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Water Quality of Streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota, 1970-2001

Scientific Investigations Report 2005–5095

U.S. Department of the Interior
U.S. Geological Survey

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By Lan H. Tornes

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U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Gale A. Norton, Secretary

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Executive Summary

Data for the Red River of the North (Red River) Basin in Minnesota, North Dakota, and South Dakota were analyzed to determine whether the water quality of streams in the basin is adequate to meet future needs. For the Red River at Emerson, Manitoba, site, pH values, water temperatures, and dissolved-oxygen concentrations generally were within the criteria established for the protection of aquatic life. Dissolved-solids concentrations ranged from 245 to 1,100 milligrams per liter. Maximum sulfate and chloride concentrations were near, but did not exceed, the established secondary maximum contaminant level. The trace elements considered potentially harmful generally were at concentrations that were less than the established guidelines, standards, and criteria. The concentrations of lead that were detected may have occurred as a result of sample contamination.

For the Red River upstream from Emerson, Manitoba, sites, pH and other field values rarely exceeded the criteria established for the protection of aquatic life. Many constituent concentrations for the Red River below Fargo, N. Dak., site exceeded water-quality guidelines, standards, and criteria. However, the trace-element exceedances could be natural or could be related to pollution or sample contamination.

Many of the tributaries in the western part of the Red River Basin had median specific-conductance values that were greater than 1,000 microsiemens per centimeter. Sulfate concentrations occasionally exceeded the established drinking-water standard. Median arsenic concentrations were 6 micrograms per liter or less, and maximum concentrations rarely exceeded the 10-microgram-per-liter drinking-water standard that is scheduled to take effect in 2006. The small concentrations of lead, mercury, and selenium that occasionally were detected may have been a result of sample contamination or other factors. The tributaries in the eastern part of the Red River Basin had median specific-conductance values that were less than 1,000 microsiemens per centimeter.

Concentrations of pesticides that were detected and that had regulatory limits were less than the cited water-quality guidelines, standards, and criteria. Concentrations of compounds that were detected generally were less than the sediment-quality standards and criteria.

The data considered in this report generally provide a good baseline from which to evaluate changes in water-quality conditions. However, because many of the trace elements detected, including lead and mercury, may have been the result of sample contamination, additional data are needed to confirm that trace-element concentrations generally are low. Concentrations of major ions, including sulfate, and specific conductance may continue to approach drinking-water standards during periods of low flow because the streams, particularly those in the western part of the basin, are sustained mostly by ground-water discharge that generally has large dissolved-solids concentrations.

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Conversion Factors and Datum

Multiply	By	To obtain
	Length	
mile	1.609	kilometer
	Area	
acre	0.4047	hectare
square mile	2.590	square kilometer
	Flow rate	
cubic foot per second	0.02832	cubic meter per second
	Mass	
pounds per square mile per day	1.18	kilograms per square kilometer per day

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F = (1.8 x °C) + 32

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (μS/cm at 25°C).

Concentrations of chemical constituents in water are given in milligrams per liter (mg/L), micrograms per liter (μg/L), or nanograms per liter.

Water Quality of Streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota, 1970-2001

By Lan H. Tornes

Abstract

Data for the Red River of the North (Red River) Basin in Minnesota, North Dakota, and South Dakota were analyzed to determine whether the water quality of streams in the basin is adequate to meet future needs. For the Red River at Emerson, Manitoba, site, pH values, water temperatures, and dissolved-oxygen concentrations generally were within the criteria established for the protection of aquatic life. Dissolved-solids concentrations ranged from 245 to 1,100 milligrams per liter. Maximum sulfate and chloride concentrations were near, but did not exceed, the established secondary maximum contaminant level. The trace elements considered potentially harmful generally were at concentrations that were less than the established guidelines, standards, and criteria. The concentrations of lead that were detected may have occurred as a result of sample contamination.

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Many of the tributaries in the western part of the Red River Basin had median specific-conductance values that were greater than 1,000 microsiemens per centimeter. Sulfate concentrations occasionally exceeded the established drinking-water standard. Median arsenic concentrations were 6 micrograms per liter or less, and maximum concentrations rarely exceeded the 10-microgram-per-liter drinking-water standard that is scheduled to take effect in 2006. The small concentrations of lead, mercury, and selenium that occasionally were detected may have been a result of sample contamination or other factors. The tributaries in the eastern part of the Red River Basin had median specific-conductance values that were less than 1,000 microsiemens per centimeter.

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Introduction

The Dakota Water Resources Act of 2000 directed the U.S. Department of the Interior, Bureau of Reclamation, to prepare a report on the comprehensive water-quality and -quantity needs in the Red River of the North (hereinafter referred to as the Red River) Basin and on the possible options to meet those water needs. To prepare the report, information was needed on municipal, rural, and industrial water supplies; water quality; the aquatic environment; recreation; and water conservation measures in the basin. To address the need for water-quality information, the U.S. Geological Survey (USGS), in cooperation with the Bureau of Reclamation, conducted a study to analyze existing water-quality data for streams in the basin in Minnesota, North Dakota, and South Dakota. The data were analyzed to determine whether the water quality of the streams in the basin is adequate to meet future needs in the basin.

The Red River Basin is a relatively flat lake plain that was formed about 8,000 years ago by glaciation. Land use in the basin, which encompasses about 33,400 square miles in the

northern United States, is mainly agricultural. Crops include small grains, corn, soybeans, sugar beets, sunflowers, and hay. Contemporary streams in the basin generally have slow velocities and carry considerable sediment that is eroded from the clays and silts of the lake plain. Many communities are located along the streams in the basin, and farmsteads are located throughout the basin. Major metropolitan areas in the United States part of the basin include Wahpeton, N. Dak., Breckenridge, Minn., Fargo, N. Dak., Moorhead, Minn., Grand Forks, N. Dak., and East Grand Forks, Minn. These rapidly growing communities are located along the banks of the main stem of the Red River and are adding to the strain on water resources in the basin (Effertz-Hanson, 2004).

The major sources of sustainable potable water for most of the communities in the Red River Basin are the Red River and its tributaries. However, the Red River and its tributaries may not be sufficient sources of sustainable potable water during future dry years in the Red River Basin because of the increasing populations in the communities in the basin (Effertz-Hanson, 2004). The Red River flows north and drains large parts of western Minnesota and eastern North Dakota and a small part of South Dakota (fig. 1) before entering Canada and emptying into Lake Winnipeg in Manitoba, Canada. The river frequently floods during snowmelt runoff because snow and river ice melt from south to north and cause the river to back up behind ice jams. The river has been described as having two water-supply issues--too much and too little. Those issues describe the problems associated with spring flooding in the Red River Basin and with dry conditions in the summer when runoff in the basin is minimal (Bureau of Reclamation, accessed November 10, 2004).

Purpose and Scope

This report presents the analysis of existing water-quality data for streams in the Red River Basin in Minnesota, North Dakota, and South Dakota for 1970-2001. The data used in the report generally were collected by the USGS. Although data from various local, State, tribal, and other Federal agencies also are available and may have been included in the analysis, those data were collected and analyzed using different methods than used by the USGS, and quality assuring the data and determining their comparability was beyond the scope of this report. Many agencies use a variety of methods to collect and analyze water data to assess a defined problem or to document an affected resource. However, the USGS generally collects water data using a clearly defined set of protocols that is used nationwide with the intent of describing the ambient condition of a resource (U.S. Geological Survey, accessed May 10, 2005). Thus, a reasonable assurance is provided that the data collected by the USGS are comparable from site to site and among different geographic and political regions.

Data Analyzed

Various agencies have collected water-quality data for streams in the Red River Basin. The data have been collected for ambient monitoring, regulatory and enforcement purposes, and to better understand special issues. The longest-term records for streams in the Red River Basin are comprised of data that were collected by the USGS as part of the high/low-flow sampling program conducted in cooperation with the North Dakota State Water Commission, the Hydrologic Benchmark Network (HBN) program, and the National Stream Quality Accounting Network (NASQAN) program. Those programs were started in 1971, 1967, and 1974, respectively, and use standard data-collection techniques that make the data comparable. Data collection for the high/low-flow sampling program continues, but data collection for the HBN and NASQAN programs has been discontinued as funding has declined.

Data also have been collected as part of the USGS National Water Quality Assessment (NAWQA) program (February 1993 through September 2002) and for other USGS studies in the basin. Major-ion, nutrient, and pesticide data were collected during 1993-95 as part of the NAWQA program, but the program excluded sampling for most trace elements and microbiological indicators. Only those metals, such as iron and manganese, that are considered less subject to sample contamination were included in the NAWQA program. Data for the USGS studies were collected using techniques that make those data comparable to the data collected as part of the NASQAN program.

The focus of data collection for the NAWQA program was different than the focus of data collection for the high/low-flow sampling, HBN, and NASQAN programs. Data collected for the NAWQA program were intended to provide a comprehensive view of water-quality characteristics related to land-use practices in the highly agricultural Red River Basin, but data collected for the other programs were not intended to directly address water-supply and drinking-water-quality concerns.

Many of the sites used in the NAWQA program were the same as those used in the HBN and NASQAN programs. However, during the late 1980's, sample-collection methods (D. Rickert, U.S. Geological Survey, written commun., 1991) caused contamination of some trace-metal samples collected by the USGS at many of the network sites, including those sites in the HBN and NASQAN programs. Therefore, the cadmium, copper, lead, and mercury data obtained as part of those programs have been questioned along with some additional trace-metal data. The questionable data are noted in this report as being the result of a possible contamination issue rather than as being the result of an actual environmental occurrence.

The USGS data analyzed for this report (appendix 1) generally were collected from 1970 through 2001 and were

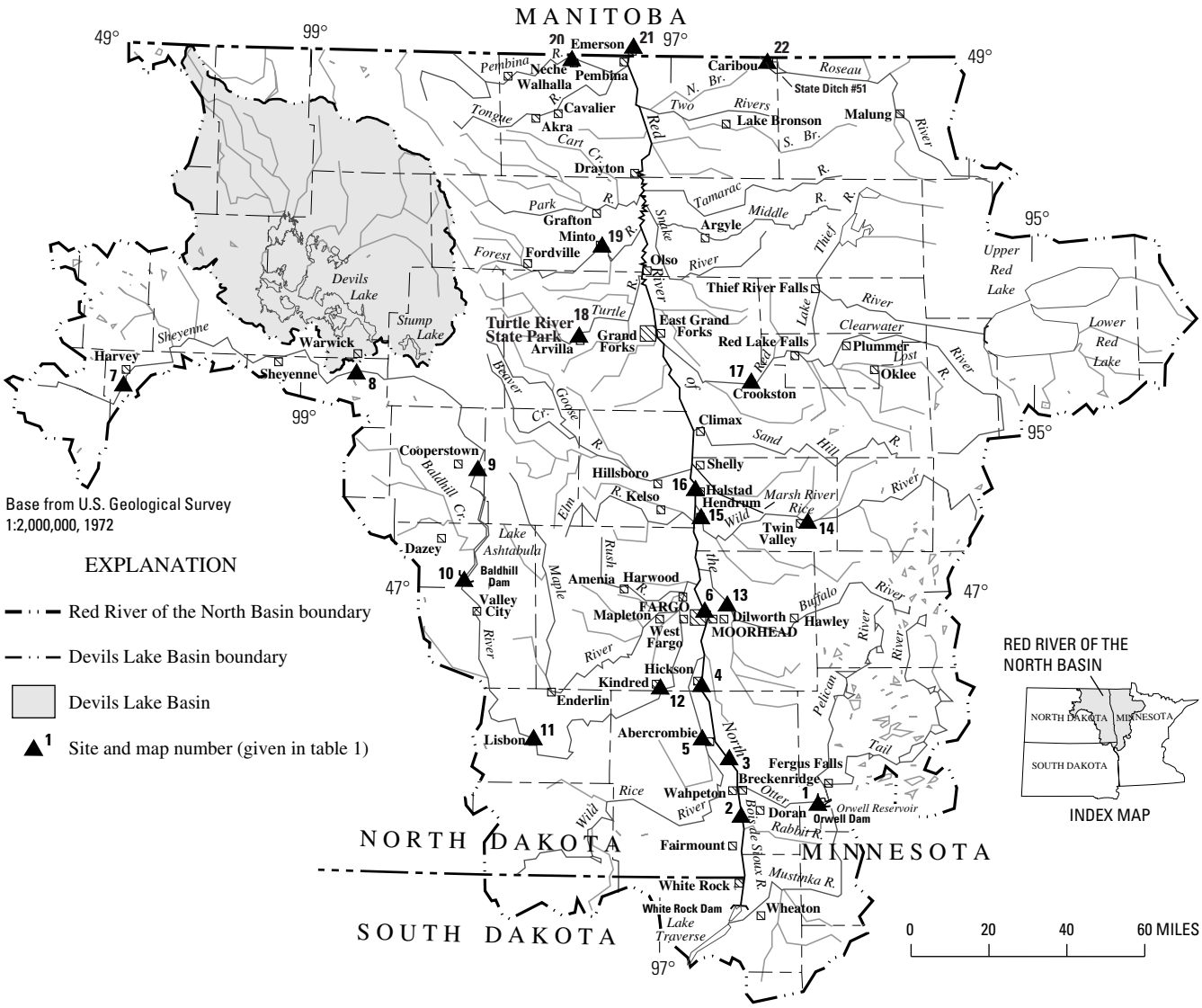

Figure 1. Locations of sites considered to be the most indicative of water quality in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.

retrieved during November 2003 from a USGS Internet-based water-resources data server called the National Water Information System Web (NWISWeb). Data from other agencies and for other time periods may have been included in the analysis. The data in NWISWeb are available at http://water-data.usgs.gov/nwis to anyone who has access to the Internet. Because the data in NWISWeb may be somewhat limited and may not be current, the NWISWeb data for selected sites used in this study were compared to internally available USGS data for those sites. The two types of data had no discernible differences.

The sites given in table 1 and shown in figure 1 are considered to be the most indicative of water quality in the basin. Sample-collection timelines for the sites are shown in figure 2. Some sites were sampled sporadically or briefly, and sampling periods for those sites may overlap or complement sampling periods for nearby sites on the same stream. The data for the nearby sites were considered in the analysis because those data possibly could provide important supplementary information. Inclusion of the data for the nearby sites is noted when appropriate. No attempt was made to normalize those data to a concurrent time period because the modeling required to accomplish that task was beyond the scope of this report. Also, streams in the Red River Basin have inherent cycles and variabilities. Thus, making generalizations about their nature--a requirement for any type of modeling--is difficult (A.V. Vecchia, U.S. Geological Survey, written commun., 2004).

Table 1. Sites considered to be the most indicative of water quality in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota (given in downstream order).

Map number (figure 1)	U.S. Geological Survey site number	Site name	Latitude	Longitude
1	05046000	Otter Tail River below Orwell Dam near Fergus Falls, Minn.	46°12’35”	96°11’05”
2	05051300	Bois de Sioux River near Doran, Minn.	46°09’08”	96°34’44”
3	05051500	Red River of the North at Wahpeton, N. Dak.	46°15’55”	96°35’40”
4	05051522	Red River of the North at Hickson, N. Dak.	46°39’35”	96°47’44”
5	05053000	Wild Rice River near Abercrombie, N. Dak.	46°28’05”	96°47’00”
6	05054020	Red River of the North below Fargo, N. Dak.	46°55’50”	96°47’05”
7	05054500	Sheyenne River above Harvey, N. Dak.	47°42’10”	99°56’55”
8	05056000	Sheyenne River near Warwick, N. Dak.	47°48’20”	98°42’57”
9	05057000	Sheyenne River near Cooperstown, N. Dak.	47°25’58”	98°01’38”
10	05058000	Sheyenne River below Baldhill Dam, N. Dak.	47°02’02”	98°05’00”
11	05058700	Sheyenne River at Lisbon, N. Dak.	46°26’49”	97°40’44”
12	05059000	Sheyenne River near Kindred, N. Dak.	46°37’54”	97°00’01”
13	05062000	Buffalo River near Dilworth, Minn.	46°57’40”	96°39’40”
14	05062500	Wild Rice River at Twin Valley, Minn.	47°16’00”	96°14’40”
15	05064000	Wild Rice River at Hendrum, Minn.	47°16’05”	96°47’50”
16	05064500	Red River of the North at Halstad, Minn.	47°21’10”	96°50’50”
17	05079000	Red Lake River at Crookston, Minn.	47°46’32”	96°36’33”
18	05082625	Turtle River at Turtle River State Park near Arvilla, N. Dak.	47°55’55”	97°30’51”
19	05085000	Forest River at Minto, N. Dak.	48°16’10”	97°22’10”
20	05100000	Pembina River at Neche, N. Dak.	48°59’23”	97°33’24”
21	05102500	Red River of the North at Emerson, Manitoba	49°00’30”	97°12’40”
22	05112000	Roseau River below State Ditch 51 near Caribou, Minn.	48°58’54”	96°27’46”

The suspended-sediment data discussed in this report more accurately represent the suspended, mostly mineral, particles carried by the streams and are not the same as suspended-solids concentrations. Suspended-solids samples often are collected by various agencies using grab or ‘dip’ techniques designed to collect samples of wastewater for compliance monitoring. Suspended-sediment samples most frequently are collected by the USGS using methods designed to collect a representative sample of stream water (U.S. Geological Survey, accessed May 10, 2005). The depth- and flow-integrating techniques and analytical methods used by the USGS incorporate the entire contents of the water sample.

