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NORTH DAKOTA
STATE WATER COMMISSION

2001 Floods in the Red River of the North Basin in Eastern North Dakota and Western Minnesota

INTRODUCTION

The Red River of the North is a complex river system in the north-central plains of the United States. The river continues to impact the people and property within its basin. During the spring of 2001, major flooding occurred for the second time in four years on the Red River of the North and its many tributaries in eastern North Dakota and western Minnesota. Unlike the 1997 floods, which were the result of record-high snowpacks region-wide and a late spring blizzard, the 2001 floods were the result of above-average soil moistures in some areas of the basin, rapid melting of above-average snowpacks in the upper basin, and heavy rainfall that swept across the region on April 7, 2001.

The U.S. Geological Survey (USGS), one of the principal Federal agencies responsible for the collection and interpretation of water-resources data, works with other Federal, State, and local agencies to ensure that accurate and timely data are available for making decisions regarding the public's welfare (a listing of cooperators in the Red River Basin is given on page 8). This report presents preliminary water-resources 2001 flood data that were obtained from selected streamflow-gaging stations located in the Red River of the North Basin (fig. 1).

Flooding in eastern North Dakota and western Minnesota usually is caused by spring snowmelt, and the severity of the flooding is affected by (1) substantial precipitation in the fall that produces high levels of soil moisture, (2) above-normal snowfall in the winter, (3) moist, frozen ground that prohibits infiltration of moisture, (4) a late spring thaw, (5) above-normal precipitation during spring thaw, and (6) ice jams (temporary dams of ice) on rivers and streams.

Stream stages (height of water in a stream above an arbitrarily established datum) and discharges measured by USGS personnel at streamflow-gaging stations are used to define a unique relation between stage and discharge. This relation, commonly called a rating curve, may not be well defined at extreme high discharges because these discharges are rare events of short duration and have unstable conditions that often make measurement extremely difficult. Therefore, estimates for some peak discharges need to be extrapolated from rating curves extended to known peak stages. The peak discharges are used to determine the probability, often expressed in recurrence intervals, that a given discharge will be exceeded in the future. For example, a flood that has a 1-percent chance of exceedance in any given year would, on the long-term average, be expected to occur only about once a century; therefore, the flood would be termed a "100-year flood." However, the chance of such a flood occurring in any given year is 1 percent. Thus, a 100-year flood can occur in successive years at the same location. In some instances,

Flooding at the headwaters of the Red River of the North, Wahpeton, North Dakota.

U. S. Geological Survey personnel measuring flood overflow at a bridge on the Red River of the North near Thompson, North Dakota.

