	967	1040	853	555	---	822	808	640	430	72	150	166
30	976	951	954	557	---	946	756	644	471	70	137	169
31	985	---	807	593	---	930	---	639	---	67	134	---
TOTAL	38651	28565	25428	19023	19240	29712	21754	18121	14778	11313	5833	5614
MEAN	1247	952	820	614	687	958	725	585	493	365	188	187
MAX	1740	1170	981	750	731	1700	883	743	630	890	446	233
MIN	956	706	641	446	643	576	653	481	429	67	54	132
AC-FT	76660	56660	50440	37730	38160	58930	43150	35940	29310	22440	11570	11140

CAL YR 1986 TOTAL 560550 MEAN 1536 MAX 5820 MIN 597 AC-FT 1112000
WTR YR 1987 TOTAL 238033 MEAN 652 MAX 1740 MIN 54 AC-FT 472100O

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	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)
OCT									
27...	1410	996	685	--	14.5	11.0	--	--	--
JAN									
13...	1455	699	560	--	9.0	0.0	--	--	--
MAR									
03...	1255	597	545	--	-2.5	0.0	--	--	--
19...	1455	699	400	7.2	1.0	0.5	50	34	13
MAY									
28...	1020	647	500	--	22.5	20.0	--	--	--
JUL									
10...	1045	581	450	--	25.0	24.0	--	--	--
28...	1315	72	542	8.1	29.0	27.0	50	35	15
SEP									
17...	0950	212	440	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	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)
MAR							
19...	5.6	220	60	13	0.1	16	316
JUL							
28...	5.1	170	75	7.0	0.3	13	313

DATE	TIME	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)
MAR											
19...	1455	2	50	50	<1	17	50	0.3	<1	<1	220
JUL											
28...	1315	5	70	20	<1	25	10	0.7	2	<1	190

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. 8 to Mar. 30. Records 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.--12 years, 649 ft^3/s, 470,200 acre-ft/yr; median of yearly mean discharges, 618 ft^3/s, 447,700 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,600 ft^3/s, Apr. 18, 1979, gage height, 33.03 ft; no flow Oct. 26, 1976, to Jan. 9, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,460 ft^3/s, Mar. 26, gage height, 15.34 ft (backwater from ice); minimum daily, 61 ft^3/s, Aug. 9,10.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2090	1030	958	850	630	762	1040	859	699	401	74	106
2	1860	1020	924	810	686	740	950	830	678	506	79	118
3	1740	1030	919	720	683	717	896	814	658	705	86	112
4	1640	1020	900	650	702	694	886	749	655	845	82	118
5	1600	1010	739	690	758	677	860	727	649	872	84	133
6	1570	947	562	750	753	853	836	722	594	870	72	152
7	1540	897	572	740	763	1220	824	723	559	852	73	182
8	1500	888	686	730	769	1760	816	718	534	777	71	162
9	1430	896	764	650	770	2030	800	699	521	718	61	154
10	1370	772	851	600	756	2020	773	665	526	672	61	151
11	1360	522	827	590	786	1740	739	624	539	649	75	158
12	1350	657	715	550	786	1670	743	605	536	591	96	181
13	1320	690	650	590	795	1710	761	588	529	478	138	206
14	1300	611	730	670	798	1520	765	546	499	405	226	216
15	1280	687	680	710	772	1340	763	526	445	378	261	212
16	1270	875	640	676	769	1120	795	538	417	377	261	206
17	1250	1040	690	552	763	985	816	521	437	255	246	202
18	1220	1090	700	554	754	946	820	521	465	141	257	202
19	1180	1040	720	640	744	937	813	514	463	109	241	208
20	1130	976	790	647	736	950	797	519	466	119	259	220
21	1110	923	860	658	739	999	764	538	482	141	243	237
22	1100	909	910	615	730	1080	773	586	475	131	231	218
23	1100	917	900	564	724	1130	800	610	465	122	199	218
24	1100	931	900	512	726	1340	775	617	450	120	202	196
25	1080	923	900	497	723	2090	772	657	425	117	201	166
26	1050	921	900	581	730	2430	833	686	424	106	192	157
27	1030	945	890	635	744	2370	927	698	430	91	320	155
28	1030	942	870	634	766	1950	960	687	415	82	443	150
29	1030	935	880	612	---	1430	949	696	423	77	407	146
30	1020	956	860	588	---	1130	925	706	423	75	215	144
31	1020	---	850	572	---	1120	---	706	---	77	127	---
TOTAL	40670	27000	24737	19837	20855	41460	24971	20195	15281	11859	5583	5186
MEAN	1312	900	798	640	745	1337	832	651	509	383	180	173
MAX	2090	1090	958	850	798	2430	1040	859	699	872	443	237
MIN	1020	522	562	497	630	677	739	514	415	75	61	106
AC-FT	80670	53550	49070	39350	41370	82240	49530	40060	30310	23520	11070	10290

CAL YR 1986 TOTAL 602549 MEAN 1651 MAX 6630 MIN 522 AC-FT 1195000
WTR YR 1987 TOTAL 257634 MEAN 706 MAX 2430 MIN 61 AC-FT 511000

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	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)
OCT									
23...	1020	1090	715	--	5.5	9.5	--	--	--
JAN									
15...	1430	717	440	--	-18.0	0.0	--	--	--
MAR									
05...	1605	672	500	--	8.5	0.0	--	--	--
31...	1540	1140	625	8.4	13.0	1.5	65	37	17
MAY									
19...	1420	487	515	--	15.0	17.0	--	--	--
JUL									
09...	1655	721	460	--	27.0	24.0	--	--	--
29...	1235	74	550	8.1	30.0	32.0	49	33	15
SEP									
16...	1235	204	450	--	18.0	19.0	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	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)
MAR							
31...	7.0	200	110	15	0.1	17	416
JUL							
29...	5.7	210	77	3.5	0.1	16	345

DATE	TIME	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)
MAR											
31...	1540	2	20	30	<1	24	30	0.1	<1	<1	270
JUL											
29...	1235	6	80	10	<1	24	20	0.7	2	1	190

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 city waterplant on 4th St. S. in Fargo, 25 mi upstream from mouth of Sheyenne River, and at mile 453.0.
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. 10 to Mar. 26. Records good except those for period with ice effect, Nov. 10 to Mar. 26, 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).--86 years, 580 ft^3/s, 420,200 acre-ft/yr; median of yearly mean discharges, 460 ft^3/s, 333,000 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, 3,300 ft^3/s, Mar. 27, gage height, 17.75 ft; minimum daily, 40 ft^3/s, Aug. 12.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2450	1040	970	888	691	819	1420	970	690	390	72	111
2	2220	1040	946	856	713	829	1230	919	678	406	58	95
3	2070	1040	928	804	730	827	1120	883	655	550	76	86
4	1960	1030	909	758	739	835	1030	839	643	753	65	100
5	1880	1040	851	770	760	819	992	792	636	865	59	96
6	1780	1000	637	798	801	1030	945	761	611	859	50	98
7	1730	940	539	798	815	1370	914	750	556	833	41	114
8	1670	927	578	778	788	1640	897	750	519	771	46	130
9	1600	904	674	710	792	1840	887	730	507	720	47	131
10	1530	884	801	667	802	1930	867	703	543	654	44	126
11	1490	750	880	655	798	1780	821	643	521	624	50	125
12	1470	500	796	639	793	1550	810	618	512	585	40	141
13	1430	580	658	637	798	1530	824	606	510	511	43	160
14	1400	600	671	666	798	1470	831	575	496	402	88	175
15	1390	595	656	681	806	1330	839	545	474	339	251	185
16	1370	730	629	691	804	1200	844	551	423	321	222	191
17	1330	919	647	660	797	1050	849	575	440	283	225	190
18	1300	1040	662	589	786	955	850	480	441	179	229	194
19	1260	1050	687	633	783	929	852	460	462	113	219	199
20	1220	998	769	673	778	933	841	479	471	105	230	184
21	1170	932	843	710	776	959	837	506	493	148	220	191
22	1150	896	890	674	776	996	826	533	496	150	213	205
23	1130	900	910	659	767	1040	817	560	478	113	200	206
24	1120	911	918	625	760	1140	826	594	463	110	182	200
25	1100	921	919	590	761	1510	860	658	452	115	173	179
26	1070	903	915	606	793	2190	885	705	429	105	184	159
27	1050	927	910	716	781	2980	955	717	420	85	201	151
28	1040	938	900	786	802	2780	1050	711	420	64	338	156
29	1030	929	907	768	---	2220	1050	682	406	57	405	155
30	1030	934	906	730	---	1800	1030	705	375	55	305	147
31	1030	---	901	698	---	1590	---	711	---	51	170	---
TOTAL	44470	26798	24807	21913	21788	43871	27799	20711	15220	11316	4746	4580
MEAN	1435	893	800	707	778	1415	927	668	507	365	153	153
MAX	2450	1050	970	888	815	2980	1420	970	690	865	405	206
MIN	1030	500	539	589	691	819	810	460	375	51	40	86
AC-FT	88210	53150	49200	43460	43220	87020	55140	41080	30190	22450	9410	9080
(+)	1166	1122	1135	1243	1100	1115	1280	1566	1862	1789	1581	1339
MEAN*	1454	912	818	727	798	1433	948	694	538	394	179	176
AC-FT*	89380	54270	50340	44700	44320	88140	56420	42650	32050	24240	10990	10420

	OBSERVED						ADJUSTED			
CAL YR 1986	TOTAL 728298	MEAN 1995	MAX 8600	MIN 500	AC-FT 1445000	MEAN 2013	AC-FT 1459570
WTR YR 1987	TOTAL 268019	MEAN 734	MAX 2980	MIN 40	AC-FT 531600	MEAN 756	AC-FT 547920

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

WATER-QUALITY RECORDS

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

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	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)
OCT									
01...	1545	2800	642	--	14.0	15.0	--	--	--
JAN									
15...	1030	657	682	--	-18.5	0.0	--	--	--
MAR									
05...	1025	719	605	--	5.0	0.0	--	--	--
31...	1205	1610	782	8.0	9.0	1.0	79	42	26
MAY									
28...	1650	702	500	--	25.0	20.0	--	--	--
JUL									
02...	1405	413	510	--	23.0	22.5	--	--	--
29...	1605	57	550	8.1	31.0	32.0	44	32	13
SEP									
16...	1450	197	465	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	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)
MAR							
31...	11	190	200	22	0.2	19	544
JUL							
29...	5.2	220	57	4.3	0.1	15	300

DATE	TIME	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)
MAR											
31...	1205	3	30	40	<1	38	60	0.1	1	<1	360
JUL											
29...	1605	5	70	10	<1	20	20	0.7	2	1	150

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 Nov. 8 to Feb. 18 and Mar. 2-4, 9-16, which are fair.

AVERAGE DISCHARGE.--37 years (water years 1945-80, 1986-87) 73.7 ft^3/s, 53,400 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 PERIOD:--Maximum discharge, 330 ft^3/s, Mar. 25, gage height, 6.06 ft; maximum gage height, 6.07 ft, Mar. 11 (backwater from ice); minimum discharge 12 ft^3/s, July 18, gage height, 3.14 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	105	51	e56	e39	e37	38	171	49	95	23	27	16
2	99	51	e57	e39	e37	e36	152	48	82	19	26	16
3	94	52	e57	e39	e37	e41	137	46	70	20	34	14
4	93	55	e58	e39	e37	e38	130	43	62	19	30	15
5	92	56	e57	e39	e37	59	128	42	55	19	28	18
6	95	57	e56	e39	e37	133	125	41	54	18	24	22
7	100	60	e54	e39	e37	228	121	39	50	18	22	28
8	102	e61	e54	e39	e38	264	120	38	46	17	22	26
9	99	e65	e53	e39	e38	e216	115	37	43	18	21	24
10	94	e67	e52	e39	e38	e243	115	35	41	15	20	23
11	90	e70	e50	e39	e39	e279	118	34	41	18	18	22
12	87	e71	e49	e39	e39	e245	125	32	40	18	18	22
13	82	e72	e48	e39	e39	e201	122	30	38	19	20	21
14	77	e72	e47	e39	e39	e161	120	29	36	19	20	21
15	73	e72	e46	e39	e39	e133	118	31	34	17	34	18
16	72	e72	e45	e38	e38	e147	118	32	32	15	30	17
17	73	e72	e44	e38	e38	123	112	33	32	14	29	16
18	66	e71	e43	e38	e37	131	103	40	31	14	32	20
19	64	e70	e41	e38	37	136	97	50	30	15	29	23
20	64	e66	e41	e38	28	140	92	56	28	24	28	22
21	64	e62	e40	e38	28	161	90	70	28	40	31	23
22	64	e60	e40	e38	28	170	84	126	28	60	24	22
23	61	e59	e40	e38	28	182	78	185	29	48	21	20
24	59	e57	e39	e38	29	262	72	178	28	47	21	21
25	57	e56	e39	e38	30	320	65	165	29	43	20	18
26	55	e56	e39	e38	33	328	63	165	28	40	22	17
27	55	e56	e39	e38	39	314	60	198	25	37	23	16
28	55	e56	e39	e38	40	271	57	188	24	35	23	14
29	55	e56	e39	e37	---	190	53	162	25	32	20	16
30	54	e56	e39	e37	---	204	51	137	26	29	19	16
31	52	---	e39	e37	---	194	---	115	---	27	17	---
TOTAL	2352	1857	1440	1190	1001	5588	3112	2474	1210	797	753	587
MEAN	75.9	61.9	46.5	38.4	35.7	180	104	79.8	40.3	25.7	24.3	19.6
MAX	105	72	58	39	40	328	171	198	95	60	34	28
MIN	52	51	39	37	28	36	51	29	24	14	17	14
AC-FT	4670	3680	2860	2360	1990	11080	6170	4910	2400	1580	1490	1160
CFSM	.24	.19	.14	.12	.11	.56	.32	.25	.13	.08	.08	.06
IN.	.27	.21	.17	.14	.12	.65	.36	.29	.14	.09	.09	.07

CAL YR 1986 TOTAL 43775 MEAN 120 MAX 853 MIN 20 AC-FT 86830 CFSM .37 IN. 5.06
WTR YR 1987 TOTAL 22361 MEAN 61.3 MAX 328 MIN 14 AC-FT 44350 CFSM .19 IN. 2.58

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.--37 years (water years 1945-80, 86, 87), 58.5 ft^3/s, 42,380 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, 689 ft^3/s, Mar. 26, gage height, 11.34 ft, from highwater mark; maximum gage height, 11.89 ft, Mar. 10 (backwater from ice); minimum discharge, 0.91 ft^3/s, June 24, gage height, 4.02 ft; minimum gage height, 3.89 ft, June 16.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	107	29	e27	e12	e6.9	e24	182	23	87	3.0	e7.1	7.8
2	90	e29	e27	e11	e6.9	e24	125	21	40	3.3	e6.7	7.9
3	83	29	e27	e11	e6.9	e24	120	e19	28	4.8	6.4	8.0
4	75	29	e27	e10	e6.9	e25	103	17	19	e4.2	6.1	8.2
5	e68	29	e27	e9.9	e6.9	e27	e95	13	13	e3.5	7.6	e8.5
6	62	e29	e26	e9.4	e7.0	e50	88	12	e10	3.0	10	e8.9
7	54	e29	e26	e8.8	e7.3	e86	90	12	e8.0	2.9	11	e8.0
8	46	e29	e26	e8.4	e7.6	e150	91	11	6.0	2.4	9.4	7.5
9	43	e28	e26	e8.0	e8.2	e270	94	9.6	4.0	2.1	e7.5	7.5
10	e43	e28	e26	e7.7	e8.7	e500	104	e9.2	2.7	2.0	5.8	7.9
11	e44	e28	e25	e7.5	e9.4	e460	106	8.7	1.7	2.2	4.3	8.3
12	e46	e28	e24	e7.4	e10	e360	e108	8.2	1.4	e2.2	3.8	8.4
13	47	e28	e22	e7.2	e11	e260	110	8.4	e1.3	2.1	3.0	e9.0
14	46	e28	e21	e7.2	e12	e195	114	8.7	e1.2	2.1	2.7	9.0
15	42	e28	e21	e7.0	e13	e150	117	7.3	1.0	4.7	4.1	9.0
16	38	e27	e20	e7.0	e14	e122	108	e7.1	1.0	6.4	e5.0	9.0
17	36	e27	e20	e6.9	e15	e115	103	e13	1.0	7.0	6.0	9.2
18	35	e27	e19	e6.9	e17	e115	98	17	1.0	7.8	7.4	9.4
19	e34	e27	e19	e6.9	e18	e115	e92	16	1.0	7.8	8.0	9.0
20	34	e27	e19	e6.9	e19	e116	85	16	e1.0	7.8	8.8	e8.8
21	30	e27	e18	e6.9	e21	e121	73	26	e1.0	7.8	8.8	8.5
22	30	e27	e18	e6.9	e22	e129	68	53	1.0	8.0	9.0	8.7
23	30	e27	e17	e6.9	e22	e180	58	e60	1.1	8.1	9.3	8.8
24	30	e27	e17	e6.9	e23	e260	50	e75	.97	8.3	7.9	8.8
25	30	e27	e16	e6.9	e23	492	48	e95	1.0	8.3	6.8	8.8
26	e30	e27	e16	e6.9	e23	664	e42	128	1.1	e8.3	6.9	9.0
27	30	e27	e15	e6.9	e23	610	36	141	1.5	8.2	6.1	e9.0
28	29	e27	e14	e6.9	e24	369	32	139	e1.9	8.0	6.6	9.0
29	29	e27	e14	e6.9	---	246	26	122	2.2	7.8	6.9	9.2
30	29	e27	e13	e6.9	---	175	23	151	2.2	7.6	e7.5	9.4
31	29	---	e13	e6.9	---	182	---	e125	---	7.3	8.1	---
TOTAL	1399	833	646	243.0	392.7	6616	2589	1372.2	243.27	169.0	214.6	258.5
MEAN	45.1	27.8	20.8	7.84	14.0	213	86.3	44.3	8.11	5.45	6.92	8.62
MAX	107	29	27	12	24	664	182	151	87	8.3	11	9.4
MIN	29	27	13	6.9	6.9	24	23	7.1	.97	2.0	2.7	7.5
AC-FT	2770	1650	1280	482	779	13120	5140	2720	483	335	426	513
CFSM	.09	.05	.04	.02	.03	.41	.17	.08	.02	.01	.01	.02
IN.	.10	.06	.05	.02	.03	.47	.18	.10	.02	.01	.02	.02

CAL YR 1986 TOTAL 59747.9 MEAN 164 MAX 2410 MIN 2.0 AC-FT 118500 CFSM .31 IN. 4.26
WTR YR 1987 TOTAL 14976.27 MEAN 41.0 MAX 664 MIN .97 AC-FT 29710 CFSM .08 IN. 1.07

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 Nov. 6 to Mar. 30, which are fair.

AVERAGE DISCHARGE.--56 years, 135 ft^3/s, 97,810 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, 954 ft^3/s, Mar. 13, gage height, 13.19 ft (backwater from ice); minimum, 20 ft^3/s, July 18, gage height, 2.94 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	227	102	e120	e64	e50	e74	504	84	250	28	35	25
2	209	99	e120	e63	e50	e95	423	79	199	28	33	23
3	196	101	e120	e60	e50	e110	359	75	160	27	33	22
4	181	102	e118	e63	e50	e125	296	72	132	25	40	22
5	171	104	e105	e63	e51	e170	264	69	109	25	40	22
6	164	e108	e97	e62	e51	e320	246	65	94	25	35	21
7	156	e113	e91	e61	e51	e510	238	59	82	24	33	23
8	151	e118	e90	e59	e51	e670	233	56	74	24	32	24
9	150	e119	e87	e56	e52	e750	230	53	67	23	34	28
10	146	e120	e84	e53	e53	e770	231	50	61	23	36	28
11	138	e122	e79	e57	e53	e850	233	48	56	23	34	27
12	129	e125	e75	e58	e54	e940	242	48	52	23	31	29
13	125	e127	e73	e56	e55	e950	249	44	49	23	29	30
14	126	e130	e69	e55	e57	e910	254	42	46	24	26	30
15	130	e135	e69	e55	e59	e800	254	41	43	24	34	30
16	127 o	e132	e69	e49	e64	e670	254	43	40	24	49	28
17	121	e129	e69	e43	e64	e540	251	48	39	22	48	27
18	117	e127	e70	e47	e58	e470	240	55	39	21	43	25
19	118	e123	e71	e51	e58	e400	229	66	38	22	49	24
20	114	e120	e69	e50	e58	e375	213	73	35	27	43	26
21	111	e120	e69	e48	e58	e385	198	90	34	34	39	31
22	111	e117	e69	e48	e57	e400	185	174	33	63	37	31
23	112	e112	e68	e48	e57	e425	173	266	32	95	38	30
24	109	e108	e68	e48	e56	e450	157	333	31	79	37	30
25	107	e108	e68	e48	e56	e600	143	375	31	62	35	30
26	106	e109	e68	e48	e59	e746	131	412	30	56	35	30
27	106	e110	e67	e48	e62	e820	121	431	30	52	34	30
28	108	e112	e67	e48	e67	e840	112	428	29	47	34	29
29	109	e114	e66	e49	---	e750	102	421	29	42	31	29
30	111	e118	e65	e49	---	e680	92	375	28	39	30	26
31	108	---	e64	e50	---	578	---	310	---	36	27	---
TOTAL	4194	3484	2484	1657	1561	17173	6857	4785	1972	1090	1114	810
MEAN	135	116	80.1	53.5	55.7	554	229	154	65.7	35.2	35.9	27.0
MAX	227	135	120	64	67	950	504	431	250	95	49	31
MIN	106	99	64	43	50	74	92	41	28	21	26	21
AC-FT	8320	6910	4930	3290	3100	34060	13600	9490	3910	2160	2210	1610
CFSM	.13	.11	.08	.05	.05	.53	.22	.15	.06	.03	.03	.03
IN.	.15	.12	.09	.06	.06	.61	.25	.17	.07	.04	.04	.03

CAL YR 1986 TOTAL 125606 MEAN 344 MAX 3390 MIN 27 AC-FT 249100 CFSM .33 IN. 4.49
WTR YR 1987 TOTAL 47181 MEAN 129 MAX 950 MIN 21 AC-FT 93580 CFSM .12 IN. 1.69

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, near center of span on downstream side of 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.--Nonrecording gage and crest-stage gage. Datum of gage is 836.75 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers).

REMARKS.--Records fair except those for Oct. 31 to Nov. 2, Nov. 11 to Apr. 2, Apr. 24, July 1-20, Aug. 24 and Sept. 21, 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.--42 years, (Water Years 1945-84, 1986-87), 267 ft^3/s, 193,400 acre-ft/yr; median of yearly mean discharges, 242 ft^3/s, 175,300 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, 1,500 ft^3/s, July 25, gage height, 14.26 ft, from graph based on gage readings; maximum gage height, 17.00 ft, Mar. 10 (backwater from ice); minimum daily discharge, 70 ft^3/s, July 16-18.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	193	e210	e158	e96	e74	e80	e1000	206	849	e76	545	116
2	181	e208	e156	e94	e74	e82	e850	202	709	e76	504	113
3	178	206	e154	e93	e74	e85	759	186	627	e76	453	110
4	192	214	e152	e92	e74	e88	654	186	534	e76	425	104
5	194	203	e150	e91	e74	e100	562	189	485	e76	397	94
6	204	211	e148	e90	e74	e200	521	168	437	e75	366	92
7	199	214	e146	e89	e74	e400	494	154	394	e75	341	91
8	193	250	e144	e88	e74	e900	477	146	365	e74	312	101
9	196	143	e142	e87	e74	e1300	460	137	340	e74	286	110
10	191	248	e140	e86	e74	e1450	448	112	308	e73	250	101
11	192	e210	e138	e85	e75	e1400	448	101	299	e73	241	97
12	202	e190	e136	e84	e75	e1300	464	95	273	e72	224	98
13	207	e190	e134	e83	e75	e1100	462	94	250	e72	197	99
14	198	e188	e132	e82	e75	e1000	452	88	238	e71	186	98
15	185	e186	e130	e81	e75	e900	427	84	215	e71	189	97
16	178	e184	e128	e80	e76	e800	411	79	193	e70	182	94
17	180	e182	e126	e79	e76	e750	389	90	179	e70	170	90
18	168	e180	e124	e78	e76	e700	357	110	167	e70	167	86
19	170	e180	e122	e77	e76	e700	349	146	146	e80	170	94
20	168	e178	e120	e76	e76	e750	317	192	137	e200	162	94
21	165	e176	e118	e75	e77	e800	318	311	125	427	159	e96
22	163	e174	e116	e74	e77	e900	333	622	130	668	147	100
23	166	e172	e114	e74	e77	e1000	332	1110	119	971	132	102
24	168	e170	e112	e74	e77	e1100	e300	1210	105	1300	e127	103
25	161	e168	e110	e74	e77	e1200	269	1100	104	1470	124	99
26	156	e166	e108	e74	e78	e1300	259	1100	111	1360	127	91
27	163	e164	e106	e74	e78	e1400	242	1360	97	1180	129	90
28	202	e162	e104	e74	e78	e1400	241	1460	92	930	145	106
29	219	e160	e102	e74	---	e1300	228	1290	88	779	150	102
30	227	e160	e100	e74	---	e1200	218	1110	80	684	142	96
31	e220	---	e98	e74	---	e1100	---	967	---	616	129	---
TOTAL	5779	5647	3968	2526	2114	26785	13041	14405	8196	11985	7278	2964
MEAN	186	188	128	81.5	75.5	864	435	465	273	387	235	98.8
MAX	227	250	158	96	78	1450	1000	1460	849	1470	545	116
MIN	156	143	98	74	74	80	218	79	80	70	124	86
AC-FT	11460	11200	7870	5010	4190	53130	25870	28570	16260	23770	14440	5880
CFSM	.12	.12	.08	.05	.05	.54	.27	.29	.17	.24	.15	.06
IN.	.13	.13	.09	.06	.05	.62	.30	.33	.19	.28	.17	.07

CAL YR 1986 TOTAL 189240 MEAN 518 MAX 3800 MIN 58 AC-FT 375400 CFSM .32 IN. 4.40
WTR YR 1987 TOTAL 104688 MEAN 287 MAX 1470 MIN 70 AC-FT 207600 CFSM .18 IN. 2.43

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. 1-6 and Nov. 10 to Apr. 4. Records good except those for period with ice effect, Nov. 10 to Apr. 4, and period of no gage height record, Oct. 1-6, which are fair.

AVERAGE DISCHARGE.--26 years (1961-87), 1,840 ft^3/s, 1,333,000 acre-ft/yr; median of yearly mean discharges, 1,820 ft^3/s, 1,319,000 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, 9,860 ft^3/s, Mar. 30, gage height, 21.43 ft (backwater from ice); minimum daily, 378 ft^3/s, Sept. 7.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3960	1540	1410	1260	879	1200	8680	2330	3000	699	1020	745
2	3720	1550	1440	1260	866	1210	7320	2220	2730	696	1110	616
3	3480	1550	1470	1260	869	1230	6320	2120	2480	692	1230	524
4	3240	1550	1490	1210	893	1280	5720	1990	2270	701	1240	456
5	3000	1540	1480	1150	923	1290	5270	1900	2090	808	1230	419
6	2760	1550	1460	1100	947	1560	4940	1790	1960	1000	1230	392
7	2520	1560	1390	1100	967	3170	4670	1660	1860	1110	1210	378
8	2460	1570	1230	1130	997	4270	4460	1520	1750	1110	1170	380
9	2390	1560	1120	1140	1030	4520	4330	1420	1640	1060	1110	390
10	2320	1310	1120	1120	1050	4820	4260	1350	1560	1000	1050	410
11	2230	1250	1190	1070	1050	5050	4210	1260	1510	961	1000	416
12	2160	1150	1270	1020	1060	4910	4150	1190	1480	915	957	422
13	2110	1120	1310	990	1060	4730	4080	1130	1440	876	921	415
14	2080	1280	1240	963	1080	4580	4060	1100	1400	836	856	414
15	2020	1420	1150	962	1090	4550	4060	1080	1350	766	824	426
16	1970	1490	1110	1000	1110	4580	4080	1040	1290	670	831	436
17	1950	1430	1090	1040	1120	4550	4080	1000	1210	580	902	444
18	1920	1430	1060	1030	1120	4430	4050	1060	1100	674	851	465
19	1870	1490	1050	978	1130	4290	4010	1440	1060	603	826	499
20	1820	1540	1070	917	1130	4390	3970	1500	1010	534	828	511
21	1780	1560	1100	921	1130	5130	3930	1560	973	710	772	536
22	1730	1490	1150	952	1130	5670	3930	1830	945	2970	731	505
23	1680	1400	1210	960	1140	5970	3900	2490	941	4180	683	492
24	1650	1330	1260	957	1140	6170	3810	2950	908	4300	637	503
25	1630	1290	1270	930	1120	6430	3600	3090	849	3950	608	507
26	1610	1280	1280	887	1120	7480	3310	3170	822	3410	594	491
27	1580	1300	1290	843	1130	8530	3030	3600	802	2740	594	474
28	1560	1310	1290	842	1180	9230	2760	3890	759	2120	635	449
29	1550	1350	1280	892	---	9520	2560	3820	723	1650	659	439
30	1550	1400	1280	921	---	9730	2430	3570	699	1330	747	423
31	1530	---	1270	905	---	9740	---	3280	---	1120	812	---
TOTAL	67830	42590	38830	31710	29461	154210	129980	63350	42611	44771	27868	13977
MEAN	2188	1420	1253	1023	1052	4975	4333	2044	1420	1444	899	466
MAX	3960	1570	1490	1260	1180	9740	8680	3890	3000	4300	1240	745
MIN	1530	1120	1050	842	866	1200	2430	1000	699	534	594	378
AC-FT	134500	84480	77020	62900	58440	305900	257800	125700	84520	88800	55280	27720

CAL YR 1986 TOTAL 1285540 MEAN 3522 MAX 17300 MIN 894 AC-FT 2550000
WTR YR 1987 TOTAL 687188 MEAN 1883 MAX 9740 MIN 378 AC-FT 1363000

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN--Continued

WATER-QUALITY RECORDS

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

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	TUR-BID-ITY (NTU) (00076)	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										
28...	1540	1540	750	8.3	7.0	9.0	12	11.5	72	28
DEC										
11...	1035	1600	850	8.0	-15.0	0.0	3.8	10.8	31	49
JAN										
26...	1545	884	770	--	-2.0	0.0	--	--	--	--
APR										
01...	1345	8560	700	8.1	3.0	1.5	80	13.0	67	450
22...	1405	3940	585	8.2	21.5	10.0	90	10.1	11	33
JUN										
01...	1655	2870	525	7.9	20.0	22.5	--	--	--	--
24...	1305	869	705	8.1	21.5	24.5	80	7.5	63	K8
AUG										
04...	1330	1190	760	8.1	21.5	25.0	30	5.8	92	88
SEP										
23...	1505	490	475	8.2	21.5	17.0	--	9.0	--	--

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, CARBON-ATE IT-FLD (MG/L AS CACO3) (00419)	BICAR-BONATE WATER WHOLE IT-FLD (MG/L) (00450)	CAR-BONATE WATER WHOLE IT-FLD (MG/L) (00447)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)
OCT								
28...	71	44	26	6.5	236	288	0	150
DEC								
11...	76	45	42	7.5	275	336	0	150
APR								
01...	61	31	35	10	--	--	--	160
22...	51	27	32	7.9	185	225	0	110
JUN								
24...	60	33	43	6.5	252	308	0	100
AUG								
04...	49	22	46	10	232	283	0	120

DATE	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)	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)
OCT								
28...	13	0.2	15	504	0.02	0.17	0.09	0.08
DEC								
11...	18	0.2	17	550	<0.01	0.36	0.85	0.94
APR								
01...	13	0.2	17	466	0.09	2.8	0.33	0.31
22...	11	0.2	12	370	0.03	0.53	0.14	0.09
JUN								
24...	29	0.3	14	436	0.02	0.63	0.07	0.06
AUG								
04...	10	0.2	13	388	--	--	--	--

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOSPHORUS, TOTAL (MG/L AS P) (00665)	PHOSPHORUS, DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT							
28...	1.4	0.21	0.08	0.07	--	--	--
DEC							
11...	2.0	0.27	0.25	0.23	--	--	--
APR							
01...	2.3	0.30	0.17	0.12	322	7450	100
22...	1.2	0.43	0.09	0.06	323	3430	100
JUN							
24...	1.6	0.39	0.24	0.16	302	709	99
AUG							
04...	--	--	--	--	181	582	99

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											
28...	1540	20	3	84	<0.5	<1	<1	<3	3	6	<5
APR											
01...	1345	40	2	110	<0.5	<1	<1	<3	6	39	<5
22...	1405	60	2	140	<0.5	<1	<1	<3	5	44	<5
AUG											
04...	1330	10	6	86	<0.5	<1	<1	<3	3	5	<5

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										
28...	43	<1	0.6	<10	6	<1	<1	270	<6	8
APR										
01...	36	77	<0.1	<10	4	<1	<1	240	<6	15
22...	31	3	0.5	<10	3	<1	<1	210	<6	11
AUG										
04...	27	1	0.1	<10	6	<1	<1	240	<6	7

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. Monthly discharge only for March 1944, published in WSP 1308. Operated as a high-flow partial-record station October 1983 to March 1985.

GAGE.--Nonrecording gage and crest-stage gage. 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.

REMARKS.--Records poor. 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.--41 years (water years 1945-83, 1986-87), 64.8 ft^3/s, 46,950 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, 1,730 ft^3/s, July 24, gage height, 15.80 ft; minimum daily, 0.01 ft^3/s, July 1.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.66	.21	e1.5	e.47	e.27	e.30	58	1.8	47	.01	e70	6.7
2	.60	.19	e1.5	e.45	e.27	e.33	57	23	33	20	43	4.8
3	.50	.19	e1.5	e.43	e.27	e.37	47	18	28	19	30	3.7
4	.35	.21	e1.5	e.42	e.27	e.45	41	14	e20	e15	21	3.3
5	.32	.19	e1.5	e.41	e.27	e.60	34	9.5	e15	e13	18	2.1
6	.32	.29	e1.5	e.40	e.27	e10	31	5.8	e10	e11	13	1.2
7	.32	.32	e1.5	e.39	e.27	e100	27	3.9	e7.0	e10	e10	1.4
8	.29	.41	e1.5	e.38	e.27	e200	25	2.7	e5.0	e9.0	e8.0	1.7
9	.32	.45	e1.5	e.38	e.27	e350	25	1.7	e3.5	e8.0	6.7	2.4
10	.38	.60	e1.5	e.37	e.27	e300	e28	.85	e2.5	e8.0	5.8	1.3
11	.45	.60	e1.5	e.36	e.27	e275	e28	.72	e1.5	e10	4.6	.32
12	.45	1.0	e1.5	e.36	e.27	e250	e28	.50	e1.0	e15	3.1	.24
13	.45	e1.2	e1.5	e.35	e.27	e220	e26	.19	.78	e20	2.9	.35
14	.38	e1.4	e1.5	e.34	e.27	e200	24	.15	.55	e17	3.1	.38
15	.38	e1.5	e1.5	e.33	e.27	e180	21	.24	.29	15	e7.0	.32
16	.38	e1.5	e1.5	e.33	e.27	e160	20	.26	.26	e15	12	.24
17	.35	e1.5	e1.4	e.32	e.27	e150	19	.29	e.22	e30	17	e.25
18	.32	e1.5	e1.3	e.32	e.27	e140	16	.32	.19	41	12	e.60
19	.29	e1.5	e1.2	e.31	e.27	e200	14	.24	.19	112	9.5	1.6
20	.24	e1.5	e1.1	e.31	e.27	401	9.5	e1.0	e.20	69	8.4	2.6
21	.24	e1.5	e1.0	e.30	e.27	e370	9.1	61	e.23	43	7.0	2.9
22	.21	e1.5	e.95	e.29	e.27	335	9.5	39	e.25	913	5.8	1.6
23	.19	e1.5	e.90	e.29	e.27	e280	6.1	31	e.28	1610	5.6	.92
24	.19	e1.5	e.85	e.28	e.27	230	4.3	36	e.20	1660	3.9	.55
25	.17	e1.5	e.80	e.28	e.27	377	5.8	93	e.15	1240	4.6	.35
26	.17	e1.5	e.75	e.27	e.27	673	2.9	102	e.10	778	7.0	.10
27	.15	e1.5	e.70	e.27	e.27	e400	2.6	122	e.07	e500	6.7	.21
28	.19	e1.5	e.65	e.27	e.27	e250	4.1	190	.05	e350	13	.29
29	.21	e1.5	e.60	e.27	---	186	2.0	167	.02	e250	13	.21
30	.21	e1.5	e.55	e.27	---	90	e1.8	52	.02	148	11	e.50
31	.21	---	e.50	e.27	---	64	---	52	---	e100	8.0	---
TOTAL	9.89	31.26	37.25	10.49	7.56	6393.05	626.7	1030.16	177.55	8049.01	390.7	43.13
MEAN	.32	1.04	1.20	.34	.27	206	20.9	33.2	5.92	260	12.6	1.44
MAX	.66	1.5	1.5	.47	.27	673	58	190	47	1660	70	6.7
MIN	.15	.19	.50	.27	.27	.30	1.8	.15	.02	.01	2.9	.10
AC-FT	20	62	74	21	15	12680	1240	2040	352	15970	775	86
CFSM	.00	.01	.01	.00	.00	1.37	.14	.22	.04	1.72	.08	.01
IN.	.00	.01	.01	.00	.00	1.57	.15	.25	.04	1.98	.10	.01

CAL YR 1986 TOTAL 20345.82 MEAN 55.7 MAX 1680 MIN .12 AC-FT 40360 CFSM .37 IN. 5.01
WTR YR 1987 TOTAL 16806.75 MEAN 46.0 MAX 1660 MIN .01 AC-FT 33340 CFSM .30 IN. 4.14

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, near center of span on downstream side of 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.--Nonrecording gage and crest-stage gage. 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.

