Floods of 1950 in the Red River of the North and Winnipeg River Basins

Prepared by WATER RESOURCES DIVISION

FLOODS OF 1950

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1137-B

A presentation of data on floods in Minnesota, North Dakota, and Manitoba, prepared in cooperation with the Water Resources Division, Department of Resources and Development, Canada.

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PREFACE

The data for this report were collected separately, but prepared for publication jointly by the Water Resources Division, U. S. Geological Survey, C. G. Paulsen, chief hydraulic engineer, and the Water Resources Division, Department of Resources and Development, Canada, Norman Marr, Chief. For the Geological Survey, the field work was performed and the report prepared in the Surface Water Branch, J. V. B. Wells, chief.

The work of gathering and preparing the data for publication was apportioned and directed as follows: North Dakota and main stem of Red River, Harlan Erskine, district engineer, Bismarck; Minnesota, Paul Speer, district engineer, St. Paul; Canada, D. B. Gow, district engineer, Winnipeg. Several engineers of the Geological Survey detailed from other parts of the United States assisted in the field and office work in Minnesota and North Dakota.

Coordination of the field work in the United States was done by Hollister Johnson, hydraulic engineer. This report was assembled and the text prepared by the staff of the special reports office in Lincoln, Nebr., R. E. Oltman, engineer in charge.

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Prepared by WATER RESOURCES DIVISION

ABSTRACT

The floods of April-July 1950 in the Red River of the North and Winnipeg River Basins were the largest that have occurred in several decades and caused the greatest damage that the flooded area has ever sustained. Five lives were lost in the United States, owing to causes directly connected with the floods. The dual peaks--on upper river and tributaries, one in April and the other in May--of nearly the same size and the large lake-like body of flood-water ponded between Grand Forks and Winnipeg were notable features of the flood in the Red River of the North Basin. The flood in the Winnipeg River Basin was characterized by the unusually large volume of runoff and the lateness of cresting on the Lake of the Woods.

The floods were caused by a combination of causes: high antecedent soil moisture, high antecedent runoff, heavy snowfall, delayed breakup, and heavy precipitation during breakup. Mid-March snow-surveys, made in the area by hydrographers of the United States and Canadian services, showed that the snow pack north of Fargo, N. Dak., had an unusually high water content and a runoff potential increasing from west to east. A narrow band, extending from near Grand Forks, N. Dak., east-northeastward across the basin, had a water content of 5 inches or higher. April 15 marked the beginning of rapid melting throughout the basins; most of the snow was turned into water by the end of the first melt period on April 24. A return of winter-like conditions until May 10 brought more snow and set the stage for second flood crests.

The records of stage and discharge collected on the Red River of the North at Grand Forks, N. Dak., since 1882 show that the important 1897 flood slightly exceeded the 1950 flood in both stage and discharge. Records collected by the Geological Survey and Corps of Engineers on the Red River of the North show that the 1950 flood stages exceeded any previously known from just below the mouth of Turtle River to the international boundary. Records for streams tributary to the Red River of the North between Fargo and the Roseau River show, in general, that the 1950 flood events exceeded those of any known past floods. In the storage basins of the Winnipeg River, Lake of the Woods and Rainy Lake reached a stage comparable to that of 1916; and the Winnipeg River discharge at Slave Falls exceeded the highest previously recorded maximum, which occurred in 1927. Records of floods on the Red River at Winnipeg show that the 1950 flood did not reach as high a stage as those of 1826, 1852, and 1861.

The total tabulated damage to Winnipeg, the largest urban center in the area reported on, was about $20,000,000 in the city, and $12,000,000 in surrounding suburbs. The fight against flooding in Greater Winnipeg began on April 21 in the area adjacent to the municipal hospitals and was considered ended with the reopening of Norwood Bridge on June 1. About 80,000 people were evacuated from their homes in Greater Winnipeg during the flood, and plans were ready to evacuate a greater number had the water risen higher.

This report contains records of stage and discharge for the flood period at 70 stream-gaging stations, 21 records of mean daily discharge at stream-gaging stations, 11 records of stage at river-height gages, and 7 records of storage or elevation of reservoirs or lakes. A summary table shows crest stages and discharges at 129 points for the 1950 event compared with the highest known past stages and discharges. Also included is a discussion of concurrent meteorology and of past floods on main streams and tributaries.

INTRODUCTION

The spring floods of 1950 in the Red River of the North and Winnipeg River Basins resulted from a combination of causes, none of which, acting alone, would have produced flood features of such size. These causes were: above-normal antecedent soil-moisture; unusually heavy snowfall during a colder-than-normal winter; delayed melting of the snow until mid-April; and above-normal precipitation during the breakup. Over much of the drainage area of the Red River of the North the floods were the largest that have occurred since 1897. An unusual feature on many tributaries and on much of the main stem, was the occurrence of two separate flood peaks of nearly the same size: one in April, the other in May. The outstanding features of the Winnipeg River floods were the greatness of runoff and the lateness of the flood crest in the Lake of the Woods, which occurred near the end of July. The flood on the Red River of the North caused the greatest damage to Winnipeg that the city has ever experienced.

This report is one of a series that the U. S. Geological Survey proposes to publish annually to describe the major floods during each year. The information is supplementary to, and published sooner than, that included in the regular annual Surface-Water Supply reports of the Geological Survey and is intended to satisfy the needs of the planner and designer of projects for which flood flows are a consideration. The information on stage and discharge is given in such detail that the flood hydrographs can be reproduced for the regular gaging stations. Also included are: stages and peak discharges observed at miscellaneous points; data on flood damage to cities, highways, and agricultural lands; and descriptions of special features of the floods.

ACKNOWLEDGMENTS

The general investigation of surface-water resources in the area within the United States covered by this report is performed by the U. S. Geological Survey in cooperation with the North Dakota State Water Conservation Commission, the South Dakota State Engineer, the Minnesota Department of Conservation, the Corps of Engineers, and the Department of State. The general investigation of surface-water resources in the area of Canada covered by this report is performed by the Water Resources Division, Department of Resources and Development, Canada, in cooperation with the Water Resources Branch and Drainage Maintenance Board of the Province of Manitoba and the Engineering Department of the City of Winnipeg.

Full cooperation exists between the United States Geological Survey and the Water Resources Division, Department of Resources and Development, Canada. On waters adjacent to the international boundary, certain stations, designated international stations, are maintained jointly by the United States and Canada under the terms of the Boundary Waters Treaty of 1909 or subsequent agreement between the two countries.

Data furnished by the following agencies or corporations have been incorporated into the text: the Corps of Engineers, U. S. Army; the Bureau of Public Roads; the U. S. Weather Bureau; the Great Northern Railway; the Northern Pacific Railway; the Chicago, Milwaukee, St. Paul, and Pacific Railway; and the Minneapolis, St. Paul, and Sault Ste. Marie Railway. Material furnished by individuals, corporations, or government agencies is acknowledged where it appears in the text.

The North Dakota State Water Conservation Commission and the Minnesota Department of Conservation furnished services of surveymen to assist in the collection of field data for computation of peak discharge by indirect methods.

GENERAL DESCRIPTION OF FLOODS

Location

The area associated with the floods discussed in this report is divided between the north central part of continental United States and the south central part of Canada. It occupies roughly the northern third of Minnesota, that part of North Dakota lying northeast of a diagonal between the northwest and southeast corners of the state, the extreme northeastern tip of South Dakota, the southwest corner of Ontario, the southern fringe of Manitoba, and the southeastern corner of Saskatchewan. This area is shown on plate 9 (in pocket), a map of part of the Red River of the North Basin and of the Winnipeg River Basin.

The floods in the Red River of the North Basin occurred in the area above the Assiniboine River, which stream had about normal spring runoff. The location of the area of intense local flooding in the Red River of the North and Winnipeg River Basins is shown by symbol. The uniform dispersal of the intensely flooded areas is readily apparent.

The location of all cultural features with respect to the ancient lake, which at one time occupied much of the Red River of the North drainage area, is of importance in understanding the flooding that occurs there. An outline of the maximum extent of Glacial Lake Agassiz is shown on plate 9. Land slopes and stream channel slopes are relatively steep outside the area of the former lake, and flat within. The drop of the Red River of the North between Fargo (below dam B) and Grand Forks, a distance of about 150 miles by river, is 72 feet at normal low water. Meandering channels combined with small high-water slopes make the carrying capacity of streams in the ancient lake bed small per unit of cross-sectional area.

Causes

The spring floods of 1950 in the Red River of the North and Winnipeg River Basins were caused by many factors so combined that nearly

record-breaking flood flows resulted. The important factors causing the flooding were: (1) high soil moisture at breakup combined with frozen ground, (2) above-normal accumulation of snow at breakup, (3) later-than-normal breakup, and(4) heavy precipitation during the breakup. Ice jams were an additional cause of flooding on a few of the tributaries.

Soil moisture in the Red River of the North and Winnipeg River Basins was above normal when the ground was frozen in the fall of 1949. Precipitation for October was 2.30 inches above normal in the northern division of Minnesota and 2.20 inches above normal in the eastern division of North Dakota according to Weather Bureau records. The excessive precipitation caused increased stream flow, filling of ponds and swamps, and charging of the soil. The first hard freeze, which occurred about December 12, 'fixed' the above antecedent conditions until spring breakup. The issues of Water Resources Review published by the U. S. Geological Survey for December 1949 to February 1950 show the high base flow of streams and above-normal ground-water levels that existed during the pre-flood period over the flooded area.

Snowfall for December 1949 and January 1950 was excessive throughout the flooded area; Weather Bureau records show a cumulative departure of plus 1.40 inches precipitation for the two months in the northern division of Minnesota and a corresponding surplus of 1.26 inches in the eastern division of North Dakota; and the records collected at Winnipeg, Manitoba, and Kenora, Ontario, indicate an equal comparative excess in the Canadian portion. Most of the snowfall came in blizzards which caused large drifts in locations sheltered from the wind. Snowfall for February was slightly below normal; but above-normal precipitation, predominantly snow, occurred in March and early April. The spring breakup came after mid-April and was interrupted after a few days by a return of winter conditions. The unusually long winter season closed about May 10 with the end of the heaviest May snowstorm ever observed. A survey was made by the Corps of Engineers in mid-March to gather information on the water content of snow on the ground; the results of that survey are shown on plate 10 (in pocket). So that the reader may know how much precipitation occurred subsequent to that survey and prior to the first thaw about April 15, and between April 16 and May 10, precipitation amounts of those periods are shown adjacent to the weather station reporting them.

Temperatures over the flood area for the period from December 1949 to March 1950, inclusive, were below normal and there were few periods of relief from the almost continuous cold. Daily maximum and minimum temperatures for four stations for the period from November 1, 1949 to May 31, 1950, are plotted on figure 17. This illustration shows the low temperatures that prevailed during most of the period from December 10, 1949 to April 13, 1950. The first basin-wide warm spell occurred April 15 to 23 and caused melting that produced flood peaks on all streams in the Red River of the North Basin. Minor melting combined with rainfall caused earlier flood peaks in the portion of the basin above Fargo. The weather turned cold again April 24 to May 9 and most of the precipitation for this period came as snow. The weather again warmed up on May 10, and continued clear and warm; the second thaw caused new flood peaks on most tributaries of the Red River of the

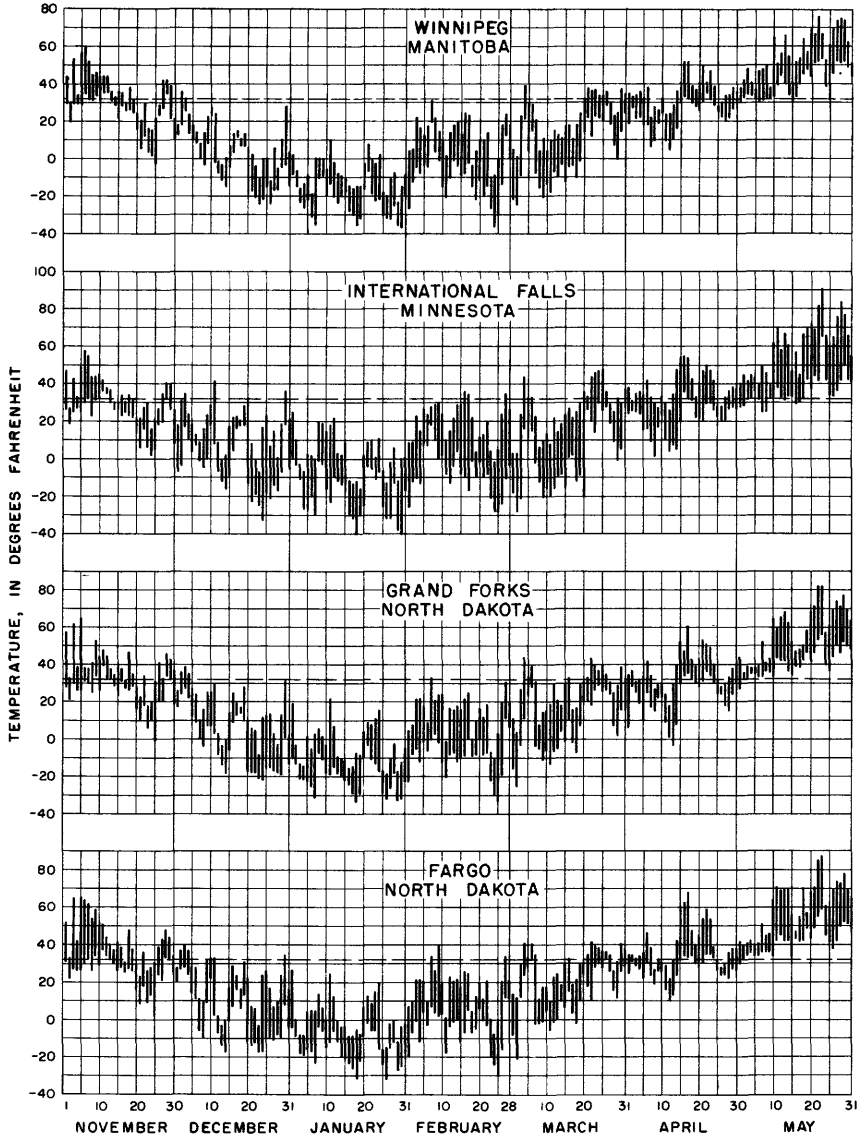

Figure 17.—Daily range of temperatures at selected weather stations in the Red River of the North and Winnipeg River Basins for the period November 1949 to May 1950.

North. The largest snowdrifts did not entirely melt until June. In May, flood conditions at and above Winnipeg were severe. A large lake-like body of floodwater stretched from near Grand Forks to Winnipeg during most of the month and to this was added more than four inches of rain that fell directly on the ponded surface, plus the runoff from equal or heavier precipitation on the drainage area upstream. The almost daily cold rains interfered with rescue work and with the heroic efforts to raise dikes in the Winnipeg area.

Main Stem Red River

The first phase of the flood on the Red River of the North in 1950 was the minor flooding at the start of the Red River at Breckenridge-Wahpeton in late March and early April. A large storm swept across North Dakota in a northeasterly direction starting on March 25. The storm brought snow to all parts of the State except the southeast, where rain fell; Fargo received the heaviest rainfall ever recorded in March. The rain caused melting of the snow and started the spring runoff. The River at Wahpeton started rising on March 26; by the afternoon of April 2 it had reached peak discharge. Damage from flooding in the Wahpeton area was nil or minor. Figures 18 and 19, plots of discharge and water surface hydrographs for Red River of the North gaging stations, show the relative size and time of occurrence of the headwater peak discharge compared with those downstream. Hydrographs are plotted in altitudes above sea level so that the height of water surface relative to features on the river banks may be readily interpreted.

The Red River of the North is confined by moderately high banks between Wahpeton and Fargo. Only small towns are located in that stretch of the River; had overbank flow occurred, the flood damage would have been minor.

At Fargo, the April flood caused some minor inconvenience and damage on lower Broadway. Pumps were in continuous operation to keep the Fargo City Auditorium dry. It was estimated that 100 families, the majority in Moorhead, Minn., had been forced from their homes by the flood as of April 5. The water continued to rise at Fargo until April 7 when it reached a peak stage of 21.2 feet. A flood almost as large occurred on May 12 as a result of the second thaw. Figure 20 shows the flooded portions of the Fargo-Moorhead area.

The Red River flood passed from Fargo downstream to Grand Forks without going overbank. At Grand Forks the Red Lake River enters from Minnesota and the flood waters of that stream, added to those of the Red River of the North, created a flood situation at Grand Forks and downstream that was the most serious to occur there since 1897.

Ample flood warning was given to the inhabitants of the area; R. W. Shultz, Weather Bureau meteorologist, issued a forecast for a flood stage of 42 feet at Grand Forks on April 8. At that time, the river stood at about 27 feet at the Weather Bureau gage in Grand Forks. Official flood stage at Grand Forks is 28 feet.

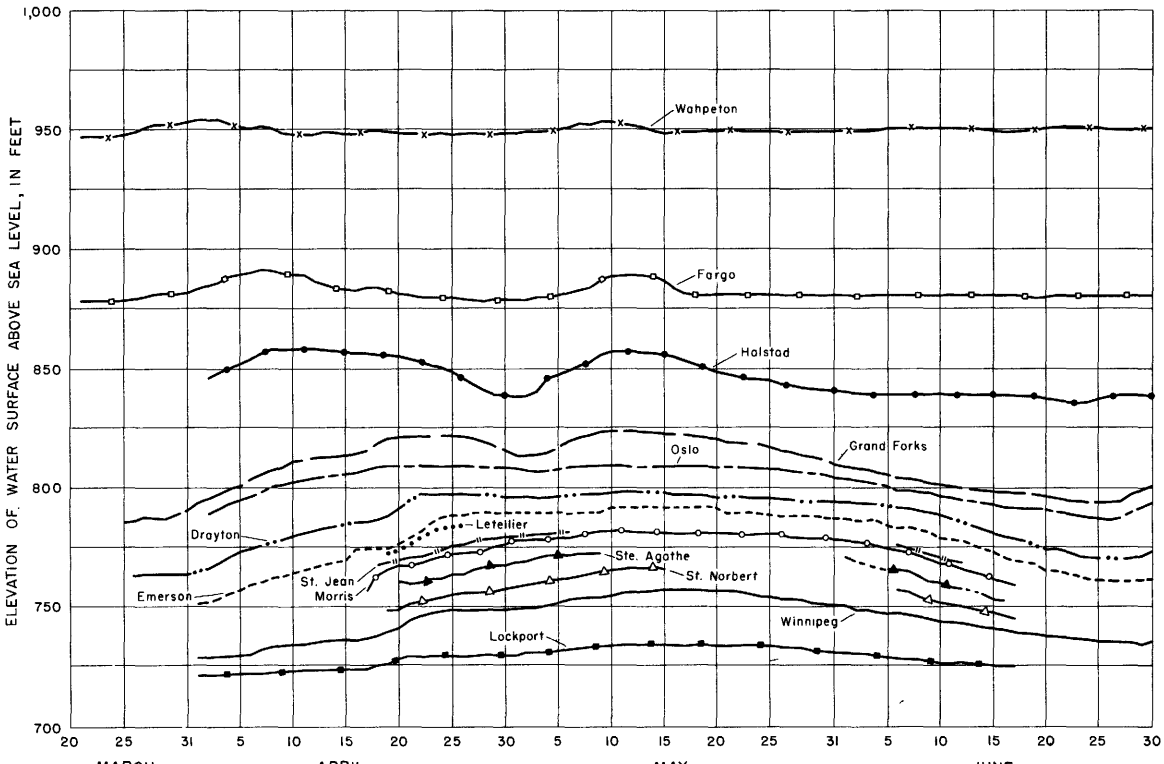

Figure 18.—Hydrograph of altitude of water surface at gaging stations, Red River of the North March-June 1950.

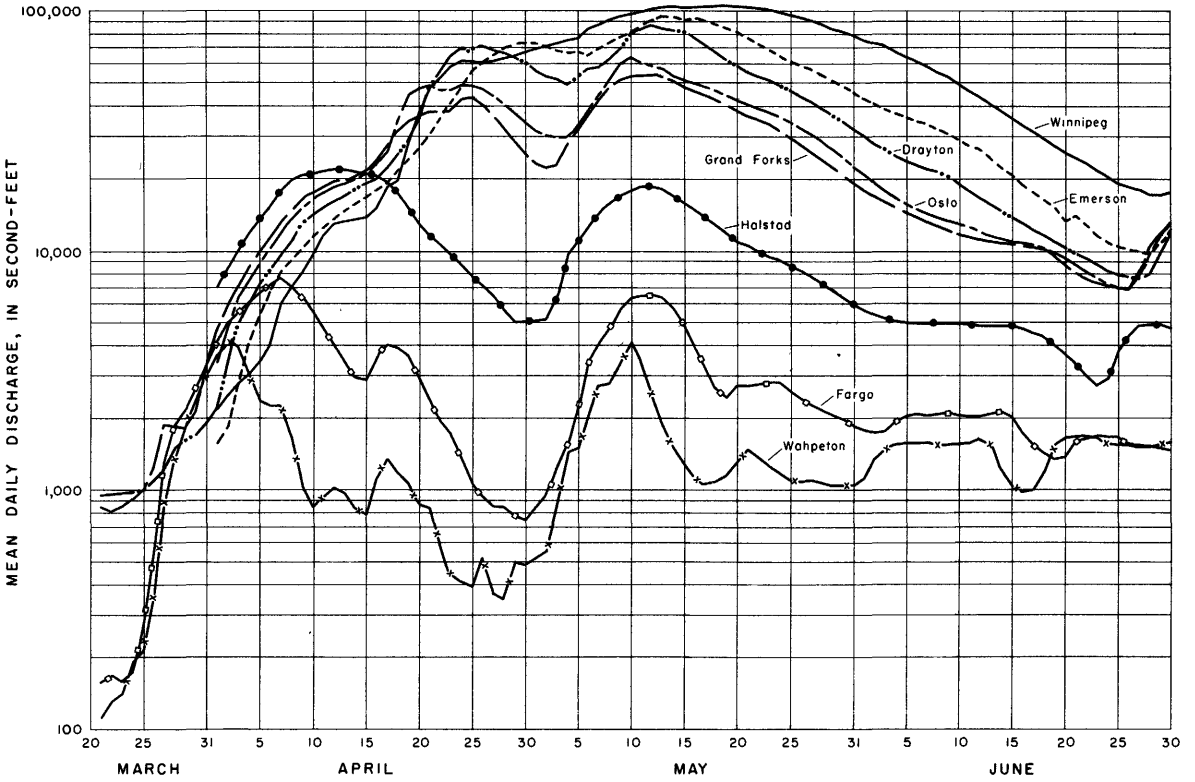

Figure 19.—Hydrograph of discharge at gaging stations, Red River of the North, March-June 1950.

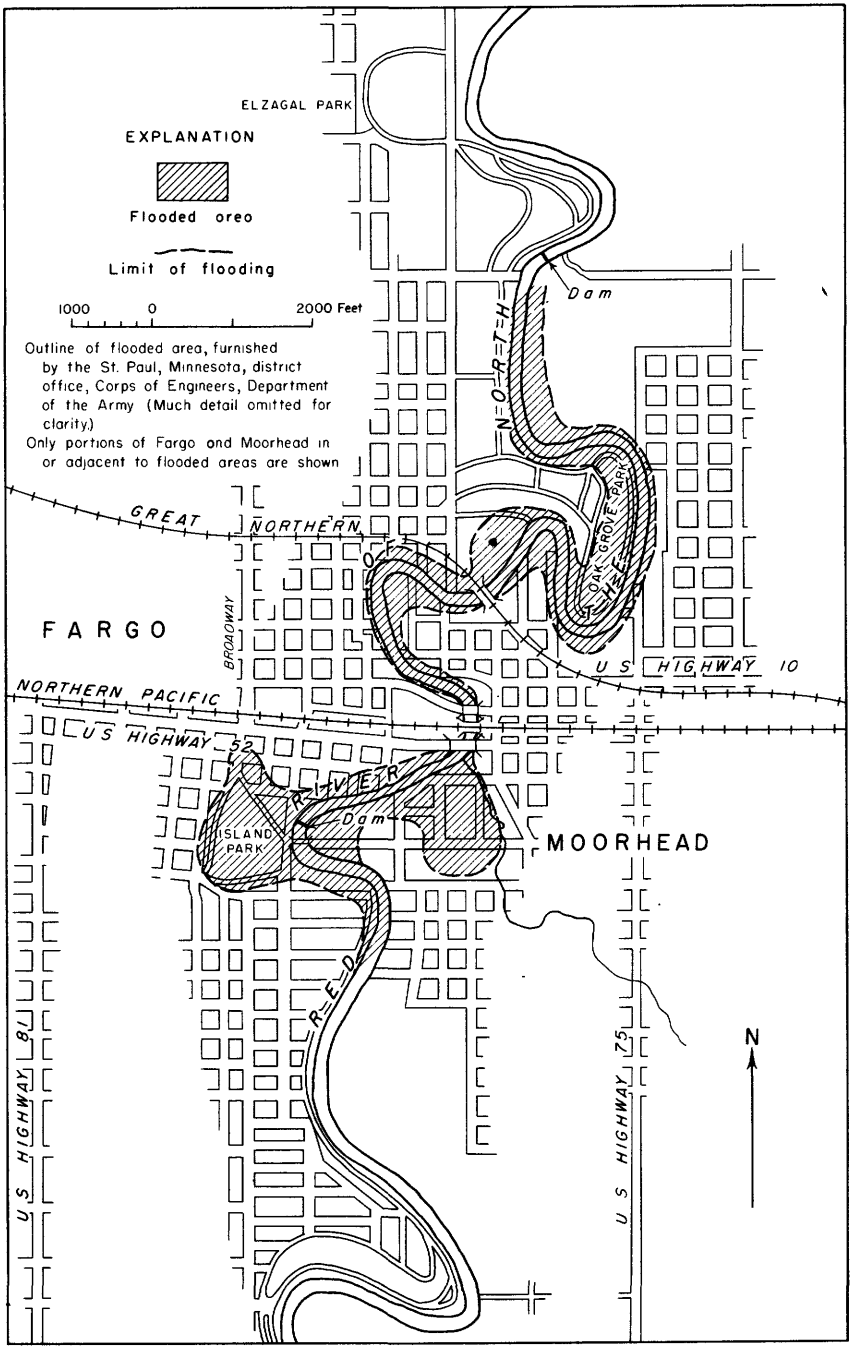

Figure 20.—Area flooded in 1950, **Fargo, N. Dak.**, and Moorhead, Minn.

Figure 21, a map of the Grand Forks area, shows the maximum extent of the 1950 flood. By April 7 some families, anticipating flooding, had moved from their homes in the Lincoln Drive area. As the waters rose, the flood threat became a reality, made ominous by the 6 inches of wet snow that fell over Easter weekend; on the morning of April 10 the river was more than 3 feet above flood stage at Grand Forks and rising. Cold weather of the period April 10-13 slowed the rate of rise but did not stop it. Warm weather, April 15-21, caused a resumption of thawing and the river rose rapidly towards a crest at Grand Forks. On April 14 about 18 families had moved from their homes in the Lincoln Drive area and four families had moved from their homes in east Grand Forks. By April 17 about 60 families had been moved from their homes in the twin-city area. The river reached the predicted stage of 42 feet on April 19 and then held to a small daily rise, finally cresting on April 24. The flood receded slowly to a stage of 35.5 feet on May 3 and began rising again for the second and higher crest.

More than 225 families had been forced from their homes in Grand Forks and East Grand Forks by the flood crest on the Red River of the North, as of April 20, according to the Grand Forks Herald. The Riverside Park and Lincoln Drive residential areas of Grand Forks were badly flooded, although the Grand Forks business district was not troubled except for wet basements. Water got into the underground tubes carrying steam heating pipes through Grand Forks and the vapor, which rose from manholes as the water touched the hot pipes, had to be carried in tubes about 10 feet above street levels to permit unobscured view of traffic. The appearance of these makeshift chimneys with vapor pouring from the top was especially weird at night.

The second flood crest came on May 12 and multiplied the damage of the April crest; many families packed up precious belongings and moved from their homes a second time. Supply of electric power and city water was not interrupted at Grand Forks at any time during the flood although interference with normal operation at both the water treatment plant and the power plant was common. Traffic into the city from the north and south was impossible because of flooded main highways. The water did not recede below flood stage until June 4. Although the 1897 flood reached a higher stage it did not last as many days; in 1950 the river was officially above flood stage at Grand Forks from April 9 to June 3.

The Red River of the North below Grand Forks resembled, for nearly two months, a series of lakes rather than a river. Figure 22 shows the 'lake' below Oslo. Plate 11 (in pocket) shows the maximum extent of the flood waters between Grand Forks and Winnipeg. Reference to the hydrographs, figures 18 and 19, will enable the reader to calculate the length of time that points within the flooded area were submerged. The descriptions of the floods in the small communities along the river between Grand Forks and Winnipeg were almost alike: the story of evacuation of personnel and prized belongings was repeated again and again in United States and Canadian towns. All towns located along the Red River between Grand Forks and Emerson were seriously flooded. The population of Pembina, N. Dak., normally 650, was reduced to 144 by migration due to the flood. Below Oslo, Minn., the dual peaks of the flood upstream were merged into one long flat crest that moved

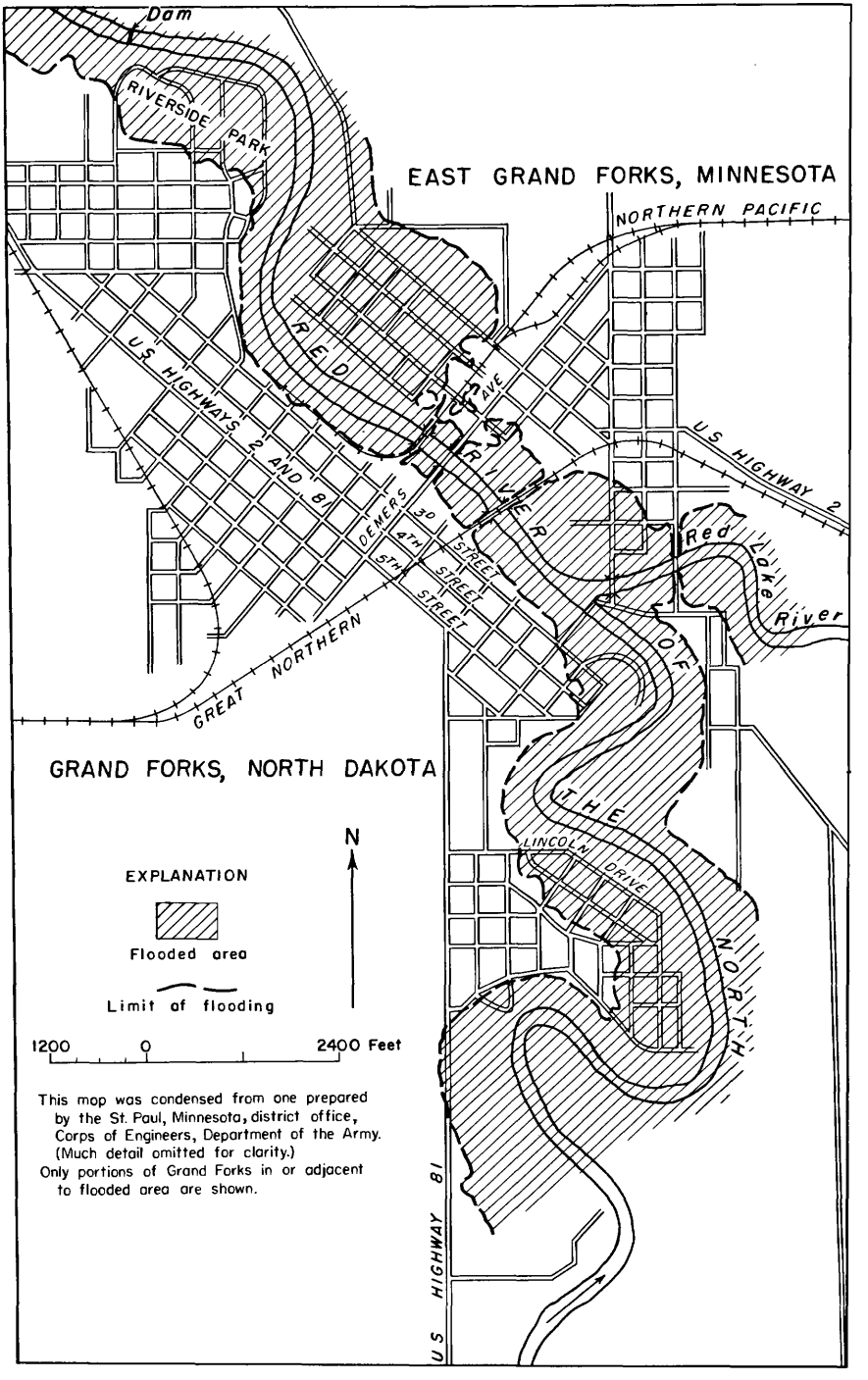

Figure 21.—Area flooded in 1950, Grand Forks, N. Dak., and East Grand Forks, Minn.