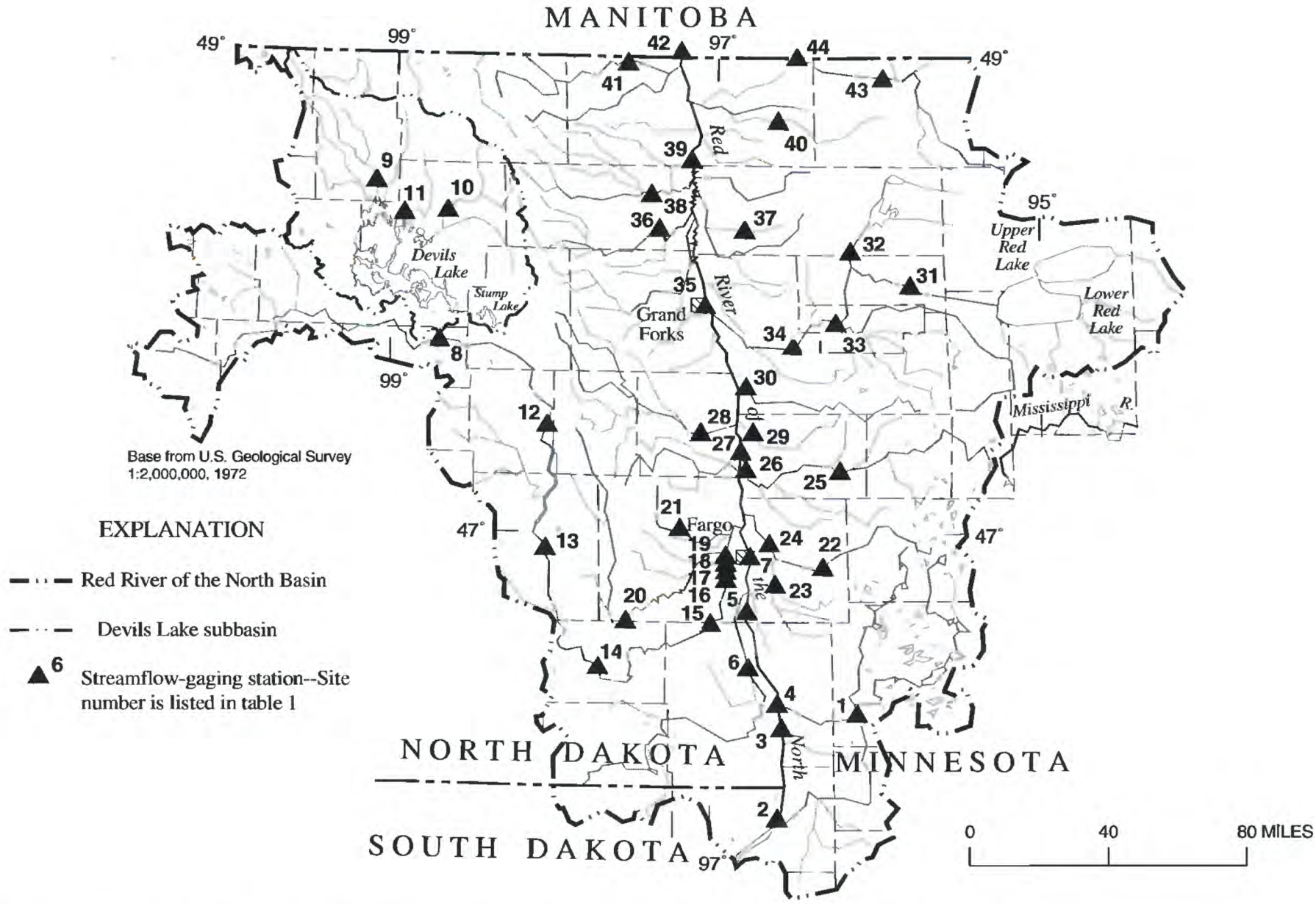

Figure 1. Locations of selected streamflow-gaging stations in the Red River of the North Basin.

recurrence interval estimates can be based on periods of regulated flow or made with historic adjustments when historic data are available.

Historical peak stages and peak discharges and the 2001 peak stages, peak discharges, and recurrence intervals are shown in table 1. The streamflow-gaging stations are listed in downstream order by station number, and station locations are shown in figure 1. Revisions to the 2001 peak stages and peak discharges given in this preliminary report may occur as site surveys are completed and additional field data are reviewed in the upcoming months.

RED RIVER OF THE NORTH BASIN

The Red River of the North (Red River) begins where the Bois de Sioux River meets the Ottertail River at Wahpeton, N. Dak., and Breckenridge, Minn. The river flows north through North Dakota and Minnesota and into Lake Winnipeg, Manitoba, Canada. The Red River is one of the few rivers in the United States to flow directly north. At Emerson, Manitoba, near the Canada-United States border, the drainage area for the Red River Basin in the United States is about 40,200 square miles. The basin is relatively flat and has a shallow river channel. The flat portions of the basin were caused by deposition from an ancient glacial lake (Lake Agassiz). Because of the northerly flow, the flatness of the basin, and the shallow river channel, the timing of spring thaw and snowmelt can greatly aggravate flooding. Snow in the headwaters of the Red River Basin begins to melt first, when areas downstream remain largely frozen. This melt pattern can cause ice jams to form, and subsequent backwater (water that is retarded, backed up, or turned back in its course because of an obstruction or an opposing current) can occur as flow moves north toward the ice jams and frozen river-channel ice.