REMARKS.--Records good except those for Nov. 10 to Apr. 2, which are poor.

AVERAGE DISCHARGE.--40 years (water years 1947-84, 1986-87), 73.0 ft^3/s, 52,890 acre-ft/yr; median of yearly mean discharges, 57 ft^3/s, 41,300 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, 492 ft^3/s, July 29, gage height, 7.95 ft, from graph based on gage readings; maximum gage height, 11.57 ft, Mar. 22 (backwater from ice); minimum daily discharge, 15 ft^3/s, July 16, 17.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	22	25	e25	e19	e16	e18	e160	57	209	18	379	38
2	24	25	e25	e19	e16	e18	e140	55	188	20	309	41
3	26	26	e25	e19	e16	e19	124	53	164	20	274	38
4	25	27	e25	e19	e16	e20	121	46	145	20	239	34
5	24	29	e25	e19	e16	e20	117	43	125	18	196	31
6	24	28	e24	e18	e16	e50	115	44	104	18	167	29
7	24	29	e24	e18	e16	e100	111	42	88	17	136	28
8	23	e30	e24	e18	e16	e180	104	37	72	16	116	28
9	23	e31	e24	e18	e16	e180	99	34	57	16	97	27
10	23	e32	e24	e18	e16	e170	91	32	52	16	80	26
11	23	e32	e23	e17	e16	e160	94	30	48	16	67	24
12	24	e31	e23	e17	e16	e150	90	24	45	18	59	23
13	24	e31	e23	e17	e16	e140	86	28	e40	19	52	25
14	24	e30	e23	e17	e16	e135	84	25	37	17	45	24
15	24	e30	e23	e17	e16	e130	76	23	34	16	39	24
16	24	e29	e22	e17	e16	e130	72	25	31	15	91	23
17	22	e29	e22	e17	e16	e130	65	26	29	15	89	22
18	24	e28	e22	e17	e16	e130	69	32	26	18	95	22
19	24	e28	e22	e17	e16	e130	60	34	24	32	85	25
20	24	e28	e22	e17	e16	e150	52	33	26	e67	78	30
21	24	e27	e21	e17	e16	e200	53	116	27	119	74	29
22	24	e27	e21	e16	e16	e300	48	242	31	230	68	26
23	24	e27	e21	e16	e16	e400	55	222	33	232	59	29
24	25	e27	e21	e16	e16	e450	48	216	32	277	e53	28
25	24	e27	e21	e16	e17	e450	44	215	29	e330	47	28
26	24	e26	e20	e16	e17	e450	46	275	25	e390	45	e27
27	25	e26	e20	e16	e17	e400	42	312	23	438	41	26
28	25	e26	e20	e16	e17	e300	37	302	21	451	39	26
29	25	e26	e20	e16	---	e250	43	290	20	478	37	27
30	25	e26	e20	e16	---	e200	56	269	19	481	39	25
31	25	---	e20	e16	---	e180	---	230	---	449	34	---
TOTAL	745	843	695	532	452	5740	2402	3412	1804	4287	3229	833
MEAN	24.0	28.1	22.4	17.2	16.1	185	80.1	110	60.1	138	104	27.8
MAX	26	32	25	19	17	450	160	312	209	481	379	41
MIN	22	25	20	16	16	18	37	23	19	15	34	22
AC-FT	1480	1670	1380	1060	897	11390	4760	6770	3580	8500	6400	1650
CFSM	.06	.07	.05	.04	.04	.43	.19	.26	.14	.32	.24	.07
IN.	.07	.07	.06	.05	.04	.50	.21	.30	.16	.37	.28	.07

CAL YR 1986 TOTAL 42436 MEAN 116 MAX 1700 MIN 16 AC-FT 84170 CFSM .27 IN. 3.71
WTR YR 1987 TOTAL 24974 MEAN 68.4 MAX 481 MIN 15 AC-FT 49540 CFSM .16 IN. 2.18

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

GAGE.--Water-stage recorder. Datum of gage is 1,100.00 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 gage height, 1,178.53 ft, June 25, 1950; minimum recorded, 1,169.80 ft, Nov. 20, 1936.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 1,174.55 ft, Nov. 7; maximum daily, 1,174.26 ft, Nov. 7; minimum, 1,172.87 ft, Nov. 8; minimum daily, 1,173.34 ft, Sept. 29.

MONTHEND ELEVATION, IN FEET, OCTOBER 1986 TO SEPTEMBER 1987

Oct. 31	1,173.68	Feb. 28	1,173.60	June 30	1,173.73
Nov. 30	1,173.82	Mar. 31	1,173.72	July 31	1,174.02
Dec. 31	1,173.69	Apr. 30	1,173.79	Aug. 31	1,173.48
Jan. 31	1,173.65	May 31	1,174.10	Sept. 30	1,173.39

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.--54 years, 504 ft^3/s, 365,100 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, 940 ft^3/s, Oct. 3, gage height, 72.45 ft; maximum gage height, 72.46 ft, Oct. 1; minimum daily discharge, 56 ft^3/s, Apr. 19.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	925	249	e670	e600	e670	675	316	59	253	e350	269	248
2	927	240	e670	e650	e670	679	308	68	195	e350	267	245
3	930	249	e650	e700	e680	661	302	67	180	e210	269	239
4	921	240	e500	e690	e680	665	302	76	149	e190	261	244
5	920	250	e650	e680	e680	659	299	84	136	e180	251	249
6	911	414	e800	e670	e680	680	300	86	134	e175	252	251
7	915	679	e750	e660	e680	692	304	89	144	e170	250	251
8	914	e685	e750	e650	e680	692	312	95	137	e170	250	252
9	908	e685	e670	e640	e680	673	316	87	162	e175	252	255
10	899	e685	e600	e650	679	653	308	81	295	e175	246	258
11	906	e685	e670	e700	688	663	307	97	326	e175	237	234
12	906	e685	e700	e700	683	659	308	79	322	e175	247	257
13	898	e685	e660	e650	e650	524	301	79	319	e175	241	257
14	890	e685	e660	e650	e650	307	294	94	322	e170	237	249
15	890	e685	e660	e600	e650	300	293	85	320	e165	244	254
16	853	e685	e660	e650	690	306	243	86	322	e165	256	254
17	661	e685	e660	e700	681	300	91	100	323	e165	185	254
18	378	e685	e660	e700	659	289	66	75	332	e165	64	254
19	277	e685	e660	e650	668	295	56	88	333	e165	217	254
20	248	e685	e660	e650	665	301	87	92	332	e165	235	252
21	240	e685	e660	e660	661	300	68	141	338	e165	245	249
22	240	e680	e660	e660	677	316	65	132	344	e165	246	249
23	236	e680	e660	e660	662	334	69	118	356	e165	242	246
24	235	e680	e660	e660	660	341	62	108	353	e165	240	246
25	234	e680	e660	e660	657	347	69	94	356	e165	242	244
26	236	e680	e650	e670	659	338	82	244	362	e165	247	238
27	237	e680	e650	e670	660	339	85	554	356	e165	244	238
28	248	e680	e650	e670	649	340	79	570	e350	e165	246	238
29	242	e670	e650	e670	---	323	80	562	e350	168	247	238
30	233	e670	e650	e670	---	313	68	558	e350	201	258	235
31	255	---	e650	e670	---	312	---	530	---	261	250	---
TOTAL	18713	18011	20560	20560	18748	14276	5840	5278	8551	5780	7437	7432
MEAN	604	600	663	663	670	461	195	170	285	186	240	248
MAX	930	685	800	700	690	692	316	570	362	350	269	258
MIN	233	240	500	600	649	289	56	59	134	165	64	234
AC-FT	37120	35720	40780	40780	37190	28320	11580	10470	16960	11460	14750	14740
CFSM	.31	.31	.34	.34	.34	.24	.10	.09	.15	.10	.12	.13
IN.	.36	.34	.39	.39	.36	.27	.11	.10	.16	.11	.14	.14

CAL YR 1986 TOTAL 311052 MEAN 852 MAX 1460 MIN 153 AC-FT 617000 CFSM .44 IN. 5.93
WTR YR 1987 TOTAL 151186 MEAN 414 MAX 930 MIN 56 AC-FT 299900 CFSM .21 IN. 2.88

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 good except those for Nov. 10 to Mar. 14 and Mar. 29-31, which are fair. Flow regulated by outlet dam on Lower Red Lake.

AVERAGE DISCHARGE.--58 years, 566 ft^3/s, 410,100 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, 1,060 ft^3/s, Oct. 1, stage falling, peak occurred Sept. 21, 1986; maximum independent peak discharge, 961 ft^3/s, May 26, gage height, 6.48 ft; minimum daily discharge, 85 ft^3/s, May 14; minimum gage height, 1.41 ft, May 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1050	260	e700	e650	e680	e660	405	110	621	362	237	277
2	1050	263	e700	e700	e680	e660	399	103	387	372	271	276
3	1050	265	e650	e750	e680	e660	400	98	277	358	277	282
4	1050	268	e500	e740	e680	e660	398	97	255	292	274	280
5	1030	264	e650	e730	e680	e660	411	95	233	232	287	273
6	1030	264	e800	e720	e680	e660	416	94	219	207	288	275
7	1030	388	e750	e720	e660	e660	419	98	210	193	284	273
8	1020	661	e750	e650	e660	e660	424	96	198	185	284	273
9	1020	534	e700	e650	e660	e660	439	92	198	182	282	270
10	1020	e700	e650	e700	e660	e660	446	96	210	182	282	267
11	1010	e700	e700	e750	e660	e660	433	92	319	184	289	268
12	1000	e700	e750	e750	e660	e660	423	93	337	188	293	258
13	1010	e700	e700	e700	e660	e660	418	95	340	187	289	255
14	1000	e700	e700	e700	e630	e660	410	85	335	182	287	263
15	1000	e700	e700	e600	e600	358	398	86	330	179	293	260
16	998	e700	e700	e700	e650	340	384	90	324	181	312	261
17	961	e700	e700	e750	e700	340	302	120	321	181	307	265
18	784	e700	e700	e750	e660	345	174	129	316	186	279	273
19	509	e700	e700	e700	e660	350	142	117	318	327	193	287
20	369	e700	e700	e700	e660	474	120	100	324	324	201	282
21	321	e700	e700	e700	e660	649	115	258	326	261	262	276
22	300	e700	e700	e700	e660	629	120	654	329	239	277	273
23	290	e700	e700	e700	e660	654	108	486	330	233	279	265
24	287	e700	e700	e700	e660	697	108	365	335	212	281	265
25	283	e700	e700	e700	e660	729	107	315	340	193	283	269
26	280	e700	e700	e700	e660	661	102	753	338	182	295	267
27	274	e700	e700	e700	e660	573	99	910	342	175	296	269
28	273	e700	e700	e700	e660	515	105	895	352	174	287	263
29	270	e700	e700	e700	---	e480	98	808	355	172	286	262
30	273	e700	e700	e680	---	e450	101	750	355	171	283	259
31	270	---	e700	e680	---	e420	---	701	---	182	278	---
TOTAL	22112	17867	21600	21770	18540	17904	8424	8881	9474	6878	8616	8086
MEAN	713	596	697	702	662	578	281	286	316	222	278	270
MAX	1050	700	800	750	700	729	446	910	621	372	312	287
MIN	270	260	500	600	600	340	98	85	198	171	193	255
AC-FT	43860	35440	42840	43180	36770	35510	16710	17620	18790	13640	17090	16040
CFSM	.31	.26	.30	.31	.29	.25	.12	.12	.14	.10	.12	.12
IN.	.36	.29	.35	.35	.30	.29	.14	.14	.15	.11	.14	.13

CAL YR 1986 TOTAL 366036 MEAN 1003 MAX 2400 MIN 260 AC-FT 726000 CFSM .44 IN. 5.92
WTR YR 1987 TOTAL 170152 MEAN 466 MAX 1050 MIN 85 AC-FT 337500 CFSM .20 IN. 2.75

e Estimated

RED RIVER OF THE NORTH BASIN

05076000 THIEF RIVER NEAR THIEF RIVER FALLS, MN

LOCATION.--Lat 48°11'08", 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 city 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 good except those for Nov. 8-17 and Mar. 17 to Apr. 6, which are poor. Some regulation by Thief and Mud Lakes.

AVERAGE DISCHARGE.--69 years (water years 1910-17, 1921, 1923-24, 1929-81, 1983-87), 167 ft^3/s, 121,000 acre-ft/yr; median of yearly mean discharges, 112 ft^3/s, 81,100 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, 1,570 ft^3/s, Mar. 26, gage height, 13.23 ft, from high water mark (backwater from ice); no flow Jan. 4, 5, and Jan. 9 to Mar. 7.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	20	2.3	1.9	.06	.00	.00	e500	68	505	11	107	5.4
2	16	2.7	1.7	.04	.00	.00	e400	65	269	22	105	5.1
3	4.4	2.6	1.6	.01	.00	.00	e330	62	104	180	103	5.5
4	2.2	2.1	1.4	.00	.00	.00	e270	59	63	186	103	11
5	1.4	3.1	.90	.00	.00	.00	e220	57	48	186	103	6.8
6	4.0	9.8	.60	.01	.00	.00	e180	56	72	185	90	5.0
7	4.0	5.4	.43	.02	.00	.00	166	56	75	166	87	5.4
8	3.2	e4.0	.35	.02	.00	.01	132	54	72	31	85	5.6
9	2.5	e3.5	.34	.00	.00	.02	115	53	98	11	84	5.0
10	2.2	e3.0	.28	.00	.00	.04	98	51	98	9.9	82	4.8
11	6.8	e2.5	.19	.00	.00	.05	74	50	103	14	81	4.5
12	5.1	e2.0	.16	.00	.00	.05	63	50	101	23	82	4.9
13	2.8	e1.7	.12	.00	.00	.05	55	51	99	21	82	5.2
14	1.9	e1.4	.11	.00	.00	.05	53	19	95	12	82	4.7
15	1.3	e1.2	.09	.00	.00	.05	48	7.4	87	10	44	4.0
16	1.1	e1.0	.09	.00	.00	.05	41	6.1	28	9.0	25	3.5
17	2.9	e.80	.07	.00	.00	e.30	38	7.3	19	9.6	26	3.1
18	3.8	.69	.07	.00	.00	e1.0	36	8.2	17	11	25	4.0
19	2.8	.56	.08	.00	.00	e2.0	32	7.9	16	72	28	5.9
20	2.1	.54	.06	.00	.00	e5.0	28	11	14	106	28	9.1
21	1.6	.53	.05	.00	.00	e20	27	235	13	88	27	10
22	1.2	.53	.04	.00	.00	e100	29	1190	12	161	27	5.5
23	1.3	.67	.05	.00	.00	e500	24	868	12	311	26	5.7
24	1.4	.78	.03	.00	.00	e1000	30	690	11	318	25	5.3
25	1.7	.78	.04	.00	.00	e1500	64	613	12	306	21	6.6
26	2.4	1.1	.06	.00	.00	e1540	65	918	11	276	11	6.2
27	1.6	1.4	.03	.00	.00	e1500	63	1300	10	242	7.1	4.4
28	1.5	2.0	.04	.00	.00	e1200	68	1120	9.7	132	6.6	3.6
29	1.7	2.7	.03	.00	---	e1000	70	926	9.8	115	4.8	3.4
30	1.6	2.4	.03	.00	---	e800	67	780	9.5	68	7.0	4.4
31	2.6	---	.04	.00	---	e650	---	657	---	97	6.4	---
TOTAL	109.1	63.78	10.98	0.16	0.00	9818.67	3386	10095.9	2093.0	3389.5	1620.9	163.6
MEAN	3.52	2.13	.35	.005	.00	317	113	326	69.8	109	52.3	5.45
MAX	20	9.8	1.9	.06	.00	1540	500	1300	505	318	107	11
MIN	1.1	.53	.03	.00	.00	.00	24	6.1	9.5	9.0	4.8	3.1
AC-FT	216	127	22	.3	.0	19480	6720	20030	4150	6720	3220	325
CFSM	.00	.00	.00	.00	.00	.33	.12	.34	.07	.11	.05	.01
IN.	.00	.00	.00	.00	.00	.38	.13	.39	.08	.13	.06	.01

CAL YR 1986 TOTAL 102421.17 MEAN 281 MAX 2410 MIN .03 AC-FT 203200 CFSM .29 IN. 3.97
WTR YR 1987 TOTAL 30751.59 MEAN 84.3 MAX 1540 MIN .00 AC-FT 61000 CFSM .09 IN. 1.19

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 good except those for Nov. 11 to Apr. 1, which are fair. Since 1968, undetermined amounts of water diverted for the flooding of wild rice paddies upstream.

AVERAGE DISCHARGE.--45 years (water years 1940-79, 1983-87), 179 ft^3/s, 129,700 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)
May 22	0615	747	5.87	July 27	1000	*1,290	*7.62
May 27	2015	1,030	6.80				

Minimum, 12 ft^3/s, Nov. 6, gage height, 2.22 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	109	26	e75	e65	e50	e50	e200	38	421	31	589	110
2	97	18	e75	e60	e50	e50	142	43	348	34	487	94
3	85	18	e75	e60	e50	e50	121	37	293	39	409	86
4	82	20	e75	e60	e50	e50	111	38	256	39	401	81
5	76	15	e70	e60	e50	e50	88	35	209	45	358	81
6	70	17	e70	e60	e50	e60	72	39	183	44	329	78
7	67	20	e70	e60	e50	e100	34	38	170	44	333	75
8	62	25	e70	e60	e50	e200	32	34	148	42	283	73
9	62	36	e70	e60	e50	e170	31	37	137	30	243	76
10	61	48	e70	e60	e50	e130	28	39	152	41	214	71
11	58	e70	e70	e55	e50	e100	38	36	142	43	197	69
12	54	e90	e70	e55	e50	e95	38	36	122	54	177	74
13	63	e90	e70	e55	e50	e90	41	40	91	51	160	72
14	74	e90	e70	e55	e50	e75	49	33	82	67	145	73
15	59	e90	e70	e55	e50	e60	51	36	78	98	132	76
16	44	e85	e70	e55	e50	e50	41	38	62	101	156	78
17	48	e85	e70	e55	e50	e45	43	57	57	100	191	83
18	46	e85	e70	e55	e50	e60	46	56	60	95	167	84
19	45	e85	e70	e55	e50	e100	50	46	53	178	140	100
20	46	e85	e70	e55	e50	e150	48	48	36	239	126	151
21	43	e85	e70	e50	e50	e200	43	247	44	286	116	148
22	43	e80	e70	e50	e50	e190	38	707	42	322	108	133
23	43	e80	e70	e50	e50	e180	36	566	36	547	98	119
24	36	e80	e65	e50	e50	e170	40	459	34	752	88	107
25	45	e80	e65	e50	e50	e250	40	399	39	919	84	104
26	42	e80	e65	e50	e50	e250	45	744	35	1150	86	102
27	37	e80	e65	e50	e50	e220	46	999	33	1280	105	99
28	35	e80	e65	e50	e50	e200	40	959	31	1180	108	93
29	31	e80	e65	e50	---	e180	33	743	31	1010	101	86
30	32	e75	e65	e50	---	e200	35	596	29	876	98	83
31	31	---	e65	e50	---	e170	---	496	---	723	121	---
TOTAL	1726	1898	2150	1705	1400	3945	1700	7719	3454	10460	6350	2759
MEAN	55.7	63.3	69.4	55.0	50.0	127	56.7	249	115	337	205	92.0
MAX	109	90	75	65	50	250	200	999	421	1280	589	151
MIN	31	15	65	50	50	45	28	33	29	30	84	69
AC-FT	3420	3760	4260	3380	2780	7820	3370	15310	6850	20750	12600	5470
CFSM	.11	.12	.14	.11	.10	.25	.11	.49	.22	.66	.40	.18
IN.	.13	.14	.16	.12	.10	.29	.12	.56	.25	.76	.46	.20

CAL YR 1986 TOTAL 67027 MEAN 184 MAX 1400 MIN 15 AC-FT 132900 CFSM .36 IN. 4.87
WTR YR 1987 TOTAL 45266 MEAN 124 MAX 1280 MIN 15 AC-FT 89790 CFSM .24 IN. 3.29

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.--Nonrecording gage and crest-stage gage. 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.

REMARKS.--Records poor.

AVERAGE DISCHARGE.--26 years, 75.1 ft^3/s, 58,410 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.

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, 661 ft^3/s, July 24, gage height, 9.00 ft, from graph based on gage readings; maximum gage height, 10.55 ft, Mar. 7, from high water mark (backwater from ice); minimum daily discharge, 4.3 ft^3/s, Nov. 4.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	21	5.7	e9.4	e7.8	e7.3	e9.0	138	34	114	6.6	118	22
2	12	5.3	e9.2	e7.8	e7.3	e9.0	145	35	101	9.4	112	16
3	7.1	5.1	e9.2	e7.8	e7.4	e9.0	94	29	74	9.4	69	20
4	9.4	4.3	e9.0	e7.8	e7.4	e9.0	68	29	60	9.1	54	18
5	22	5.1	e9.0	e7.8	e7.6	e50	64	32	49	9.4	43	17
6	21	7.8	e8.8	e7.8	e7.8	e150	59	30	39	7.5	41	17
7	18	8.8	e8.8	e7.6	e8.0	e300	44	25	34	6.8	38	13
8	18	8.3	e8.6	e7.6	e8.2	e250	43	24	33	6.6	26	11
9	18	8.6	e8.6	e7.6	e8.4	e215	47	22	30	6.4	21	13
10	19	11	e8.4	e7.6	e9.0	e195	46	21	27	6.2	16	9.7
11	19	11	e8.4	e7.6	e10	e180	47	24	26	7.1	17	13
12	19	12	e8.4	e7.6	e10	e160	46	21	25	12	20	13
13	18	e11	e8.4	e7.6	e10	e140	40	18	22	11	15	11
14	14	e11	e8.2	e7.6	e10	e130	36	13	19	11	16	10
15	13	e11	e8.2	e7.4	e9.7	e120	34	14	16	11	20	10
16	12	e11	e8.2	e7.4	e9.3	e110	34	18	13	8.3	39	10
17	10	e11	e8.2	e7.4	e9.1	e100	31	17	16	11	34	9.7
18	9.1	e11	e8.0	e7.4	e9.0	e120	32	17	14	21	32	16
19	8.6	e11	e8.0	e7.4	e9.0	e140	33	18	13	48	23	24
20	9.7	e10	e8.0	e7.4	e9.0	248	33	27	12	38	20	29
21	10	e10	e8.0	e7.4	e9.0	284	30	429	12	34	19	25
22	9.4	e10	e8.0	e7.4	e9.0	250	27	529	12	254	18	41
23	8.3	e10	e8.0	e7.4	e9.0	238	26	371	9.4	437	17	21
24	7.5	e10	e8.0	e7.4	e9.0	280	28	294	5.3	500	14	20
25	7.5	e9.8	e8.0	e7.4	e9.0	349	27	240	5.1	564	20	19
26	7.8	e9.8	e8.0	e7.3	e9.0	350	26	586	4.9	367	24	16
27	7.3	e9.8	e8.0	e7.3	e9.0	281	25	443	4.7	248	22	21
28	7.1	e9.6	e8.0	e7.3	e9.0	276	24	288	4.7	193	21	19
29	7.1	e9.6	e8.0	e7.3	---	183	24	247	5.1	165	22	18
30	6.8	e9.4	e7.8	e7.3	---	138	23	210	4.9	142	36	18
31	6.2	---	e7.8	e7.3	---	157	---	154	---	123	33	---
TOTAL	382.9	278.0	258.6	232.8	245.5	5430.0	1374	4259	805.1	3282.8	1020	520.4
MEAN	12.4	9.27	8.34	7.51	8.77	175	45.8	137	26.8	106	32.9	17.3
MAX	22	12	9.4	7.8	10	350	145	586	114	564	118	41
MIN	6.2	4.3	7.8	7.3	7.3	9.0	23	13	4.7	6.2	14	9.7
AC-FT	759	551	513	462	487	10770	2730	8450	1600	6510	2020	1030
CFSM	.05	.03	.03	.03	.03	.66	.17	.52	.10	.40	.12	.07
IN.	.05	.04	.04	.03	.03	.76	.19	.60	.11	.46	.14	.07

CAL YR 1986 TOTAL 28304.0 MEAN 77.5 MAX 1630 MIN 1.9 AC-FT 56140 CFSM .29 IN. 3.96
WTR YR 1987 TOTAL 18089.1 MEAN 49.6 MAX 586 MIN 4.3 AC-FT 35880 CFSM .19 IN. 2.53

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 Nov. 10 to Mar. 27, which are fair.

AVERAGE DISCHARGE.--60 years (1910-17, 1935-81, 1983-87), 321 ft^3/s, 232,600 acre-ft/yr; median of yearly mean discharges, 284 ft^3/s, 206,000 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, 2,170 ft^3/s, May 27, gage height, 5.93 ft; minimum, 22 ft^3/s, Nov. 4, gage height, 1.67 ft, result of freeze up.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	151	72	e115	e95	e75	e75	414	112	869	45	904	179
2	151	58	e110	e95	e75	e75	404	128	729	48	779	157
3	139	61	e110	e95	e75	e75	351	120	601	51	656	139
4	124	37	e110	e90	e75	e75	351	105	508	55	583	120
5	117	51	e110	e90	e75	e75	306	100	432	56	553	116
6	110	52	e105	e90	e75	e250	273	93	359	61	493	117
7	117	50	e105	e90	e75	e500	256	89	326	65	478	112
8	114	67	e105	e90	e75	e600	225	85	287	59	439	108
9	109	55	e105	e90	e75	e700	210	74	254	57	387	103
10	110	e75	e105	e85	e75	e600	201	72	243	44	334	105
11	108	e90	e105	e85	e75	e500	189	71	255	46	293	102
12	104	e120	e105	e85	e75	e450	196	68	228	62	270	99
13	100	e140	e105	e85	e75	e400	192	68	200	66	242	109
14	109	e140	e105	e85	e75	e350	186	66	164	64	225	105
15	120	e135	e105	e85	e75	e300	188	61	147	74	221	100
16	107	e130	e105	e85	e75	e250	180	71	135	106	223	97
17	88	e130	e105	e85	e75	e200	167	80	118	113	254	102
18	93	e130	e105	e80	e75	e160	164	99	108	113	267	104
19	88	e130	e105	e80	e75	e200	169	96	108	117	233	108
20	89	e125	e105	e80	e75	e400	170	94	98	236	211	135
21	91	e120	e105	e80	e75	e800	162	261	79	289	191	197
22	87	e120	e105	e80	e75	e750	154	1400	79	474	176	195
23	85	e120	e100	e80	e75	e700	145	1560	83	1030	162	177
24	85	e120	e100	e80	e75	e700	134	1220	78	1380	148	162
25	76	e120	e100	e80	e75	e1000	131	1040	71	1600	138	148
26	83	e120	e100	e75	e75	e1000	128	1390	71	1700	139	144
27	84	e120	e100	e75	e75	e700	127	2120	64	1710	139	139
28	76	e120	e100	e75	e75	495	126	1980	62	1630	161	132
29	75	e120	e95	e75	---	410	116	1550	53	1470	158	122
30	68	e115	e95	e75	---	421	108	1230	50	1300	151	117
31	66	---	e95	e75	---	442	---	1020	---	1110	153	---
TOTAL	3124	3043	3225	2595	2100	13653	6123	16523	6859	15231	9761	3850
MEAN	101	101	104	83.7	75.0	440	204	533	229	491	315	128
MAX	151	140	115	95	75	1000	414	2120	869	1710	904	197
MIN	66	37	95	75	75	75	108	61	50	44	138	97
AC-FT	6200	6040	6400	5150	4170	27080	12140	32770	13600	30210	19360	7640
CFSM	.07	.07	.08	.06	.05	.32	.15	.39	.17	.36	.23	.09
IN.	.08	.08	.09	.07	.06	.37	.17	.45	.19	.41	.27	.10

CAL YR 1986 TOTAL 148818 MEAN 408 MAX 3620 MIN 37 AC-FT 295200 CFSM .30 IN. 4.04
WTR YR 1987 TOTAL 86087 MEAN 236 MAX 2120 MIN 37 AC-FT 170800 CFSM .17 IN. 2.34

e Estimated

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 Nov. 13 to Apr. 7, 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.--86 years, 1,152 ft^3/s, 834,600 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, 5,360 ft^3/s, May 28, gage height, 11.22 ft; maximum gage height, 15.93 ft, Mar. 27 (backwater from ice); minimum discharge, 140 ft^3/s, Nov. 9, gage height, 2.77 ft, result of freeze up.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1160	353	e850	e750	e700	e700	e1900	378	2530	365	1290	446
2	1190	347	e850	e750	e700	e700	e1700	366	2160	375	1130	462
3	1230	335	e850	e700	e700	e700	e1600	379	1690	384	1040	434
4	1100	335	e850	e700	e700	e700	e1500	398	1270	382	967	431
5	1140	313	e850	e750	e700	e700	e1400	374	926	582	938	422
6	1060	347	e800	e800	e700	e700	e1300	348	837	542	926	435
7	1130	348	e750	e750	e700	e1000	e1200	337	723	544	950	419
8	1120	378	e850	e750	e700	e2000	1000	330	710	496	840	415
9	1040	164	e900	e750	e700	e2200	1030	316	644	393	769	413
10	1110	250	e900	e700	e700	e2150	1110	289	627	309	729	413
11	1120	495	e900	e700	e700	e2000	1020	274	620	262	680	408
12	1050	400	e850	e700	e700	e1700	984	268	662	283	643	412
13	1060	e500	e800	e750	e700	e1500	1030	262	615	333	619	409
14	1060	e900	e900	e750	e700	e1300	942	263	661	368	593	417
15	1080	e900	e850	e750	e700	e1100	926	256	644	276	652	419
16	1160	e900	e800	e750	e700	e1000	926	257	559	281	689	381
17	952	e900	e800	e700	e650	e900	784	341	557	318	611	395
18	1010	e900	e800	e650	e600	e850	705	277	526	344	595	428
19	1040	e900	e800	e700	e650	e900	696	282	470	375	577	391
20	844	e900	e800	e750	e700	e1200	587	249	433	413	557	454
21	746	e900	e750	e750	e750	e1800	468	570	421	809	504	484
22	543	e900	e750	e700	e700	e2500	444	1730	407	1050	458	524
23	463	e900	e750	e700	e700	e3000	410	3940	419	1210	420	527
24	416	e900	e750	e700	e700	e3500	362	3360	421	1810	421	504
25	394	e900	e750	e700	e700	e4000	404	2620	402	2080	459	473
26	387	e900	e750	e700	e700	e4500	411	2440	380	2160	461	481
27	292	e900	e750	e700	e700	e4500	397	3830	380	2140	475	467
28	408	e900	e750	e700	e700	e4000	391	5150	400	2030	438	475
29	410	e900	e750	e700	---	e3000	406	4310	385	1910	477	456
30	381	e900	e750	e700	---	e2500	375	3390	377	1660	469	444
31	326	---	e750	e700	---	e2200	---	2880	---	1480	450	---
TOTAL	26422	19865	25000	22350	19450	59500	26408	40464	21856	25964	20827	13239
MEAN	852	662	806	721	695	1919	880	1305	729	838	672	441
MAX	1230	900	900	800	750	4500	1900	5150	2530	2160	1290	527
MIN	292	164	750	650	600	700	362	249	377	262	420	381
AC-FT	52410	39400	49590	44330	38580	118000	52380	80260	43350	51500	41310	26260
CFSM	.16	.13	.15	.14	.13	.36	.17	.25	.14	.16	.13	.08
IN.	.19	.14	.18	.16	.14	.42	.19	.29	.15	.18	.15	.09

CAL YR 1986 TOTAL 667335 MEAN 1828 MAX 11000 MIN 164 AC-FT 1324000 CFSM .35 IN. 4.70
WTR YR 1987 TOTAL 321345 MEAN 880 MAX 5150 MIN 164 AC-FT 637400 CFSM .17 IN. 2.26

e Estimated

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 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 AIR (DEG C) (00020)	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)
NOV												
04...	1300	340	380	384	8.4	8.3	-1.0	2.0	3.2	739	13.6	K10
DEC												
16...	1530	788	325	370	7.9	8.1	3.0	0.0	3.7	737	12.3	110
MAR												
10...	1600	2150	250	293	8.0	7.5	-2.0	0.5	12	747	7.4	95
APR												
21...	1445	474	395	431	8.4	8.4	14.0	14.0	4.0	751	9.6	K24
JUN												
02...	1430	2170	490	514	8.4	8.6	23.0	20.5	16	733	8.3	72
AUG												
25...	1400	465	415	451	8.3	8.6	15.0	19.0	8.5	743	8.5	200

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 WATER DISSOLV FLD. AS CACO3 (MG/L) (39086)	CAR-BONATE WATER DISSOLV FIELD AS CO3 (MG/L) (00452)	BICAR-BONATE WATER DISSOLV FIELD AS HCO3 (MG/L) (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)
NOV											
04...	60	51	19	7.7	2.8	184	7	217	23	6.3	0.1
DEC											
16...	48	50	17	4.6	2.6	197	0	240	13	10	0.1
MAR											
10...	390	37	13	3.9	5.4	128	0	156	21	5.3	0.1
APR											
21...	K32	54	21	5.9	3.2	187	10	209	46	4.7	0.1
JUN											
02...	190	68	24	5.5	4.6	184	7	210	91	4.6	0.2
AUG											
25...	340	59	24	6.7	3.3	200	0	244	46	4.3	0.2

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	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)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
04...	5.8	238	<0.10	<0.01	0.80	0.04	0.02	0.01	7	6.4	98
DEC											
16...	8.3	233	<0.10	0.05	1.4	0.01	0.01	<0.01	20	43	100
MAR											
10...	7.6	185	0.93	0.51	1.9	0.23	0.20	0.15	16	93	100
APR											
21...	2.7	276	<0.10	0.02	0.90	0.05	0.01	<0.01	23	29	99
JUN											
02...	9.9	337	0.16	0.05	--	0.11	0.07	<0.01	68	398	96
AUG											
25...	7.7	295	<0.10	0.03	1.3	0.08	0.04	0.01	35	44	85

DATE	TIME	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)
NOV											
04...	1300	20	2	57	<0.5	<1	1	<3	<1	5	<5
MAR											
10...	1600	30	2	43	<0.5	<1	<1	<3	2	49	<5
JUN											
02...	1430	20	2	63	<0.5	<1	<1	<3	2	20	<5
AUG											
25...	1400	<10	2	56	<0.5	<1	<1	<3	1	19	<5

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
NOV										
04...	11	20	<0.1	<10	<1	<1	<1	100	<6	10
MAR										
10...	7	15	0.5	<10	1	<1	<1	75	<6	9
JUN										
02...	17	6	0.1	<10	<1	<1	<1	150	<6	<3
AUG										
25...	12	19	0.8	<10	2	<1	<1	140	<6	12

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, .4 mi downstream from Red Lake 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 May 1901 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: Oct. 13-31, Mar. 6 to Apr. 4, and Aug. 18, 19. Records good.