Figure 22.—Red River of the North resembles a huge lake during the 1950 flood. Airview looking north from Oslo, Minn. Photo Lee-Evanson Studios, Grand Forks, N. Dak.

on downstream in that form, the flood becoming serious at Pembina and Emerson about the third week of April. The small Canadian communities located between the border and Winnipeg were flooded continuously for weeks.

Winnipeg, a city of about 300,000, is the largest urban center in the flooded area. The description of the flood sequence at Winnipeg merits detail. An epic fight to save as much as possible from the flood began on April 21 and ended about June 1. Volunteers and military personnel working on dikes and utilities as pictured in figures 23 and 24 became a familiar scene. Figure 25, a map of Greater Winnipeg, shows the flooded areas, dikes, and other principal features mentioned in the description of the flood contained in the following condensed tabulation. Mr. D. B. Gow, district engineer of the Water Resources Division, Department of Resources and Development, Canada, furnished 'gleanings' from the news accounts describing the flood which have been incorporated into the description contained herein.

Figure 23.—Army, Navy, and civilian volunteer personnel carry on a continuous battle with the flood at Winnipeg in April-May 1950. Sandbags for the dike on the Winnipeg approach to Norwood Bridge are carried on human shoulders. Photo by Winnipeg Free Press.

Figure 24.—Canadian naval personnel plug leaks in electric power conduits under Winnipeg streets. Photo by Winnipeg Free Press.

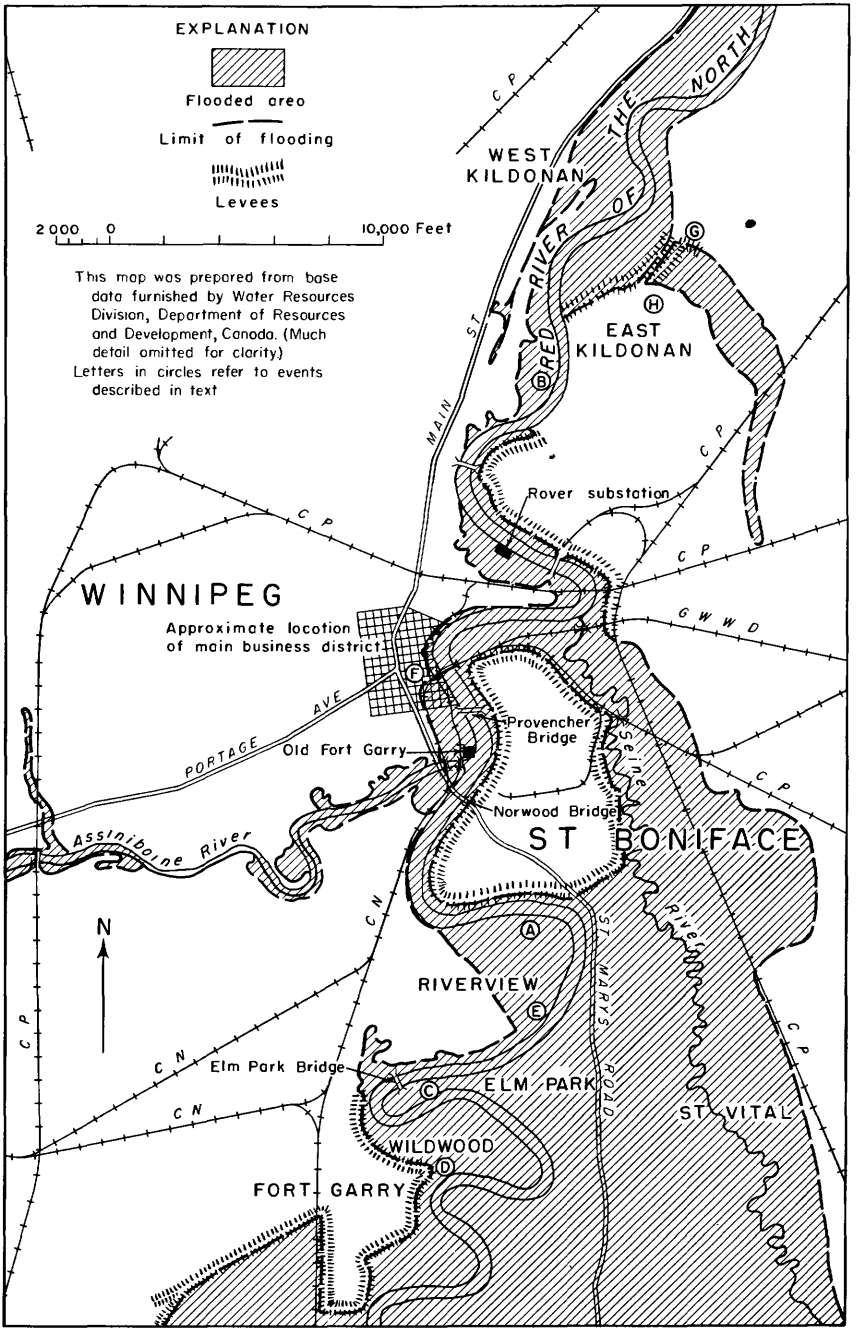

Figure 25.—Map showing flooded areas in greater Winnipeg, April-June 1950.

Date	Stage* (James Ave.)	Event (Letters refer to figure 25.)
April 21	18.7	Minor flooding at rear of municipal hospitals (A) and on Scotia Street. (B) The Seine River overflows in St. Vital.
April 22	19.9	Dikes being constructed in Elm Park, St. Vital, to prevent river from crossing narrow neck at (C). Seine River continues flooding.
April 24	21.5	Water now one foot deep at (C). Emergency dike in Wildwood being raised (D). Part of Churchill Drive flooded in Riverview (E). Scotia Ave. in West Kildonan under one foot of water (B).
May 1	23.4	Red River passes 1948 peak in St. Vital where 70 families have moved out. No flooding yet within Winnipeg city limits.
May 2	23.8	Canadian National Railway tracks at foot of Lombard Street under 2 feet of water (F).
May 3	24.2	60 homes in Elm Park flooded. Elm Park Bridge closed except for emergency traffic.
May 4	24.6	75 homes in Elm Park flooded (see fig. 26). Holly Avenue dikes in Wildwood smashed. Further flooding in West Kildonan. Rain falls for 24 hours.
May 6	26.4	The Army takes over. Secondary dike fails and Civic Hospital must be evacuated (A). Main emergency dike (D) in Wildwood fails; complete evacuation of Wildwood ordered. Norwood and Provencher Bridges closed. Subways (underpasses) at Higgins, North Main, Osborne, and Annabella Streets flooded. Dike on Rover Street broken and 7 or 8 avenues flooded. Man drowned in Elm Park area.
May 8	27.7	Mass evacuation in St. Vital, West Kildonan, and Norwood. Flood threat at City of Winnipeg Rover Ave. power station. East Kildonan dike, broken in many places (G), repaired. Many residents behind dike evacuated. Only bridges open: Redwood and Norwood (emergency use).
May 9	28.3	Evacuation in Glenwood–Crescent and Fort Garry continues.
May 10	29.0	East Kildonan dike breaks at Leighton Ave. (H) at 9 p.m.

*at 8 a.m. Zero of gage 727.57 feet, Geodetic Survey of Canada.

Date	Stage* (James Ave.)	Event (Letters refer to figure 25.)
May 11	29.4	New dike in East Kildonan being constructed. Victoria–Crescent and Elm Park districts floodswept and deserted. Norwood Bridge approach out.
May 15	30.1	"Crest believed here."
May 16	30.2	10-hour rainfall covers flooded area.
May 24	29.4	Report 8,000 homes flooded in City, 2,358 have water on first floor.
May 29	26.5	Suburbs set flood loss at $12,000,000. City loss $20,000,000.
June 1	24.7	Norwood Bridge reopened.
June 10	18.0	River returns to initial flood stage.

*at 8 a.m. Zero of gage 727.57 feet, Geodetic Survey of Canada.

Figure 26.—Some residential sections of Winnipeg are flooded for weeks. Elm Park's fine homes receive the worst flooding of any in greater Winnipeg. Depth and force of current are indicated by houses and trees in foreground. Photo by Winnipeg Free Press.

The flood crest passed from the northern limits of Winnipeg into Lake Winnipeg without going overbank. At the time of the crest only about $2\frac{1}{2}$ square miles of city land was under water owing to the hasty erection of earth and sandbag dikes. It was estimated that 80,000 people of greater Winnipeg left their homes because of flooding or threatened flooding. The main business district of Winnipeg was not flooded (see fig. 27), but disruption of utility services hampered activities.

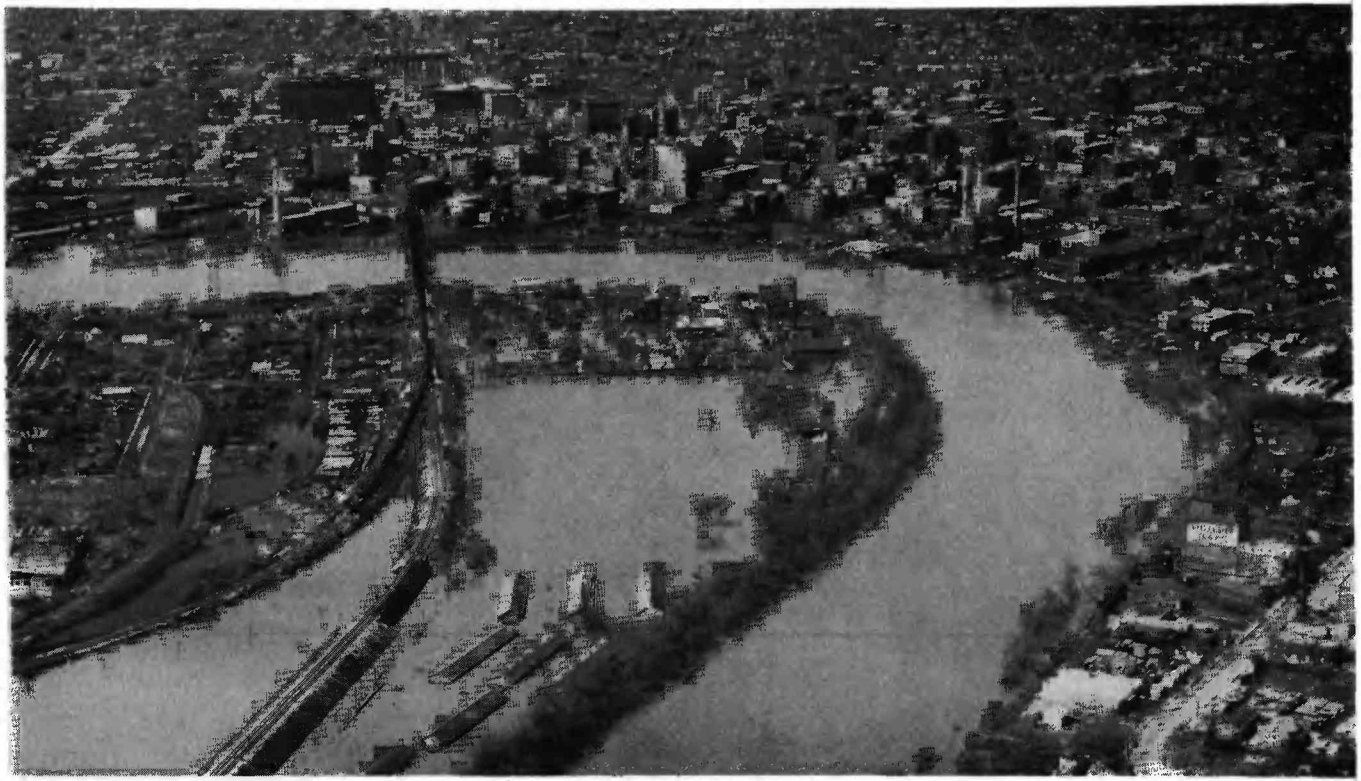

Figure 27.—Winnipeg's business district just escapes flooding. Note iminence of overflow at center right.
Photo by Winnipeg Free Press.

Tributary Streams

A description of only the important features of floods on tributary streams can be given in this report because of space limitation. Tributaries omitted from discussion had no flooding worth mention. Routine information on the time of occurrence and size of the flood crest will be given later in this report in the tables of stage and discharge. Tributary streams are discussed in downstream order. Common to all tributaries were two separate flood peaks, one in April and the other in May; no consistent pattern of predominance was found--on some tributaries the April flood was larger, on others the May flood was larger. Flood hydrographs for selected tributaries are shown on figures 28 and 29.

Sheyenne River

The upper Sheyenne River began carrying flood runoff as early as April 5 when a brief warm spell over Central North Dakota started snow melt. The flow built up gradually after April 5 and increased rapidly on the 17th owing to the much warmer weather that came April 15-17. Lake Ashtabula (capacity 70,700 acre-feet) above Baldhill Dam, a Corps of Engineers project, stored the flood runoff in excess of the discharge that could be passed safely downstream. Emergency operation of the reservoir (not completed at time of flood) undoubtedly prevented considerable flood damage at Valley City and many communities downstream. The flow above the mouth near Fargo was sluggish and the flood waters ponded behind road fills. Farm lands bordering the river from Horace to the mouth were under water for many weeks. The river was out of bank at the West Fargo gage from April 20 to June 18. The flood waters, although shallow, interfered with the operations at the West Fargo stockyards. Some flood waters left the Sheyenne River near Horace and passed overland to the Red River upstream from Fargo.

The May flood on Sheyenne River was minor compared to that in April. Because of regulation by Lake Ashtabula the May discharge at and below Valley City remained practically constant.

Buffalo River

Flooding in parts of the Buffalo River Basin began on April 4 when large accumulations of melt water, together with some rain that fell in the storm of March 25, began running over fields and ponding behind county roads in the lower reaches of the Buffalo River, although the stream remained within banks. The flooding was the result of plugged culverts, snowdrift in the upland drains, and the generally poor drainage features of the country along the lower Buffalo River. About 50

farm families in northwest Clay County were isolated owing to flooded roads and fields. The Clay County Engineer reported a minor overflow from the South Branch Buffalo River in the general vicinity of the junction of U. S. 52 and Clay County Route 44, about 12 miles southeast of Moorhead.

Wild Rice River of Minnesota

The Wild Rice River (of Minnesota) had a moderately heavy snow cover at the time thawing began. Early in April the melt runoff from the more steeply sloped headwater area descended rapidly to the flat portion of the basin adjacent to the Red River and spread overbank downstream from Ada to flood farmlands more than a mile from the channel. Freezing weather during the period April 8-13 stopped thawing and the flood situation eased until April 15 when owing to warm weather all the streams were again swollen with runoff. The peak passed Ada on April 16. Some basements in Ada were flooded by overflow water when the Wild Rice River abandoned course and moved across country, uniting with the Marsh River. The crest receded slowly and traffic in the area was hampered for more than a week.

Goose River

The Goose River crested at the Portland gage on April 18, two days after rapid thawing had removed most of the snow. The crest passed rapidly downstream and reached Hillsboro at noon on April 19. The waters spread over the City Parks and around a few low-lying houses at Mayville and Hillsboro, but no extensive damage was reported from either place. The City Park at Hillsboro was completely submerged by the flood. Some Goose River water crossed and joined the Elm River in the upper part of the drainage basin.

The May flood on the upper Goose River produced crests higher than the April flood, but downstream the flood was less intense in May than in April.

Turtle River

The headwater drainage channels of Turtle River, snow-choked and frozen, had little capacity for the rush of water that came from the first thawing days April 15 and 16. Water flowed overland across fields and over the top of the snow-filled channels, ponding up at obstructions presented by highway or railroad embankments. When the pond level became high enough, overflow and contingent washout of the fill began. The main line tracks of the Great Northern Railway were under water and damaged by washouts on April 16, about 20 miles west of Grand Forks, where a tributary, normally low in discharge, was carrying a wide flood towards the Turtle River.

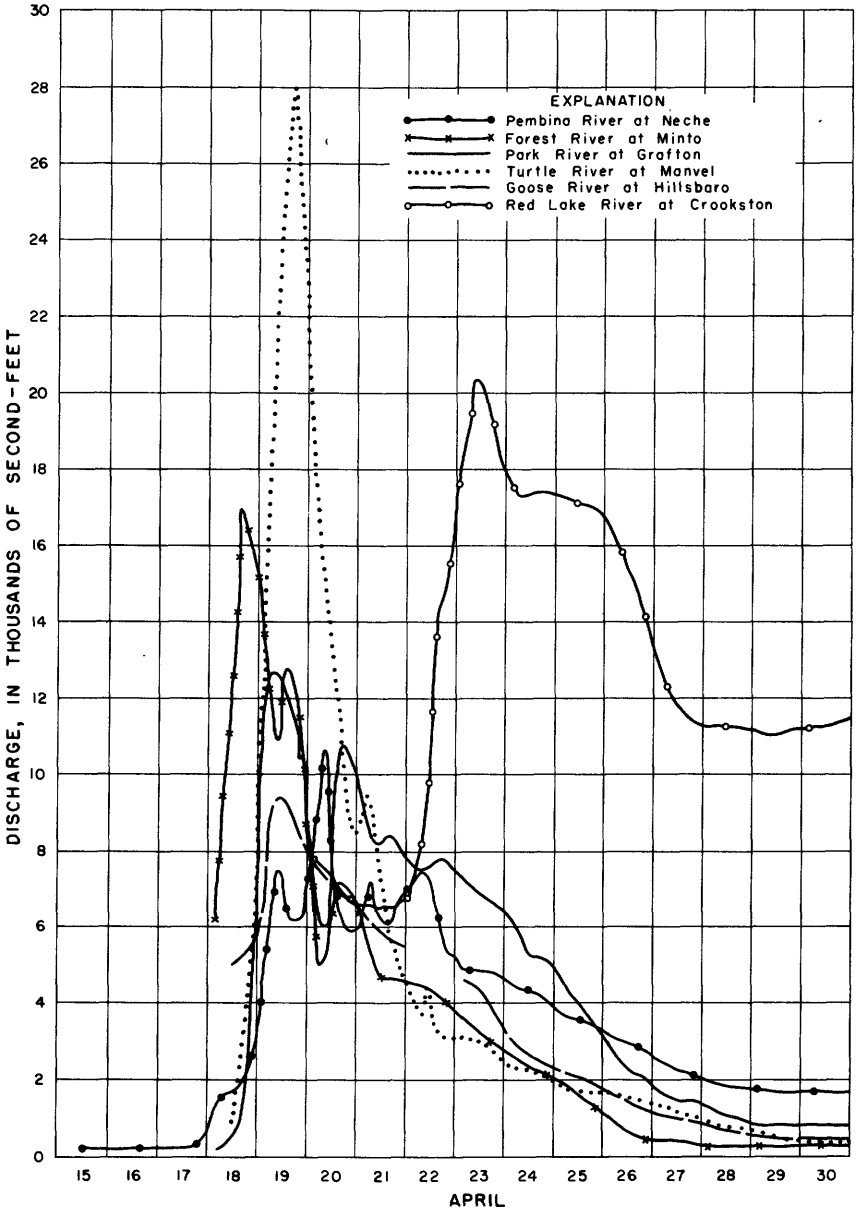

Figure 28.—Discharge hydrograph for selected streams in Red River of the North Basin, April 1950.

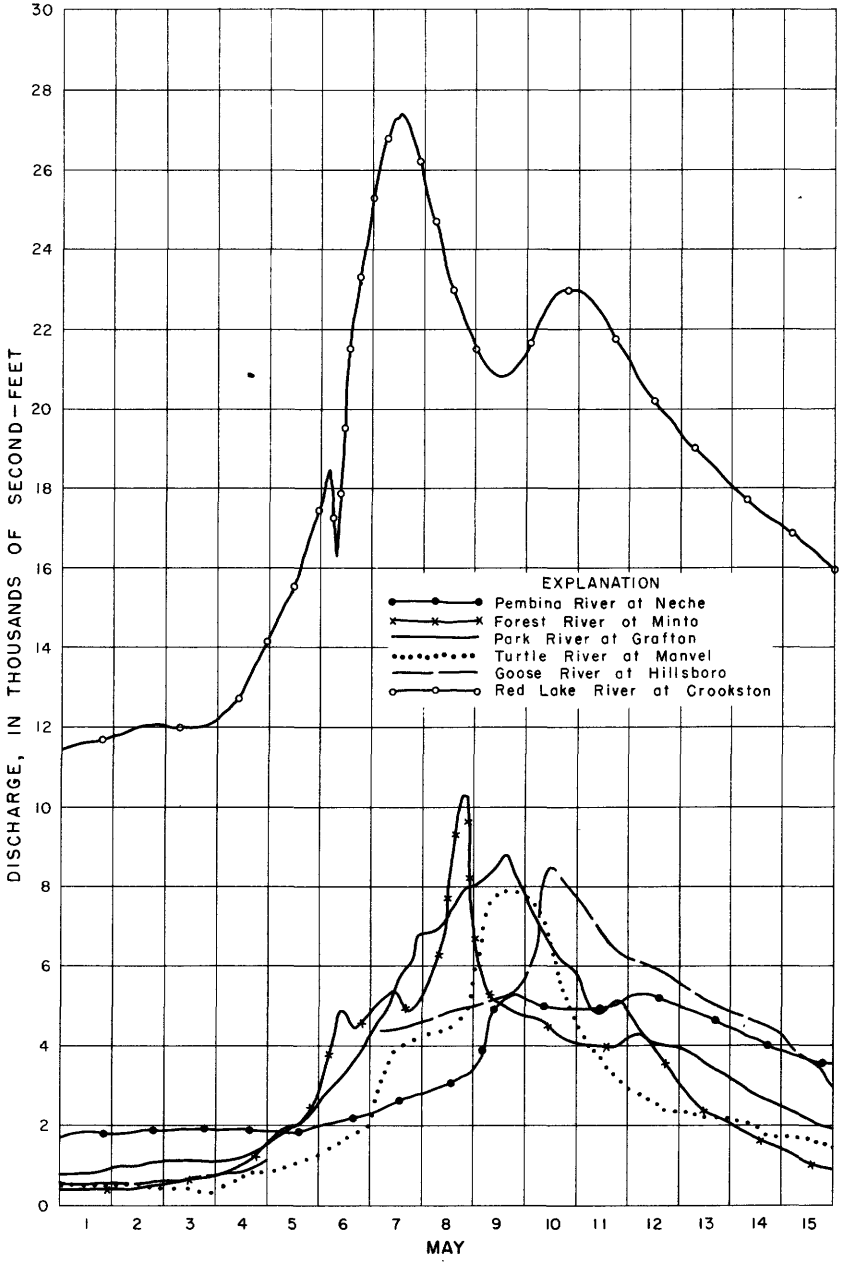

Figure 29.— Discharge hydrograph for selected streams in Red River of the North Basin, May 1950.

The town of Mekinock was flooded April 17; several residents had to leave their flooded homes, an occurrence not associated with the lower flooding common in the past. Manvel was almost all flooded on the 19th and the Great Northern Railway track was under water for a considerable distance. In many places the overflow scoured ballast from the roadbed and cut channels under the track.

Red Lake River

Red Lake River, largest of the Red River of the North tributaries, drains from an area of mixed characteristics. The northern part of the upper basin is flat and occupied by swamps and lakes the largest of which, Red Lake, the source of Red Lake River, has a surface area of about 430 square miles. The remainder of the upper basin is steep to gently rolling and the Clearwater, Lost, Hill, and Poplar Rivers that drain it have comparatively steep gradients so that flood waters move fast in this region. The drainage network of streams is all combined upstream from Crookston, the largest urban center in the basin. This one stream is of a meandering nature in accordance with the flat slope characteristic of old glacial Lake Agassiz. This situation is responsible for the recurrent flooding at and below Crookston.

The first flood at Crookston started on April 20 when snow-melt waters originating in the Clearwater drainage reached the city. The rise was gradual until the crest, 7.5 feet above flood stage, was reached on April 23. At the time of crest about 3/4 of both Woods and Sampsons Additions and 1/3 of Jeromes addition were flooded; for the location of the additions referred to see figure 30, a map of Crookston. The flooding was of a severely damaging nature; many homes had water ceiling-deep for nearly three days. The flood receded as fast as it had risen.

Outside of the Crookston area there was little damage. A timber crib dam at Red Lake Falls was partially destroyed on April 23 by ice floes. The Red Lake River from Red Lake to near Thief River Falls overflowed the flat swampy banks and caused water-logging of fields for several weeks because the river, in that reach, remained at a relatively constant discharge for nearly a month.

Cold weather after April 25 delayed further snow melt in the basin until the return of warm weather in early May. Rains and wet snow, however, brought the Clearwater up to a second crest. When this crest reached Crookston it exceeded the April rise. The second rise crested at 9 feet over flood stage on May 7 and the water stayed above flood stage more than a week. Areas and homes flooded during the first flood were visited again and with higher water. Attemps at diking the flooded areas were unsuccessful--the temporary dike around Jeromes Addition burst near flood crest and added to the general distress of the victims. National Guard 'ducks' became standard transportation in most of Crookston. Much trouble was experienced from water backing into the basements of homes through sewers.

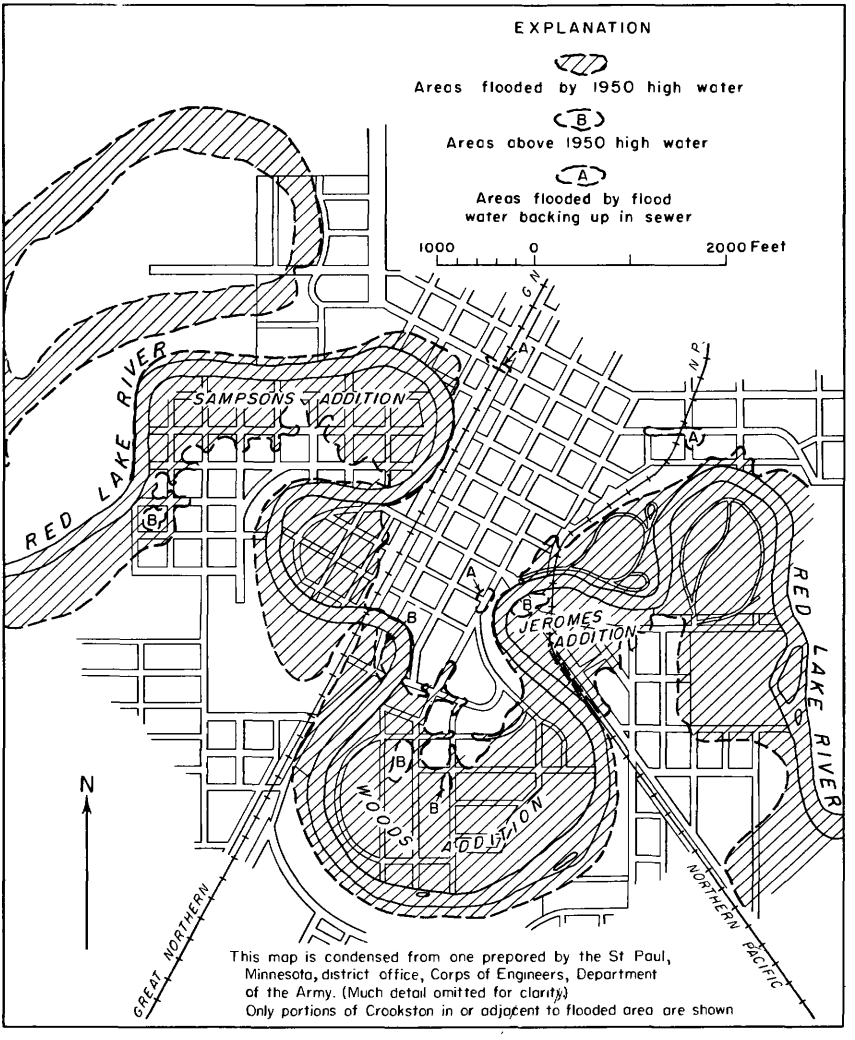

Figure 30.—Areas flooded in 1950 at Crookston, Minn., by the Red Lake River.

Forest River

The warm weather that began April 15 started rapid melting throughout the Forest River Basin, and during the following days, also warm, most of the snow on the ground became water. Runoff was delayed by some condition, probably snowdrifts blocking flow in the upland watercourses, because the main stream at the Fordville gage did not begin to carry much water until the afternoon of the 16th. By early morning of the 17th a near record discharge was occurring at Fordville gage, and towns farther east were beginning the battle with floodwaters coming overland, ignoring established drainageways in many instances. Sheets of water spreading out for miles were reported near Voss and Fordville, and the Northern Pacific Railway track running through the town of Forest River was under water in many places. A Northern Pacific Railway

passenger train was derailed on the flooded track near the town of Forest River on April 17 and several days passed before the flood receded enough so that workmen could attempt salvage operations. Figure 31 shows the damage to the 'Soo Line' near Forest River.

The floodwaters flowed overland and along the stream channel to Minto where the low-lying parts of town were inundated. An additional bridge installed under the Great Northern Railway tracks at Minto after the 1948 flood reduced stages and the damage to many residences. The May flood caused further damage to part of the area submerged in April at Minto.

Figure 31.—The Forest River damages the 'Soo Line' tracks near the town of Forest River, N. Dak. Photo by Lee-Evanson Studios, Grand Forks, N. Dak.

Snake River

Snake River, swollen beyond bankful capacity by melt runoff flooded the town of Warren on April 21 and again on April 22. The two floods resembled flash floods in character, so rapidly did the waters invade Warren. Almost all homes and business houses had flood damage from direct flooding or from backing up of sewers.

The Snake River again went overbank and on the rampage in Warren from May 4-6 as the result of a one-inch rainstorm. The second flood rose higher on the west side of Warren than the first flood. The 1950 floods at Warren were the highest known.

Park River

Flood runoff started on April 15 in the Park River Basin; by April 16 almost all the snow had melted and water was flowing over parts of the basin in wide, shallow sheets. The town of Crystal on Cart Creek was isolated by overland flow, and farmlands west of the town of Park River were being flooded by April 17. The normal river channel, partially choked with snow and ice, was unable to carry much of the flood flow, and as the waters approached Grafton, located just downstream from the confluence of the three branches of Park River, they spread out over a wide expanse of country. Travel on U. S. 81 was difficult because the highway was submerged for miles. In Grafton flooding began in the night of April 18 and by morning the entire city was under water. Almost all business places in Grafton were closed, as Hill Avenue, its main street, was under 20 inches of water. A few restaurants and stores remained open to care for the needs of the inhabitants.

The flood at Grafton receded a little the night of April 19 but rose to nearly the crest level again on the afternoon of April 20. The low-lying residential areas were under several feet of water that did not recede for several days. Grafton was isolated from the south by a washout on U. S. Highway 81, 2 miles south, during the night of April 20.

Homme Dam, partially completed on the South Branch Park River about 3 miles northeast of the town of Park River, was damaged slightly by the April flood. A temporary earth spillway on the north end of the dam failed on the 24th and released the stored water suddenly. The resulting flash flood, 13,000 cfs just below the dam, passed rapidly downstream, diminishing in intensity. The surge from the breached dam was hardly noticeable at Grafton although merchants had hastily reassembled their flood protection material when the news of failure reached town.

The May flood caused suffering in the low-lying parts of Grafton to the north of the business district, which was spared flooding. A breach was purposely made in U. S. Highway 81 north of Grafton to give larger passage for the Park River waters.