Water-Quality Criteria

Because this report includes data collected from two states and one province--Minnesota, North Dakota, and Manitoba--in two countries--the United States and Canada, multiple guidelines, standards, and criteria for drinking water and aquatic health are, or may be, applicable. In the United States, the most stringent guidelines, standards, and criteria for drinking water and aquatic health are established by the U.S. Environmental Protection Agency (USEPA). However, states have an option to enhance the USEPA guidelines, standards, and criteria, and the

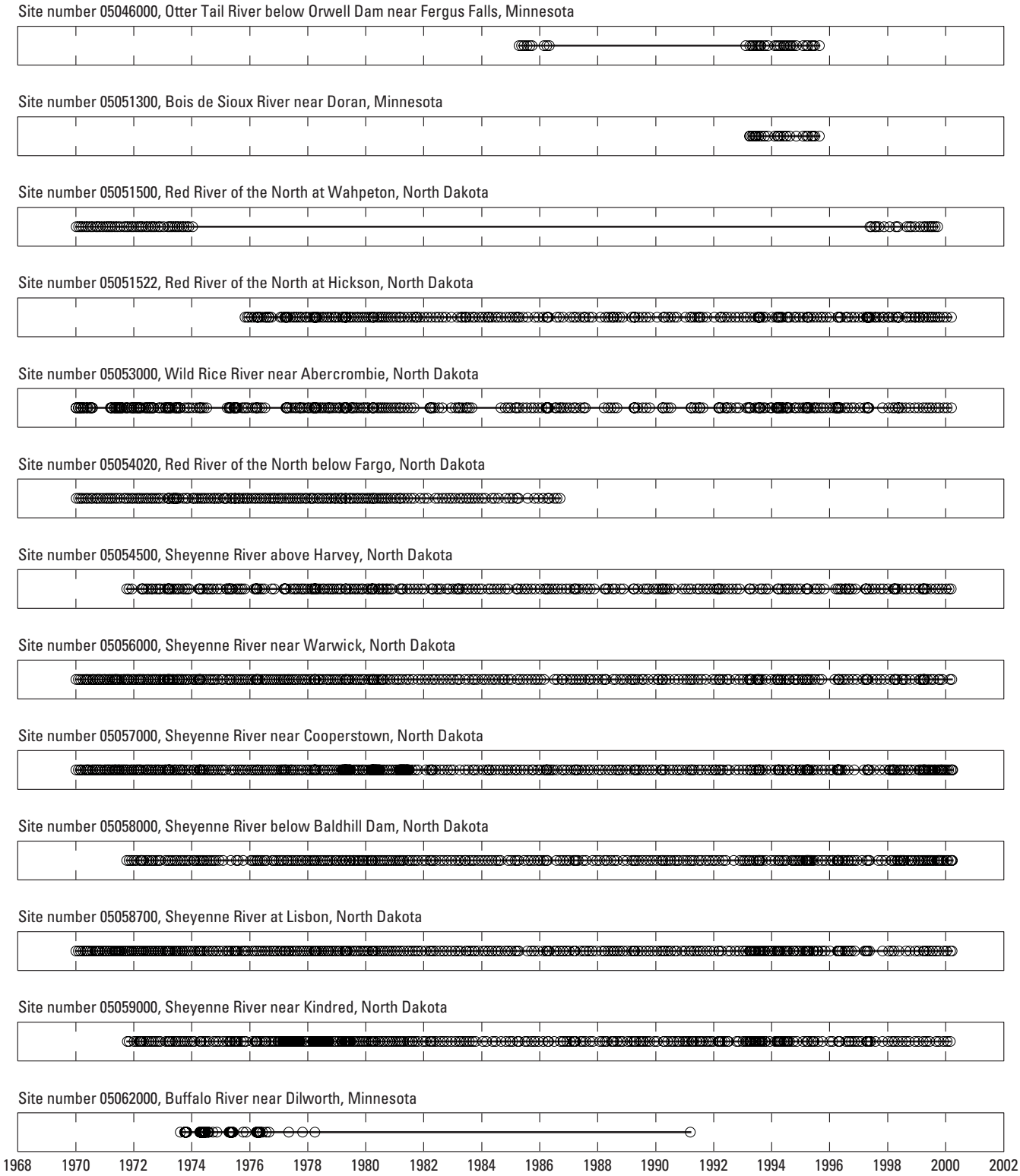

Figure 2. Sample-collection timelines for sites considered to be the most indicative of water quality in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.

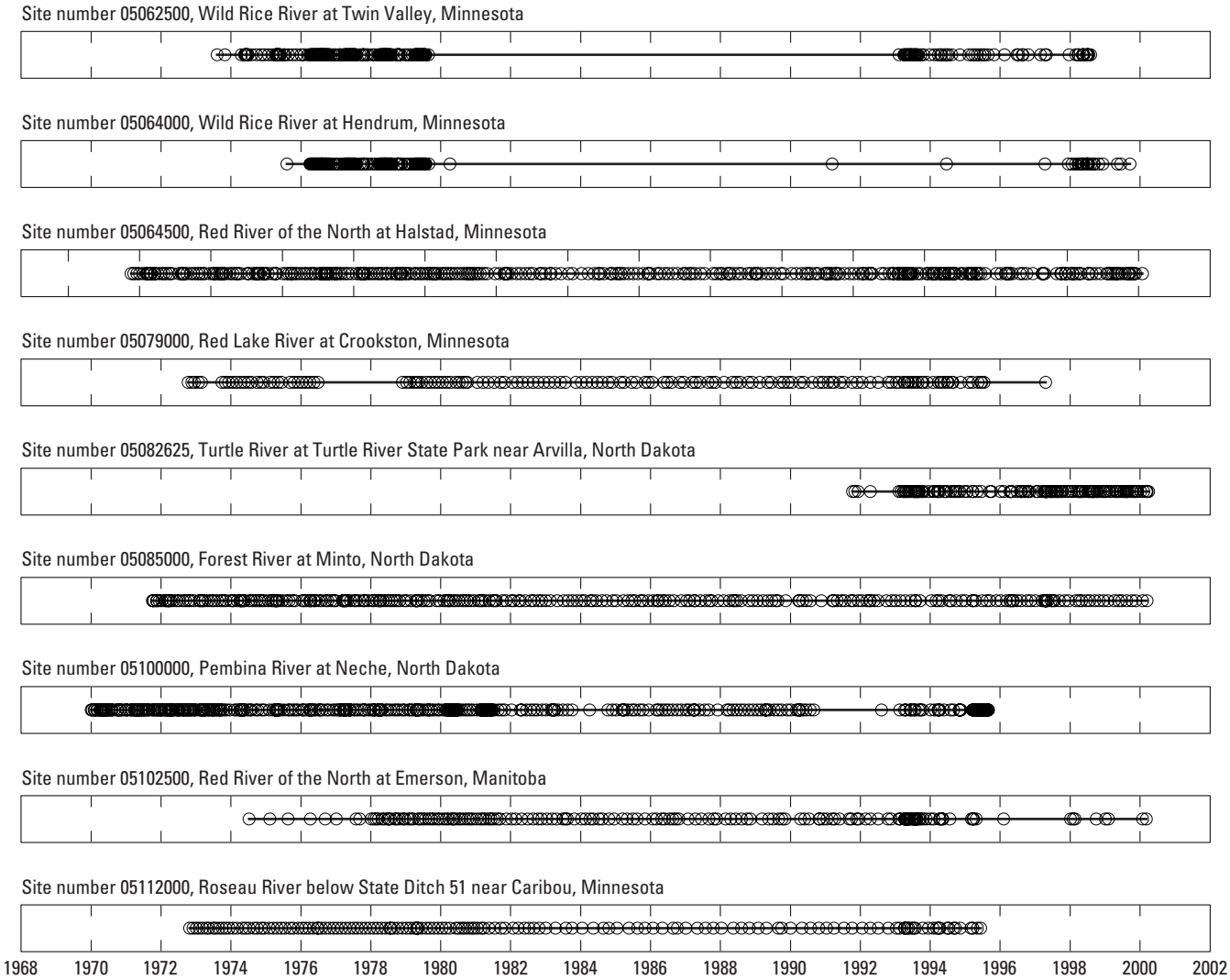

Figure 2. Sample-collection timelines for sites considered to be the most indicative of water quality in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota--Continued.

new state guidelines, standards, and criteria sometimes are challenged by other organizations as being too strict or inadequate. Thus, the state guidelines, standards, and criteria often are preliminary and subject to change. The guidelines, standards, and criteria also may differ from one state to another. Thus, a stream that meets the guidelines, standards, and criteria for one state may not meet the guidelines, standards, and criteria for another state and vice versa. Therefore, for this report, the state guidelines, standards, and criteria generally are cited, but the Federal (United States and Canadian) guidelines, standards, and criteria take precedent. Also, because the Canadian and provincial governments generally have more guidelines, standards, and criteria to protect aquatic life than the United States and state governments and because the Canadian guidelines, standards, and criteria often are stricter than those in the United States, the Canadian guidelines, standards, and criteria are given precedent in this report. Likewise, if more than one guideline, standard, or criterion exists for any constituent measured, the strictest guideline, standard, or criterion will be cited in the report. By using the Canadian guidelines, standards, and criteria to assess whether the water in the Red River Basin meets the guidelines, standards, and criteria established by either Federal entity, the level of confidence that the streams meet the needs of all stakeholders is high.

In many cases, the constituent concentrations given in this report may exceed the drinking-water standards. However, the constituents generally can be removed from the water by conventional treatment methods such as sedimentation and filtration, which also remove many hydrophobic nutrients and organic compounds from the water. In cases where additional

treatment is necessary, reverse osmosis and carbon filtration can be used to remove the constituents from the water.

Also, several streams in the Red River Basin are listed as impaired by the state environmental agencies in Minnesota and North Dakota under the 303(d) program administered by the USEPA. The 303(d) program often is called the total maximum daily load program. The lists of impaired streams generally are maintained on the Internet and may be updated at frequent intervals. The impaired streams listed for Minnesota and North Dakota are given in appendixes 2 and 3, respectively.

Water Quality

Red River of the North at Emerson, Manitoba

The Red River at Emerson, Manitoba, is the most downstream site considered for this report. The Red River at Emerson, Manitoba, site is important because of its implication for the international transport of stream water. Most of the water flowing north from the United States into Canada flows past the Emerson site because the site is located less than 1 mile north of the United States-Canada border. The Emerson site has a long period of record and, as an international site, has been monitored by both the United States and Canada. Thus, the data collected for the Emerson site have had considerable verification.

The Red River at Emerson integrates flow from all of the streams that drain the United States part of the Red River Basin except for the Roseau River. The Roseau River joins the Red River north of Emerson and, from that point, annually contributes an additional 10 percent to the amount of streamflow carried by the Red River at Emerson (USGS water-resources data reports, published annually and available online at http://water.usgs.gov/pubs/). The Red River at Emerson also assimilates all of the point and nonpoint inputs to the system, including industrial and wastewater discharges and agricultural runoff. Because the Red River at Emerson integrates water from many streams, the constituent concentrations at the Emerson site generally were less variable than those at upstream sites. Therefore, for this report, other influences, such as point sources and tributaries, will be related to the concentrations measured at the Emerson site.

The pH values for the Emerson site ranged from 7.2 to 8.9 standard units (appendix 1). The median value was 8.1 standard units. All values were within the range of 6.5 to 9.0 standard units established by the USEPA (2005) and Environment Canada (2002) for the protection of aquatic life.

Water temperatures for the Emerson site ranged from zero to 29.0 degrees Celsius (appendix 1). All values were within the range of zero to 30 degrees Celsius recommended by the USEPA (1986) for the protection of aquatic life, including the fish species Carp (*Cyprinus carpio*) and Channel Catfish (*Ictalurus punctatus*), commonly found in the Red River [see Goldstein (1995) for more information about the distribution of fish communities in streams in the Red River Basin].

Dissolved oxygen is one of the more critical factors for the maintenance of healthy aquatic ecosystems. In well-mixed and minimally-polluted rivers, the dissolved-oxygen concentration is near equilibrium with the atmosphere (near saturation) and ranges from about 8 to 15 mg/L, depending on temperature, barometric pressure, and other factors. Dissolved-oxygen concentrations for the Emerson site ranged from 1.3 to 18.2 mg/L (appendix 1). The median concentration was 9.8 mg/L. The minimum concentration was measured during August 1993 and was among several concentrations for that month that were less than the USEPA (1986) minimum dissolved-oxygen criterion of 3.0 mg/L for the protection of aquatic life. Streamflow in the Red River during the late summer of 1993 was unusually high and exceeded 30,000 ft^3/s (Tornes and others, 1997). Thus, runoff in the Red River Basin probably washed considerable oxygen-demanding substances into the streams in the basin. Oxygen-demanding substances include materials that consume oxygen as microorganisms decompose organic carbon and other materials associated with runoff and point-source inputs. Except for the late-summer-1993 period when streamflow in the basin was unusually high, the dissolved-oxygen concentrations were always greater than the USEPA (1986) minimum dissolved-oxygen criterion of 3.0 mg/L and the Environment Canada (2002) guideline of 5.5 mg/L. The maximum concentration for the Emerson site was measured in December 1980 and appears to be an outlier because no other concentrations for that site exceeded 15.6 mg/L.

Dissolved-solids concentrations for the Emerson site ranged from 245 to 1,100 mg/L (appendix 1). The median concentration was 438 mg/L. The relatively large concentrations (mostly dissolved salts and silica) probably originated from tributaries in the western part of the Red River Basin because the basins for those tributaries had little precipitation and runoff and the salts in the lakes and reservoirs could become concentrated as a result of evaporation (Strobel and Haffield, 1995). The dissolved-solids concentrations in ground-water discharge from aquifers in the western part of the basin also tend to be large (Strobel and Haffield, 1995). The USEPA (2005) drinking-water standard, also called a secondary maximum contaminant level (SMCL), for dissolved solids is 500 mg/L.

Suspended sediment is transported by streams and leads to sedimentation of pools, lakes, and reservoirs and, thus, reduced clarity. Suspended sediment also is associated with the transport of various contaminants, including trace elements, hydrophobic organic compounds, and phosphorus. Stoner and others (1998) showed that the concentrations of trace elements and hydrophobic organic compounds in recently-deposited bottom sediments in the Red River Basin during 1992 were consistent with those

at other sites in the United States and that the concentrations were not known to cause a threat to human health or the health of aquatic ecosystems in the basin. Brigham and others (1998) provided a more detailed discussion of constituents in bottom sediments in the basin. Tornes and Brigham (1994) indicated that, for 1970-90, the Red River at Emerson had the largest median suspended-sediment concentration (108 mg/L) of any of the sites evaluated for their study. The Pembina River, which joins the Red River a few miles upstream from Emerson, had the largest load per unit of area (1,010 pounds per square mile per day) of suspended sediment of any of the streams evaluated by Tornes and others (1997).

Hardness often is cited in USEPA guidelines, standards, and criteria as a factor that affects the toxicity of metals to aquatic organisms. The hardness values for the Emerson site were calculated from the calcium and magnesium concentrations and were as large as 496 mg/L. The median value was 280 mg/L as calcium carbonate. Many of the trace-element aquatic-life criteria provided by the USEPA (2005) use a hardness value of 100 mg/L, which generally is less than the hardness values for the Red River at Emerson. The trace-element aquatic-life criteria provide a numeric value to which the Red River values can be compared, but specific exceedances were not calculated for this report.

The water in the Red River at Emerson, as in most streams in the Red River Basin, was predominantly a calcium-magnesium bicarbonate type. The median concentrations for the Emerson site were 63 mg/L for calcium, 30 mg/L for magnesium, and 255 mg/L for bicarbonate (appendix 1). The median concentrations for sodium, sulfate, and chloride were 34, 94, and 35 mg/L, respectively. The maximum sulfate and chloride concentrations were 230 and 240 mg/L, respectively. Those concentrations were near, but did not exceed, the SMCLs established by the USEPA (2005).

Large nutrient concentrations in streams may enhance plant growth and, thus, may adversely affect aquatic habitat and the potability of the water supply. Nutrient concentrations for the Red River at Emerson generally were less than those for smaller streams that drain agricultural areas, possibly because of the integrating effect of the stream system at Emerson. The median total ammonia plus organic nitrogen concentration for the Emerson site was 1.2 mg/L as N (Tornes and Brigham, 1994). Most (about 1 mg/L) of the total ammonia plus organic nitrogen (as N) was in the dissolved state. The median nitrite plus nitrate nitrogen concentration was 0.34 mg/L as N (Tornes and Brigham, 1994). The maximum concentration (5.8 mg/L) for that constituent was less than the USEPA (2005) drinking-water standard of 10 mg/L (U.S. Environmental Protection Agency, 2005). The median ammonia concentration was 0.08 mg/L (Tornes and Brigham, 1994). The maximum concentration (2.3 mg/L) for that constituent was recorded in 1981. Based on preliminary criteria from the USEPA (2005), the aquatic organisms that would have been affected adversely during the circumstances in which the 2.3-mg/L concentration occurred are unknown. Since more stringent water-quality standards have been enacted by the Clean Water Act of 1972, which was amended in 1977 (U.S. Environmental Protection Agency, 2005), and by other regulations, ammonia concentrations in the Red River have been much smaller than in previous years. Thus, the aquatic habitat in the Red River has improved. Data collected at the Emerson site as part of the NAWQA program indicate the maximum ammonia concentration for that site during 1993-95 was 0.37 mg/L (Tornes and others, 1997).

Trace elements were included in the analysis of samples collected at the Emerson site and at other sites in the Red River Basin as part of the NASQAN program. However, beginning in the early 1990's, much of the sampling for the NASQAN program was discontinued because of concerns about sample contamination. Therefore, the only trace elements for which samples continued to be routinely collected after the early 1990's were iron and manganese, which generally are considered to be nontoxic micronutrients. Trace-element data collected before sampling was discontinued are discussed in this report with the caveat that the data may have been affected adversely by sample contamination. Mercury and other trace-element data collected more recently (Brigham and others, 1999; Brigham and others, 2002; Sando and others, 2003) further suggest that previously collected data may have been biased.

The trace elements considered potentially harmful generally were at concentrations that were less than the guidelines, standards, and criteria established by the United States and Canada. The maximum dissolved arsenic concentration (11 µg/L) (appendix 1) was slightly more than the 10-µg/L USEPA drinking-water standard that is scheduled to take effect in January 2006. That concentration and a few other concentrations exceeded the 5-µg/L guideline established by Environment Canada (2002) for the protection of aquatic life, but the concentrations were much less than the 150-µg/L criterion established by the USEPA (2005). The maximum dissolved barium concentration (240 µg/L) (appendix 1) was almost an order of magnitude less than the 2-mg/L USEPA (2005) drinking-water standard and was much less than any other standard used in the analysis. Although the dissolved cadmium concentrations generally were less than the laboratory detection level, when cadmium was detected, the concentrations were less than the established USEPA (2005) drinking-water standard of 5 µg/L. The maximum dissolved copper concentration (17 µg/L) (appendix 1) was nearly three orders of magnitude less than the 1.3-mg/L USEPA (2005) drinking-water standard. The maximum dissolved iron concentration (640 µg/L) (appendix 1) was measured in April 1991 and was the only concentration that exceeded the 300-µg/L guideline established by Environment Canada (2002) for the protection of aquatic life. Dissolved lead concentrations were less than the laboratory detection level in more than 75 percent of the samples collected. When lead was detected, the concentrations were 11 µg/L or less (appendix 1). The USEPA (2005) action level for removal of lead from drink-

ing water is 15 µg/L, and the Environment Canada (2002) guideline for the protection of aquatic life is 1.7 µg/L. The concentrations of lead may have occurred as a result of pollution before the widespread use of lead as an octane booster in gasoline was restricted. Lead weights that commonly were used and handled during field trips also could cause sample contamination. Dissolved lead concentrations were variable until sampling was discontinued at the end of 1991 (fig. 3).

Dissolved mercury concentrations ranged from less than 0.1 to 0.5 µg/L (appendix 1). At the reporting level established for this analysis and with the analytical method presently (2005) used, mercury probably would not have been detected in the samples collected at the Emerson site. Total and dissolved mercury and methylmercury concentrations in samples that were collected recently in various parts of the Red River Basin (Brigham and others, 1999; Sando and others, 2003) typically were less than 10 nanograms per liter, and methylated concentrations were much smaller. Those samples were collected and analyzed using methods that are more refined than those used in previous years. The USEPA (2005) criterion for mercury in aquatic ecosystems is 0.77 µg/L. Criteria for methylmercury concentrations in tissue have been promulgated to protect human health, but criteria for methylmercury concentrations in environmental samples were not available.

The previously straightforward sampling and analysis methods for total and dissolved mercury in water recently have become more refined because of a developing understanding of how mercury behaves in the environment. The chemical behavior of mercury in the environment is changed by biogeochemical processes that were not evident by the concentrations obtained by previous sampling and analysis methods. Concentrations reported in recent studies are much less than those considered for this report.

Red River of the North Upstream from Emerson, Manitoba

Samples were collected at sites upstream from the Red River at Emerson, Manitoba, site as part of the NASQAN and NAWQA programs and for USGS studies in the Red River Basin. The upstream sites that were used for this study were the Red River at Wahpeton, N. Dak.; the Red River at Hickson, N. Dak; the Red River below Fargo, N. Dak.; and the Red River at Halstad, Minn.