In the fall of 2000, soil moistures varied across North Dakota and Minnesota. Soil moistures were above average in southeastern North Dakota but were below average in western Minnesota because of below normal rainfall during the growing season. Before freeze-up in November 2000, a series of storms saturated the upper portions of the soils preventing further infiltration of moisture and leaving many parts of the Red River Basin with 1 to 2 feet of snow. Along the Red River, the 2000-2001 snowfall was above average but was less than the record 1997 snowfall. Unofficial 2000-2001 snowfall totals were 39.1 inches, compared to 74.0 inches in 1997, for Wahpeton, N. Dak., and Breckenridge, Minn.; 44.5 inches, compared to 117 inches in 1997, for Fargo, N. Dak., and Moorhead, Minn.; and 44.6 inches, compared to 97.9 inches in 1997, for Grand Forks, N. Dak., and East Grand Forks, Minn. In western Minnesota, 2000-2001 snowfall totals exceeding 60 inches were common. Temperatures began to warm during the end of March and caused the flooding to start in the upper Red River Basin. A massive storm system that brought heavy rains and high winds moved through the upper plains on April 6 and 7, 2001. The upper part of the basin received 1 to 2 inches of rain that added to the flooding problem. Rainfall continued periodically throughout April in parts of the Red River Basin.

Red River of the North

In April 2001, peak stages or peak discharges occurred at many streamflow-gaging stations in the Red River Basin (fig. 1). Recurrence intervals for the peak discharges on the main stem of the Red River ranged from 2 to 50 years.

Warm temperatures during the first few days of April increased the snow and ice melt.

Table 1. Historical peak stages and peak discharges and 2001 peak stages, peak discharges, and recurrence intervals at selected streamflow-gaging stations in the Red River of the North Basin, North Dakota and Minnesota

[Revisions to the current peak stages and peak discharges given in this preliminary table may occur as site surveys are completed and additional field data are reviewed in the upcoming months; ft^3/s, cubic feet per second; --, not available]

Site number (fig. 1)	Station name and number	Drainage area (square miles)	Period of known peaks	Maximum peaks previously known from period of record				Maximum peaks during February through May 2001				
				Date	Stage (feet)	Date	Discharge (ft^3/s)	Date	Stage (feet)	Date	Discharge (ft^3/s)	Recurrence interval (years)
	RED RIVER OF THE NORTH BASIN											
1	Otter Tail River below Orwell Dam near Fergus Falls, Minn. (05046000)	1,740	1931-2001	06-17-1953 05-22-1997	[b]5.60 4.63	06-17-1953 05-22-1997	1,710 1,500	04-08-2001	4.43	04-08-2001	1,430	[a]5-10
2	Bois de Sioux River near White Rock, S. Dak. (05050000)	1,160	1942-2001	04-19-1969 04-20-1997	[c]15.07 16.90	04-19-1969 04-20-1997	3,770 8,750	04-13-2001	15.29	04-13-2001	3,990	[a]25-50
3	Bois de Sioux River near Doran, Minn. (05051300)	1,880	1989-2001	03-16-1995 04-16-1997	22.33 24.42	03-16-1995 04-16-1997	4,290 12,300	04-15-2001	23.63	04-15-2001	9,060	--
4	Red River of the North at Wahpeton, N. Dak. (05051500)	4,010	1897 1942-2001	1897 04-06-1997 04-15-1997	[d]17.00 [bc]19.42 19.25	1897 -- 04-15-1997	[d]10,500 -- [e]12,800	04-09-2001	16.94	04-09-2001	9,220	25-50
5	Red River of the North at Hickson, N. Dak. (05051522)	4,300	1976-2001	04-07-1989 04-14-1997 04-16-1997	35.81 36.85 37.60	04-07-1989 04-14-1997 04-16-1997	12,900 13,300 12,800	04-13-2001	35.78	04-13-2001	11,300	25-50
6	Wild Rice River near Abercrombie, N. Dak. (05053000)	2,080	1897 1933-2001	1897 04-11-1969 04-06-1997 04-16-1997	27.50 24.58 [b]26.59 25.40	-- 04-11-1969 -- 04-16-1997	-- 9,540 -- 9,470	04-09-2001	25.20	04-09-2001	9,320	[a]10-25
7	Red River of the North at Fargo, N. Dak. (05054000)	6,800	1882 1897 1902-2001	04-07-1897 04-17-1997 04-18-1997	[d]39.10 39.54 39.72	04-07-1897 04-17-1997 04-18-1997	[d]25,000 28,000 27,700	04-14-2001	36.63	04-14-2001	20,300	25-50
8	Sheyenne River near Warwick, N. Dak. (05056000)	2,070	1950-2001	04-18-1956 04-21-1997	[b]7.83 8.08	04-14-1969 04-21-1997	4,660 3,990	04-06-2001	6.11	04-06-2001	1,830	2-5
9	Mauvais Coulee near Cando, N. Dak. (05056100)	387	1954-2001	04-25-1979 04-21-1997	11.18 11.68	04-25-1979 04-21-1997	2,660 3,000	04-11-2001	10.15	04-12-2001	1,840	10-25