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Pembina River

The 1950 floods were anticipated by the Pembina River Valley residents for many weeks before their arrival. The Walhalla Mountaineer for April 13, 1950 reported increased flood probability after the severe snowstorm of April 8-10. That storm closed practically all roads in Pembina County and no train could reach Walhalla for three days. Warm weather produced intense local runoff throughout the basin by the afternoon of April 15. Walhalla, situated at the Pembina Escarpment, had flood problems peculiar to that topography--water flowed onto the flatter lands in a thick sheet from the steep slopes of the hills. Local drainage down the cemetery road came into the north end of Walhalla and flooded basements of many homes. The city sewers were unable to carry the additional flow from the snow melt.

Thawing continued April 16 at a rapid rate and the Pembina River at Walhalla rose about 8 feet that afternoon carrying much flowing ice. Bridges across the Pembina River near Walhalla were closed because of submerged approaches on April 18, the day of the crest. The flood at crest lacked one floot in height of completely submerging the highest point in Riverside Park, Walhalla. At Leroy, a small town on the Pembina River about 8 miles downstream from Walhalla, the flooding of bridge approaches isolated the town and drove four families from their homes.

The crest moved slowly from Walhalla to Neche and reached the downstream city on April 20, two days after passing Walhalla. At Neche the Pembina River caused the most serious flooding in more than 50 years. Damage estimated at $500,000 was suffered. The river went over its banks and covered a wide area owing to phenomenal ice jams; the flood lake extended into Gretna, Manitoba, located about 3 miles north.

The Tongue River, major tributary of the Pembina from the south, flooded at about the same time as the Pembina. Cavalier was flooded by water coming overland from the west, and damage was sustained by many homes and business places in the north and south ends of town. The Tongue River, to a greater extent than in less severe floods, left its channel in the 3-mile reach west of Cavalier and most of the total discharge was carried in sheet flow on both sides of the river in an easterly direction. Most of this flow passed south of Cavalier and was to a large extent prevented by a hastily built dike from entering the town. Bathgate, home of the North Dakota State School for the Blind, was flooded and isolated; it received some supplies by air. Water flowed 3 to 4 feet deep down the entire length of Bathgate's main street. Flooding at Cavalier and Bathgate was of short duration.

The flooded Pembina and Tongue Rivers spread over a large area, after merging, and forced evacuation of many farm homes west of the city of Pembina. The flood on the Red River of the North caused most of the damage from flooding at Pembina but that from the Pembina River reached the city first.

Cold weather and snow came to the Pembina Valley during the period April 24 to May 9 slowing the runoff of the April flood and setting up conditions for the May flood, which crested at Walhalla on the 10th and at Neche on the 12th. Although not as large as the April flood, it caused almost as much damage to highways, farm buildings, and farm lands. The total damage from the two floods to the highways and railways of Pembina County was very great. No train service reached Walhalla between April 16 and May 1. About 600 feet of track at Neche was moved 36 feet laterally from the roadbed by floodwaters. Boats were used to get in and out of Neche during the flood crest.

Roseau River

Wet snow of the storm of April 9-11, added to the already deep accumulation of winter snow, made flooding in the Roseau River Basin certain. The first flooding in the headwater area occurred on April 21 after protracted warm weather had caused much melting. Fields along the overflowing South Fork of the Roseau River were flooded and a rapid rise in the River at the city of Roseau began. By April 23 all bridges at Malung were under water and many homes in Roseau were abandoned to the flood which spread out, in and around the town, in a huge lake. The flood crested at Roseau on April 24 at 20.36 feet (city gage), having risen steadily from a reading of 10.86 feet on April 21. The Roseau City Power plant was saved from serious flooding but many homes and business places were flooded or had basements filled with seep-water. Cold weather slowed further headwater runoff and Roseau City had temporary relief until the second thaw brought a return of flood conditions on May 11.

Below Roseau City the river flows into Roseau Lake and then into a large swamp west of Duxby. The natural storage of lake and swamp retarded the passage of floodwaters and also smoothed out the dual peak characteristic of the flood at Roseau City. The town of Ross is the only community of any size along the river between Roseau Lake and the international boundary. That town was flooded for nearly two weeks as the river spread out into a lake that was 6 miles wide in many places. The water isolated more than 71 farms, according to a count made on May 12 by a rescue pilot and reported in the Roseau Times-Region. Stranded livestock were moved to nearest unflooded ground by rescue patrols operating boats.

In the Canadian part of Roseau River Basin, the flat and swampy topography from Roseau City to the international boundary continues for several miles up to the town of Stuartburn, where a change to steeper river gradient and land slopes alters the flow characteristics. The peak discharge for the lower river occurred on May 6 at the Dominion City gage, long before the crest had come to Ross in Minnesota.

Winnipeg River Basin

The spring breakup began about April 20 in the portion of the drainage basin immediately adjacent to Lake of the Woods; in the portion east of Red Lake the breakup was later. The streams draining the central part of the United States portion of the basin, such as Little Fork and Big Fork Rivers, crested about May 7 or 8. The lake country east of Little Fork River and in the Canadian portion of the drainage basin did not produce peak runoff until late in May. Rainy River, reflecting the discharge of Big Fork and Little Fork and other tributaries, crested on May 12 at the Manitou Rapids gage but the discharge remained high to pass the large volume stored in the international boundary waters.

The floodwaters caused interference with normal highway travel by overtopping bridge floors at such strategic crossings as Little Fork. (See fig. 32.) Black River, overtopping the highway bridge just east of Loman, stopped traffic between International Falls and Warroad for a few days. Flooding in urban areas was insignificant or not reported.

Figure 32.—The Little Fork River creates a log jam at the highway bridge near the town of Little Fork, Minn. Photo from Daily

When the peak flow passed through the international waters many difficulties were experienced. Every waste gate in Koochiching Dam (outlet of Rainy Lake) was opened to pass the flood. At Warroad, the Lake of the Woods level rose so high as to make the sewage treatment plant inoperative and on June 25, pushed by a strong NE wind, lake waters partially flooded the town. The Lake reached the highest stage since 1916. Outflow from the Lake, which is controlled by Norman Dam, under the Treaty of 1925, peaked on August 1.

Unusual Events

Flow of water in a wide, shallow stream--aptly described as sheetflow--occurred in several places in the flat area of former Lake Agassiz. This type of flow is unusual in the Red River Valley. This so-called sheetflow can happen only where land slopes are uniformly minor, as in an old lake bed, and where precipitation is sufficient to cause heavy runoff. In the case of the Red River Valley, several inches of melting snow provided the runoff source. Such sheetflows were common in the old glacial lake bed north of Grand Forks. Figure 33 shows such an occurrence near Horace, N. Dak., a community located about 10 miles southwest of Fargo. Overflows from one sub-basin to another usually occurred in this manner.

Figure 33.—Water from the Sheyenne River flows over fields and roads in a sheet near Horace, N. Dak. Photo by Corps of Engineers. St. Paul District.

The spring floods of 1950 caused an unusual amount of erosion in the Red River Valley through the combined effects of snow drifts and melted snow. Snow drifts caused local ponding of the melt water by acting as low dams. The pond behind the dam built up in level until the drift was overtopped at a point; this small overflow soon cut a channel through the drift allowing a larger volume of flow to erode the drift away to ground surface. Further flow through the snow-drift channel resulted in soil erosion. Slight depressions parallel to the direction of flow caused increased velocities and erosion at such locations.

A third unusual feature of the flood was the enormous body of water ponded above Winnipeg at the crest of the flood. Although there was slope to the water surface, indicating movement, the whole resembled a giant lake. Wind action churned up waves that were an additional hazard to dike building or boat work. The approximate volume of water in storage between the international boundary and Winnipeg during the period April 25 to May 20 has been computed by the Department of Mines and Natural Resources of Manitoba as:

Date	Volume (acre-feet)
April 25	25,000
April 30	220,000
May 5	365,000
May 10	495,000
May 15	650,000
May 20	700,000

METEOROLOGY

(Prepared by staff of United States Weather Bureau)

The basin of the Red River of the North lies in the region where the major rainfall of the year occurs during the late spring and summer, with a pronounced maximum in June. Much of the summer rain is a result of forced lifting of warm moist air from the Gulf of Mexico over a wedge of cooler polar air and frequently is associated with thunderstorms.

The floods of April-June 1950 in the Red River Basin were the result of a critical combination of factors: abnormal amounts of snow and an unusually cold spring, followed by warm weather, rain, and rapid snow melt. March 1950 in North Dakota was the fourth consecutive month with below-normal temperatures. Very little melting had occurred during the winter, and the accumulated snow was piled in huge drifts in exposed places. The precipitation for the winter had been above normal with unusually heavy amounts in January and March. Most of the streams in the state were still frozen at the end of March and caused no trouble, but the Red River was beginning to flood in the Fargo-Wahpeton area.

In Minnesota, April 1950 was the coldest April since the beginning of State-wide records in 1891, and the average snowfall for the State was the second greatest of record for April. In North Dakota it was the coldest April since 1920, and nearly three times the normal snowfall was recorded. This is the greatest amount of snow ever recorded in April since records were begun in 1892.

As April 1950 opened, the valley of the Red River of the North was dominated by a polar high centered over western South Dakota. A deepening cyclonic system, however, had moved in on the west coast, just north of the Canadian border. The system moved rapidly east-southeastward, producing precipitation (primarily in the form of snow) over the Red River Basin, and causing a dip in temperatures. (See fig. 34.) As the low moved off east of the basin, it was replaced by a polar high which, by afternoon of April 4, dominated the circulation of the United States from the west coast to the Mississippi.

A mass of polar air, building up in northwestern Canada at this time, moved slowly east-southeastward in the next 24 hours. By afternoon of the 7th the forward edge of the polar air mass had swept past the Red River of the North Basin. Although the center of the high remained in Canada, the strong circulation around it poured cold air into North Dakota and Minnesota and sent temperatures plunging. (See fig. 34.)

The high progressed eastward and was centered east of Hudson Bay on the 9th. A low in southern Wyoming at this time contained a front which stretched eastward marking the southern boundary of the polar air mass. North of the front a huge area of precipitation extending from the Gulf of Mexico moved northward and was lifted over the cold air mass. Precipitation in the form of freezing rain and snow continued in most of the Red River area through the 11th when the low was finally replaced by a wedge of high pressure.

The cold air of the high dominated the Red River area through April 14. In the following 2 days, two weak frontal systems from the Pacific crossed the area bringing in mild Pacific air. Skies cleared and temperatures rose sharply. (See fig. 34.) Still another Pacific system, stronger and slower moving, crossed the North Dakota-Minnesota region on the 17th, releasing some light precipitation over the Red River Basin behind it. The influx of warm Pacific air was renewed, again raising temperatures.

The passage of a complex frontal system on April 22, however, was followed by a southward push of a polar high from Canada. The Bermuda high at this time extended to great heights and was displaced westward so that it intruded over the southeastern part of the United States. As a result, the polar high was halted midway in its progress southward. A low developed in Kansas on the 24th and moved slowly northeastward, deepening as it went. The strong circulation created by the low pulled warm moist air northward from the Gulf. This air was then lifted over the denser polar air dominating the northeastern half of the country and caused widespread precipitation.

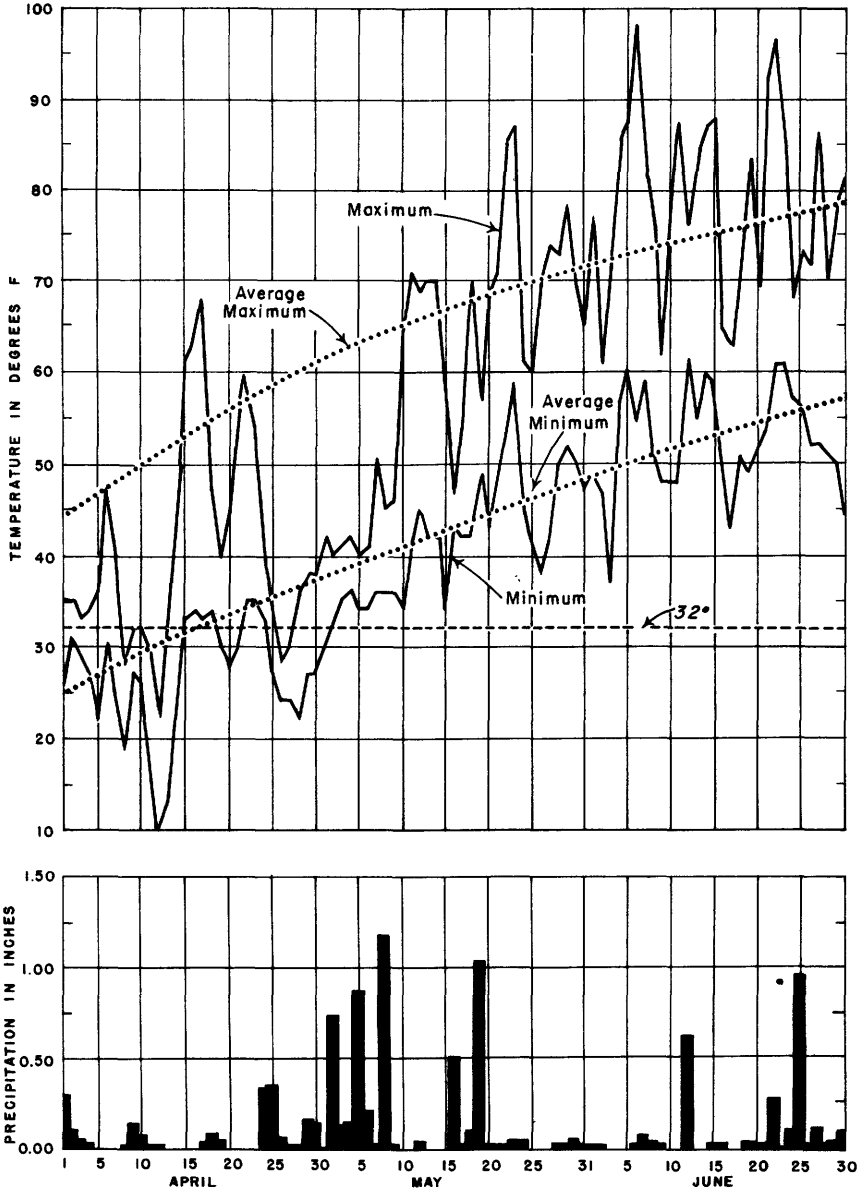

Figure 34.—Precipitation and temperature, April-June 1950, in Fargo, N. Dak.

The Bermuda high slowly gave way on the 25th, and the deep low pulled polar air down over North Dakota and Minnesota. (See the North American Map for April 27, fig. 35.) At many stations in the Red River area maximum temperatures for the 25th-27th were at the freezing level or lower. Minimum temperatures at this time were as low as 17°. Devils Lake, N. Dak., reported 6.5 inches of snow on the 24th, and Red Lake Indian Agency, Minn., reported 6.9 inches on the 25th.

As the low finally moved off to eastern Canada, a new polar high descended over most of the eastern two-thirds of the country. Early on April 29, however, the Bermuda high began to reassert itself. The southward progress of the polar air was halted and the warm air, moving northward, was lifted over the cold air mass. Precipitation fell over the Red River Basin on the 29th and 30th as a result.

Flooding in the upper valley of the Red River of the North had begun on March 31 as the frozen northerly reaches of the river blocked runoff from the south. At Fargo, N. Dak., the river was above flood stage from March 30 to April 20. At the close of April, the southern part of the Red River had reached the highest flood stages ever recorded.

May weather in North Dakota was a continuation of one of the most backward seasons ever experienced, and in Minnesota the spring months (March, April, and May) were the coolest in 60 years of record. Snowfall in both North Dakota and Minnesota established new records. In Minnesota the snowfall was the greatest recorded in May since 1924; in North Dakota the snowfall was twice the previous all-time high set in 1905. Precipitation in both states was above normal.

Floods on the Red River of the North continued through May, with crests exceeding those of April. In the lower valley from Grand Forks northward to the Canadian border, the flood was the most disastrous on record. The Roseau River (a tributary of the Red) at Ross, near the international boundary, reached the highest flood stage since 1896.

As May opened, a polar high dominated the Red River Basin. Early on the 2d, however, the southerly winds of an approaching frontal system lifted warm moist air over the cold dome, releasing heavy precipitation. Petersburg and Sharon, N. Dak., each received 8 inches of snow, and Thief River Falls, Minn., reported 6 inches. Trail, Minn., recorded 3.05 inches of precipitation on the 2d.

The frontal system had not yet passed on the morning of May 3, when another low began to develop and deepen in eastern Utah. The Bermuda high again pushed its nose over the Southeast, retarding the southward push of the polar air mass. Precipitation started again on the 4th, and continued through the 6th as the circulation intensified with the rapid deepening of the low. Just as the low appeared to be moving out of the range of influence, and another polar high started to descend from the north, a new low started to develop in Utah. The weather of May 8-9 was a repetition of the storm of May 4-6, with many stations reporting more than an inch of precipitation in the two days. Many stations recorded more than three inches of precipitation during the first 9 days of May; Sharon, N. Dak., and Trail, Minn., each reported more than 5 inches.

The Pacific high advanced into the United States behind the eastward-moving low and on May 10 extended as far as the Red River Basin. It dominated the circulation over the basin until early afternoon of the 11th, when a Canadian high moved down over most of the Red River of the North. Then, as a frontal system passed to the east of the basin on the 13th, the Pacific high pressed eastward over the area for a brief period.

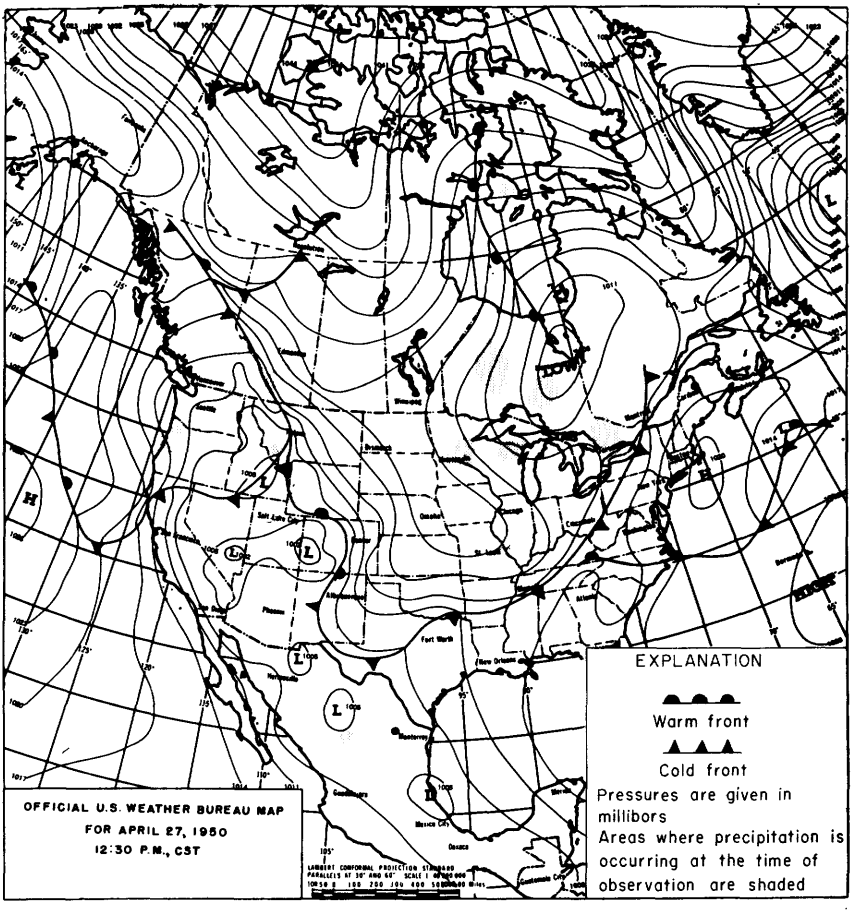

Figure 35.—Weather map for April 27, 1950.

On the 15th polar air once more invaded the Red River Basin, and temperatures which had soared briefly sank again. Polar air remained over the basin until the morning of the 18th, when an active Pacific front approached. (See fig. 36, North American Map for the 18th.) A strong flow from the south aloft over the Red River area at this time indicated that warm air was overrunning the cold. Many stations in the region reported more than in inch of precipitation during the short period between the front's approach and passage.

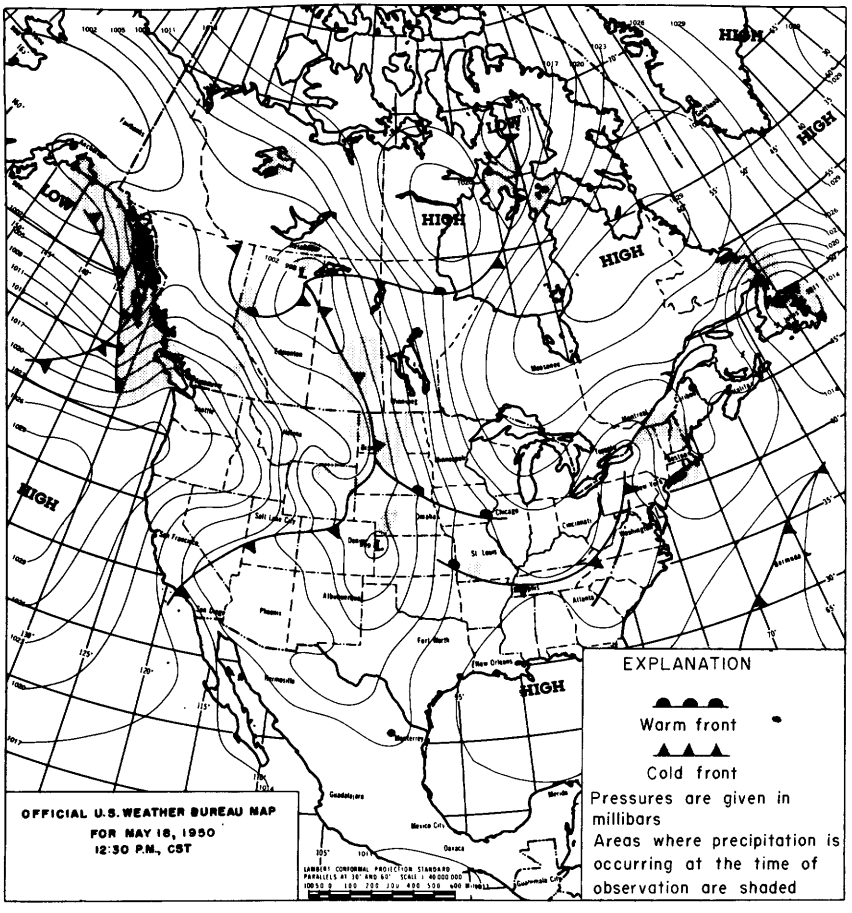

Figure 36.—Weather map for May 18, 1950.

Very little precipitation occurred during the remaining part of May, as the basin was dominated first by the Pacific high, then the polar high from Canada. On the last day of the month polar air again invaded the Red River Valley.

Precipitation in June was slightly above normal in northern Minnesota, although in eastern North Dakota precipitation averaged a little below normal. The record-breaking spring flood in the lower Red River of the North continued in the month of June.

On June 2 a cold front from Canada moved southeastward across the North Dakota-Minnesota region with a great high behind it. The high settled in the Great Basin and controlled the circulation of the major part of the country through the 5th.

On the 6th a strong frontal system approached the Red River Basin from the west. A wave formed on the front in Wyoming, and a deep low developed around it. As the polar air behind the front invaded the valley of the Red River of the North on the 7th, the strong circulation of the low pulled warm moist air up from the south and lifted it over the cold dense air. Many stations on the North Dakota side of the basin received more than half an inch of rain as a result of this activity.

The low traveled north-northeastward at a slow pace, releasing precipitation intermittently over the Red River Basin until the 10th. A polar high replaced the low and dominated the circulation of the north-central part of the country through morning of the 12th. The pressure field was very flat from the 12th through the 14th--winds were light; skies were comparatively clear; and temperatures rose well above the average.

The passage of a new frontal system from the west pulled a Canadian polar front down over the basin on the 16th. Precipitation occurred behind the front with at least half a dozen stations reporting 0.80 inches, while Sharon, N. Dak., reported 1.25 inches. The Canadian high which moved down behind the polar front dominated the circulation for two days, after which an extension of the Pacific high became the major influence.

On June 21 a frontal system from the Pacific lay through central Montana, its low north of the Canadian border. The frontal system moved eastward slowly while the low in south-central Canada deepened rapidly. The Pacific cold front swept past the Red River Basin area late on the 22d, and on the 23d the intense cyclonic circulation pulled a polar front from Canada down across the North Dakota-Minnesota region.

The low in Canada now moved rapidly northeastward, but low pressure started to develop in the Great Basin. The strong cyclonic circulation halted the front just past the Red River Basin area and pulled warm air laden with moisture up from the south. Precipitation resulted at many stations, but much greater amounts were reported on the following day as the Great Basin low deepened and moved rapidly northeastward. The combination of strong over-running and sharp cyclonic turning resulted in such rainfall totals as 6 inches at the Fosston Power Plant, Minn., 6.50 inches at Leonard, Minn., and 4.10 inches at Mahnomen, Minn.

The passage of this low brought an extension of the Pacific high deep into the United States where it governed the weather until the passage of a minor polar front on the 27th. The high that followed behind the front controlled the weather of the Red River of the North area until the end of the month.

FLOOD DAMAGES

Despite the severity of flooding throughout the area reported on, loss of life was small because of the slowness of crest buildup in populated areas. Five fatalities were caused by the flood in the United States; one by electrocution from flood-downed wires, two by a flood-induced furnace explosion, and two due to drowning. One volunteer worker in Winnipeg was drowned during flood emergency work.

Direct flood-damage to farm lands by erosion was extensive in the Red River of the North Basin and almost as serious were the secondary effects of saturated lands and delayed crops. High ground-water levels interfered with normal drainage of many fields for several weeks after recession of the flood waters. Some fields in territory adjacent to the Red River could not be planted during the 1950 growing season.

The drainage area of the Winnipeg River does not have many farms as the land is not favorable to agriculture. The high waters were a nuisance to the tourist trade, interfering with normal fishing and creating high beaches on many lakes.

Damage figures compiled by Federal and State agencies are listed in the following tabulations for urban centers, rural areas, and highway property.

Table 1.--Flood damage during spring of 1950 in the United States portion of the Red River of the North Basin
(Prepared by Corps of Engineers, Department of the Army)

State and county	Direct and indirect flood damages a				Red Cross, Nat. Guard, Coast Guard	Total
	Urban	Highways	Rural	Railroad		
Minnesota:						
Traverse			$300,000			$300,000
Wilkin	$38,100	$65,000	170,000			273,100
Otter Tail	-	75,000	-			75,000
Clay	96,800	170,000	114,000			380,800
Norman	12,000	280,000	315,000			607,000
Mahnomen	-	262,000	-			262,000
Polk	1,856,000	238,000	1,210,000			3,304,000
Red Lake	24,500	60,000	200,000			284,500
Clearwater	-	35,000	20,000			55,000
Pennington	10,400	107,000	300,000			417,400
Marshall	447,800	871,000	2,000,000			3,318,800
Beltrami	20,900	55,000	-			75,900
Kittson	256,000	465,000	1,000,000			1,721,000
Roseau	125,000	161,000	660,000			946,000
b State highways	-	125,000	-			125,000
North Dakota:						
Richland	28,000	-	-			28,000
Ransom	-	13,000	-			13,000
Cass	48,800	100,000	450,000			598,900
Barnes	3,000	-	-			3,000
Traill	14,400	610,000	175,000			799,400
Steele	-	60,000	125,000			185,000
Grand Forks	634,000	2,225,000	525,000			3,384,000
Nelson	-	135,000	555,000			690,000
Walsh	623,900	2,160,000	2,990,000			5,773,900
Ramsey	-	59,000	705,000			764,000
Pembina	814,300	1,280,000	2,635,000			4,729,300
c State highways	-	2,025,000	-			2,025,000
Basin-wide				c $1,500,000	c $350,000	1,850,000
Total, United States	$5,054,000	$11,636,000	$14,449,000	$1,500,000	$350,000	$32,989,000

a Damages from stream flooding (does not include damages resulting from poor drainage).
b Minnesota and North Dakota State highways (no breakdown by counties available).
c No breakdown by counties available.

An interesting breakdown by drainage basins of the flood damages sustained in the United States portion of the Red River of the North Basin was submitted by the representative of the Corps of Engineers in hearings on disaster relief legislation before the Congress. (Congressional documents, 81st Cong., H. R. Hearings, p. 98). It was as follows:

Main river	
Fargo-Halstad reach	$429,000
Grand Forks-Drayton reach	7,425,000
Drayton-Pembina reach	4,650,000
Tributaries, North Dakota	
Sheyenne River Basin	710,000
Goose River Basin	500,000
Turtle River Basin	1,710,000
Forest River Basin	1,504,000
Park River Basin	3,630,000
Pembina River Basin	3,140,000
Devils Lake Sub-basin	1,250,000
Tributaries, Minnesota	
Wild Rice and Marsh Rivers Basin	361,000
Sand Hill River Basin	514,000
Red Lake River Basin	2,400,000
Snake and Tamarack Rivers Basin	1,350,000
Two Rivers Basin	210,000
Roseau River Basin	1,137,000
Total in United States	$30,920,000

A summary of flood damages by county in Minnesota prepared by the Minnesota Disaster Committee, submitted in the above hearings on disaster relief legislation before the Congress, shows cost figures for several counties both in the Red River valley and in the Lake of the Woods drainage areas. It is as follows:

Table 2.--Flood damage from 1950 spring floods in Hudson Bay drainage in Minnesota, by counties

County	County roads, bridges, and culverts	Township roads, bridges, and culverts	City and village streets and bridges	Public Utilities and buildings	Total Property Damage		Total of all property damage
					Public	Private	
Clay	$70,500	$35,993.36	$9,380.00	-	$115,873.36	$162,933.86	$278,807.22
Marshall	399,700	225,433.37	8,840.00	$32,500	666,473.37	5,647,000.00	6,313,473.37
Polk	35,100	84,000.00	51,250.00	10,000	180,350.00	600,000.00	780,350.00
Norman	90,005	16,000,00	-	-	106,005.00	50,000.00	156,005.00
Roseau	90,000	15,000.00	-	25,000	130,000.00	85,000.00	215,000.00
Pennington	49,604	20,773.00	322.50	6,725	77,424.50	-	-
Kittson	222,400	114,600.00	5,500.00	-	342,500.00	320,550.00	663,050.00
Beltrami	24,263	15,315.00	-	-	39,578.00	-	-
Red Lake	21,100	21,900.00	-	-	43,000.00	-	-
Clearwater	21,000	20,000.00	-	-	41,000.00	-	-
Lake of the Woods	10,000	10,000.00	-	-	20,000.00	-	-

The Federal Bureau of Public Roads collected data on flood damage to highways and bridges throughout the United States part of the flooded area. A tabulation furnished by them follows:

Table 3.--1950 flood damage to highways and bridges in Red-Winnipeg River Basins in North Dakota and Minnesota

County	Federal aid systems a	Non-federal aid b	Total
North Dakota:			
c Barnes	0	$4,150	$4,150
Benson	0	54,600	54,600
Cass	0	14,819	14,819
Cavalier	0	80,000	80,000
c Eddy	0	0	0
Grand Forks	$169,500	459,690	629,190
Griggs	25,000	25,595	50,595
McHenry	5,000	30,650	35,650
Nelson	39,950	297,100	337,050
Pembina	164,000	393,525	557,525
Pierce	2,200	0	2,200
Ramsey	63,000	52,672	115,672
c Sheridan	283,000	69,735	352,735
Steele	24,000	74,293	98,293
Traill	209,000	37,645	246,645
Walsh	461,600	308,787	770,387
Minnesota:			
Becker	1,160	17,300	18,460
Beltrami	0	51,438	51,438
Clay	0	101,873	101,873
Clearwater	3,100	58,789	61,889
c Grant	1,000	6,900	7,900
c Itasca	9,896	134,852	144,748
Kittson	149,120	260,225	409,345
Koochiching	925	41,210	42,135
c Lake	27,750	105,250	133,000
Lake of the Woods	2,490	34,908	37,398
Mahnomen	15,125	188,945	204,070
Marshall	468,770	465,832	934,602
Norman	57,395	199,445	256,840
c Ottertail	7,000	13,000	20,000
Pennington	24,705	71,223	95,928
Polk	493,765	157,179	650,944
Red Lake	2,786	31,785	34,571
Roseau	2,625	129,876	132,501
c St. Louis	8,500	192,045	200,545
Traverse	5,000	24,775	29,775
Wilkin	5,565	42,435	48,000
Total	$1,286,677	$2,329,285	$3,615,962

a Based on cost of replacement to adequate standards.
b Based on estimated damage suffered except washed out bridges to be replaced by adequate structures.
c Part of county drains outside Red-Winnipeg drainage.