AVERAGE DISCHARGE.--105 years, 2,629 ft^3/s, 1,905,000 acre-ft/yr; median of yearly mean discharge, 2,370 ft^3/s, 1,720,000 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, 17,500 ft^3/s, Mar. 29, gage height, 33.19 ft; minimum daily, 855 ft^3/s, Sept. 10.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6100	1910	2440	1970	1630	1850	15300	2960	6980	1130	4180	1390
2	5840	1870	2480	1970	1640	1840	15000	2840	6250	1100	3480	1420
3	5380	1890	2490	1970	1620	1830	14700	2730	5530	1120	3030	1330
4	4900	1890	2490	1940	1630	1850	13700	2620	4760	1110	2860	1170
5	4400	1890	2470	1860	1630	1910	12100	2530	4070	1090	2730	1040
6	4140	1910	2430	1860	1680	2020	10800	2410	3470	1270	2600	977
7	3930	1920	2300	1860	1720	2590	9800	2260	3090	1520	2480	918
8	3830	2060	2090	1350	1750	4870	9200	2120	2800	1610	2390	897
9	3750	1870	2040	1850	1760	6750	8500	1940	2620	1620	2250	875
10	3610	1490	1970	1850	1790	7300	8080	1800	2450	1500	2090	855
11	3570	1180	1940	1810	1820	7500	7820	1660	2310	1450	1920	867
12	3540	1010	1910	1740	1820	7400	7460	1570	2200	1320	1800	880
13	3410	1330	1930	1700	1820	7200	7040	1450	2170	1250	1770	904
14	3330	1450	1920	1710	1830	6940	6620	1380	2090	1220	1710	897
15	3310	1630	1970	1670	1860	6600	6330	1320	2070	1260	1620	888
16	3280	1870	1940	1700	1870	6400	6140	1270	1990	1170	1600	904
17	3280	2060	1880	1720	1870	6300	6000	1250	1870	1100	1750	889
18	3140	2170	1850	1660	1810	6200	5890	1260	1750	1160	1730	908
19	3120	2230	1830	1560	1750	6100	5660	1350	1620	1090	1580	994
20	3080	2300	1810	1610	1820	6620	5410	1570	1490	1110	1510	988
21	2940	2420	1810	1640	1890	7760	5260	1970	1390	1080	1470	1020
22	2740	2520	1810	1610	1930	9300	5090	2470	1360	1850	1430	1080
23	2550	2530	1850	1610	1910	11000	4940	3990	1370	6150	1310	1110
24	2190	2500	1900	1610	1880	12200	4820	6440	1380	9270	1220	1110
25	2110	2450	1940	1590	1860	13200	4640	6780	1360	10800	1210	1100
26	2040	2400	1970	1550	1860	14300	4440	6440	1280	11100	1230	1070
27	2040	2380	1990	1520	1840	15700	4090	6520	1220	10300	1250	1040
28	1980	2380	2010	1500	1840	16700	4100	8140	1160	8820	1260	999
29	1910	2380	2010	1510	---	17200	3950	9350	1160	7330	1250	983
30	2010	2390	2000	1550	---	16400	3800	8960	1180	6080	1280	953
31	1940	---	1980	1600	---	15700	---	7910	---	5040	1340	---
TOTAL	103390	60280	63450	53150	50130	249530	226680	107260	74440	103020	59330	30456
MEAN	3335	2009	2047	1715	1790	8049	7556	3460	2481	3323	1914	1015
MAX	6100	2530	2490	1970	1930	17200	15300	9350	6980	11100	4180	1420
MIN	1910	1010	1810	1500	1620	1830	3800	1250	1160	1080	1210	855
AC-FT	205100	119600	125900	105400	99430	494900	449600	212800	147700	204300	117700	60410

CAL YR 1986 TOTAL 2071720 MEAN 5676 MAX 31800 MIN 1010 AC-FT 4109000
WTR YR 1987 TOTAL 1181120 MEAN 3236 MAX 17200 MIN 855 AC-FT 2343000

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	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)
OCT									
24...	1250	2300	690	--	8.0	10.0	--	--	--
DEC									
17...	1445	1890	600	--	0.0	1.0	--	--	--
JAN									
28...	1620	1480	550	--	-2.0	0.5	--	--	--
MAR									
02...	1635	1940	--	--	2.0	0.5	--	--	--
30...	1515	16300	475	7.3	-2.0	0.0	49	21	11
a30...	1516	16300	475	7.3	-2.0	0.0	51	21	10
APR									
01...	1750	15300	700	--	-3.0	0.5	--	--	--
05...	1550	11900	545	--	15.5	4.0	--	--	--
27...	1215	4020	650	--	16.0	14.0	--	--	--
MAY									
22...	1045	2430	685	7.7	7.0	13.0	70	36	28
JUN									
25...	1035	1450	590	--	16.0	25.0	--	--	--
JUL									
27...	1135	10100	350	--	28.0	27.0	--	--	--
AUG									
27...	1210	1250	580	--	14.0	17.0	--	--	--
SEP									
25...	1435	1100	490	--	10.0	15.5	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	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)
MAR							
30...	6.3	140	83	13	0.3	12	305
a30...	6.5	148	86	9.8	0.2	12	294
MAY							
22...	6.7	240	120	16	0.2	9.1	448

DATE	TIME	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)
MAR											
30...	1515	2	40	80	<1	16	40	0.1	1	<1	210
a30...	1516	3	20	60	<5	20	45	--	1	<1	130
MAY											
22...	1045	3	60	40	<1	33	20	--	1	<1	350

a - Split sample analysis for quality assurance.

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 Nov. 8 to Apr. 2, which are poor.

AVERAGE DISCHARGE.--36 years (water years 1951-81, 1983-87), 41.4 ft^3/s, 29,990 acre-ft/yr; median of yearly mean discharges, 38 ft^3/s, 27,500 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, 550 ft^3/s, Mar. 28, gage height, 11.78 ft (backwater from ice); no flow Sept. 11, 14-17, and 21-30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.29	.69	e.60	e.60	e.60	e.60	e350	8.5	67	.68	3.3	.15
2	.32	.70	e.60	e.60	e.60	e.60	e320	8.0	45	.94	1.7	.13
3	.32	.82	e.60	e.60	e.60	e.60	292	7.5	31	1.0	.80	.11
4	.32	1.4	e.60	e.60	e.60	e.60	273	6.9	23	.84	.35	.08
5	.33	1.8	e.60	e.60	e.60	e.65	237	6.3	17	.33	.28	.05
6	.33	1.4	e.60	e.60	e.60	e.70	231	5.7	14	.29	.22	.03
7	.34	1.8	e.60	e.60	e.60	e.80	224	5.6	11	.27	.17	.02
8	.38	e1.4	e.60	e.60	e.60	e.90	203	5.6	8.6	.25	.18	.04
9	.34	e1.2	e.60	e.60	e.60	e1.0	191	5.1	7.1	.24	.18	.02
10	.33	e1.0	e.60	e.60	e.60	e1.0	177	4.4	7.0	.24	.14	.01
11	.32	e.90	e.60	e.60	e.60	e.90	154	3.7	6.2	.25	.12	.00
12	.32	e.75	e.60	e.60	e.60	e.90	133	4.0	4.8	.28	.11	.01
13	.33	e.70	e.60	e.60	e.60	e.90	113	4.0	4.3	.31	.11	.01
14	.33	e.66	e.60	e.60	e.60	e.90	96	3.3	3.6	.54	.12	.00
15	.39	e.63	e.60	e.60	e.60	e.90	82	3.4	3.1	.56	.16	.00
16	.45	e.61	e.60	e.60	e.60	e.90	70	3.5	2.4	.33	.17	.00
17	.53	e.60	e.60	e.60	e.60	e.90	57	3.4	1.7	.30	.17	.00
18	.60	e.60	e.60	e.60	e.60	e.90	47	3.2	1.5	.36	.17	.01
19	.60	e.60	e.60	e.60	e.60	e1.0	39	3.2	1.2	2.1	.15	.02
20	.60	e.60	e.60	e.60	e.60	e5.0	32	4.0	1.0	2.8	.17	.01
21	.60	e.60	e.60	e.60	e.60	e20	30	8.5	1.3	1.4	.18	.00
22	.55	e.60	e.60	e.60	e.60	e50	29	6.7	1.5	2.0	.16	.00
23	.35	e.60	e.60	e.60	e.60	e100	24	7.5	1.4	1.3	.13	.00
24	.66	e.60	e.60	e.60	e.60	e200	22	11	1.2	.92	.12	.00
25	.85	e.60	e.60	e.60	e.60	e350	20	25	1.7	.76	.15	.00
26	.88	e.60	e.60	e.60	e.60	e500	17	37	1.4	.80	.18	.00
27	.64	e.60	e.60	e.60	e.60	e535	16	45	1.0	.90	.18	.00
28	.60	e.60	e.60	e.60	e.60	e540	15	66	.76	6.1	.17	.00
29	.60	e.60	e.60	e.60	---	e500	10	103	.52	10	.18	.00
30	.63	e.60	e.60	e.60	---	e450	8.7	107	.51	7.3	.16	.00
31	.69	---	e.60	e.60	---	e400	---	93	---	4.4	.15	---
TOTAL	14.82	24.86	18.60	18.60	16.80	3665.65	3512.7	609.0	271.79	48.79	10.53	0.70
MEAN	.48	.83	60	.60	.60	118	117	19.6	9.06	1.57	.34	.023
MAX	.88	1.8	.60	.60	.60	540	350	107	67	10	3.3	.15
MIN	.29	.60	.60	.60	.60	.60	8.7	3.2	.51	.24	.11	.00
AC-FT	29	49	37	37	33	7270	6970	1210	539	97	21	1.4
CFSM	.00	.00	.00	.00	.00	.45	.44	.07	.03	.01	.00	.00
IN.	.00	.00	.00	.00	.00	.51	.49	.09	.04	.01	.00	.00

CAL YR 1986 TOTAL 20444.46 MEAN 56.0 MAX 994 MIN .08 AC-FT 40550 CFSM .21 IN. 2.87
WTR YR 1987 TOTAL 8212.84 MEAN 22.5 MAX 540 MIN .00 AC-FT 16290 CFSM .08 IN. 1.15

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 SE¼SE¼SE¼ 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: Dec. 14-19 and Jan. 11 to Apr. 5. Records good except those for period of estimated daily discharges, Nov. 8 to Apr. 5, which are fair. Some regulation by reservoirs on tributaries.

AVERAGE DISCHARGE.--38 years (water years 1950-87), 3,907 ft^3/s, 2,831,000 acre-ft/yr; median of yearly mean discharges, 3,870 ft^3/s, 2,800,000 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, 27,600 ft^3/s, Apr. 7, gage height, 36.61 ft; minimum daily, 960 ft^3/s, Sept. 15-18.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5860	2040	2620	2250	1560	1710	22200	4000	9800	1080	6050	1310
2	6060	1990	2670	2210	1560	1710	22800	3800	8700	1060	5300	1370
3	6000	1930	2710	2210	1560	1710	23500	3540	7700	1050	4750	1410
4	5670	1920	2740	2220	1560	1710	24300	3240	6800	1020	4250	1400
5	5170	1910	2750	2230	1560	1740	25700	2970	5900	1010	3740	1360
6	4630	1910	2770	2180	1570	1800	27000	2720	4880	997	3420	1270
7	4170	1920	2760	2070	1580	1910	27500	2570	4030	995	3300	1170
8	3880	2040	2710	1980	1590	2060	27400	2400	3420	1100	3120	1100
9	3660	1360	2550	1970	1650	2800	26500	2220	3020	1250	2970	1050
10	3550	1320	2390	1970	1730	4600	24900	2050	2750	1360	2840	999
11	3460	1620	2300	1960	1730	6300	23000	1890	2570	1370	2640	999
12	3410	1750	2180	1960	1720	7000	21000	1750	2360	1370	2440	979
13	3390	1630	2190	1950	1720	7380	18800	1560	2170	1300	2270	969
14	3310	1510	2180	1940	1720	7500	16700	1480	2040	1230	2130	969
15	3270	1540	2170	1850	1720	7550	14800	1390	1960	1150	2080	960
16	3230	1630	2160	1820	1720	7430	13300	1310	1880	1080	1980	960
17	3220	1750	2150	1800	1720	7300	11800	1270	1840	1040	1910	960
18	3220	1890	2140	1780	1720	6600	10500	1250	1760	1050	1870	960
19	3170	2050	2130	1720	1720	6450	9400	1220	1680	1170	1940	989
20	3100	2150	2110	1660	1720	6300	8450	1230	1590	1180	1940	1020
21	3080	2230	2060	1650	1720	6300	7600	1330	1520	1140	1850	1060
22	3020	2320	2080	1640	1720	7000	6900	1570	1410	1180	1760	1080
23	2880	2400	2100	1610	1720	8500	6300	1850	1330	1310	1680	1080
24	2680	2510	2130	1600	1720	10200	5800	2660	1290	3460	1610	1070
25	2490	2620	2150	1590	1710	12000	5600	4910	1250	6450	1570	1070
26	2320	2660	2180	1570	1710	13900	5100	6800	1230	8200	1450	1080
27	2190	2650	2260	1560	1710	15600	4950	7300	1220	9400	1390	1070
28	2110	2630	2290	1560	1710	17000	4700	7500	1180	10000	1370	1070
29	2100	2620	2320	1560	---	18500	4530	8300	1130	9600	1320	1060
30	2070	2620	2300	1560	---	19500	4150	9750	1100	8200	1310	1040
31	2020	---	2270	1560	---	21000	---	10400	---	7000	1320	---
TOTAL	108390	61120	72520	57190	46850	241060	455180	106230	89510	88802	77570	32884
MEAN	3496	2037	2339	1845	1673	7776	15170	3427	2984	2865	2502	1096
MAX	6060	2660	2770	2250	1730	21000	27500	10400	9800	10000	6050	1410
MIN	2020	1320	2060	1560	1560	1710	4150	1220	1100	995	1310	960
AC-FT	215000	121200	143800	113400	92930	478100	902800	210700	177500	176100	153900	65230

CAL YR 1986 TOTAL 2201320 MEAN 6031 MAX 29500 MIN 1320 AC-FT 4366000
WTR YR 1987 TOTAL 1437310 MEAN 3938 MAX 27500 MIN 960 AC-FT 2851000

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	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)
OCT									
02...	1655	6070	550	--	10.0	12.0	--	--	--
16...	1350	4960	565	--	3.0	5.0	--	--	--
JAN									
05...	1645	2160	--	--	0.0	0.5	--	--	--
FEB									
09...	1610	1690	--	--	1.0	--	--	--	--
APR									
07...	1200	27500	603	8.0	15.5	3.5	54	23	31
14...	1430	16300	645	--	14.0	9.0	--	--	--
MAY									
26...	1700	6460	--	--	18.0	18.0	--	--	--
JUL									
20...	1545	1200	675	--	30.0	26.0	--	--	--
28...	1640	10200	--	--	30.0	--	--	--	--
SEP									
03...	1255	1400	725	7.8	20.0	18.0	63	31	44

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	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)
APR							
07...	8.5	140	120	33	0.2	15	385
SEP							
03...	6.5	220	100	43	0.2	12	455

DATE	TIME	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											
07...	1200	5	50	40	1	27	40	0.3	<1	1	250
SEP											
03...	1255	4	80	20	<1	33	10	0.3	2	<1	300

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 city of 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 Nov. 8 to Mar. 24, which are fair. Flow partly regulated since 1937 by Bronson Lake, usable capacity, 3,700 acre-ft.

AVERAGE DISCHARGE.--42 years (water years 1929-36, 1942, 1943, 1946, 1947, 1954-81, 1986-87), 88.3 ft^3/s, 63,970 acre-ft/yr; median of yearly mean discharges, 56 ft^3/s, 40,600 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, 996 ft^3/s, Mar. 27, gage height, 7.62 ft; minimum daily, 0.11 ft^3/s, Jan. 4-14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.9	.71	e.15	e.12	e.12	e.12	642	14	68	3.8	7.7	.39
2	1.1	.68	e.15	e.12	e.12	e.12	439	27	2.9	4.8	6.7	.50
3	1.8	.68	e.15	e.12	e.12	e.12	477	3.4	1.2	4.0	5.5	.59
4	3.5	.72	e.14	e.11	e.12	e.12	606	1.5	2.8	3.6	9.8	.51
5	3.7	.71	e.14	e.11	e.12	e.12	792	1.7	8.6	3.1	1.3	.47
6	3.8	.68	e.14	e.11	e.12	e.20	917	3.7	20	3.0	.36	.49
7	3.8	.79	e.14	e.11	e.12	e.20	848	6.0	24	2.6	.28	.54
8	3.8	e1.0	e.14	e.11	e.12	e.20	744	7.4	20	1.9	.20	.54
9	3.7	e.80	e.14	e.11	e.12	e.20	622	8.2	19	1.6	.52	.52
10	3.9	e.70	e.14	e.11	e.12	e.20	545	8.8	14	1.5	1.4	.60
11	3.7	e.60	e.13	e.11	e.12	e.20	440	7.7	2.7	1.3	.55	.65
12	3.9	e.50	e.13	e.11	e.12	e.20	340	7.3	5.5	1.6	.33	.88
13	10	e.45	e.13	e.11	e.12	e.20	226	12	18	1.8	.20	.96
14	18	e.40	e.13	e.11	e.12	e.20	186	5.8	17	1.2	.18	.74
15	18	e.35	e.13	e.12	e.12	e.20	161	4.3	16	.98	.20	.85
16	18	e.30	e.13	e.12	e.12	e.20	88	5.9	2.4	1.3	.20	.79
17	15	e.26	e.13	e.12	e.12	e.20	94	6.8	.72	1.4	.20	.75
18	9.6	e.23	e.13	e.12	e.12	e1.0	71	6.4	.68	1.8	.20	.72
19	9.6	e.20	e.13	e.12	e.12	e10	71	5.6	.48	9.7	.18	.68
20	8.9	e.18	e.13	e.12	e.12	e50	69	5.6	.28	10	.20	.62
21	7.5	e.17	e.12	e.12	e.12	e50	48	23	.45	15	.28	.65
22	7.7	e.17	e.12	e.12	e.12	e50	30	32	.68	24	.22	.60
23	6.4	e.17	e.12	e.12	e.12	e100	30	29	.88	25	.20	.63
24	1.3	e.16	e.12	e.12	e.12	e400	64	56	2.9	22	.20	.60
25	.87	e.16	e.12	e.12	e.12	599	3.5	67	10	19	.22	.59
26	.79	e.16	e.12	e.12	e.12	669	1.9	87	5.7	16	.48	.64
27	.69	e.16	e.12	e.12	e.12	872	4.4	110	5.2	13	.50	.73
28	.59	e.15	e.12	e.12	e.12	e900	34	152	4.9	11	.41	.86
29	.54	e.15	e.12	e.12	---	e870	40	153	4.3	9.8	.45	.81
30	.53	e.15	e.12	e.12	---	e840	14	122	3.6	8.6	.43	.77
31	.68	---	e.12	e.12	---	808	---	110	---	8.8	.38	---
TOTAL	173.29	12.54	4.05	3.61	3.36	6222.00	8647.8	1090.1	282.87	233.18	39.97	19.67
MEAN	5.59	.42	.13	.12	.12	201	288	35.2	9.43	7.52	1.29	.66
MAX	18	1.0	.15	.12	.12	900	917	153	68	25	9.8	.96
MIN	.53	.15	.12	.11	.12	.12	1.9	1.5	.28	.98	.18	.39
AC-FT	344	25	8.0	7.2	6.7	12340	17150	2160	561	463	79	39
CFSM	.01	.00	.00	.00	.00	.45	.65	.08	.02	.02	.00	.00
IN.	.01	.00	.00	.00	.00	.52	.72	.09	.02	.02	.00	.00

CAL YR 1986 TOTAL 56477.88 MEAN 155 MAX 2460 MIN .12 AC-FT 112000 CFSM .35 IN. 4.73
WTR YR 1987 TOTAL 16732.44 MEAN 45.8 MAX 917 MIN .11 AC-FT 33190 CFSM .10 IN. 1.40

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., 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 700.00 ft above National Geodetic Vertical Datum of 1929, by Survey of Canada. See WSP 1728 or 1913 for history of changes prior to Apr. 10, 1953.

REMARKS.--Records good. Discharge partially regulated by reservoirs on tributaries.

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

AVERAGE DISCHARGE.--75 years (water years 1913-87), 3,420 ft^3/s, 2,478,000 acre-ft/yr; median of yearly mean discharges, 2,890 ft^3/s, 2,094,000 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 daily discharge, 37,400 ft^3/s, Apr. 9; minimum daily, 953 ft^3/s, Sept. 17.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5400	2170	2130	1990	1570	1690	21900	6000	9890	1510	7420	1310
2	5650	2170	2130	1990	1570	1690	24000	5620	9390	1470	6180	1310
3	5690	2120	2140	1990	1580	1680	26100	5190	8510	1450	5260	1340
4	5580	2070	2170	1990	1590	1670	28300	4840	7590	1440	4410	1360
5	5300	2060	2190	1990	1600	1670	30400	4590	6670	1410	3810	1370
6	4940	2060	2220	1990	1590	1690	32500	4340	5860	1380	3390	1340
7	4560	2070	2220	1970	1570	1720	36000	4130	5160	1360	3140	1270
8	4240	1880	2220	1950	1560	1760	37100	3960	4520	1330	3010	1180
9	3990	1890	2200	1920	1560	1850	37400	3710	4030	1420	2860	1090
10	3810	1880	2150	1890	1560	2220	37100	3510	3670	1590	2750	1040
11	3670	1910	2060	1870	1570	3470	36400	3310	3430	1710	2630	982
12	3600	2000	1990	1870	1590	5030	35100	3160	3230	1730	2470	971
13	3510	2060	1930	1860	1610	6070	33600	2930	3010	1740	2330	961
14	3450	2060	1890	1850	1620	6690	31400	2750	2820	1730	2210	961
15	3380	2010	1870	1820	1630	7000	28700	2600	2660	1620	2150	957
16	3320	1960	1870	1780	1640	7100	25200	2480	2550	1510	2060	953
17	3260	2000	1870	1750	1650	7020	23400	2370	2490	1430	1980	953
18	3220	2020	1880	1730	1660	6870	21400	2300	2420	1410	1890	957
19	3210	2040	1900	1740	1660	6710	19100	2230	2330	1500	1880	985
20	3160	2110	1880	1760	1650	6580	16800	2190	2240	1560	1910	989
21	3090	2160	1860	1740	1640	6490	14800	2250	2180	1570	1920	1020
22	3030	2180	1840	1710	1600	6590	13000	2350	2060	1570	1840	1080
23	2960	2200	1810	1690	1600	7120	11200	2550	1940	1600	1780	1110
24	2840	2220	1800	1670	1620	8230	9820	2830	1830	1840	1700	1100
25	2690	2240	1810	1660	1660	9730	8790	3810	1780	4130	1620	1100
26	2540	2240	1830	1640	1690	11300	8090	5720	1710	7240	1520	1110
27	2410	2210	1860	1640	1700	13200	7520	6890	1680	9040	1450	1120
28	2300	2200	1890	1640	1700	14900	7060	7200	1660	10100	1390	1120
29	2260	2170	1920	1630	---	17000	6600	7450	1600	10300	1360	1110
30	2240	2150	1950	1610	---	18700	6180	8550	1550	9890	1330	1110
31	2180	---	1980	1590	---	20300	---	9680	---	8790	1310	---
TOTAL	111480	62510	61460	55920	45240	213740	674960	131490	110460	96370	80960	33259
MEAN	3596	2084	1983	1804	1616	6895	22500	4242	3682	3109	2612	1109
MAX	5690	2240	2220	1990	1700	20300	37400	9680	9890	10300	7420	1370
MIN	2180	1880	1800	1590	1560	1670	6180	2190	1550	1330	1310	953
AC-FT	221100	124000	121900	110900	89730	424000	1339000	260800	219100	191100	160600	65970

CAL YR 1986 TOTAL 2585570 MEAN 7084 MAX 34200 MIN 1680 AC-FT 5128000
WTR YR 1987 TOTAL 1677850 MEAN 4597 MAX 37400 MIN 953 AC-FT 3328000

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. Letter K indicates non-ideal colony count.

EXTREMES FOR PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: Maximum daily mean, 1,200 microsiemens, Sept. 24, 1978, Aug. 30, 1980, and on many days during October 1980 through March 1981; minimum daily mean, 330 microsimens, Apr. 10, 16, 17, 1978.
WATER TEMPERATURES: Maximum daily mean, 26.0°C July 13, 14, 1981, Aug. 2, 1987; minimum daily mean, 0.0°C on many days during winter months.

EXTREMES FOR CURRENT YEAR.--
SPECIFIC CONDUCTANCE: Maximum daily mean, 893 microsiemens, Dec. 1; minimum daily mean, 372 microsiemens, Mar. 15.
WATER TEMPERATURES: Maximum daily mean, 26.0°C Aug. 2; minimum daily mean, 0.1°C on many days during winter months.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	DIS-CHARGE, IN CUBIC FEET PER SECOND (00060)	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)	TUR-BID-ITY (NTU) (00076)	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											
21...	1100	3090	--	725	8.1	8.0	9.0	40	10.8	K8	K10
JAN											
27...	1120	1640	--	742	7.3	-3.5	0.0	4.2	10.2	30	22
APR											
16...	1535	--	25100	585	7.9	15.0	9.0	46	9.5	<1	800
JUN											
15...	1340	2660	--	865	8.5	32.0	24.5	32	7.6	7	100
SEP											
01...	1100	--	1240	735	8.5	21.5	17.5	38	9.0	12	24

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, CARBON-ATE IT-FLD (MG/L AS CACO3) (00419)	BICAR-BONATE WATER WHOLE IT-FLD (MG/L) (00450)	CAR-BONATE WATER WHOLE IT-FLD (MG/L) (00447)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)
OCT								
21...	68	37	30	6.7	204	249	0	130
JAN								
27...	68	34	37	5.3	197	240	0	83
APR								
16...	57	23	30	7.8	136	166	0	110
JUN								
15...	77	37	48	8.2	259	219	48	150

DATE	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)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)
OCT						
21...	27	0.1	15	468	--	--
JAN						
27...	46	0.2	15	447	<0.01	0.35
APR						
16...	21	0.2	17	373	0.06	1.6
JUN						
15...	50	0.3	13	557	0.01	0.22

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	NITROGEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOSPHORUS, TOTAL (MG/L AS P) (00665)	PHOSPHORUS, DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT									
21...	0.04	--	1.5	0.13	--	--	66	550	100
JAN									
27...	0.18	0.17	1.4	0.07	0.02	0.04	37	16	99
APR									
16...	0.15	0.14	1.1	0.19	0.13	0.11	130	8810	100
JUN									
15...	0.09	0.07	0.80	0.33	0.12	0.09	136	98	99
SEP									
01...	0.03	<0.01	3.7	0.15	0.09	0.07	101	33	99

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											
21...	1100	20	4	60	<0.5	<1	<1	<3	4	8	<5
JAN											
27...	1120	<10	2	64	<0.5	2	<1	<3	2	10	<5
APR											
16...	1535	30	4	97	<0.5	<1	<1	<3	5	33	<5
SEP											
01...	1100	20	5	81	<0.5	<1	2	<3	4	21	<5

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										
21...	39	3	--	<10	2	<1	<1	260	<6	13
JAN										
27...	37	20	<0.1	260	<1	<1	<1	<6	<6	44
APR										
16...	31	9	0.5	<10	6	<1	<1	220	<6	20
SEP										
01...	34	15	0.5	<10	4	<1	<1	270	<6	6

RED RIVER OF THE NORTH BASIN

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

TEMPERATURE, WATER (DEG. C), WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	12.0	3.1	.5	.1	.1	.1	.3	15.6	20.0	20.8	25.5	17.5
2	11.7	3.1	.4	.2	.1	.2	.2	15.6	20.0	21.7	26.0	17.5
3	10.9	3.0	.4	.1	.1	.2	.3	15.5	20.1	22.0	25.7	17.8
4	10.2	2.7	.2	.1	.1	.2	.6	15.4	20.3	22.1	24.6	17.8
5	9.7	2.7	.2	.2	.1	.2	.7	15.5	20.8	22.6	23.9	18.0
6	9.3	2.4	.1	.2	.1	.2	1.2	15.6	21.6	23.4	23.0	17.5
7	9.1	2.3	.1	.1	.1	.2	2.3	15.6	21.8	24.1	22.6	17.3
8	9.0	2.0	.1	.1	.1	.2	3.4	15.8	22.1	24.0	23.0	16.8
9	8.2	2.0	.1	.1	.1	.2	4.4	16.0	21.6	24.0	22.9	17.0
10	7.5	1.7	.1	.1	.1	.2	5.5	16.2	20.8	24.1	23.1	16.8
11	6.6	1.6	.1	.1	.1	.2	6.5	16.4	20.7	23.4	22.5	16.0
12	5.4	1.5	.1	.1	.1	.2	7.6	16.1	21.0	22.6	22.0	15.4
13	5.3	1.3	.1	.1	.1	.2	8.3	15.6	21.7	21.5	21.0	15.1
14	4.9	1.0	.1	.2	.1	.2	10.0	15.2	22.1	20.4	20.6	15.4
15	4.8	.8	.1	.1	.1	.2	11.5	14.9	22.6	20.8	20.6	16.5
16	5.0	.8	.1	.1	.1	.2	12.5	14.7	23.0	21.3	20.7	17.2
17	5.9	.6	.1	.1	.1	.3	12.7	14.0	23.6	21.9	20.3	17.1
18	6.7	.6	.1	.1	.1	.3	13.0	14.0	24.4	21.4	20.3	16.2
19	8.5	.6	.1	.1	.1	.3	14.8	13.5	24.4	20.4	20.2	15.2
20	9.2	.5	.1	.1	.1	.3	14.8	13.5	24.5	21.3	20.4	14.8
21	8.8	.5	.1	.1	.1	.3	14.6	13.5	24.8	22.0	20.8	15.1
22	7.4	.5	.1	.1	.1	.3	14.0	13.7	25.6	21.8	19.8	15.6
23	7.0	.5	.1	.2	.1	.3	14.0	14.0	25.2	21.9	18.9	15.8
24	6.5	.5	.1	.2	.1	.3	14.4	14.6	24.8	22.1	18.9	15.2
25	6.2	.5	.1	.2	.1	.3	14.4	15.4	23.6	23.2	19.0	14.4
26	5.3	.5	.1	.2	.1	.3	14.6	15.6	22.4	23.7	18.9	14.0
27	5.4	.5	.1	.1	.1	.3	14.4	16.2	21.6	24.1	19.2	13.4
28	5.4	.5	.1	.1	.1	.3	14.8	17.2	21.6	24.4	19.2	12.9
29	4.7	.5	.1	.1	---	.3	15.0	18.2	20.9	25.0	19.0	12.8
30	3.5	.5	.1	.1	---	.3	15.5	18.6	20.8	25.0	18.7	12.4
31	3.4	---	.1	.1	---	.3	---	18.9	---	24.8	17.9	---
MEAN	7.21	1.31	.14	.13	.10	.25	9.21	15.5	22.3	22.6	21.3	15.8

SPECIFIC CONDUCTANCE MICROSIEMENS/CM AT 25 DEG C, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	576	755	893	739	651	583	441	715	699	791	491	712
2	586	762	853	700	642	586	456	719	712	780	552	680
3	612	794	806	706	610	584	480	717	727	750	597	705
4	508	805	775	704	625	586	474	727	744	757	629	710
5	493	792	760	686	621	617	469	735	746	838	635	698
6	519	773	753	680	620	597	460	744	749	849	642	720
7	555	743	761	671	645	630	489	761	767	849	653	744
8	575	713	792	676	635	637	527	753	754	832	655	725
9	598	707	816	675	633	625	539	763	763	824	665	707
10	607	721	787	678	622	600	524	775	806	818	660	712
11	611	725	768	681	624	565	507	760	808	787	665	720
12	639	724	754	686	626	510	502	768	809	802	704	715
13	659	717	770	680	626	455	505	790	807	786	755	698
14	656	695	756	671	613	425	511	804	816	756	771	712
15	677	686	768	672	617	372	527	796	833	777	816	712
16	677	736	757	676	603	376	549	801	829	753	861	704
17	668	810	733	682	595	398	576	808	793	722	864	717
18	671	825	712	690	587	463	608	803	771	722	836	718
19	673	823	720	687	592	500	633	815	773	739	807	724
20	673	785	760	677	594	499	646	820	768	704	800	726
21	669	750	761	675	574	529	672	817	764	695	795	715
22	678	762	764	682	573	549	710	815	780	678	767	726
23	681	726	759	682	587	550	691	831	783	672	765	734
24	695	704	750	675	584	565	705	840	784	681	761	748
25	692	738	736	671	582	520	690	837	784	704	754	755
26	687	735	750	695	588	495	691	815	790	654	745	759
27	709	740	723	669	590	470	680	740	790	489	733	763
28	725	730	721	661	589	457	692	690	789	465	712	751
29	763	791	713	664	---	430	699	721	789	420	687	747
30	760	861	702	652	---	425	701	731	788	422	686	739
31	756	---	726	647	---	427	---	723	---	451	712	---
MEAN	647	754	761	680	609	517	578	772	777	709	715	723

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.--41 years, 144 ft^3/s, 104,300 acre-ft/yr; median of yearly mean discharges, 114 ft^3/s, 82,600 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, and Sept. 9-11, 1980.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,080 ft^3/s, Mar. 24, gage height, 13.62 ft, from high water mark (backwater from ice); minimum daily, 0.02 ft^3/s, Sept. 8-11.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.8	2.4	e4.4	e3.8	e3.8	e5.0	154	40	238	e3.7	7.8	e.30
2	2.5	2.4	e4.4	e3.7	e3.8	e5.3	125	38	185	e3.8	5.2	e.20
3	2.5	e2.4	e4.4	e3.7	e3.8	e5.6	113	36	148	e3.9	4.3	e.15
4	2.2	2.5	e4.4	e3.7	e3.8	e6.0	120	34	121	e3.0	3.6	e.10
5	2.0	2.9	e4.4	e3.6	e3.8	e6.4	147	33	100	e2.5	3.3	e.07
6	2.1	3.0	e4.3	e3.6	e3.9	e6.8	153	31	84	e2.0	2.7	e.05
7	2.3	3.8	e4.3	e3.5	e3.9	e7.2	142	28	73	e1.9	2.2	e.03
8	2.1	6.3	e4.3	e3.5	e3.9	e7.6	131	26	62	e1.8	1.0	e.02
9	2.0	e6.0	e4.3	e3.5	e3.9	e8.0	138	23	52	e1.7	.70	e.02
10	1.8	e5.7	e4.3	e3.5	e4.0	e8.5	144	21	45	e1.6	e.70	e.02
11	1.7	e5.4	e4.2	e3.5	e4.0	e9.0	132	18	41	e1.5	e.65	.02
12	1.7	e5.2	e4.2	e3.5	e4.0	e10	121	16	38	e4.0	e.60	.03
13	1.7	e5.1	e4.2	e3.5	e4.0	e11	114	14	32	e5.0	e.55	.04
14	1.8	e5.0	e4.2	e3.5	e4.0	e12	105	13	31	e4.5	e.50	.06
15	1.8	e4.9	e4.2	e3.5	e4.0	e14	101	11	28	e4.0	e.60	.08
16	1.9	e4.9	e4.1	e3.5	e4.0	e17	94	12	24	e3.7	e.60	.09
17	2.0	e4.8	e4.1	e3.5	e4.0	e20	89	12	21	e3.4	e.55	.10
18	2.1	e4.8	e4.1	e3.5	e4.0	e25	86	12	17	e3.3	e.50	.15
19	2.4	e4.8	e4.1	e3.6	e4.0	e30	82	11	15	14	e.40	.19
20	2.6	e4.7	e4.1	e3.6	e4.1	e40	77	11	12	17	e.30	.24
21	2.8	e4.7	e4.0	e3.6	e4.1	e55	71	29	11	14	e.30	.28
22	3.6	e4.6	e4.0	e3.6	e4.2	e90	70	79	10	18	e.30	.32
23	2.6	e4.6	e4.0	e3.6	e4.3	e300	63	166	7.2	19	e.30	.36
24	2.3	e4.6	e4.0	e3.6	e4.4	e1050	59	245	6.0	15	e.30	.37
25	2.5	e4.5	e3.9	e3.6	e4.5	e800	58	264	6.0	16	e.30	.38
26	2.8	e4.5	e3.9	e3.7	e4.6	e650	56	270	5.4	16	e.30	.39
27	2.9	e4.5	e3.9	e3.7	e4.7	e500	51	304	5.2	16	e.30	.43
28	3.2	e4.5	e3.9	e3.7	e4.8	e400	47	343	4.3	13	e.30	.47
29	3.0	e4.5	e3.8	e3.7	---	e300	44	353	3.3	11	e.35	.46
30	2.8	e4.5	e3.8	e3.7	---	250	42	336	e3.3	8.3	e.40	.42
31	2.6	---	e3.8	e3.7	---	e200	---	295	---	7.8	e.35	---
TOTAL	72.1	132.5	128.0	111.5	114.3	4849.4	2929	3124	1428.7	240.4	40.25	5.84
MEAN	2.33	4.42	4.13	3.60	4.08	156	97.6	101	47.6	7.75	1.30	.19
MAX	3.6	6.3	4.4	3.8	4.8	1050	154	353	238	19	7.8	.47
MIN	1.7	2.4	3.8	3.5	3.8	5.0	42	11	3.3	1.5	.30	.02
AC-FT	143	263	254	221	227	9620	5810	6200	2830	477	80	12
CFSM	.00	.01	.01	.01	.01	.27	.17	.18	.08	.01	.00	.00
IN.	.00	.01	.01	.01	.01	.31	.19	.20	.09	.02	.00	.00

CAL YR 1986 TOTAL 59968.68 MEAN 164 MAX 3300 MIN .04 AC-FT 118900 CFSM .29 IN. 3.89
WTR YR 1987 TOTAL 13175.99 MEAN 36.1 MAX 1050 MIN .02 AC-FT 26130 CFSM .06 IN. .86

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, 1,031.91 ft, Apr. 3, but may have been higher during period of no gage-height record Mar. 28 to Apr. 3; minimum observed, 1,020.77 ft, Sept 9, but may have been lower during period of no gage-height record Sept. 3-8, 10-30.