Table 1. Historical peak stages and peak discharges and 2001 peak stages, peak discharges, and recurrence intervals at selected streamflow-gaging stations in the Red River of the North Basin, North Dakota and Minnesota—Continued

[Revisions to the current peak stages and peak discharges given in this preliminary table may occur as site surveys are completed and additional field data are reviewed in the upcoming months; ft^3/s, cubic feet per second; --, not available]

Site number (fig. 1)	Station name and number	Drainage area (square miles)	Period of known peaks	Maximum peaks previously known from period of record				Maximum peaks during February through May 2001				
				Date	Stage (feet)	Date	Discharge (ft^3/s)	Data	Stage (feet)	Date	Discharge (ft^3/s)	Recurrence interval (years)
RED RIVER OF THE NORTH BASIN—Continued												
10	Edmore Coulee near Edmore, N. Dak. (05056200)	382	1956-2001	07-30-1993 04-24-1997	87.76 87.95	07-30-1993 04-24-1997	1,180 1,830	04-11-2001	86.56	04-11-2001	757	2-5
11	Starkweather Coulee near Webster, N. Dak. (05056239)	310	1980-2001	04-06-1989 04-04-1997 04-27-1997	10.05 8.79 7.75	08-11-1987 -- 04-27-1997	570 -- 782	04-07-2001	7.52	04-07-2001	710	10-25
12	Sheyenne River near Cooperstown, N. Dak. (05057000)	6,470	1945-2001	04-18-1996 04-24-1997	19.13 18.52	04-17-1950 04-24-1997	7,830 5,280	04-05-2001	[b]17.36	04-08-2001	3,060	5-10
13	Sheyenne River at Valley City, N. Dak. (05058500)	7,810	1882 1897 1919 1938-2001	04-1882 04-21-1996 04-19-1997	20.00 18.78 18.01	-- 04-21-1996 04-19-1997	-- 5,250 4,810	04-14-2001	11.60	04-14-2001	2,340	[a]2-5
14	Sheyenne River at Lisbon, N. Dak. (05058700)	8,190	1950 1957-2001	04-13-1996 04-05-1997	[b]19.20 [b]19.29	07-01-1975 04-05-1997	5,270 [b]6,100	04-08-2001	[b]12.37	04-10-2001	2,760	2-5
15	Sheyenne River near Kindred, N. Dak. (05059000)	8,800	1947 1950-2001	1947 04-08-1997 04-27-1997	22.10 [b]22.33 21.38	04-30-1996 04-08-1997 04-27-1997	5,100 [b]5,800 5,970	04-09-2001	[b]18.36	04-10-2001	3,310	[a]5-10
16	Sheyenne River above Sheyenne River Diversion near Horace, N. Dak. (05059300)[f]	8,840	1992-2001	05-02-1996 04-17-1997 05-08-1997	24.67 [b]25.44 25.27	05-02-1996 -- 05-08-1997	4,430 -- 5,210	04-10-2001	[b]25.28	04-10-2001	3,500	--
17	Sheyenne River Diversion near Horace, N. Dak. (05059310)[g]	--	1992-2001	05-02-1996 04-17-1997 04-28-1997	24.67 [b]25.44 25.38	04-22-1996 -- 04-28-1997	[h]2,300 -- 2,590	04-10-2001	25.28	04-10-2001	2,100	--
18	Sheyenne River Diversion at West Fargo, N. Dak. (05059480)	--	1992-2001	04-18-1996 04-09-1997 04-19-1997	[b]28.77 [b]22.90 22.68	05-02-1996 -- 04-19-1997	4,280 -- [i]4,810	04-11-2001	22.02	04-11-2001	3,680	--

Table 1. Historical peak stages and peak discharges and 2001 peak stages, peak discharges, and recurrence intervals at selected streamflow-gaging stations in the Red River of the North Basin, North Dakota and Minnesota—Continued

[Revisions to the current peak stages and peak discharges given in this preliminary table may occur as site surveys are completed and additional field data are reviewed in the upcoming months; ft^3/s, cubic feet per second; --, not available]