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American Red Cross data on damage and flood relief in the United States portion of the drainage area have been tabulated in Table 4.

The following data on Canadian flood damage have been prepared by the Winnipeg staff of the Water Resources Division, Department of Resources and Development, Canada:

"In the Canadian portion of the area flooded in 1950 by the Red River of the North, it has been estimated that flood fighting costs and direct loss and damage totalled approximately $30,000,000.

"The Hon. D. L. Campbell, Provincial Treasurer of Manitoba, in his budget speech of 21 March, 1951, presented a statement of the amounts expended by the province as of 28 February, 1951, and the further expenditures anticipated in connection with the Red River Valley flood of 1950. These amounts were summarized under several headings as follows:

Flood fighting costs	$4,355,880.91
Emergency relief and welfare	245,127.93
Flood damage and restoration	15,164,622.11
Total	$19,765,630.95

"Additional to the amounts expended by the provincial government, expenditures were made by the Canadian Red Cross for assistance during the flood and from a Welfare Fund raised by public subscription to cover personal property replacement, farm restoration, etc. The amounts supplied from these two sources were as follows:

Canadian Red Cross	$200,000.00
Welfare Fund	7,680,000.00
Total	$7,880,000.00

"Other direct losses and damages sustained by railways, public utilities, and large industries and business enterprises have been estimated to total approximately $1,750,000.00.

"The amounts shown above do not include indirect losses, such as loss in revenue to business, crop loss to farmers and other relative items."

The experience of Winnipeg public utility personnel in preventing and repairing damage and maintaining service during a major flood should prove valuable to others with similar responsibilities. Also noteworthy was the difficulty and danger of removing patients from hospital facilities that were located in the flooded area. (See fig. 37.) The city engineer of Winnipeg has related his experiences during the 1950 flood. (Hurst, 1950, pp. 1095-1110). He recommends in similar flood-created emergencies, that:

Table 4.--Flood losses and American Red Cross relief, due to the 1950 floods of the Red-Winnipeg River Basins in North Dakota and Minnesota, by counties 1/

State and County	Name of Chapter	Number of families having losses	Buildings		Persons		Number of families aided	Expenditures
			damaged	destroyed	killed	injured		
Minnesota-								
Clay	Clay Co.	100	180	-	1	1	30	$2,597.89
Kittson	Kittson Co.	250	330	14	-	-	195	18,561.91
Marshall	Marshall Co.	1,500	1,450	100	1	10	637	26,281.17
Polk	Polk Co.	1,200	1,000	25	2	2	856	57,071.26
Roseau	Roseau Co.	100	120	-	-	-	21	1,316.62
Total		3,150	3,080	139	4	13	1,739	$105,828.85
North Dakota-								
Cass	Cass Co.	25	50	-	-	-	2	$143.29
Grand Forks	Grand Forks Co.	650	1,005	6	1	1	107	19,095.24
Pembina	Pembina Co.	2,025	2,950	112	-	7	955	55,899.79
Traill	Traill Co.	18	14	-	-	-	5	1,328.15
Walsh	Walsh Co.	800	951	57	-	2	351	13,297.10
Total		3,518	4,970	175	1	10	1,420	$89,763.57
Grand total		6,668	8,050	314	5	23	3,159	$195,592.43

1 From statistics collected by the Office of Statistical and Reference Information, American National Red Cross, St. Louis, Mo., under date of June 29, 1951.

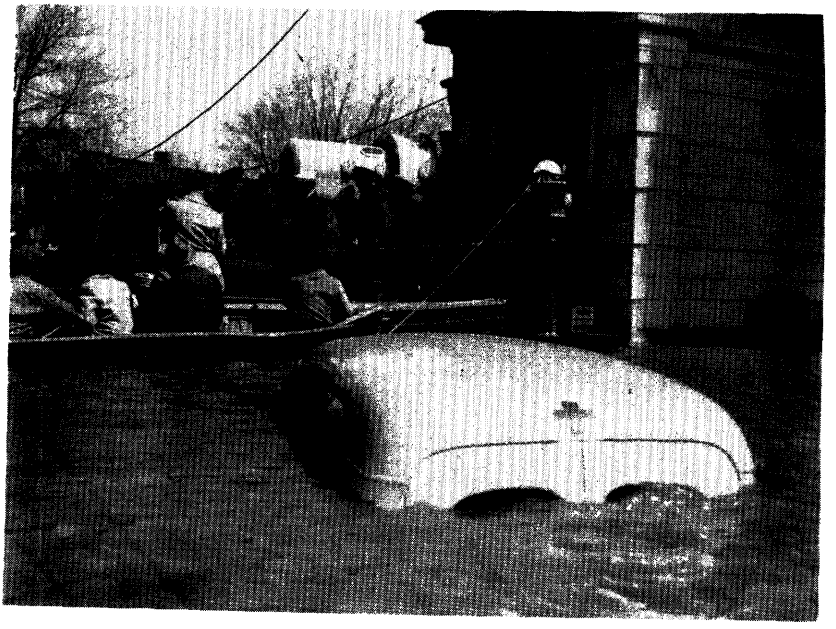

Figure 37.—Essential public services of Winnipeg are operated as well as possible during the 1950 flood. Civic Hospital patient is removed in iron lung by naval personnel when removal of patients becomes necessary. Photo by Winnipeg **Free Press.**

1. Positive pressure be maintained on all water mains to prevent entrance of contamination (the Winnipeg sewers backed up all over the city, spreading contamination throughout the groundwater and surface water for nearly three weeks).

2. Chlorine dosage be increased (local knowledge will prove best guide).

3. Portable sterilizers be in supply to purify local sections of mains that have been shut off for repair of breaks (breaks perversely come during floods too).

4. Standby power units be available to operate main pumps, etc. (Diesel or gas-engine units are recommended by Mr. Hurst).

5. A plan of emergency action be formulated before disaster strikes.

The fact that no epidemic occurred in Winnipeg although the water supply was polluted proves the effectiveness of Mr. Hurst's suggestions.

Mr. Hurst further observes that power plants, steam plants, and distribution lines should be located in flood-proof areas or built above flood levels. Sewers should be equipped with pumps if subject to flooding.

DETERMINATION OF FLOOD DISCHARGE

The usual method of the Geological Survey for collecting discharge data by making current-meter measurements could not be used at many regular gaging stations because overtopped or washed-out bridges and highways made the gage location inaccessible or use of the gaging structure impossible. The usual method of obtaining the peak discharge at gaging stations by means of current-meter measurements and rating curves has been described in detail in many previous Water-Supply Papers and will not be repeated here. At regular gaging stations and at points of miscellaneous determinations where the usual method could not be used, the peak discharge has been computed from slope-area or contracted-opening observations. Fairly detailed information about these mtehods, as used by the Geological Survey for previous severe floods, is given in Water-Supply Papers 773-E, 796-G, 798, 799, 800, 816, 843, and 888.

The surveys for contracted-opening or slope-area data were made more than ordinarily difficult by snow drifts, which prevented high-water marks from depositing on the ground. In using the indirect methods of determining peak discharge, engineers had to be continuously on guard against error due to this cause.

STAGES AND DISCHARGES AT STREAM-GAGING STATIONS

The basic hydrologic information in this report is presented in detail so that any essential hydrographs of stage and discharge can be accurately reconstructed for the use of designing engineers.

Only records of streams on which floods occurred or which are located on the fringe of the flooded area are included in this report.

The following paragraph taken from Geological Survey Water-Supply Paper 1080, p. 39, is offered here in definition of the term, "base data".

"The basic data systematically collected at stream-gaging stations consist of records of stage, measurements of discharge, and general information useful in determining the daily flow from the records of gage heights and discharge measurements. The records of stage are obtained by either periodic direct readings on a nonrecording gage or by a water-stage recorder which provides a continuous graph of stage. Measurements of discharge are generally made by a current meter, the methods of use of which are outlined in standard textbooks. Occasionally determination of extraordinary peak flows must be made by auxiliary methods referred to in the preceding section of this report. A typical stream-gaging station is usually equipped with a water-stage recorder and a bridge or a cableway and a suspended car from which discharge measurements are made. Rating tables showing the discharges for indicated stages are prepared from the results of discharge measurements. At some river stations other or auxiliary devices are used in the determination of discharge, such as artificial controls, turbines, venturi meters, and gates, so calibrated as to indicate rates of discharge."

The data tabulated on the following pages for each stream-gaging station set forth: a station description; a table showing the daily discharge throughout the flood period, which was all or part of the period March to September 1950; and a table showing the stage and discharge at selected intervals during each day of the major flood period, in sufficient detail for reliable definition of flood hydrograph. No sacrifice of detail has been made to obtain a concise tabulation.

The station description gives information on the type, location, and datum of the gage, the drainage area above the gage, and the information about stages and discharges during the flood. Information about stages and discharges includes the following: the method used in determining the stage; the method used to define the rating curve applicable during the flood period; the maximum stage and discharge during the period April-June 1950 (May to September in Winnipeg River Basin) and for the indicated period of station records, plus historical stages where available; and remarks on miscellaneous items not covered in the other categories listed.

Mean daily discharge for the months April to June 1950, in some cases March to June or May to September, are tabulated below the station description. The period selected covers the flood event in the area reported on with definition considered adequate for both antecedent conditions and the recession. Runoff volumes are expressed in depth in inches over the drainage area and in acre-feet. Figures 28, 29, show hydrographs of selected tributaries; comparison with hydrographs at main stream stations can be had by referring to figures 18 and 19.

A table following the tabulation of mean daily discharges gives, for each station where such detailed definition is necessary, the stages and discharges at selected times of each day during the period of rapid change in stage and discharge. The time interval for selecting momentary data was chosen to offer adequate hydrograph definition without including unnecessary information. Standard time is the basis throughout. Data for each station are listed from the beginning of the flood until the recession is adequately defined by the daily information presented above. Momentary data are presented only where accurate determination had been possible; information for periods of ice backwater or other similarly indefinite periods has been omitted in some cases.

The records of stages at indicated times were obtained from recording gages when such records were available. Where the gage was manual, graphs were constructed on the basis of all available gage readings, high-water marks, and other pertinent evidence, and the indicated stages were picked from the graph. Departures from this general procedure are noted in the description under gage-height.

Records are presented in downstream order, the Red River of the North Basin first. Plate 12 (in pocket) is a map of the area reported on and shows the location of all sites for which records are published herein. The first records are for the Otter Tail River (head of Red River of the North) followed by the Red River of the North main stream. Then the tributaries of the Red River of the North follow beginning with the most upstream and proceding downstream. The Winnipeg River Basin is treated in a similar manner following the last tributary of the Red River of the North.

Red River of the North Main Stem

Otter Tail River near Detroit Lakes, Minn.

Location.—Lat. 46°50', long. 95°42', in sec. 23, T. 139 N., R. 40 W., 5 miles downstream from Height of Land Lake, and 7½ miles east of city of Detroit Lakes.
Drainage area.—270 square miles.
Gage-height record.—Water-stage recorder chart except for periods Apr. 3 to May 4 when average of twice-daily readings from reference point waa used, Apr. 2 when one reading was available, and Apr. 1 when no record was obtained.
Discharge record.—Artificial control of concrete. Stage-discharge relation defined by current-meter measurements below 290 second-feet and extended to peak stage. Discharge for Apr. 1 interpolated. Gage heights used to hundredths.
Maxima.—April-June 1950: Discharge, 332 second-feet May 29, 30 (gage height, 4.71 feet).
1937 to March 1950: Daily discharge, 368 second-feet June 26, 1943.
Remarks.—Flow partly regulated by dams of Minnesota Department of Conservation on several lakes above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	58	161	328	11	55	232	286	21	95	296	201
2	61	169	324	12	55	235	283	22	99	300	193
3	54	178	324	13	57	238	276	23	106	318	183
4	54	181	318	14	62	241	267	24	117	321	181
5	51	188	318	15	87	248	257	25	129	321	188
6	57	198	314	16	106	251	248	26	133	321	178
7	54	207	318	17	109	238	235	27	139	324	172
8	51	215	310	18	106	254	223	28	148	328	165
9	51	226	300	19	92	286	212	29	150	328	161
10	54	232	293	20	92	296	207	30	154	328	129
								31	-	328	-
Monthly mean discharge, in second-feet									87.9	258	246
Runoff, in acre-feet									5,230	15,840	14,660
Runoff, in inches									0.37	1.10	1.01

Otter Tail River below Pelican River nr. Fergus Falls, Minn.

Location.—Lat. 46°13'45", long. 96°07'00", in SW¼ sec. 20, T. 132 N., R. 43 W., 500 feet downstream from Dayton Hollow Dam, 5 miles downstream from Pelican River, and 5 miles southwest of city of Fergus Falls. Datum of gage is 1,069.95 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).
Drainage area.—1,810 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 1-11 and by aquatic vegetation May 29 to Aug. 31.
Maxima.—March-August 1950: Discharge, 1,100 second-feet 6 p.m. May 23; gage height, 4.31 feet 6:30 a.m. July 9.
1930 to February 1950: Discharge, 1,200 second-feet June 4, 1944.
Remarks.—No diversions. Flow regulated by power dam 500 feet upstream from gage and by storage in several lakes on the headwaters.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	373	536	982	11	325	900	900	21	380	982	900
2	427	564	955	12	314	872	845	22	412	1,010	845
3	386	564	955	13	362	872	900	23	420	982	900
4	338	573	928	14	411	790	900	24	409	955	872
5	314	685	900	15	538	818	900	25	539	1,010	790
6	413	764	900	16	435	818	900	26	386	982	790
7	394	845	900	17	578	900	928	27	419	982	790
8	404	872	900	18	578	900	928	28	559	982	818
9	383	928	900	19	573	955	928	29	488	982	764
10	363	900	900	20	535	982	955	30	398	1,040	737
								31	-	1,010	-
Monthly mean discharge, in second-feet									428	870	884
Runoff, in acre-feet									25,500	53,460	52,580
Runoff, in inches									0.26	0.55	0.54

Red River of the North at Wahpeton, N. Dak.

Location.—Lat. 46°15'55", long. 96°35'40", in NE¼ sec. 8, T. 132 N., R. 47 W., in Wahpeton, 800 feet downstream from confluence of Bois de Sioux and Otter Tail Rivers. Datum of gage is 942.97 feet above mean sea level, datum of 1929.

Drainage area.—4,010 square miles.

Gage-height record.—Graph based on twice-daily wire-weight gage readings except Mar. 1, 7, when no readings were made.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1-31.

Maxima.—March-June 1950: Discharge, 4,190 second-feet 4 p.m. Apr. 2 (gage height, 11.62 feet).
1942 to February 1950: Daily discharge, 5,000 second-feet Apr. 2-6, 1943 (gage height, 14.75 feet, from floodmark, affected by ice).
Known stage, 15.6 feet, Mar. 31, 1897 (discharge not determined).

Remarks.—Flow partly regulated by several power plants and numerous controlled lakes and ponds, of which Lake Traverse is the largest.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	110	3,690	356	1,100	16	140	1,100	1,130	985
2	130	4,120	554	1,310	17	120	1,360	1,060	995
3	140	3,920	841	1,460	18	140	1,180	1,080	1,150
4	140	3,090	1,440	1,520	19	130	1,060	1,140	1,520
5	140	2,330	1,500	1,560	20	140	877	1,280	1,630
6	160	2,250	2,010	1,570	21	110	841	1,480	1,670
7	180	2,270	2,720	1,570	22	130	574	1,370	1,690
8	200	1,650	2,760	1,540	23	140	430	1,260	1,670
9	240	1,060	3,440	1,540	24	190	417	1,180	1,550
10	270	838	4,050	1,560	25	210	394	1,100	1,540
11	230	946	3,450	1,560	26	360	513	1,080	1,520
12	180	1,010	2,500	1,620	27	880	368	1,100	1,500
13	160	979	1,850	1,560	28	1,340	350	1,060	1,500
14	140	830	1,520	1,210	29	1,810	496	1,040	1,540
15	150	784	1,300	1,040	30	2,400	487	1,040	1,560
					31	3,030	-	1,030	-
Monthly mean discharge, in second-feet						446	1,340	1,572	1,458
Runoff, in acre-feet						27,450	79,760	96,640	86,760
Runoff, in inches						0.13	0.37	0.45	0.41

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 25			Apr. 3			Apr. 13			Apr. 21	
8	4.44	190	8	11.24	3,960	8	6.04	1,070	8	5.68	891
4	4.58	210	4	11.15	3,910	4	5.71	906	4	5.61	858
12	4.74	240	12	10.76	3,680	12	5.70	901	12	5.31	720
	Mar. 26			Apr. 4			Apr. 14			Apr. 22	
8	4.90	260	8	9.79	3,090	4	5.71	906	8	5.02	593
4	5.68	420	4	9.63	3,000	8	5.72	911	4	4.91	546
12	6.40	590	12	9.10	2,700	10	5.54	825	12	4.66	448
	Mar. 27			Apr. 5		N	5.46	788		Apr. 23	
8	7.11	780	8	8.29	2,260	4	5.47	792	8	4.52	395
4	8.03	1,000	4	8.33	2,280	8	5.43	774	4	4.68	455
12	8.48	1,150	12	8.20	2,210	12	5.36	742	12	4.62	433
	Mar. 28			Apr. 6			Apr. 15			Apr. 24	
8	8.85	1,280	8	8.08	2,140	4	5.33	728	8	4.53	399
4	9.29	1,370	4	8.37	2,300	8	5.34	733	4	4.63	436
8	9.51	1,460	12	8.52	2,390	N	5.39	756	12	4.53	399
12	9.45	1,570		Apr. 7		4	5.49	801		Apr. 25	
	Mar. 29		8	8.48	2,360	8	5.61	858	8	4.43	364
8	9.18	1,700	4	8.28	2,250	12	5.72	911	4	4.50	388
4	9.22	1,900	12	7.88	2,030		Apr. 16		12	4.69	459
12	9.26	2,100		Apr. 8		8	6.02	1,060		Apr. 26	
	Mar. 30		8	7.40	1,770	4	6.19	1,140	8	4.89	538
8	9.30	2,300	4	6.96	1,520	12	6.43	1,260	4	4.93	555
4	9.50	2,500	12	6.44	1,270		Apr. 17		12	4.63	436
12	9.62	2,700		Apr. 9		8	6.64	1,370		Apr. 27	
	Mar. 31		8	6.00	1,050	4	6.76	1,430	8	4.36	340
8	9.84	2,900	4	6.00	1,050	12	6.55	1,320	4	4.45	370
4	10.16	3,150	12	5.70	901		Apr. 18		12	4.40	353
12	10.37	3,400		Apr. 10		8	6.33	1,220		Apr. 28	
	Apr. 1		8	5.55	830	4	6.13	1,120	8	4.24	301
8	10.63	3,600	4	5.48	797	12	6.09	1,100	4	4.41	356
4	10.93	3,780	12	5.64	872		Apr. 19		12	4.63	436
12	11.28	3,990		Apr. 11		8	6.09	1,100		Apr. 29	
	Apr. 2		8	5.80	950	4	6.00	1,050	8	4.78	494
8	11.53	4,140	4	5.82	960	12	5.86	980	4	4.85	522
4	11.62	4,190	12	5.87	985		Apr. 20		12	4.82	510
12	11.44	4,080		Apr. 12		8	5.74	921		Apr. 30	
			8	5.97	1,040	4	5.50	806	8	4.82	510
			4	5.87	985	12	5.55	830	4	4.79	498
			12	5.94	1,020				12	4.52	395

Red River of the North at Wahpeton, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 1			May 5			May 8			May 12	
8	4.25	304	4	6.92	1,510	8	9.12	2,720	8	8.96	2,630
4	4.40	353	8	6.84	1,470	4	9.15	2,730	4	8.46	2,350
12	4.61	429	N	6.76	1,430	8	9.28	2,800	12	8.03	2,120
	May 2		4	6.84	1,470	12	9.46	2,900		May 13	
8	4.87	530	8	6.99	1,540		May 9		8	7.66	1,910
4	5.01	588	12	7.10	1,600	8	9.98	3,210	4	7.38	1,760
12	5.17	658		May 6		4	10.72	3,650	12	7.15	1,630
	May 3		4	7.26	1,690	12	11.31	4,010		May 14	
8	5.34	733	8	7.41	1,780		May 10		8	7.00	1,550
4	5.68	891	N	7.69	1,930	4	11.46	4,100	4	6.87	1,480
12	6.18	1,140	4	8.06	2,130	8	11.49	4,110	12	6.71	1,400
	May 4		8	8.66	2,460	N	11.48	4,110		May 15	
4	6.50	1,300	12	8.81	2,550	4	11.42	4,070	8	6.57	1,340
8	6.74	1,420		May 7		8	11.29	3,990	4	6.46	1,280
N	6.88	1,490	4	8.93	2,610	12	11.10	3,880	12	6.28	1,190
4	6.98	1,540	8	9.06	2,680		May 11				
8	7.00	1,550	N	9.17	2,740	8	10.69	3,630			
12	6.98	1,540	4	9.24	2,780	4	10.16	3,320			
			8	9.29	2,810	12	9.53	2,940			
			12	9.28	2,800						

Red River of the North at Fargo, N. Dak.

Location. —Lat. 46°52'10", long. 96°47'00", in NE¼ sec. 7, T. 139 N., R. 48 W., just upstream from Island Park Dam in Fargo, and 10 miles upstream from Sheyenne River. Datum of gage is 870.00 feet above mean sea level, adjustment of 1912.

Drainage area. —6,800 square miles.

Gage-height record. —Staff gage read once daily Mar. 1-26 and twice daily Mar. 27 to June 30 (once on Sundays) except Mar. 5, 12, 19, May 28 when gage was not read. Graph drawn Mar. 24 to June 30.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Loop rating curves used Mar. 30 to Apr. 20, May 5-18. Shifting control method used Mar. 1-26.

Maxima. —March-May 1950: Discharge, 7,800 second-feet 4 a.m. Apr. 7; gage height, 21.21 feet, 12 p.m. Apr. 7.

1901 to February 1950: Discharge, 17,000 second-feet Apr. 7, 1943 (gage height, 28.40 feet). Known stage, about 34.2 feet, Apr. 7, 1897, present datum.

Remarks. —Flow partly regulated by several power plants and numerous controlled lakes and ponds, of which Lake Traverse is the largest. Some small diversions for municipal supply. Records include overbank discharge of Sheyenne River (maximum, about 500 second-feet) which left that stream near Horace and entered Red River of the North above Fargo.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	114	4,120	832	1,780	16	210	3,520	4,060	1,720
2	104	4,940	937	1,730	17	194	4,020	3,240	1,530
3	88	5,520	1,280	1,740	18	191	3,940	2,620	1,420
4	101	6,120	1,540	1,900	19	170	3,670	2,430	1,340
5	120	6,600	2,200	2,010	20	145	2,960	2,690	1,380
6	151	7,260	3,470	2,070	21	157	2,380	2,700	1,590
7	194	7,680	4,180	2,060	22	169	1,980	2,720	1,670
8	207	7,140	4,790	2,080	23	157	1,710	2,810	1,680
9	221	6,400	5,770	2,100	24	172	1,380	2,810	1,670
10	194	5,570	6,250	2,060	25	265	1,080	2,610	1,670
11	228	4,750	6,450	2,010	26	532	936	2,420	1,560
12	250	3,980	6,520	2,010	27	1,280	850	2,260	1,530
13	272	3,360	6,400	2,090	28	1,860	850	2,160	1,500
14	279	2,920	5,870	2,120	29	2,120	778	2,060	1,500
15	249	2,900	4,980	2,030	30	2,620	750	1,990	1,480
					31	3,330	-	1,860	-
Monthly mean discharge, in second-feet						527	3,669	3,320	1,768
Runoff, in acre-feet						32,420	218,300	204,100	105,200
Runoff, in inches						0.09	0.60	0.56	0.29

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 25			Apr. 6			Apr. 17 (cont'd.)			Apr. 30	
N	8.27	257	8	19.34	7,050	4	13.94	3,980	N	9.25	744
12	8.49	344	4	19.85	7,390	12	13.88	3,950	12	9.29	770
	Mar. 26		12	20.46	7,750		Apr. 18			May 1	
N	8.79	483		Apr. 7		8	13.94	3,980	N	9.39	840
12	9.38	819	4	20.68	7,800	4	13.85	3,940	12	9.44	877
	Mar. 27		8	20.88	7,760	12	13.65	3,880		May 2	
N	9.92	1,320	4	21.11	7,650		Apr. 19		8	9.44	877
12	10.24	1,670	12	21.21	7,470	N	13.20	3,690	4	9.52	940
	Mar. 28			Apr. 8		12	12.56	3,410	12	9.72	1,110
N	10.43	1,880	N	21.07	7,170		Apr. 20			May 3	
12	10.55	2,010	12	20.83	6,730	N	11.66	2,920	N	9.91	1,310
	Mar. 29			Apr. 9		12	11.20	2,600	12	10.00	1,400
N	10.63	2,090	N	20.65	6,420		Apr. 21			May 4	
12	10.85	2,300	12	20.35	6,010	N	10.91	2,360	N	10.12	1,530
	Mar. 30			Apr. 10		12	10.72	2,180	12	10.27	1,700
N	11.15	2,620	N	19.90	5,550		Apr. 22			May 5	
12	11.50	2,960	12	19.49	5,160	N	10.48	1,940	8	10.40	1,850
	Mar. 31			Apr. 11		12	10.39	1,840	4	10.87	2,400
N	11.97	3,310	N	18.90	4,750		Apr. 23		12	11.35	2,970
12	12.64	3,740	12	18.18	4,330	N	10.28	1,720		May 6	
	Apr. 1			Apr. 12		12	10.15	1,560	N	12.05	3,520
N	13.26	4,100	N	17.28	3,960		Apr. 24		12	12.61	3,860
12	14.13	4,530	12	16.36	3,650	N	9.97	1,370		May 7	
	Apr. 2			Apr. 13		12	9.82	1,210	N	13.30	4,230
8	14.70	4,800	N	15.31	3,340		Apr. 25		12	13.65	4,410
4	15.46	5,130	12	14.41	3,100	N	9.67	1,070		May 8	
12	15.78	5,250		Apr. 14		12	9.57	981	8	13.93	4,550
	Apr. 3		N	13.74	2,880		Apr. 26		4	14.73	4,920
8	16.16	5,400	12	13.18	2,800	N	9.52	940	12	15.78	5,380
4	16.63	5,610		Apr. 15		12	9.45	885		May 9	
12	17.17	5,820	8	12.90	2,830		Apr. 27		8	16.50	5,670
	Apr. 4		4	12.74	2,930	N	9.37	826	4	17.13	5,900
8	17.47	5,990	12	12.75	3,070	12	9.42	862	12	17.58	6,080
4	18.01	6,270		Apr. 16			Apr. 28			May 10	
12	18.15	6,350	8	12.90	3,300	N	9.42	862	N	18.06	6,270
	Apr. 5		4	13.24	3,700	12	9.35	812	12	18.38	6,380
8	18.36	6,450	12	13.75	4,080		Apr. 29			May 11	
4	18.81	6,720		Apr. 17		N	9.30	777	N	18.60	6,450
12	19.17	6,920	8	14.06	4,070	12	9.25	744	12	18.76	6,520

Red River of the North at Fargo, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 12			May 14			May 15			May 17	
N	18.90	6,540	8	18.41	6,050	N	16.70	4,980	N	12.81	3,210
12	18.96	6,500	4	17.93	5,710	12	15.74	4,500	12	11.97	2,900
	May 13		12	17.51	5,450		May 16			May 18	
8	18.93	6,460				N	14.77	4,050	N	11.34	2,600
4	18.82	6,360				12	13.79	3,620	12	10.96	2,380
12	18.66	6,230									

Red River of the North at Halstad, Minnesota

Location.—Lat. 47°21', long. 96°51', on line between secs. 24 and 25, T. 145 N., R. 49 W., at highway bridge half a mile west of Halstad and 2½ miles downstream from Wild Rice River. Datum of gage is 826.65 feet above mean sea level, datum of 1929.

Drainage area.—17,860 square miles (excludes closed Devils Lake Basin).

Gage-height record.—Graph drawn through once or twice-daily wire-weight gage readings. No readings May 6.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-15. Discharge for day of no gage-height record computed by interpolation and by comparison with station at Fargo. Discharge for ice-affected period, Apr. 1-15, not computed.

Maxima.—April-June 1950: Discharge, 22,000 second-feet Apr. 12, 13; gage height, 32.00 feet, 5:30 p.m. Apr. 11.

1936-37, 1942 to March 1950: Discharge, 24,500 second-feet Apr. 16, 1947; gage height, 34.00 feet, Apr. 17, 1947.

Remarks.—Small amounts of diversion for city water supplies, most of which is returned above the gage. Flow partly regulated by many lakes and reservoirs on tributaries.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	7,000	5,010	5,650	11	21,500	18,400	4,900	21	11,500	10,400	3,400
2	8,500	5,100	5,390	12	22,000	18,500	4,850	22	10,600	9,900	3,010
3	10,000	6,460	5,190	13	22,000	18,100	4,820	23	9,630	9,450	2,760
4	12,000	9,600	5,040	14	21,500	17,000	4,820	24	8,750	9,110	2,900
5	13,500	10,800	4,990	15	21,000	16,000	4,890	25	7,830	8,720	3,780
6	15,500	12,600	4,980	16	20,500	14,900	4,790	26	7,180	8,350	4,420
7	18,000	14,400	4,980	17	19,300	13,800	4,570	27	6,440	7,940	4,870
8	20,000	15,800	4,970	18	17,400	12,800	4,340	28	5,640	7,380	4,890
9	20,500	17,000	4,940	19	15,000	11,800	4,100	29	5,110	6,850	4,910
10	21,000	17,900	4,930	20	12,700	10,900	3,780	30	5,000	6,360	4,790
								31	-	5,970	-
Monthly mean discharge, in second-feet									13,890	11,530	4,555
Runoff, in acre-feet									826,300	708,700	271,000
Runoff, in inches									0.87	0.74	0.28

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	April 16			April 27			May 7			May 17	
8	30.52	20,600	8	16.87	6,610	8	25.08	14,200	N	27.33	13,800
4	30.50	20,400	4	15.80	6,280	4	25.86	14,700	12	26.53	13,200
12	30.46	20,200	12	14.90	6,000	12	26.58	15,200		May 18	
	April 17			April 28			May 8		N	25.60	12,800
8	30.40	19,700	8	14.12	5,730	8	27.22	15,700	12	24.63	12,300
4	30.28	18,900	4	13.58	5,530	4	27.73	16,000		May 19	
12	30.16	18,200	12	13.10	5,330	12	28.32	16,400	N	23.65	11,700
	April 18			April 29			May 9		12	22.78	11,300
8	30.08	17,800	8	12.73	5,170	8	28.90	16,800		May 20	
4	29.96	17,200	4	12.44	5,030	4	29.46	17,200	N	22.12	10,900
12	29.76	16,400	12	12.32	4,950	12	29.94	17,600	12	21.68	10,600
	April 19			April 30			May 10			May 21	
8	29.48	15,400	8	12.42	5,020	4	30.11	17,800	N	21.30	10,400
4	29.18	14,500	4	12.40	5,010	8	30.28	17,900	12	20.92	10,100
12	28.80	13,600	12	12.34	4,970	N	30.42	18,000		May 22	
	April 20			May 1		4	30.49	18,100	N	20.53	9,910
8	28.42	12,800	8	12.37	4,990	8	30.40	18,000	12	20.17	9,680
4	28.14	12,400	4	12.43	5,030	12	30.44	18,100		May 23	
12	27.94	12,000	12	12.48	5,060		May 11		N	19.71	9,410
	April 21			May 2		8	30.70	18,300	12	19.47	9,300
8	27.68	11,700	8	12.50	5,080	4	31.02	18,600		May 24	
4	27.38	11,300	4	12.53	5,090	12	31.30	18,700	N	19.10	9,100
12	27.06	11,000	12	12.68	5,190		May 12		12	18.80	8,930
	April 22			May 3		4	31.34	18,700		May 25	
8	26.66	10,700	4	12.85	5,300	8	31.30	18,600	N	18.40	8,710
4	26.22	10,400	8	13.30	5,650	N	31.27	18,500	12	18.00	8,510
12	25.76	10,100	N	14.13	6,290	4	31.25	18,500		May 26	
	April 23		4	14.90	6,910	8	31.22	18,400	N	17.72	8,350
8	25.25	9,800	8	15.90	7,700	12	31.22	18,400	12	17.39	8,180
4	24.71	9,450	12	17.00	8,580		May 13			May 27	
12	24.16	9,190		May 4		4	31.23	18,400	N	16.98	7,940
	April 24		4	17.78	9,140	8	31.20	18,300	12	16.55	7,680
8	23.57	8,880	8	18.23	9,450	N	31.07	18,100		May 28	
4	22.97	8,600	N	18.58	9,700	4	30.98	17,900	N	16.06	7,370
12	22.34	8,340	4	18.89	9,900	8	30.90	17,800	12	15.58	7,080
	April 25		8	19.10	10,000	12	30.84	17,700		May 29	
8	21.50	8,000	12	19.24	10,200		May 14		N	15.19	6,850
4	20.37	7,600		May 5		N	30.64	17,000	12	14.79	6,600
12	19.74	7,420	4	19.44	10,300	12	30.08	16,500		May 30	
	April 26		8	19.70	10,500		May 15		N	14.43	6,350
8	19.29	7,280	N	19.98	10,700	N	29.70	16,000	12	14.15	6,160
4	18.70	7,100	4	20.47	11,000	12	29.21	15,400		May 31	
12	17.94	6,880	8	21.05	11,400		May 16		N	13.86	5,960
			12	21.78	11,900	N	28.70	14,900	12	13.61	5,800
						12	28.06	14,400			

Red River of the North at Grand Forks, N. Dak.