The pH criterion of 9.0 standard units established by the USEPA (2005) and Environment Canada (2002) for the protection of aquatic life rarely was exceeded at the upstream sites (appendix 1). Values for the Halstad site on September 27, 1984, exceeded the criterion, but the values probably were measured during a special study intended to evaluate stresses imposed upon the Red River. Water temperatures for the upstream sites occasionally exceeded the USEPA (1986) criterion of 30 degrees Celsius for the protection of aquatic life (appendix 1). The USEPA (1986) minimum dissolved-oxygen criterion of 3.0 mg/L was exceeded during the 1970's when the concentration reached 0.6 mg/L at the Hickson site and 1.4 mg/L at the below Fargo site (appendix 1). On occasion during the same period, the concentration reached 3.0 mg/L as far downstream as Halstad. Since more stringent water-quality standards were enacted by the Clean Water Act of 1972, which was amended in 1977 (U.S. Environmental Protection Agency, 2005), dissolved-oxygen concentrations in the Red River have improved. However, during July 1993, the criterion was exceeded at the Halstad site when increased flows apparently washed oxygen-demanding substances into the Red River.

Many constituent concentrations for the below Fargo site exceeded water-quality guidelines, standards, and criteria. The maximum sulfate concentration of 330 mg/L (appendix 1) was more than the 250-mg/L USEPA (2005) drinking-water standard. Other exceedances, including cadmium, copper, lead, and selenium concentrations, generally occurred during the 1970's or before and could be natural or could be related to pollution or sample contamination.

Large cadmium concentrations of 26 and 45 µg/L (appendix 1) were measured in samples collected at the Halstad site in 1983 and 1988, respectively. The concentrations were much larger than the Environment Canada (2002) freshwater aquatic-life guideline of 0.017 µg/L and the USEPA (2005) aquatic-life criterion of 0.25 µg/L.

Dissolved mercury was detected at some upstream sites, but the source or cause of the mercury is uncertain. The largest concentration (11 µg/L) was measured at the Hickson site (appendix 1). Because no other trace elements or other indicators were evident, the concentrations probably were an artifact of sample collection, processing, handling, or analysis (Windom and others, 1991). Mercury detections at the Emerson site and other caveats cast doubt on the reliability of the mercury detections at the upstream sites.

Sheyenne River

The Sheyenne River is the longest tributary to the Red River. Although the Sheyenne River has a large drainage area, the river carries proportionately little water because runoff in that part of the Red River Basin is minimal when compared to runoff from tributaries in the eastern part of the basin. Data from sites located from near the headwaters of the Sheyenne River where the river occasionally dries up (Robinson and others, 2004) to near the mouth of the Sheyenne River where the river joins the Red River were included in this study.

Generally, the physical and chemical data for the Sheyenne River indicate the water is suitable for most currently designated uses. pH values rarely exceeded the criterion of 9.0

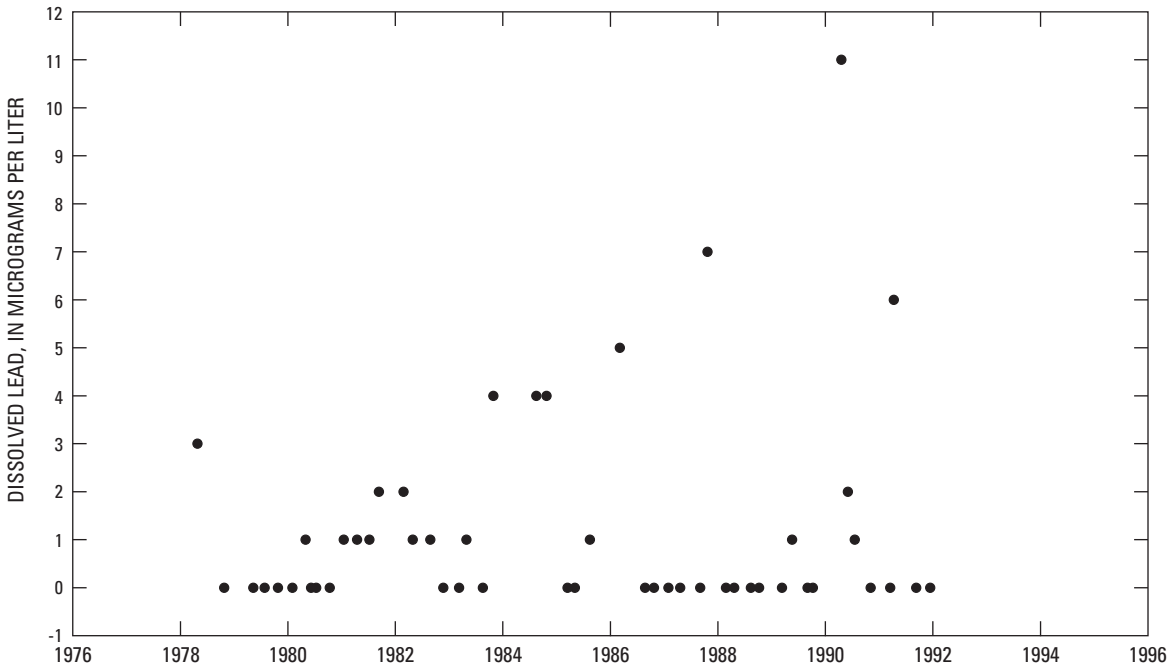

Figure 3. Dissolved lead concentrations for the Red River of the North at Emerson, Manitoba.

standard units established by the USEPA (2005) and Environment Canada (2002) for the protection of aquatic life and generally were less than 8.0 standard units (appendix 1). Water temperatures generally were less than the criterion of 30 degrees Celsius established by the USEPA (1986) for the protection of aquatic life (appendix 1). Dissolved-oxygen concentrations generally exceeded 3.0 mg/L and usually ranged from more than 6.0 mg/L to near saturation (appendix 1). The smallest dissolved-oxygen concentrations occurred at the Sheyenne River above Harvey, N. Dak., site at various times during the early 1990's or earlier and occurred most often when streamflows were low. Thus, the stream probably was not able to assimilate the load of internally- or externally-derived oxygen-demanding substances.

The water chemistry of the Sheyenne River was relatively constant along the length of the river. The water in the Sheyenne River contained a mixture of calcium, sodium, bicarbonate, and sulfate ions. Although sodium concentrations generally were much less than 100 mg/L for sites downstream from the Sheyenne River above Harvey, N. Dak., site, the median concentration for the Harvey site was 250 mg/L (appendix 1). Maximum concentrations were near or greater than 500 mg/L for the Harvey site and for the Sheyenne River near Cooperstown, N. Dak., and Sheyenne River at Lisbon, N. Dak., sites (appendix 1). At many sites, the sulfate concentration occasionally exceeded the USEPA (2005) drinking-water standard of 250 mg/L.

Chromium, lead, mercury, nickel, and zinc generally were detected less frequently and had smaller concentrations with time, indicating better controls on wastewater discharges and/or improved sample-collection and -processing techniques that reduced unintended sample contamination. Trace elements that were detected more commonly included arsenic, copper, and nickel. Median arsenic concentrations typically were 4 µg/L or less (appendix 1), and maximum concentrations occasionally exceeded the 10-µg/L USEPA drinking-water standard that is scheduled to take effect in 2006.

Lake Ashtabula, a major reservoir along the Sheyenne River, is used for recreation, water supply, and flood control. The Sheyenne River data most pertinent to this study were collected at the Sheyenne River below Baldhill Dam, N. Dak., site near the outlet of the reservoir during 1959 through 2000. Specific conductance for the Baldhill Dam site is shown in figure 4. A gradual increase in specific conductance occurred with time although the trend was not tested to determine its statistical significance. An increase in specific conductance could result from a decrease in precipitation, an increase in evaporation, a change in withdrawal and irrigation patterns, or various other factors. However, changes in streamflow were not evaluated for this study.

All constituent concentrations for the Baldhill Dam site were within the USEPA (2005) and Environment Canada (2002) water-quality guidelines, standards, and criteria. Dissolved-oxygen concentrations were consistently 6.0 mg/L or

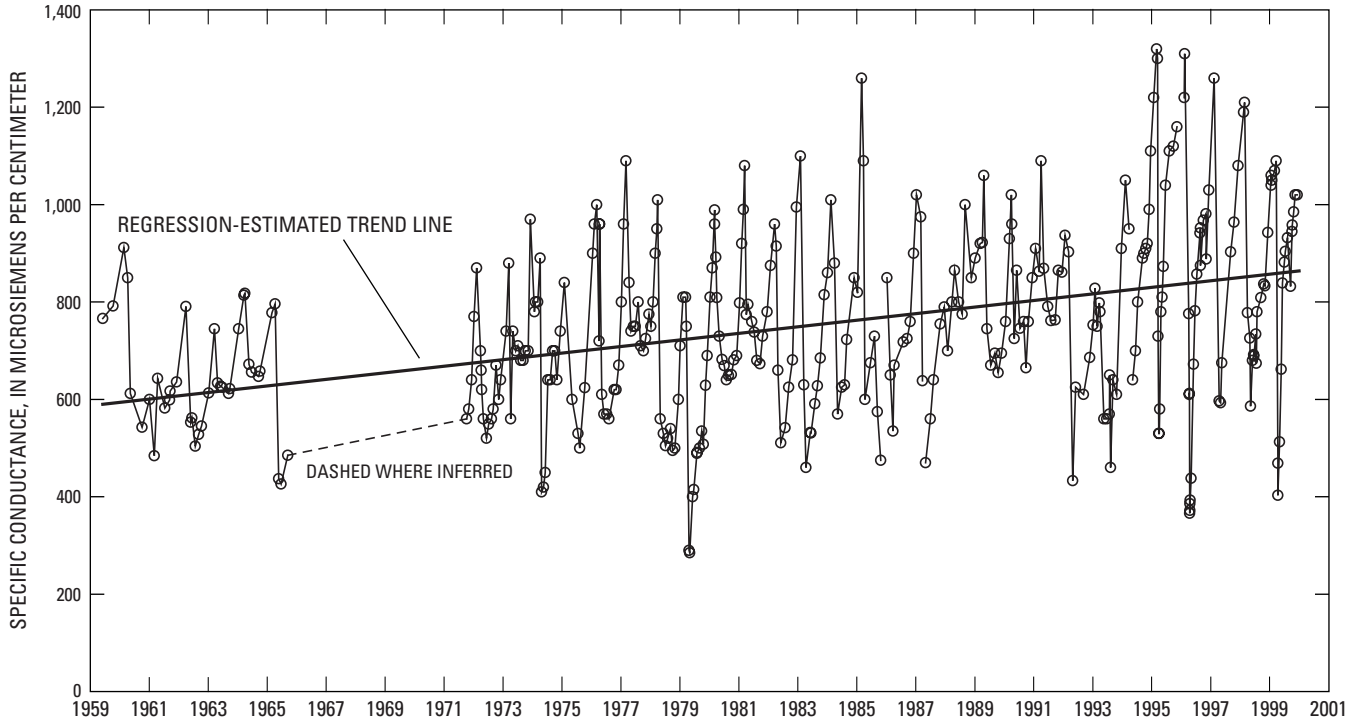

Figure 4. Specific conductance for the Sheyenne River below Baldhill Dam, North Dakota.

larger (appendix 1). The median sulfate concentration was 120 mg/L. Median arsenic and selenium concentrations were 4 µg/L and less than 1 µg/L, respectively.

Western Tributaries

The tributaries in the western part of the Red River Basin drain areas that have relatively large evaporation rates and small amounts of runoff (Stoner and others, 1998). During baseflow, the streams are sustained mostly by ground-water discharge that generally has large dissolved-solids concentrations. Thus, large concentrations of salts and trace elements that may be considered harmful to aquatic ecosystems and human health may be introduced to the streams during low-flow conditions.

Many of the tributaries in the western part of the basin had median specific-conductance values that were greater than 1,000 µS/cm (appendix 1). Much of the salt that comprised the specific conductances was calcium and sodium. Sulfate concentrations occasionally exceeded the 250-mg/L USEPA (2005) drinking-water standard, and median sulfate concentrations for the Wild Rice River near Abercrombie, N. Dak.; Maple River near Mapleton, N. Dak.; and Goose River at Hillsboro, N. Dak., sites indicate that water from those streams exceeded the USEPA (2005) drinking-water standard in more than half of the samples. However, the sulfate concentrations were considerably less in the tributaries that are located farther north in the western part of the basin.

The median arsenic concentrations for the tributaries in the western part of the basin were 6 µg/L or less (appendix 1). The median concentrations for the Abercrombie, Mapleton, and Hillsboro sites were 4 µg/L or greater, and the median concentrations for the tributaries that are located farther north in the western part of the basin were 3 µg/L. Maximum arsenic concentrations rarely exceeded the 10-µg/L USEPA drinking-water standard that is scheduled to take effect in 2006. The largest concentration (20 µg/L) was for the Forest River at Minto, N. Dak., site. Arsenic in the tributaries in the western part of the basin probably originated from ground-water discharge that contains as much as 50 µg/L of arsenic (Stoner and others, 1993).

Other trace elements also were detected in the tributaries in the western part of the basin, but the concentrations for those trace elements were small. Small concentrations of copper, nickel, strontium, and zinc commonly were detected in the tributaries that are located farther south in the western part of the basin. The small concentrations of lead, mercury, and selenium that occasionally were detected may have been a result of sample contamination or other factors that are unrelated to source-water inputs (Windom and others, 1991). Trace metals have been detected less frequently in recent years, indicating

improved sample-collection, -processing, and -analytical techniques or, possibly, improved water quality.

Eastern Tributaries

The tributaries in the eastern part of the Red River Basin drain areas that have relatively large amounts of runoff and small evaporation rates compared to the tributaries in the western part of the basin (Stoner and others, 1993). For this report, the Bois de Sioux River was included with the tributaries in the eastern part of the basin because the river forms part of the boundary between Minnesota and North Dakota and could be considered the 'headwaters' of the Red River.

The tributaries in the eastern part of the basin had median specific-conductance values that were less than 1,000 µS/cm (appendix 1). For the Bois de Sioux River near Doran, Minn., site, one-fourth of the samples had specific-conductance values that were greater than 1,340 µS/cm (appendix 1). The median sulfate concentration for the Doran site was 350 mg/L (appendix 1), indicating the sulfate concentrations for that site often exceeded the USEPA (2005) drinking-water standard of 250 mg/L. All other measurements for the Doran site indicated the concentrations were within established water-quality guidelines, standards, and criteria.

The relatively large amounts of runoff in the tributaries in the eastern part of the basin generally provided a dilution effect for other inputs to the Red River. The Otter Tail River, which drains upland lakes and streams in west-central Minnesota, had dissolved-oxygen concentrations that were greater than 3.5 mg/L and generally had small nutrient concentrations. The data reviewed for the Otter Tail River indicated no exceedances of water-quality guidelines, standards, and criteria.

Sulfate concentrations for the Otter Tail River below Orwell Dam near Fergus Falls, Minn., site were at or less than 32 mg/L (appendix 1). However, sulfate concentrations for the Buffalo River near Dilworth, Minn., site were as large as 230 mg/L (appendix 1). The Buffalo River mostly drains the Red River Lake Plain and empties into the Red River more than 50 linear (not river) miles north of the Otter Tail River. The differences in the concentrations for the two sites may be related to the location of the sites. Both sites are located in the southern part of the Red River Basin where sulfate concentrations from the Lake Plain may be larger than from upland areas (Stoner and others, 1993).

During February 1977, the dissolved-oxygen concentration for the Wild Rice River at Hendrum, Minn., site was less than 1 mg/L during low flow. The minimum dissolved-oxygen concentration for the Wild Rice River at Twin Valley, Minn., site was 3.1 mg/L (Tornes, 1980). Thus, oxygen-demanding substances within the stream or input to the system probably are depleting the oxygen in the Wild Rice River. The spatial distribution of sulfate concentrations that was evident for the Otter Tail River was not evident for the Wild Rice River in Minnesota. Sulfate concentrations for the Twin Valley and Hendrum sites were similar although the median concentration for the Hendrum site was larger than the median concentration for the Twin Valley site. The maximum concentration for both stations was 85 mg/L (appendix 1; Tornes, 1980). Other potential contaminants in the Wild Rice River included nitrate nitrogen, which was at a concentration of 2.5 mg/L or less, and arsenic, which was at a concentration of 7 µg/L or less (Tornes, 1980). The concentrations for both constituents were less than the drinking-water guidelines, standards, and criteria for those constituents.

About one-third of the flow below the confluence of the Red Lake River and the Red River is contributed by the Red Lake River. Therefore, the Red Lake River can have a large influence on the quantity and quality of water in the Red River. All constituent concentrations for the Red Lake River at Crookston, Minn., site were within the USEPA (2005) and Environment Canada (2002) guidelines, standards, and criteria. Specific-conductance values were 730 µS/cm or less (appendix 1), sulfate concentrations were 120 mg/L or less (appendix 1), and nitrate concentrations were 2.4 mg/L or less (Tornes and Brigham, 1994). Trace elements were detected in small concentrations or were less than the laboratory detection level. Arsenic concentrations were 6 µg/L or less (appendix 1).

The only other tributary in the eastern part of the Red River Basin that was routinely sampled was the Roseau River. However, because the Roseau River joins the Red River in Canada, the Roseau River was not included in this analysis. The Roseau River below State Ditch 51 near Caribou, Minn., site is given in table 1 and shown on figure 1 for information purposes only.

Other Related Data

Hydrophyllic (water-soluble) pesticide samples and hydrophobic compound samples were collected from selected streams in the Red River Basin as part of the NAWQA study conducted during 1993-95. Results of the analysis of the hydrophyllic pesticide samples are given by Tornes and Brigham (1995), Tornes and others (1997), and Stoner and others (1998). The concentrations of the pesticides that were detected and that had regulatory limits were less than the water-quality guidelines, standards, and criteria cited in those reports. Although most of the pesticides that were detected were related to domestic and agricultural use, water-quality guidelines, standards, and criteria for many of the pesticides have not been established. The ability to detect small concentrations of pesticides provides information about seasonal variability and responses to hydrologic influences. For example, pesticides, such as atrazine, that typically are applied early in the growing season were evident in runoff that occurred after application of the pesticides. Pesti-

cides, such as triallate, that are applied during late summer and early fall generally were detected in late fall and early spring runoff. Other pesticides, such as prometon, that are applied more generally, such as on transportation rights of way, were detected randomly.

The hydrophobic compound samples were collected from the bottom sediments at the stream sites. Results of the analysis of those samples are given by Brigham and others (1998), Goldstein (1995) (which included a discussion of concentrations in fish tissue), Tornes and others (1996), and Stoner and others (1998). Hydrophobic compounds include chlorinated pesticides and high molecular weight organic compounds. Generally, concentrations of the compounds detected were less than the Canadian sediment-quality standards and criteria. Few sediment-quality standards and criteria exist for compounds in United States waters. Because bottom-sediment samples usually were collected only once during the NAWQA program, temporal variability cannot be assessed. However, the spatial coverage of the samples provides some indication about the distribution of compounds in the Red River Basin.

Trace-element samples also were collected from bottom sediments at selected stream sites in the Red River Basin as part of the NAWQA study. Results of the analyses of those samples are given by Brigham and others (1998), Goldstein (1995) (which included a discussion of concentrations in fish tissue), Tornes and others (1996), and Stoner and others (1998). Concentrations of the trace elements that were detected were less than the Canadian sediment-quality standards and criteria. Few, if any, sediment-quality standards and criteria exist for trace elements in United States water.