Site number (fig. 1)	Station name and number	Drainage area (square miles)	Period of known peaks	Maximum peaks previously known from period of record				Maximum peaks during February through May 2001				
				Date	Stage (feet)	Date	Discharge (ft^3/s)	Date	Stage (feet)	Date	Discharge (ft^3/s)	Recurrence interval (years)
RED RIVER OF THE NORTH BASIN—Continued												
19	Sheyenne River at West Fargo, N. Dak. (05059500)[j]	8,870	1902 1903-05 1919 1929-2001	07-05-1975 04-09-1997 04-19-1997	22.25 [k]22.90 22.68	05-02-1996 -- 04-19-1997	[h]4,240 -- 4,810	04-11-2001	22.02	04-11-2001	3,680	10-25
20	Maple River near Enderlin, N. Dak. (05059700)	843	1956-2001	06-30-1975	15.41	06-30-1975	7,610	04-10-2001	10.07	04-10-2001	2,070	2-5
21	Rush River at Amenia, N. Dak. (05060500)	116	1946-2001	03-23-1966	[b]12.15	04-19-1979	3,490	04-08-2001	10.12	04-08-2001	1,200	5-10
22	Buffalo River near Hawley, Minn. (05061000)	322	1945-2001	1921 04-06-1997	[d]11.30 [b]10.77	-- 04-06-1997	-- [b,l]2,360	04-08-2001	10.17	04-08-2001	1,900	10-25
23	South Branch Buffalo River near Sabin, Minn. (05061500)	522	1945-2001	07-02-1975 -- 04-06-1997	19.90 -- [b]19.11	07-02-1975 04-05-1997 --	8,500 [b,l]5,850 --	04-09-2001	16.67	04-09-2001	4,080	5-10
24	Buffalo River near Dilworth, Minn. (05062000)	1,040	1931-2001	07-02-1975 04-06-1997	27.10 [b]27.02	07-02-1975 04-06-1997	13,600 [l]8,370	04-10-2001	23.30	04-10-2001	6,450	10-25
25	Wild Rice River at Twin Valley, Minn. (05062500)	929	1909-17 1931-2001	07-22-1909 04-06-1997	20.00 15.91	07-22-1909 04-06-1997	9,200 10,000	04-07-2001	[b]12.60	04-08-2001	5,370	10-25
26	Wild Rice River at Hendrum, Minn. (05064000)[m]	1,600	1944-2001	04-21-1979 04-18-1997	32.30 [n]33.85	04-10-1978 04-18-1997	9,350 10,600	04-14-2001	[n]31.62	04-10-2001	9,760	[a]10-25
27	Red River of the North at Halstad, Minn. (05064500)	21,800	1936-37 1942-2001	04-22-1979 04-19-1997	39.00 40.74	04-22-1979 04-19-1997	42,000 71,500	04-15-2001	38.44	04-15-2001	37,800	10-25
28	Goose River at Hillsboro, N. Dak. (05066500)	1,203	1931-2001	04-21-1979 04-06-1997	16.76 15.62	04-21-1979 04-06-1997	14,800 8,520	04-08-2001	10.30	04-08-2001	4,200	5-10
29	Marsh River near Shelly, Minn. (05067500)	151	1944-2001	04-19-1979 04-18-1997	[c]23.36 [c]25.45	04-19-1979 04-18-1997	4,880 [n]4,300	04-10-2001	19.26	04-10-2001	2,240	2-5

Table 1. Historical peak stages and peak discharges and 2001 peak stages, peak discharges, and recurrence intervals at selected streamflow-gaging stations in the Red River of the North Basin, North Dakota and Minnesota—Continued

[Revisions to the current peak stages and peak discharges given in this preliminary table may occur as site surveys are completed and additional field data are reviewed in the upcoming months; ft^3/s, cubic feet per second; --, not available]