Location.—Lat. 47°56'26", long. 97°02'47", in SE¼NE¼ sec. 33, T. 152 N., R. 50 W., in Grand Forks, 2 miles downstream from Red Lake River. Datum of gage is 778.42 feet above mean sea level. datum of 1929.

Drainage area.—26,100 square miles (excludes closed Devils Lake Basin).

Gage-height record.—Water-stage recorder graph except for periods Mar. 27-30, Apr. 8-12, 21-26, May 7-18, when gage heights are from graph based on several daily staff gage readings.

Discharge record.—Stage discharge relation affected by ice Mar. 1-24. Discharge Mar. 25 to June 30 computed from loop curves based on thirty current-meter measurements.

Maxima.—March-June 1950: Discharge, 54,000 second-feet 7 a.m. May 12 (gage height, 45.61 feet). 1882 to February 1950: Discharge, about 80,000 second-feet Apr. 10, 1897 (gage height, 50.2 feet), from rating curve extended above 54,000 second-feet.

Remarks.—Flow partly regulated by many lakes and reservoirs on tributaries. Minor diversions for municipal and industrial use.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	830	4,640	23,300	17,900	16	810	23,400	46,200	10,300
2	790	5,960	22,200	16,800	17	900	27,400	44,400	10,200
3	750	7,290	22,800	15,900	18	890	31,600	42,500	10,000
4	760	8,580	27,800	15,000	19	890	34,400	40,500	9,520
5	750	9,940	31,400	14,300	20	890	36,400	38,300	8,700
6	720	11,400	36,100	13,600	21	850	37,600	36,100	8,060
7	810	13,200	42,000	13,000	22	820	37,500	34,700	7,600
8	770	14,800	47,200	12,500	23	840	38,300	33,700	7,360
9	680	16,200	50,900	12,000	24	910	42,200	31,800	7,070
10	750	17,300	52,500	11,600	25	990	43,000	29,700	6,970
11	750	18,400	53,400	11,300	26	1,260	40,400	27,500	6,970
12	790	19,200	53,900	11,000	27	1,880	36,600	25,500	7,990
13	800	19,800	52,800	10,800	28	1,820	32,300	23,800	10,100
14	800	20,400	50,800	10,600	29	1,810	28,300	22,100	11,800
15	830	21,300	48,200	10,400	30	2,230	25,300	20,600	13,000
					31	3,390	-	19,200	-
Monthly mean discharge, in second-feet						1,057	24,100	36,510	11,080
Runoff, in acre-feet						64,980	1,434,000	2,245,000	659,200
Runoff, in inches						0.05	1.03	1.61	0.47

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 26			Apr. 6			Apr. 19			May 2	
N	7.52	1,200	N	24.87	11,300	N	41.79	34,500	N	35.69	22,200
4	7.70	1,280	12	25.95	12,300	12	42.23	35,500	12	35.53	21,900
12	8.52	1,620		Apr. 7			Apr. 20			May 3	
	Mar. 27		N	26.92	13,100	N	42.52	36,500	N	35.49	21,800
6	9.07	1,880	12	28.02	14,100	12	42.77	37,200	12	35.82	25,800
9	9.22	1,940		Apr. 8			Apr. 21			May 4	
3	9.21	1,930	N	28.94	14,900	N	42.84	37,800	N	36.41	27,700
12	9.11	1,890	12	29.66	15,500	12	42.85	37,800	12	37.24	29,800
	Mar. 28			Apr. 9			Apr. 22			May 5	
N	8.95	1,820	N	30.38	16,200	N	42.81	37,500	N	38.05	31,200
12	8.85	1,770	12	31.14	16,800	12	42.77	37,200	12	39.33	33,600
	Mar. 29			Apr. 10			Apr. 23			May 6	
8	8.85	1,770	N	31.64	17,300	N	42.87	38,000	N	40.54	35,900
4	8.95	1,820	12	32.34	17,800	12	43.26	40,000	12	41.93	39,100
12	9.12	1,890		Apr. 11			Apr. 24			May 7	
	Mar. 30		N	32.84	18,400	N	43.63	42,500	N	42.93	42,000
8	9.41	2,030	12	33.23	18,800	12	43.79	43,800	12	43.90	45,000
4	10.06	2,340		Apr. 12			Apr. 25			May 8	
12	10.92	2,770	N	33.53	19,200	N	43.70	43,100	N	44.52	47,300
	Mar. 31		12	33.84	19,600	12	43.48	42,100	12	44.96	49,300
N	12.06	3,380		Apr. 13			Apr. 26			May 9	
12	13.26	4,030	N	34.04	19,800	N	43.16	40,500	N	45.27	51,100
	Apr. 1		12	34.24	20,000	12	42.71	38,700	12	45.40	52,000
N	14.38	4,640		Apr. 14			Apr. 27			May 10	
12	15.46	5,240	N	34.52	20,400	N	42.16	36,700	N	45.48	52,500
	Apr. 2		12	34.74	20,700	12	41.46	34,500	12	45.51	52,900
N	16.77	5,980		Apr. 15			Apr. 28			May 11	
12	17.91	6,650	N	35.01	21,200	N	40.62	32,200	N	45.57	53,500
	Apr. 3		12	35.63	22,100	12	39.85	30,200	12	45.59	53,800
N	19.04	7,300		Apr. 16			Apr. 29			May 12	
12	20.06	7,920	N	36.26	23,200	N	39.05	28,200	N	45.60	54,000
	Apr. 4		12	37.21	25,200	12	38.30	26,700	12	45.59	53,800
N	21.08	8,550		Apr. 17			Apr. 30			May 13	
12	22.22	9,300	N	38.01	27,200	N	37.58	25,200	N	45.51	52,900
	Apr. 5		12	39.28	29,800	12	36.98	24,200	12	45.39	51,800
N	23.03	9,880		Apr. 18			May 1			May 14	
12	24.01	10,700	N	40.40	31,700	N	36.42	23,300	N	45.27	50,900
			12	41.24	33,200	12	35.98	22,500	12	45.07	49,500

Red River of the North at Grand Forks, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 15			May 21			May 27			June 2	
N	44.87	48,000	N	41.08	36,000	N	36.76	25,500	N	30.07	16,800
12	44.67	47,100	12	40.83	35,300	12	36.25	24,600	12	29.50	16,300
	May 16			May 22			May 28			June 3	
N	44.42	46,200	N	40.59	34,600	N	35.72	23,700	N	28.91	15,900
12	44.16	45,200	12	40.45	34,300	12	35.19	23,000	12	28.36	15,500
	May 17			May 23			May 29			June 4	
N	43.87	44,400	N	40.25	33,800	N	34.65	22,100	N	27.81	15,000
12	43.57	43,500	12	39.96	32,900	12	34.11	21,300	12	27.29	14,700
	May 18			May 24			May 30			June 5	
N	43.25	42,500	N	39.58	31,800	N	33.53	20,600	N	26.81	14,300
12	42.91	41,400	12	39.17	30,700	12	32.97	19,900	12	26.33	13,900
	May 19			May 25			May 31			June 6	
N	42.62	40,500	N	38.72	29,700	N	32.39	19,300	N	25.89	13,600
12	42.23	39,500	12	38.24	28,600	12	31.82	18,500	12	25.47	13,300
	May 20			May 26			June 1			June 7	
N	41.84	38,300	N	37.75	27,500	N	31.24	17,900	N	25.12	13,000
12	41.46	37,100	12	37.25	26,500	12	30.64	17,300	12	24.80	12,800

Red River of the North at Oslo, Minn.

Location.—Lat. 48°11', long. 97°09', in sec. 31, T. 155 N., R. 50 W., on highway bridge in Oslo. Datum of gage is 777.65 feet above mean sea level, datum of 1929. Gage at Grand Forks used as auxiliary gage to compute slope.

Drainage area.—27,300 square miles (excludes closed Devils Lake Basin).

Gage-height record.—Wire-weight gage at Oslo read twice daily. Water-stage recorder or staff gages at Grand Forks read twice daily.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 9,800 second-feet and slope-stage-discharge relation defined above 9,800 second-feet to peak stage. Affected by ice Apr. 2-18. Discharge for day of no gage-height record Apr. 1 computed on basis of record for station at Grand Forks.

Maxima.—April-June 1950: Discharge, 63,000 second-feet 8:15 p.m. May 10 (gage height, 31.83 feet). 1936-37, 1941 to March 1950: Daily discharge, 41,400 second-feet Apr. 17, 1948; gage height, 31.17 feet Apr. 15, 1948.

Remarks.—Flow partly regulated by many lakes and reservoirs on tributaries. Minor diversions for municipal and industrial use.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	3,400	31,500	20,600	11	17,500	60,700	12,400	21	48,000	40,200	8,670
2	4,700	30,000	19,100	12	18,500	58,200	11,900	22	46,700	38,700	8,090
3	6,200	29,600	17,700	13	19,000	57,300	11,400	23	46,600	37,700	7,590
4	7,400	29,400	16,500	14	20,000	53,600	11,000	24	48,200	36,100	7,180
5	8,700	32,900	15,500	15	21,000	51,500	10,700	25	48,400	34,400	6,980
6	10,200	38,100	14,800	16	23,000	49,700	10,600	26	47,400	32,200	6,930
7	12,000	43,700	14,100	17	26,000	48,000	10,400	27	44,500	30,200	7,740
8	13,500	49,800	13,600	18	35,000	46,400	10,100	28	40,900	28,000	9,720
9	15,000	59,300	13,200	19	44,000	44,200	9,650	29	37,400	26,200	11,600
10	16,500	62,700	12,800	20	47,300	42,300	9,280	30	34,000	24,200	12,800
								31	-	22,400	-
Monthly mean discharge, in second-feet									27,030	40,940	11,750
Runoff, in thousand acre-feet									1,609	2,517	699.4
Runoff, in inches									1.11	1.73	0.48

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 19			May 1			May 15			May 28	
N	31.39	44,400	N	29.67	31,500	N	31.51	51,500	N	28.93	28,000
	Apr. 20			May 2			May 16			May 29	
6	31.46	46,000	N	29.20	30,000	N	31.44	49,700	N	28.37	26,200
N	31.53	47,800		May 3			May 17			May 30	
6	31.58	48,800	N	29.01	29,600	N	31.37	48,000	N	27.75	24,200
12	31.56	48,300		May 4			May 18			May 31	
	Apr. 21		N	29.15	29,400	N	31.30	46,400	N	27.06	22,400
N	31.52	48,000		May 5			May 19			June 1	
	Apr. 22		N	29.69	32,900	N	31.09	44,200	N	26.28	20,600
N	31.43	46,700		May 6			May 20			June 2	
	Apr. 23		N	30.36	38,100	N	30.99	42,300	N	25.41	19,100
N	31.40	46,600		May 7			May 21			June 3	
	Apr. 24		N	30.87	43,700	N	30.79	40,200	N	24.52	17,700
N	31.42	48,200		May 8			May 22			June 4	
	Apr. 25		N	31.43	49,800	N	30.62	38,700	N	23.65	16,500
N	31.43	48,400		May 9			May 23			June 5	
	Apr. 26		N	31.75	59,300	N	30.47	37,700	N	22.81	15,500
N	31.42	47,400		May 10			May 24			June 6	
	Apr. 27		N	31.81	62,500	N	30.30	36,100	N	21.91	14,800
N	31.25	44,500	8:15	31.83	63,000		May 25			June 7	
	Apr. 28			May 11		N	30.07	34,400	N	21.14	14,100
N	31.03	40,900	N	31.77	60,700		May 26			June 8	
	Apr. 29			May 12		N	29.79	32,200	N	20.42	13,600
N	30.63	37,400	N	31.70	58,200		May 27			June 9	
	Apr. 30			May 13		N	29.41	30,200	N	19.67	13,200
N	30.22	34,000	N	31.67	57,300					June 10	
				May 14					N	18.86	12,800
			N	31.57	53,600						

Red River of the North at Drayton, N. Dak.

Location.—Lat. 48°33'40", long. 97°10'30", in NW¼SE¼ sec. 26, T. 159 N., R. 51 W., on highway bridge in Drayton. Datum of gage is 756.59 feet above mean sea level, datum of 1929.
Drainage area.—30,900 square miles (excludes closed Devils Lake Basin).
Gage-height record.—Graph based on two to four daily wire-weight gage readings.
Discharge record.—Stage-discharge relation and loop curves defined by current-meter measurements. Affected by ice Apr. 1-21.
Maxima.—April-June 1950: Discharge, 86,500 second-feet at 3 p.m. May 12 (gage height, 41.58 feet).
1936-37, 1941 to March 1950: Daily discharge, 57,000 second-feet Apr. 21, 1948; gage height, 40.05 feet Apr. 22, 1948.
Known stage, about 41 feet about Apr. 20, 1897, from marks furnished by local residents.
Remarks.—Small diversions above gage for municipal use. Flow partly regulated by many lakes and reservoirs on tributaries.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,200	56,700	30,000	11	15,000	83,800	17,800	21	48,000	55,000	9,760
2	3,400	53,600	27,600	12	16,000	86,100	16,400	22	56,000	52,300	9,240
3	4,800	51,800	26,300	13	17,000	85,300	15,400	23	64,000	50,500	8,680
4	6,000	49,900	24,900	14	18,000	83,200	14,600	24	69,700	48,400	8,140
5	7,200	52,500	23,700	15	19,000	81,800	13,700	25	69,100	46,500	7,900
6	8,200	57,000	22,700	16	20,000	77,200	13,000	26	71,500	44,000	7,720
7	9,500	58,000	21,900	17	22,000	72,000	12,100	27	68,900	41,400	7,560
8	11,000	62,700	21,100	18	25,000	66,500	11,500	28	66,600	38,700	7,950
9	13,000	68,800	20,200	19	29,000	62,000	10,800	29	64,000	36,600	9,550
10	14,000	78,800	19,000	20	35,000	58,200	10,200	30	60,500	34,200	11,300
								31	-	32,200	-
Monthly mean diacharge, in second-feet									31,120	58,890	15,360
Runoff, in thousand acre-feet									1,852	3,621	913.8
Runoff, in inches									1.13	2.20	0.55

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 22			May 4			May 17			May 29	
N	39.93	56,000	N	39.42	49,900	N	40.88	72,000	N	38.07	36,600
	Apr. 23			May 5			May 18			May 30	
N	40.50	64,000	N	39.64	52,500	N	40.63	66,500	N	37.79	34,200
	Apr. 24			May 6			May 19			May 31	
N	40.76	69,700	N	40.03	57,000	N	40.38	62,000	N	37.54	32,200
	Apr. 25			May 7			May 20			June 1	
N	40.74	69,100	N	40.10	58,000	N	40.12	58,200	N	37.25	30,000
	Apr. 26			May 8			May 21			June 2	
N	40.86	71,500	N	40.43	62,700	N	39.87	55,000	N	36.86	27,600
7	40.88	72,000		May 9			May 22			June 3	
	Apr. 27		N	40.72	68,800	N	39.62	52,300	N	36.57	26,300
N	40.73	68,900		May 10			May 23			June 4	
	Apr. 28		N	41.22	78,800	N	39.45	50,500	N	36.11	24,900
N	40.64	66,600		May 11			May 24			June 5	
	Apr. 29		N	41.46	83,800	N	39.27	48,400	N	35.57	23,700
N	40.50	64,000		May 12			May 25			June 6	
	Apr. 30		N	41.56	86,100	N	39.09	46,500	N	34.93	22,700
N	40.28	60,500		May 13			May 26			June 7	
	May 1		N	41.52	85,300	N	38.85	44,000	N	34.22	21,900
N	39.99	56,700		May 14			May 27			June 8	
	May 2		N	41.44	83,200	N	38.58	41,400	N	33.41	21,100
N	39.73	53,600		May 15			May 28			June 9	
	May 3		N	41.35	81,800	N	38.30	38,700	N	32.49	20,200
N	39.58	51,800		May 16						June 10	
			N	41.14	77,200				N	31.44	19,000

Red River of the North at Emerson, Manitoba

Location. – Lat. 49°00'17", long. 97°13'00", at Canadian National Railway Bridge, ¼ mile west of station and about ½ mile downstream from the international boundary. Datum Geodetic Survey of Canada, adjustment of 1929.

Drainage area. – 40,200 square miles. (Includes closed Devils Lake Basin.)

Gage-height record. – Chain gage read thrice daily during high water and daily at other times.

Discharge record. – Stage-discharge relation defined by current-meter measurements. Ice effect prior to Apr. 23. Gage heights used to hundredths.

Maxima. – April-June 1950: Discharge, 95,500 second-feet 5:00 p.m. May 13 (gage height, 790.89 feet). 1912 to March 1950: Discharge, 51,800 second-feet Apr. 27, 1948 (gage height, 787.62 feet).

Remarks. – This station is one of the international gaging stations maintained by Canada under agreement with the United States. Records furnished by the Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,560	72,900	42,900	11	12,500	85,900	27,300	21	30,300	76,600	13,900
2	1,840	70,600	40,500	12	13,600	90,200	26,100	22	36,100	73,200	12,500
3	2,760	68,300	38,600	13	14,700	94,400	24,100	23	41,600	69,200	11,600
4	4,060	66,500	37,200	14	15,800	94,400	22,000	24	48,100	64,000	10,800
5	5,470	66,500	35,900	15	16,800	91,200	20,700	25	55,900	61,300	10,200
6	6,820	65,100	34,600	16	17,900	92,200	18,800	26	61,000	59,300	10,100
7	8,050	69,400	33,400	17	19,000	90,400	17,500	27	65,100	56,400	9,890
8	9,110	73,000	32,000	18	21,500	87,700	16,300	28	69,600	53,400	9,880
9	10,200	76,600	30,500	19	23,900	84,600	15,300	29	71,900	50,500	10,800
10	11,400	79,300	28,900	20	26,500	81,300	13,000	30	73,200	48,100	12,000
								31	-	45,000	-
Monthly mean discharge, in second-feet									26,500	72,800	22,200
Runoff, in thousand acre-feet									1,579	4,478	1,324
Runoff, in inches (computed on basis of net contributing area)									0.81	2.32	0.68

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	April 16			April 27			May 8			May 19	
8	770.03	17,700	8	788.94	64,500	8	789.57	72,600	8	790.40	85,700
*N	770.12	17,900	N	788.99	65,100	N	789.60	73,000	N	790.34	84,600
5	770.34	18,100	5	789.09	66,300	5	789.64	73,600	5	790.29	83,800
	April 17			April 28			May 9			May 20	
8	770.99	18,900	8	789.32	69,200	8	789.79	75,800	8	790.19	82,100
N	771.07	19,000	N	789.35	69,600	N	789.84	76,600	N	790.14	81,300
5	771.49	19,500	5	789.39	70,100	5	789.86	76,900	5	790.09	80,500
	April 18			April 29			May 10			May 21	
8	772.69	21,200	8	789.50	71,600	8	789.94	78,100	8	789.94	78,100
N	772.94	21,500	N	789.52	71,900	N	790.01	79,300	N	789.84	76,600
5	773.39	22,100	5	789.54	72,200	5	790.14	81,300	5	789.79	75,800
	April 19			April 30			May 11			May 22	
8	774.64	23,700	8	789.59	72,900	8	790.29	83,800	8	789.69	74,300
N	774.89	23,900	N	789.61	73,200	N	790.41	85,900	N	789.61	73,200
5	775.34	24,500	5	789.62	73,300	5	790.44	86,400	5	789.52	71,900
	April 20			May 1			May 12			May 23	
8	776.44	26,200	8	789.58	72,700	8	790.59	89,200	8	789.39	70,100
N	776.59	26,500	N	789.59	72,900	N	790.64	90,200	N	789.32	69,200
5	777.14	27,100	5	789.53	72,000	5	790.69	91,200	5	789.24	68,100
	April 21			May 2			May 13			May 24	
8	778.84	29,700	8	289.44	70,800	8	790.81	93,700	8	788.99	65,100
N	779.24	30,300	N	789.43	70,600	N	790.84	94,400	N	788.89	64,000
5	779.94	31,200	5	789.42	70,500	5	790.89	95,500	5	788.79	62,900
	April 22			May 3			May 14			May 25	
8	782.49	35,200	8	789.29	68,800	8	790.82	93,900	8	788.69	61,800
N	782.99	36,100	N	789.25	68,300	N	790.84	94,400	N	788.64	61,300
5	783.86	37,500	5	789.22	67,900	5	790.74	92,200	5	788.59	60,800
	April 23			May 4			May 15			May 26	
8	785.29	41,000	8	789.13	66,800	8	790.69	91,200	8	788.48	59,700
N	785.54	41,600	N	789.11	66,500	N	790.69	91,200	N	788.44	59,300
5	785.94	42,600	5	789.11	66,500	5	790.74	92,200	5	788.39	58,800
	April 24			May 5			May 16			May 27	
8	787.04	46,900	8	789.11	66,500	8	790.74	92,200	8	788.19	56,800
N	787.19	48,100	N	790.11	66,500	N	790.74	92,200	N	788.14	56,400
5	787.44	50,100	5	789.11	66,500	5	790.74	92,200	5	788.09	55,900
	April 25			May 6			May 17			May 28	
8	787.99	55,000	8	789.01	65,300	8	790.67	90,800	8	787.84	53,700
N	788.09	55,900	N	788.99	65,100	N	790.65	90,400	N	787.81	53,400
5	788.19	56,800	5	788.99	65,100	5	790.64	90,200	5	787.79	53,200
	April 26			May 7			May 18			May 29	
8	788.54	60,300	8	789.29	68,800	8	790.54	88,300	8	787.54	51,000
N	788.61	61,000	N	789.34	69,400	N	790.51	87,700	N	787.49	50,500
5	788.69	61,800	5	789.41	70,300	5	790.49	87,300	5	787.44	50,100

*All observations in this table shown as N readings, actually observed 11:30 a.m.

Red River of the North at Emerson, Manitoba-Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 30			June 2			June 5			June 8	
8	787.24	48,500	8	786.07	41,000	8	784.56	36,000	8	782.31	32,200
N*	787.19	48,100	N	785.99	40,500	N	784.49	35,900	N	782.20	32,000
5	787.09	47,300	5	785.89	40,000	5	784.27	35,400	5	781.94	31,700
	May 31			June 3			June 6			June 9	
8	786.84	45,500	8	785.62	38,900	8	783.94	34,800	8	781.29	30,700
N	786.77	45,000	N	785.54	38,600	N	783.84	34,600	N	781.12	30,500
5	786.69	44,500	5	785.46	38,300	5	783.64	34,300	5	780.84	30,100
	June 1			June 4			June 7			June 10	
8	786.49	43,300	8	785.16	37,400	8	783.14	33,500	8	780.14	29,200
N	786.42	42,900	N	785.09	37,200	N	783.12	33,400	N	779.94	28,900
5	786.34	42,400	5	784.94	36,800	5	782.94	33,100	5	779.69	28,600

*All observations in this table shown as N readings, actually observed 11:30 a.m.

Red River of the North at Letellier, Manitoba

Location. – Lat. 49°07'51", long. 97°15'16", Red River Lot 127 at Ferry, 2 miles east of Letellier. Datum Geodetic Survey of Canada, adjustment of 1950.
Gage-height record. – Staff gage during high water periods.
Maximum. – April-June, 1950: Elevation, 785.2 feet from floodmarks, date unknown.
Remarks. – Records furnished by Drainage Office, Manitoba Department of Public Works.

Elevation, in feet, 1950

Day	April		May		June		Day	April		May		June	
	8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.		8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.
1							16						
2							17						
3							18						
4							19	772.2	772.9				
5							20	773.8	774.6				
6							21	775.7	776.7				
7							22	778.2	779.5				
8							23	781.1	781.4				
9							24	782.2	782.7				
10							25	783.3	783.6				
11							26	783.9	784.2				
12							27						
13							28						
14							29						
15							30						
							31						

Red River of the North at St. Jean, Manitoba

Location. – Lat. 49°15'55", long. 97°20'16", Red River Lot 239, at highway bridge. Datum Geodetic Survey of Canada, adjustment of 1950.
Gage-height record. – Staff gage read during period of high flow.
Maximum. – April-June 1950: Elevation, 782.2 feet from floodmarks, date unknown.
Remarks. – Records furnished by Drainage Office, Manitoba Department of Public Works.

Elevation, in feet, 1950

Day	April		May		June		Day	April		May		June	
	8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.		8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.
1			779.8	779.8			16						
2			779.8				17						
3			780.0	780.1			18		767.6				
4			780.1	780.2			19	768.5	768.8				
5			780.25				20	769.3	769.5				
6			780.55	780.7	775.2		21	770.2	770.3				
7					774.4		22	770.9	771.4				
8					773.3		23	772.6	773.8				
9			781.05		772.0		24	774.6	774.6				
10					770.7		25	775.8	776.3				
11					769.4		26	776.8	777.2				
12					768.3		27	777.7	778.0				
13							28	778.2	778.6				
14							29	779.0	779.2				
15							30	779.4	779.5				
							31						

Red River of the North at Morris, Manitoba

Location. —Lat. 49°21'12", long. 97°20'57", in SE¼ sec. 2, T. 5, R. 2 E., at highway bridge. Datum Geodetic Survey of Canada, adjustment of 1950.
Gage-height record. —Staff gage read during periods of high flow.
Maxima. —April-June 1950: Elevation, 781.74 feet 8:00 a.m. May 14.
1948, date unknown (probably April 27-28), elevation, 776.3 feet from floodmarks.
Remarks. —Records furnished by Drainage Office, Manitoba Department of Public Works.

Elevation, in feet, 1950

Day	April		May		June		Day	April		May		June	
	8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.		8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.
1			777.2	777.5	778.09		16			781.62		760.7	
2			777.9	778.1	777.38		17	759.8	761.2	781.6		759.4	
3			778.4	778.6	776.8		18	764.7	766.3	781.27			
4			778.8	779.0	775.85		19	767.4	768.1	781.42			
5			779.2		774.9		20	768.3	768.4	781.32			
6			779.7		773.7		21	768.5	768.7	781.15			
7			780.34		772.3		22	769.2	769.5	781.0			
8			780.84		771.2		23	770.3	771.1	780.96			
9			781.21		769.8		24	771.9	772.2	780.79			
10			781.46		768.5		25	773.0	773.3	780.58			
11			781.58		767.1		26	773.8	774.2	780.25			
12			781.6		765.8		27	774.6	775.1	779.9			
13			781.66				28	774.9	775.3	779.57			
14			781.74		763.3		29	775.8	776.1	779.3			
15			781.7		762.1		30	776.6	776.9	779.01			
							31			778.51			

Red River of the North at Ste. Agathe, Manitoba

Location. - Lat. 49°33'50", long. 97°08'00", River Lot 567 at ferry. Datum Geodetic Survey of Canada, adjustment of 1950.
Gage-height record. - Staff gage, read during high water period.
Maximum. - April-June 1950: Elevation, 773.2 feet from floodmarks, date unknown.
Remarks. - Records furnished by Drainage Office, Manitoba Department of Public Works.

Elevation, in feet, 1950

Day	April		May		June		Day	April		May		June	
	8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.		8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.
1			768.6	768.7	770.2		16					753.4	
2			769.3	769.6	769.2		17						
3			770.1	770.2			18						
4			770.5				19		759.2				
5			770.9		766.35		20	760.2	760.7				
6			771.65		765.2	764.7	21	760.0	760.2				
7			772.19		764.1	763.6	22	760.7	760.31				
8			772.4		762.7	762.2	23	761.8	762.2				
9			772.75		761.6	761.1	24	762.31	763.4				
10					760.3	759.7	25	764.0	764.2				
11					759.2	758.6	26	764.6	764.7				
12					758.0		27	765.2	765.7				
13						756.4	28	766.1	766.8				
14					755.8	755.2	29	767.1	767.2				
15					754.6	754.0	30	767.7	768.1				
							31						

Red River of the North at St. Norbert, Manitoba

Location. – Lat. 49°46'20", long. 97°09'20", at highway bridge over mouth of Riviere Sale, 10½ miles upstream from southerly limits of City of Winnipeg. Datum Geodetic Survey of Canada, adjustment of 1950.
Gage-height record. – Staff gage, read during high water periods.
Maximum. – April-June, 1950: Elevation, 765.7 feet from floodmarks, date unknown.
Remarks. – Records furnished by Drainage Office, Manitoba Department of Public Works.