Summary and Conclusions

Data for the Red River of the North (Red River) Basin in Minnesota, North Dakota, and South Dakota were analyzed to determine whether the water quality of streams in the basin is adequate to meet future needs. For the Red River at Emerson, Manitoba, site, pH values, water temperatures, and dissolved-oxygen concentrations generally were within the criteria established for the protection of aquatic life. Dissolved-solids concentrations ranged from 245 to 1,100 milligrams per liter. Maximum sulfate and chloride concentrations were near, but did not exceed, the established secondary maximum contaminant level. Nutrient concentrations generally were less than those for smaller streams that drain agricultural areas, possibly because of the integrating effect of the stream system at Emerson. The trace elements considered potentially harmful generally were at concentrations that were less than the established guidelines, standards, and criteria. When lead was detected, the concentrations were 11 micrograms per liter or less. The concentrations that were detected may have occurred as a result of sample contamination.

For the Red River upstream from Emerson, Manitoba, sites, pH values rarely exceeded the criterion established for the protection of aquatic life, and water temperatures occasionally exceeded the criterion. Dissolved-oxygen concentrations occasionally exceeded the criterion during the 1970's. Many constituent concentrations for the Red River below Fargo, N. Dak., site exceeded water-quality guidelines, standards, and criteria. However, the trace-element exceedances could be natural or could be related to pollution or sample contamination.

For the Sheyenne River sites, pH values rarely exceeded the criterion established for the protection of aquatic life. Water temperatures and dissolved-oxygen concentrations generally were within the criterion. Sodium concentrations generally were much less than 100 milligrams per liter for sites downstream from the Sheyenne River above Harvey, N. Dak., site. At many sites, the sulfate concentrations occasionally exceeded the established drinking-water standard of 250 milligrams per liter. Median arsenic concentrations typically were 4 micrograms per liter or less, and maximum concentrations occasionally exceeded the drinking-water standard that is scheduled to take effect in 2006. All constituent concentrations for the Sheyenne River below Baldhill Dam, N. Dak., site were within established guidelines, standards, and criteria.

Many of the tributaries in the western part of the Red River Basin had median specific-conductance values that were greater than 1,000 microsiemens per centimeter. Sulfate concentrations occasionally exceeded the established drinking-water standard. Median arsenic concentrations were 6 micrograms per liter or less, and maximum concentrations rarely exceeded the 10-microgram-per-liter drinking-water standard that is scheduled to take effect in 2006. The small concentrations of lead, mercury, and selenium that occasionally were detected may have been a result of sample contamination or other factors.

The tributaries in the eastern part of the Red River Basin had median specific-conductance values that were less than 1,000 microsiemens per centimeter. For the Bois de Sioux River near Doran, Minn., site (which was included with the tributaries in the eastern part of the basin), one-fourth of the samples had specific-conductance values that were greater than 1,340 microsiemens per centimeter. The sulfate concentrations for the Doran site often exceeded the established drinking-water standard of 250 milligrams per liter. All other measurements for the Doran site indicated the concentrations were within established water-quality guidelines, standards, and criteria. Data reviewed for the Otter Tail River indicated no exceedances of water-quality guidelines, standards, and criteria. The dissolved-oxygen concentration for the Wild Rice River at Hendrum, Minn., site was less than 1 milligram per liter during low flow. The minimum concentration for the Wild Rice River at Twin Valley, Minn., site was 3.1 milligrams per liter. All constituent concentrations for the Red Lake River at Crookston, Minn., site were within established guidelines, standards, and criteria.

Concentrations of pesticides that were detected and that had regulatory limits were less than the cited water-quality guidelines, standards, and criteria. Concentrations of compounds that were detected generally were less than the sediment-quality standards and criteria.

The data considered in this report generally provide a good baseline from which to evaluate changes in water-quality conditions. However, because many of the trace elements detected, including lead and mercury, may have been the result of sample contamination, additional data are needed to confirm that trace-element concentrations generally are low. Concentrations of major ions, including sulfate, and specific conductance may continue to approach drinking-water standards during periods of low flow because the streams, particularly those in the western part of the basin, are sustained mostly by ground-water discharge that generally has large dissolved-solids concentrations.

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Appendixes 1-3

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Otter Tail River below Orwell Dam near Fergus Falls, Minn. (05046000) (Period of record: October 12, 1960, to August 24, 1995; Number of dates: 47)						
Discharge (ft^3/s)	85	446	687	907	1,220	47
Specific conductance (µS/cm at 25 degrees Celsius)	367	399	418	441	505	47
pH, field	7.2	8.0	8.2	8.4	8.8	46
Temperature, water (degrees Celsius)	0	5.1	14.8	20.1	24.5	40
Oxygen, dissolved (mg/L)	3.5	8.3	9.4	12.2	15.4	38
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	225	243	252	266	299	41
Calcium, dissolved (mg/L as Ca)	32	37	39	41	47	39
Magnesium, dissolved (mg/L as Mg)	25	27	28	29	35	39
Sodium, dissolved (mg/L as Na)	6.5	7.9	8.3	9.2	11	39
Potassium, dissolved (mg/L as K)	1.8	3.8	4.1	4.6	5.8	38
Bicarbonate, dissolved, field (mg/L as HCO_3)	193	221	228	244	271	24
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	5	17	24
Sulfate, dissolved (mg/L as SO_4)	9.3	12	16	20	32	42
Chloride, dissolved (mg/L as Cl)	2.7	6.9	8.9	10	14	42

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Bois de Sioux River near Doran, Minn. (05051300) (Period of record: March 27, 1993, to August 24, 1995; Number of dates: 26)						
Discharge (ft^3/s)	2.7	64	501	1,410	3,420	26
Specific conductance (µS/cm at 25 degrees Celsius)	384	743	985	1,340	2,270	25
pH, field	6.8	7.8	7.9	8.2	8.9	25
Temperature, water (degrees Celsius)	0	1.1	12.3	20.0	24.0	26
Oxygen, dissolved (mg/L)	2.8	5.6	8.8	11.7	13.4	23
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	250	535	760	1,110	1,860	26
Calcium, dissolved (mg/L as Ca)	32	77	95	130	220	25
Magnesium, dissolved (mg/L as Mg)	16	41	63	93	140	25
Sodium, dissolved (mg/L as Na)	15	25	42	60	100	25
Potassium, dissolved (mg/L as K)	6.0	8.0	10	15	25	24
Bicarbonate, dissolved, field (mg/L as HCO_3)	79	161	222	317	666	25
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	29	25
Sulfate, dissolved (mg/L as SO_4)	85	230	350	560	790	26
Chloride, dissolved (mg/L as Cl)	7.0	11	17	19	40	25
Alachlor, dissolved (µg/L)	<.002	--	<.002	--	.120	3
Atrazine, dissolved (µg/L)	.12	--	.21	--	.23	3
Chlorpyrifos, dissolved (µg/L)	<.004	--	<.004	--	<.004	3
Dieldrin, dissolved (µg/L)	<.001	--	<.001	--	<.001	3
Lindane, dissolved (µg/L)	<.004	--	<.004	--	<.004	3
Parathion, dissolved (µg/L)	<.004	--	<.004	--	<.004	3

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Wahpeton, N. Dak. (05051500) (Period of record: October 5, 1971, to August 11, 2000; Number of dates: 320)						
Discharge (ft^3/s)	1.7	242	499	1,130	10,800	313
Specific conductance (µS/cm at 25 degrees Celsius)	123	450	520	604	1,050	304
pH, field	7.2	7.8	8.1	8.3	8.8	58
Temperature, water (degrees Celsius)	0	0.5	7.3	18.9	30.0	310
Oxygen, dissolved (mg/L)	13.0	13.0	13.1	13.3	13.6	4
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	177	252	293	344	601	55
Solids, sum, dissolved (mg/L)	189	229	262	297	337	18
Calcium, dissolved (mg/L as Ca)	27	38	45	53	70	55
Magnesium, dissolved (mg/L as Mg)	10	28	30	33	51	55
Sodium, dissolved (mg/L as Na)	5.0	11	13	16	33	55
Potassium, dissolved (mg/L as K)	1.7	3.9	5.0	6.3	15	55
Sulfate, dissolved (mg/L as SO_4)	15	32	60	94	230	55
Chloride, dissolved (mg/L as Cl)	1.7	7.1	11	13	22	55
Arsenic, dissolved (µg/L as As)	1	2	3	5	7	38
Barium, dissolved (µg/L as Ba)	--	--	80	--	--	1
Boron, dissolved (µg/L as B)	30	50	60	120	1,600	44
Cadmium, dissolved (µg/L as Cd)	--	--	<1	--	--	1
Chromium, dissolved (µg/L as Cr)	--	--	<5	--	--	1
Copper, dissolved (µg/L as Cu)	--	--	<10	--	--	1
Lead, dissolved (µg/L as Pb)	<1	<1	<1	1	3	38
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.1	1.0	38
Nickel, dissolved (µg/L as Ni)	--	--	<10	--	--	1
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	2	38
Silver, dissolved (µg/L as Ag)	--	--	<1	--	--	1
Zinc, dissolved (µg/L as Zn)	--	--	8	--	--	1

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Hickson, N. Dak. (05051522) (Period of record: November 3, 1975, to August 15, 2000; Number of dates: 282)						
Discharge (ft^3/s)	2.9	267	586	1,580	14,100	280
Specific conductance (µS/cm at 25 degrees Celsius)	47	480	541	612	1,590	272
pH, field	7.2	8.0	8.2	8.4	9.4	116
Temperature, water (degrees Celsius)	<0	0.8	9.0	20.0	32.0	273
Oxygen, dissolved (mg/L)	.6	7.2	9.2	11.6	18.6	83
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	168	288	329	391	1,180	95
Solids, sum, dissolved (mg/L)	224	282	326	384	1,150	55
Calcium, dissolved (mg/L as Ca)	21	43	50	58	140	118
Magnesium, dissolved (mg/L as Mg)	10	29	33	37	110	118
Sodium, dissolved (mg/L as Na)	7.0	11	15	19	92	118
Potassium, dissolved (mg/L as K)	1.3	4.6	5.5	6.6	24	118
Bicarbonate, dissolved, field (mg/L as HCO_3)	--	--	254	--	--	1
Carbonate, dissolved, field (mg/L as CO_3)	--	--	0	--	--	1
Sulfate, dissolved (mg/L as SO_4)	5.0	35	64	110	340	118
Chloride, dissolved (mg/L as Cl)	1.3	7.8	10	13	44	117
Arsenic, dissolved (µg/L as As)	1	3	3	4	6	34
Barium, dissolved (µg/L as Ba)	40	80	<100	<100	200	10
Boron, dissolved (µg/L as B)	<10	60	80	110	530	85
Cadmium, dissolved (µg/L as Cd)	<1	<2	<2	<2	3	9
Chromium, dissolved (µg/L as Cr)	<1	<1	<1	<1	30	10
Copper, dissolved (µg/L as Cu)	2	2	4	5	15	10
Lead, dissolved (µg/L as Pb)	<1	<1	<1	3	7	33
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.2	11	34
Nickel, dissolved (µg/L as Ni)	2	2	2	5	11	10
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	1	34
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	<1	5
Zinc, dissolved (µg/L as Zn)	<3	[1]10	<20	<20	140	10

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Wild Rice River near Abercrombie, N. Dak. (05053000) (Period of record: June 20, 1966, to August 8, 2001; Number of dates: 458)						
Discharge (ft^3/s)	0.01	2.8	25	227	9,260	458
Specific conductance (µS/cm at 25 degrees Celsius)	125	763	1,180	1,620	3,430	438
pH, field	6.8	7.7	7.9	8.1	8.6	272
Temperature, water (degrees Celsius)	<0	0.5	8.5	19.5	29.5	349
Oxygen, dissolved (mg/L)	4.8	--	5.7	--	6.6	2
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	83	586	918	1,230	2,840	280
Solids, sum, dissolved (mg/L)	159	566	893	1,238	2,660	174
Calcium, dissolved (mg/L as Ca)	13	72	100	130	290	256
Magnesium, dissolved (mg/L as Mg)	4.5	35	56	74	150	256
Sodium, dissolved (mg/L as Na)	5.3	60	100	160	420	281
Potassium, dissolved (mg/L as K)	1.9	12	15	17	47	263
Bicarbonate, dissolved, field (mg/L as HCO_3)	55	260	380	460	980	209
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	45	198
Sulfate, dissolved (mg/L as SO_4)	11	210	360	500	1,200	243
Chloride, dissolved (mg/L as Cl)	2.3	23	39	62	180	227
Nitrogen, nitrate, dissolved (mg/L as N)	<.01	.04	.13	.29	1.9	163
Phosphorus, total (mg/L as P)	.18	--	.20	--	.21	2
Phosphorus, dissolved (mg/L as P)	.01	.19	.27	.42	2.0	111
Arsenic, dissolved (µg/L as As)	<1	4	6	10	18	56
Barium, dissolved (µg/L as Ba)	40	<100	<100	<100	170	19
Boron, dissolved (µg/L as B)	30	190	290	400	840	213
Cadmium, dissolved (µg/L as Cd)	<2	<2	<2	<2	18	19
Chromium, dissolved (µg/L as Cr)	<2	<2	<20	<20	<20	19
Copper, dissolved (µg/L as Cu)	3	5	8	11	36	19
Lead, dissolved (µg/L as Pb)	<1	<1	1	<2	480	56
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.4	2.4	53
Nickel, dissolved (µg/L as Ni)	<1	3	5	8	15	18
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	13	56
Silver, dissolved (µg/L as Ag)	<2	<2	<2	<2	<2	8
Zinc, dissolved (µg/L as Zn)	<2	<20	20	<30	70	19

Note: The water-quality standard for selenium, dissolved (µg/L as Se), was last exceeded in 1978.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Fargo, N. Dak. (05054000) (Period of record: May 16, 1949, to September 8, 2000; Number of dates: 791)						
Discharge (ft^3/s)	9.1	213	511	1,460	25,200	791
Specific conductance (µS/cm at 25 degrees Celsius)	180	465	526	608	1,400	769
pH, field	6.2	7.6	7.8	8.0	8.8	531
Temperature, water (degrees Celsius)	0	1.0	8.5	20.0	32.0	414
Oxygen, dissolved (mg/L)	6.6	--	9.8	--	13.3	4
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	134	282	317	375	650	493
Solids, sum, dissolved (mg/L)	130	268	299	362	609	205
Calcium, dissolved (mg/L as Ca)	21	41	46	52	82	272
Magnesium, dissolved (mg/L as Mg)	8.0	29	32	36	52	272
Sodium, dissolved (mg/L as Na)	5.0	11	14	19	43	506
Potassium, dissolved (mg/L as K)	1.7	4.6	5.3	6.3	18	239
Bicarbonate, dissolved, field (mg/L as HCO_3)	--	--	303	--	--	1
Carbonate, dissolved, field (mg/L as CO_3)	--	--	0	--	--	1
Sulfate, dissolved (mg/L as SO_4)	13	39	60	100	270	441
Chloride, dissolved (mg/L as Cl)	.2	4.9	6.3	8.0	39	235
Arsenic, dissolved (µg/L as As)	1	2	3	5	13	42
Barium, dissolved (µg/L as Ba)	80	<100	<100	<100	600	9
Boron, dissolved (µg/L as B)	<20	70	80	100	590	230
Cadmium, dissolved (µg/L as Cd)	<1	1	<2	<2	<2	10
Chromium, dissolved (µg/L as Cr)	<5	<5	<5	<5	<5	9
Copper, dissolved (µg/L as Cu)	4	7	<10	18	32	10
Lead, dissolved (µg/L as Pb)	<1	<1	1	<2	6	42
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.4	.7	37
Nickel, dissolved (µg/L as Ni)	5	7	9	<10	<10	10
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	14	41
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	4	8
Zinc, dissolved (µg/L as Zn)	9	10	<20	20	30	10

Notes: The respective water-quality standards for copper, dissolved (µg/L as Cu), and selenium, dissolved (µg/L as Se), were last exceeded in 1973.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North below Fargo, N. Dak. (05054020) (Period of record: July 16, 1969, to September 13, 1994; Number of dates: 190)						
Discharge (ft^3/s)	2.0	164	340	723	17,300	183
Specific conductance (µS/cm at 25 degrees Celsius)	290	500	557	638	1,140	182
pH, field	7.2	7.8	8.1	8.2	8.9	180
Temperature, water (degrees Celsius)	0	0.3	9.0	19.5	28.0	183
Oxygen, dissolved (mg/L)	1.4	6.8	9.2	11.0	16.1	118
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	183	308	356	414	769	180
Solids, sum, dissolved (mg/L)	170	294	334	384	741	106
Calcium, dissolved (mg/L as Ca)	30	43	48	54	98	169
Magnesium, dissolved (mg/L as Mg)	11	30	33	36	70	169
Sodium, dissolved (mg/L as Na)	7.0	15	20	24	110	149
Potassium, dissolved (mg/L as K)	3.7	5.3	6.2	7.7	20	139
Sulfate, dissolved (mg/L as SO_4)	19	49	69	100	330	180
Chloride, dissolved (mg/L as Cl)	4.4	8.7	11	14	96	168
Arsenic, dissolved (µg/L as As)	<1	2	4	5	10	47
Barium, dissolved (µg/L as Ba)	30	80	<100	100	230	20
Boron, dissolved (µg/L as B)	40	70	80	110	420	90
Cadmium, dissolved (µg/L as Cd)	<1	1	<2	<2	26	48
Chromium, dissolved (µg/L as Cr)	<10	<20	<20	<20	<20	49
Copper, dissolved (µg/L as Cu)	<2	4	5	9	140	47
Lead, dissolved (µg/L as Pb)	<1	<2	<2	4	15	47
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.3	<.5	8.0	42
Nickel, dissolved (µg/L as Ni)	<1	2	4	7	43	27
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	140	44
Silver, dissolved (µg/L as Ag)	<1	<1	<1	1	2	13
Zinc, dissolved (µg/L as Zn)	<3	10	<20	<30	190	48

Note: The respective water-quality standards for all trace elements except mercury were last exceeded in the 1970's; the water-quality standard for mercury, dissolved (µg/L as Hg), was last exceeded in 1979.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River above Harvey, N. Dak. (05054500) (Period of record: October 4, 1971, to September 5, 2000; Number of dates: 293)						
Discharge (ft^3/s)	0.16	1.6	5.1	30	500	268
Specific conductance (µS/cm at 25 degrees Celsius)	50	932	1,280	1,480	2,300	286
pH, field	7.4	8.0	8.2	8.5	9.2	176
Temperature, water (degrees Celsius)	0	0.5	7.0	17.0	28.5	289
Oxygen, dissolved (mg/L)	0	6.6	8.8	10.5	16.6	70
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	152	804	921	1,020	1,590	181
Solids, sum, dissolved (mg/L)	140	791	927	1,010	1,570	73
Calcium, dissolved (mg/L as Ca)	13	28	33	42	140	181
Magnesium, dissolved (mg/L as Mg)	3.2	15	22	36	69	181
Sodium, dissolved (mg/L as Na)	20	180	250	300	480	181
Potassium, dissolved (mg/L as K)	4.2	6.3	7.9	11	20	180
Sulfate, dissolved (mg/L as SO_4)	37	170	210	250	560	181
Chloride, dissolved (mg/L as Cl)	2.2	14	17	21	54	181
Arsenic, dissolved (µg/L as As)	1	2	3	4	8	53
Barium, dissolved (µg/L as Ba)	20	40	60	80	400	45
Boron, dissolved (µg/L as B)	10	530	730	860	1,200	172
Cadmium, dissolved (µg/L as Cd)	<1	<1	<1	<1	<3	46
Chromium, dissolved (µg/L as Cr)	<1	<1	1	<10	10	45
Copper, dissolved (µg/L as Cu)	<1	1	1	2	<10	46
Lead, dissolved (µg/L as Pb)	<1	<1	<1	2	<5	53
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.2	.8	52
Nickel, dissolved (µg/L as Ni)	<1	1	2	3	<10	45
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	1	53
Zinc, dissolved (µg/L as Zn)	<3	<3	5	10	130	46