GAGE HEIGHT, IN FEET, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	23.53	25.99	---	---	---
2	---	---	---	---	---	---	---	23.34	25.54	---	---	20.81
3	---	---	---	---	---	---	---	23.15	24.93	---	---	---
4	---	---	---	---	---	---	29.44	22.97	24.24	---	---	---
5	---	---	---	---	---	---	29.63	22.86	23.67	---	---	---
6	---	---	---	---	---	---	29.69	22.74	23.24	---	---	---
7	21.88	---	---	---	---	---	29.67	22.66	22.97	---	---	---
8	---	---	---	---	---	---	29.64	22.54	22.71	---	---	---
9	---	---	---	---	---	---	29.60	22.42	22.47	---	---	20.77
10	---	---	---	---	---	---	29.57	22.32	22.29	---	---	---
11	---	---	---	---	---	---	29.50	22.27	22.45	---	---	---
12	---	---	---	---	---	---	29.41	22.25	22.57	---	---	---
13	---	---	---	---	---	---	29.31	22.25	22.47	---	---	---
14	---	---	---	---	---	---	29.19	22.24	22.23	---	---	---
15	---	---	---	---	---	---	29.01	22.24	---	---	---	---
16	---	---	---	---	---	---	28.83	---	---	---	---	---
17	---	---	---	---	---	---	28.62	---	---	---	---	---
18	---	21.81	---	---	---	---	28.41	---	21.69	---	---	---
19	---	---	---	---	---	---	28.17	---	---	---	---	---
20	---	---	---	---	---	---	27.89	---	---	22.40	---	---
21	---	---	---	---	---	---	27.64	22.75	---	22.65	---	---
22	---	---	---	---	---	---	27.32	24.86	---	22.50	---	---
23	---	---	---	---	---	---	26.99	25.79	---	22.43	---	---
24	---	---	---	---	---	---	26.63	25.96	---	22.33	---	---
25	---	---	---	---	---	30.62	26.25	26.02	21.39	---	---	---
26	---	---	---	---	---	30.66	25.95	26.17	---	---	---	---
27	---	---	---	---	---	31.00	25.62	26.41	---	---	---	---
28	---	---	---	---	---	---	25.09	26.52	---	---	---	---
29	---	---	---	---	---	---	24.39	26.52	---	21.45	---	---
30	---	---	---	---	---	---	23.82	26.43	---	---	---	---
31	---	---	---	---	---	---	---	26.27	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---
MAX	---	---	---	---	---	---	---	---	---	---	---	---
MIN	---	---	---	---	---	---	---	---	---	---	---	---

NOTE: Add 1,000 ft to obtain elevations in adjustment of 1928. Gage height below intake elevation of 1,022.23 ft (gage height, 22.23 ft) Oct. 1 to Nov. 18, May 16-20, June 15 to July 19, and July 25 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 Nov. 2-4 and Nov. 9 to Apr. 3, which are poor. High flow affected by natural storage in Roseau Lake.

AVERAGE DISCHARGE.--59 years, 266 ft^3/s, 192,700 acre-ft/yr; median of yearly mean discharges, 239 ft^3/s, 173,200 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, 1,290 ft^3/s, Apr. 4, gage height, 10.47 ft; minimum, 3.2 ft^3/s, Sept. 9, 10, gage height, 1.03 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25	23	e24	e17	e13	e16	e1200	227	506	12	30	4.9
2	26	e23	e24	e17	e12	e17	e1250	206	452	12	25	4.1
3	28	e22	e24	e17	e12	e17	e1250	186	386	11	22	4.1
4	35	e22	e24	e17	e12	e18	1270	169	316	9.5	19	3.9
5	45	22	e23	e16	e12	e18	1270	155	259	7.4	16	4.0
6	43	23	e23	e16	e12	e19	1280	143	217	6.4	13	3.4
7	38	25	e23	e16	e12	e20	1270	133	189	6.0	12	3.5
8	35	28	e23	e16	e12	e21	1240	122	165	5.4	9.9	3.3
9	34	e30	e23	e16	e12	e22	1210	110	140	5.0	7.2	3.2
10	32	e30	e22	e16	e12	e23	1190	98	119	4.6	7.5	3.4
11	33	e30	e22	e15	e12	e24	1170	92	131	4.6	7.3	3.6
12	34	e29	e22	e15	e12	e25	1150	86	154	7.1	7.0	3.9
13	33	e29	e22	e15	e12	e26	1130	78	148	16	6.0	3.7
14	30	e29	e22	e15	e12	e27	1100	67	123	21	5.3	3.8
15	28	e28	e21	e15	e12	e28	1060	60	100	22	5.5	3.7
16	26	e28	e21	e15	e12	e30	1010	62	83	21	6.2	3.8
17	26	e28	e21	e14	e12	e32	973	67	74	19	6.4	3.7
18	31	e28	e21	e14	e12	e35	929	69	68	18	5.9	3.7
19	31	e27	e21	e14	e13	e40	883	64	50	44	5.3	3.5
20	30	e27	e20	e14	e13	e50	825	62	39	129	4.9	3.4
21	33	e27	e20	e14	e13	e90	777	130	39	162	5.2	3.5
22	30	e27	e20	e14	e14	e200	718	349	77	150	5.2	3.8
23	27	e26	e19	e14	e14	e400	658	467	70	140	5.3	3.9
24	26	e26	e19	e14	e14	e650	595	494	50	132	5.1	3.9
25	25	e26	e19	e14	e14	e800	538	505	41	111	4.6	3.8
26	23	e25	e19	e13	e15	e900	493	527	39	88	4.4	3.8
27	22	e25	e18	e13	e15	e950	451	561	35	71	4.2	4.4
28	22	e25	e18	e13	e16	e1000	392	579	27	57	4.2	4.3
29	23	e25	e18	e13	---	e1050	319	577	21	48	4.3	4.1
30	23	e24	e18	e13	---	e1100	260	568	15	42	4.9	4.4
31	24	---	e18	e13	---	e1150	---	545	---	39	5.9	---
TOTAL	921	787	652	458	358	8798	27861	7558	4133	1421.0	274.7	114.5
MEAN	29.7	26.2	21.0	14.8	12.8	284	929	244	138	45.8	8.86	3.82
MAX	45	30	24	17	16	1150	1280	579	506	162	30	4.9
MIN	22	22	18	13	12	16	260	60	15	4.6	4.2	3.2
AC-FT	1830	1560	1290	908	710	17450	55260	14990	8200	2820	545	227
CFSM	.02	.02	.02	.01	.01	.23	.76	.20	.11	.04	.01	.00
IN.	.03	.02	.02	.01	.01	.27	.85	.23	.13	.04	.01	.00

CAL YR 1986 TOTAL 151401.5 MEAN 415 MAX 2790 MIN 8.5 AC-FT 300300 CFSM .34 IN. 4.62
WTR YR 1987 TOTAL 53336.2 MEAN 146 MAX 1280 MIN 3.2 AC-FT 105800 CFSM .12 IN. 1.63

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.--30 years (water years 1921-30, 1933, 1937, 1941-43, 1973-87), 294 ft^3/s, 213,000 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.

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, 1,630 ft^3/s, part or all of each day April 12-14, gage height, 7.82 ft; maximum gage height, 9.59 ft, Apr. 6 (backwater from ice); minimum discharge, 1.1 ft^3/s, Sept. 13; minimum gage height, 1.20 ft, Sept. 10.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	42	e45	e32	e25	e18	e20	e940	491	653	43	44	3.8
2	41	e70	e32	e25	e18	e21	e1000	420	609	39	40	3.5
3	44	94	e32	e24	e17	e21	e1100	357	560	36	36	3.2
4	42	e65	e32	e24	e17	e22	e1200	316	501	33	32	2.9
5	42	e50	e31	e24	e17	e23	e1300	284	453	30	28	2.7
6	46	e30	e31	e24	e17	e24	e1400	258	375	28	25	2.5
7	59	e20	e31	e24	e17	e25	e1500	234	309	26	22	2.3
8	58	17	e31	e24	e17	e26	1560	213	261	25	20	2.1
9	52	19	e30	e23	e17	e27	1590	201	225	23	18	1.9
10	47	43	e30	e23	e17	e28	1600	207	191	21	16	1.7
11	56	41	e30	e23	e17	e29	1610	211	174	19	14	1.5
12	64	e40	e30	e23	e17	e30	1620	210	172	18	13	1.3
13	64	e39	e29	e23	e17	e32	1630	198	171	17	12	1.2
14	62	e39	e29	e22	e17	e33	1630	164	167	17	10	1.4
15	59	e38	e29	e22	e17	e35	1620	106	155	16	9.5	1.4
16	56	e37	e29	e22	e17	e37	1610	81	129	17	9.0	1.3
17	52	e37	e28	e22	e17	e39	1590	73	109	17	8.4	1.4
18	48	e36	e28	e21	e17	e41	1570	68	97	17	7.9	1.6
19	46	e36	e28	e21	e17	e43	1540	66	89	18	7.5	2.0
20	46	e36	e28	e21	e17	e46	1510	65	81	19	7.1	2.5
21	46	e35	e27	e20	e17	e50	1480	67	75	31	6.9	3.0
22	47	e35	e27	e20	e17	e66	1450	108	69	80	6.7	3.2
23	50	e35	e27	e20	e17	e100	1410	231	66	111	6.3	3.2
24	50	e35	e27	e20	e18	e200	1350	431	66	111	6.0	3.1
25	42	e34	e26	e19	e18	e340	1290	549	66	105	5.8	2.7
26	e40	e34	e26	e19	e19	e500	1200	588	63	96	5.4	2.5
27	e39	e34	e26	e19	e19	e580	1080	635	60	83	5.1	2.3
28	e38	e33	e26	e19	e19	e650	945	677	56	71	4.8	2.3
29	e37	e33	e25	e19	---	e720	780	693	51	62	4.5	2.3
30	e36	e33	e25	e18	---	e780	614	693	46	53	4.3	2.4
31	e36	---	e25	e18	---	e850	---	677	---	48	4.1	---
TOTAL	1487	1173	887	671	486	5438	40719	9572	6099	1330	439.3	69.2
MEAN	48.0	39.1	28.6	21.6	17.4	175	1357	309	203	42.9	14.2	2.31
MAX	64	94	32	25	19	850	1630	693	653	111	44	3.8
MIN	36	17	25	18	17	20	614	65	46	16	4.1	1.2
AC-FT	2950	2330	1760	1330	964	10790	80770	18990	12100	2640	871	137
CFSM	.03	.02	.02	.01	.01	.11	.86	.20	.13	.03	.01	.00
IN.	.04	.03	.02	.02	.01	.13	.96	.23	.14	.03	.01	.00

CAL YR 1986 TOTAL 167999.2 MEAN 460 MAX 2360 MIN 8.1 AC-FT 333200 CFSM .29 IN. 3.98
WTR YR 1987 TOTAL 68370.5 MEAN 187 MAX 1630 MIN 1.2 AC-FT 135600 CFSM .12 IN. 1.62
e Estimated

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 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 AIR (DEG C) (00020)	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												
07...	1015	58	430	434	8.3	8.0	13.0	10.0	4.0	725	10.4	50
JAN												
06...	1100	24	540	531	7.4	8.3	-4.0	0.0	6.3	733	2.5	K4
MAY												
05...	1000	275	380	441	7.7	8.0	15.0	13.0	7.2	740	10.2	--
JUL												
28...	0930	73	360	392	8.2	8.0	24.0	25.0	24	736	6.0	73

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 WATER DISSOLV FLD. AS CACO3 (MG/L) (39086)	CAR-BONATE WATER DISSOLV FIELD AS CO3 (MG/L) (00452)	BICAR-BONATE WATER DISSOLV FIELD AS HCO3 (MG/L) (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											
07...	170	57	25	8.1	2.6	216	0	264	33	3.6	0.1
JAN											
06...	K10	70	28	9.5	1.9	282	0	344	18	3.5	0.1
MAY											
05...	--	54	22	5.3	2.8	181	0	221	39	2.7	0.1
JUL											
28...	K36	51	22	7.0	2.2	185	0	226	25	4.3	0.2

RED RIVER OF THE NORTH BASIN

05112000 ROSEAU RIVER BELOW STATE DITCH 51 NR CARIBOU, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	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)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
07...	12	307	<0.10	<0.01	1.3	<0.20	<0.20	<0.01	27	4.2	86
JAN											
06...	21	336	0.10	0.16	0.70	0.03	0.02	0.02	68	4.3	90
MAY											
05...	7.0	271	<0.10	0.05	1.1	0.05	0.03	0.01	26	19	99
JUL											
28...	12	268	0.16	0.05	1.6	0.08	0.01	0.01	39	7.6	100

DATE	TIME	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)
OCT											
07...	1015	30	2	49	<0.5	1	<1	<3	4	44	<5
JAN											
06...	1100	<10	1	51	<0.5	1	<1	<3	1	120	<5
MAY											
05...	1000	<10	1	42	<0.5	<1	<1	<3	<1	75	<5
JUL											
28...	0930	40	2	49	<0.5	<1	<1	<3	3	27	<5

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
OCT										
07...	19	17	1.4	<10	<1	<1	<1	130	<6	6
JAN										
06...	16	140	0.3	<10	2	<1	<1	150	<6	14
MAY										
05...	17	25	<0.1	<10	<1	<1	<1	120	<6	32
JUL										
28...	16	7	2.5	<10	1	<1	<1	110	<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.--Records good except those for Nov. 10 - 21, 30, Dec. 1, 4-16, 18-28, 30, Jan. 2, 3, 8-12, 15-31, Feb. 1-3, 15, which are fair.

AVERAGE DISCHARGE.--21 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, 573 ft^3/s, Aug. 15, 16, gage height, 4.66 ft; minimum, 47 ft^3/s, part or all of each day Mar. 16-23, gage height, 2.92 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1984 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	129	78	e120	116	e75	54	53	88	381	128	261	345
2	125	76	123	e115	e75	55	54	90	389	125	287	329
3	122	76	127	e110	e75	53	53	91	374	124	309	318
4	116	76	e130	108	72	51	52	91	355	118	333	310
5	114	75	e130	108	70	51	52	91	344	113	357	299
6	111	77	e130	105	68	51	53	91	343	114	376	296
7	111	79	e130	105	67	53	55	88	345	110	390	286
8	112	84	e130	e105	65	54	57	86	334	104	408	280
9	106	88	e130	e100	66	52	59	86	322	99	431	272
10	103	e90	e130	e100	63	54	59	85	314	95	454	265
11	103	e95	e135	e95	63	51	61	83	316	94	475	263
12	103	e95	e135	e95	62	51	62	80	310	100	510	259
13	99	e95	e135	91	62	50	64	79	299	105	536	251
14	99	e100	e135	91	60	49	65	80	288	104	552	245
15	99	e100	e135	e90	e60	48	65	79	273	102	566	239
16	99	e100	e135	e90	59	48	67	80	260	103	572	234
17	98	e100	138	e90	58	47	69	103	248	102	567	227
18	94	e100	e135	e90	58	48	70	129	235	107	554	218
19	94	e100	e130	e85	57	48	72	137	225	117	552	218
20	93	e105	e130	e85	56	47	74	146	212	119	539	231
21	93	e105	e130	e85	54	47	75	168	201	120	526	231
22	91	105	e130	e85	54	47	75	244	191	118	509	224
23	91	106	e125	e85	55	48	76	297	183	153	487	220
24	88	106	e125	e80	55	50	77	351	175	196	462	213
25	86	112	e125	e80	56	53	80	387	166	221	443	206
26	85	115	e125	e80	54	54	82	411	161	243	432	203
27	83	116	e120	e80	53	56	87	420	154	255	416	201
28	83	117	e120	e80	53	56	88	423	146	255	402	197
29	83	118	116	e80	---	55	89	410	140	248	386	193
30	81	e120	e116	e75	---	52	88	399	133	238	380	190
31	80	---	116	e75	---	51	---	387	---	226	364	---
TOTAL	3074	2909	3971	2859	1725	1584	2033	5780	7817	4456	13836	7463
MEAN	99.2	97.0	128	92.2	61.6	51.1	67.8	186	261	144	446	249
MAX	129	120	138	116	75	56	89	423	389	255	572	345
MIN	80	75	116	75	53	47	52	79	133	94	261	190
AC-FT	6100	5770	7880	5670	3420	3140	4030	11460	15510	8840	27440	14800
CFSM	.39	.38	.51	.36	.24	.20	.27	.74	1.03	.57	1.76	.98
IN.	.45	.43	.58	.42	.25	.23	.30	.85	1.15	.66	2.03	1.10

CAL YR 1986 TOTAL 72214 MEAN 198 MAX 876 MIN 52 AC-FT 143200 CFSM .78 IN. 10.62
WTR YR 1987 TOTAL 57507 MEAN 158 MAX 572 MIN 47 AC-FT 114100 CFSM .62 IN. 8.46

e Estimated

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.

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 AIR (DEG C) (00020)	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												
29...	1145	84	24	31	7.0	7.2	1.5	7.0	0.90	735	10.4	K1
FEB												
04...	1200	75	27	36	6.7	6.8	-10.0	0.0	0.50	731	11.2	K1
JUN												
11...	1100	308	28	34	7.2	7.7	15.0	17.5	1.3	715	7.6	K2
SEP												
02...	1130	336	25	34	6.5	7.0	15.0	18.0	0.80	734	8.7	K5

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 WATER DISSOLV FLD. AS CACO3 (MG/L) (39086)	CAR-BONATE WATER DISSOLV FIELD AS CO3 (MG/L) (00452)	BICAR-BONATE WATER DISSOLV FIELD AS HCO3 (MG/L) (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											
29...	62	3.0	1.4	1.0	0.4	10	0	12	1.2	0.6	<0.1
FEB											
04...	K2	3.4	1.6	1.1	0.3	10	0	12	12	0.7	<0.1
JUN											
11...	32	2.9	1.4	1.0	0.4	11	0	13	12	0.6	0.1
SEP											
02...	>200	3.2	1.6	1.1	0.3	--	--	--	2.6	0.4	0.1

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	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)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
29...	3.4	40	<0.10	0.01	0.30	0.02	0.02	<0.01	2	0.45	100
FEB											
04...	4.2	33	0.10	0.02	0.90	<0.01	0.01	<0.01	2	0.41	70
JUN											
11...	3.1	40	<0.10	0.02	0.90	0.03	<0.01	<0.01	1	0.83	100
SEP											
02...	3.6	41	<0.10	0.02	<0.20	<0.01	<0.01	<0.01	4	3.6	96

05124480 KAWISHIWI RIVER NEAR ELY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)
OCT											
29...	1145	40	<1	11	<0.5	1	<1	<3	2	180	<5
FEB											
04...	1200	40	<1	8	<0.5	<1	<1	<3	2	180	<5
JUN											
11...	1100	20	<1	8	<0.5	<1	<1	<3	4	150	<5
SEP											
02...	1130	30	<1	8	<0.5	<1	<1	<3	2	190	<5

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
OCT										
29...	<4	5	<0.1	<10	1	3	<1	12	<6	6
FEB										
04...	<4	4	<0.1	<10	<1	<1	<1	12	<6	11
JUN										
11...	<4	4	0.2	<10	<1	<1	<1	12	<6	14
SEP										
02...	<4	3	0.1	<10	<1	1	<1	13	<6	7

RADIOCHEMICAL ANALYSES, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)	RADIUM 226, DIS-SOLVED, RADON METHOD (PCI/L) (09511)
OCT								
29...	1145	<0.4	<0.4	1.2	<0.4	1.1	<0.4	0.04
JUN								
11...	1100	<0.4	0.7	1.1	0.6	1.0	0.6	0.02

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 poor. 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).--68 years (water years 1906, 1916-17, 1919, 1924-87), 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, 4,820 ft^3/s, May 28; minimum daily, 97 ft^3/s, Feb. 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1180	882	962	547	398	398	825	358	4050	411	2130	785
2	1100	882	962	547	398	366	815	326	3740	443	1870	817
3	1100	784	962	515	430	333	763	326	3830	411	1750	629
4	1100	815	994	548	398	398	691	326	3400	443	1300	826
5	987	880	962	548	398	366	723	326	2830	443	1180	794
6	1030	760	962	516	398	366	694	294	2310	411	1030	762
7	962	710	930	719	398	366	679	253	1610	443	1030	697
8	994	429	877	516	366	398	712	399	1270	346	1060	729
9	962	495	882	516	366	333	712	303	1220	443	1030	729
10	962	777	882	516	398	366	624	271	1220	362	1060	762
11	930	796	882	549	398	398	470	271	1360	431	1030	816
12	865	731	785	516	398	398	357	287	1370	431	1060	880
13	962	819	882	661	398	398	414	408	1230	363	1060	880
14	930	905	819	603	97	398	381	182	1160	443	1060	828
15	962	1030	852	634	161	398	381	279	1250	443	1030	727
16	865	1030	791	667	412	437	414	376	1060	443	1120	760
17	897	1030	729	633	334	388	381	440	964	443	1230	663
18	928	1060	697	632	334	420	447	608	1040	475	1480	727
19	903	1120	728	533	399	575	415	578	964	475	1420	857
20	884	1090	695	513	367	760	447	762	867	502	1350	953
21	852	1060	760	481	335	823	382	1120	781	621	1340	889
22	884	1130	666	481	399	790	350	1740	695	830	1370	824
23	884	1100	619	482	367	882	274	2460	762	1800	1340	857
24	916	1130	651	482	367	834	326	3420	562	2480	1190	792
25	884	1070	716	482	399	891	326	4000	580	2460	990	760
26	884	969	684	469	367	924	326	4240	483	2330	992	792
27	884	996	546	442	334	859	294	4100	548	2230	1060	792
28	884	956	578	416	367	859	326	4820	515	2230	1030	792
29	852	961	514	398	---	956	261	4770	483	2190	964	727
30	884	930	579	430	---	857	326	4460	458	2260	963	698
31	851	---	611	398	---	922	---	4060	---	2050	929	---
TOTAL	29162	27327	24159	16390	10181	17857	14536	46563	42612	30086	37448	23544
MEAN	941	911	779	529	364	576	485	1502	1420	971	1208	785
MAX	1180	1130	994	719	430	956	825	4820	4050	2480	2130	953
MIN	851	429	514	398	97	333	261	182	458	346	929	629
§	-61	+33	-157	-126	-86	-173	228	357	-81	46	-9	-38
MEAN ¥	880	944	622	403	278	403	713	1859	1339	1017	1199	747
CFSM ¥	.72	.77	.51	.33	.23	.33	.58	1.51	1.09	.83	.98	.61
IN ¥	.83	.86	.58	.38	.24	.38	.65	1.74	1.22	.95	1.13	.68

CAL YR 1986 TOTAL 412620 MEAN 1130 MAX 4820 MIN 180 MEAN ¥ 1133 CFSM ¥ .92 IN ¥ 12.52
WTR YR 1987 TOTAL 319865 MEAN 876 MAX 4820 MIN 97 MEAN ¥ 871 CFSM ¥ .71 IN ¥ 9.62

§ 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.--59 years (water years 1926, 1927, 1931-87), 1,400 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, 3,420 ft^3/s, Aug. 6, gage height, 5.15 ft; minimum, 441 ft^3/s, May 14, 15, 16, gage height, 2.77 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1590	1080	1190	925	702	539	826	618	2920	1060	2650	2020
2	1570	1070	1190	906	694	548	844	605	3110	1060	3040	1950
3	1540	1070	1190	886	694	546	860	590	3180	1030	3190	1890
4	1510	1070	1190	866	694	548	875	572	3240	991	3300	1830
5	1460	1070	1190	849	689	544	886	559	3250	952	3380	1790
6	1440	1080	1180	828	673	548	896	539	3240	912	3390	1770
7	1430	1090	1180	813	662	545	906	527	3170	881	3380	1730
8	1410	1100	1170	802	651	544	918	517	3060	846	3360	1690
9	1380	1070	1160	789	647	539	923	501	2930	823	3320	1650
10	1360	1060	1160	778	637	536	928	499	2800	788	3280	1610
11	1340	1030	1160	768	632	534	928	479	2690	786	3190	1600
12	1320	1000	1160	756	619	528	923	473	2560	778	3230	1570
13	1300	990	1140	749	617	528	908	468	2460	752	3160	1550
14	1310	990	1140	738	617	528	892	450	2340	733	3070	1520
15	1290	990	1130	738	604	528	877	449	2250	731	3070	1490
16	1280	1000	1130	746	588	524	864	454	2170	721	3060	1470
17	1270	1000	1120	756	572	520	843	497	2080	718	2950	1430
18	1250	1010	1110	762	558	519	827	526	1980	788	2900	1400
19	1240	1020	1100	777	549	512	812	524	1890	816	2840	1400
20	1230	1040	1090	784	544	513	788	529	1800	821	2800	1410
21	1220	1060	1080	786	537	522	772	584	1710	815	2760	1380
22	1210	1080	1080	784	536	538	757	675	1640	823	2710	1360
23	1210	1110	1070	779	536	563	736	732	1580	1080	2640	1330
24	1200	1130	1060	769	536	598	725	853	1510	1290	2570	1300
25	1180	1160	1040	756	536	634	715	1030	1430	1460	2500	1280
26	1170	1170	1030	747	535	666	699	1270	1350	1620	2450	1260
27	1150	1180	1020	737	528	698	672	1530	1290	1760	2370	1230
28	1140	1190	1010	729	527	722	667	1850	1230	1870	2290	1210
29	1130	1190	980	722	---	746	639	2170	1170	1960	2200	1190
30	1130	1200	970	720	---	767	629	2470	1100	2050	2170	1170
31	1110	---	950	720	---	790	---	2720	---	2150	2080	---
TOTAL	40370	32300	34370	24265	16914	17915	24535	26260	67130	33865	89300	45480
MEAN	1302	1077	1109	783	604	578	818	847	2238	1092	2881	1516
MAX	1590	1200	1190	925	702	790	928	2720	3250	2150	3390	2020
MIN	1110	990	950	720	527	512	629	449	1100	718	2080	1170
AC-FT	80070	64070	68170	43130	33550	35530	48670	52090	133200	67170	177100	90210
CFSM	.75	.62	.64	.45	.35	.33	.47	.49	1.29	.63	1.66	.87
IN.	.86	.69	.73	.52	.36	.38	.52	.56	1.44	.72	1.91	.97

CAL YR 1986 TOTAL 555504 MEAN 1522 MAX 5070 MIN 577 AC-FT 1102000 CFSM .87 IN. 11.88
WTR YR 1987 TOTAL 452704 MEAN 1240 MAX 3390 MIN 449 AC-FT 897900 CFSM .71 IN. 9.68

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.--65 years (water years 1923-87), 3,834 ft^3/s, 10.07 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, 10,100 ft^3/s, Aug. 21, elevation, 1,187.31 ft; minimum, 1,440 ft^3/s, Mar. 22, elevation, 1,182.65 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2940	2530	2320	2220	1850	1600	1560	1830	2270	2960	2600	9170
2	2980	2520	2330	2210	1840	1600	1580	1830	2350	2920	2870	8970
3	3040	2520	2340	2210	1850	1590	1580	1820	2350	2900	3200	8760
4	3040	2500	2360	2190	1840	1590	1590	1780	2490	2850	3600	8540
5	2990	2480	2360	2190	1830	1580	1600	1770	2620	2790	4050	8420
6	3030	2470	e2360	2170	1820	1570	1620	1730	2760	2710	4510	8340
7	3040	2490	2360	2150	1810	1570	1630	1720	2870	2660	5020	8180
8	3030	2500	2360	2130	1790	1550	1650	1690	2990	2610	5590	8080
9	3010	2440	2360	2120	1780	1550	1660	1690	3110	2560	6110	7880
10	3010	2440	2350	2090	1770	1550	1670	1700	3260	2490	6610	7750
11	2990	2440	2360	2080	1760	1540	1690	1630	3390	2490	7020	7650
12	2980	2410	2360	2070	1750	1530	1710	1640	3470	2420	7500	7510
13	2960	2410	2320	2060	1740	1530	1730	1600	3580	2360	7900	7350
14	2960	2400	2300	2040	1730	1510	1750	1570	3580	2320	8270	7240
15	2940	2390	2350	2030	1720	1500	1770	1580	3620	2310	8540	7110
16	2950	2380	2350	1990	1710	1490	1780	1590	3640	2260	8890	6990
17	2940	2370	2350	1980	1700	1470	1790	1630	3620	2220	9120	6830
18	2920	2350	2340	1970	1690	1460	1830	1660	3590	2260	9420	6700
19	2910	2350	2340	1950	1680	1450	1860	1630	3590	2230	9660	6590
20	2880	2360	2330	1940	1670	1450	1820	1630	3590	2210	9840	6530
21	2860	e2350	2320	1930	1660	1450	1860	1740	3550	2170	9980	6440
22	2840	2340	2320	1920	1660	1440	1870	1860	3510	2150	10000	6320
23	2830	2360	2310	e1910	1660	1450	1860	1910	3430	2260	10000	6210
24	2800	2360	2300	e1900	1650	1480	1870	1950	3370	2290	10000	6080
25	2770	2360	2280	e1890	1650	1490	1890	1990	3270	2270	10000	5940
26	2750	2360	2280	e1880	1640	1490	1850	2020	3200	2270	9960	5850
27	2710	2360	2270	e1860	1620	1510	1830	2060	3180	2270	9900	5720
28	2670	2350	2260	1850	1610	1520	1840	2090	3130	2260	9790	5600
29	2660	e2340	2250	1840	---	1530	1830	2120	3060	2260	9640	5440
30	2650	2320	2340	1850	---	1540	1830	2160	3000	2280	9480	5300
31	2570	---	2230	1850	---	1550	---	2200	---	2360	9290	---
TOTAL	89650	72250	72060	62470	48480	47130	52400	55820	95440	75370	238360	213490
MEAN	2892	2408	2325	2015	1731	1520	1747	1801	3181	2431	7689	7116
MAX	3040	2530	2360	2220	1850	1600	1890	2200	3640	2960	10000	9170
MIN	2570	2320	2230	1840	1610	1440	1560	1570	2270	2150	2600	5300
AC-FT	177800	143300	142900	123900	96160	93480	103900	110700	189300	149500	472800	423500
CFSM	.56	.47	.45	.39	.33	.29	.34	.35	.62	.47	1.49	1.38
IN.	.65	.52	.52	.45	.35	.34	.38	.40	.69	.54	1.72	1.54

CAL YR 1986 TOTAL 1520420 MEAN 4166 MAX 12800 MIN 1970 AC-FT 3016000 CFSM .81 IN. 10.94
WTR YR 1987 TOTAL 1122920 MEAN 3076 MAX 10000 MIN 1440 AC-FT 2227000 CFSM .60 IN. 8.08

e Estimated

LAKE OF THE WOODS BASIN

05128200 VERMILION LAKE NEAR SOUDAN, MN

LOCATION.--Lat 47°49'52", long 92°16'20", in SW¼SE¼ sec.20, T.62 N., R.15 W., St. Louis County, Hydrologic Unit 09030002, on south shore of Vermilion Lake, 2 mi northwest of Soudan.

PERIOD OF RECORD.--October 1913 to July 1915, July 1941 to November 1942, June 1946 to September 1987 (fragmentary during 1947), (discontinued).

GAGE.--Water-stage recorder. Datum of gage is 1,355.10 ft National Geodetic Vertical Datum of 1929. October 1913 to July 1915, nonrecording gage at Tower, 2 mi southwest of present gage, at datum about 1,354.60 ft. July 1941 to November 1942, and June 1946 to June 1951, nonrecording gage approximately 13 mi northwest at Vermilion Dam near Tower, at same datum. All gage readings have been reduced to elevations above National Geodetic Vertical Datum of 1929.

EXTREMES FOR PERIOD OF RECORD.--Maximum elevation observed, 1,359.52 ft May 16, 1950; minimum observed, 1356.02 ft, Jan. 29, 1942; minimum 1,355.96 ft, Dec. 14, 1976, result of wind action.