Elevation, in feet, 1950

Day	April		May		June		Day	April		May		June	
	8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.		8 a.m.	6 p.m.	8 a.m.	6 p.m.	8 a.m.	6 p.m.
1			758.5	758.7			16					746.2	745.6
2			759.4	759.4			17					745.1	
3			759.7	760.2			18						
4			760.4	760.9			19	749.1	749.15				
5			761.2	761.7			20	749.2	750.6				
6			762.2		757.4	756.9	21	751.3	752.3				
7			763.0	763.7	756.2	755.5	22	752.7	753.4				
8			764.0		754.2	753.7	23	753.7	754.3				
9			764.6		753.2	752.6	24	754.7	755.4				
10			765.1		752.1	751.6	25	755.7	755.6				
11			765.4		751.0	750.5	26	755.7	755.6				
12			765.6		750.1	749.6	27	755.7	756.2				
13					749.1	749.1	28	756.4	756.6				
14			756.6		748.1	747.6	29	757.4	757.5				
15			765.6		747.2	746.7	30	757.7	758.3				
							31						

Red River of the North at Winnipeg, Manitoba

Location. – Lat. 49°54'55", long. 97°07'30", at Redwood Bridge, Winnipeg, about 3½ miles below mouth of Assiniboine River. Datum Geodetic Survey of Canada, adjustment of 1929.
Drainage area. – 111,000 square miles. (Includes closed Devils Lake Basin.)
Gage-height record. – Chain gage read daily. From Apr. 24 by relation with City of Winnipeg gage at James Ave., 2 miles upstream.
Discharge record. – Stage-discharge relation defined by current-meter measurements. Ice effect prior to Apr. 24. Gage heights used to hundredths.
Maxima. – April-June 1950: Discharge, 103,600 second-feet May 18-19 (gage height, 755.86 feet). 1912 to March 1950: Estimated discharge, 79,900 second-feet Apr. 22, 1916 (gage height, 751.33 feet).
Remarks. – Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2,200	69,600	75,600	11	11,600	98,900	46,000	21	47,600	102,700	24,500
2	2,500	71,400	72,900	12	13,000	100,900	43,200	22	53,800	101,900	23,200
3	2,800	73,200	70,100	13	13,300	102,500	40,800	23	58,200	100,700	21,800
4	3,000	75,000	67,400	14	13,500	103,000	38,200	24	61,500	98,100	20,400
5	3,400	76,800	64,400	15	13,700	102,500	35,800	25	61,500	95,400	19,100
6	4,000	84,300	61,400	16	15,000	102,800	33,400	26	60,700	93,100	18,500
7	6,000	87,100	58,300	17	18,600	103,000	31,200	27	61,200	90,200	18,000
8	7,000	90,500	55,100	18	19,800	103,400	29,100	28	62,800	87,000	17,300
9	8,000	93,500	52,400	19	28,300	103,600	27,200	29	64,800	83,800	17,100
10	9,500	96,700	49,000	20	36,800	103,000	25,600	30	66,900	81,200	17,300
								31	-	78,500	-
Monthly mean discharge, in second-feet									27,700	92,100	39,100
Runoff, in thousand acre-feet									1,648	5,661	2,329
Runoff, in inches (computed on basis of net contributing area)									0.29	0.99	0.41

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	April 16			May 7			May 16			May 25	
5:20p	736.05	15,000	8	752.75	86,600	8	755.73	102,800	8	754.60	96,100
	April 17		N	752.84	87,100	N	755.73	102,800	N	754.50	95,600
8:50a	736.94	18,600	4	752.95	87,600	4	755.77	103,000	4	754.41	95,100
	April 18		12	753.14	88,600	12	755.77	103,000	12	754.31	94,600
8:55a	737.18	19,800		May 8			May 17			May 26	
	April 19		8	753.34	89,600	8	755.77	103,000	8	754.08	93,500
9:15a	739.47	28,300	N	753.53	90,500	N	755.77	103,000	N	754.04	93,100
	April 20		4	753.63	91,100	4	755.77	103,000	4	753.99	92,800
1:10p	741.55	36,800	12	753.82	92,000	12	755.82	103,300	12	753.80	91,900
	April 21			May 9			May 18			May 27	
8a	744.15	47,600	8	753.92	92,500	8	755.82	103,300	8	753.61	90,900
	April 22		N	754.02	93,000	N	755.82	103,300	N	753.47	90,200
10:45a	745.57	53,800	4	754.10	93,500	4	755.86	103,600	4	753.38	89,800
	April 23		12	754.40	95,000	12	755.86	103,600	12	753.19	88,900
2:45p	746.58	58,200		May 10			May 19			May 28	
	April 24		8	754.61	96,100	8	755.86	103,600	8	752.95	87,600
8a	747.28	61,500	N	754.71	96,600	N	755.86	103,600	N	752.86	87,200
	April 25		4	754.75	96,900	4	755.81	103,300	4	752.72	86,500
8a	747.28	61,500	12	754.85	97,500	12	755.81	103,300	12	752.49	85,500
	April 26			May 11			May 20			May 29	
8a	747.08	60,700	8	755.00	98,300	8	755.77	103,000	8	752.31	84,600
	April 27		N	755.10	98,900	N	755.77	103,000	N	752.12	83,700
8a	747.19	61,200	4	755.10	98,900	4	755.77	103,000	4	752.02	83,200
	April 28		12	755.29	100,000	12	755.77	103,000	12	751.93	82,700
8a	747.58	62,800		May 12			May 21			May 30	
	April 29		8	755.38	100,600	8	755.77	103,000	8	751.74	81,800
8a	748.06	64,800	N	755.38	100,600	N	755.77	103,000	N	751.60	81,200
	April 30		4	755.48	101,200	4	755.72	102,700	4	751.50	80,700
8a	748.55	66,900	12	755.58	101,900	12	755.72	102,700	12	751.36	80,000
	May 1			May 13			May 22			May 31	
8a	749.14	69,600	8	755.63	102,200	8	755.63	102,200	8	751.08	78,700
	May 2		N	755.68	102,500	N	755.63	102,200	N	751.04	78,500
8a	749.53	71,400	4	755.73	102,800	4	755.58	101,900	4	750.99	78,300
	May 3		12	755.77	103,000	12	755.53	101,500	12	750.80	77,300
8a	749.92	73,200		May 14			May 23			June 1	
	May 4		8	755.77	103,000	8	755.44	100,900	8	750.62	76,400
8a	750.31	75,000	N	755.77	103,000	N	755.40	100,700	N	750.43	75,500
	May 5		4	755.77	103,000	4	755.35	100,400	4	750.38	75,300
8a	750.70	76,800	12	755.68	102,500	12	755.21	99,600	12	750.15	74,300
	May 6			May 15			May 24			June 2	
8	752.07	83,400	8	755.68	102,500	8	755.02	98,400	8	749.96	73,400
N	752.07	83,400	N	755.68	102,500	N	754.97	98,100	N	749.86	72,900
4	752.29	84,500	4	755.68	102,500	4	754.92	97,800	4	749.77	72,500
12	752.55	85,800	12	755.73	102,800	12	754.74	96,800	12	749.58	71,600

Red River of the North at Winnipeg, Manitoba - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 3			June 5			June 7			June 9	
8	749.34	70,600	8	748.08	64,900	8	746.59	58,700	8	745.09	52,600
N	749.30	70,400	N	747.99	64,600	N	746.49	58,300	N	745.00	52,200
4	749.16	69,700	4	747.90	64,200	4	746.40	57,900	4	745.00	52,200
12	749.02	69,100	12	747.62	63,000	12	746.12	56,800	12	744.62	50,700
	June 4			June 6			June 8			June 10	
8	748.74	67,800	8	747.34	61,800	8	745.84	55,700	8	744.34	49,600
N	748.65	67,400	N	747.24	61,400	N	745.75	55,300	N	744.25	49,200
4	748.56	67,000	4	747.15	61,000	4	745.65	54,900	4	744.06	48,400
12	748.37	66,200	12	746.87	59,900	12	745.37	53,800	12	743.87	47,700

Red River of the North at Lockport, Manitoba

Location.—Lat. 50°05', long. 96°54'20", just above St. Andrews Lock and Dam. Datum Geodetic Survey of Canada, adjustment of 1929.
Gage-height record.—Staff gage read daily at 8:00 a.m.
Maxima.—April-June, 1950: Elevation, 734.9 feet May 18.
May 1, 1948, elevation, 730.1 feet.
Remarks.—Ice conditions prior to April 24, 1950. Records furnished by Department of Public Works, Canada.

Elevation, in feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	721.4	729.9	731.0	11	723.2	734.4	726.7	21	729.2	734.7	
2	721.5	730.2	730.6	12	723.3	734.5	726.8	22	729.1	734.6	
3	721.6	730.5	730.2	13	723.7	734.8	726.5	23	729.2	734.6	
4	721.8	730.8	729.6	14	723.8	734.8	726.2	24	729.4	734.4	
5	721.9	731.2	729.2	15	724.0	734.7	725.9	25	729.4	734.0	
6	722.1	732.3	728.8	16	724.1	734.7	725.6	26	729.3	733.7	
7	722.0	-	728.1	17	724.6	734.8	725.4	27	729.4	733.2	
8	722.5	733.1	727.6	18	725.6	734.9		28	729.6	732.7	
9	722.8	733.6	727.2	19	726.8	734.8		29	729.8	732.2	
10	723.0	734.1	726.7	20	728.2	734.7		30	-	731.8	
								31	-	731.4	
Monthly mean discharge, in second-feet											
Runoff, in acre-feet											
Runoff, in inches											

Pelican River Basin

Pelican River near Detroit Lakes, Minn.

Location.—Lat. 46°43'26", long. 95°54'56", in NE¼SW¼ sec. 31, T. 138 N., R. 41 W., at highway crossing at Buck's Mill, 200 feet downstream from concrete millpond dam, and 6½ miles southwest of city of Detroit Lakes.
Drainage area.—123 square miles.
Gage-height record.—Once or twice-daily staff gage readings except for periods Apr. 20, 22, May 17, 19, which are from graphs based on gage readings and for periods Apr. 5-19, May 20-29, June 1, when no readings were obtained.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 140 second-feet and extended to peak stage by logarithmic plotting. Discharge for periods of no gage-height record estimated. Gage heights used to hundredths. Shifting-control method used May 30 to July 5.
Maxima.—April-June 1950: Discharge, 210 second-feet about 3 p.m. May 19 (gage height, 5.10 feet, from floodmark).
1942 to March 1950: Discharge observed, 139 second-feet July 18, 1946 (gage height, 4.04 feet).
Remarks.—Flow regulated by ponds and lakes above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0.6	116	179	11	166	164	141	21	98	190	115
2	.9	118	182	12	166	169	151	22	100	190	109
3	.9	133	178	13	166	162	150	23	99	190	105
4	.9	135	171	14	166	156	147	24	100	190	103
5	125	146	165	15	166	157	150	25	101	190	101
6	125	147	164	16	190	158	147	26	103	190	92
7	125	155	163	17	190	169	142	27	105	190	88
8	125	148	153	18	190	170	133	28	110	190	86
9	125	152	139	19	190	186	131	29	111	190	82
10	125	160	136	20	141	190	125	30	114	188	80
								31	-	182	-
Monthly mean discharge, in second-feet									118	167	134
Runoff, in acre-feet									6,990	10,260	7,950
Runoff, in inches									1.06	1.56	1.21

Pelican River near Fergus Falls, Minn.

Location.—Lat. 46°20'10", long. 96°07'00", in NE¼ sec. 17, T. 133 N., R. 43 W., on highway bridge, 3 miles northwest of Fergus Falls, and 7½ miles upstream from mouth.
Drainage area.—482 square miles.
Gage-height record.—Staff gage read twice daily.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Apr. 1-17. Shifting-control method used Apr. 18 to May 9, May 22 to June 30. Gage heights used to hundredths.
Maxima.—April-June 1950: Discharge, 296 second-feet 5:30 p.m. May 6; gage height observed, 5.46 feet 8:30 a.m. Apr. 11.
1909-12, 1942 to March 1950: Discharge observed, 756 second-feet Mar. 29, 1943; gage height observed, 5.60 feet 8:30 a.m. Mar. 28, 1950.
Remarks.—Flow regulated by lakes above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	85	172	240	11	160	260	202	21	129	290	187
2	85	188	232	12	180	262	204	22	127	284	185
3	75	192	228	13	190	252	200	23	119	278	183
4	75	196	218	14	200	270	198	24	126	276	181
5	70	216	212	15	220	242	194	25	132	266	175
6	70	220	208	16	240	236	192	26	139	260	177
7	80	254	202	17	220	240	187	27	156	258	174
8	95	268	196	18	185	250	187	28	165	252	172
9	120	278	208	19	158	264	190	29	156	244	147
10	140	272	224	20	136	278	188	30	165	246	155
								31	-	242	-
Monthly mean discharge, in second-feet									140	249	195
Runoff, in acre-feet									8,330	15,280	11,600
Runoff, in inches									0.32	0.59	0.45

Bois de Sioux River Basin

Lake Traverse near White Rock, S. Dak.

Location.—Lat. 45°51'45", long. 96°34'25", in SW¼SW¼ sec. 27, T. 128 N., R. 47 W., at White Rock Dam at outlet of Mud Lake, 4 miles south of White Rock, and 5 miles northwest of Wheaton, Minn.
Maxima.—March-September 1950: Contents, 200,576 acre-feet May 30.
1940 to February 1950: Contents observed, 212,000 acre-feet Apr. 21, 1943.
Remarks.—Figures of contents represent combined storage in Lake Traverse and Mud Lake. During periods of low stages the two lakes are separated by a stop log barrier in spillway of dam at outlet of Lake Traverse; during high stages stop logs are removed. Storage began in May 1942. Available capacity for flood control, 137,000 acre-feet. Record of contents furnished by Corps of Engineers.

Daily contents, in acre-feet, 1950

Day	March	April	May	June	July	August	September
1	104,806	124,056	163,258	199,726	159,172	139,146	117,738
2	104,786	127,206	163,982	198,546	157,310	137,052	117,440
3	104,766	130,536	165,866	197,234	155,892	134,978	117,142
4	104,746	133,446	167,132	195,806	153,892	132,954	116,844
5	104,726	135,080	168,998	194,362	151,888	130,980	116,544
6	104,700	136,150	172,618	192,832	149,752	130,444	116,244
7	105,160	137,220	175,478	191,234	147,604	130,618	115,946
8	105,320	137,958	180,818	189,872	151,074	129,162	115,646
9	105,300	138,728	183,718	188,236	158,736	127,506	115,446
10	105,280	140,270	186,818	186,498	161,216	126,000	115,578
11	105,260	140,810	189,678	184,750	163,556	124,764	115,612
12	105,240	141,152	191,333	132,988	165,655	123,878	115,448
13	105,220	141,462	192,300	184,348	166,606	123,442	115,286
14	105,200	141,916	192,788	184,358	168,196	122,806	115,126
15	105,180	142,558	193,138	184,490	169,400	122,068	114,966
16	105,160	144,022	193,904	184,522	169,602	121,328	114,818
17	105,140	146,332	194,732	183,594	168,526	120,788	114,668
18	105,120	149,112	195,708	181,982	166,778	120,446	114,728
19	105,100	151,502	197,296	180,186	164,902	120,204	114,582
20	105,080	153,332	198,764	178,196	162,936	119,980	114,434
21	105,060	154,726	199,314	176,092	161,116	119,774	114,286
22	105,040	155,878	199,592	174,000	159,098	119,608	114,138
23	105,220	156,876	199,316	174,752	156,960	119,450	113,988
24	106,010	157,950	200,008	172,900	154,832	119,292	113,840
25	106,784	159,498	200,168	171,022	152,704	119,134	113,690
26	108,264	160,682	200,288	169,138	150,686	118,986	113,540
27	110,544	161,134	200,400	167,110	148,586	118,838	113,392
28	113,424	161,622	200,480	165,178	146,506	118,690	113,242
29	115,800	162,448	200,544	163,126	144,446	118,542	113,092
30	118,266	163,082	200,576	161,072	142,456	118,304	113,344
31	120,826	-	200,526	-	140,696	118,026	-
Monthly change in contents	+16,000	+42,256	+37,444	-39,454	-20,376	-22,670	-4,682

Bois de Sioux River near White Rock, S. Dak.

Location.—Lat. 45°51'45", long. 96°34'25", in SW¼SW¼ sec. 27, T. 128 N., R. 47 W., just downstream from Big Slough outlet, 300 feet downstream from White Rock Dam, 4 miles south of White Rock, and 5 miles northwest of Wheaton, Minn. Datum of gage is 959.89 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Drainage area.—1,160 square miles.

Gage-height record.—Water-stage recorder graph except for periods 12:01 a.m.-10 a.m. Mar. 22, 5 p.m. Mar. 26 to 8 a.m. Mar. 27, 10 p.m. Mar. 28 to 8 a.m. Mar. 29, 10 a.m.-12 m. Apr. 5, for which graphs were drawn on basis of record before and after periods Mar. 6, 11, from staff gage readings, and Mar. 1-5, 7-10, 12-21, when no record was obtained.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 640 second-feet and extended to peak stage. Stage-discharge relation affected by ice Mar. 5-11, Mar. 22 to Apr. 20. Discharge for period of no gage-height record computed on basis of weather records and observer's notes. Gage heights used to hundredths.

Maxima.—May-Aug. 1950: Discharge, 1,060 second-feet at 6:30 p.m. July 8 (gage height, 9.16 feet). 1941 to Apr. 1950: Discharge observed, 1,120 second-feet May 24, 1943; gage height, 9.28 feet June 23, 1944.

Remarks.—Flow, except for small inflow from Big Slough, regulated by Lake Traverse-Bois de Sioux Flood Control and Water Conservation Project. Available capacity for flood control, 137,000 acre-feet.

Mean discharge, in second-feet, 1950

Day	May	June	July	August	Day	May	June	July	August
1	3.4	279	760	855	16	7.5	63	620	267
2	6.6	463	750	870	17	8.4	325	832	207
3	16	506	782	858	18	7.5	718	878	100
4	13	561	802	835	19	16	765	868	48
5	18	588	835	800	20	31	805	862	36
6	39	627	911	775	21	17	788	855	16
7	27	586	945	762	22	12	755	875	1.9
8	24	618	863	738	23	11	745	895	.9
9	93	664	305	705	24	9.3	735	888	.6
10	46	661	146	576	25	8.4	732	882	.6
11	17	661	268	449	26	7.1	760	875	.4
12	14	548	501	345	27	6.2	752	868	.4
13	12	92	431	272	28	5.8	790	860	.4
14	10	55	106	271	29	5.8	788	850	.3
15	8.0	56	282	271	30	5.8	768	745	40
					31	45	-	762	60
Monthly mean discharge, in second-feet						17.8	575	713	328
Runoff, in acre-feet						1,090	34,220	43,840	20,160
Runoff, in inches						0.02	0.55	0.71	0.33

Mustinka River Basin

Mustinka River above Wheaton, Minn.

Location.—Lat. 45°49', long. 96°29', on line between secs. 7 and 8, T. 127 N., R. 46 W., 1 mile upstream from Chicago, Milwaukee, St. Paul & Pacific Railroad bridge, 1½ miles northeast of Wheaton, and 8 miles upstream from mouth. Datum of gage is 977.30 feet above mean sea level, datum of 1929 (levels by Minnesota Highway Dept.).

Drainage area.—834 square miles.

Gage-height record.—Graph drawn on basis of twice-daily wire-weight gage readings Mar. 24-31, Apr. 4-9, 15-19, May 2-12, and average daily gage heights for all other periods except Apr. 2, which was based on one reading.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 21 to Apr. 4, Apr. 8-15. Gage heights used to hundredths.

Maxima.—March-June 1950: Discharge, 1,690 second-feet 7:30 a.m. May 11; gage height, 13.82 feet 6 p.m. Mar. 30 (backwater from ice).

1917, 1919-24, 1931 to February 1950: Discharge observed, 2,710 second-feet Apr. 13, 1947 (gage height, 14.68 feet).

Flood of late March or early April 1916 reached a stage of 17.4 feet, former datum (discharge, 2,980 second-feet).

Remarks.—No regulation. During high stages some flow diverts into Rabbit Creek Basin.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	1,200	171	95	16	.0	647	239	259
2	0	1,400	250	95	17	0	990	223	180
3	0	1,400	428	80	18	0	1,060	233	148
4	0	1,200	584	73	19	0	955	220	69
5	0	699	589	66	20	0	760	306	48
6	0	494	797	60	21	0	542	272	34
7	0	482	1,090	53	22	0.2	419	231	26
8	0	260	1,170	43	23	2.4	307	201	40
9	0	120	1,330	38	24	6.5	241	178	30
10	0	100	1,630	36	25	24	219	162	17
11	0	120	1,540	32	26	100	192	150	12
12	0	110	860	28	27	140	176	139	8.3
13	0	110	537	164	28	170	162	126	7.0
14	0	130	340	221	29	180	165	119	5.9
15	0	130	265	259	30	550	163	109	3.6
					31	950	-	104	-
Monthly mean discharge, in second-feet						68.5	498	471	74.4
Runoff, in acre-feet						4,210	29,660	28,940	4,420
Runoff, in inches						0.09	0.67	0.65	0.10

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 24			Mar. 30 (cont'd.)			Apr. 8 (cont'd.)			May 3 (cont'd.)	
4	5.62		6	13.82		4	5.58		4	7.05	450
8	5.67		12	13.76		8	5.27		12	7.85	548
N	6.15			Mar. 31		12	4.96			May 4	
4	6.82		8	13.60			Apr. 9		6	8.22	596
8	7.12		4	13.35		6	4.52		N	8.28	603
12	7.10		12	12.95		N	4.27		6	8.14	585
	Mar. 25			Apr. 4		6	4.20		12	7.87	550
4	6.91		6	11.97		12	4.15			May 5	
8	7.08		N	11.76			Apr. 15		4	7.73	532
N	7.37		6	11.60		6	4.90		8	7.69	527
4	7.56		12	11.10		N	5.12		N	7.90	554
8	7.62			Apr. 5		6	5.46		4	8.32	609
12	7.42		2	9.40	780	12	6.30		8	8.85	684
	Mar. 26		4	8.79	676		Apr. 16		12	9.01	710
4	7.05		6	8.81	678	4	7.15	462		May 6	
8	6.99		8	8.89	690	8	7.92	557	6	9.07	719
N	7.23		10	8.95	700	N	8.65	655	N	9.26	753
4	7.68		N	8.98	705	4	9.25	751	6	9.90	880
8	8.35		2	8.93	697	8	9.67	834	12	10.22	960
12	9.20		4	8.83	682	12	9.92	885		May 7	
	Mar. 27		6	8.65	655		Apr. 17		6	10.40	1,000
6	9.80		8	8.49	633	6	10.22	960	N	10.75	1,100
N	10.00		10	8.28	603	N	10.40	1,000	6	11.02	1,180
6	10.14		12	8.00	567	6	10.51	1,030	12	10.99	1,170
12	10.27			Apr. 6		12	10.61	1,060		May 8	
	Mar. 28		4	7.55	510		Apr. 18		8	10.82	1,120
6	10.31		8	7.32	482	8	10.74	1,090	4	11.05	1,180
N	10.66		N	7.28	478	4	10.61	1,060	12	11.24	1,240
6	11.75		4	7.29	479	12	10.40	1,000		May 9	
12	11.90		8	7.35	486		Apr. 19		6	11.16	1,220
	Mar. 29		12	7.38	490	8	10.28	975	N	11.40	1,290
6	12.01			Apr. 7		4	10.16	945	6	11.85	1,420
N	12.47		8	7.34	485	12	9.95	892	12	12.25	1,540
6	13.21		4	7.33	484		May 2			May 10	
12	13.48		12	7.15	462	8	4.61	186	8	12.54	1,630
	Mar. 30			Apr. 8		4	5.70	300	4	12.65	1,660
6	13.57		4	6.70		12	6.16	351	12	12.70	1,680
N	13.70		8	6.28			May 3				
			N	5.92		8	6.46	384			

Mustinka River above Wheaton, Minn.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 11			May 11 (cont'd.)			May 12			May 12 (cont'd.)	
4	12.72	1,690	4	11.96	1,460	6	10.69	1,000	6	8.73	662
8	12.73	1,690	8	11.55	1,340	N	10.00	870	12	8.22	591
N	12.43	1,600	12	11.18	1,220						

Supplemental record. - May 4, 10 a.m., 8.30 ft., 606 sec.-ft.; May 11, 7:30 a.m., 12.74 ft., 1,690 sec.-ft.

West Branch Mustinka River below Mustinka ditch near Charlesville, Minn.

Location.—Lat. 45°53'30", long. 96°21'40", on line between secs. 18 and 19, T. 128 N., R. 45 W., at highway bridge, 40 feet downstream from Mustinka ditch, 1-3/4 miles upstream from mouth, and 6 miles southwest of Charlesville. Datum of gage is 990.00 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Gage-height record.—Graph drawn on basis of twice-daily staff gage readings Mar. 25 to Apr. 6, Apr. 13-19, May 2-10, June 13, 17, and average daily gage heights for all other periods.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 15 to Apr. 13, and by shifting control Apr. 17, 18. Gage heights used to hundredths.

Maxima.—March-May 1950: Discharge, 1,140 second-feet at 7:25 a.m. Mar. 28 (gage height, 10.51 feet, backwater from ice).

1943 to February 1950: Daily discharge, 1,500 second-feet Apr. 12, 1947; gage height, 13.57 feet (from floodmark) sometime during Apr. 1-5, 1943.

Remarks.—Flow is diverted to Mustinka ditch at stages above 1.6 feet to relieve flood conditions in West Branch Mustinka River Basin. Gage readings furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	0	750	173	11	0	85	539	21	.4	340	209
2	0	800	212	12	0	60	384	22	.8	268	192
3	0	600	382	13	0	80	291	23	2.8	232	178
4	0	400	389	14	0	199	238	24	8.0	207	160
5	0	280	401	15	0	532	215	25	48	207	154
6	0	220	720	16	0	723	199	26	300	198	150
7	0	220	745	17	0	800	192	27	850	164	140
8	0	200	725	18	0	700	195	28	1,100	170	116
9	0	120	1,060	19	0	596	206	29	800	168	108
10	0	100	848	20	0	461	215	30	700	166	99
								31	750	-	87
Monthly mean discharge, in second-feet									147	335	320
Runoff, in acre-feet									9,040	19,930	19,680
Runoff, in inches									-	-	-

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 25			Mar. 31			Apr. 15			May 4	
6	3.14		6	8.56		4	5.80		8	5.64	103
N	3.41		N	8.71		8	6.21		4	5.41	92
6	4.25		6	9.04		N	6.61		12	5.30	86
12	4.56		12	8.96		4	6.92			May 5	
	Mar. 26			Apr. 1		8	7.17		8	5.45	94
4	4.77		8	8.72		12	7.18		4	5.52	97
8	5.09		4	8.96			Apr. 16		12	6.40	145
N	5.76		12	9.07		4	7.12			May 6	
4	6.83			Apr. 2		8	7.22		6	7.53	213
8	7.60		8	9.11		N	7.61		N	7.82	233
12	8.24		4	9.13		4	7.96		6	7.89	238
	Mar. 27		12	8.82		8	8.16		12	7.94	242
4	8.13			Apr. 3		12	8.16			May 7	
8	9.08		8	8.17			Apr. 17		6	7.96	243
N	9.28		4	7.71		8	7.92		N	7.92	240
4	9.57		12	7.26		4	7.64		6	7.61	219
8	9.87			Apr. 4		12	7.37		12	7.07	185
12	10.14		6	6.77			Apr. 18			May 8	
	Mar. 28		N	6.36		8	7.20	193	4	6.88	174
4	10.41		6	6.35		4	7.08	186	8	6.87	173
8	10.51		12	6.15		12	7.16	191	N	7.31	200
N	10.24			Apr. 13			Apr. 19		4	8.08	252
4	10.04		4	2.13		8	7.07	185	8	8.51	286
8	10.02		8	2.25		4	6.83	171	12	8.87	322
12	9.77		N	2.89		12	6.54	153		May 9	
	Mar. 29		4	3.32			May 2		6	9.19	359
6	9.17		8	3.50		8	3.98	28	N	9.31	374
N	8.91		12	3.33		4	4.00	29	6	9.26	368
6	8.78			Apr. 14		12	4.45	47	12	9.04	341
12	8.51		4	3.27			May 3			May 10	
	Mar. 30		8	3.45		6	5.21	82	8	8.57	291
6	8.34		N	3.71		N	5.66	104	4	7.97	244
N	8.45		4	4.02		6	5.85	114	12	7.36	203
6	8.68		8	4.55		12	5.80	111			
12	8.67		12	5.30							

Supplemental record.- Apr. 16, 10 p.m., 8.18 ft.

Mustinka ditch above West Branch Mustinka River near Charlesville, Minn.

Location. – Lat. 45°53'30", long. 96°21'30", in NE¼NE¼ sec. 19, T. 128 N., R. 45 W., 0.2 mile upstream from West Branch Mustinka River, and 6 miles southwest of Charlesville. Datum of gage is 990.00 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Gage-height record. – Graph drawn on basis of twice-daily staff gage readings Mar. 26 to Apr. 21, May 3-12, and average of daily readings for all other periods except Mar. 1-25, when no readings were obtained.

Discharge record. – Stage-discharge relation defined by current-meter measurements below 260 second-feet and extended to peak stage. Stage-discharge relation affected by ice Mar. 26 to Apr. 16; affected by shifting control Apr. 17 to June 30. Discharge estimated for period of no gage-height record.

Maxima. – March-May 1950: Discharge, 440 second-feet 8 a.m.-4 p.m. May 9; gage height, 11.10 feet 6:00-6:20 p.m. Mar. 30 (backwater from ice).

1943 to February 1950: Discharge, 422 second-feet July 10, 1949; gage height, 12.13 feet Apr. 11, 1947.

Remarks. – Flow is diversion of Mustinka River. Gage readings furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	0	130	110	11	0	20	220	21	0	160	120
2	0	120	130	12	0	11	180	22	0	140	120
3	0	120	180	13	0	18	140	23	5	130	110
4	0	120	180	14	0	120	130	24	10	130	100
5	0	100	180	15	0	190	130	25	15	120	90
6	0	90	260	16	0	260	120	26	20	120	85
7	0	70	300	17	0	280	120	27	80	110	80
8	0	55	240	18	0	240	120	28	150	110	75
9	0	40	420	19	0	220	130	29	140	100	75
10	0	30	340	20	0	180	120	30	140	100	70
								31	130	-	65
Monthly mean discharge, in second-feet									22.3	121	153
Runoff, in acre-feet									1,370	7,210	9,400
Runoff, in inches									-	-	-

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 26			Apr. 3			Apr. 12			May 3	
6	7.33		6	8.53		6	3.70		8	6.49	170
N	8.98		N	8.34		N	3.64		4	6.84	190
6	9.94		6	8.46		6	3.65		12	6.78	190
12	10.22		12	8.03		12	3.70			May 4	
	Mar. 27			Apr. 4			Apr. 13		8	6.60	180
6	10.39		6	6.88		6	3.73		4	6.42	170
N	10.50		N	6.73		N	4.68		12	6.37	170
6	10.60		6	7.08		6	5.89			May 5	
12	10.73		12	6.72		12	6.13		6	6.45	170
	Mar. 28			Apr. 5			Apr. 14		N	6.63	180
6	10.88		6	5.20		6	6.11		6	6.72	180
N	11.02		N	5.62		N	6.04		12	7.18	200
6	11.07		6	6.34		6	5.98			May 6	
12	10.96		12	5.61		12	6.48		6	7.80	240
	Mar. 29			Apr. 6			Apr. 15		N	8.29	280
4	10.62		6	5.05		6	7.05		6	8.64	300
8	10.24		N	5.38		N	7.70		12	8.85	320
N	10.36		6	6.24		6	8.46			May 7	
4	10.62		12	5.95		12	8.69		4	8.93	320
8	10.80			Apr. 7			Apr. 16		8	8.96	320
12	10.78		6	5.44		8	8.50		N	8.88	320
	Mar. 30		N	5.46		4	8.98		4	8.72	300
6	10.60		6	6.06		12	9.28		8	8.43	280
N	10.75		12	5.23			Apr. 17		12	7.86	240
6	11.10			Apr. 8		8	8.88	280		May 8	
12	10.98		6	4.58		4	8.64	260	2	7.50	220
	Mar. 31		N	4.66		12	8.38	260	4	7.20	200
6	10.46		6	4.78			Apr. 18		6	6.98	200
N	10.18		12	4.48		8	8.09	240	8	6.81	190
6	10.32			Apr. 9		4	8.10	240	10	6.77	190
12	9.98		6	3.98		12	8.14	240	N	6.95	200
	Apr. 1		N	3.78			Apr. 19		2	7.48	220
4	9.34		6	3.97		6	8.04	240	4	8.01	260
8	9.14		12	4.15		N	7.93	220	6	8.42	280
N	9.52			Apr. 10		6	7.83	220	8	9.08	320
4	10.04		8	4.24		12	7.43	200	10	9.52	360
8	10.26		4	4.20			Apr. 20		12	9.88	400
12	10.37		12	4.16		6	6.99	180		May 9	
	Apr. 2			Apr. 11		N	7.04	180	4	10.23	420
4	10.39		4	4.09		6	7.06	180	8	10.38	440
8	10.32		8	3.98		12	6.87	170	N	10.39	440
N	10.23		12	3.81			Apr. 21		4	10.33	440
4	9.91					8	6.41	160	8	10.24	420
8	9.53					4	6.24	150	12	10.09	420
12	9.04					12	6.10	150			

Supplemental record. - Apr. 16, 10 p.m., 9.32 ft.

Mustinka ditch below West Branch Mustinka River near Charlesville, Minn.

Location.—Lat. 45°53'30", long. 96°21'40", on line between secs. 18 and 19, T. 128 N., R. 45 W., at highway bridge over West Branch Mustinka River, 40 feet downstream from inlet to Mustinka ditch, and 6 miles southwest of Charlesville. Datum of gage is 990.00 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Gage-height record.—Graph drawn on basis of twice-daily staff gage readings Mar. 25 to Apr. 6, Apr. 13-19, May 2-10, June 13, 17, and average daily gage heights for all other periods.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 15 to Apr. 17. Gage heights used to hundredths.

Maxima.—March-May 1950: Discharge, 374 second-feet 12 m.-4 p.m. May 9; gage height, 10.51 feet 7:25 a.m. Mar. 28 (backwater from ice).

1943 to February 1950: Daily discharge, 580 second-feet Apr. 12, 1947; gage height, 13.57 feet, during period Apr. 1-5, 1943, from floodmark.