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River near Warwick, N. Dak. (05056000) (Period of record: January 8, 1951, to August 30, 2000; Number of dates: 716)						
Discharge (ft^3/s)	0.10	6.0	20	97	3,160	290
Specific conductance (µS/cm at 25 degrees Celsius)	210	575	734	930	1,680	703
pH, field	6.7	7.6	7.9	8.2	9.2	535
Temperature, water (degrees Celsius)	0	1.0	7.4	17.0	30.0	344
Oxygen, dissolved (mg/L)	2.1	5.2	5.9	8.0	11.4	8
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	150	362	468	598	1,010	532
Solids, sum, dissolved (mg/L)	139	323	427	564	768	110
Calcium, dissolved (mg/L as Ca)	16	42	50	60	110	282
Magnesium, dissolved (mg/L as Mg)	6.9	21	29	34	54	282
Sodium, dissolved (mg/L as Na)	10	41	68	100	230	537
Potassium, dissolved (mg/L as K)	1.8	6.1	7.8	9.6	17	276
Bicarbonate, dissolved, field (mg/L as HCO_3)	313	332	384	437	461	4
Sulfate, dissolved (mg/L as SO_4)	28	60	88	130	240	279
Chloride, dissolved (mg/L as Cl)	.6	8.2	12	17	37	249
Arsenic, dissolved (µg/L as As)	<1	2	5	8	13	58
Barium, dissolved (µg/L as Ba)	30	<100	<100	<100	200	22
Boron, dissolved (µg/L as B)	<10	90	140	190	390	179
Cadmium, dissolved (µg/L as Cd)	<2	<2	<2	<2	3	22
Chromium, dissolved (µg/L as Cr)	<20	<20	<20	<20	<20	22
Copper, dissolved (µg/L as Cu)	<2	2	4	11	27	22
Lead, dissolved (µg/L as Pb)	<1	<1	1	<2	16	56
Mercury, dissolved (µg/L as Hg)	.01	<.1	.1	<.5	6.5	53
Nickel, dissolved (µg/L as Ni)	<2	<2	2	5	12	23
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	23	58
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	4	16
Zinc, dissolved (µg/L as Zn)	2	<3	10	<20	40	22

Notes: The water-quality standard for selenium, dissolved (µg/L as Se), was last exceeded in 1973; the water-quality standard for mercury, dissolved (µg/L as Hg), was last exceeded in 1979.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River near Cooperstown, N. Dak. (05057000) (Period of record: October 11, 1959, to September 7, 2000; Number of dates: 585)						
Discharge (ft^3/s)	0.02	14	57	313	5,290	327
Specific conductance (µS/cm at 25 degrees Celsius)	213	710	906	1,010	1,880	573
pH, field	6.5	7.7	8.0	8.2	8.7	380
Temperature, water (degrees Celsius)	0	0.5	7.4	16.5	27.8	462
Oxygen, dissolved (mg/L)	3.0	7.0	8.4	10.1	13.5	77
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	143	499	596	667	1,240	370
Solids, sum, dissolved (mg/L)	129	494	591	653	1,230	265
Calcium, dissolved (mg/L as Ca)	19	56	66	78	154	340
Magnesium, dissolved (mg/L as Mg)	6.5	27	32.5	37	72	340
Sodium, dissolved (mg/L as Na)	10	63	83	99	920	373
Potassium, dissolved (mg/L as K)	2.3	7.7	8.5	9.6	28	354
Sulfate, dissolved (mg/L as SO_4)	21	120	140	170	360	322
Chloride, dissolved (mg/L as Cl)	.1	12	16	19	39	317
Arsenic, dissolved (µg/L as As)	<1	2	4	6	12	55
Barium, dissolved (µg/L as Ba)	10	<100	<100	<100	200	22
Boron, dissolved (µg/L as B)	30	130	180	210	890	298
Cadmium, dissolved (µg/L as Cd)	1	<2	<2	<2	2	22
Chromium, dissolved (µg/L as Cr)	<20	<20	<20	<20	<20	22
Copper, dissolved (µg/L as Cu)	<2	3	6	11	34	21
Lead, dissolved (µg/L as Pb)	<1	<1	1	<2	200	54
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.3	.9	52
Nickel, dissolved (µg/L as Ni)	<1	<1	4	9	18	22
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	18	55
Silver, dissolved (µg/L as Ag)	<2	<2	<2	<2	4	13
Zinc, dissolved (µg/L as Zn)	4	<20	<20	20	400	22

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River below Baldhill Dam, N. Dak. (05058000) (Period of record: June 5, 1959, to September 7, 2000; Number of dates: 369)						
Discharge (ft^3/s)	0.05	22	79	235	5,510	283
Specific conductance (µS/cm at 25 degrees Celsius)	285	620	740	890	1,320	364
pH, field	6.9	7.7	8.1	8.5	9.1	124
Temperature, water (degrees Celsius)	0	3.0	7.0	18.5	26.2	334
Oxygen, dissolved (mg/L)	6.0	9.6	10.8	12.5	14.6	39
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	196	379	448	524	764	114
Solids, sum, dissolved (mg/L)	176	352	407	470	713	81
Calcium, dissolved (mg/L as Ca)	22	40	47	54	76	114
Magnesium, dissolved (mg/L as Mg)	2.0	23	26	32	48	114
Sodium, dissolved (mg/L as Na)	20	51	65	77	120	114
Potassium, dissolved (mg/L as K)	1.8	9.0	9.8	11	16	114
Bicarbonate, dissolved, field (mg/L as HCO_3)	170	217	267	371	453	10
Sulfate, dissolved (mg/L as SO_4)	48	94	120	150	240	114
Chloride, dissolved (mg/L as Cl)	5.0	11	13	17	26	124
Arsenic, dissolved (µg/L as As)	1	4	4	5	10	33
Boron, dissolved (µg/L as B)	40	120	140	170	310	104
Lead, dissolved (µg/L as Pb)	<1	<1	<1	<1	2	32
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.2	<1.0	33
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	2	33

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River at Valley City, N. Dak. (05058500) (Period of record: November 3, 1971, to June 20, 2000; Number of dates: 99)						
Discharge (ft^3/s)	11	46	171	1,420	5,200	69
Specific conductance (µS/cm at 25 degrees Celsius)	235	610	705	830	1,300	95
pH, field	7.6	7.8	8.0	8.3	8.7	30
Temperature, water (degrees Celsius)	0	1.8	4.0	16.3	26.0	95
Oxygen, dissolved (mg/L)	--	--	7.3	--	--	1
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	278	392	484	554	734	28
Solids, sum, dissolved (mg/L)	297	390	444	477	524	11
Calcium, dissolved (mg/L as Ca)	30	43	50	56	79	28
Magnesium, dissolved (mg/L as Mg)	16	25	29	36	48	28
Sodium, dissolved (mg/L as Na)	24	52	64	76	100	28
Potassium, dissolved (mg/L as K)	6.4	8.3	10	12	15	28
Sulfate, dissolved (mg/L as SO_4)	81	120	130	160	260	28
Chloride, dissolved (mg/L as Cl)	5.1	12	15	19	24	28
Arsenic, dissolved (µg/L as As)	1	2	3	5	9	18
Boron, dissolved (µg/L as B)	<10	100	140	180	290	21
Lead, dissolved (µg/L as Pb)	<1	<1	<1	<1	1	18
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.2	.8	18
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	2	18

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River at Lisbon, N. Dak. (05058700) (Period of record: August 2, 1956, to August 9, 2000; Number of dates: 765)						
Discharge (ft^3/s)	1.1	37	128	518	5,230	319
Specific conductance (µS/cm at 25 degrees Celsius)	110	686	832	988	5,220	758
pH, field	6.7	7.6	7.8	8.1	9.0	610
Temperature, water (degrees Celsius)	0	1.0	7.0	19.1	28.5	392
Oxygen, dissolved (mg/L)	6.0	8.2	10.4	12.0	14.7	57
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	185	450	541	644	1,000	600
Solids, sum, dissolved (mg/L)	198	451	539	650	1,040	201
Calcium, dissolved (mg/L as Ca)	30	51	60	69	130	368
Magnesium, dissolved (mg/L as Mg)	9.0	25	29	35	53	368
Sodium, dissolved (mg/L as Na)	13	59	76	91	560	616
Potassium, dissolved (mg/L as K)	4.9	9.7	11	12	22	384
Bicarbonate, dissolved, field (mg/L as HCO_3)	169	239	301	328	448	24
Sulfate, dissolved (mg/L as SO_4)	39	130	160	200	450	549
Chloride, dissolved (mg/L as Cl)	8.0	20	26	38	110	335
Arsenic, dissolved (µg/L as As)	1	2	4	6	20	45
Barium, dissolved (µg/L as Ba)	70	<100	<100	<100	400	22
Boron, dissolved (µg/L as B)	20	150	200	240	400	303
Cadmium, dissolved (µg/L as Cd)	<2	<2	<2	<2	3	19
Chromium, dissolved (µg/L as Cr)	<20	<20	<20	<20	<20	22
Copper, dissolved (µg/L as Cu)	<1	5	4	12	38	22
Lead, dissolved (µg/L as Pb)	<1	<1	<1	1	40	40
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	<.5	1.6	39
Nickel, dissolved (µg/L as Ni)	<1	3	6	7	23	20
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	14	43
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	2	13
Zinc, dissolved (µg/L as Zn)	7	<20	<20	20	140	24

Note: The water-quality standard for lead, dissolved (µg/L as Pb), was last exceeded in 1976.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River near Kindred, N. Dak. (05059000) (Period of record: October 13, 1971, to August 7, 2000; Number of dates: 531)						
Discharge (ft^3/s)	18	60	140	555	5,600	374
Specific conductance (µS/cm at 25 degrees Celsius)	180	679	765	900	1,420	514
pH, field	6.9	8.0	8.2	8.4	8.8	295
Temperature, water (degrees Celsius)	<0	1.0	9.0	18.2	28.0	525
Oxygen, dissolved (mg/L)	4.0	7.7	9.1	11.5	16.1	310
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	200	478	539	600	832	227
Solids, sum, dissolved (mg/L)	189	447	519	589	777	128
Calcium, dissolved (mg/L as Ca)	28	64	75	83	110	224
Magnesium, dissolved (mg/L as Mg)	11	26	29	33	54	224
Sodium, dissolved (mg/L as Na)	10	54	64	76	110	224
Potassium, dissolved (mg/L as K)	3.8	8.0	8.9	10	15	223
Bicarbonate, dissolved, field (mg/L as HCO_3)	171	277	319	341	436	47
Sulfate, dissolved (mg/L as SO_4)	50	130	150	170	310	224
Chloride, dissolved (mg/L as Cl)	5.7	20	26	35	74	224
Arsenic, dissolved (µg/L as As)	1	3	4	5	12	67
Barium, dissolved (µg/L as Ba)	10	80	<100	110	300	69
Boron, dissolved (µg/L as B)	70	110	170	220	2,600	31
Cadmium, dissolved (µg/L as Cd)	<1	<1	<1	1	27	53
Chromium, dissolved (µg/L as Cr)	<1	<1	1	10	10	57
Copper, dissolved (µg/L as Cu)	<1	2	2	4	28	57
Lead, dissolved (µg/L as Pb)	<1	<1	1	4	350	61
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.1	20	73
Nickel, dissolved (µg/L as Ni)	1	4	5	6	31	57
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	1	79
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	<1	69
Zinc, dissolved (µg/L as Zn)	<3	4	9	20	100	57

Note: All water-quality standard exceedances for mercury, dissolved (µg/L as Hg), occurred in 1979.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Sheyenne River at West Fargo, N. Dak. (05059500) (Period of record: September 16, 1969, to August 8, 2000; Number of dates: 329)						
Discharge (ft^3/s)	5.3	64	164	484	3,840	283
Specific conductance (µS/cm at 25 degrees Celsius)	237	673	833	950	1,700	323
pH, field	6.7	7.7	8.0	8.2	8.6	62
Temperature, water (degrees Celsius)	<0	0.5	8.0	19.0	27.5	320
Oxygen, dissolved (mg/L)	---	--	6.7	--	--	1
Calcium, dissolved (mg/L as Ca)	24	53	70	84	110	60
Magnesium, dissolved (mg/L as Mg)	13	21	27	30	55	60
Sodium, dissolved (mg/L as Na)	23	46	61	71	95	60
Potassium, dissolved (mg/L as K)	3.3	7.3	8.2	9.9	14	60
Bicarbonate, dissolved, field (mg/L as HCO_3)	--	--	320	--	--	1
Sulfate, dissolved (mg/L as SO_4)	9.0	110	140	170	310	60
Chloride, dissolved (mg/L as Cl)	8.0	19	27	36	57	60
Arsenic, dissolved (µg/L as As)	1	3	5	6	10	28
Barium, dissolved (µg/L as Ba)	--	--	90	--	--	1
Boron, dissolved (µg/L as B)	<20	80	120	200	5,400	54
Cadmium, dissolved (µg/L as Cd)	--	--	<1	--	--	1
Chromium, dissolved (µg/L as Cr)	--	--	<5	--	--	1
Copper, dissolved (µg/L as Cu)	--	--	<10	--	--	1
Lead, dissolved (µg/L as Pb)	<1	<1	<1	<1	4	29
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.2	.4	28
Nickel, dissolved (µg/L as Ni)	--	--	<10	--	--	1
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	2	28
Silver, dissolved (µg/L as Ag)	--	--	<1	--	--	1

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Maple River near Mapleton, N. Dak. (05060000) (Period of record: October 6, 1971, to May 8, 2001; Number of dates: 94)						
Discharge (ft^3/s)	0.10	11	106	906	11,600	93
Specific conductance (µS/cm at 25 degrees Celsius)	240	600	1,060	1,440	2,620	90
pH, field	6.5	7.9	8.0	8.1	8.6	15
Temperature, water (degrees Celsius)	0	0.5	6.8	19.0	27.5	88
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	326	720	859	1,060	1,130	12
Solids, sum, dissolved (mg/L)	648	815	928	1,030	1,110	8
Calcium, dissolved (mg/L as Ca)	40	94	110	110	140	12
Magnesium, dissolved (mg/L as Mg)	18	45	55	63	77	12
Sodium, dissolved (mg/L as Na)	19	61	80	120	130	12
Potassium, dissolved (mg/L as K)	9.0	10	12	12	16	12
Bicarbonate, dissolved, field (mg/L as HCO_3)	200	278	290	325	400	8
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	0	8
Sulfate, dissolved (mg/L as SO_4)	100	290	360	420	480	12
Chloride, dissolved (mg/L as Cl)	15	36	51	84	99	12
Nitrogen, nitrate, dissolved (mg/L as N)	.20	.20	.50	1.0	2.3	16
Arsenic, dissolved (µg/L as As)	3	--	6	--	12	4
Boron, dissolved (µg/L as B)	<20	30	120	300	1,000	8
Lead, dissolved (µg/L as Pb)	<1	--	<1	--	<1	4
Selenium, dissolved (µg/L as Se)	<1	--	<1	--	1	4

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Buffalo River near Dilworth, Minn. (05062000) (Period of record: April 10, 1962, to March 12, 1991; Number of dates: 217)						
Discharge (ft^3/s)	0.36	143	255	536	5,180	217
Specific conductance (µS/cm at 25 degrees Celsius)	260	570	620	750	1,100	117
pH, field	7.0	7.7	7.9	8.1	8.4	11
Temperature, water (degrees Celsius)	0	7.5	10.5	15.3	26.0	207
Oxygen, dissolved (mg/L)	--	--	6.1	--	--	1
Hardness, total (mg/L as $CaC0_3$)	120	330	420	430	600	10
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	168	432	534	556	736	11
Solids, sum, dissolved (mg/L)	156	465	510	548	658	5
Calcium, dissolved (mg/L as Ca)	28	73	89	95	140	11
Magnesium, dissolved (mg/L as Mg)	11	40	44	50	59	11
Sodium, dissolved (mg/L as Na)	4.5	15	18	20	27	11
Potassium, dissolved (mg/L as K)	4.6	5.8	6.3	6.7	7.4	11
Bicarbonate, dissolved, field (mg/L as HCO_3)	--	--	427	--	--	1
Carbonate, dissolved, field (mg/L as CO_3)	--	--	0	--	--	1
Sulfate, dissolved (mg/L as SO_4)	36	95	120	150	230	11
Chloride, dissolved (mg/L as Cl)	0	3.6	6.4	7.5	15	11
Barium, dissolved (µg/L as Ba)	--	--	60	--	--	1
Beryllium, dissolved (µg/L as Be)	--	--	<10	--	--	1
Cadmium, dissolved (µg/L as Cd)	--	--	<10	--	--	1
Chromium, dissolved (µg/L as Cr)	--	--	<5	--	--	1
Cobalt, dissolved (µg/L as Co)	--	--	<30	--	--	1
Copper, dissolved (µg/L as Cu)	--	--	<10	--	--	1
Lead, dissolved (µg/L as Pb)	--	--	10	--	--	1
Nickel, dissolved (µg/L as Ni)	--	--	<10	--	--	1
Silver, dissolved (µg/L as Ag)	--	--	1	--	--	1
Zinc, dissolved (µg/L as Zn)	--	--	<20	--	--	1

Notes: The water-quality standards used were the same as those used for the Red River main stem; all major-ion data are for the 1960's and 1970's; all heavy-metal data are for 1991; no hardness data were available to calculate hardness-dependent standards.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Wild Rice River at Hendrum, Minn. (05064000) (Period of record: October 1, 1962, to September 14, 2000; Number of dates: 305)						
Discharge (ft^3/s)	0.09	36	80	464	9,010	175
Specific conductance (µS/cm at 25 degrees Celsius)	239	480	540	595	2,150	163
pH, field	5.8	7.9	8.2	8.4	9.4	270
Temperature, water (degrees Celsius)	0	1.8	16.0	22.0	28.0	276
Oxygen, dissolved (mg/L)	.8	6.3	7.4	9.8	13.4	261
Hardness, total (mg/L as $CaC0_3$)	260	260	290	320	490	5
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	250	312	355	424	621	7
Solids, sum, dissolved (mg/L)	301	--	342	--	383	2
Calcium, dissolved (mg/L as Ca)	42	58	66	82	93	7
Magnesium, dissolved (mg/L as Mg)	16	28	31	37	63	7
Sodium, dissolved (mg/L as Na)	5.2	9.0	10	19	31	7
Potassium, dissolved (mg/L as K)	3.7	4.2	4.5	4.7	6.5	7
Bicarbonate, dissolved, field (mg/L as HCO_3)	--	--	471	--	--	1
Carbonate, dissolved, field (mg/L as CO_3)	--	--	0	--	--	1
Sulfate, dissolved (mg/L as SO_4)	28	39	48	52	85	8
Chloride, dissolved (mg/L as Cl)	0	3.4	4.2	5.8	31	118
Barium, dissolved(µg/L as Ba)	--	--	100	--	--	1
Beryllium, dissolved (µg/L as Be)	--	--	<10	--	--	1
Cadmium, dissolved (µg/L as Cd)	--	--	<1	--	--	1
Chromium, dissolved (µg/L as Cr)	--	--	<5	--	--	1
Cobalt, dissolved (µg/L as Co)	--	--	<3	--	--	1
Copper, dissolved (µg/L as Cu)	--	--	<10	--	--	1
Nickel, dissolved (µg/L as Ni)	--	--	<10	--	--	1
Zinc, dissolved (µg/L as Zn)	--	--	<30	--	--	1
Carbon, organic, dissolved (mg/L AS C)	--	--	14	--	--	1