EXTREMES OUTSIDE PERIOD OF RECORD.--Elevation on June 6, 1913 was 1,359.94 ft, determined from reference point set by local observers.

EXTREMES FOR CURRENT YEAR.--Maximum elevation, 1,358.12 ft, June 3, result of wind action; maximum daily, 1,358.02 ft, June 3; minimum, 1,357.04 ft, May 16, result of wind action; minimum daily, 1,357.07, Mar. 21, 22.

MONTHEND ELEVATION, IN FEET NGVD, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

Oct. 31	1,357.54	Feb. 28	1,357.12	June 30	1,357.41
Nov. 30	1,357.48	Mar. 31	1,357.32	July 31	1,357.48
Dec. 31	1,357.31	Apr. 30	1,357.37	Aug. 31	1,357.25
Jan. 31	1,357.20	May 31	1,357.91	Sept. 30	1,357.17

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

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 fair.

AVERAGE DISCHARGE.--8 years, 639 ft^3/s, 463,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,360 ft^3/s, Apr. 25, 1965, 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, 1,600 ft^3/s, May 24, gage height, 10.29 ft; minimum, 216 ft^3/s, Feb. 27, gage height, 5.39 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	646	519	e500	368	249	218	748	439	1060	330	e650	281
2	669	494	e494	364	252	221	699	430	1160	345	e700	278
3	789	488	e488	359	256	219	666	422	1230	335	e680	274
4	828	480	e482	350	255	218	646	411	1270	323	e650	276
5	839	480	e476	345	257	219	645	398	1220	313	e620	283
6	824	481	e470	340	257	226	655	370	1150	306	e600	322
7	819	480	e464	324	257	261	673	345	1120	299	e580	354
8	815	584	e458	326	253	295	690	333	1040	292	e560	380
9	804	686	453	323	247	307	706	318	979	275	e540	400
10	787	669	444	316	246	309	709	302	932	266	e520	412
11	775	671	438	310	247	297	706	292	919	271	491	457
12	749	650	448	304	244	288	705	279	893	277	493	480
13	732	617	453	299	240	276	691	282	850	260	468	486
14	726	598	457	294	237	264	673	269	809	251	440	480
15	737	579	457	291	230	259	664	250	762	255	427	464
16	743	565	452	279	226	256	662	249	724	263	425	444
17	737	550	443	272	226	254	647	294	693	276	404	421
18	723	531	435	271	226	257	634	380	661	298	386	398
19	710	522	429	271	226	271	635	478	622	349	382	392
20	689	523	421	271	226	290	637	538	593	393	374	408
21	666	523	413	270	226	335	606	682	564	408	382	425
22	645	524	409	269	224	392	589	1290	537	422	376	436
23	623	526	407	260	224	509	574	1550	511	583	354	427
24	615	526	406	250	221	835	551	1580	478	814	339	410
25	610	526	406	242	219	1080	543	1510	450	837	324	394
26	598	526	399	243	219	1160	536	1410	427	829	318	374
27	586	526	391	246	219	1160	502	1320	405	812	309	364
28	572	518	388	250	218	1080	489	1230	382	758	298	352
29	550	512	386	249	---	981	467	1160	362	700	293	331
30	534	e506	381	249	---	889	448	1120	343	656	309	307
31	547	---	375	249	---	803	---	1080	---	e620	293	---
TOTAL	21687	16380	13523	9054	6627	14429	18796	21011	23146	13416	13985	11510
MEAN	700	546	436	292	237	465	627	678	772	433	451	384
MAX	839	686	500	368	257	1160	748	1580	1270	837	700	486
MIN	534	480	375	242	218	218	448	249	343	251	293	274
AC-FT	43020	32490	26820	17960	13140	28620	37280	41680	45910	26610	27740	22830

CAL YR 1986 TOTAL 275732 MEAN 755 MAX 2710 MIN 245 AC-FT 546900
WTR YR 1987 TOTAL 183564 MEAN 503 MAX 1580 MIN 218 AC-FT 364100

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.--5 years, 240 ft^3/s, 173,900 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 863 ft^3/s, June 25, 1985, gage height, 19.22 ft; no flow from approximately the middle of January to the first of May each year; minimum gage height, 10.30 ft, Mar. 23, 1987.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 788 ft^3/s, Aug. 15, gage height, 18.72 ft; no flow Jan. 19 to May 31; minimum gage height, 10.30 ft, Mar. 23.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	461	230	63	e13	.00	.00	.00	.00	.05	275	579	594
2	462	227	62	e12	.00	.00	.00	.00	.30	280	574	593
3	457	215	55	e12	.00	.00	.00	.00	.46	292	561	603
4	463	211	53	e11	.00	.00	.00	.00	2.4	313	564	594
5	434	199	54	e9.8	.00	.00	.00	.00	5.4	326	576	589
6	460	185	51	e8.1	.00	.00	.00	.00	9.7	335	571	590
7	458	188	50	e7.0	.00	.00	.00	.00	13	351	573	582
8	446	189	50	e6.1	.00	.00	.00	.00	17	361	588	579
9	449	152	44	e5.2	.00	.00	.00	.00	23	374	590	572
10	464	154	44	e4.5	.00	.00	.00	.00	32	382	620	561
11	440	154	41	e3.6	.00	.00	.00	.00	40	395	648	553
12	432	133	38	e2.9	.00	.00	.00	.00	44	389	685	546
13	431	140	e36	1.8	.00	.00	.00	.00	55	403	702	536
14	433	135	e36	.92	.00	.00	.00	.00	60	416	729	533
15	433	126	e35	.45	.00	.00	.00	.00	73	435	734	528
16	436	124	e34	.41	.00	.00	.00	.00	86	450	748	525
17	437	112	e32	.24	.00	.00	.00	.00	100	437	738	518
18	438	108	e29	.04	.00	.00	.00	.00	105	457	742	516
19	433	109	e29	.00	.00	.00	.00	.00	120	473	724	511
20	425	101	e27	.00	.00	.00	.00	.00	136	481	716	514
21	412	99	e26	.00	.00	.00	.00	.00	147	484	697	512
22	397	93	e25	.00	.00	.00	.00	.00	160	497	659	506
23	379	85	e22	.00	.00	.00	.00	.00	168	534	656	494
24	363	86	e22	.00	.00	.00	.00	.00	176	535	648	490
25	348	82	e21	.00	.00	.00	.00	.00	185	534	641	482
26	338	76	e20	.00	.00	.00	.00	.00	188	535	642	491
27	317	75	e18	.00	.00	.00	.00	.00	213	530	631	489
28	300	69	e17	.00	.00	.00	.00	.00	229	524	622	476
29	279	66	e17	.00	---	.00	.00	.00	237	515	620	458
30	282	65	e16	.00	---	.00	.00	.00	256	520	581	459
31	249	---	e15	.00	---	.00	---	.00	---	549	583	---
TOTAL	12556	3988	1082	99.06	0.00	0.00	0.00	0.00	2881.31	13382	19942	15994
MEAN	405	133	34.9	3.20	.00	.00	.00	.00	96.0	432	643	533
MAX	464	230	63	13	.00	.00	.00	.00	256	549	748	603
MIN	249	65	15	.00	.00	.00	.00	.00	.05	275	561	458
AC-FT	24900	7910	2150	196	.0	.0	.0	.0	5720	26540	39550	31720

CAL YR 1986 TOTAL 93714.46 MEAN 257 MAX 713 MIN .00 AC-FT 185900
WTR YR 1987 TOTAL 69924.37 MEAN 192 MAX 748 MIN .00 AC-FT 138700

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 town 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, 1,108.44 ft, Sept. 28; maximum daily elevation, 1,108.41 ft, Sept. 26; minimum, 1,104.44 ft, May 15; minimum daily, 1,104.51 ft, May 15.

MONTHEND ELEVATION, IN FEET NGVD, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

Oct. 31 ..... 1,107.46	Feb. 28 ..... 1,105.31	June 30 ..... 1,104.75
Nov. 30 ..... 1,107.12	Mar. 31 ..... 1,104.94	July 31 ..... 1,105.22
Dec. 31 ..... 1,106.46	Apr. 30 ..... 1,104.67	Aug. 31 ..... 1,107.59
Jan. 31 ..... 1,105.93	May 31 ..... 1,104.78	Sept.30 ..... 1,107.79

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 Nov. 10 to Dec. 15, which are fair.

AVERAGE DISCHARGE.--45 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, 3.8 ft^3/s, Jan. 31 to Feb. 3, 1977.

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)
May 23	1700	*836	*4.55	No other peak greater than base discharge			

Minimum discharge, 19 ft^3/s, July 11, gage height, 1.41 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	127	79	e67	52	35	36	145	57	192	24	116	30
2	123	76	e66	51	35	37	125	53	181	31	108	29
3	129	76	e65	50	34	36	115	48	167	30	97	30
4	125	76	e64	50	33	36	108	45	151	28	82	31
5	120	78	e63	50	33	36	106	43	138	25	71	43
6	119	81	e62	50	33	41	109	40	126	25	64	74
7	117	85	e62	50	34	62	117	38	116	25	58	69
8	120	146	e61	51	35	84	124	37	106	24	56	67
9	114	188	e61	51	36	95	133	36	98	22	51	67
10	107	e170	e61	51	36	95	139	33	91	21	46	64
11	106	e150	e61	50	35	91	144	31	91	24	43	73
12	107	e130	e61	50	35	83	151	30	86	25	42	73
13	109	e115	e61	48	35	73	144	29	79	23	40	70
14	114	e100	e61	47	35	64	123	32	71	22	38	65
15	119	e95	e61	46	35	59	117	28	65	21	39	59
16	118	e90	61	46	36	56	112	31	60	21	47	55
17	117	e85	61	44	36	65	107	175	56	22	44	50
18	113	e82	61	43	35	59	103	340	53	67	44	48
19	109	e80	60	42	34	57	98	464	49	132	42	58
20	104	e78	60	40	33	61	97	520	46	148	41	77
21	98	e76	59	40	33	73	98	577	43	181	39	80
22	96	e74	60	39	33	87	94	729	40	282	40	80
23	92	e73	58	38	33	137	87	820	38	382	37	73
24	89	e73	58	39	33	248	81	786	35	422	35	66
25	87	e72	57	40	34	350	75	643	33	470	33	60
26	85	e72	56	40	35	406	74	512	32	482	34	56
27	85	e71	56	39	36	391	71	413	30	376	33	53
28	84	e70	55	37	36	321	72	334	28	267	32	54
29	82	e69	55	36	---	257	69	282	26	201	30	55
30	80	e68	53	34	---	212	61	246	25	162	32	53
31	81	---	53	34	---	167	---	215	---	134	32	---
TOTAL	3276	2778	1860	1378	966	3875	3199	7667	2352	4119	1546	1762
MEAN	106	92.6	60.0	44.5	34.5	125	107	247	78.4	133	49.9	58.7
MAX	129	188	67	52	36	406	151	820	192	482	116	80
MIN	80	68	53	34	33	36	61	28	25	21	30	29
AC-FT	6500	5510	3690	2730	1920	7690	6350	15210	4670	8170	3070	3490
CFSM	.57	.50	.32	.24	.18	.67	.57	1.32	.42	.71	.27	.31
IN.	.65	.55	.37	.27	.19	.77	.64	1.53	.47	.82	.31	.35

CAL YR 1986 TOTAL 48079 MEAN 132 MAX 841 MIN 26 AC-FT 95360 CFSM .70 IN. 9.56
WTR YR 1987 TOTAL 34778 MEAN 95.3 MAX 820 MIN 21 AC-FT 68980 CFSM .51 IN. 6.92

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 Nov. 10 to Apr. 5, which are fair.

AVERAGE DISCHARGE.--64 years (water years 1912-16, 1929-87), 1,063 ft^3/s, 8.34 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 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, 6,520 ft^3/s, May 24, gage height 9.46 ft; minimum 114 ft^3/s, July 1, gage height, 2.10 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1010	475	e390	e195	e135	e130	e2000	770	2150	119	950	246
2	964	463	e385	e190	e135	e130	e1800	738	2090	125	837	240
3	943	467	e380	e190	e135	e130	e1600	706	2340	136	804	229
4	1100	467	e370	e185	e135	e130	e1500	666	2140	144	720	222
5	1100	468	e360	e180	e135	e130	e1400	629	1890	146	647	213
6	1050	472	e350	e180	e135	e140	1380	589	1670	140	591	227
7	993	497	e340	e175	e135	e200	1250	533	1450	134	531	315
8	944	544	e330	e175	e130	e300	1290	497	1260	132	481	573
9	921	940	e320	e170	e130	e400	1310	475	1080	130	429	741
10	884	e1200	e310	e170	e130	e500	1340	436	965	126	384	762
11	854	e1100	e300	e165	e130	e500	1380	412	890	137	354	700
12	826	e1000	e290	e162	e130	e500	1410	409	822	140	349	672
13	804	e900	e285	e160	e130	e460	1420	380	740	137	323	673
14	795	e850	e280	e155	e130	e420	1390	360	675	140	283	676
15	804	e800	e275	e155	e130	e390	1360	326	620	139	265	664
16	824	e750	e270	e150	e130	e360	1320	329	555	137	279	614
17	843	e700	e265	e150	e130	e340	1270	370	500	138	263	544
18	838	e650	e260	e150	e130	e320	1290	490	406	141	263	481
19	807	e600	e255	e150	e130	e300	1360	1380	320	185	260	445
20	770	e560	e250	e145	e130	e300	1340	2820	280	598	268	433
21	731	e530	e245	e145	e130	e300	1330	3360	251	1590	283	471
22	688	e510	e240	e145	e130	e350	1270	4790	228	1690	288	550
23	650	e490	e235	e145	e130	e500	1240	6260	209	2470	304	640
24	627	e470	e230	e145	e130	e800	1160	6390	194	4670	301	643
25	612	e450	e225	e145	e130	e2000	1090	5950	178	4780	283	603
26	583	e440	e220	e140	e130	e3000	1020	5240	165	4060	277	529
27	540	e430	e215	e140	e130	e3500	962	4650	155	3200	264	471
28	522	e420	e210	e140	e130	e3200	913	4030	143	2430	254	430
29	516	e410	e210	e140	---	e3000	863	3410	132	1900	240	397
30	511	e400	e205	e140	---	e2500	804	2830	125	1480	232	366
31	495	---	e200	e140	---	e2200	---	2540	---	1150	235	---
TOTAL	24549	18453	8700	4917	3675	27430	39062	62765	24623	32644	12242	14770
MEAN	792	615	281	159	131	885	1302	2025	821	1053	395	492
MAX	1100	1200	390	195	135	3500	2000	6390	2340	4780	950	762
MIN	495	400	200	140	130	130	804	326	125	119	232	213
AC-FT	48690	36600	17260	9750	7290	54410	77480	124500	48840	64750	24280	29300
CFSM	.46	.36	.16	.09	.08	.51	.75	1.17	.47	.61	.23	.28
IN.	.53	.40	.19	.11	.08	.59	.84	1.35	.53	.70	.26	.32

CAL YR 1986 TOTAL 400991 MEAN 1099 MAX 9150 MIN 180 AC-FT 795400 CFSM .64 IN. 8.62
WTR YR 1987 TOTAL 273830 MEAN 750 MAX 6390 MIN 119 AC-FT 543100 CFSM .43 IN. 5.89

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 fair. Prior to 1971, a powerplant, located 0.3 mi upstream, caused some diurnal fluctuation at low flows.

AVERAGE DISCHARGE.--56 years (water years 1929-79, 1983-87), 736 ft^3/s, 6.85 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, 5,670 ft^3/s, May 23, gage height, 9.34 ft; minimum, 184 ft^3/s, July 17, gage height 3.13 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	920	655	e550	e290	e240	e220	1140	572	2080	234	837	340
2	948	649	e540	e290	e230	e220	1070	553	1980	247	776	334
3	987	665	e530	e290	e230	e220	990	525	1880	237	765	329
4	1010	668	e520	e280	e230	e220	929	509	1700	233	746	324
5	1020	625	e500	e280	e230	e220	915	502	1510	226	712	328
6	982	635	e490	e280	e230	e220	949	488	1300	224	675	352
7	939	668	e480	e270	e230	e250	886	486	1150	213	634	372
8	893	782	e470	e270	e230	e300	816	482	1040	206	593	408
9	829	e900	e460	e270	e230	e500	817	462	937	208	557	420
10	814	e850	e450	e260	e230	e600	830	444	858	196	522	412
11	794	e820	e440	e260	e220	e550	850	420	810	194	493	408
12	771	e800	e430	e260	e220	e500	862	409	778	195	475	403
13	768	e780	e420	e260	e220	e480	861	392	729	207	443	406
14	765	e760	e410	e250	e220	e460	845	377	675	212	423	416
15	761	e740	e400	e250	e220	e440	822	370	613	213	416	412
16	749	e720	e390	e250	e220	e420	821	376	550	199	416	402
17	745	e700	e380	e250	e220	e410	811	484	498	189	405	389
18	739	e680	e370	e250	e220	e400	793	1490	455	211	402	382
19	731	e670	e370	e250	e220	e390	786	2930	419	245	413	406
20	722	e660	e360	e250	e220	e380	771	3260	392	907	410	437
21	722	e650	e360	e250	e215	e380	782	3380	372	1440	415	515
22	711	e640	e350	e250	e215	e380	814	4540	349	1320	404	582
23	700	e630	e340	e240	e215	e400	815	5590	332	1820	385	590
24	688	e620	e330	e240	e215	e600	779	5570	324	2430	372	571
25	687	e610	e330	e240	e215	e900	744	5030	310	2330	361	546
26	681	e600	e320	e240	e215	e1500	717	4240	298	2060	357	522
27	689	e590	e320	e240	e215	e1800	681	3630	286	1710	347	505
28	693	e580	e310	e240	e215	e2000	668	3170	271	1400	340	481
29	690	e570	e310	e240	---	e1900	652	2810	257	1180	346	468
30	689	e560	e300	e240	---	1710	617	2460	243	1030	365	458
31	660	---	e300	e240	---	1340	---	2240	---	919	354	---
TOTAL	24497	20477	12530	7970	6230	20310	24833	58191	23396	22635	15159	12918
MEAN	790	683	404	257	222	655	828	1877	780	730	489	431
MAX	1020	900	550	290	240	2000	1140	5590	2080	2430	837	590
MIN	660	560	300	240	215	220	617	370	243	189	340	324
AC-FT	48590	40620	24850	15810	12360	40280	49260	115400	46410	44900	30070	25620
CFSM	.54	.47	.28	.18	.15	.45	.57	1.29	.53	.50	.33	.29
IN.	.62	.52	.32	.20	.16	.52	.63	1.48	.60	.58	.39	.33

CAL YR 1986 TOTAL 365171 MEAN 1000 MAX 7950 MIN 300 AC-FT 724300 CFSM .69 IN. 9.30
WTR YR 1987 TOTAL 249146 MEAN 683 MAX 5590 MIN 189 AC-FT 494200 CFSM .47 IN. 6.35

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. 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.--59 years, 12,920 ft^3/s, 9.04 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, 17,300 ft^3/s, May 25, gage height, 8.04 ft; maximum gage height, 9.08 ft, Oct. 15 (backwater from ice); minimum discharge, 2,800 ft^3/s, July 2, gage height, 0.96 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	11100	9580	e10800	e8000	e8500	e7500	12600	5720	9910	2970	5780	9330
2	11000	9620	e10700	e8000	e8500	e7500	12200	5350	9230	2850	5160	9550
3	10900	9500	e10700	e8000	e8500	e7500	11900	5140	8740	3150	4760	9590
4	10800	9150	e10000	e8000	e8500	e7500	11700	5010	8700	3380	4580	9120
5	10900	8900	e9800	e8000	e8500	e7500	11600	4920	8290	3200	4400	9190
6	10900	9020	e10000	e8000	e8500	e7500	11600	4810	7920	3090	4190	9580
7	9790	9400	e11000	e8000	e8500	e7500	11700	4740	7420	3130	4090	9670
8	9140	10700	e11000	e8000	e8500	e7500	11700	4630	6830	3150	3960	9640
9	8540	10300	e11000	e8000	e8500	e7500	11200	4510	6370	3120	3790	9940
10	7860	10000	e11100	e8000	e8500	e8000	10900	4460	5960	3060	3710	10200
11	7430	10400	e11100	e8000	e8000	e8000	9980	4340	5650	3060	3570	10300
12	7320	10700	e11100	e8000	e8000	e8000	9330	4310	5340	3070	3500	11400
13	7240	e10900	e11100	e8500	e8000	e8000	9200	4250	5130	3110	3530	11900
14	6690	e11200	e11100	e8500	e8000	e8000	9000	4180	4880	3100	3480	12100
15	6250	e11400	e11100	e8500	e8000	e8000	8540	4160	4650	3110	3360	12100
16	6570	e11300	e11000	e8500	e8000	e8000	7990	4160	4420	3120	3600	12000
17	7160	e11200	e11000	e8500	e8000	e8000	7350	4190	4210	3090	3650	12000
18	7420	e11000	e9200	e8500	e8000	e8000	7040	4240	4010	3190	3640	12000
19	7460	e10900	e8500	e8500	e8000	e8000	6950	4590	3960	3230	3580	11900
20	7390	e10700	e8200	e8500	e8000	e8000	7060	7040	3740	3310	3580	11900
21	7710	e10700	e8200	e8500	e7500	e8500	7360	10300	3520	3640	3600	12000
22	8080	e10600	e8200	e8500	e7500	e8500	7180	12100	3400	5450	3620	12000
23	8130	e10500	e8000	e8500	e7500	e9500	6970	14500	3310	6330	3640	12300
24	8100	e10500	e8000	e8500	e7500	e10000	6970	16800	3260	7870	3610	12400
25	8480	e10500	e8000	e8500	e7500	e11000	7020	17200	3210	10600	3560	12300
26	8780	e10500	e8000	e8500	e7500	12900	7040	16500	3140	11200	3530	12300
27	8830	e10500	e8000	e8500	e7500	14100	6880	15300	3140	10300	3670	12100
28	9160	e10500	e7900	e8500	e7500	14500	6580	14000	3120	9040	3940	12100
29	9760	e10600	e7900	e8000	---	14500	6070	12800	3060	7890	5540	12000
30	9870	e10800	e7900	e8000	---	14000	5950	11700	3010	6970	7810	11900
31	9460	---	e7900	e8000	---	13400	---	10700	---	6300	9130	---
TOTAL	268220	311570	297500	256000	225000	286400	267560	246650	157530	148080	131560	334810
MEAN	8652	10390	9597	8258	8036	9239	8919	7956	5251	4777	4244	11160
MAX	11100	11400	11100	8500	8500	14500	12600	17200	9910	11200	9130	12400
MIN	6250	8900	7900	8000	7500	7500	5950	4160	3010	2850	3360	9120
AC-FT	532000	618000	590100	507800	446300	568100	530700	489200	312500	293700	260900	664100
CFSM	.45	.54	.49	.43	.41	.48	.46	.41	.27	.25	.22	.58
IN.	.51	.60	.57	.49	.43	.55	.51	.47	.30	.28	.25	.64

CAL YR 1986 TOTAL 5137410 MEAN 14080 MAX 38600 MIN 4950 AC-FT 10190000 CFSM .73 IN. 9.85
WTR YR 1987 TOTAL 2930880 MEAN 8030 MAX 17200 MIN 2850 AC-FT 5813000 CFSM .41 IN. 5.62

e Estimated

05133500 RAINY RIVER AT MANITOU RAPIDS, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1969-70, 1977 to current year.

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

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	DIS-CHARGE, IN CUBIC FEET PER SECOND (00060)	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 AIR (DEG C) (00020)	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)
OCT												
21...	1330	--	7660	130	98	7.4	7.3	22.0	8.0	4.5	732	9.8
JAN												
05...	1110	7700	--	70	76	7.2	7.0	3.0	0.0	1.1	730	12.2
FEB												
09...	1230	8300	--	96	80	7.4	7.5	-3.0	0.0	1.1	728	11.2
MAY												
04...	1230	--	5000	100	117	7.3	7.7	20.0	12.0	2.5	743	8.8
JUN												
16...	1030	--	4350	116	128	7.3	7.5	30.0	23.0	2.8	737	7.0
SEP												
08...	1200	--	9660	74	80	7.5	7.8	19.0	17.0	4.2	732	8.5

DATE	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	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 WATER DISSOLV FLD. AS CACO3 (MG/L) (39086)	CAR-BONATE WATER DISSOLV FIELD AS CO3 (MG/L) (00452)	BICAR-BONATE WATER DISSOLV FIELD AS HCO3 (MG/L) (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												
21...	110	K8	12	3.9	4.2	1.3	41	0	50	13	5.0	<0.1
JAN												
05...	260	24	7.4	2.1	3.9	0.90	34	0	41	11	4.3	<0.1
FEB												
09...	260	27	8.3	2.4	3.4	0.90	26	0	32	12	4.1	<0.1
MAY												
04...	>240	140	12	3.5	4.8	1.1	36	0	44	11	6.5	<0.1
JUN												
16...	K28	K6	14	4.0	5.8	1.0	61	0	74	10	7.8	0.1
SEP												
08...	93	94	8.4	2.5	3.0	0.80	25	0	30	15	3.2	0.1

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	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)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
21...	3.8	90	<0.10	0.03	0.80	0.40	0.02	<0.01	10	207	87
JAN											
05...	3.1	56	<0.10	0.01	1.4	0.02	0.01	0.01	3	62	100
FEB											
09...	3.1	42	0.11	0.01	0.80	0.02	0.02	0.01	2	45	100
MAY											
04...	2.1	73	<0.10	0.05	0.60	0.03	0.02	<0.01	4	54	100
JUN											
16...	2.7	104	<0.10	0.02	1.0	0.03	0.02	<0.01	10	117	100
SEP											
08...	1.7	51	<0.10	0.02	0.80	<0.01	<0.01	<0.01	12	313	100

DATE	TIME	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)
OCT											
21...	1330	40	<1	17	<0.5	<1	<1	<3	4	140	<5
FEB											
09...	1230	30	<1	17	1	<1	<1	<3	1	79	<5
MAY											
04...	1230	50	<1	17	<0.5	<1	<1	<3	3	110	<5
SEP											
08...	1200	40	<1	17	<0.5	<1	2	<3	2	72	<5

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
OCT										
21...	<4	9	<0.1	<10	1	<1	<1	27	<6	17
FEB										
09...	<4	6	<0.1	<10	<1	<1	<1	25	<6	4
MAY										
04...	6	11	<0.1	<10	<1	<1	<1	28	<6	18
SEP										
08...	<4	6	<0.1	<10	1	<1	<1	24	<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, 62.36 ft, Sept. 12, 1978; 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, 60.57 ft, Nov 8; maximum daily, 59.88 ft, Oct. 2; minimum, 57.31 ft, May 13; minimum daily, 57.75 ft, May 13.

GAGE HEIGHT, IN FEET ABOVE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59.70	58.86	59.00	58.77	58.47	58.28	58.17	58.23	58.45	58.43	58.71	58.44
2	59.88	59.05	58.98	58.78	58.49	58.26	58.17	58.23	58.05	58.50	58.69	58.40
3	59.85	59.19	58.94	58.75	58.46	58.28	58.18	58.14	58.41	58.49	58.61	58.22
4	59.46	58.84	58.95	58.76	58.46	58.26	58.18	58.03	58.54	58.42	58.80	58.25
5	59.63	58.89	58.96	58.73	58.45	58.24	58.19	57.96	58.64	58.44	58.60	58.47
6	59.49	59.14	58.95	58.70	58.41	58.23	58.19	58.08	58.70	58.47	58.41	58.35
7	59.63	59.81	58.96	58.68	58.42	58.20	58.20	58.09	58.62	58.40	58.63	58.28
8	59.63	59.55	58.96	58.67	58.42	58.20	58.21	57.84	58.81	58.45	58.49	58.26
9	59.54	59.13	58.90	58.66	58.42	58.19	58.22	58.09	58.61	58.45	58.69	58.36
10	59.23	58.82	58.95	58.65	58.42	58.18	58.22	58.10	58.58	58.34	58.58	58.47
11	59.57	58.96	58.92	58.63	58.39	58.16	58.22	58.13	58.55	58.51	58.40	58.41
12	59.64	58.95	58.92	58.63	58.39	58.16	58.22	57.77	58.63	58.61	58.55	58.37
13	59.42	59.04	58.95	58.61	58.39	58.17	58.21	57.75	58.67	58.46	58.58	58.39
14	59.52	58.99	58.93	58.59	58.40	58.16	58.22	58.03	58.69	58.44	58.64	58.28
15	59.21	59.03	58.94	58.58	58.39	58.15	58.22	57.90	58.62	58.49	58.57	58.40
16	59.46	59.02	58.93	58.59	58.37	58.13	58.18	58.18	58.65	58.34	58.54	58.51
17	59.35	59.01	58.91	58.57	58.36	58.14	58.17	58.42	58.54	58.49	58.51	58.50
18	59.30	59.01	58.90	58.57	58.35	58.12	58.20	58.31	58.63	59.01	58.50	58.51
19	59.30	59.06	58.90	58.60	58.32	58.10	58.20	58.02	58.68	58.55	58.47	58.64
20	59.30	59.02	58.90	58.57	58.32	58.10	58.16	58.11	58.66	58.44	58.44	58.70
21	59.25	59.04	58.89	58.58	58.32	58.10	58.22	59.11	58.61	58.57	58.34	58.58
22	59.32	59.01	58.86	58.54	58.28	58.08	58.11	58.61	58.59	58.65	58.42	58.42
23	59.33	59.00	58.89	58.53	58.28	58.08	58.20	58.19	58.46	58.53	58.42	58.57
24	59.27	59.04	58.85	58.54	58.29	58.09	58.19	58.27	58.44	58.52	58.33	58.62
25	59.23	59.00	58.83	58.54	58.30	58.11	58.14	58.40	58.44	58.49	58.41	58.55
26	59.14	59.01	58.85	58.52	58.28	58.12	58.09	58.41	58.52	58.66	58.37	58.68
27	59.22	58.97	58.82	58.48	58.29	58.12	58.17	58.47	58.55	58.61	58.40	58.66
28	59.17	59.00	58.81	58.52	58.30	58.12	57.99	58.42	58.54	58.57	58.36	58.66
29	59.23	59.00	58.79	58.52	---	58.14	58.20	58.45	58.58	58.58	58.20	58.62
30	59.21	59.01	58.80	58.49	---	58.15	58.09	58.52	58.50	58.61	58.28	58.63
31	58.78	---	58.77	58.51	---	58.19	---	58.55	---	58.84	58.34	---
MEAN	59.40	59.05	58.90	58.61	58.37	58.16	58.18	58.22	58.57	58.53	58.49	58.47
MAX	59.88	59.81	59.00	58.78	58.49	58.28	58.22	59.11	58.81	59.01	58.80	58.70
MIN	58.78	58.82	58.77	58.48	58.28	58.08	57.99	57.75	58.05	58.34	58.20	58.22

CAL YR 1986 MEAN 59.73 MAX 61.03 MIN 58.54
WTR YR 1987 MEAN 58.58 MAX 59.88 MIN 57.75

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, 62.12 ft, July 3, 1985; maximum daily, 61.81 ft, July 6, 7, 1985; minimum, 57.58 ft, May 13, 1987; minimum daily, 57.87 ft, May 13, 1986.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 60.22 ft, Nov. 8; maximum daily, 59.86 ft, Oct. 2; minimum, 57.58 ft, May 13; minimum daily, 57.87 ft, May 13.

GAGE HEIGHT, IN FEET ABOVE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59.72	58.86	58.94	58.70	58.41	58.23	58.13	58.15	58.41	58.47	58.71	58.39
2	59.86	59.04	58.93	58.70	58.42	58.20	58.12	58.16	58.05	58.50	58.69	58.37
3	59.85	59.13	58.87	58.68	58.40	58.22	58.13	58.11	58.35	58.50	58.59	58.26
4	59.50	58.86	58.89	58.68	58.39	58.21	58.14	58.01	58.49	58.46	58.75	58.25
5	59.62	58.88	58.89	58.66	58.39	58.19	58.16	58.00	58.58	58.44	58.61	58.43
6	59.49	59.09	58.89	58.65	58.35	58.19	58.16	58.06	58.68	58.46	58.41	58.35
7	59.59	59.63	58.90	58.62	58.36	58.16	58.16	58.07	58.58	58.41	58.60	58.27
8	59.57	59.44	58.90	58.60	58.35	58.15	58.18	57.93	58.69	58.44	58.49	58.26
9	59.50	59.05	58.85	58.59	58.35	58.13	58.20	58.08	58.55	58.44	58.65	58.33
10	59.26	58.78	58.89	58.59	58.36	58.14	58.19	58.13	58.58	58.34	58.59	58.42
11	59.50	58.92	58.85	58.59	58.33	58.12	58.19	58.06	58.51	58.46	58.42	58.36
12	59.57	58.92	58.85	58.59	58.32	58.10	58.19	57.89	58.57	58.55	58.51	58.35
13	59.39	59.01	58.88	58.57	58.33	58.12	58.18	57.87	58.62	58.45	58.54	58.36
14	59.48	58.96	58.86	58.54	58.35	58.11	58.19	57.99	58.63	58.44	58.62	58.30
15	59.24	59.01	58.86	58.51	58.34	58.11	58.19	57.93	58.57	58.47	58.55	58.39
16	59.44	59.00	58.86	58.52	58.32	58.09	58.17	58.11	58.59	58.37	58.51	58.50
17	59.34	59.00	58.83	58.50	58.31	58.09	58.17	58.25	58.51	58.47	58.48	58.49
18	59.29	59.00	58.83	58.50	58.29	58.08	58.20	58.22	58.57	58.91	58.47	58.50
19	59.28	59.03	58.83	58.53	58.27	58.07	58.20	57.98	58.63	58.53	58.45	58.60
20	59.27	58.99	58.83	58.50	58.27	58.06	58.11	58.04	58.62	58.45	58.42	58.65
21	59.24	59.00	58.81	58.51	58.27	58.05	58.16	58.77	58.59	58.55	58.33	58.55
22	59.30	58.97	58.79	58.47	58.23	58.04	58.10	58.48	58.59	58.63	58.37	58.43
23	59.28	58.96	58.81	58.46	58.23	58.04	58.15	58.15	58.46	58.51	58.38	58.55
24	59.24	59.01	58.78	58.46	58.24	58.04	58.15	58.22	58.42	58.51	58.30	58.59
25	59.21	58.96	58.76	58.45	58.25	58.07	58.13	58.34	58.41	58.48	58.38	58.54
26	59.15	58.97	58.77	58.46	58.23	58.07	58.07	58.37	58.47	58.63	58.35	58.66
27	59.21	58.92	58.75	58.42	58.23	58.08	58.12	58.43	58.53	58.60	58.37	58.64
28	59.15	58.94	58.74	58.44	58.24	58.08	58.00	58.42	58.51	58.57	58.35	58.64
29	59.19	58.94	58.71	58.45	---	58.11	58.14	58.44	58.55	58.58	58.21	58.59
30	59.21	58.95	58.72	58.42	---	58.11	58.06	58.49	58.50	58.61	58.24	58.61
31	58.81	---	58.72	58.45	---	58.15	---	58.50	---	58.83	58.31	---
MEAN	59.38	59.01	58.83	58.54	58.32	58.12	58.15	58.18	58.53	58.52	58.47	58.45
MAX	59.86	59.63	58.94	58.70	58.42	58.23	58.20	58.77	58.69	58.91	58.75	58.66
MIN	58.81	58.78	58.71	58.42	58.23	58.04	58.00	57.87	58.05	58.34	58.21	58.25

CAL YR 1986 MEAN 59.72 MAX 60.98 MIN 58.55
WTR YR 1987 MEAN 58.54 MAX 59.86 MIN 57.87

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 analylses, dependingon the type of data collected. In addition, discharge measurements are made at other sites not included in the partial-record prcgram. 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. Discharge measurements made at miscellaneous sites for both low flow and high flow are given in a third table.