Site number (fig. 1)	Station name and number	Drainage area (square miles)	Period of known peaks	Maximum peaks previously known from period of record				Maximum peaks during February through May 2001				
				Date	Stage (feet)	Date	Discharge (ft^3/s)	Date	Stage (feet)	Date	Discharge (ft^3/s)	Recurrence interval (years)
RED RIVER OF THE NORTH BASIN—Continued												
30	Sand Hill River at Climax, Minn. (05069000)	426	1943-2001	04-23-1979 04-20-1997	[c n]32.79 [n]39.40	04-14-1965 04-20-1997	4,560 [l n]4,360	04-14-2001	[b]26.05	04-10-2001	3,500	10-25
31	Red Lake River at High Landing near Goodridge, Minn. (05075000)[m]	2,300	1929-2001	07-03-1975 07-07-1975 04-10-1997 --	13.44 13.39 [b]12.36 --	-- 07-07-1975 -- 04-15-1997	-- 4,060 -- 2,260	04-08-2001	11.44	04-08-2001	2,640	2-5
32	Thief River near Thief River Falls, Minn. (05076000)	959	1909-17 1920-21 1922-24 1928-81 1982-2001	05-13-1950 04-18-1997 04-22-1997	17.38 [b]16.33 15.20	05-13-1950 -- 04-22-1997	5,610 -- 4,120	04-09-2001	[b]16.59	04-09-2001	[b,l]3,400	5-10
33	Clearwater River at Red Lake Falls, Minn. (05078500)	1,370	1909-17 1934-81 1982-2001	04-25-1979 03-06-1983 04-15-1997	12.38 [b]15.85 11.10	04-25-1979 -- 04-15-1997	10,300 -- 7,860	04-07-2001	[b]10.76	04-09-2001	6,120	5-10
34	Red Lake River at Crookston, Minn. (05079000)	5,270	1897 1902 1904-20 1922-2001	04-12-1969 04-17-1997	27.33 [b]28.40	04-12-1969 04-17-1997	28,400 [o]28,000	04-09-2001	[b]26.51	04-10-2001	[o]18,000	10-25
35	Red River of the North at Grand Forks, N. Dak. (05082500)	30,100	1882-1997	04-10-1897 04-18-1997 04-22-1997	50.20 52.21 [c]54.35	04-10-1897 04-18-1997 04-22-1997	85,000 [p]137,000 114,000	04-14-2001	44.87	04-11-2001	55,800	10-25
36	Forest River at Minto, N. Dak. (05085000)	740	1944-2001	04-18-1950 04-04-1997	11.80 [b]9.11	04-18-1950 --	16,600 --	04-10-2001	[q]3.26	04-10-2001	[q]628	1-2
37	Middle River at Argyle, Minn. (05087500)	265	1945 1950-81 1982-2001	05-19-1996 04-19-1997	[c]18.27 17.96	05-19-1996 04-19-1997	5,020 4,330	04-09-2001	15.69	04-09-2001	1,990	5-10
38	Park River at Grafton, N. Dak. (05090000)	695	1932-2001	04-19-1950 04-21-1997	20.13 15.40	04-19-1950 04-21-1997	12,600 5,250	04-09-2001	11.43	04-09-2001	2,120	[a]2-5
39	Red River of the North at Drayton, N. Dak. (05092000)	34,800	1936-37 1941-2001	04-28-1979 04-24-1997	43.66 45.55	04-28-1979 04-24-1997	92,900 124,000	04-20-2001	41.38	04-18-2001	56,400	10-25

Table 1. Historical peak stages and peak discharges and 2001 peak stages, peak discharges, and recurrence intervals at selected streamflow-gaging stations in the Red River of the North Basin, North Dakota and Minnesota—Continued

[Revisions to the current peak stages and peak discharges given in this preliminary table may occur as site surveys are completed and additional field data are reviewed in the upcoming months; ft^3/s, cubic feet per second; --, not available]

Site number (fig. 1)	Station name and number	Drainage area (square miles)	Period of known peaks	Maximum peaks previously known from period of record				Maximum peaks during February through May 2001				
				Date	Stage (feet)	Date	Discharge (ft^3/s)	Date	Stage (feet)	Date	Discharge (ft^3/s)	Recurrence interval (years)
	RED RIVER OF THE NORTH BASIN—Continued											
40	South Branch Two Rivers at Lake Bronson, Minn. (05094000)	444	1929-37 1941-47 1954-2001	04-05-1966 04-20-1997	18.23 14.58	04-05-1966 04-20-1997	5,410 4,260	04-09-2001	13.46	04-09-2001	3,320	5-10
41	Pembina River at Neche, N. Dak. (05100000)	3,410	1904-08 1910-15 1919-2001	04-20-1979 04-21-1997 04-27-1997	[b]23.64 [b]24.51 24.20	04-20-1950 04-21-1997 04-27-1997	[b]12,800 15,100	04-09-2001	[b]19.97	04-22-2001	4,190	5-10
42	Red River of the North at Emerson, Manitoba (05102500)	40,200	1902 1912-29 1929-2001	05-01-1979 04-26-1997	791.19 792.41	05-13-1950 04-26-1997	95,500 133,000	04-24-2001	788.79	04-24-2001	[q]55,600	10-25
43	Roseau River at Ross, Minn. (05107500)	1,220	1928-91 1995-2001	05-12-1950 04-26-1997	18.25 17.30	05-12-1950 04-26-1997	6,560 4,670	04-18-2001	15.11	04-18-2001	2,650	--
44	Roseau River below State Ditch 51 near Caribou, Minn. (05112000)	1,560	1917 1920-2001	05-19-1950 04-19-1997 05-08-1997	11.81 [b]11.13 10.74	05-19-1950 04-19-1997 --	4,080 3,320 --	04-11-2001	[b]10.20	04-14-2001	2,980	--