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Halstad, Minn. (05064500) (Period of record: July 8, 1961, to September 8, 2000; Number of dates: 536)						
Discharge (ft^3/s)	23	619	1,450	6,000	69,200	405
Specific conductance (µS/cm at 25 degrees Celsius)	245	570	658	748	1,650	512
pH, field	5.9	7.8	8.1	8.3	9.3	279
Temperature, water (degrees Celsius)	0	0.5	8.7	18.4	28.0	517
Turbidity (JTU)	7	8	12	34	90	4
Turbidity (NTU)	1.0	7.0	28	75	500	112
Oxygen, dissolved (mg/L)	1.9	7.5	8.3	10.8	16.2	269
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	176	367	425	484	695	165
Solids, sum, dissolved (mg/L)	170	336	393	471	631	74
Calcium, dissolved (mg/L as Ca)	28	52	60	69	96	165
Magnesium, dissolved (mg/L as Mg)	12	29	33	39	58	165
Sodium, dissolved (mg/L as Na)	8.0	22	30	38	77	165
Potassium, dissolved (mg/L as K)	3.9	6.3	7.1	8.3	18	165
Bicarbonate, dissolved, field (mg/L as HCO_3)	122	233	268	327	433	43
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	6	23	44
Sulfate, dissolved (mg/L as SO_4)	36	80	110	130	240	165
Chloride, dissolved (mg/L as Cl)	4.0	12	16	22	52	165
Arsenic, dissolved (µg/L as As)	<1	3	4	5	11	64
Barium, dissolved (µg/L as Ba)	50	60	80	<100	200	65
Boron, dissolved (µg/L as B)	<20	<20	110	120	290	23
Cadmium, dissolved (µg/L as Cd)	<1	<1	<1	<1	45	51
Chromium, dissolved (µg/L as Cr)	<1	<1	<1	<10	<10	54
Copper, dissolved (µg/L as Cu)	1	2	3	5	22	54
Lead, dissolved (µg/L as Pb)	<1	<1	<2	4	190	60
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.1	6.9	63
Nickel, dissolved (µg/L as Ni)	<1	2	3	5	25	57
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	1	75
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	2	65
Zinc, dissolved (µg/L as Zn)	<3	7	10	20	190	54

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Goose River at Hillsboro, N. Dak. (05066500) (Period of record: September 15, 1969, to August 13, 2001; Number of dates: 346)						
Discharge (ft^3/s)	0	5.0	24	220	8,000	346
Specific conductance (µS/cm at 25 degrees Celsius)	204	945	1,330	1,640	3,400	332
pH, field	7.2	7.7	7.9	8.1	8.5	97
Temperature, water (degrees Celsius)	0	0.5	6.0	18.5	27.5	340
Oxygen, dissolved (mg/L)	4.1	--	9.8	--	10.4	4
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	184	662	977	1,140	2,190	97
Solids, sum, dissolved (mg/L)	208	892	1,020	1,240	2,060	59
Calcium, dissolved (mg/L as Ca)	32	82	120	150	230	97
Magnesium, dissolved (mg/L as Mg)	10	36	58	71	98	97
Sodium, dissolved (mg/L as Na)	9.0	54	84	120	330	97
Potassium, dissolved (mg/L as K)	3.0	9.0	10	12	20	97
Bicarbonate, dissolved, field (mg/L as HCO_3)	110	160	270	360	460	22
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	22	22
Sulfate, dissolved (mg/L as SO_4)	49	240	400	480	800	97
Chloride, dissolved (mg/L as Cl)	5.0	24	49	89	310	97
Nitrogen, nitrate, dissolved (mg/L as N)	<.01	.20	.60	1.1	2.9	83
Phosphorus, total (mg/L as P)	0	.03	.18	.39	.91	22
Phosphorus, dissolved (mg/L as P)	.09	--	.24	--	.39	2
Arsenic, dissolved (µg/L as As)	1	3	4	7	19	38
Boron, dissolved (µg/L as B)	<10	70	200	310	1,100	81
Lead, dissolved (µg/L as Pb)	<1	<1	<1	1	3	38
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	4	38

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red Lake River at Crookston, Minn. (05079000) (Period of record: April 11, 1962, to September 11, 2000; Number of dates: 178)						
Discharge (ft^3/s)	6.0	499	980	1,680	20,200	176
Specific conductance (µS/cm at 25 degrees Celsius)	195	358	395	452	730	171
pH, field	6.9	7.8	8.1	8.3	8.7	163
Temperature, water (degrees Celsius)	0	0.5	6.5	17.6	28.5	164
Turbidity (NTU)	.60	3.0	4.7	12	95	98
Oxygen, dissolved (mg/L)	5.7	8.4	10.2	12.3	14.1	115
Hardness, total (mg/L as $CaC0_3$)	100	180	210	240	390	169
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	68	188	207	235	326	65
Solids, sum, dissolved (mg/L)	145	230	263	300	463	171
Calcium, dissolved (mg/L as Ca)	25	46	52	57	94	169
Magnesium, dissolved (mg/L as Mg)	8.0	16	19	22	38	169
Sodium, dissolved (mg/L as Na)	2.3	4.3	5.1	6.6	15	170
Potassium, dissolved (mg/L as K)	<.1	2.7	3.3	4.1	9.8	171
Bicarbonate, dissolved, field (mg/L as HCO_3)	102	207	222	242	372	65
Sulfate, dissolved (mg/L as SO_4)	7.0	18	32	50	120	171
Chloride, dissolved (mg/L as Cl)	.1	3.0	3.9	5.7	12	169
Aluminum, dissolved (µg/L as Al)	<10	<10	<10	10	60	47
Arsenic, dissolved (µg/L as As)	<1	1	2	3	6	52
Barium, dissolved (µg/L as Ba)	40	50	60	60	100	65
Beryllium, dissolved (µg/L as Be)	<10	<10	<10	<10	<10	37
Boron, dissolved (µg/L as B)	<20	40	50	70	310	50
Cadmium, dissolved (µg/L as Cd)	<1	<1	<1	<1	4	54
Chromium, dissolved (µg/L as Cr)	<1	<1	1	10	30	52
Cobalt, dissolved (µg/L as Co)	<1	2	<3	<3	3	66
Copper, dissolved (µg/L as Cu)	<1	1	2	3	16	54
Iron, dissolved (µg/L as Fe)	<10	10	20	40	220	102
Lead, dissolved (µg/L as Pb)	<1	1	<2	<5	5	54
Manganese, dissolved (µg/L as Mn)	2	8	13	23	79	102
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.1	2.0	49
Nickel, dissolved (µg/L as Ni)	<1	<1	1	2	7	61

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red Lake River at Crookston, Minn. (05079000), Continued (Period of record: April 11, 1962, to September 11, 2000; Number of dates: 178)						
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	10	64
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	3	65
Zinc, dissolved (µg/L as Zn)	<3	5	<20	<20	90	54
Alachlor, dissolved (µg/L)	<.002	--	--	--	<.002	5
Chlorpyrifos, dissolved (µg/L)	<.004	--	--	--	<.004	5
Dieldrin, dissolved (µg/L)	<.001	--	--	--	<.001	5
Lindane, dissolved (µg/L)	<.004	--	--	--	<.004	5
Parathion, dissolved (µg/L)	<.004	--	--	--	<.004	5
Fecal coliform, 0.7-µ MF (colonies per 100 milliliters)	2	16	49	200	7,400	96

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Grand Forks, N. Dak. (05082500) (Period of record: June 22, 1949, to September 26, 2000; Number of dates: 927)						
Discharge (ft^3/s)	1.9	1,190	2,400	7,730	106,000	924
Specific conductance (µS/cm at 25 degrees Celsius)	200	460	531	600	1,040	894
pH, field	7.0	7.5	7.7	7.9	8.7	532
Temperature, water (degrees Celsius)	0	1.0	8.0	18.0	28.0	556
Oxygen, dissolved (mg/L)	3.9	7.7	9.9	11.1	14.5	31
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	158	303	336	385	570	513
Solids, sum, dissolved (mg/L)	170	271	311	359	1,890	186
Calcium, dissolved (mg/L as Ca)	30	49	55	62	150	286
Magnesium, dissolved (mg/L as Mg)	6.0	22	25	30	110	285
Sodium, dissolved (mg/L as Na)	3.0	14	17	20	43	535
Potassium, dissolved (mg/L as K)	.8	4.3	5.2	6.2	60	255
Bicarbonate, dissolved, field (mg/L as HCO_3)	140	216	253	264	373	25
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	8	25
Sulfate, dissolved (mg/L as SO_4)	18	51	70	95	200	468
Chloride, dissolved (mg/L as Cl)	.5	7.0	9.1	12	34	255
Arsenic, dissolved (µg/L as As)	<1	2	3	4	13	46
Barium, dissolved (µg/L as Ba)	80	<100	<100	<100	300	12
Boron, dissolved (µg/L as B)	<10	60	80	100	760	212
Cadmium, dissolved (µg/L as Cd)	<1	<2	<2	<2	7	18
Chromium, dissolved (µg/L as Cr)	<5	<5	<5	<5	<5	21
Copper, dissolved (µg/L as Cu)	3	13	<20	<20	20	23
Lead, dissolved (µg/L as Pb)	<1	<1	<1	<1	5	53
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.1	.2	1.4	40
Nickel, dissolved (µg/L as Ni)	<1	1	10	10	13	21
Selenium, dissolved (µg/L as Se)	<1	<1	<1	2	23	46
Silver, dissolved (µg/L as Ag)	<1	<2	<2	2	5	11
Zinc, dissolved (µg/L as Zn)	10	<20	<20	20	50	23

Note: The water-quality standard for selenium, dissolved (µg/L as Se), was last exceeded in 1973.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Turtle River at Turtle River State Park near Arvilla, N. Dak. (05082625) (Period of record: October 11, 1991, to September 27, 2001; Number of dates: 170)						
Discharge (ft^3/s)	2.7	11	17	113	12,200	119
Specific conductance (µS/cm at 25 degrees Celsius)	283	795	913	1,020	1,530	169
pH, field	7.0	7.9	8.1	8.3	8.6	108
Temperature, water (degrees Celsius)	0	0.9	10.0	18.0	26.0	164
Oxygen, dissolved (mg/L)	6.0	9.0	10.0	12.0	19.0	96
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	165	548	617	714	1,150	85
Calcium, dissolved (mg/L as Ca)	25	85	99	110	130	85
Magnesium, dissolved (mg/L as Mg)	7.0	31	36	41	60	85
Sodium, dissolved (mg/L as Na)	11	33	46	62	130	85
Potassium, dissolved (mg/L as K)	4.2	5.3	5.9	7.1	11	85
Bicarbonate, dissolved, field (mg/L as HCO_3)	110	266	308	339	408	73
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	14	73
Sulfate, dissolved (mg/L as SO_4)	48	170	200	250	490	85
Chloride, dissolved (mg/L as Cl)	7.0	20	23	29	160	85
Nitrogen, nitrate, dissolved (mg/L as N)	.10	.20	.40	.70	2.6	81
Phosphorus, total (mg/L as P)	0	.10	.10	.20	1.3	84
Arsenic, dissolved (µg/L as As)	3	--	3	--	8	4
Boron, dissolved (µg/L as B)	--	--	30	--	--	1
Lead, dissolved (µg/L as Pb)	<1	--	<1	--	2	4
Mercury, dissolved (µg/L as Hg)	<.1	--	<.1	--	<.1	4
Selenium, dissolved (µg/L as Se)	<1	--	3	--	3	4
Lindane, dissolved (µg/L)	<.004	<.004	<.004	<.004	.009	34
Dieldrin, dissolved (µg/L)	<.001	<.001	<.001	<.001	<.001	34

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Forest River at Minto, N. Dak. (05085000) (Period of record: October 6, 1971, to September 10, 2001; Number of dates: 308)						
Discharge (ft^3/s)	0.03	5.0	14	58	6,210	302
Specific conductance (µS/cm at 25 degrees Celsius)	240	672	804	940	2,120	294
pH, field	7.1	7.7	8.0	8.2	8.8	100
Temperature, water (degrees Celsius)	0	0.5	6.5	17.5	27.0	302
Oxygen, dissolved (mg/L)	1.8	5.4	8.8	10.5	12.4	12
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	171	444	511	582	1,370	95
Solids, sum, dissolved (mg/L)	152	441	491	548	1,370	55
Calcium, dissolved (mg/L as Ca)	32	70	78	88	180	95
Magnesium, dissolved (mg/L as Mg)	7.0	29	34	37	140	95
Sodium, dissolved (mg/L as Na)	6.0	32	39	49	170	95
Potassium, dissolved (mg/L as K)	3.6	5.3	6.8	8.1	62	95
Bicarbonate, dissolved, field (mg/L as HCO_3)	93	270	295	330	690	54
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	12	54
Sulfate, dissolved (mg/L as SO_4)	36	120	140	180	290	95
Chloride, dissolved (mg/L as Cl)	1.0	18	24	38	270	95
Nitrogen, nitrate, dissolved (mg/L as N)	.10	.20	.60	.90	2.7	39
Arsenic, dissolved (µg/L as As)	<1	2	3	5	20	41
Boron, dissolved (µg/L as B)	<20	50	80	190	500	80
Lead, dissolved (µg/L as Pb)	<1	<1	<1	1	2	41
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	4	41
Fecal coliform, mFC MF (colonies per 100 milliliters)	<1	<1	6	58	230	10

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Park River at Grafton, N. Dak. (05090000) (Period of record: September 22, 1969, to August 28, 2001; Number of dates: 297)						
Discharge (ft^3/s)	0	1.0	8.0	113	8,460	293
Specific conductance (µS/cm at 25 degrees Celsius)	289	750	1,110	1,340	2,500	283
pH, field	6.3	7.7	7.9	8.1	8.7	85
Temperature, water (degrees Celsius)	0	0.5	7.0	18.0	28.0	292
Oxygen, dissolved (mg/L)	--	--	12.2	--	--	1
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	83	425	709	845	1,450	84
Solids, sum, dissolved (mg/L)	193	529	749	819	1,220	46
Calcium, dissolved (mg/L as Ca)	31	58	75	96	130	84
Magnesium, dissolved (mg/L as Mg)	8.0	20	33	41	68	84
Sodium, dissolved (mg/L as Na)	12	46	97	130	370	84
Potassium, dissolved (mg/L as K)	3.8	7.4	8.6	11	16	84
Bicarbonate, dissolved, field (mg/L as HCO_3)	93	210	260	320	440	45
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	6	45
Sulfate, dissolved (mg/L as SO_4)	53	130	210	270	420	84
Chloride, dissolved (mg/L as Cl)	6.0	31	81	130	410	84
Nitrogen, nitrate, dissolved (mg/L as N)	<.01	.23	.45	.80	2.9	36
Phosphorus, dissolved (mg/L as P)	0	.10	.30	.40	.80	13
Arsenic, dissolved (µg/L as As)	<1	2	4	6	12	39
Boron, dissolved (µg/L as B)	<20	50	160	300	830	71
Lead, dissolved (µg/L as Pb)	<1	<1	<1	1	2	39
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.2	1.0	39
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	4	39

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Drayton, N. Dak. (05092000) (Period of record: October 12, 1971, to August 29, 2001; Number of dates: 416)						
Discharge (ft^3/s)	111	1,430	3,350	14,600	92,900	416
Specific conductance (µS/cm at 25 degrees Celsius)	275	520	620	746	2,010	386
pH, field	7.1	7.8	8.1	8.3	8.7	59
Temperature, water (degrees Celsius)	<0	0.5	9.0	18.0	28.5	407
Oxygen, dissolved (mg/L)	10.5	--	11.2	--	11.9	2
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	179	328	389	472	932	59
Solids, sum, dissolved (mg/L)	169	246	339	415	564	18
Calcium, dissolved (mg/L as Ca)	29	49	56	66	98	59
Magnesium, dissolved (mg/L as Mg)	3.0	21	26	32	56	59
Sodium, dissolved (mg/L as Na)	7.0	22	30	44	130	59
Potassium, dissolved (mg/L as K)	3.0	5.0	7.0	8.0	12	59
Sulfate, dissolved (mg/L as SO_4)	35	65	87	120	220	59
Chloride, dissolved (mg/L as Cl)	5.0	20	30	51	160	59
Nitrogen, nitrate, dissolved (mg/L as N)	.20	.20	.50	1.2	3.6	14
Phosphorus, dissolved (mg/L as P)	0	0	.10	.10	.20	12
Arsenic, dissolved (µg/L as As)	1	3	3	5	8	41
Barium, dissolved (µg/L as Ba)	--	--	90	--	--	1
Boron, dissolved (µg/L as B)	30	70	90	150	1,100	45
Cadmium, dissolved (µg/L as Cd)	--	--	<1	--	--	1
Chromium, dissolved (µg/L as Cr)	--	--	<5	--	--	1
Copper, dissolved (µg/L as Cu)	--	--	<10	--	--	1
Lead, dissolved (µg/L as Pb)	<1	<1	<1	<2	10	41
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.2	.6	41
Nickel, dissolved (µg/L as Ni)	--	--	<10	--	--	1
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	3	41
Silver, dissolved (µg/L as Ag)	--	--	1.0	--	--	1
Zinc, dissolved (µg/L as Zn)	--	--	9.0	--	--	1
Fecal coliform, 0.7-µ MF (colonies per 100 milliliters)	--	--	<2	--	--	1

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Pembina River at Neche, N. Dak. (05100000) (Period of record: October 13, 1971, to August 9, 2001; Number of dates: 334)						
Discharge (ft^3/s)	0.04	21	112	837	19,000	334
Specific conductance (µS/cm at 25 degrees Celsius)	250	583	825	942	1,700	294
pH, field	6.5	7.8	8.1	8.3	8.7	55
Temperature, water (degrees Celsius)	0	0.5	7.8	17.5	28.0	328
Oxygen, dissolved (mg/L)	--	--	12.4	--	--	1
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	194	363	514	583	763	57
Solids, sum, dissolved (mg/L)	215	321	470	569	596	18
Calcium, dissolved (mg/L as Ca)	26	46	70	87	140	57
Magnesium, dissolved (mg/L as Mg)	8.0	18	29	36	53	57
Sodium, dissolved (mg/L as Na)	19	28	42	49	59	57
Potassium, dissolved (mg/L as K)	3.2	6.6	8.3	10	13	57
Bicarbonate, dissolved, field (mg/L as HCO_3)	110	150	210	320	340	17
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	13	17
Sulfate, dissolved (mg/L as SO_4)	56	110	160	190	250	57
Chloride, dissolved (mg/L as Cl)	3.0	8.0	14	18	34	57
Nitrogen, nitrate, dissolved (mg/L as N)	.02	.22	.23	.64	1.7	20
Arsenic, dissolved (µg/L as As)	<1	2	3	5	12	38
Boron, dissolved (µg/L as B)	<20	60	90	150	550	44
Lead, dissolved (µg/L as Pb)	<1	<1	<1	<2	3	39
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.2	.8	39
Selenium, dissolved (µg/L as Se)	<1	<1	1	2	4	39