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 1987

Station No.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Lake Superior Basin				
04010530	Reservation River near Hovland, MN	Lat 47°52'38", long 89°51'45", in SW¼ sec.6, T.62 N., R.5 E., Cook County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, 0.2 mile upstream from mouth, 4 miles northeast of Hovland.	-	1974, 1984, 1986-87	5-13-87	3.30
04010850	Brule River near Grand Marais, MN	Lat 47°55'57", long 90°18'37", in SE¼SW¼ sec.15, T.63 N., R.1 E., Cook County, Hydrologic Unit 04010101, at bridge on National Forest Development Road 309, 0.5 mile upstream from South Brule River, 13 miles north of Grand Marais.	88.8	1970-71 1974, 1976, 1987	5-14-87	23
04010900	South Brule River near Grand Marais, MN	Lat 47°55'34", long 90°18'22", in SW¼NE¼ sec.22, T.63 N., R.1 E., Cook County, Hydrologic Unit 04010101, at bridge on County Highway 12 (Gunflint Trail), 0.1 mile upstream from mouth, 12 miles north of Grand Marais.	76.5	1970-71 1974, 1976, 1987	5-14-87	25
04011000	Brule River near Hovland, MN	Lat 47°49'06", long 90°03'04", in SE¼SW¼ sec.27, T.62 N., R.3 E., Cook County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, 0.3 mile upstream from mouth, 4.5 miles southwest of Hovland.	a264	1912, 1970-71, 1974, 1976, 1986-87	5-13-87	78
04011500	Devil Track River near Grand Marais, MN	Lat 47°46'12", long 90°15'39", in SW¼NE¼ sec.13, T.61 N., R.1 E., Cook County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, 0.1 mile upstream from mouth, 3.9 miles northeast of Grand Marais.	a74.8	1911-12, 1970-71, 1974, 1976, 1987	5-14-87	32
04012000	Cascade River near Grand Marais, MN	Lat 47°42'26", long 90°31'21", in NE¼SW¼ sec.1, T.60 N., R.2 W., Cook County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, at mouth, 9.2 miles southwest of Grand Marais.	111	1911-12, 1970-71, 1974, 1976, 1987	5-14-87	45

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measusrements made at low-flow partial-record stations during water year 1987--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Lake Superior Basin.--Continued				
04012600	Temperance River near Tofte, MN	Lat 47°48'04", long 90°50'43", in NE¼NW¼ sec.4, T.61 N., R.4 W., Cook County, Hydrologic Unit 04010101, at bridge on National Forest Development Road 165, 1.8 miles downstream from Sawbill Creek, 16 miles north of Tofte.	87.6	1970-71, 1974, 1976, 1980, 1983, 1986-87	5-13-87	22
04012700	Temperance River near Schroeder, MN	Lat 47°33'17", long 90°52'28", in SE¼NE¼ sec.31, T.59 N., R.4 W., Cook County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, 0.1 mile upstream from mouth, 1.2 miles northeast of Schroeder.	a185	1911-12 1970-71 1974, 1976, 1987	5-13-87	53
04013000	Cross River at Schroeder, MN	Lat 47°32'40", long 90°54'10", in NE¼NE¼ sec.1, T.58 N., R.5 W., Cook County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, at Schroeder.	a91	1911-12, 1930-32#, 1974, 1984, 1986-87	5-13-87	21
04013300	Manitou River near Little Marais, MN	Lat 47°26'40", long 91°04'07", in SE¼SE¼ sec.3, T.57 N., R.6 W., Lake County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, 0.3 mile upstream from mouth, 3 miles northeast of Little Marais.	98.2	1911-12, 1970-71, 1974-76, 1986-87	5-13-87	14
04015090	Split Rock River near Beaver Bay, MN	Lat 47°11'02", long 91°24'32", in NW¼NW¼ sec.7, T.54 N., R.8 W., Lake County, Hydrologic Unit 0401012, above culvert on Highway 61, 4 miles northeast of Gooseberry Falls State Park, at edge of Split Rock Lighthouse State Park.	-	1974, 1986-87	5-14-87	6.86
04015140	Gooseberry River near Two Harbors, MN	Lat 47°08'37", long 91°28'05", in SW¼SW¼ sec.22, T.54 N., R.9 W., Lake County, Hydrologic Unit 04010101, at bridge on U.S. Highway 61, in Gooseberry Falls State Park, about 1 mile upstream from mouth, 2.5 miles northeast of Castle Danger, 12.5 miles northeast of Two Harbors.	a74.6	1911, 1970-71 1974, 1976, 1987	5-14-87	11
04015260	Silver Creek near Two Harbors, MN	Lat 47°03'52", long 91°36'18", in SE¼NE¼ sec.21, T.53 N., R.10 W., Lake County, Hydrologic Unit 04010102, at culvert on U.S. Highway 61, 4.3 miles northeast of Two Harbors.	a25	1911, 1984-87	5-14-87	1.60
04015310	Stewart River near Two Harbors, MN	Lat 47°02'53", long 91°37'49", in SW¼NE¼ sec.29, T.53 N., R.10 W., Lake County, Hydrologic Unit 04010102, at U.S. Highway 61, 0.2 mile upstream from mouth, 1.5 miles northeast of Two Harbors.	-	1974, 1984, 1987	5-14-87	5.45
04015350	French River near Duluth, MN	Lat 46°53'59", long 91°53'32", in NE¼SW¼ sec.17, T.51 N., R.12 W., St. Louis County, Hydrologic Unit 04010102, at bridge on County Highway 61, at mouth, 12.7 miles northeast of aerial bridge in Duluth.	18.4	1970-71, 1974, 1976, 1980, 1986-87	5-14-87	6.28
04015387	Amity Creek at Duluth, MN	Lat 46°50'39", long 92°00'36", in SE¼NE¼ sec.5, T.50 N., R.13 W., St. Louis County, Hydrologic Unit 04010102, at bridge on Parkway Road, 0.4 mile upstream from Lester River, 6 miles northeast of aerial bridge in Duluth.	16.2	1970-71, 1974, 1976, 1980, 1983, 1986-87	5-14-87	3.73

"See footnotes at end of table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measusrements made at low-flow partial-record stations during water year 1987--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Lake Superior Basin.--Continued				
04015438	St. Louis River near Skibo, MN	Lat 47°28'58", long 92°02'24", in NE¼SW¼ sec.30, T.58 N., R.13 W., St. Louis County, Hydrologic Unit 04010201, at bridge on Forest Service Road 133, 2 miles southwest of Skibo, 6 miles southeast of Hoyt Lakes.	a84	1971, 1974, 1976, 1978, 1987	5-11-87	35
04021000	Whiteface River below Meadowlands, MN	Lat 47°02'21", long 92°44'35", in NW¼NW¼ sec.34, T.53 N., R.19 W., St. Louis County, Hydrologic Unit 04010201, at bridge on County Highway 5, 5.5 miles above mouth, 2 miles south of Meadowlands.	a453	1909-17#, 1955, 1974, 1987	5-13-87	92
04022970	Us-Kab-Wan-Ka River near Twig, MN	Lat 46°58'55", long 92°20'01", in SE¼SW¼ sec.14, T.52 N., R.16 W., St. Louis County, Hydrologic Unit 04010201, at bridge on trail, 0.8 mile upstream from mouth, 6.2 miles north of Twig.	38.9	1970-71, 1973-76, 1987	5-13-87	11
04024100	Rock Creek near Blackhoof, MN	Lat 46°32'10", long 92°22'12", in SW¼SE¼ sec.21, T.47 N., R.16 W., Carlton County, Hydrologic Unit 04010301, at culvert on State Highway 23, 4.0 miles upstream from mouth, 4.4 miles east of Blackhoof, 5 miles north of Holyoke.	-	1960-86+, 1987	5-5-87	0.38
		Red River of the North Basin				
05077700	Ruffy Brook near Gonvick, MN	Lat 47°44'50", long 95°24'45", on line between secs. 5 and 8, T.149 W., R.37 W., Clearwater County, Hydrologic Unit 09020305, at County Highway 67, 4 miles upstream of mouth, 4.8 miles east of Gonvick.	45.2	1957-59, 1960-78#, 1980+, 1987+	6-16-87	2.65
05086000	Snake River at Alvarado, MN	Lat 48°11'50", long 97°00'20", on line between sec.6, T.154 N., R.49 W., and sec.31, T.155 N., R.49 W., Marshall County, Hydrologic Unit 09020309, at bridge on State Highway 1, at west edge of Alvarado.	a309	1945#, 1946, 1948-51, 1954-56#, 1978-80, 1983, 1986-87	9- 9-87	.004
05090500	Tamarac River near Strandquist, MN	Lat 48°25'30", long 96°37'40", in NE¼NE¼ sec.18, T.157 N., R.46 W., Marshall County, Hydrologic Unit 09020311, at County Highway 1, 1.2 miles south of Florian, 9 miles southwest of Strandquist.	-	1953-56#, 1963, 1983, 1987	9-10-87	0.10
05095000	Two Rivers at Hallock, MN	Lat 48°46'30", long 96°55'52", in SE¼SE¼ sec.12, T.161 N., R.49 W., Kittson County, Hydrologic Unit 09020312, at bridge on State Highway 175 at east edge of Hallock 0.2 mile downstream from South Branch Two Rivers.	625	1911-14# 1929-30# 1941-43# 1967 1969 1976 1987	9-10-87	0.54
05096500	State Ditch 85 near Lancaster, MN	Lat 48°52'02", long 96°40'01", at intersection of secs. 6 and 7, T.162 N. R.46 W., and secs. 1 and 12, T.162 N., R.47 W., Kittson County, Hydrologic Unit 09020312, at bridge on County Highway 4, 1.3 miles upstream from mouth, 6.5 miles northeast of Lancaster.	a95	1928, 1929-38#, 1942-55#, 1987	9-10-87	0

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measusrements made at low-flow partial-record stations during water year 1987--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Red River of the North Basin.--Continued				
05102600	Joe River near Noyes, MN	Lat 48°59'30", long 97°07'43", in NW¼NW¼ T.164 N., R.50 W., Sec.34, Kittson County, Hydrologic Unit 09020311, 1.1 miles upstream of Minnesota-Canadian border, 3.5 miles east of Junction of U.S. Highway 75 and County Road 16, on township road.	-	1984, 1987	8-30-84 9-10-87	0 0
05102900	Roseau River near Skime, MN	Lat 48°38'30", long 95°35'47", in SE¼SW¼ sec.30, T.160 N., R.38 W., Roseau County, Hydrologic Unit 09020314, at bridge on County Highway 4, 6.5 miles north of Skime, about 11 miles southeast of Malung.	134	1971-73, 1975-77, 1979-80, 1983 1986-87	6-18-87	11
05103000	Roseau River near Malung, MN	Lat 48°45'45", long 95°42'05", in SE¼SE¼ sec.17, T.161 N., R.39 W., Roseau County, Hydrologic Unit 09020314, at highway bridge, 0.75 mile downstream from Bear Creek, 1.25 miles southeast of Malung, 3.25 miles upstream from South Fork.	252	1928-46#, 1947	6-18-87 9-9- 87	16 0.01
05104000	South Fork Roseau River near Malung, MN	Lat 48°47'00", long 95°44'00", in NE¼SW¼ sec.7, T.161 N., R.39 W., Roseau County, Hydrologic Unit 09020314, below bridge on County Highway 2, 500 ft downstream from Sucker Creek, 0.5 mile upstream from mouth, 1.1 miles northwest of Malung.	312	1911-14#, 1928-46#, 1947-48, 1986-87	6-18-87 9- 9-87	2.67 0
05105000	Roseau River at Roseau, MN	Lat 48°51'53", long 95°45'37", in SW¼ sec.13, T.162 N., R.40 W., Roseau County, Hydrologic Unit 09020314, at dam 0.2 mile downstream from State Highway 11.		1911-14, 1943, 1967-70, 1978-79, 1984	6-18-87	20
05106000	Sprague Creek near Sprague, Manitoba	Lat 48°59'33", long 95°39'43", in NE¼ sec.34, T.164 N., R.39 W., Roseau County, Hydrologic Unit 09020314, on left bank 0.5 mile, south of international boundary, 3.5 miles south of Sprague, Manitoba, 8 miles upstream from mouth, 10.5 miles northeast Roseau.	169	1928-81#, 1986-87	9-10-87	0.56
05110500	Roseau River at head of state ditch 51, near Oak Point, MN	Lat 48°56'53", long 96°22'56" in NE¼NE¼ sec.18, T.163 N., R.44 W., Roseau County, Hydrologic Unit 09020314, at head of state ditch 51 (known locally as Caribou cut-off ditch), 2 miles southeast of Oak Point.	---	1933-42#, 1986-87	6-17-87 9-10-87	100 1.66
05124497	Little Isabella River near Isabella, MN	Lat 47°44'24", long 91°30'20", in SE¼NW¼ sec.29, T.61 N., R.9 W., Lake County, Hydrologic Unit 09030001, at bridge on National Forest Development Road 173, 7 miles upstream from mouth, 10 miles southwest of Forest Center Landing, 11 miles northwest of Isabella.	48.3	1970-73, 1975-76, 1987	5-13-87	13
05134200	Rapid River near Baudette, MN	Lat 48°32'10", long 94°33'45", in SE¼NE¼ sec.1, T.158 N., R.31 W., Lake of the Woods County, Hydrologic Unit 09030007, on left bank 20 ft upstream from bridge on State Highway 72, 1.2 miles downstream from North Branch Rapid River, 12 miles south of Baudette.	543	1956-85#, 1987	6-16-87	158

Operated as a continuous-record gaging station.
+ Operated as a high-flow partial record station.
a Approximate


Lake of the Woods
Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Moorhead
Grand Rapids
Mille Lacs Lake
Superior
5137000
5134100
5086900
5075700
5078400
5079901
5077700
5131750
5134878
5130300
5125550
4012500
5200445
5209200
5205200
5210200
4015250
4015370
5062900
5062500
5067060
5063200
5069800
5061400
5061200
5229450
5244000
5244200
5244440
5245800
5221020
4024100
4024095
5336200
5261520
5261000
5336550
5050700

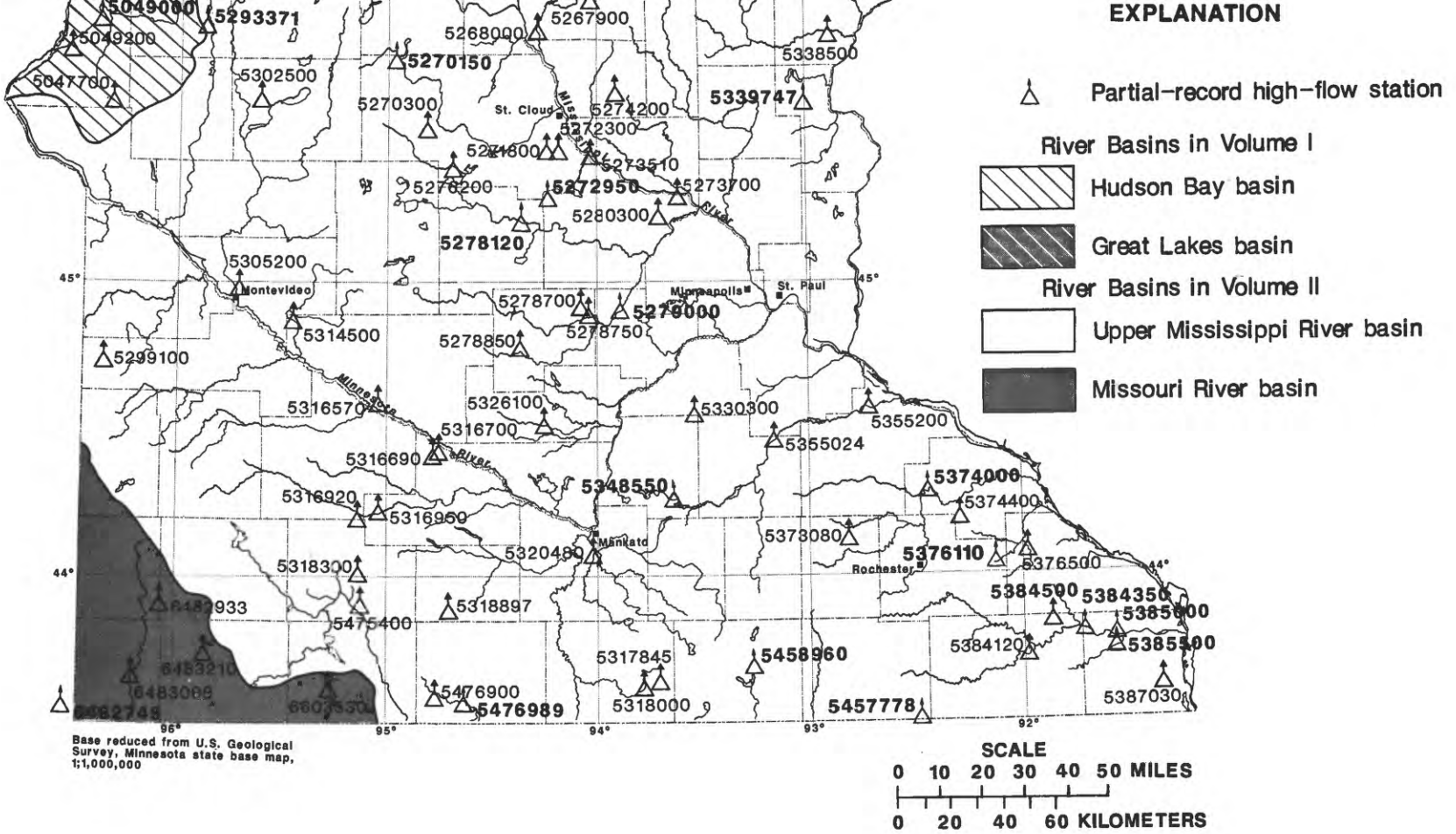


Figure10.--Location of high-flow partial-record stations

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 1987

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Annual maximum Date	Annual maximum Gage height (feet)	Annual maximum 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.	-	1985-87	8-1-85	10.98	621
04012500	Poplar River at Lutsen, MN	Lat 47°38'23", long 90°42'31", in SW¼NE¼ sec.33, T.60 N., R.3 W., Cook County, Hydrologic Unit 04010101, 350 ft upstream from bridge on U.S. Highway 61 at Lutsen, 0.3 mile upstream from mouth.	112	1912-17#, 1928-47#, 1952-61#, 1972-87	5-22-87	5.05	910
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.	.96	1960-87	7-18-87	7.59	§
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	1965-87	5-18-87	5.10	270
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, 2.0 miles upstream from mouth, 2.7 miles north of Two Harbors.	5.54	1960-87	5-18-87	10.23	§
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	1964-87	7-18-87	13.50	120
04020480	North Branch Whiteface River near Fairbanks, MN	Lat 47°22'20", long 91°56'28", at common corner of secs.35, 36, 1, and 2, along line between T.57 N., and 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	1979-87	7-19-87	12.73	288

"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 1987--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Annual maximum Date	Annual maximum Gage height (feet)	Annual maximum Discharge (ft^3/s)
		Streams tributary to Lake Superior--Continued					
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	1979-87	7-20-87	a14.24	335
04021205	Floodwood River above Floodwood, MN	Lat 46°17'15", long 92°53'40", in NE¼NW¼ sec.32, T.52 N., R.20 W., St. Louis County, Hyrologic Unit 04010201, at bridge on County Highway 835, 500 ft west of State Highway 73, 2 miles north of Floodwood.	198	1972-87	7-20-87	b15.28	662
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 04010201, at bridge on County Highway 2, 5.8 miles southeast of Toimi, 23 miles north of Two Harbors.	-	1986-87	5-18-87	6.89	475
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.	118	1972-87	5-21-87	c	d100
04024100	Rock Creek near Blackhoof, MN	Lat 45°32'10", long 92°22'12", in SW¼SE¼ sec.21, T.47 N., R.16 W., Carlton County, Hydrologic Unit 04010301, at culvert on State Highway 23, 4.0 miles upstream from mouth, 4.4 mile east of Blackhoof.	4.94	1961-65, 1967-87	6-1-87	-	d19
		Red River of the North basin					
05047700	West Branch Mustinka River tributary near Graceville, MN	Lat 45°36'53", long 96°19'47", in NE¼NW¼ sec.28, T.125 N., R.45 W., Traverse County, Hydrologic Unit 09020102, at culvert on county highway, 6.0 miles northeast of Graceville.	3.37	1964-87	5-29-87	e7.65	30
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#, 1985-87	6-1-87	4.78	275
05049200	Eighteenmile Creek near Wheaton, MN	Lat 45°47'18", long 96°31'52", on west quarter of line between secs.24 and 25, T.127 N., R.47 W., Traverse County, Hydologic Unit 09020102, at culvert on County Highway 67, 1.4 miles upstream from mouth, 2.0 miles southwest of Wheaton.	68.5	1965-68, 1970-87	5-29-87	4.88	26
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 right downstream piling of bridge on County Road 19, 2.6 miles north of Nashua, 4.8 miles upstream from mouth of South Fork Rabbit River.	56.1	1979-87	3-7-87	e11.59	380

"See footnotes at end of the table."

Annual maximum discharge at high-flow partial-record stations during water year 1987--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Annual maximum Date	Annual maximum Gage height (feet)	Annual maximum Discharge (ft^3/s)
		Red River of the North basin--Continued					
05060800	Buffalo River near Callaway, MN	Lat 47°01'17", long 95°54'43", in SW¼SE¼, 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	1960-87	3-8-87	f13.03	71
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#, 1967-87	3-6-87	f4.85	79
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	1961-87	3-6-87	f6.82	28
05062500	Wild Rice River at Twin Valley, MN	Lat 47°16'00", long 96°14'40", in NW¼NE¼ sec.27, T.144 N., R.44 W., Norman County, Hydrologic Unit 09020108, on left bank, 100 ft upstream from highway bridge 0.8 mile northeast of village of Twin Valley.	888	1909-17#, 1930-83#, 1985-87	7-24-87	6.91	1,280
05062900	Wild Rice River near 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.	-	1985-87	7-24-87	e17.90	1,600
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.	-	1985-87	1987	-	¥
05063200	Spring Creek tributary near Ogema, MN	Lat 47°07'22", long 95°57'35", in SE¼SE¼ sec.11, T.142 N., R.42 W., Becker County, Hydrologic Unit 09020108, at culvert on county highway, 2.0 miles northwest of Ogema.	4.99	1963-87	7-22-87	e6.87	42
05075700	Mud River near Grygla, MN	Lat 48°19'31", long 95°44'35", at common corner of secs.13, 14, 23, and 24, T.156 N., R.40 W., Hydrologic Unit 09020304, Marshall County, at bridge on State Highway 89, 6 miles west of Grygla.	170	1979-87	3-23-87	f16.13	644
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, on downstream side of bridge on County Highway 17, 4.0 miles upstream from mouth, 4.8 miles east of Gonvick.	45.2	1960-78#, 1979-85, 1986,# 1987	7-22-87	6.05	395
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, 1.2 miles upstream from mouth, 5.3 miles southwest of Plummer.	6.51	1961-87	5-27-87	11.48	$

"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 1987--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					
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 culvert on U.S. Highway 75, 0.75 mile northeast of Girard, 3 miles southwest of Crookston, 7 miles above mouth.	g111	1986-87	3-22-87	f15.77	§
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	1979-87	3-25-87	f14.59	215
		Lake of the Woods basin					
05125550	Stony River near Babbitt, MN	Lat 47°41'39", long 91°45'38", in SW¼SW¼ sec.8, T.60 N., R.11 W., Lake County, Hydrologist Unit 09030001, in Superior National Forest, at bridge on Forest Route 424, 4.7 miles upstream from mouth, 8.5 miles southeast of Babbitt.	219	1975-80#, 1986-87	5-24-87	6.89	1,210
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	1959-87	7-19-87	a12.35	46
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	1973-87	5-22-87	e12.89	1,420
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, on left downstream wing wall of bridge on State Highway 6, 2.4 miles upstream from mouth, 7.0 miles west of Craigville.	25.0	1979-87	5-22-87	13.64	360
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.	-	1986-87	5-22-87	7.36	365
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 0903008, at bridge on State Highway No. 11, 4.5 miles west of Baudette, 1.8 miles east of Pitt, 5 miles upstream of mouth.	-	1986-87	3-25-87	9.41	§

Operated as a continuous-record gaging station.
§ Discharge not determined.
a Affected by beaver dam.
b Affected by shifting control.
c Peak stage did not reach bottom of pipe.
d Discharge estimated.
e Backwater from aquatic growth and debris.
f Backwater from ice.
g Approximate.
¥ No evidence of any flow during the water year.

ANALYSES OF SAMPLES COLLECTED AT WATER-QUALITY PARTIAL-RECORD STATIONS

Water-quality partial-record stations are particular sites where chemical-quality, biological and (or) sediment data are collected systematically over a period of years for use in hydrologic analyses.

480730094523001 - UPPER RED LAKE NR RED LAKE, MN

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	SAMPLING DEPTH (M) (00098)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE WATER (DEG C) (00010)	OXYGEN, DISSOLVED (MG/L) (00300)
AUG						
12...	1038	1.0	247	8.2	22.0	7.8
12...	1039	2.0	247	8.2	22.0	7.8
12...	1040	3.0	248	8.2	22.0	7.8
12...	1041	4.0	250	8.2	22.0	7.5

DATE	TIME	DEPTH TO BOT. FROM SURFACE AT SAMP LOC. METERS (82903)	DEPTH TO TOP OF SAMPLE INTERVAL(IN METERS) (82047)	DEPTH TO BOTTOM OF SAMPLE INTERVAL(IN METERS) (82048)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE WATER (DEG C) (00010)	TRANSPARENCY (SECCHI DISK) (M) (00078)	OXYGEN, DISSOLVED (MG/L) (00300)	NITROGEN, NITRITE TOTAL (MG/L AS N) (00615)	NITROGEN, NITRITE DISSOLVED (MG/L AS N) (00613)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N) (00630)
AUG												
12...	1000	4.6	0.0	1.5	247	8.20	22.0	1.7	7.8	<0.01	<0.01	<0.10

DATE	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	NITROGEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITROGEN,AMMONIA + ORGANIC DIS. (MG/L AS N) (00623)	PHOSPHOROUS TOTAL (MG/L AS P) (00665)	PHOSPHOROUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P) (70507)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P) (00671)	CARBON, ORGANIC DISSOLVED (MG/L AS C) (00681)	CARBON, ORGANIC SUSPENDED TOTAL (MG/L AS C) (00689)	CARBON, INORGANIC, DISSOLVED (MG/L AS C) (00691)
AUG												
12...	<0.10	<0.01	0.01	2.0	1.4	0.12	0.01	<0.01	0.01	16	4.5	21

ANALYSES OF SAMPLES COLLECTED AT WATER-QUALITY PARTIAL-RECORD STATIONS

480000095000001 - LOWER RED LAKE, NEAR CENTER, NR RED LAKE, MN

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	TIME	SAMPLING DEPTH (M) (00098)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE WATER (DEG C) (00010)	OXYGEN, DISSOLVED (MG/L) (00300)
AUG						
11...	1407	1.0	246	8.3	23.0	7.9
11...	1408	2.0	240	8.3	23.0	7.9
11...	1409	3.0	240	8.3	23.0	7.9
11...	1410	3.5	240	8.3	23.0	8.0

DATE	TIME	DEPTH TO BOT. FROM SURFACE AT SAMP LOC. METERS (82903)	DEPTH TO TOP OF SAMPLE INTERVAL(IN METERS) (82047)	DEPTH TO BOTTOM OF SAMPLE INTERVAL(IN METERS) (82048)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE AIR (DEG C) (00020)	TEMPERATURE WATER (DEG C) (00010)	BAROMETRIC PRESSURE (MM OF HG) (00025)
AUG									
11...	1400	4.5	0.0	1.5	246	8.3	27.5	23.0	729

DATE	TRANSPARENCY (SECCHI DISK) (M) (00078)	OXYGEN, DISSOLVED (MG/L) (00300)	NITROGEN, NITRITE TOTAL (MG/L AS N) (00615)	NITROGEN, NITRITE DISSOLVED (MG/L AS N) (00613)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	NITROGEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)
AUG									
11...	2.5	7.9	<0.01	<0.01	<0.10	<0.10	0.02	<0.01	1.7

DATE	NITROGEN,AMMONIA + ORGANIC DIS. (MG/L AS N) (00623)	PHOSPHOROUS TOTAL (MG/L AS P) (00665)	PHOSPHOROUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P) (70507)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P) (00671)	CARBON, ORGANIC DISSOLVED (MG/L AS C) (00681)	CARBON, ORGANIC SUSPENDED TOTAL (MG/L AS C) (00689)	CARBON, INORGANIC, DISSOLVED (MG/L AS C) (00691)
AUG								
11...	1.2	0.07	0.02	<0.01	<0.01	15	4.3	22

MISCELLANEOUS WATER QUALITY DATA COLLECTED AT CONTINUOUS-RECORD STATIONS

WATER QUALITY DATA AT STREAMFLOW STATIONS

Field determinations of water temperature and specific conductance are made at many streamflow stations in addition to those that are also regular water-quality stations. These data are usually collected at regular intervals during routine visits to the station. Additional data for each station are published elsewhere in this report.

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
04010500 PIGEON RIVER AT MIDDLE FALLS NEAR GRAND PORTAGE, MN							
OCT. 01, 1986	308	11.0	88	APR. 30	249	9.5	74
NOV. 03	156	1.0	105	JUNE 09	328	15.0	---
DEC. 16	224	.0	---	JUNE 11	285	---	---
DEC. 19	204	.0	---	JULY 30	163	---	---
FEB. 03, 1987	157	.0	90	AUG. 31	530	---	---
MAR. 02	100	0.5	---	Sept. 01	494	15.0	---
MAR. 17	140	.0	110				
04014500 BAPTISM RIVER NEAR BEAVER BAY, MN							
NOV. 13, 1986	240	2.0	55	APR. 29	91	13.0	66
DEC. 16	67	.0	---	JULY 22	401	20.5	60
FEB. 02, 1987	29	.0	75	Sept. 01	25	15.5	101
MAR. 17	56	.0	75				
04015330 KNIFE RIVER NEAR TWO HARBORS, MN							
OCT. 02, 1986	103	10.0	100	MAY 07	39	10.0	110
NOV. 13	52	---	---	JUNE 08	18	17.5	---
DEC. 15	22	.0	---	JULY 22	99	---	---
FEB. 02, 1987	11	---	---	AUG. 31	7.9	15.5	---
MAR. 16	31	.0	140				
04015475 PARTRIDGE RIVER ABOVE COLBY LAKE NEAR HOYT LAKES, MN							
OCT. 28, 1986	49	6.5	55	APR. 28	63	13.5	47
DEC. 18	19	.0	55	JUNE 11	47	16.0	---
FEB. 05, 1987	9.4	---	---	JULY 23	825	---	---
MAR. 19	18	0.5	95	SEPT. 04	14	14.5	---
04016500 ST. LOUIS RIVER NEAR AURORA, MN							
OCT. 28, 1986	154	7.0	60	APR. 28	137	15.0	57
DEC. 18	106	.0	110	JUNE 11	257	17.0	---
FEB. 05, 1987	87	---	---	JULY 23	1,810	---	---
MAR. 19	77	.0	---	SEPT. 04	81	14.5	---

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
04018750 ST. LOUIS RIVER AT FORBES, MN							
OCT. 28, 1986	447	7.0	195	MAY 11	206	17.0	210
DEC. 12	353	.0	---	JULY 09	206	23.0	---
JAN. 12, 1987	184	.0	---	AUG. 10	342	23.0	---
FEB. 23	141	---	---	SEPT. 25	400	---	---
APR. 08	463	---	---				
04024000 ST. LOUIS RIVER AT SCANLON, MN							
OCT. 02, 1986	5,650	12.5	115	MAR. 31	2,370	1.5	110
NOV. 14	2,230	---	---	JUNE 12	2,170	18.0	---
DEC. 10	1,960	.0	140	JUNE 22	782	24.5	133
JAN. 15, 1987	1,720	---	---	SEPT. 14	1,290	17.5	---
FEB. 18	1,790	0.5	---				
04024098 DEER CREEK NEAR HOLYOKE, MN							
OCT. 21, 1986	4.32	7.0	270	JUNE 16	2.28	21.5	---
DEC. 10	2.40	.0	320	AUG. 04	1.98	19.5	---
JAN. 21, 1987	1.95	.0	310	AUG. 28	1.81	---	---
MAR. 18	4.32	1.0	290	SEPT. 30	1.70	12.5	310
MAY 05	2.59	14.0	298				
05046000 OTTER RAIL RIVER BELOW ORWELL DAM NEAR FERGUS FALLS, MN							
DEC. 01, 1986	730	3.5	480	JULY 15	90	---	---
JAN. 21, 1987	512	0.5	495	AUG. 03	72	26.0	---
MAR. 26	799	4.0	425	SEPT. 24	164	---	---
MAY 20	451	18.0	---				
05050000 BOIS DE SIOUX RIVER NEAR WHITE ROCK, SOUTH DAKOTA							
OCT. 10, 1986	546	8.5	1,020	APR. 27	181	15.5	1,240
NOV. 12	83	.0	1,560	JUNE 03	3.3	18.0	1,240
DEC. 15	38	1.0	1,890	JULY 23	.18	---	---
FEB. 12, 1987	24	.0	1,280	SEPT. 24	.04	---	---
MAR. 23	26	3.0	1,210				
05061000 BUFFALO RIVER NEAR HAWLEY							
OCT. 08, 1986	103	9.5	680	MAR. 10	254	.0	670
NOV. 21	62	.0	630	APR. 15	118	13.0	490
DEC. 19	41	0.5	640	JUNE 18	30	18.5	---
JAN. 21, 1987	38	.0	680	AUG. 24	21	19.0	---
FEB. 19	36	1.0	660				

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
05061500 SOUTH BRANCH BUFFALO RIVER AT SABIN, MN							
OCT. 08, 1986	45	10.0	1,040	APR. 15	117	11.0	880
NOV. 21	27	.0	1,160	MAY 20	16	14.0	820
JAN. 21, 1987	6.9	.0	970	JUNE 24	.97	24.0	---
FEB. 19,	18	.0	790	JULY 23	8.2	25.0	---
MAR. 10	524	.0	570	AUG. 24	8.0	18.0	---
MAR. 16	128	0.5	620				
05062000 BUFFALO RIVER NEAR DILWORTH, MN							
OCT. 23, 1986	112	11	740	APR. 15	254	11.5	790
NOV. 21	120	.0	860	MAY 20	72	14.0	740
DEC. 19	71	.0	830	JUNE 24	31	26.0	---
JAN. 21, 1987	48	.0	790	JULY 23	98	27.0	---
FEB. 19	58	.0	720	AUG. 24	37	19.0	---
MAR. 26	746	2.0	570				
05064000 WILD RICE RIVER AT HENDRUM, MN							
NOV. 04, 1986	208	---	---	APR. 22	361	---	---
DEC. 17	126	0.5	---	JUNE 03	632	---	---
JAN. 26, 1987	74	.0	580	JULY 23	973	---	---
MAR. 11	1,410	---	---	AUG. 26	128	18.0	---
05067500 MARSH RIVER NEAR SHELLY, MN							
NOV. 04, 1986	0.23	1.0	---	APR. 22	10	---	---
DEC. 17	1.4	---	---	JUNE 03	29	---	---
JAN. 16, 1987	.27	0.5	---	JULY 23	1,570	---	---
MAY 11	277	---	---	AUG. 25	4.9	17.0	---
05069000 SANDHILL RIVER AT CLIMAX, MN							
NOV. 04, 1986	23	1.0	---	APR. 21	51	11.0	620
DEC. 16	22	0.5	775	JUNE 02	194	---	---
JAN. 27, 1987	16	.0	740	JULY 21	115	25.0	---
MAR. 10	171	---	---	AUG. 25	44	17.0	---
05074500 RED LAKE RIVER NEAR RED LAKE, MN							
OCT. 10, 1986	898	9.0	265	MAY 07	92	---	---
NOV. 21	685	---	---	JUNE 19	329	25.0	---
JAN. 09, 1987	641	1.0	---	JULY 31	264	---	---
FEB. 12	708	1.0	335	SEPT. 11	260	---	---
MAR. 27	319	4.0	275				