[a]Affected by regulation period.
[b]Backwater from aquatic vegetation, ice, debris, or other water source.
[c]From floodmark/high watermark.
[d]Extreme outside period of record.
[e]About 2,200 cubic feet per second of overland flow entered the Wild Rice River Basin about 7 miles upstream of gage.
[f]Total Sheyenne River flow immediately upstream from Horace flood diversion.
[g]When flows are greater than 1,000 ft^3/s at Sheyenne River above Sheyenne River Diversion near Horace, diversions are made to this channel in order to control flood discharge downstream.
[h]Maximum daily discharge.
[i]Unknown amount of flow entered diversion through flapper gates and overtopping of diversion levee during April and May.
[j]Includes flow of diversion.
[k]Maximum gage height in diversion channel: backwater from ice.
[l]Estimated.
[m]Most peaks affected by diversion.
[n]Backwater from Red River of the North.
[o]Approximate value.
[p]Maximum observed flow affected by breakout flow from Red River about 20 river miles upstream of gage. The breakout flow reentered the Red Lake River about 2 miles upstream of the gage.
[q]From measurement.

A storm on April 6-7, 2001, brought up to two inches of rain to the basin and accelerated the rising water. On April 9, 2001, the peak stage on the Red River at Wahpeton, N. Dak. (site 4, fig. 1; table 1), was 16.94 feet, which is 2.48 feet less than the record set in 1997, and the peak discharge was 9,220 cubic feet per second. The recurrence interval for this peak discharge was between 25 and 50 years. During the first two weeks of April, the U.S. Army Corps of Engineers (COE) built additional levees in Wahpeton, N. Dak., and Breckenridge, Minn., to help minimize the flood damages. On April 13, 2001, the peak stage on the Red River at Hickson, N. Dak. (site 5, fig. 1; table 1), was 35.78 feet, which is 1.82 feet less than the record set in 1997, and the peak discharge was 11,300 cubic feet per second. The recurrence interval for this peak discharge was between 25 and 50 years.

On April 14, 2001, the peak stage of the Red River at Fargo, N. Dak. (site 7, fig. 1; table 1), was 36.63 feet, which is 3.09 feet less than the record set in 1997, and the peak discharge was 20,300 cubic feet per second. The recurrence interval for this peak discharge was between 25 and 50 years. In early April, the COE built five earthen levees adjacent to the Red River to protect the city of Fargo from the rising water.

High discharges continued downstream on the Red River. On April 14, 2001, the peak stage of the Red River at Grand Forks, N. Dak. (site 35, fig. 1; table 1), was 44.87 feet, which is 9.48 feet less than the record set in 1997. The peak discharge was 55,800 cubic feet per second, which occurred on April 11, 2001. The recurrence interval for this peak discharge was between 10 and 25 years. Because of high discharges upstream and heavy rainfall during the first week of April, Grand Forks city officials asked the COE to help raise the city dikes to 52 feet.

On April 20, 2001, the peak stage of the Red River at Drayton, N. Dak. (site 39, fig. 1; table 1), was 41.38 feet, which is 4.17 feet less than the record set in 1997. The peak discharge was 56,400 cubic feet per second, which occurred on April 18, 2001. The recurrence interval for this peak discharge was between 10 and 25 years. On April 24, 2001, the peak stage of the Red River at Emerson, Manitoba (site 42, fig. 1; table 1), just north of the international boundary between the United States and Canada, was 788.79 feet, which is 3.62 feet less than the record set in 1997, and the peak discharge was 55,600 cubic feet per second. The recurrence interval for this peak discharge was between 10 and 25 years.