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Tongue River at Akra, N. Dak. (05101000) (Period of record: October 14, 1971, to August 8, 2001; Number of dates: 270)						
Discharge (ft^3/s)	0.02	2.6	7.1	27	663	269
Specific conductance (µS/cm at 25 degrees Celsius)	235	510	570	650	1,490	252
pH, field	6.4	7.8	8.0	8.3	8.8	86
Temperature, water (degrees Celsius)	0	2.5	9.0	18.5	28.5	265
Oxygen, dissolved (mg/L)	6.5	8.2	9.8	10.7	13.2	8
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	172	315	360	407	515	81
Solids, sum, dissolved (mg/L)	177	312	339	380	463	44
Calcium, dissolved (mg/L as Ca)	28	55	63	71	98	82
Magnesium, dissolved (mg/L as Mg)	7.0	16	20	22	35	82
Sodium, dissolved (mg/L as Na)	11	22	26	29	37	82
Potassium, dissolved (mg/L as K)	3.0	5.0	6.0	7.0	12	82
Bicarbonate, dissolved, field (mg/L as HCO_3)	97	200	230	308	380	34
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	0	6	34
Sulfate, dissolved (mg/L as SO_4)	6.0	72	87	97	140	82
Chloride, dissolved (mg/L as Cl)	2.0	8.0	10	11	40	82
Nitrogen, nitrate, dissolved (mg/L as N)	<.01	.23	.29	.56	2.3	30
Arsenic, dissolved (µg/L as As)	<1	2	3	7	12	39
Boron, dissolved (µg/L as B)	<20	30	80	100	350	68
Lead, dissolved (µg/L as Pb)	<1	<1	1	1	6	39
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	<.1	2.4	39
Selenium, dissolved (µg/L as Se)	<1	<1	<1	1	3	39
Fecal coliform, 0.7-µ MF (colonies per 100 milliliters)	<1	6	10	33	720	8

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Pembina, N. Dak. (05102490) (Period of record: July 15, 1969, to August 30, 2000; Number of dates: 102)						
Discharge (ft^3/s)	887	2,100	5,120	9,780	91,700	69
Specific conductance (µS/cm at 25 degrees Celsius)	310	583	667	794	1,060	97
pH, field	6.5	8.0	8.2	8.3	8.7	96
Temperature, water (degrees Celsius)	0	5.1	13.4	19.5	25.0	96
Oxygen, dissolved (mg/L)	4.6	7.8	9.3	10.3	13.9	90
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	203	361	411	463	661	74
Calcium, dissolved (mg/L as Ca)	32	54	62	69	140	63
Magnesium, dissolved (mg/L as Mg)	13	24	29	34	96	63
Sodium, dissolved (mg/L as Na)	8.0	22	29	37	52	65
Bicarbonate, dissolved, field (mg/L as HCO_3)	122	211	243	260	312	45
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	2	11	45
Sulfate, dissolved (mg/L as SO_4)	39	73	94	120	220	73
Chloride, dissolved (mg/L as Cl)	5.0	17	22	30	62	64
Arsenic, dissolved (µg/L as As)	<1	<1	1	6	8	12
Barium, dissolved (µg/L as Ba)	<100	--	<100	--	<100	4
Boron, dissolved (µg/L as B)	50	70	110	120	160	9
Cadmium, dissolved (µg/L as Cd)	<1	<1	<1	<1	1	12
Copper, dissolved (µg/L as Cu)	<2	4	7	20	48	12
Lead, dissolved (µg/L as Pb)	<2	<2	<2	2	7	12
Mercury, dissolved (µg/L as Hg)	<.1	<.1	.2	.4	2.0	8
Nickel, dissolved (µg/L as Ni)	<1	<1	1	2	11	12
Selenium, dissolved (µg/L as Se)	<1	1	5	8	21	9
Silver, dissolved (µg/L as Ag)	<1	<1	<1	1	5	12
Zinc, dissolved (µg/L as Zn)	<10	10	<20	<30	140	11

Note: All trace-metal data are for 1969-72.

Appendix 1. Summary data for selected sites in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Sites are given in downstream order; site number is given in parentheses; median may be a calculated mean value; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; JTU, Jackson turbidity unit; NTU, nephelometric turbidity unit; µ, micrometer; MF, membrane filtration; mFC, a method of detecting fecal coliform]

Property or constituent	Minimum	25th percentile	Median	75th percentile	Maximum	Number of samples
Red River of the North at Emerson, Manitoba (05102500) (Period of record: July 9, 1974, to March 7, 2000; Number of dates: 173)						
Discharge (ft^3/s)	170	1,140	2,160	5,240	62,800	158
Specific conductance (µS/cm at 25 degrees Celsius)	76	589	690	809	1,810	171
pH, field	7.2	7.8	8.1	8.4	8.9	158
Temperature, water (degrees Celsius)	0	0.5	7.5	18.5	29.0	172
Oxygen, dissolved (mg/L)	1.3	7.9	9.8	11.6	18.2	150
Solids, residue on evaporation at 180 degrees Celsius, dissolved (mg/L)	245	375	438	503	1,100	145
Solids, sum, dissolved (mg/L)	243	338	381	453	1,060	53
Calcium, dissolved (mg/L as Ca)	36	58	63	69	110	144
Magnesium, dissolved (mg/L as Mg)	16	26	30	34	54	144
Sodium, dissolved (mg/L as Na)	8.0	28	34	50	190	144
Potassium, dissolved (mg/L as K)	3.8	5.5	6.7	8.2	17	144
Bicarbonate, dissolved, field (mg/L as HCO_3)	136	222	255	304	398	50
Carbonate, dissolved, field (mg/L as CO_3)	0	0	0	1	22	50
Alkalinity, dissolved (mg/L as $CaCO_3$)	110	180	220	250	330	50
Sulfate, dissolved (mg/L as SO_4)	6.0	70	94	120	230	145
Chloride, dissolved (mg/L as Cl)	10	25	35	61	240	145
Aluminum, dissolved (µg/L as Al)	<10	<10	20	30	400	43
Arsenic, dissolved (µg/L as As)	<1	2	3	4	11	53
Barium, dissolved (µg/L as Ba)	30	60	70	<100	240	64
Boron, dissolved (µg/L as B)	130	--	140	--	160	2
Cadmium, dissolved (µg/L as Cd)	<1	<1	<1	<1	3	53
Copper, dissolved (µg/L as Cu)	<1	2	4	7	17	53
Iron, dissolved (µg/L as Fe)	<3	<10	20	30	640	93
Lead, dissolved (µg/L as Pb)	<1	1	<2	<5	11	50
Manganese, dissolved (µg/L as Mn)	<1	4	10	26	85	93
Mercury, dissolved (µg/L as Hg)	<.1	<.1	<.1	.1	.5	50
Nickel, dissolved (µg/L as Ni)	<1	2	3	5	12	57
Selenium, dissolved (µg/L as Se)	<1	<1	<1	<1	1	65
Silver, dissolved (µg/L as Ag)	<1	<1	<1	<1	2	64
Zinc, dissolved (µg/L as Zn)	<3	6	<20	<30	60	53

[1]Some analyses can quantify results below the censoring level.

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Bois de Sioux River																							
09020101-501	Y	Bois de Sioux River	Rabbit River to Otter Tail River	15.31	NA	NS	NA	NS	PS		FS		FS	FS						EN			
09020101-502	Y	Rabbit River	Wilkin County line to Bois de Sioux River	22.66	NA	NS	NA	NS	PS	NS	FS			FS						EN	EN		
Mustinka River																							
09020102-501	Y	Twelvemile Creek	West Branch Twelvemile Creek to Mustinka River	18.96	NA	NS	NA	NS															
09020102-503	Y	Mustinka River	Unnamed creek to Lake Traverse	8.28	NA	NS	NA		FS	NS	FS			FS						EN	EN		
09020102-518	Y	Mustinka River	Grant/Traverse County line to Fivemile Creek	4.76	NA	NS	NA		FS	NS	FS			FS						EN	EN		

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Otter Tail River																					
09020103-502	Y	Otter Tail River	Breckenridge Lake to Bois de Sioux River	8.20	NA	NS	NA		FS	NS	FS	FS	FS					OK	EN	OK	EN
09020103-503	N	Otter Tail River	Pelican River to Dayton Hollow Reservoir	2.50	NA	FS	NA		FS	FS	FS	FS	FS					OK	OK	OK	EN
09020103-504	Y	Otter Tail River	Judicial ditch 2 to Brecken-ridge Lake	19.04	NA	NS	NA	NS	FS	NS	FS		FS					OK	EN		
09020103-506	N	Otter Tail River	Orwell Dam to judicial ditch 2	7.61	NA	FS	NA		FS		FS	FS	FS					OK	OK		
09020103-521	N	Otter Tail River	Pine Lake to Rush Lake	11.71	NA	FS	NA				FS		FS								

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Otter Tail River, Continued																								
09020103-526	N	Toad River	Little Toad Lake to T. 138 N., R. 38 W., sec. 30, southwest corner	8.51	NA	NA	NA																	
09020103-532	Y	Otter Tail River	Rice Lake to Mud Lake	10.9	NA	PS	NA		PS		FS		FS	FS										
09020103-535	N	Otter Tail River	Little Pine Lake to Pine Lake	1.01	NA	FS	NA				FS			FS										
09020103-542	N	Toad River	T. 138 N., R. 38 W., sec. 31, northwest corner to Pine Lake	9.74	NA	FS	NA		FS		FS			FS										

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red River of the North (headwaters)																								
09020104-501	Y	Whiskey Creek	Headwaters to Red River	20.36	NA	NS	NA		FS	NS	FS			FS							EN	EN		
09020104-502	Y	Red River	Fargo/Moorhead Dam A to Sheyenne River (North Dakota)	21.24	NS	NA	NA										NS	NS						
09020104-503	Y	Red River	Breckenridge Dam to Whiskey Creek	25.00	NS	NS	FS	FS	FS	NS	FS		FS	FS		FS	NS	NS			OK	EN	EN	EN
09020104-504	Y	Red River	Fargo/Moorhead Dam 1 to Dam A	3.11	NS	NS	PS		FS	NS	FS		FS	FS		PS	NS	NS			EN	EN	EN	EN
09020104-505	Y	Red River	Whiskey Creek to Comstock Dam 3	39.65	NS	NA	NA										NS	NS						
09020104-506	Y	Red River	Otter Tail River to Breckenridge Dam	2.34	NS	NA	NA										NS	NS						
09020104-507	Y	Red River	Fargo/Moorhead Dam 2 to Dam 1	5.92	NS	NA	NA										NS	NS						

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red River of the North (headwaters), Continued																								
09020104-508	Y	Red River	Wild Rice River (North Dakota) to Dam 2	12.33	NS	NA	NA										NS	NS						
09020104-509	Y	Red River	Comstock Dam 3 to Wolverton Creek	5.90	NS	NA	NA										NS	NS						
09020104-510	Y	Red River	Wolverton Creek to Wild Rice River (North Dakota)	6.76	NS	NA	NA										NS	NS						
09020104-511	Y	Red River	Sheyenne River (North Dakota) to Buffalo River	10.40	NS	NA	NA										NS	NS						

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Buffalo River																					
09020106-501	Y	Buffalo River	South Branch Buffalo River to Red River	45.07	NA	FS	NA	FS													
09020106-502	Y	Stony Creek	Hay Creek to South Branch Buffalo River	12.83	NA	NA	NA														
09020106-503	N	South Branch Buffalo River	Stony Creek to Buffalo River	16.28	NA	NA	NA														
09020106-504	N	South Branch Buffalo River	Whiskey Creek to Stony Creek	10.40	NA	NA	NA														
09020106-505	Y	South Branch Buffalo River	Deerhorn Creek to Whiskey Creek	16.58	NA	NS	NA	NS													
09020106-506	N	Buffalo River	Headwaters to South Branch Buffalo River	69.49	NA	FS	NA	FS													

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Buffalo River, Continued																								
09020106-509	N	Whiskey Creek	T. 137 N., R. 47 W., sec. 13, east line of section to South Branch Buffalo River	5.91	NA	NA	NA																	
09020106-519	N	Hay Creek	Unnamed creek to Spring Creek	9.12	NA	FS	NA	FS																
Red River of the North (Hillsboro)--Marsh River																								
09020107-501	Y	Red River	Buffalo River to Elm River (North Dakota)	29.39	NS	NS	NA		FS	NS	FS		FS	FS			NS	NS			EN	EN	EN	EN
09020107-502	Y	Red River	Wild Rice River to Goose River (North Dakota)	22.77	NS	FS	NA				FS		FS	FS			NS	NS						
09020107-503	N	Marsh River	Headwaters to Red River	51.07	NA	FS	NA	FS																

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red River of the North (Hillsboro)--Marsh River, Continued																							
09020107-504	Y	Red River	Elm River (North Dakota) to Wild Rice River	6.70	NS	NA	NA										NS	NS					
09020107-505	Y	Red River	Goose River (North Dakota) to Marsh River	.88	NS	FS	NA	FS									NS	NS					
Wild Rice River																							
09020108-501	N	Wild Rice River	South Branch Wild Rice River to Red River	30.58	NA	FS	NA	FS	FS					FS									
09020108-502	N	South Branch Wild Rice River	Otto Lake to Wild Rice River	56.80	NA	FS	NA	FS															
09020108-503	N	Wild Rice River	Marsh Creek to South Branch Wild Rice River	44.58	NA	FS	NA	FS	FS		FS		FS	FS						OK			

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red River of the North (Sand Hill River)																								
09020301-501	Y	Red River	Cole Creek (North Dakota) to Red Lake River	8.01	NS	NS	NA		FS	NS	FS		FS	FS			NS	NS			EN	EN	EN	EN
09020301-502	Y	Red River	Buffalo Coulee to Cole Creek (North Dakota)	20.39	NS	NA	NA										NS	NS						
09020301-503	Y	Red River	Grand Forks Dam to English Coulee	1.68	NS	NA	NA										NS	NS						
09020301-504	Y	Red River	Red Lake River to Grand Forks Dam	2.14	NS	FS	NA		FS		FS		FS	FS			NS	NS						
09020301-506	Y	Red River	Marsh River to Sand Hill Creek	21.22	NS	NA	NA										NS	NS						
09020301-507	Y	Red River	Sand Hill River to Buffalo Coulee	10.66	NS	NA	NA										NS	NS						

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red Lake River																					
09020303-501	Y	Red Lake River	Burnham Creek to unnamed creek	30.52	NS	NS	NA		FS	NS	FS	FS	FS		NS			OK	EN		EN
09020303-502	Y	Red Lake River	Black River to Gentilly River	9.98	NS	NA	NA								NS						
09020303-503	Y	Red Lake River	Unnamed creek to Red River	1.88	NS	NS	NA		FS	NS	FS	FS	FS		NS			OK	EN	OK	EN
09020303-504	Y	Red Lake River	Unnamed creek to Clearwater River	21.22	NS	FS	NA	FS							NS						
09020303-506	Y	Red Lake River	Crookston Dam to Burnham Creek	20.54	NS	FS	NA		FS		FS	FS	FS		NS						
09020303-507	N	Black River	Headwaters to Red Lake River	34.53	NA	FS	NA	FS													
09020303-508	Y	Red Lake River	Headwaters to Thief River	66.05	NS	NA	NA								NS						
09020303-509	Y	Red Lake River	Thief River to Thief River Falls Dam	.83	NS	NA	NA								NS						

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red Lake River, Continued																					
09020303-510	Y	Red Lake River	Clearwater River to Cyr Creek	9.42	NS	NA	NA								NS						
09020303-511	Y	Red Lake River	Cyr Creek to Black River	4.83	NS	NA	NA								NS						
09020303-512	Y	Red Lake River	Gentilly River to Crookston Dam	16.17	NS	NA	NA								NS						
09020303-513	Y	Red Lake River	Thief River Falls Dam to unnamed creek	13.87	NS	NA	NA								NS						
Clearwater River																					
09020305-501	Y	Clearwater River	Lower Badger Creek to Red Lake River	7.19	NS	FS	NA	FS	FS		FS		FS		NS			OK			EN
09020305-502	N	Lower Badger Creek	County ditch 14 to Clearwater River	11.90	NA	FS	NA	FS													

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Clearwater River, Continued																					
09020305-504	N	Poplar River	Highway 59 to Lost River	10.34	NA	FS	NA	FS													
09020305-505	N	Lost River	Hill River to Poplar River	2.44	NA	NA	NA														
09020305-507	Y	Lost River	Anderson Lake to Hill River	40.02	NA	FS	NA	FS					FS								
09020305-508	Y	County ditch 57	Unnamed ditch to Clearwater River	.37	NA	NA	NA														
09020305-509	Y	Walker Brook	Walker Brook Lake to Clearwater River	4.82	NA	NA	NA														
09020305-510	Y	Clearwater River	Ruffy Brook to Lost River	58.24	NS	FS	NA		FS		FS		FS		NS			OK			EN
09020305-511	Y	Clearwater River	Lost River to Beau Gerlot Creek	11.63	NS	NA	NA								NS						

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment													Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Clearwater River, Continued																								
09020305-512	N	Lost River	Pine Lake to Anderson Lake	8.43	NA	NA	NA																	
09020305-513	N	Ruffy Brook	Headwaters to Clearwater River	20.95	NA	NA	NA																	
09020305-514	Y	Clearwater River	Clearwater Lake to Ruffy Brook	16.74	NS	FS	NA		FS		FS			FS			NS				OK			OK
09020305-516	Y	Clearwater River	T. 148 N., R. 35 W., sec. 31, west line of section to Clearwater Lake	17.60	NS	FS	PS				FS			FS		PS	NS				OK			OK
09020305-517	Y	Clearwater River	Headwaters to Thief Lake, T. 148 N., R. 36 W., sec. 36, east line of section	29.48	NS	NA	FS									FS	NS				EN			OK
09020305-518	Y	Poplar River	Spring Lake to Highway 59	34.82	NA	NA	NA																	

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Clearwater River, Continued																					
09020305-519	Y	Clearwater River	Beau Gerlot Creek to Lower Badger Creek	1.63	NS	NA	NA								NS						
09020305-539	N	Hill River	Hill River Lake to Lost River	28.06	NA	FS	NA	FS													
Red River of the North (Grand Marais Creek)																					
09020306-501	Y	Red River	Grand Marais Creek to North Marais River (North Dakota)	41.97	NS	NA	NA								NS	NS					
09020306-502	Y	Red River	English Coulee to Grand Marais Creek	6.95	NS	NA	NA								NS	NS					
09020306-503	Y	Red River	North Marais River (North Dakota) to Forest River (North Dakota)	3.70	NS	NA	NA								NS	NS					

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals Chloride	pH	Invertebrates Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red River of the North (Grand Marais Creek), Continued																					
09020306-504	Y	Red River	Forest River (North Dakota) to Snake River	13.52	NS	NA	NA								NS	NS					
09020306-505	Y	Red River	Snake River to Park River (North Dakota)	8.11	NS	NA	NA								NS	NS					
09020306-506	N	Grand Marais Creek	Unnamed creek to Red River	5.48	NA	NA	NA														
Snake River (Red River of the North)																					
09020309-501	Y	Snake River	Middle River to Red River	9.11	NA	NS	NA		PS	NS	FS	FS	FS					EN	EN		EN
09020309-503	Y	Snake River	County ditch 7 to county ditch 3	15.37	NA	NS	NA	NS	PS		FS	FS	FS					EN			
09020309-504	Y	Snake River	South Branch Snake River to county ditch 7	22.85	NA	NS	NA	NS													
09020309-505	N	Middle River	Headwaters to Snake River	88.93	NA	FS	NA	FS													