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
05075000 RED LAKE AT HIGH LANDING NEAR GOODRIDGE, MN							
OCT. 09, 1986	1,010	---	---	MAY 06	94	19.0	255
NOV. 19	695	---	---	JUNE 23	331	27.0	---
JAN. 07, 1987	717	.0	315	JULY 29	172	26.0	---
FEB. 12	657	.0	310	SEPT. 11	269	---	---
MAR. 26	659	---	---				
05076000 THIEF RIVER NEAR THIEF RIVER FALLS, MN							
OCT. 09, 1986	2.4	---	---	MAY 06	55	---	---
NOV. 19	.58	---	---	JUNE 23	11	29.0	---
JAN. 08, 1987	.03	---	---	JULY 30	58	26.0	---
FEB. 11	.0	---	---	SEPT. 09	4.7	---	---
MAR. 26	1,540	---	---				
05078000 CLEARWATER RIVER AT PLUMMER, MN							
NOV. 05, 1986	15	0.5	510	APR. 20	51	---	---
DEC. 15	70	.0	500	JUNE 01	404	22.5	505
JAN. 27, 1987	49	.0	375	JULY 20	243	23.0	500
MAR. 09	156	---	---	AUG. 24	87	17.0	---
05078230 LOST RIVER AT OKLEE, MN							
NOV. 05, 1986	5.0	0.5	---	JUNE 01	115	---	---
DEC. 15	8.2	0.5	---	JULY 20	37	23.5	---
JAN. 28, 1987	7.3	.0	---	JULY 29	167	26.0	---
FEB. 12	10	---	---	JULY 29	192	---	---
MAR. 09	217	---	---	AUG. 24	14	16.0	---
APR. 20	33	14.0	---				
05078500 CLEAR WATER RIVER AT RED LAKE FALLS, MN							
NOV. 05, 1986	55	0.5	535	APR. 21	159	10	550
DEC. 16	105	0.5	415	JUNE 02	732	19	550
JAN. 27, 1987	76	.0	550	JULY 21	272	24	---
MAR. 10	700	---	---	AUG. 24	145	19	---
05079000 RED LAKE RIVER AT CROOKSTON, MN							
NOV. 04, 1986	340	2.0	380	APR. 22	443	13.0	410
DEC. 16	788	.0	325	JUNE 02	2,170	20.5	490
JAN. 27, 1987	684	.0	360	JULY 22	988	25.0	334
MAR. 10	2,150	0.5	250	AUG. 25	465	19.0	415
APR. 21	474	14.0	395				

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

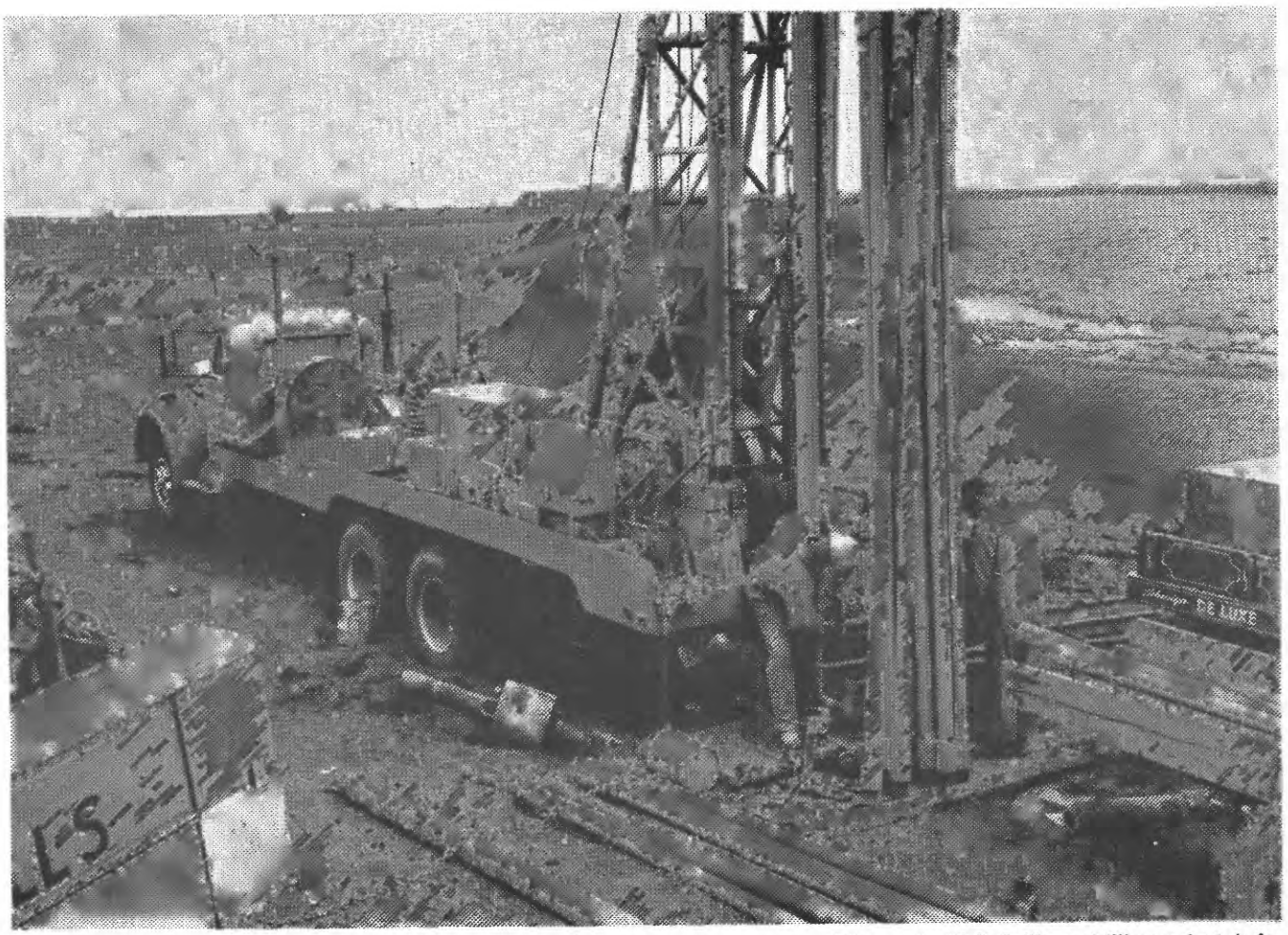
DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
05087500 MIDDLE RIVER AT ARGYLE, MN							
OCT. 08, 1986	0.34	---	---	MAY 07	6.0	16.0	620
NOV. 20	.59	---	---	JUNE 24	1.2	24.0	---
JAN. 08, 1987	.60	---	---	JULY 30	8.1	26.0	---
FEB. 11	.59	---	---	SEPT. 09	0.02	---	---
MAR. 25	369	---	---				
05094000 SOUTH BRANCH TWO RIVERS AT LAKE BRONSON, MN							
OCT. 08, 1986	3.9	---	---	MAY 07	5.7	14.0	400
NOV. 20	.18	---	---	JUNE 24	2.9	25.9	---
JAN. 08, 1987	.11	---	---	JULY 30	8.5	25.0	---
FEB. 11	.12	1.0	---	SEPT. 01	.38	17.0	---
MAR. 25	609	---	---				
05104500 ROSEAU RIVER BELOW SOUTH FORK RIVER NEAR MALUNG, MN							
OCT. 09, 1986	1.9	---	---	MAY 05	33	---	---
NOV. 17	4.8	---	---	JUNE 18	18	24.0	---
JAN. 07, 1987	3.5	---	---	JULY 28	13	26.0	---
FEB. 10	4.0	.0	---	SEPT. 09	.02	---	---
MAR. 24	1,070	---	---				
05107500 ROSEAU RIVER AT ROSS, MN							
OCT. 07, 1986	36	11.0	345	MAY 05	151	14.0	330
NOV. 18	28	0.5	395	MAY 06	148	14.0	300
JAN. 06, 1987	16	.0	---	JUNE 17	74	27.0	---
FEB. 10	12	.0	540	JULY 28	59	25.0	---
MAR. 24	657	---	---	SEPT. 02	4.1	16.0	---
05112000 ROSEAU RIVER BELOW STATE DITCH 51 NEAR CARIBOU, MN							
OCT. 06, 1986	45	9.0	---	JUNE 17	110	25.0	383
OCT. 07	58	10.0	430	JUNE 17	107	---	---
NOV. 18	36	1.0	260	JULY 28	73	25.0	360
JAN. 06, 1987	24	.0	540	SEPT. 02	3.6	17.0	---
FEB. 10	17	.0	600	SEPT. 10	1.8	---	---
MAY 05	275	13.0	380	SEPT. 16	1.3	---	---

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

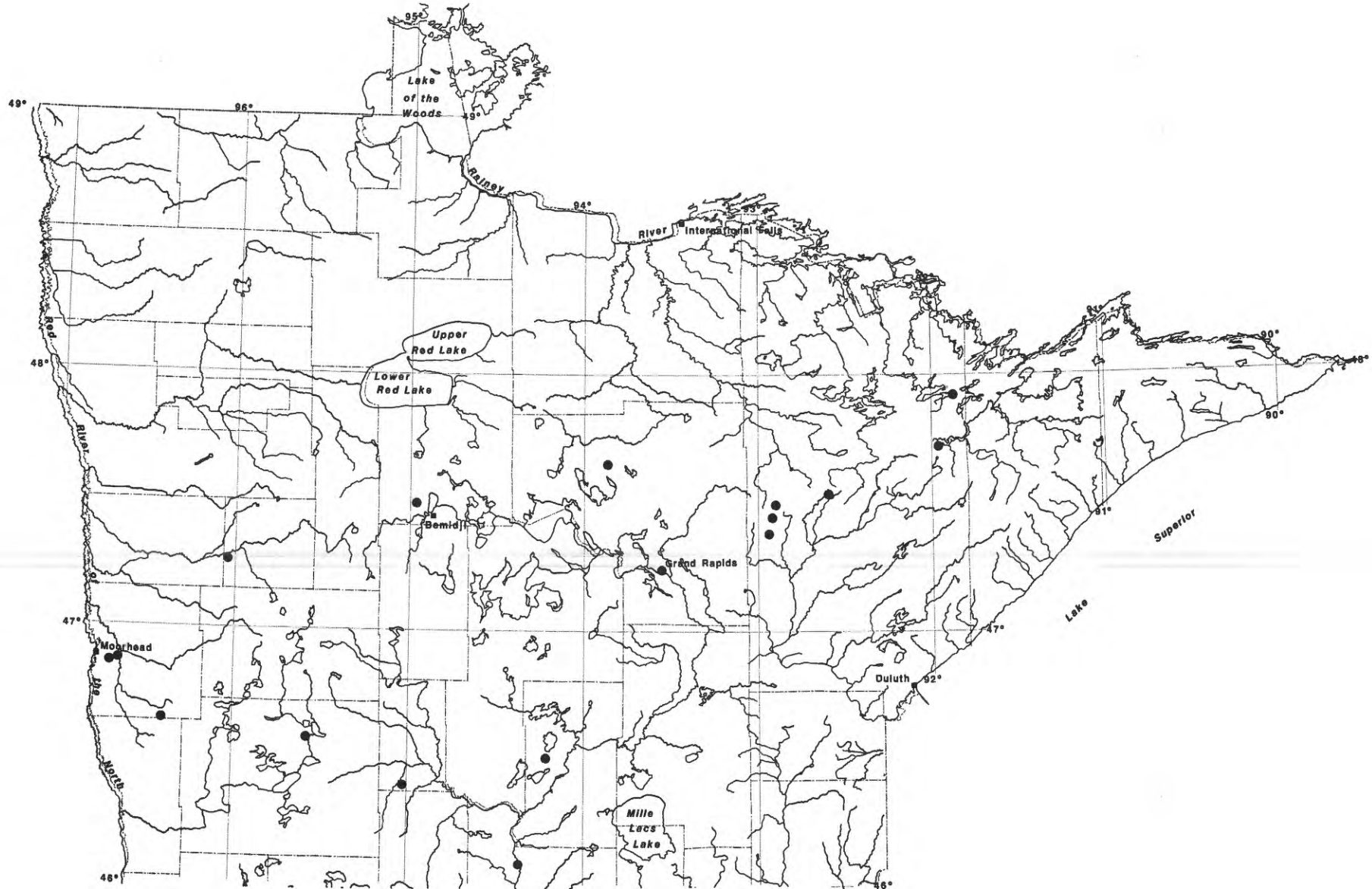
DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
05124480 KAWISHIWI RIVER NEAR ELY, MN							
OCT. 29, 1986	84	7.0	---	APR. 29	85	12.0	---
DEC. 17	136	.0	---	JUNE 11	308	17.5	28
FEB. 04, 1987	75	.0	27	JULY 28	265	---	---
MAR. 18	49	0.5	---	SEPT. 02	336	18.0	25
05127000 KAWISHIWI RIVER NEAR WINTON, MN							
JUNE 11, 1987	1,280	---	---	SEPT. 02	863	---	---
05127500 BASSWOOD RIVER NEAR WINTON, MN							
MAY 12, 1987	488	---	---	JUNE 24	1,590	---	---
05128000 NAMAKAN RIVER AT OUTLET OF LAC LA CROIX, ONTARIO							
JUNE 02, 1987	2,290	---	---	AUG. 05	4,130	22.0	---
05129115 VERMILLION RIVER NEAR CRANE LAKE, MN							
DEC. 09, 1986	437	---	---	MAY 20	540	15.5	50
JAN. 14, 1987	283	---	---	JULY 08	287	25.0	---
FEB. 24	227	---	---	AUG. 11	491	23.0	---
APR. 07	650	4.5	40	SEPT. 24	392	---	---
05129290 GOLD PORTAGE OUTLET FROM KABETOGAMA LAKE NEAR RAY, MN							
OCT. 22, 1986	386	---	---	AUG. 12	688	23.0	---
JAN. 13, 1987	2.0	---	---	SEPT. 21	528	---	---
JULY 08	361	24.0	---				
05130500 STURGEON RIVER NEAR CHISHOLM, MN							
OCT. 27, 1986	85	7.5	95	MAY 11	31	16.5	105
DEC. 08	61	---	---	JULY 10	22	24.0	---
JAN. 14, 1987	46	---	---	AUG. 10	46	21.0	---
FEB. 24	34	---	---	SEPT. 24	63	---	---
APR. 07	120	8.0	60				
05131500 LITTLE FORK RIVER AT LITTLEFORK, MN							
OCT. 20, 1986	736	8.0	120	MAY 19	1,740	15.0	140
DEC. 02	383	1.0	150	JULY 01	119	---	---
JAN. 12, 1987	162	0.5	220	AUG. 12	349	23.0	---
FEB. 24	130	.0	270	SEPT. 24	638	---	---
APR. 06	1,310	2.0	80				

WATER QUALITY DATA AT STREAMFLOW STATIONS, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)	DATE	MEASURED DISCHARGE (ft^3/s)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROSIEMANS)
05132000 BIG FORK RIVER AT BIG FALLS, MN							
OCT. 20, 1986	720	8.0	200	MAY 19	2,970	13.0	120
DEC. 03	531	.0	---	JUNE 29	244	---	---
JAN. 12, 1987	257	0.5	290	AUG. 13	457	21.0	---
FEB. 23	213	.0	300	SEPT. 23	585	---	---
APR. 06	944	---	---				
05133500 RAINY RIVER AT MANITOU RAPIDS, MN							
JAN. 13, 1987	8,810	0.5	80	MAY 04	5,000	12.0	100
MAR. 23	9,400	---	---	JUNE 25	3,150	---	---



Minnesota Well Drillers drilling a test hole


Lake of the Woods
Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Bemidji
Grand Rapids
Moorhead
Red
Lake
Superior
Duluth
Mille Lacs Lake
49°
96°
95°
94°
93°
92°
91°
90°
48°
47°

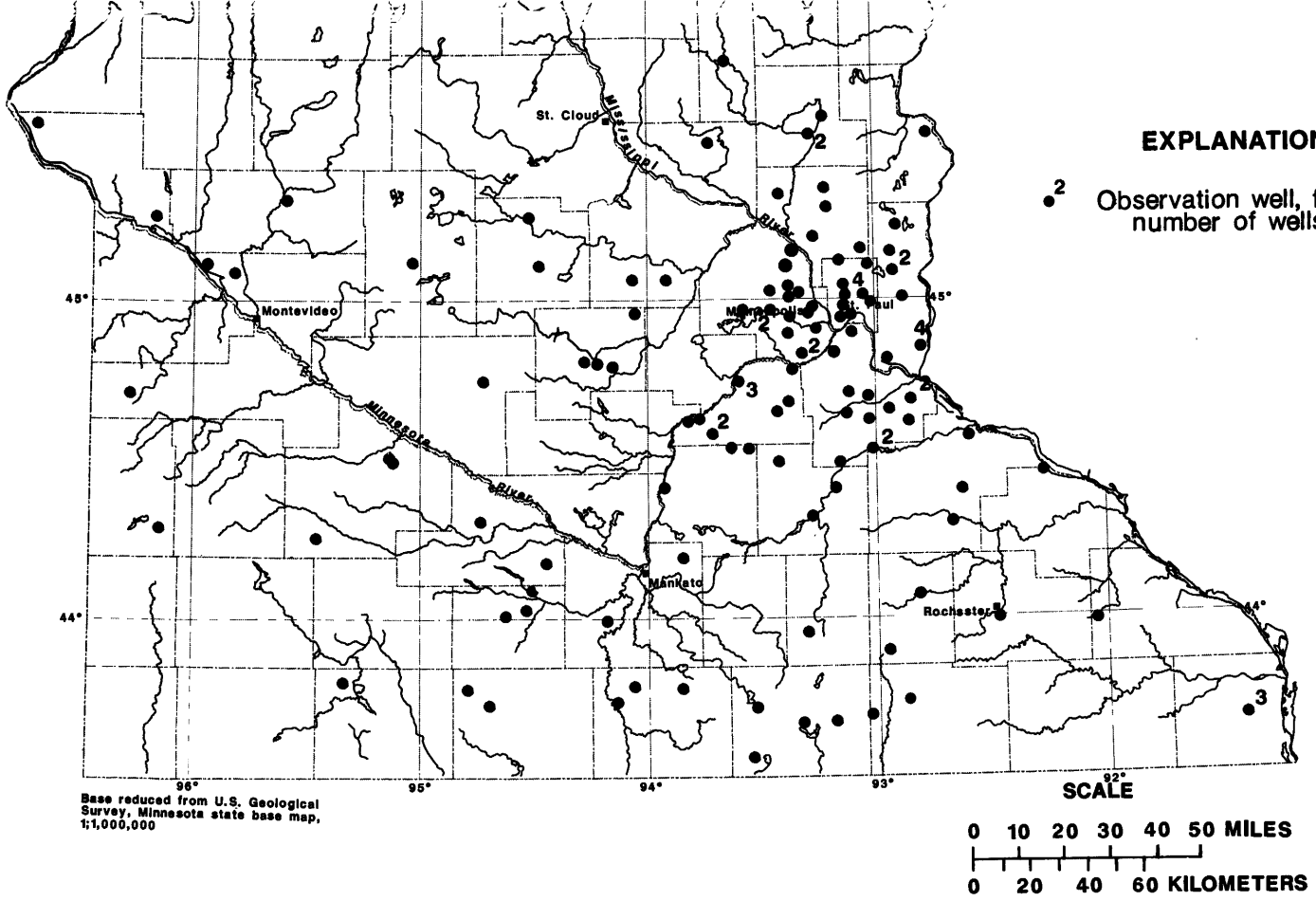
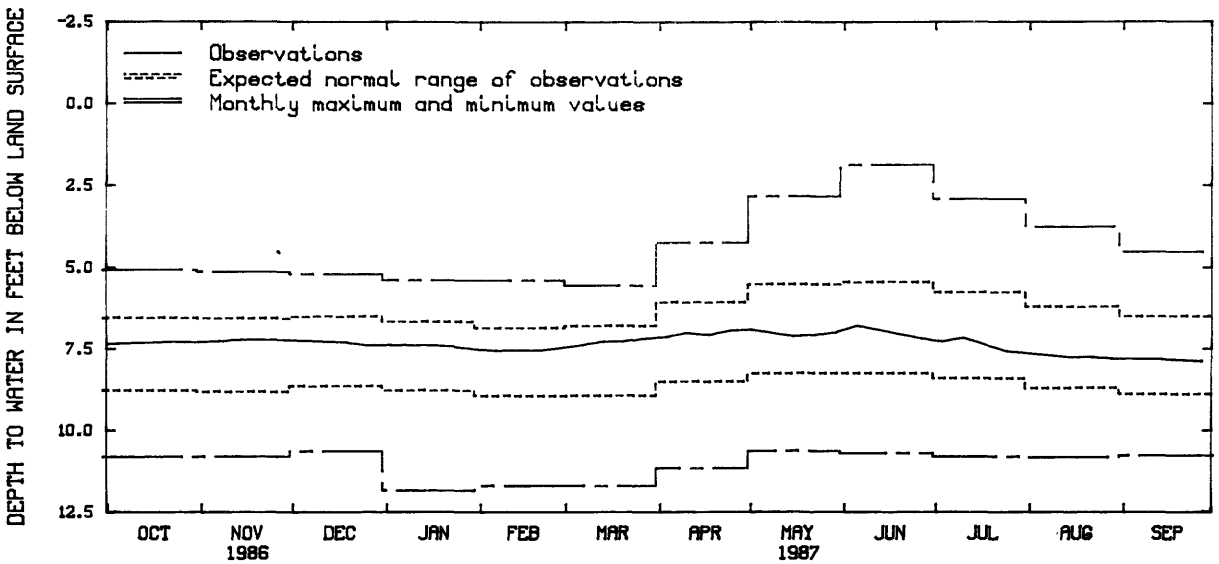


Figure 11.--Location of ground-water wells

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. (0.25 m), depth 73 ft (22.2 m).
DATUM.--Altitude of land-surface datum is 1,022 ft (312 m). Measuring point: Top of casing, 1.50 ft (0.46 m) 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 (0.57 m) below land-surface datum, June 9, 1962; lowest, 11.86 ft (3.61 m) below land-surface datum, June 3, 1970.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 24	7.28	Dec. 19	7.32	Feb. 6	7.57	Mar. 27	7.17	May 15	7.13	July 10	7.16
31	7.31	26	7.42	13	7.56	Apr. 3	7.12	22	7.06	24	7.59
Nov. 7	7.27	Jan. 2	7.38	20	7.55	10	7.00	29	6.98	Aug. 14	7.78
14	7.21	16	7.40	Mar. 6	7.38	17	7.09	June 5	6.78	21	7.75
21	7.22	23	7.45	13	7.27	24	6.93	26	7.20	28	7.82
28	7.24	30	7.53	20	7.26	May 1	6.90	July 3	7.30	Sep. 11	7.83
										25	7.90

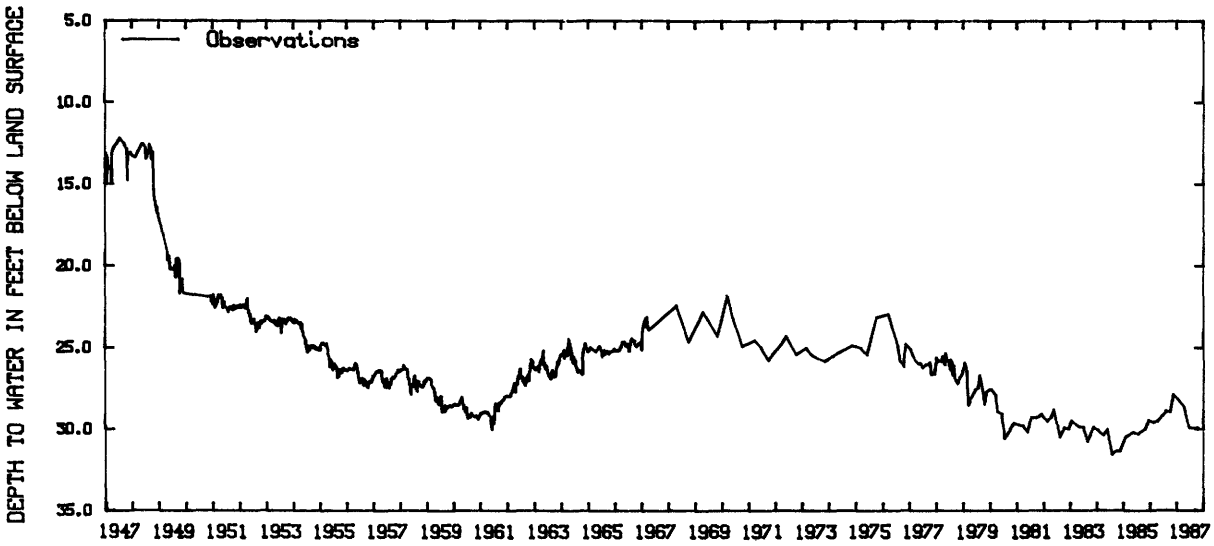


Ground-water levels, 1987 water year
Well 137N45W30CDB01

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 (3.9 km) 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. (0.20 m), depth 131 ft (39.9 m), slotted 91 to 107 ft (27.7 to 32.6 m).
DATUM.--Land-surface datum is 916.7 ft (279.4 m) National Geodetic Vertical Datum of 1929. Measuring point: Top of recorder floor, 3.60 ft (1.10 m) 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 (3.72 m) below land-surface datum, July 15, 1947; lowest, 31.59 ft (9.63 m) below land-surface datum, Aug. 3, 1984.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 8	28.98	Nov. 21	27.89	Jan. 21	28.20	Apr. 15	28.68	June 24	29.96

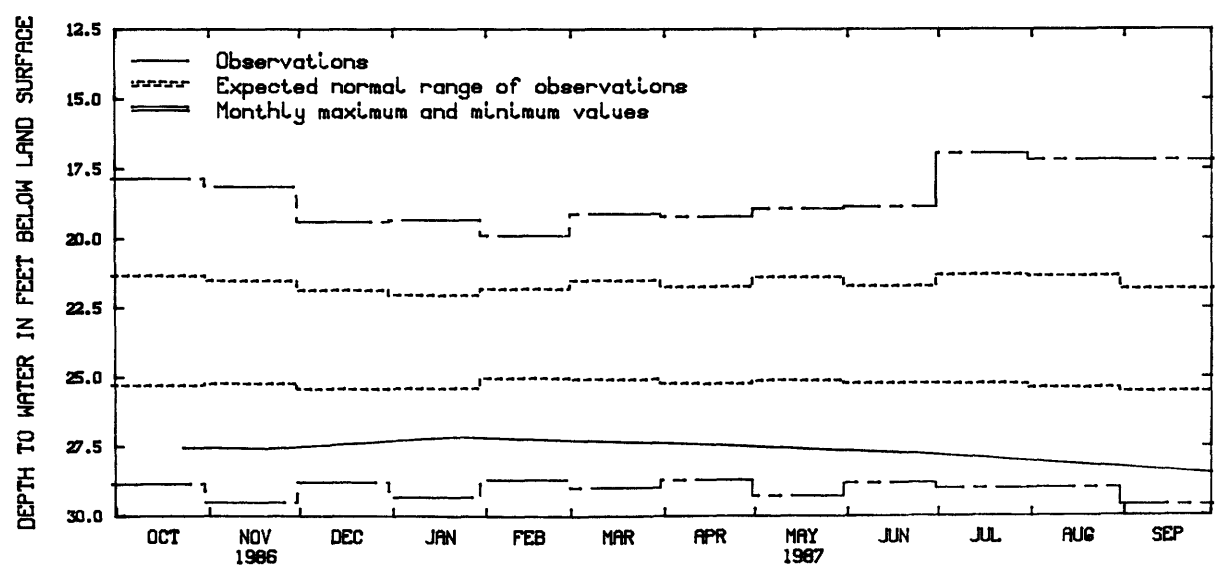


Ground-water level, 1947-87
Well 139N47W05CDC01

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 (4.3 km) 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. (0.08 m), depth 103 ft (31.4 m), casing slotted near bottom.
DATUM.--Altitude of land-surface datum is 915 ft (279 m). Measuring point: Top of casing, 2.50 ft (0.76 m) 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 (5.16 m) below land-surface datum, July 16, 1949; lowest, 29.62 ft (9.03 m) below land-surface datum, Sept. 24, 1984.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 23	27.55	Nov. 21	27.59	Jan. 21	27.15	Apr. 15	27.45	June 24	27.78



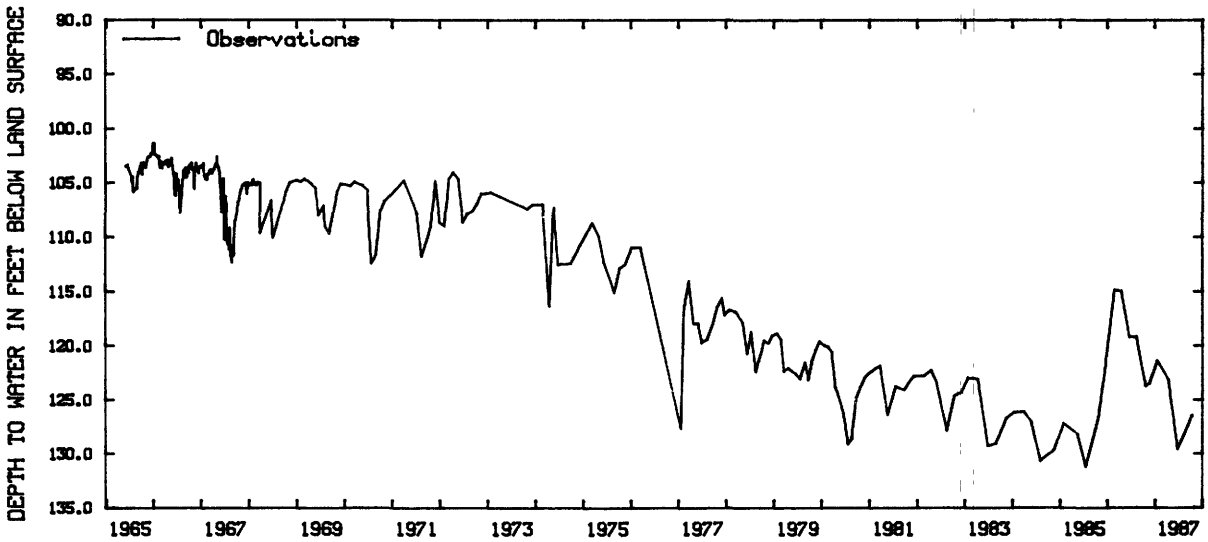
Ground-water levels, 1987 water year
Well 139N47W06AAA01

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. (0.20 m), depth 152 ft (46.3 m).
DATUM.--Altitude of land-surface datum is 908 ft (277 m). Measuring point: Top of recorder platform, 2.40 ft (0.73 m) 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 (30.88 m) below land-surface datum, Dec. 29, 1965; lowest, 131.24 ft (40.00 m) below land-surface datum, July 18, 1985.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 23	123.74	Nov. 21	123.46	Jan. 21	121.38	Apr. 15	123.14	June 24	129.62



Ground-water levels, 1965-87
Well 139N48W11ABA01

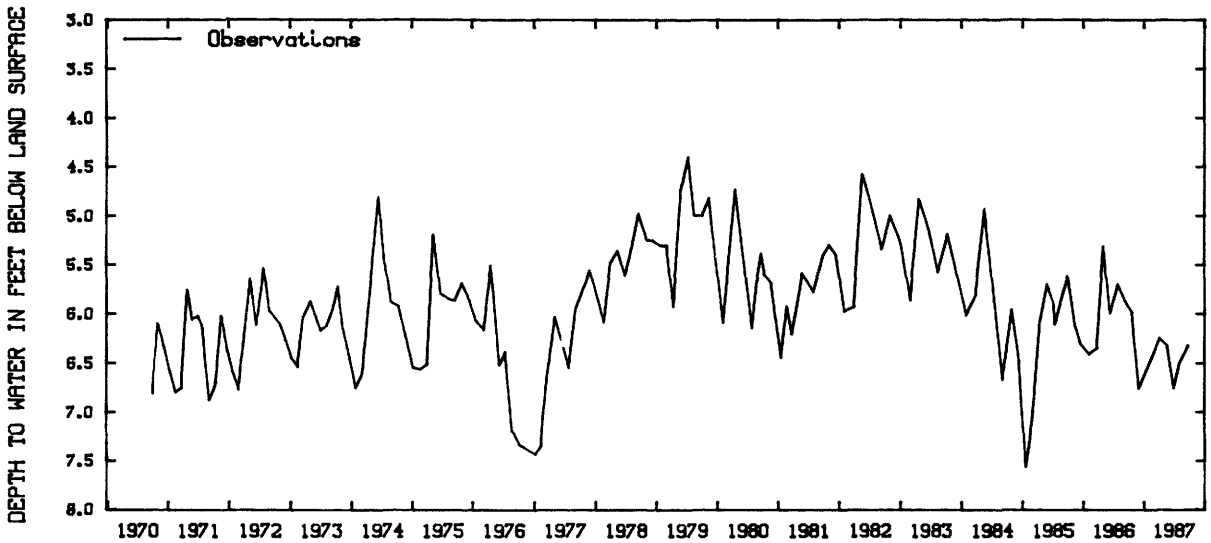
ITASCA COUNTY

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. (0.03 m), depth 10 ft (3.0 m), screened 8 to 10 ft (2.4 to 3.0 m).
DATUM.--Altitude of land-surface datum is 1,350 ft (411 m). Measuring point: Top of casing, 3.40 ft (1.04 m) above land-surface datum.
PERIOD OF RECORD.--September 1970 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 4.40 ft (1.34 m) below land-surface datum, July 13, 1979; lowest, 7.57 ft (2.30 m) below land-surface datum, Jan. 22, 1985.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 20	5.99	Apr. 6	6.25	May 19	6.33	June 29	6.76	Aug. 3	6.50	Sep. 23	6.33
Dec. 2	6.76										

ITASCA COUNTY..Continued



Ground-water levels, 1970-87 water year
Well 148N25W08DDD01

MAHNOMEN COUNTY

471653096020301. Local number, 144N42W20BBA01.
LOCATION.--Lat 47°16'53", long 96°02'03", in NE¼NW¼NW¼ sec.20, T.144 N., R.42 W., Hydrologic Unit 09020108, about 3 mi (4.8 km) southwest of Mahnomen.
Owner: Tom Wendt.
AQUIFER.--Buried sand of Pleistocene.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 4 in. (0.10 m), depth 130 ft (39.6 m).
DATUM.--Altitude of land-surface datum is 1,197 ft (365 m). Measuring point: Top of casing, 1.60 ft (0.49 m) above land-surface datum.
PERIOD OF RECORD.--August 1964 to September 1969, August 1979 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 43.58 ft (13.28 m) below land-surface datum, May 22, 1986; lowest, 47.81 ft (14.57 m) below land-surface datum, Sept. 16, 1981.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 3	44.68	Jan. 26	44.70	Apr. 9	44.13	July 24	45.22	Aug. 26	45.32
Dec. 17	44.55	Mar. 11	44.90	June 3	44.71				

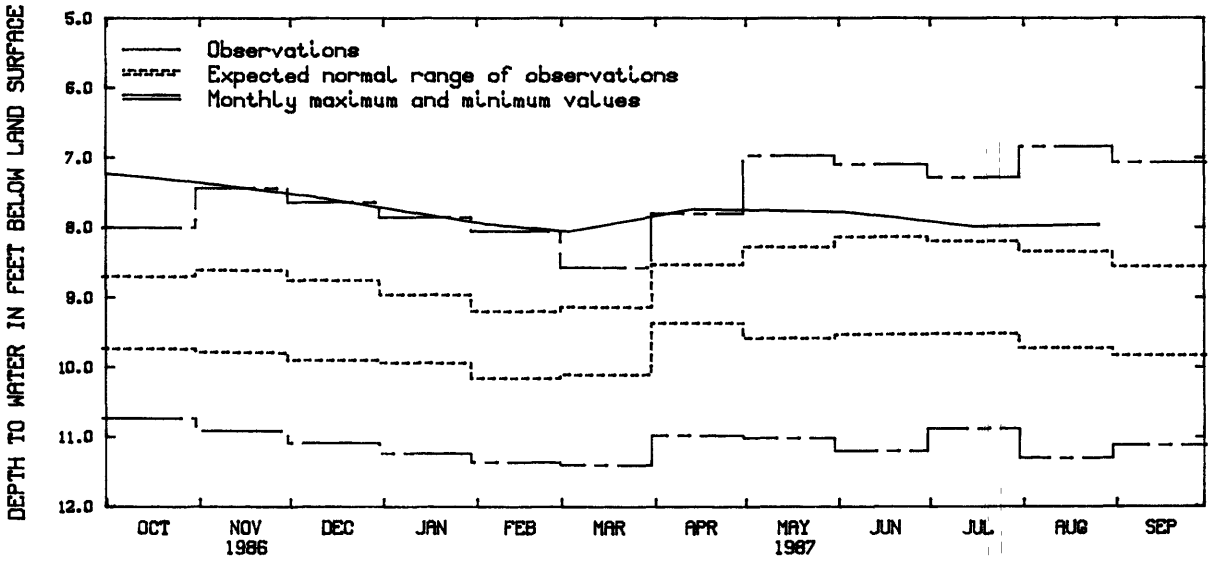
OTTER TAIL COUNTY

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 (7.2 km) north of Perham.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 2 in. (0.10 m), depth 24 ft (7.3 m), screened 21 to 24 ft (6.4 to 7.3 m).
DATUM.--Altitude of land-surface datum is 1,370 ft (418 m). Measuring point: Top of casing, 0.50 ft (0.15 m) above land-surface datum.
PERIOD OF RECORD.--December 1967 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 6.84 ft (2.08 m) below land-surface datum, Aug. 12, 1985; lowest, 11.41 ft (3.48 m) below land-surface datum, Mar. 10, 15, 1977.