Remarks.—Flow is diverted to Mustinka ditch at stages above 1.6 feet, to relieve flood conditions in West Branch Mustinka River Basin. Gage readings furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	0	90	19	11	0	3.8	155	21	0	78	30
2	0	75	31	12	0	1.9	96	22	.3	51	24
3	0	60	95	13	0	.4	60	23	.8	38	20
4	0	40	98	14	0	19	40	24	1.8	29	16
5	0	34	102	15	0	140	31	25	2.6	29	14
6	0	28	219	16	0	200	26	26	30	26	14
7	0	22	229	17	0	220	24	27	80	17	11
8	0	16	223	18	0	192	25	28	140	18	7
9	0	11	358	19	0	176	28	29	130	18	5.8
10	0	7	269	20	0	125	31	30	120	17	4.3
								31	110	-	2.8
Monthly mean discharge, in second-feet									19.8	60	74.4
Runoff, in acre-feet									1,222	3,568	4,578
Runoff, in inches									-	-	-

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 25			Mar. 31			Apr. 15			Apr. 4	
6	3.14		6	8.56		4	5.80	425	8	5.64	403
N	3.41		N	8.71		8	6.21	484	4	5.41	373
6	4.25		6	9.04		N	6.61	546	12	5.30	359
12	4.56		12	8.96		4	6.92	596		Apr. 5	
	Mar. 26			Apr. 1		8	7.17	639	8	5.45	378
4	4.77		8	8.72		12	7.18	641	4	5.52	388
8	5.09		4	8.96			Apr. 16		12	6.40	512
N	5.76		12	9.07		4	7.12	630		May 6	
4	6.83			Apr. 2		8	7.22	648	6	7.53	703
8	7.60		8	9.11		N	7.61	718	N	7.82	758
12	8.24		4	9.13		4	7.96	785	6	7.89	771
	Mar. 27		12	8.82		8	8.16	825	12	7.94	781
4	8.73			Apr. 3		12	8.16	825		May 7	
8	9.08		8	8.17			Apr. 17		6	7.96	785
N	9.28		4	7.71		8	7.92		N	7.92	777
4	9.57		12	7.26		4	7.64		6	7.61	718
8	9.87			Apr. 4		12	7.37		12	7.07	622
12	10.14		6	6.77			Apr. 18			May 8	
	Mar. 28		N	6.36		8	7.20		4	6.88	590
4	10.41		6	6.35		4	7.08		8	6.87	588
8	10.51		12	6.15		12	7.16		N	7.31	664
N	10.24			Apr. 13			Apr. 19		4	8.08	809
4	10.04		4	2.13		8	7.07	622	8	8.51	898
8	10.02		8	2.25		4	6.83	581	12	8.87	979
12	9.77		N	2.89		12	6.54	534		May 9	
	Mar. 29		4	3.32			May 2		6	9.19	1,060
6	9.17		8	3.50		8	3.98	206	N	9.31	1,090
N	8.91		12	3.33		4	4.00	208	6	9.26	1,080
6	8.78			Apr. 14		12	4.45	258	12	9.04	1,020
12	8.51		4	3.27	134		May 3			May 10	
	Mar. 30		8	3.45	152	6	5.21	347	8	8.57	911
6	8.34		N	3.71	178	N	5.66	406	4	7.97	787
N	8.45		4	4.02	210	6	5.85	432	12	7.36	673
6	8.68		8	4.55	268	12	5.80	425			
12	8.67		12	5.30	359						

Supplemental record.- Apr. 16, 10 p.m., 8.18 ft., 829 sec.-ft.

Rabbit Creek Basin

Rabbit Creek at Campbell, Minn.

Location.—Lat. 46°05'40", long. 96°24'40", in sec. 1, T. 130 N., R. 46 W., at highway bridge in Campbell, three-quarters of a mile downstream from an unnamed tributary, and 10 miles upstream from mouth.

Drainage area.—266 square miles.

Gage-height record.—Graph drawn on basis of once-daily wire-weight gage readings Mar. 31 to Apr. 5, Apr. 7-11, 13-15, 18-24, 26, May 3, 5-10, and daily gage readings for all other periods except those of no gage-height record.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 22, Mar. 31 to Apr. 5, Apr. 7-11, 13-16. Discharge for periods of no gage-height record interpolated or computed on basis of adjacent days, weather records, and records for Mustinka River above Wheaton. Gage heights used to hundredths.

Maxima.—March-May 1950: Discharge, 1,430 second-feet 8 a.m. May 9; gage height, 11.40 ft. 7:15 a.m. Apr. 1 (backwater from ice).

1942 to February 1950: Discharge observed, 1,860 second-feet June 4, 1944; gage height, 15.07 ft. Apr. 2, 1943, from floodmark (backwater from ice).

Remarks.—No regulation. During high stages some flow enters Rabbit Creek Basin from Mustinka River. Gage readings furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	0	550	50	11	.2	24	580	21	.4	99	71
2	0	650	200	12	.1	16	462	22	1.1	78	44
3	0	600	512	13	0	11	257	23	3.5	52	58
4	.1	550	450	14	0	20	172	24	7.5	25	44
5	1.0	550	428	15	0	90	130	25	15	13	22
6	4.0	460	644	16	0	160	90	26	35	10	30
7	3.0	380	857	17	0	198	99	27	75	8	41
8	1.5	240	1,050	18	0	171	71	28	90	12	35
9	.5	120	1,300	19	0	131	62	29	105	13	24
10	.2	70	780	20	.1	112	67	30	150	15	17
								31	300	-	8
Monthly mean discharge, in second-feet									25.6	181	279
Runoff, in acre-feet									1,570	10,770	17,170
Runoff, in inches									0.11	0.76	1.21

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 31			Apr. 5			Apr. 11			May 8	
8	10.42		8	6.90		6	4.84		6	8.04	974
4	10.83		4	7.08		N	4.54		N	8.30	1,030
12	11.22		12	7.22		6	4.10		6	8.68	1,110
	Apr. 1			Apr. 7		12	3.85		12	9.32	1,260
8	11.39		8	6.20			May 5			May 9	
4	11.15		4	5.86		6	5.10	377	4	9.80	1,360
12	10.80		12	5.58		N	5.32	413	8	10.10	1,430
	Apr. 2			Apr. 8		6	5.65	471	N	9.91	1,390
8	10.40		8	5.33		12	5.94	528	4	9.50	1,300
4	9.95		4	5.00			May 6		8	8.94	1,170
12	9.47		12	4.66		6	6.24	588	12	8.40	1,050
	Apr. 3			Apr. 9		N	6.52	645		May 10	
6	9.05		6	4.48		6	6.77	698	6	7.50	855
N	8.42		N	4.39		12	7.07	761	N	6.96	738
6	8.25		6	4.42			May 7		6	6.70	683
12	8.12		12	4.48		6	7.29	809	12	6.50	641
	Apr. 4			Apr. 10		N	7.53	862			
8	7.96		8	4.67		6	7.75	910			
4	7.70		4	4.85		12	7.87	936			
12	7.35		12	4.91							

Supplemental record.- Apr. 1, 7:15 a.m., 11.40 ft.

Wild Rice River Basin

Wild Rice River near Mantador, N. Dak.

Location.—Lat. 46°10'20", long. 97°00'35", on S½ of east line of sec. 12, T. 131 N., R. 51 W., 1½ miles west of Mantador. Datum of gage is 997.78 feet above mean sea level (Corps of Engineers bench mark).

Drainage area.—1,340 square miles.

Gage-height record.—Graph drawn through once or twice-daily wire-weight gage readings Mar. 24 to June 30.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1 to Apr. 14. Shifting-control method used May 30 to June 24. Discharge for period of no gage-height record, Mar. 1-23 computed on basis of weather records and one observation of no flow.

Maxima.—March-June 1950: Discharge, 485 second-feet at 2 p.m. Apr. 14; gage height observed, 8.75 feet at 6:30 p.m. Mar. 29 (affected by ice).

1944 to February 1950: Discharge, 938 second-feet Mar. 20, 1945 (gage height, 9.57 feet).

Remarks.—No diversions. Some regulation by lakes in Migratory Waterfowl Refuges.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	230	128	96	16	0	379	301	16
2	0	240	127	76	17	0	366	283	13
3	0	240	145	64	18	0	337	276	12
4	0	240	153	56	19	0	292	283	11
5	0	300	164	50	20	0	255	289	10
6	0	340	207	43	21	0	220	307	9.6
7	0	320	240	38	22	0	188	314	9.2
8	0	270	264	37	23	10	164	306	8.4
9	0	220	315	32	24	80	158	292	7.0
10	0	200	355	29	25	100	158	272	6.3
11	0	180	372	26	26	120	158	247	5.7
12	0	180	361	24	27	140	156	207	5.1
13	0	270	354	22	28	140	149	172	4.2
14	0	430	348	20	29	170	143	151	3.0
15	0	398	329	18	30	180	135	130	2.3
					31	180	-	112	-
Monthly mean discharge, in second-feet						36.1	244	252	25.1
Runoff, in acre-feet						2,220	14,510	15,480	1,500
Runoff, in inches						0.03	0.20	0.22	0.02

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 28			Apr. 6			Apr. 18			May 2	
6	6.65	110	8	6.97	300	4	6.99	346	N	4.09	125
N	6.79	120	4	7.60	370	8	6.96	343	12	4.20	132
6	8.52	170	8	7.70	380	2	6.98	345		May 3	
12	8.44	170	12	7.50	360	4	6.90	338	8	4.38	143
	Mar. 29			Apr. 7		12	6.60	311	4	4.48	149
8	8.24	160	8	6.86	290		Apr. 19		12	4.53	152
6:30	8.75	190	4	7.34	340	N	6.37	29[illegible]		May 4	
12	8.48	170	8	7.45	350	12	6.19	275	N	4.56	154
	Mar. 30		12	7.08	300		Apr. 20		12	4.53	152
8	7.98	160		Apr. 8		N	5.94	3[illegible]5		May 5	
7	8.26	210	8	6.72	260	12	5.69	25[illegible]	8	4.49	149
12	7.96	200	4	6.84	260		Apr. 21		N	4.58	156
	Mar. 31		12	6.75	240	N	5.50	220	4	4.86	175
8	7.42	160		Apr. 9		12	5.27	20[illegible]	12	5.08	191
4	7.69	180	N	6.42	210		Apr. 22			May 6	
8	7.78	190	12	6.41	210	N	5.03	187	N	5.30	206
12	7.50	170		Apr. 10		12	4.82	172	12	5.55	224
	Apr. 1		N	6.39	200		Apr. 23			May 7	
8	6.71	200	12	6.18	190	N	4.68	163	N	5.79	243
4	7.71	260		Apr. 11		12	4.62	158	12	5.88	250
8	7.79	270	N	6.00	170		Apr. 24			May 8	
12	7.59	260	12	6.09	170	N	4.62	158	N	5.99	259
	Apr. 2			Apr. 12		12	4.62	158	12	6.36	289
8	7.17	230	N	6.50	180		Apr. 25			May 9	
4	7.34	240	12	7.20	210	N	4.62	158	N	6.68	318
8	7.46	250		Apr. 13		12	4.62	158	12	6.88	336
12	7.30	240	N	7.88	260		Apr. 26			May 10	
	Apr. 3		12	8.38	350	N	4.62	158	N	7.09	355
8	6.96	220		Apr. 14		12	4.61	158	12	7.30	375
4	7.60	260	8	8.46	420		Apr. 27			May 11	
8	7.80	270	2	8.34	485	N	4.58	15[illegible]	N	7.28	373
12	7.53	250	12	7.68	413	12	4.53	152	12	7.20	365
	Apr. 4			Apr. 15			Apr. 28			May 12	
4	7.08	220	8	7.51	396	N	4.48	149	N	7.16	361
8	6.99	220	4	7.50	395	12	4.43	14[illegible]	12	7.12	358
N	7.07	220	12	7.46	391		Apr. 29			May 13	
4	7.58	260		Apr. 16		N	4.38	1[illegible]3	N	7.08	354
8	7.77	280	4	7.37	382	12	4.31	139	12	7.05	352
12	7.60	270	8	7.28	373		Apr. 30			May 14	
	Apr. 5		12	7.28	373	N	4.25	135	N	7.02	349
8	6.99	260		Apr. 17		12	4.19	131	12	6.94	342
4	7.61	310	4	7.29	374		May 1			May 15	
8	7.92	350	8	7.16	361	N	4.13	123	N	6.81	330
12	7.49	330	12	7.03	350	12	4.09	125	12	6.64	315

Wild Rice River near Abercrombie, N. Dak.

Location. —Lat. 46°28'35", long. 96°47'15", in NE¼SW¼ sec. 25, T. 135 N., R. 49 W., 160 feet upstream from rubble masonry dam which serves as control, 3½ miles northwest of Abercrombie, and 8 miles downstream from Antelope Creek. Datum of gage is 907.94 feet above mean sea level, datum of 1929.

Drainage area. —2,170 square miles.

Gage-height record. —Graph based on once or twice daily staff gage readings and floodmarks Mar. 24 to June 15, except no readings on Mar. 28, Apr. 8, 9, 11-13, 25, May 26-31. Daily staff gage readings Mar. 6, 9, 13-23, June 16-30.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1 to Apr. 20. Shifting-control method used May 14-25. Discharge for periods of no gage-height record computed on basis of weather records, one observation of no flow, and records for station near Mantador.

Maxima. —March-June 1950: Discharge, 2,300 second-feet at 12 p.m. Apr. 3 (gage height, 16.28 feet, from floodmark).

1932 to February 1950: Discharge, 5,500 second-feet Apr. 2, 1943 (gage height, 21.02 feet, from floodmark).

Remarks. —No diversions. Some regulation by lakes in Migratory Waterfowl Refuges.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	1,330	176	212	16	2	800	383	42
2	0	1,810	199	161	17	2	880	378	38
3	0	2,150	280	151	18	2	820	365	24
4	0	2,190	294	126	19	2	740	360	24
5	0	2,000	385	114	20	2	670	424	22
6	2	1,810	786	103	21	2	564	451	22
7	10	1,550	1,040	89	22	2	414	438	20
8	10	1,100	1,220	82	23	5	338	442	16
9	8	800	1,590	67	24	14	290	502	14
10	6	550	1,810	56	25	54	250	438	13
11	4	400	1,600	51	26	500	223	400	12
12	3	400	1,140	64	27	910	202	360	10
13	2	450	766	60	28	950	192	330	9.2
14	2	490	600	58	29	910	185	300	8.6
15	2	610	440	50	30	940	180	270	7.7
					31	1,130	-	240	-
Monthly mean discharge, in second-feet						177	813	594	57.6
Runoff, in acre-feet						10,860	48,370	36,510	3,420
Runoff, in inches						0.09	0.42	0.32	0.03

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	March 24			April 4			April 19			May 2	
8	1.81	11	8	15.95	2,200	8	5.22	750	8	2.57	177
4	1.93	14	4	15.74	2,160	4	4.98	730	4	2.67	212
12	2.19	20	12	15.42	2,100	12	4.73	700	12	2.75	242
	March 25			April 5			April 20			May 3	
8	2.39	25	8	15.10	2,030	8	4.47	680	N	2.86	287
4	2.73	38	4	14.80	1,960	4	4.23	660	12	2.90	303
12	3.91	180	12	14.49	1,900	12	3.99	636		May 4	
	March 26			April 6			April 21		N	2.89	299
8	5.17	440	8	14.17	1,830	N	3.59	571	12	2.83	274
4	6.60	620	4	13.89	1,780	12	3.30	480		May 5	
12	8.14	730	12	13.77	1,700		April 22		8	2.82	270
	March 27			April 7		N	3.13	406	4	3.19	433
8	10.50	910	8	13.58	1,600	12	3.04	365	12	3.96	632
4	11.58	960	4	13.36	1,500		April 23			May 6	
12	11.70	970	12	13.15	1,400	N	2.98	338	8	4.71	736
	March 29			April 10		12	2.92	312	4	5.38	841
8	11.19	920	3p	7.59	520		April 24		12	5.95	932
4	11.02	900	4:45	7.49	480	N	2.87	291		May 7	
12	10.91	890		April 14		12	2.81	266	8	6.45	1,010
	March 30		5p	4.77	530		April 26		4	6.87	1,080
8	10.91	900	6:20	4.83	550	N	2.70	223	12	7.21	1,140
4	11.19	960	12	4.80	560	12	2.66	209		May 8	
12	11.53	1,030		April 15			April 27		8	7.51	1,190
	March 31		8	4.75	570	N	2.64	201	4	7.75	1,230
8	11.90	1,100	4	4.98	630	12	2.63	198	12	8.54	1,370
4	12.29	1,160	12	5.34	690		April 28			May 9	
12	12.57	1,210		April 16		N	2.61	191	8	9.48	1,540
	April 1		8	5.81	770	12	2.60	187	4	10.11	1,660
8	12.79	1,260	4	6.25	850		April 29		12	10.57	1,760
4	12.67	1,350	12	6.40	880	N	2.59	184		May 10	
12	13.51	1,550		April 17		12	2.59	184	8	10.87	1,820
	April 2		8	6.34	880		April 30		4	10.90	1,830
8	14.40	1,750	4	6.32	880	N	2.58	180	12	10.67	1,780
4	15.09	1,900	12	6.18	870	12	2.57	177		May 11	
12	15.50	2,000		April 18			May 1		8	10.17	1,680
	April 3		8	5.91	830	N	2.57	177	4	9.49	1,540
8	15.69	2,100	4	5.78	820	12	2.56	174	12	8.71	1,400
4	15.96	2,200	12	5.50	780						
12	16.28	2,300									

Wild Rice River near Abercrombie, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 12			May 13			May 14			May 15	
8	7.82	1,240	8	5.10	796	8	3.97	624	8	3.42	451
4	6.64	1,040	4	4.58	717	4	3.76	584	4	3.35	415
12	5.75	900	12	4.23	667	12	3.58	517	12	3.30	388

Sheyenne River Basin

Sheyenne River near Harvey, N. Dak.

Location. —Lat. 47°47'25", long. 99°53'25", in SE¼SW¼ sec. 21, T. 150 N., R. 72 W., 300 feet north of Harvey Water Works and 2¼ miles northeast of Harvey.
Drainage area. —585 square miles.
Gage-height record. —Graph based on once or twice-daily staff-gage readings.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 7 to Apr. 17.
Maxima. —March-June 1950: Discharge observed, 1,430 second-feet 9 a.m. Apr. 18; gage height observed, 6.95 feet 8:30 a.m. Apr. 17 (affected by ice).
1945 to February 1950: Discharge observed, 1,220 second-feet Apr. 18, 1948 (gage height, 6.45 feet).
Remarks. —Small diversions for local farm and power use.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	10	151	61	11	150	284	17	21	506	177	14
2	25	144	56	12	110	328	73	22	419	148	17
3	50	134	50	13	80	550	77	23	358	133	12
4	55	140	42	14	75	617	59	24	294	123	8.7
5	95	144	36	15	220	461	48	25	237	113	17
6	170	119	27	16	750	348	36	26	188	105	21
7	250	143	18	17	1,200	272	28	27	203	93	17
8	340	176	39	18	1,360	224	22	28	183	81	16
9	250	184	30	19	984	200	17	29	164	72	15
10	150	236	20	20	693	190	12	30	156	68	14
								31	-	65	-
Monthly mean discharge, in second-feet									324	201	30.7
Runoff, in acre-feet									19,290	12,340	1,820
Runoff, in inches									0.62	0.40	0.06

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 14			Apr. 22			May 3			May 14	
8	3.88	55	8	5.48	441	N	4.40	133	N	5.83	635
2	4.03	70	4	5.40	405	6	4.38	130	12	5.67	538
6	4.28	95	12	5.33	377	12	4.42	136		May 15	
12	4.43	110		Apr. 23			May 4		N	5.50	450
	Apr. 15		8	5.32	373	N	4.45	140	12	5.40	405
8	4.64	140	4	5.25	348	12	4.49	146		May 16	
2	5.00	200	12	5.20	330		May 5		N	5.23	340
4	5.28	260		Apr. 24		N	4.50	148	12	5.13	307
12	6.05	450	N	5.08	291	12	4.42	136		May 17	
	Apr. 16		12	5.00	265		May 6		N	5.02	271
6	6.64	1,000		Apr. 25		N	4.28	117	12	4.92	241
10	6.83	1,300	N	4.90	235	6	4.20	107		May 18	
1	6.00	600	12	4.82	213	12	4.27	115	N	4.86	224
5	5.88	500		Apr. 26			May 7		12	4.80	207
5:30	6.32	900	8	4.72	188	N	4.47	144		May 19	
8	6.07	600	4	4.68	179	12	4.62	168	N	4.77	200
12	6.18	700	12	4.70	183		May 8		12	4.74	193
	Apr. 17			Apr. 27		N	4.65	174		May 20	
6	6.79	1,100	8	4.83	215	12	4.72	188	N	4.73	190
8:30	6.95	1,400	4	4.79	205		May 9		12	4.72	188
10	6.68	1,200	12	4.74	193	N	4.68	179		May 21	
4	6.63	1,300		Apr. 28		12	4.72	188	N	4.68	179
12	6.61	1,400	N	4.70	183		May 10		12	4.58	161
	Apr. 18		12	4.64	172	N	4.91	238		May 22	
N	6.60	1,400		Apr. 29		12	5.05	281	N	4.50	148
12	6.46	1,210	N	4.59	162		May 11		12	4.42	136
	Apr. 19		12	4.56	158	N	5.05	281		May 23	
N	6.26	982		Apr. 30		12	5.09	294	N	4.40	133
12	6.01	763	N	4.55	156		May 12		12	4.37	129
	Apr. 20		12	4.54	154	N	5.17	320		May 24	
8	5.93	7[illegible]		May 1		6	5.22	337	N	4.33	123
4	5.91	6[illegible]		4.52	151	12	5.40	405	12	4.29	118
12	5.80	61[illegible]		4.50	148		May 13			May 25	
	Apr. 21			May 2		N	5.72	567	N	4.25	113
8	5.63	516	N	4.48	14[illegible]	12	5.87	660	12	4.22	109
4	5.54	470	12	4.45	14[illegible]						
12	5.49	446									

Sheyenne River at Sheyenne, N. Dak.

Location. — Lat. 47°57'20", long. 99°07'30", in NE¼ sec. 5, T. 150 N., R. 66 W., at recreation-pond dam, 1 mile north of Sheyenne. Datum of gage is 1,408.65 feet above mean sea level, adjustment of 1912.

Drainage area. — 1,830 square miles (revised).

Gage-height record. — Staff gage read once daily. Graph drawn Apr. 1 to June 1. No reading made on May 2.

Discharge record. — Stage-discharge relation defined by current-meter measurements below 2,300 second-feet and extended to peak stage on basis of former curves.

Maxima. — April-June 1950: Discharge, 3,940 second-feet 3:30 a.m. Apr. 18 (gage height, 8.31 feet). 1929-33, 1939 to March 1950: Discharge, 3,840 second-feet Apr. 18, 19, 1948 (gage height, 8.51 feet).

Remarks. — No regulation or diversion of importance.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	43	326	124	11	1,550	1,100	70	21	1,800	985	49
2	55	320	120	12	1,600	1,260	49	22	1,540	484	43
3	260	311	63	13	1,650	1,180	49	23	1,390	404	49
4	360	294	124	14	1,650	988	49	24	1,040	344	40
5	1,000	293	124	15	1,700	826	91	25	704	308	110
6	1,400	310	70	16	1,850	776	91	26	506	287	30
7	1,700	326	49	17	2,300	830	82	27	441	269	25
8	1,700	408	25	18	3,290	830	82	28	378	223	30
9	1,700	891	30	19	2,310	1,270	30	29	350	217	18
10	1,600	1,030	27	20	2,040	1,460	56	30	343	190	27
								31	-	144	-
Monthly mean discharge, in second-feet									1,275	609	60.9
Runoff, in acre-feet									75,870	37,460	3,620
Runoff, in inches									0.78	0.38	0.04

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
		Apr. 16			Apr. 24			May 6			May 16
8	7.45	1,850	6	5.18	1,110	N	4.40	311	N	4.78	762
4	7.52	1,900	N	5.03	1,020	12	4.40	311	12	4.80	800
12	7.56	1,900	12	4.87	877			May 7			May 17
		Apr. 17			Apr. 25	N	4.42	325	N	4.83	833
6	7.61	1,950	N	4.74	686	12	4.45	345	12	4.85	855
N	7.74	2,000	12	4.67	569			May 8			May 18
6	7.79	2,350			Apr. 26	N	4.50	379	N	4.80	800
12	8.18	3,700	N	4.62	501	12	4.64	528	12	4.86	866
		Apr. 18	12	4.58	455			May 9			May 19
3:30	8.31	3,940			Apr. 27	N	4.97	973	6	5.11	1,070
8	8.24	3,810	N	4.57	446	12	5.15	1,090	N	5.48	1,270
N	7.94	3,320	12	4.54	417			May 10	6	5.88	1,520
4	7.68	2,970			Apr. 28	6	5.12	1,090	12	6.00	1,600
8	7.38	2,630	N	4.49	372	N	5.00	1,040			May 20
12	7.25	2,500	12	4.46	352	6	4.90	964	N	5.82	1,480
		Apr. 19	q		Apr. 29	12	4.91	919	12	5.48	1,270
8	7.06	2,330	N	4.46	352			May 11			May 21
4	6.98	2,260	12	4.45	345	N	5.19	1,120	N	5.05	1,030
12	6.87	2,180			Apr. 30	12	5.46	1,260	12	4.70	610
		Apr. 20	N	4.45	345			May 12			May 22
8	6.72	2,070	12	4.44	338	N	5.49	1,280	N	4.58	455
4	6.63	2,010			May 1	12	5.42	1,240	12	4.54	417
12	6.52	1,930	N	4.42	325			May 13			May 23
		Apr. 21	12	4.41	318	N	5.31	1,180	N	4.51	417
N	6.34	1,820	•		May 3	12	5.17	1,110	12	4.47	365
12	6.09	1,650	N	4.40	311			May 14			May 24
		Apr. 22	12	4.40	311	N	4.98	982	N	4.42	345
N	5.89	1,520			May 4	12	4.87	877	12	4.39	318
12	5.77	1,450	N	4.37	293			May 15			May 25
		Apr. 23	12	4.35	281	N	4.82	822	N	4.37	318
6	5.73	1,420			May 5	12	4.79	781	12	4.34	281
N	5.71	1,410	N	4.37	293						
6	5.67	1,390	12	4.39	305						
12	5.45	1,260									

Sheyenne River near Warwick, N. Dak.

Location.—Lat. 47°48'20", long. 98°42'57", on S¼ of line between sec. 15 and 16, T. 150 N., R. 63 W., at bridge on county road a quarter of a mile west and 3.3 miles south of Warwick.
Drainage area.—2,100 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 3,300 second-feet and extended to peak stage. Affected by ice Apr. 1 to 4 p.m. Apr. 17.
Maximum.—April-June 1950: Discharge, 3,800 second-feet 9 p.m. Apr. 17 (gage height, 7.45 feet). Continuous low flow November 1949 to March 1950.
Remarks.—No diversions. Minor regulation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	85	474	200	11	1,700	1,140	107	21	2,620	1,470	83
2	80	466	179	12	1,750	1,370	96	22	2,420	1,600	68
3	80	421	160	13	1,650	1,580	98	23	2,240	1,280	59
4	100	394	145	14	1,500	1,640	90	24	1,980	840	59
5	140	458	136	15	1,550	1,550	83	25	1,540	618	72
6	260	507	129	16	1,850	1,320	77	26	1,090	494	70
7	620	570	116	17	2,890	1,120	72	27	864	400	79
8	1,200	627	112	18	3,450	1,090	83	28	690	324	74
9	1,450	724	101	19	3,310	1,130	88	29	580	268	61
10	1,550	908	129	20	2,880	1,240	88	30	505	233	50
								31	-	217	-
Monthly mean discharge, in second-feet									1,427	854	98.8
Runoff, in acre-feet									84,940	52,510	5,880
Runoff, in inches									0.76	0.47	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 1			Apr. 14			Apr. 29			May 15	
N	2.63	85	N	6.00	1,500	N	3.85	578	N	5.52	1,560
12	2.62	85	12	5.94	1,500	12	3.77	537	12	5.34	1,440
	Apr. 2			Apr. 15			Apr. 30			May 16	
N	2.59	75	N	6.01	1,500	N	3.70	501	N	5.14	1,320
12	2.60	80	6	6.17	1,600	12	3.66	481	12	4.92	1,190
	Apr. 3		12	6.30	1,700		May 1			May 17	
N	2.61	80		Apr. 16		N	3.64	471	N	4.80	1,110
12	2.65	90	8	6.43	1,800	12	3.64	471	12	4.76	1,090
	Apr. 4		4	6.64	1,900		May 2			May 18	
N	2.68	100	12	6.94	2,100	N	3.63	466	N	4.76	1,090
12	2.81	120		Apr. 17		12	3.62	461	10	4.76	1,090
	Apr. 5		8	7.31	2,600		May 3		12	4.80	1,110
6	2.84	120	4	7.40	2,970	N	3.54	422		May 19	
N	2.86	130	9	7.45	3,800	12	3.45	378	N	4.83	1,130
6	2.97	160	12	7.44	3,760		May 4		12	4.87	1,160
12	3.05	180		Apr. 18		N	3.46	383		May 20	
	Apr. 6		8	7.38	3,530	12	3.56	431	N	4.99	1,230
N	3.16	210	4	7.30	3,260		May 5		12	5.16	1,330
6	3.47	340	12	7.33	3,360	N	3.59	446		May 21	
12	3.64	420		Apr. 19		6	3.67	486	N	5.40	1,480
	Apr. 7		8	7.35	3,430	12	3.68	491	12	5.59	1,600
6	3.80	500	4	7.30	3,260		May 6			May 22	
N	4.00	600	12	7.25	3,120	N	3.71	506	8	5.63	1,630
6	4.24	720		Apr. 20		12	3.75	526	4	5.59	1,600
12	4.57	900	N	7.12	2,850		May 7		12	5.47	1,530
	Apr. 8		12	7.02	2,720	N	3.82	562		May 23	
6	4.93	1,100		Apr. 21		6	3.90	604	N	5.08	1,280
N	5.10	1,200	N	6.93	2,620	12	3.92	615	12	4.62	1,010
12	5.37	1,350	12	6.84	2,520		May 8			May 24	
	Apr. 9			Apr. 22		N	3.92	615	N	4.30	822
6	5.52	1,450	N	6.72	2,410	12	4.01	662	12	4.09	706
N	5.58	1,450	12	6.64	2,340		May 9			May 25	
6	5.62	1,450		Apr. 23		N	4.11	716	N	3.91	609
12	5.71	1,500	N	6.51	2,240	12	4.26	800	12	3.79	547
	Apr. 10		12	6.35	2,120		May 10			May 26	
6	5.83	1,550		Apr. 24		N	4.43	896	N	3.68	491
N	5.90	1,550	N	6.19	2,010	12	4.67	1,040	12	3.59	446
6	5.91	1,600	12	5.89	1,800		May 11			May 27	
12	6.02	1,600		Apr. 25		N	4.82	1,130	N	3.50	402
	Apr. 11		N	5.51	1,550	12	5.01	1,240	12	3.39	349
6	6.16	1,700	12	5.04	1,260		May 12			May 28	
N	6.16	1,700		Apr. 26		N	5.23	1,370	N	3.34	326
6	6.20	1,700	6	4.86	1,150	12	5.42	1,490	12	3.27	295
12	6.29	1,700	N	4.73	1,070		May 13			May 29	
	Apr. 12		6	4.64	1,020	N	5.57	1,590	N	3.21	268
6	6.35	1,750	12	4.55	966	12	5.65	1,640	12	3.15	244
N	6.34	1,750		Apr. 27			May 14			May 30	
12	6.27	1,700	N	4.37	862	6	5.66	1,650	N	3.12	232
	Apr. 13		12	4.20	766	10	5.66	1,650	12	3.10	224
N	6.18	1,650		Apr. 28		N	5.65	1,640		May 31	
12	6.13	1,600	N	4.05	684	12	5.63	1,630	N	3.08	217
			12	3.94	625				12	3.06	210

Sheyenne River near Cooperstown, N. Dak.