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Snake River (Red River of the North), Continued																							
09020309-506	N	Snake River	Headwaters to South Branch Snake River	29.16	NA	FS	NA	FS															
Red River of the North (Tamarac River)																							
09020311-501	Y	Red River	Pembina River (North Dakota) to Canadian border	2.91	NS	FS	NA		FS				FS	FS			NS	NS					
09020311-502	Y	Red River	Tamarac River to Drayton Dam	16.51	NS	NA	NA										NS	NS					
09020311-503	Y	Tamarac River	Florian Park Reservoir to Stephen Dam	33.20	NA	NS	NA	NS															
09020311-504	Y	Red River	Two Rivers to Pembina River (North Dakota)	17.52	NS	NA	NA										NS	NS					
09020311-506	Y	Red River	Unnamed creek to Two Rivers	16.51	NS	NA	NA										NS	NS					

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Red River of the North (Tamarac River), Continued																								
09020311-507	Y	Red River	Park River (North Dakota) to Tamarac River	2.97	NS	NA	NA										NS	NS						
09020311-508	Y	Red River	Drayton Dam to unnamed creek	12.28	NS	NA	NA										NS	NS						
Two Rivers																								
09020312-501	N	Two Rivers	Middle Branch Two Rivers to North Branch Two Rivers	20.59	NA	FS	NA		FS		FS		FS	FS							OK	EN		OK
09020312-502	N	South Branch Two Rivers	Lake Bronson to Middle Branch Two Rivers	32.96	NA	FS	NA	FS																
09020312-503	Y	Middle Branch Two Rivers	Headwaters to South Branch Two Rivers	27.03	NA	NS	NA	NS																

Appendix 2. Assessment of water quality of streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota.—Continued

[Modified from Minnesota Pollution Control Agency, 2004; FCA, fish consumption advisory; PCB, polychlorinated biphenyls; Y, yes; NA, not assessed; NS, not supporting; PS, partial support; FS, full support; EN, exceeds ecoregion norms; OK, within acceptable values; N, no]

					Uses			Indicators of impairment												Ecoregion data			
National hydrography dataset assessment reach identification	Impaired waters list	River reach	Location	National hydrography dataset length (miles)	Aquatic consumption	Aquatic life	Aquatic recreation	Fish	Oxygen depletion	Turbidity	Un-ionized ammonia	Metals	Chloride	pH	Invertebrates	Bacteria	Mercury FCA	PCB FCA	Mercury water column	PCB water column	Total phosphorus	Nitrite/nitrate	Biochemical oxygen demand	Suspended solids
Two Rivers, Continued																								
09020312-504	Y	North Branch Two Rivers	Headwaters to Little Joe River	39.31	NA	NS	NA	NS																
09020312-506	Y	South Branch Two Rivers	Unnamed ditch to lateral ditch #2	24.89	NA	NS	NA	NS																
Roseau River																								
09020314-501	Y	Roseau River	Hay Creek to Canada border	49.53	NS	NS	NA		NS		FS		FS	FS			NS				EN			
09020314-502	Y	Roseau River	South Fork Roseau River to Hay Creek	9.15	NS	NA	NA										NS							
09020314-504	Y	Roseau River	Headwaters to South Fork Roseau River	53.45	NS	NA	NA										NS							
End of basin																								

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020101-001-S_00	Bois de Sioux River from the North Dakota-South Dakota border downstream to its confluence with the Rabbit River	12.77 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
					Biological indicators	2
ND-09020101-002-S_00	Bois de Sioux River from its confluence with the Rabbit River downstream to its confluence with the Otter Tail River	15.03 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
					Biological indicators	2
ND-09020104-001-S_00	Red River from its confluence with the Otter Tail River downstream to its confluence with Whiskey Creek	26.81 miles	Recreation	Fully supporting but threatened	Total fecal coliform	2
			Fish consumption	Not supporting	Methylmercury	3
ND-09020104-002-S_00	Red River from its confluence with Whiskey Creek downstream to its confluence with the Wild Rice River	51.64 miles	Recreation	Fully supporting but threatened	Total fecal coliform	2
			Fish consumption	Not supporting	Methylmercury	3
ND-09020104-003-S_00	Red River from its confluence with the Wild Rice River downstream to the 12th Avenue North bridge in Fargo, North Dakota (just upstream from the Moorhead, Minnesota, wastewater discharge)	21 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
			Fish consumption	Not supporting	Methylmercury	3
ND-09020104-004-S_00	Red River from the 12th Avenue North bridge in Fargo, North Dakota, downstream to its confluence with the Sheyenne River	20.09 miles	Fish and other aquatic biota	Fully supporting but threatened	Ammonia	1
					Carbonaceous biochemical oxygen demand	1
					Oxygen, dissolved	1
			Recreation	Not supporting	Total fecal coliform	1
			Fish consumption	Not supporting	Methylmercury	3
ND-09020104-005-S_00	Red River from its confluence with the Sheyenne River downstream to its confluence with the Buffalo River	10.45 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
			Fish consumption	Not supporting	Methylmercury	3

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020105-001-L_00	Lake Elsie	260.5 acres	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
					Turbidity	2
ND-09020105-001-S_00	Wild Rice River from its confluence with the Colfax watershed downstream to its confluence with the Red River	38.01 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
					Biological indicators	1
			Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-002-L_00	Mooreton Pond	36.8 acres	Fish and other aquatic biota	Not supporting	Total dissolved solids	1
					Turbidity	1
ND-09020105-003-S_00	Wild Rice River from its confluence with a tributary northeast of Great Bend, North Dakota, downstream to its confluence with the Colfax watershed	51.8 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
					Organic enrichment/ oxygen, dissolved	1
ND-09020105-005-S_00	Antelope Creek downstream to its confluence with the Wild Rice River	40.09 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
					Temperature, water	1
ND-09020105-009-S_00	Wild Rice River from Elk Creek downstream to its confluence with a tributary northeast of Great Bend, North Dakota	52.31 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
					Organic enrichment/ oxygen, dissolved	1
			Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-012-S_00	Wild Rice River from its confluence with Shortfoot Creek downstream to its confluence with Elk Creek	44.78 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
			Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-016-S_00	Shortfoot Creek from its confluence with the Wild Rice River upstream to the North Dakota-South Dakota border, including tributaries	16.16 miles	Recreation	Not supporting	Total fecal coliform	1

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020105-017-S_00	Unnamed tributaries to the Wild Rice River (ND-09020105-015-S), including Crooked Creek	16.17 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-018-S_00	Wild Rice River from its confluence with the Silver Lake diversion downstream to Lake Tewaukon	18.82 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-019-S_00	Wild Rice River upstream from its confluence with Wild Rice Creek, including tributaries	57.06 miles	Fish and other aquatic biota	Not supporting	Biological indicators	1
			Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-020-S_00	Wild Rice Creek from its confluence with the Wild Rice River upstream to the North Dakota-South Dakota border, including tributaries	118.17 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020105-022-S_00	Wild Rice River from its confluence with Wild Rice Creek downstream to its confluence with the Silver Lake diversion	5.54 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020107-001-S_00	Red River from its confluence with the Buffalo River downstream to its confluence with the Elm River	29.4 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020107-014-S_00	Red River from its confluence with the Elm River downstream to its confluence with the Marsh River	29.83 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020107-008-S_00	Elm River from dam northwest of Galesburg, North Dakota, downstream to dam northeast of Galesburg, North Dakota	20.49 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	2
					Biological indicators	2
ND-09020107-011-S_00	North Branch Elm River downstream to its confluence with the Elm River	33.4 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	2
					Biological indicators	2

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020109-001-S_00	Goose River from a tributary upstream from Hillsboro, North Dakota, downstream to its confluence with the Red River	27.68 miles	Recreation	Fully supporting but threatened	Total fecal coliform	2
ND-09020109-002-L_00	South Golden Lake	323.5 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020109-007-S_00	North Branch Goose River downstream to its confluence with the Goose River	37.12 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
ND-09020109-011-S_00	Goose River from its confluence with Beaver Creek downstream to its confluence with the South Branch Goose River	19.38 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	2
ND-09020109-027-S_00	Beaver Creek downstream to the Golden Lake diversion channel	37.01 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
ND-09020109-034-S_00	Little Goose River from Little Goose River National Wildlife Refuge downstream to the Goose River	28.64 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
ND-09020201-006-L_00	Devils Lake	125,000 acres	Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
			Fish consumption	Not supporting	Methylmercury	3

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020202-001-L_00	Warsing Dam	53.4 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Sedimentation/siltation	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020202-002-L_00	Balta Dam	108 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020202-004-S_00	Sheyenne River from its confluence with Big Coulee downstream to its confluence with the Warsing Dam watershed (ND-09020202-003-S)	40.37 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
ND-09020202-006-S_00	Sheyenne River from Harvey Dam downstream to its confluence with Big Coulee	35.06 miles	Fish and other aquatic biota	Fully supporting but threatened	Biological indicators	2
ND-09020202-008-S_00	North Fork Sheyenne River upstream from its confluence with the Sheyenne River, excluding the Trappers Coulee and Buffalo Coulee watersheds	52.66 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
ND-09020202-012-S_00	Sheyenne River from Coal Mine/Sheyenne Lakes downstream to Harvey Dam	6.19 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
			Recreation	Fully supporting but threatened	Total fecal coliform	2
ND-09020203-001-L_00	Lake Ashtabula	5,430 acres	Recreation	Not supporting	Nutrients/eutrophication	2

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020203-002-S_00	Baldhill Creek from tributary watershed (ND-09020203-005-S) downstream to Lake Ashtabula	30.21 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020203-004-L_00	Red Willow Lake	130 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020203-004-S_00	Silver Creek, including Gunderson Creek and all tributaries	38.51 miles	Recreation	Fully supporting but threatened	Total fecal coliform	2
ND-09020203-007-L_00	McVille Dam	33.4 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Sedimentation/siltation	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020203-008-L_00	Tolna Dam	152 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Sedimentation/siltation	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020203-008-S_00	Unnamed tributary watershed to Baldhill Creek (ND-09020203-007-S)	16.07 miles	Recreation	Not supporting	Total fecal coliform	1
ND-09020203-012-S_00	Pickerel Lake Creek, including tributaries	28.04 miles	Fish and other aquatic biota	Not supporting	Biological indicators	1
			Recreation	Not supporting	Total fecal coliform	1

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020203-013-S_00	Unnamed tributary watershed to the Sheyenne River (ND-09020203-001-S)	33.92 miles	Recreation	Not supporting	Total fecal coliform	1
ND-09020204-003-L_00	Brewer Lake	128 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	1
					Oxygen, dissolved	1
					Sedimentation/siltation	1
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	1
ND-09020204-003-S_00	Sheyenne River from its confluence with the Maple River downstream to its confluence with the Red River	18.51 miles	Recreation	Not supporting	Total fecal coliform	2
ND-09020204-004-S_00	Rush River from its confluence with an unnamed tributary watershed (ND-09020204-011-S) downstream to its confluence with the Sheyenne River	17.44 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
					Organic enrichment	1
					Biological indicators	1
ND-09020204-005-L_00	Dead Colt Creek Dam	124 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	1
					Oxygen, dissolved	1
					Sedimentation/siltation	1
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	1
ND-09020204-007-S_00	Rush River downstream to unnamed tributary watershed (ND-09020204-011-S)	40.92 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	1
					Organic enrichment	1
					Biological indicators	1

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020204-015-S_00	Sheyenne River from its confluence with tributary watershed (ND-09020204-016-S) downstream to tributary (ND-09020204-014-S)	27.68 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
					Biological indicators	2
ND-09020204-017-S_00	Sheyenne River from unnamed tributary (ND-09020204-018-S) downstream to unnamed tributary watershed (ND-09020204-016-S)	56.72 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
					Biological indicators	2
ND-09020204-022-S_00	Sheyenne River from tributary near Lisbon, North Dakota (ND-09020204-0024-S), downstream to its confluence with Dead Colt Creek (ND-09020204-021-S)	11.37 miles	Recreation	Fully supporting but threatened	Total fecal coliform	1
ND-09020204-023-S_00	Tiber Coulee, including tributaries	32.33 miles	Recreation	Fully supporting but threatened	Total fecal coliform	2
ND-09020204-025-S_00	Sheyenne River from its confluence with a tributary near Highway 46 (ND-09020204-025-S) downstream to its confluence with a tributary near Lisbon, North Dakota (ND-09020204-024-S)	46.06 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
					Sedimentation/siltation	2
ND-09020204-027-S_00	Sheyenne River from its confluence with a tributary watershed below Valley City, North Dakota (ND-09020204-028-S), downstream to its confluence with a tributary near Highway 46 (ND-09020204-026-S)	33.59 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	1
					Biological indicators	1

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020204-034-S_00	Sheyenne River from its confluence with a tributary above Valley City, North Dakota, near railroad bridge (ND-09020204-038-S) downstream to its confluence with a tributary below Valley City, North Dakota (ND-09020204-028-S)	13.18 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	1
					Biological indicators	1
ND-09020204-040-S_00	Sheyenne River from Lake Ashtabula downstream to its confluence with a tributary above Valley City, North Dakota, near railroad bridge (ND-09020204-038-S)	4.13 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	1
					Biological indicators	1
ND-09020205-001-S_00	Maple River from its confluence with Buffalo Creek downstream to its confluence with the Sheyenne River	27.02 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
			Recreation	Fully supporting but threatened	Total fecal coliform	2
ND-09020205-010-S_00	Maple River from its confluence with tributary near Leonard, North Dakota (ND-09020205-011-S), downstream to its confluence with Buffalo Creek	13.96 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
ND-09020301-001-S_00	Red River from its confluence with the Marsh River downstream to its confluence with Sand Hill Creek	21.26 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020301-002-S_00	English Coulee from its confluence with a tributary upstream from Grand Forks, North Dakota, downstream to its confluence with the Red River (lower reach)	5.53 miles	Fish and other aquatic biota	Not supporting	Nutrients	2
					Sedimentation/siltation	2
					Total dissolved solids	2
					Organic enrichment	2
			Recreation	Not supporting	Total fecal coliform	2
					Nutrients	2
					Sedimentation/siltation	2

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020301-007-S_00	Red River from its confluence with the Sand Hill River downstream to its confluence with Cole Creek	31.13 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020301-010-S_00	Red River from its confluence with Cole Creek downstream to its confluence with the Red Lake River	8.06 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020301-014-S_00	Red River from its confluence with the Red Lake River downstream to its confluence with English Coulee	4.02 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020306-001-S_00	Red River from its confluence with English Coulee downstream to its confluence with Grand Marais Creek	8.65 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020306-003-S_00	Red River from its confluence with Grand Marais Creek downstream to its confluence with the Turtle River	12.62 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020306-004-S_00	Red River from its confluence with the Turtle River downstream to its confluence with the Forest River	31.94 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020306-005-S_00	Red River from its confluence with the Forest River downstream to its confluence with the Park River	22.02 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020307-001-S_00	Turtle River from its confluence with the Salt Water Coulee downstream to its confluence with the Red River	30.36 miles	Fish and other aquatic biota	Not supporting	Cadmium	2
					Sedimentation/siltation	2
					Selenium	2
					Total dissolved solids	2

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020307-006-S_00	Turtle River from its confluence with Kelly Slough downstream to its confluence with Salt Water Coulee	0.65 mile	Fish and other aquatic biota	Not supporting	Cadmium	2
					Sedimentation/siltation	2
					Selenium	2
					Total dissolved solids	2
ND-09020307-016-S_00	Kelly Slough from the control structure at Kelly Slough National Wildlife Refuge downstream to its confluence with the Turtle River	2.69 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
ND-09020308-001-L_00	Fordville Dam	197 acres	Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020308-001-S_00	Forest River from Lake Ardoch downstream to its confluence with the Red River	16.17 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
					Sedimentation/siltation	2
					Total dissolved solids	2
ND-09020308-002-L_00	Whitman Dam	143 acres	Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020308-003-L_00	Matejcek Dam	130 acres	Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020310-001-L_00	Homme Dam	194 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Sedimentation/siltation	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020310-001-S_00	Park River from its confluence with Salt Lake outlet (ND-09020310-009-S) downstream to its confluence with the Red River	15.06 miles	Fish and other aquatic biota	Not supporting	Biological indicators	2
					Sedimentation/siltation	2
					Total dissolved solids	2
					Organic enrichment	2

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020310-010-S_00	Park River from its confluence with a tributary east of Grafton, North Dakota (ND-09020310-012-S), downstream to its confluence with the Salt Lake outlet (ND-09020310-009-S)	14.68 miles	Fish and other aquatic biota	Not supporting	Sedimentation/siltation	2
					Total dissolved solids	2
					Organic enrichment	2
ND-09020310-013-S_00	Park River from the confluence of the South Branch Park River and the Middle Branch Park River downstream to its confluence with a tributary east of Grafton, North Dakota (ND-09020310-012-S)	6.83 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	2
					Total dissolved solids	2
					Organic enrichment	2
ND-09020311-001-S_00	Red River from its confluence with the Park River downstream to its confluence with a small tributary north of Drayton, North Dakota	19.02 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020311-003-S_00	Red River from its confluence with a small tributary north of Drayton, North Dakota, downstream to its confluence with Two Rivers	30.3 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020311-005-S_00	Red River from its confluence with Two Rivers downstream to its confluence with the Pembina River	17.99 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020311-007-S_00	Red River from its confluence with the Pembina River downstream to the United States-Canada border	3 miles	Fish consumption	Not supporting	Methylmercury	3
ND-09020313-002-L_00	Renwick Dam	220 acres	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	1
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	1

Appendix 3. Streams in the Red River of the North Basin that are listed as impaired by the State of North Dakota under the U.S. Environmental Protection Agency's total maximum daily load section 303(d) program.—Continued

[Modified from North Dakota Department of Health, 2004; TMDL, total maximum daily load]

Assessment unit identifier	Assessment unit description	Assessment unit size	Designated use	Use support	Impairment	TMDL priority[1]
ND-09020313-006-S_00	Tongue River from its confluence with a tributary northeast of Cavalier, North Dakota, downstream to its confluence with Big Slough	22.54 miles	Fish and other aquatic biota	Fully supporting but threatened	Sedimentation/siltation	1
ND-09020313-007-L_00	Lake Upsilon	414 acres	Fish and other aquatic biota	Fully supporting but threatened	Nutrients/eutrophication	2
					Sedimentation/siltation	2
					Oxygen, dissolved	2
			Recreation	Fully supporting but threatened	Nutrients/eutrophication	2
ND-09020313-011-L_00	Armourdale Dam	79.8 acres	Fish and other aquatic biota	Not supporting	Nutrients/eutrophication	1
					Oxygen, dissolved	1
					Sedimentation/siltation	1
			Recreation	Not supporting	Nutrients/eutrophication	1
ND-09020313-021-S_00	Pembina River from its confluence with a tributary west of Neche, North Dakota, downstream to its confluence with the Tongue River	32.72 miles	Recreation	Fully supporting but threatened	Total fecal coliform	2

[1]Priority 1 assessment units are scheduled for total maximum daily load development in the next 2 years. Priority 2 assessment units are scheduled for total maximum daily load development in the next 10 years. Assessment units listed as priority 3 are listed as impaired for fish consumption because of methylmercury. Those assessment units are a low priority for the State because of complexities related to the fate and transport of methylmercury and because of the interstate and international nature of atmospheric mercury sources.