WATER LEVEL, IN FEET ABOVE LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 3	7.38	Jan. 7	7.77	Mar. 3	8.07	June 3	7.79	July 16	8.00	Aug. 26	7.96
Dec. 9	7.57	Feb. 4	7.96	Apr. 14	7.73						

OTTER TAIL COUNTY..Continued



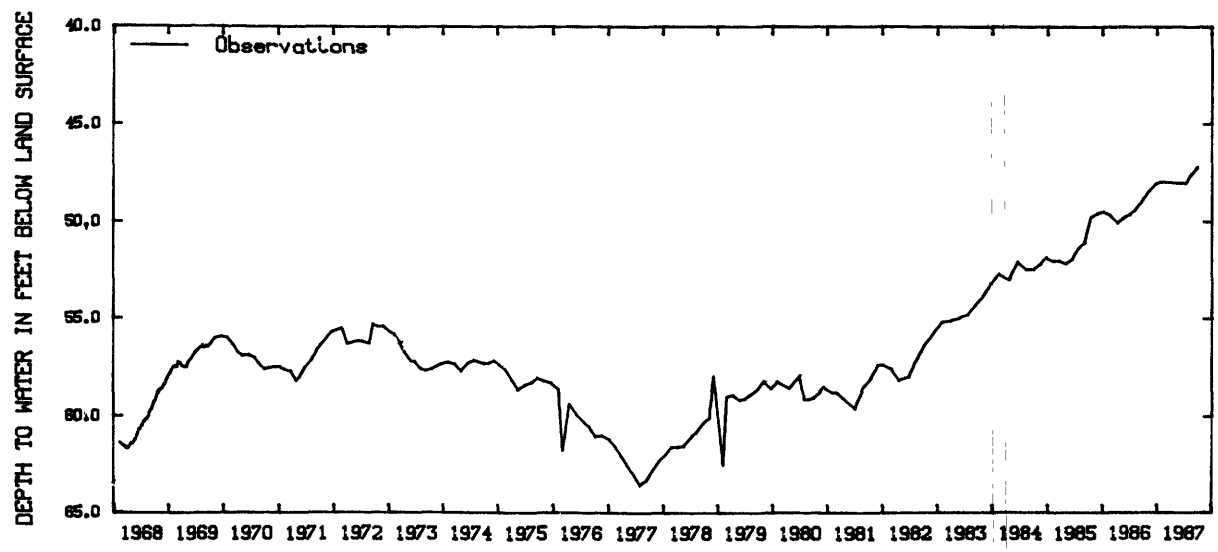
Ground-water levels, 1987 water year
Well 137N39W22ACD01

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 (4.0 km) east of Hibbing.
Owner: Burlington Northern, Inc.
AQUIFER.--Biwabik Iron Formation of Middle Precambrian Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 12 in. (0.30 m), depth 430 ft (131 m), cased to 315 ft (96.0 m).
DATUM.--Altitude of land-surface datum is 1,470 ft (448 m). Measuring point: Top of platform, 1.20 ft (0.37 m) above land-surface datum.
PERIOD OF RECORD.--August 1955 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 47.24 ft (14.39 m) below land-surface datum, Sept. 25, 1987; lowest, 69.07 ft (21.05 m) below land-surface datum, Jan. 15, 1965.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	48.51	Jan. 23	47.95	Apr. 7	48.01	July 9	48.07	Aug. 10	47.66	Sep. 25	47.24
Dec. 18	48.07	Feb. 24	47.98	May 11	48.05						



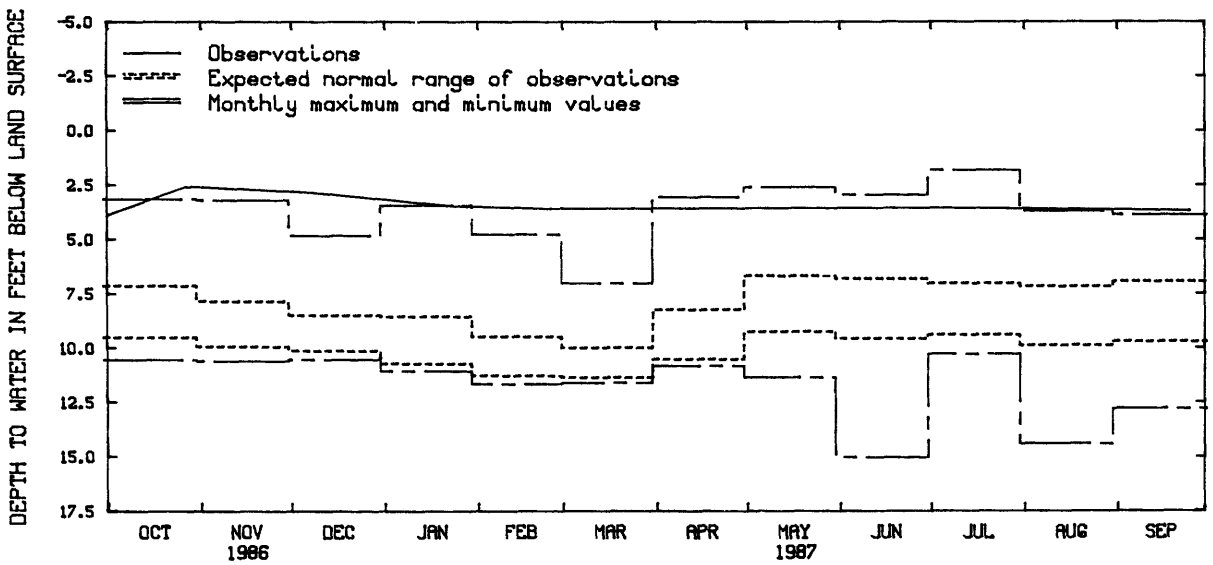
Ground-water levels, 1968-87 water year
Well 057N20W05DAD01

ST. LOUIS COUNTY..Continued

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 (2.25 km) 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. (0.46 m), depth 92 ft (28.0 m), screened 82 to 92 ft (25.0 to 28.0 m).
DATUM.--Altitude of land-surface datum is 1,391 ft (424 m). Measuring point: Hole east side of pump base, 3.00 ft (0.91 m) 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, 1.82 ft (0.55 m) below land-surface datum, July 26, 1985; lowest, 15.05 ft (3.56 m) below land-surface datum, June 30, 1980.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	2.56	Jan. 23	3.50	Feb. 25	3.63	Apr. 8	3.58	July 9	3.57	Sep. 25	3.73
Dec. 8	2.87										

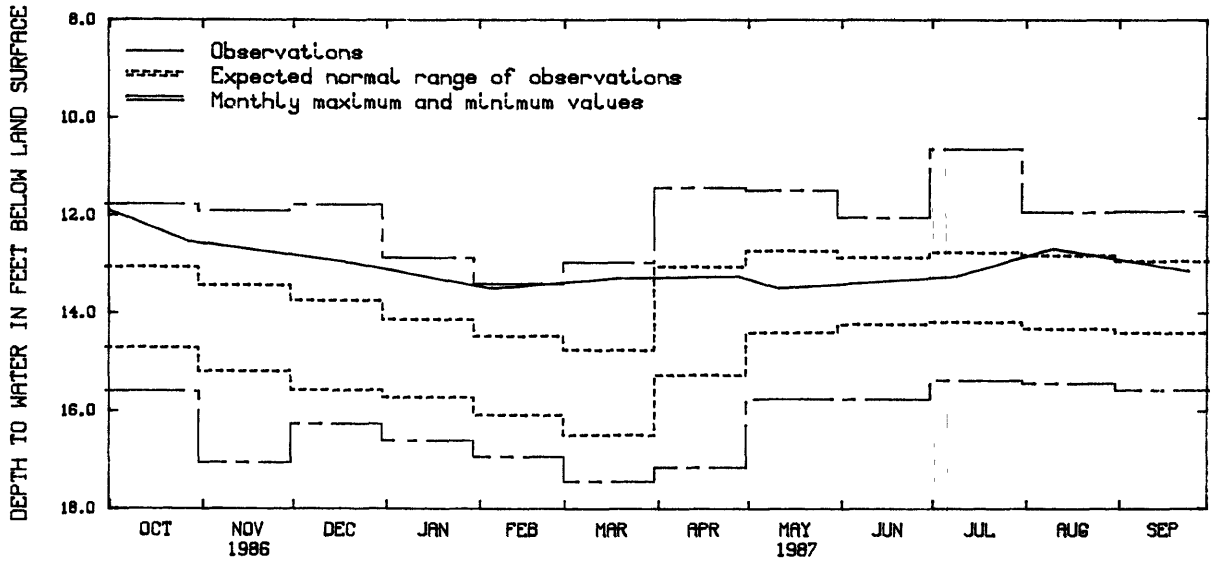


Ground-water levels, 1987 water year
Well 057N20W31DBC01

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 (1.6 km) 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. (0.15 m), depth 97 ft (29.6 m), slotted casing between 67 to 97 ft (20.4 to 29.6 m).
DATUM.--Land-surface datum is 1,427.5 ft (435.1 m) National Geodetic Vertical Datum of 1929. Measuring point: Edge of vent pipe, 1.90 ft (0.58 m) 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 (3.24 m) below land-surface datum, July 20, 1957; lowest, 17.47 ft (5.32 m) below land-surface datum, Apr. 2, 1964.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	12.55	Feb. 5	13.52	Apr. 28	13.25	July 9	13.25	Aug. 10	12.68	Sep. 24	13.15
Dec. 18	12.97	Mar. 18	13.29	May 11	13.51						

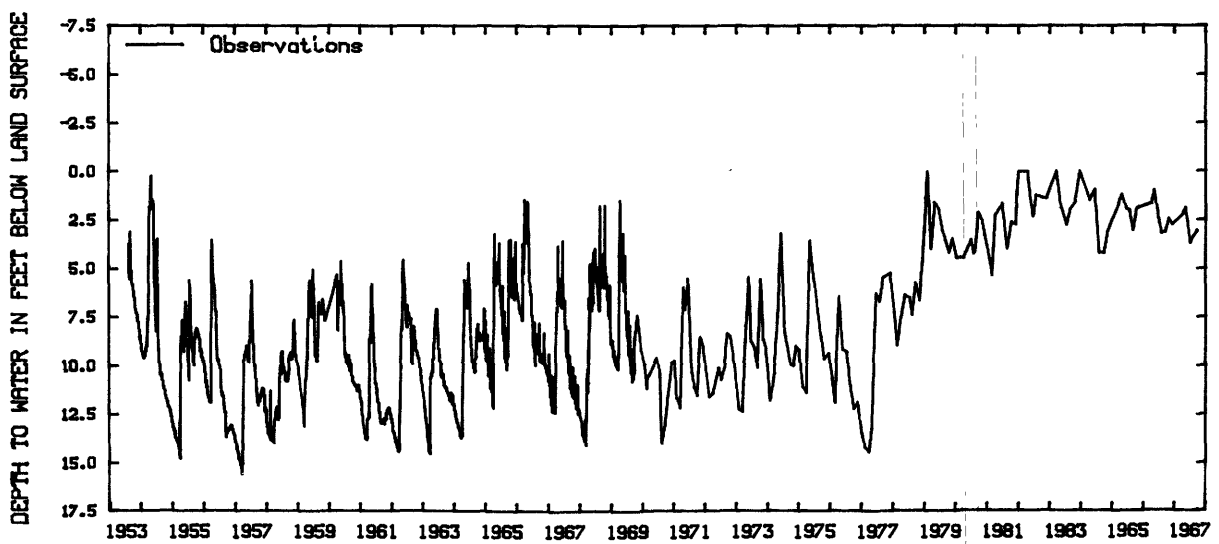


Ground-water levels, 1987 water year
Well 058N18W12CCC01

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. (0.30 m), depth 40 ft (12.2 m), screened 30 to 40 ft (9.1 to 12.2 m).
DATUM.--Altitude of land-surface datum is 1,500 ft (457 m). Measuring point: Top of wood platform, 1.70 ft (0.52 m) 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 (0.07 m) below land-surface datum, May 10, 1954; lowest, 15.60 ft (4.75 m) below land-surface datum, Mar. 23-24, 1957.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	2.46	Apr. 7	2.22	May 11	1.88	July 9	3.72	Aug. 10	3.37	Sep. 24	3.08
Dec. 8	2.77										

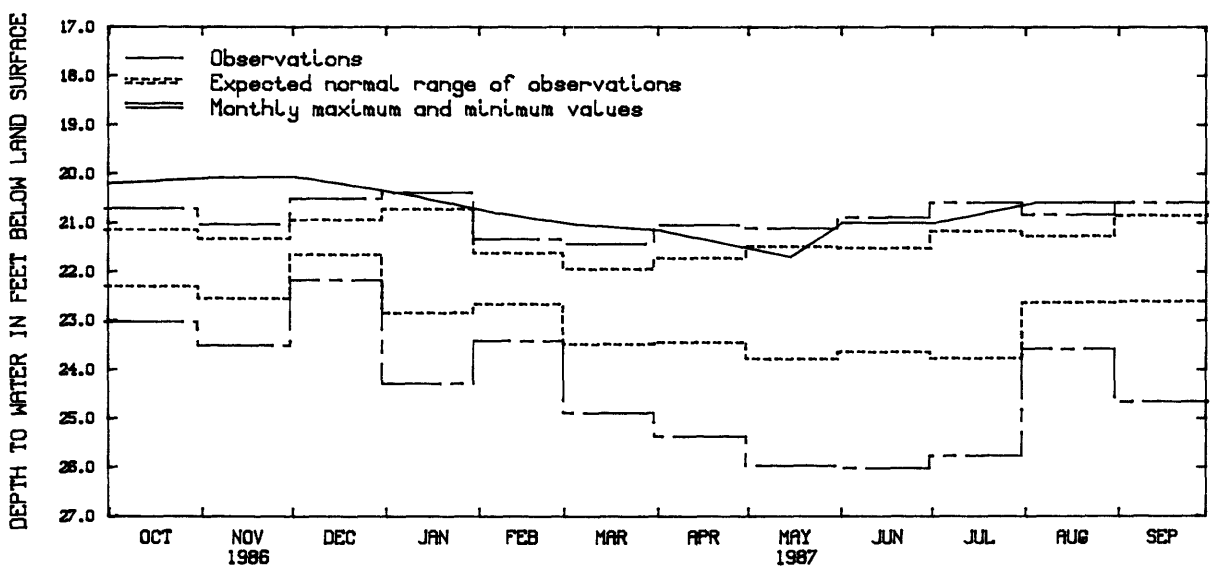


Ground-water levels, 1953-87 water year
Well 058N20W16DBC01

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. (0.05 m), depth 30 ft (9.1 m), screened 27 to 30 ft (8.2 to 9.1 m).
DATUM.--Altitude of land-surface datum is 1,485 ft (453 m). Measuring point: Top of 3 in (0.08 m) pipe, 4.00 ft (1.22 m) 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, 20.06 ft (6.11 m) below land-surface datum, Dec. 2, 1986; lowest, 26.03 ft (7.93 m) below land-surface datum, June 14, 1977.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 1	20.21	Dec. 2	20.06	Feb. 5	20.79	Apr. 2	21.17	June 1	21.00	Aug. 4	20.58
Nov. 3	20.08	Jan. 7	20.42	Mar. 4	21.04	May 15	21.71	July 2	21.00	Sep. 1	20.58

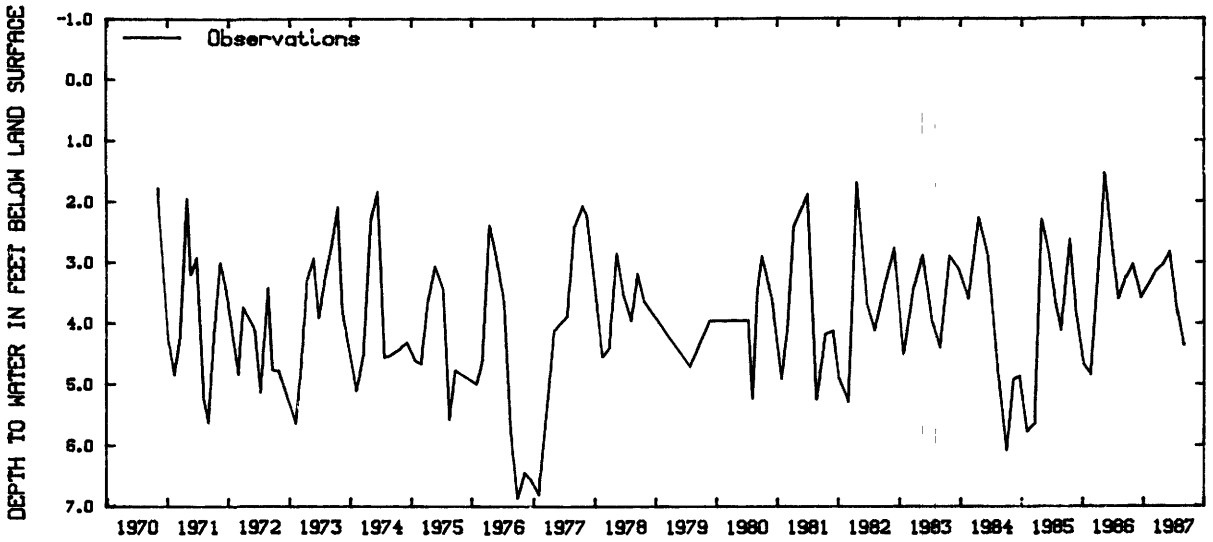


Ground-water levels, 1987 water year
Well 060N13W01BBA01

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. (0.03 m), depth 9 ft (2.7 m), screened 7 to 9 ft (2.1 to 2.7 m).
DATUM.--Altitude of land-surface datum is 1,342 ft (409 m). Measuring point: Top of casing, 4.00 ft (1.22 m) above land-surface datum.
PERIOD OF RECORD.--October 1970 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.53 ft (0.46 m) below land-surface datum, May 14, 1986; lowest, 6.87 ft (2.09 m) below land-surface datum, Sept. 27, 1976.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 28	3.03	Mar. 17	3.14	Apr. 28	3.03	June 9	2.83	July 23	3.80	Sep. 2	4.36
Dec. 17	3.58										



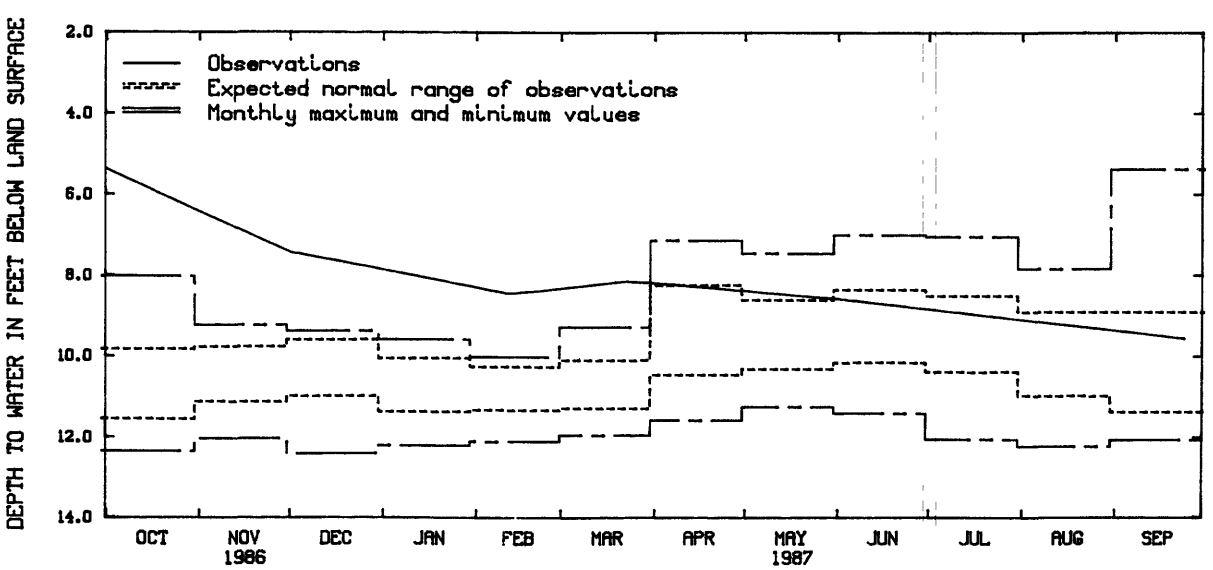
Ground-water levels, 1970-87 water year
Well 063N12W26ABB01

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 (14.5 km) north of Wheaton.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in. (0.03 m), depth 39 ft (11.9 m), open end.
DATUM.--Altitude of land-surface datum is 1,010 ft (308 m). Measuring point: Top of casing, 2.00 ft (0.61 m) above land-surface datum.
PERIOD OF RECORD.--October 1965 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 5.39 ft (1.64 m) below land-surface datum, Sept. 23, 1986; lowest, 12.42 ft (3.79 m) below land-surface datum, Dec. 2, 1983.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Dec. 1	7.43	Feb. 12	8.47	Mar. 23	8.13	June 3	8.61	Sep. 24	9.58



Ground-water levels, 1987 water year
Well 129N47W25CDC01

QUALITY OF GROUND WATER

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

BELTRAMI COUNTY

STATION NUMBER	LOCAL IDENTIFIER	GEO-LOGIC UNIT	DATE	TIME	DEPTH OF WELL, TOTAL (FEET) (72008)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)
474852095021501	150N34W17BAD	112BRDO	08-17-87	1600	80	--	516
475200095030001	151N34W30DBB	112DMDF	08-11-87	1400	90	558	625
		112DMDF	08-18-87	1400	90	--	--
475220094575201	151N34W26ABC	112DMDF	08-18-87	1200	85	--	536
480057094493901	153N33W02ADD	112BRDO	08-11-87	1000	111	400	478
		112BRDO	08-18-87	1100	111	--	--
480107094551701	152N33W05BBB	112DMDF	08-18-87	1000	61	--	651

DATE	PH (STAND-ARD UNITS) (00400)	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 WH WAT TOTAL FIELD (MG/L AS CACO3) (00410)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)
08-17-87	--	7.6	--	74	21	2.0	1.0	--	279	8.9
08-11-87	7.6	7.4	--	81	33	6.6	3.1	361	334	0.9
08-18-87	--	--	--	--	--	--	--	--	--	--
08-18-87	--	7.4	--	75	22	2.6	1.6	--	292	2.8
08-11-87	--	8.1	11.0	31	16	48	3.7	258	256	1.9
08-18-87	--	--	--	--	--	--	--	--	--	--
08-18-87	--	7.5	--	85	28	6.4	3.4	--	267	24

DATE	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)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	ARSENIC TOTAL (UG/L AS AS) (01002)	BERYL-LIUM, TOTAL RECOV-ERABLE (UG/L AS BE) (01012)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD) (01027)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR) (01034)
08-17-87	0.5	0.1	23	<0.01	<0.10	<1	<10	<1	6
08-11-87	0.8	0.2	29	--	--	<1	<10	<1	<1
08-18-87	--	--	--	<0.01	<0.10	--	--	--	--
08-18-87	9.7	0.1	25	<0.01	<0.10	<1	<10	<1	<1
08-11-87	5.2	0.3	14	--	--	7	<10	<1	<1
08-18-87	--	--	--	<0.01	<0.10	--	--	--	--
08-18-87	4.7	0.2	23	<0.01	<0.10	6	<10	<1	2

DATE	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU) (01042)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB) (01051)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG) (71900)	NICKEL, TOTAL RECOV-ERABLE (UG/L AS NI) (01067)	SELE-NIUM, TOTAL (UG/L AS SE) (01147)	SILVER, TOTAL RECOV-ERABLE (UG/L AS AG) (01077)	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN) (01092)	ANTI-MONY, TOTAL (UG/L AS SB) (01097)
08-17-87	--	<1	<5	0.2	16	<1	<1	--	<1
08-11-87	1	13	<5	0.2	4	<1	<1	<10	<1
08-18-87	--	--	--	--	--	--	--	--	--
08-18-87	--	1	<5	0.1	6	<1	<1	80	<1
08-11-87	--	<1	<5	0.2	<1	<1	<1	30	<1
08-18-87	--	--	--	--	--	--	--	--	--
08-18-87	--	2	<5	<0.1	1	<1	<1	10	<1

CLEARWATER COUNTY

STATION NUMBER	LOCAL IDENTIFIER	GEO-LOGIC 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)
473005095241800	147N37W31 DDDA BILL LANGE	112DMDF	08-21-87	1500	60.00	90	1510
473107095240300	147N37W29CC-BAGLEY CITY	112DMDF	08-20-87	1100	30.00	170	--
473150095210500	147.37.22CDD BAGLEY OLD HWY	112DMDF	08-03-87	1930	0.99	31	1470
473332095284000	147N38W22BA-MARTINE	112DMDF	08-21-87	1300	30.00	152	1490
473547095160800	148.36.33 BCB DUDLEY WEST	112DMDF	08-31-87	1400	13.20	18	1437
473802095243100	148N37W18 DDB EDNA NELSON	112DMDF	08-21-87	0900	69.00	85	1490
473832095253300	148N37W18 BBC NORDLUND	112DMDF	08-21-87	1100	9.20	155	1460
473924095161100	148N36W09BBB HENRY LINDOM	112DMDF	08-20-87	1700	--	212	1450
474618095153200	150N36W33 ADA GORDON OLSON	112DMDF	08-20-87	1500	--	--	--
474620095151700	150N36W34BBD-ETTISH DOM WEL	112DMDF	08-20-87	1400	100.00	356	--

DATE	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)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	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)
08-21-87	600	670	7.3	7.3	14.0	--	90	31	3.4	3.0
08-20-87	615	707	7.6	7.5	12.0	745	87	32	17	2.4
08-03-87	825	837	7.6	7.5	9.0	750	110	36	10	3.2
08-21-87	510	563	7.7	7.7	12.0	--	74	24	8.4	2.4
08-31-87	315	358	7.3	7.9	9.5	--	54	13	1.4	0.9
08-21-87	890	1040	7.2	7.1	7.5	--	130	60	8.6	5.7
08-21-87	750	887	7.5	7.5	8.0	--	98	48	29	5.0
08-20-87	600	682	8.1	8.0	15.0	--	77	40	14	4.8
08-20-87	320	381	7.6	7.6	8.5	--	54	16	1.4	2.4
08-20-87	590	649	7.5	7.7	8.5	--	74	34	18	3.1

DATE	ALKA-LINITY WH WAT TOTAL FIELD (MG/L AS CACO3) (00410)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	ALKA-LINITY, CARBON-ATE IT-FLD (MG/L CACO3) (00419)	CAR-BONATE WATER WHOLE IT-FLD (MG/L) (00447)	BICAR-BONATE WATER WHOLE IT-FLD (MG/L) (00450)	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)
08-21-87	464	321	470	0	573	11	1.9	0.2	21	393
08-20-87	378	253	390	0	476	0.9	6.1	1.2	25	400
08-03-87	333	341	334	0	407	6.3	73	0.2	23	454
08-21-87	302	261	306	0	373	1.8	0.4	0.2	19	325
08-31-87	190	177	192	0	234	3.6	1.0	0.1	20	208
08-21-87	508	354	516	0	629	88	6.4	0.2	28	583
08-21-87	444	289	448	0	547	61	1.0	0.2	22	506
08-20-87	376	365	378	0	461	6.9	0.9	0.3	20	392
08-20-87	188	205	196	0	239	1.3	0.6	0.2	27	232
08-20-87	356	354	--	0	449	1.4	0.7	0.2	23	358

QUALITY OF GROUND WATER

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

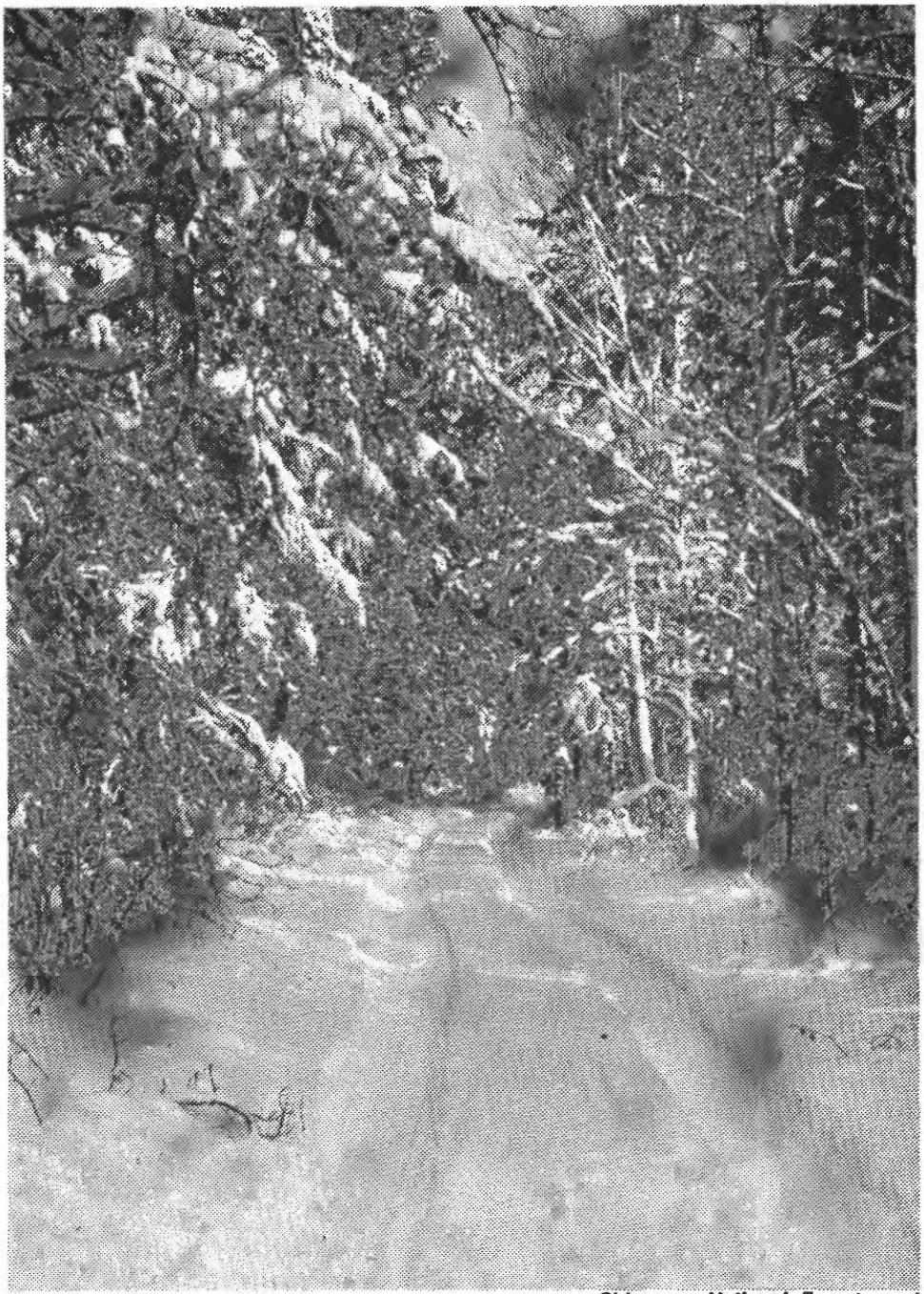
CLEARWATER COUNTY--Continued

DATE	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)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)	CARBON, ORGANIC TOTAL (MG/L AS C) (00680)
08-21-87	<0.10	0.03	0.60	0.057	0.009	--	--	--	1.3
08-20-87	<0.10	0.25	1.0	0.006	0.006	--	--	--	2.1
08-03-87	<0.10	0.17	0.80	0.049	0.003	--	--	--	2.4
08-21-87	<0.10	0.40	0.40	0.010	0.003	--	--	--	--
08-31-87	1.9	<0.01	0.30	0.048	0.040	1	9	<10	3.9
08-21-87	<0.10	0.34	0.80	0.007	0.005	--	--	--	2.4
08-21-87	<0.10	0.55	0.70	0.005	0.004	--	--	--	--
08-20-87	<0.10	0.02	0.40	0.012	0.006	--	--	--	--
08-20-87	<0.10	0.18	0.70	0.013	0.013	--	--	--	--
08-20-87	<0.10	1.1	1.2	0.014	0.014	--	--	--	2.3

VOLATILE ORGANIC ANALYSES

STATION NUMBER	LOCAL IDENTIFIER	GEOLOGIC UNIT	DATE	TIME	PROPAZINE TOTAL (UG/L) (39024)	TRIFLURALIN TOTAL RECOVER (UG/L) (39030)	SIMETRYNE TOTAL (UG/L) (39054)
473547095160800	148.36.33 BCB DUDLEY WEST	112DMDF	08-31-87	1400	<0.10	<0.10	<0.1

DATE	SIMAZINE TOTAL (UG/L) (39055)	PROMETONE TOTAL (UG/L) (39056)	PROMETRYNE TOTAL (UG/L) (39057)	ATRAZINE, TOTAL (UG/L) (39630)	ALACHLOR TOTAL RECOVER (UG/L) (77825)	CYANAZINE TOTAL (UG/L) (81757)	AMETRYNE TOTAL (82184)	METRIBUZIN WATER WHOLE TOT.REC (UG/L) (82611)	METOLACHLOR WATER WHOLE TOT.REC (UG/L) (82612)
08-31-87	<0.10	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.1	<0.1



Chippewa National Forest road

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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

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