Tributaries to the Red River of the North

Streamflow-gaging stations recorded peak stages and peak discharges on many tributaries to the Red River during the 2001 spring floods. The recurrence intervals for these peak discharges ranged from less than 1 year to 50 years.

On April 13, 2001, the peak stage of the Bois de Sioux River near White Rock, S. Dak. (site 2, fig. 1; table 1), was 15.29 feet, which is 1.61 feet less than the record set in 1997, and the peak discharge was 3,990 cubic feet per second. The recurrence interval for this peak discharge was between 25 and 50 years. On April 9, 2001, the peak stage of the Wild Rice River at Abercrombie, N. Dak. (site 6, fig. 1; table 1), was 25.20 feet, which is 1.39 feet less than the record set in 1997, and the peak discharge was 9,320 cubic feet per second. The recurrence interval for this peak discharge was between 10 and 25 years. There are two Wild Rice Rivers that flow into the Red River; one is located in North Dakota and the other is located in Minnesota. On April 7, 2001, the peak stage of the Wild Rice River at Twin Valley, Minn. (site 25, fig. 1; table 1), was 12.60 feet, which is 7.40 feet less than the record set in 1909. The peak discharge was 5,370 cubic feet per second, which occurred on April 8, 2001. The recurrence interval for this peak discharge was between 10 and 25 years. On April 9, 2001, the peak stage of the Red Lake River at Crookston, Minn. (site 34, fig. 1; table 1), was 26.51 feet, which is 1.89 feet less than the record set in 1997. The peak discharge was about 18,000 cubic feet per second, which occurred on April 10, 2001. The recurrence interval for this peak discharge was between 10 and 25 years. The Red Lake River generally accounts for about 35 percent of the Red River discharge at Grand Forks, N. Dak.

Devils Lake

Devils Lake is a 3,810-square-mile closed subbasin within the Red River Basin in North Dakota. At an elevation of about 1,446.5 feet above sea level (asl), Devils Lake begins to spill into nearby Stump Lake (fig. 1). The combined lakes discharge no water until the lake level reaches about 1,459 feet asl, the lowest natural outlet elevation. When water reaches this level, it spills into the Sheyenne River through Tolna Coulee. Within the past 10,000 years, Devils Lake has fluctuated from being dry to spilling over its natural outlet. Between 1867 and 2001, the lake level has fluctuated from a minimum of 1,400.9 feet asl in 1940 to a maximum of 1,447.74 feet asl in May 2001. Since 1993, the lake has risen about 25 feet in response to above-normal precipitation in the basin and below-normal evaporation from the lake surface. The rising water has inundated homes, businesses, and agricultural lands and has caused roads to be closed. Some small towns have been abandoned because of flooding. The rising water has caused damages exceeding $300 million and sparked controversy on mitigating the rising water.

In the Red River Basin, the USGS works in cooperation with the U.S. Army Corps of Engineers, Bureau of Reclamation, International Joint Commission of the U.S. State Department, U.S. Fish and Wildlife Service, U.S. Bureau of Indian Affairs, Minnesota Department of Natural Resources, North Dakota State Water Commission, North Dakota Department of Health, Cass County Joint Water Resource District, Devils Lake Basin Joint Water Resource Board, Red River Joint Water Management Board, Red River Watershed Management Board, Southeast Cass Water Resources District.

—K.M. Macek-Rowland

For additional information on the 2001 floods and related topics, contact the following Internet sites:

USGS, North Dakota District	http://nd.water.usgs.gov/
USGS, Minnesota District	http://mn.water.usgs.gov/
U.S. Army Corps of Engineers	http://www.mvp.usace.army.mil/flood_control/current_act/
National Weather Service	http://www.crh.noaa.gov/fgf
North Dakota Water Commission	http://www.swc.state.nd.us/
Minnesota Department of Natural Resources	http://www.dnr.state.mn.us/waters/
University of Minnesota - Climate	http://climate.umn.edu.doc/journal/flood_2001flood_2001.htm

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For more information contact any of the following:

For water information:
District Chief
821 East Interstate Avenue
Bismarck, ND 58503-1199
(701) 250-7400

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-888-ASK-USGS.

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "http://www.usgs.gov".