Location.—Lat. 47°26', long. 98°02', in NE¼SE¼ sec. 27, T. 146 N., R. 58 W., at county bridge 5 miles east of Cooperstown. Datum of gage is 1,274.57 feet above mean sea level, datum of 1929 (Corps of Engineers bench mark).
Drainage area.—2,840 square miles (excludes closed Devils Lake Basin).
Gage-height record.—Graph based on twice-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-16. Gage heights used to hundredths.
Maxima.—April-June 1950: Discharge, 7,830 second-feet about 4 a.m. Apr. 17 (gage height, 18.69 feet, from floodmark).
1945 to March 1950: Discharge, 5,600 second-feet Apr. 23, 1948 (gage height, 18.10 feet, from floodmark).
Remarks.—Minor regulation and diversion above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	120	1,700	817	11	700	3,230	203	21	4,870	1,960	148
2	110	1,550	641	12	720	2,810	193	22	4,460	1,790	144
3	170	1,390	518	13	740	2,440	186	23	3,930	1,700	143
4	260	1,300	451	14	840	2,190	181	24	3,480	1,620	145
5	360	1,530	399	15	1,100	2,000	214	25	3,200	1,560	284
6	520	1,740	353	16	4,100	1,930	329	26	2,800	1,580	271
7	700	1,980	302	17	7,410	1,960	276	27	2,480	1,640	219
8	640	2,470	263	18	6,590	2,010	197	28	2,250	1,630	188
9	640	3,190	237	19	5,620	2,240	174	29	2,080	1,490	171
10	680	3,390	218	20	5,330	2,200	157	30	1,880	1,270	157
								31	-	1,040	-
Monthly mean discharge, in second-feet									2,293	1,953	272
Runoff, in acre-feet									136,420	120,100	16,220
Runoff, in inches									0.90	0.79	0.11

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 30			May 11			May 27	
N	17.82	3,300	N	14.89	1,880	N	16.87	3,230	N	13.92	1,640
12	18.56	7,700		May 1			May 12		12	13.98	1,650
	Apr. 17		N	14.32	1,700	N	16.54	2,810		May 28	
4	18.69	7,830		May 2			May 13		N	13.94	1,640
N	18.52	7,220	N	13.69	1,550	N	16.11	2,440	12	13.74	1,590
6	18.54	7,290		May 3			May 14			May 29	
12	18.48	7,080	N	13.07	1,390	N	15.66	2,190	N	13.46	1,490
	Apr. 18		12	12.77	1,310		May 15			May 30	
N	18.32	6,540		May 4		N	15.20	2,000	N	12.68	1,270
6	18.28	6,400	6	12.61	1,310	12	14.99	1,940		May 31	
12	18.19	6,110	N	12.59	1,300		May 16		N	11.57	1,040
	Apr. 19		6	12.59	1,300	8a	14.92	1,920		June 1	
6	18.07	5,730	12	12.63	1,310	12	14.98	1,930	N	10.19	817
N	17.99	5,490		May 5			May 17		12	9.45	714
12	17.98	5,460	6	12.77	1,380	N	15.06	1,960		June 2	
	Apr. 20		N	13.09	1,520	12	15.21	2,010	N	8.87	639
N	17.94	5,350	6	13.67	1,680		May 18		12	8.37	572
12	17.87	5,150	12	14.07	1,750	9p	15.21	2,010		June 3	
	Apr. 21			May 6		12	15.27	2,100	N	8.01	518
N	17.76	4,860	6	14.33	1,740		May 19		12	7.76	483
12	17.65	4,600	N	14.31	1,740	N	15.76	2,300		June 4	
	Apr. 22		12	14.26	1,720	6	15.86	2,290	N	7.53	451
N	17.62	4,530		May 7		12	15.84	2,280		June 5	
12	17.46	4,190	8	14.33	1,780		May 20		N	7.16	399
	Apr. 23		N	14.63	1,990	N	15.68	2,200		June 6	
N	17.32	3,930	6	15.26	2,170	12	15.45	2,060	N	6.86	353
	Apr. 24		12	15.69	2,320		May 21		12	6.71	328
N	17.05	3,480		May 8		N	15.19	1,960		June 7	
	Apr. 25		6	15.95	2,390		May 22		N	6.55	300
N	16.85	3,200	N	16.06	2,410	N	14.64	1,790	12	6.43	279
	Apr. 26		6	16.17	2,540		May 23			June 8	
N	16.53	2,800	12	16.38	2,740	N	14.16	1,700	N	6.31	260
	Apr. 27			May 9			May 24		12	6.26	252
N	16.17	2,480	N	16.84	3,270	N	13.88	1,620		June 9	
	Apr. 28		6	16.98	3,380		May 25		N	6.16	237
N	15.78	2,250	12	17.04	3,470	N	13.64	1,560		June 10	
	Apr. 29			May 10			May 26		N	6.02	218
N	15.41	2,080	N	17.00	3,410	N	13.69	1,580			
			12	16.91	3,280						

Lake Ashtabula Reservoir at Baldhill Dam, N. Dak.

Location.—Lat. 47°02'00", long. 98°05'00", in NW¼ sec. 18, T. 141 N., R. 58 W., at Baldhill Dam on Sheyenne River, 8 miles northwest of Valley City. Datum of gage is mean sea level, datum of 1929.

Drainage area.—3,960 square miles (excludes closed Devils Lake Basin).

Gage-height record.—Water-stage recorder graph.

Maximum.—March-June 1950: Contents, 91,600 acre-feet 8 p.m. May 14 (elevation 1,269.46 feet).

Remarks.—Reservoir is formed by earth-fill dam 1,650 feet long; storage began in July 1949; dam completed September 1949. Usable capacity is 69,500 acre-feet between invert of outlet conduit, elevation 1,238.0 feet, and normal pool level, elevation 1,266.0 feet. Dead storage below elevation 1,238.0 feet is 1,200 acre-feet. Maximum pool is elevation 1,273.2 feet; capacity 116,500 acre-feet. Low flows are controlled by 2 sluice gates 3 feet in diameter. The spillway crest is at elevation 1,252.0 feet and is 120 feet long surmounted by 3 Tainter gates, each 40 feet long and 15 feet high. The reservoir is operated for flood control and improvement of low-water flow. Records given herein represent total contents.

Gage-height record and capacity curve furnished by Corps of Engineers.

Elevation*, in feet, and contents, in acre-feet, at 12 p.m. of indicated day, 1950

Day	March		April		May		June	
	Elevation	Contents	Elevation	Contents	Elevation	Contents	Elevation	Contents
1	39.20	1,900	44.70	6,100	66.68	74,600	63.75	58,600
2	39.20	1,900	45.52	7,100	66.55	73,900	62.98	54,800
3	39.20	1,900	46.27	8,100	66.12	71,400	61.98	50,200
4	39.25	2,000	47.10	9,200	65.88	70,000	61.00	46,000
5	39.36	2,000	48.20	10,900	65.92	70,300	60.04	42,200
6	39.87	2,300	50.10	14,200	65.90	70,100	58.92	37,900
7	39.90	2,300	52.52	19,100	66.00	70,700	58.00	34,600
8	39.89	2,300	53.84	22,200	66.50	73,600	56.82	30,700
9	39.86	2,300	54.14	23,000	67.20	77,700	55.77	27,500
10	39.84	2,300	54.20	23,100	67.93	82,100	54.54	24,100
11	39.80	2,300	54.18	23,100	68.58	86,100	53.66	21,800
12	39.77	2,300	54.17	23,100	69.02	88,800	53.16	20,600
13	39.75	2,200	54.22	23,200	69.25	90,300	52.82	19,800
14	39.70	2,200	54.38	23,600	69.37	91,000	52.59	19,300
15	39.70	2,200	54.73	24,600	69.26	90,300	52.52	19,100
16	39.69	2,200	55.39	26,400	69.15	89,600	52.23	18,500
17	39.67	2,200	57.50	33,000	68.95	88,400	52.27	18,600
18	39.63	2,200	61.14	46,600	68.70	86,800	52.19	18,400
19	39.59	2,200	63.07	55,200	68.92	88,200	52.16	18,400
20	39.55	2,100	64.42	62,000	68.89	88,000	52.02	18,000
21	39.59	2,200	65.52	68,000	68.72	87,000	51.91	17,800
22	40.12	2,500	66.38	72,900	68.52	85,700	51.80	17,600
23	40.43	2,700	67.00	76,500	68.24	84,000	51.70	17,400
24	40.68	2,800	67.72	80,800	67.85	81,600	51.74	17,500
25	41.07	3,000	67.65	80,400	67.40	78,900	51.64	17,200
26	41.74	3,500	67.68	80,600	66.92	76,000	51.80	17,600
27	42.08	3,800	67.60	80,100	66.42	73,100	51.90	17,800
28	42.35	4,000	67.48	79,400	66.02	70,800	51.89	17,800
29	42.64	4,200	67.28	78,200	65.55	68,200	51.83	17,600
30	43.12	4,600	66.98	76,400	65.03	65,300	51.75	17,500
31	43.90	5,300	-	-	64.40	61,900	-	-
Change in contents, acre-feet		+3,400		+71,100		-14,500		-44,400
Change in contents, equivalent mean second-feet		+55.3		+1,195		-236		-746

* Add 1,200 feet to obtain elevation above mean sea level.

Sheyenne River below Baldhill Dam, N. Dak.

Location. —Lat. 47°01'50", long. 98°05'00", in NW¼ sec. 18, T. 141 N., R. 58 W., 600 feet downstream from Baldhill Dam, and 8 miles northwest of Valley City. Datum of gage is 1,200.00 feet above mean sea level, datum of 1929.

Drainage area. —3,960 square miles (excludes closed Devils Lake Basin).

Gage-height record. —Water-stage recorder graph.

Discharge record. —Stage-discharge relation defined by current-meter measurements.

Maximum. —March-June 1950: Discharge, 3,150 second-feet May 23 (gage height, 32.62 feet). Continuous low flow November 1949 to February 1950.

Known discharge about 4,580 second-feet Apr. 27 or 28, 1948.

Remarks. —Slight diversions above station. Flow regulated by Lake Ashtabula above Baldhill Dam (capacity, 70,700 acre-feet to normal full pool) beginning in August 1949, and several smaller reservoirs.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	11	220	2,850	3,070	16	21	2,030	2,960	392
2	11	230	2,820	3,050	17	21	1,970	2,960	343
3	12	240	2,740	2,990	18	20	2,360	3,020	343
4	13	240	2,720	2,930	19	19	2,420	2,950	322
5	14	260	2,660	2,930	20	19	2,420	3,000	293
6	25	320	2,520	2,700	21	19	2,410	2,990	268
7	60	290	2,620	2,050	22	30	2,590	3,030	264
8	25	160	2,590	2,100	23	70	2,600	3,050	264
9	22	780	2,590	2,180	24	73	2,680	3,060	278
10	22	1,410	2,760	2,140	25	95	2,860	3,100	286
11	22	1,800	2,880	1,480	26	110	2,920	3,100	264
12	22	1,810	2,940	954	27	100	2,920	3,080	275
13	22	1,770	2,970	681	28	110	2,910	3,060	271
14	21	1,710	2,960	528	29	110	2,900	3,060	268
15	21	1,800	2,940	441	30	160	2,880	3,040	271
					31	250	-	3,070	-
Monthly mean discharge, in second-feet						50	1,730	2,906	1,154
Runoff, in acre-feet						3,070	103,000	178,700	68,680
Runoff, in inches						0.01	0.49	0.85	0.33

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 9			Apr. 19			Apr. 30			May 9 (cont'd.)	
8	27.71	520	8	31.45	2,460	N	32.15	2,870	7	31.58	2,540
4	28.74	1,000	4	31.37	2,420	12	32.14	2,870	9	31.74	2,630
12	29.22	1,220	12	31.28	2,370		May 1		12	31.79	2,660
	Apr. 10			Apr. 20		N	32.10	2,840		May 10	
N	29.47	1,360	8p	31.45	2,460	12	32.09	2,840	5	31.79	2,660
12	30.12	1,700	9	31.54	2,520		May 2		6	31.95	2,760
	Apr. 11		12	31.29	2,370	8p	32.09	2,840	3	31.95	2,760
N	30.32	1,820		Apr. 21		12	31.97	2,770	5	32.04	2,810
12	30.42	1,870	N	31.31	2,380		May 3		12	32.06	2,820
	Apr. 12		12	31.54	2,520	N	31.90	2,730		May 11	
N	30.29	1,800		Apr. 22		12	31.89	2,720	N	32.11	2,850
6	30.24	1,770	10	31.60	2,550		May 4		6	32.26	2,940
12	30.30	1,810	2	31.84	2,690	N	31.87	2,710	12	32.28	2,950
	Apr. 13		12	31.67	2,590	12	31.95	2,760		May 12	
N	30.24	1,770		Apr. 23			May 5		N	32.29	2,950
12	30.17	1,730	N	31.67	2,590	10	31.87	2,710	6	32.25	2,930
	Apr. 14		12	31.71	2,620	2	21.88	2,710	12	32.23	2,920
6	30.17	1,730		Apr. 24		4	31.70	2,610		May 13	
N	30.09	1,690	N	31.68	2,600	12	31.47	2,480	N	32.35	2,990
6	30.08	1,680	4	31.96	2,760		May 6		12	32.34	2,980
12	30.19	1,740	12	32.03	2,800	8	31.43	2,450		May 14	
	Apr. 15			Apr. 25		4	31.66	2,590	N	32.32	2,970
N	30.22	1,760	7	32.03	2,800	12	31.64	2,580	12	32.22	2,910
12	30.50	1,920	N	32.17	2,880		May 7			May 15	
	Apr. 16		12	32.24	2,920	10	31.65	2,680	N	32.29	2,950
10	30.68	2,020		Apr. 26		N	31.82	2,680	12	32.28	2,950
8	31.10	2,260	N	32.23	2,920	4	31.82	2,680		May 16	
9	30.50	1,920	12	32.24	2,920	12	31.70	2,610	2p	32.42	3,030
12	30.22	1,760		Apr. 27			May 8		4	32.15	2,870
	Apr. 17		N	32.24	2,920	8	31.69	2,600	12	32.24	2,920
10	30.35	1,830	12	32.23	2,920	N	31.73	2,630		May 17	
N	30.77	2,070		Apr. 28		2	31.63	2,570	10	32.29	2,950
12	30.94	2,170	N	32.22	2,910	12	31.60	2,550	N	32.35	2,990
	Apr. 18		12	32.22	2,910		May 9		12	32.32	2,970
N	31.37	2,420		Apr. 29		10	31.64	2,580			
12	31.35	2,410	N	32.20	2,900	11	31.72	2,620			
			12	32.20	2,900	2	31.72	2,620			

Sheyenne River below Baldhill Dam, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 18			May 25			June 2			June 8	
6	32.35	2,990	N	32.55	3,110	7a	32.42	3,030	7	30.76	2,060
N	32.45	3,050	12	32.55	3,110	9a	32.48	3,070	8	30.31	2,090
8	32.49	3,070		May 26		12	32.42	3,030	2	30.79	2,080
12	32.35	2,990	N	32.54	3,100		June 3		6	30.89	2,140
	May 19		12	32.52	3,090	2p	32.27	2,940	12	30.80	2,090
N	32.27	2,940		May 27		4	32.39	3,010		June 9	
8	32.24	2,920	N	32.52	3,090	12	32.37	3,000	9	30.66	2,010
12	32.36	3,000	12	32.49	3,070		June 4		N	31.07	2,240
	May 20			May 28		5p	32.16	2,880	2	31.17	2,300
8	32.31	2,970	N	32.46	3,060	6	32.23	2,920	4	31.10	2,260
4	32.40	3,020	12	32.44	3,040	12	32.24	2,920	6	31.21	2,330
12	32.35	2,990		May 29			June 5		12	31.15	2,290
	May 21		6	32.41	3,030	8	32.14	2,870		June 10	
8	32.30	2,960	N	32.55	3,110	N	32.31	2,970	1p	30.80	2,090
N	32.39	3,010	9	32.46	3,060	12	32.26	2,940	2	30.87	2,130
12	32.39	3,010	12	32.36	3,000		June 6		8	30.82	2,100
	May 22			May 30		8	32.11	2,850	12	30.58	1,960
N	32.40	3,020	8	32.33	2,980	2	32.11	2,850		June 11	
4	32.47	3,060	10	32.47	3,060	4	32.20	2,900	N	29.58	1,420
12	32.45	3,050	4	32.50	3,080	6	32.20	2,900	12	28.96	1,120
	May 23		12	32.48	3,070	8	30.91	2,150		June 12	
N	32.48	3,070		May 31		10	30.56	1,950	9	28.61	957
6	32.62	3,150	8a	32.46	3,060	12	30.43	1,880	10	28.73	1,010
8	32.27	2,940	10a	32.52	3,090		June 7		6	28.43	874
12	32.33	2,980	12	32.47	3,060	8	30.27	1,790	12	28.27	800
	May 24			June 1		10	30.83	2,110			
8	32.37	3,000	7	32.44	3,040	N	30.97	2,190			
N	32.56	3,120	8	32.48	3,070	4	31.02	2,220			
12	32.51	3,090	2	32.53	3,100	12	30.88	2,130			
			12	32.46	3,060						

Sheyenne River at Valley City, N. Dak.

Location.—Lat. 46°54'50", long. 98°00'30", in SE¼NW¼ sec. 28, T. 140 N., R. 58 W., 100 feet downstream from College Dam in Valley City and 13 miles downstream from Baldhill Dam.
Drainage area.—4,260 square miles (revised) (excludes closed Devils Lake Basin).
Gage-height record.—Water-stage recorder graph, except intermittently Apr. 1, 2, 5-9, 11-13, for which graph has been reconstructed (except Apr. 8) from partial record and high-water mark.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-11. Discharge for Apr. 8 computed on basis of adjacent record and weather records.
Maxima.—April-June 1950: Discharge, 3,050 second-feet 9 p.m. May 5 (gage height, 14.60 feet). 1919, 1938 to March 1950: Discharge, 4,580 second-feet Apr. 28, 1948 (gage height, 17.51 feet).
Remarks.—Flow regulated by Lake Ashtabula above Baldhill Dam (capacity, 70,700 acre-feet to normal full pool) beginning in August 1949, and several smaller reservoirs.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	400	2,950	2,970	11	1,400	2,940	1,830	21	2,570	2,990	305
2	350	2,950	2,960	12	1,580	3,000	1,170	22	2,650	3,000	298
3	320	2,940	2,940	13	1,640	3,010	806	23	2,720	3,000	296
4	320	2,900	2,910	14	1,630	3,010	603	24	2,740	2,990	388
5	320	2,980	2,880	15	1,760	2,990	492	25	2,860	3,010	904
6	380	2,950	2,880	16	2,110	2,990	437	26	2,950	3,020	385
7	380	2,940	2,350	17	2,230	2,980	361	27	2,970	3,020	332
8	320	2,980	2,160	18	2,380	2,980	350	28	2,980	3,000	320
9	400	2,910	2,120	19	2,560	3,030	332	29	2,970	2,980	313
10	940	2,870	2,210	20	2,580	3,000	324	30	2,970	2,960	309
								31	-	2,970	-
Monthly mean discharge, in second-feet									1,746	2,975	1,231
Runoff, in acre-feet									103,900	183,000	73,260
Runoff, in inches									0.46	0.81	0.32

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 9			Apr. 16			Apr. 24			May 5	
4	4.40	320	6	10.63	2,010	6	13.10	2,730	4	14.02	2,930
8	4.40	320	N	10.81	2,060	N	13.17	2,740	8	14.03	2,940
N	4.55	340	6	11.25	2,200	6	13.15	2,740	N	14.03	2,940
4	4.99	380	12	11.90	2,390	12	13.37	2,790	4	14.38	3,010
8	5.63	510		Apr. 17			Apr. 25		8	14.59	3,050
12	6.26	680	2	11.92	2,400	N	13.72	2,870	9	14.60	3,050
	Apr. 10		4	11.80	2,360	12	13.97	2,920	12	14.53	3,040
6	7.00	870	8	11.41	2,240		Apr. 26			May 6	
N	7.36	980	N	11.07	2,140	N	14.13	2,960	8	14.09	2,950
6	7.49	1,000	4	11.00	2,120	12	14.19	2,970	4	13.92	2,910
12	7.73	1,100	8	11.20	2,180		Apr. 27		12	14.06	2,940
	Apr. 11		12	11.40	2,240	N	14.21	2,970		May 7	
6	8.51	1,300		Apr. 18		12	14.23	2,980	6	14.02	2,930
N	9.05	1,500	N	11.87	2,380		Apr. 28		N	13.93	2,910
6	9.30	1,600	12	12.31	2,510	N	14.23	2,980	6	14.11	2,950
12	9.38	1,640		Apr. 19		12	14.22	2,970	12	14.27	2,980
	Apr. 12		8	12.47	2,560		Apr. 29			May 8	
6	9.33	1,630	4	12.55	2,580	N	14.19	2,970	4	14.26	2,980
N	9.17	1,580	12	12.60	2,590	12	14.22	2,970	8	14.18	2,970
6	9.00	1,530		Apr. 20			Apr. 30		N	14.18	2,970
10	8.91	1,500	4	12.59	2,590	N	14.19	2,970	4	14.24	2,980
12	9.00	1,530	8	12.52	2,570	12	14.18	2,970	8	14.25	2,980
	Apr. 13		N	12.49	2,560		May 1		12	14.17	2,960
4	9.75	1,750	4	12.51	2,570	N	14.08	2,950		May 9	
6:30	9.95	1,800	8	12.56	2,580	12	14.03	2,940	N	13.92	2,910
8	9.88	1,790	12	12.61	2,600		May 2		12	13.68	2,860
N	9.30	1,620		Apr. 21		4	14.01	2,930		May 10	
4	9.12	1,560	4	12.65	2,610	8	14.05	2,940	6	13.69	2,860
8	9.08	1,550	8	12.56	2,580	N	14.09	2,950	N	13.71	2,870
12	9.07	1,550	N	12.46	2,550	4	14.15	2,960	6	13.79	2,880
	Apr. 14		4	12.44	2,550	8	14.20	2,970	12	13.90	2,910
4	9.33	1,630	8	12.46	2,550	12	14.20	2,970		May 11	
8	9.57	1,700	12	12.54	2,580		May 3		N	14.03	2,940
N	9.25	1,600		Apr. 22		8	14.08	2,950	12	14.20	2,970
4	9.25	1,600	6	12.68	2,620	4	13.94	2,920		May 12	
8	9.41	1,650	N	12.78	2,640	12	13.85	2,900	8	14.33	3,000
12	9.50	1,680	6	12.94	2,680		May 4		4	14.34	3,000
	Apr. 15		12	13.09	2,720	8	13.79	2,880	12	14.40	3,010
4	9.54	1,680		Apr. 23		4	13.95	2,920		May 13	
8	9.66	1,720	N	13.07	2,720	12	14.00	2,930	8	14.36	3,000
N	9.64	1,720	12	13.07	2,720				4	14.40	3,010
4	9.81	1,760							12	14.43	3,020
8	10.16	1,870									
12	10.39	1,940									

Sheyenne River at Valley City, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 14			May 22			May 30			June 7	
8	14.39	3,010	8	14.32	2,990	6	14.22	2,970	6	12.43	2,550
4	14.35	3,000	4	14.33	3,000	N	14.11	2,950	N	11.32	2,220
12	14.36	3,000	12	14.35	3,000	6	14.09	2,950	4	11.05	2,140
	May 15			May 23		12	14.17	2,960	6	11.10	2,150
8	14.29	2,990	6	14.35	3,000		May 31		12	11.30	2,210
4	14.25	2,980	N	14.35	3,000	N	14.20	2,970		June 8	
12	14.28	2,990	6	14.34	3,000	12	14.23	2,980	6	11.26	2,200
	May 16		10	14.40	3,010		June 1		N	11.13	2,160
8	14.27	2,980	12	14.37	3,000	N	14.19	2,970	6	11.00	2,120
4	14.37	3,000		May 24		12	14.20	2,970	12	10.93	2,110
12	14.32	2,990	4	14.31	2,990		June 2			June 9	
	May 17		8	14.25	2,980	8	14.14	2,960	6	10.96	2,110
8	14.23	2,980	N	14.20	2,970	4	14.11	2,950	N	10.88	2,080
4	14.22	2,970	4	14.23	2,980	12	14.13	2,960	6	11.02	2,130
12	14.27	2,980	8	14.31	2,990		June 3		12	11.29	2,210
	May 18		12	14.38	3,010	8	14.08	2,950		June 10	
8	14.24	2,980		May 25		4	13.99	2,930	6	11.47	2,260
4	14.22	2,970	N	14.40	3,010	12	13.99	2,930	N	11.36	2,230
12	14.38	3,010	12	14.43	3,020		June 4		6	11.17	2,170
	May 19			May 26		8	13.97	2,920	12	11.07	2,140
6	14.51	3,030	N	14.45	3,020	4	13.87	2,900		June 11	
N	14.55	3,040	12	14.44	3,020	12	13.80	2,890	8	10.60	2,000
2	14.56	3,040		May 27			June 5		4	9.62	1,710
6	14.48	3,030	N	14.43	3,020	8	13.78	2,880	12	8.52	1,400
12	14.37	3,000	12	14.39	3,010	4	13.78	2,880		June 12	
	May 20			May 28		12	13.88	2,900	4	8.08	1,270
8	14.33	3,000	N	14.33	2,800		June 6		8	7.70	1,170
4	14.29	2,990	12	14.27	2,980	4	13.90	2,910	10:30	7.52	1,120
12	14.31	2,990		May 29		8	13.87	2,900	11:30	7.32	1,200
	May 21		8	14.24	2,980	N	13.80	2,890	N	7.75	1,180
8	14.28	2,990	4	14.22	2,970	4	13.74	2,870	4	7.62	1,150
4	14.23	2,980	12	14.25	2,980	8	13.73	2,870	8	7.29	1,060
12	14.30	2,990				10	13.69	2,860	12	6.98	978
						12	13.49	2,820			

Sheyenne River near Kindred, N. Dak.

Location. —Lat. 46°37'35", long. 97°00'05", in NE¼NW¼ sec. 5, T. 136 N., R. 50 W., at Great Northern Railway bridge, 1½ miles southeast of Kindred. Datum of gage is 929.16 feet above mean sea level (Great Northern Railway benchmark).

Drainage area. —5,230 square miles (excludes closed Devils Lake Basin).

Gage-height record. —Graph based on wire-weight gage readings, made twice daily Mar. 27 to June 5, June 14-21, and once daily at other times.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1 to Apr. 18.

Maxima. —March-June 1950: Discharge, 3,210 second-feet May 13, 14 (gage height, 20.50 feet).
July 1949 to February 1950: Maximum discharge observed, 392 second-feet Aug. 2, 1949 (gage height, 5.15 feet).
Previously known: Gage height, 22.1 feet April 1947 (affected by ice).

Remarks. —Slight amount of diversion. Flow partly regulated by Lake Ashtabula above Baldhill Dam (capacity, 70,700 acre-feet to normal full pool) and several smaller reservoirs.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	30	1,100	2,470	3,080	16	150	1,200	3,160	2,270
2	30	1,050	2,560	3,080	17	250	1,630	3,130	1,730
3	30	1,000	2,680	3,070	18	250	1,950	3,100	1,250
4	35	1,000	2,760	3,060	19	220	2,140	3,120	987
5	40	1,100	2,840	3,050	20	200	2,180	3,160	836
6	50	1,250	2,940	3,030	21	160	2,190	3,170	734
7	70	1,350	2,980	3,010	22	140	2,170	3,170	660
8	70	1,250	3,040	3,000	23	130	2,120	3,170	625
9	60	1,100	3,130	2,990	24	130	2,110	3,160	581
10	55	1,050	3,160	2,980	25	150	2,160	3,140	560
11	50	1,000	3,170	2,960	26	250	2,220	3,130	548
12	50	960	3,200	2,950	27	500	2,280	3,110	542
13	50	900	3,210	2,920	28	550	2,310	3,110	634
14	70	820	3,210	2,720	29	600	2,360	3,090	850
15	100	900	3,190	2,530	30	750	2,420	3,090	895
					31	1,000	-	3,080	-
Monthly mean discharge, in second-feet						201	1,575	3,053	1,938
Runoff, in acre-feet						12,340	93,720	187,700	115,300
Runoff, in inches						0.04	0.34	0.67	0.41

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 29			May 14			June 5	
8	11.64	1,100	N	17.09	2,360	N	20.49	3,210	N	19.87	3,050
4	12.50	1,300	12	17.20	2,390		May 15			June 6	
12	13.37	1,400		Apr. 30		N	20.40	3,190	N	19.80	3,030
	Apr. 17		N	17.32	2,420		May 16			June 7	
8	14.40	1,600	12	17.47	2,450	N	20.30	3,160	N	19.74	3,010
4	14.94	1,700		May 1			May 17			June 8	
12	15.44	1,800	N	17.55	2,470	N	20.18	3,130	N	19.69	3,000
	Apr. 18		12	17.67	2,500		May 18			June 9	
8	15.88	1,900		May 2		N	20.08	3,100	N	19.65	2,990
4	16.04	2,000	N	17.92	2,560		May 19			June 10	
12	16.11	2,100	12	18.19	2,630	N	20.16	3,120	N	19.59	2,980
	Apr. 19			May 3			May 20			June 11	
8	16.15	2,140	N	18.42	2,680	N	20.32	3,160	N	19.50	2,960
4	16.20	2,150	12	18.60	2,730		May 21			June 12	
12	16.27	2,160		May 4		N	20.35	3,170	8	19.41	2,930
	Apr. 20		N	18.73	2,760		May 22		4	19.53	2,960
N	16.39	2,190	12	18.85	2,790	N	20.36	3,170	12	19.56	2,970
12	16.41	2,200		May 5			May 23			June 13	
	Apr. 21		N	19.03	2,840	N	20.36	3,170	N	19.43	2,940
N	16.38	2,190	12	19.30	2,900		May 24		12	19.04	2,840
12	16.35	2,180		May 6		N	20.32	3,160		June 14	
	Apr. 22		N	19.47	2,950		May 25		N	18.57	2,720
N	16.31	2,170	12	19.54	2,960	N	20.25	3,140	12	18.16	2,620
12	16.19	2,150		May 7			May 26			June 15	
	Apr. 23		N	19.64	2,990	N	20.19	3,130	N	17.78	2,530
N	16.07	2,120	12	19.69	3,000		May 27		12	17.40	2,440
12	16.00	2,100		May 8		N	20.13	3,110		June 16	
	Apr. 24		N	19.82	3,040		May 28		N	16.83	2,300
N	16.03	2,110	12	20.07	3,100	N	20.10	3,110	12	15.72	2,040
12	16.11	2,130		May 9			May 29			June 17	
	Apr. 25		N	20.23	3,140	N	20.05	3,090	N	14.25	1,730
N	16.26	2,160	12	20.25	3,140		May 30		12	12.58	1,430
12	16.39	2,190		May 10		N	20.03	3,090		June 18	
	Apr. 26		N	20.29	3,160		May 31		N	11.27	1,230
N	16.50	2,220	12	20.31	3,160	N	20.01	3,080	12	10.37	1,100
12	16.62	2,250		May 11			June 1			June 19	
	Apr. 27		N	20.36	3,170	N	20.01	3,080	8	9.80	1,010
N	16.68	2,260	12	20.40	3,180		June 2		6	9.40	951
12	16.77	2,280		May 12		N	19.99	3,080	8	9.10	909
	Apr. 28		N	20.47	3,200		June 3		12	8.92	884
N	16.88	2,310	12	20.50	3,210	N	19.95	3,070		June 20	
12	16.98	2,340		May 13			June 4		N	8.59	838
			N	20.50	3,210	N	19.92	3,060	12	8.22	786

Sheyenne River at West Fargo, N. Dak.

Location. — Lat. 46°53'20", long. 96°54'55", in SW¼SE¼ sec. 31, T. 140 N., R. 49 W., 80 feet below highway bridge, 1 mile north of West Fargo, and 3 miles upstream from Maple River. Datum of gage is 877.19 feet above mean sea level, datum of 1929.

Drainage area. — 5,330 square miles (revised) (excludes closed Devils Lake Basin).

Gage-height record. —Water-stage recorder graph, except for periods 10 a.m. Apr. 8 to 12:30 p.m. Apr. 15, 8 p.m. May 1 to 10:30 a.m. May 6, and 5 a.m. June 13 to 10:30 a.m. June 16, when record is based on graph drawn through daily gage readings.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1 to Apr. 16. Backwater from downstream tributaries May 2-18; discharge computed on basis of measurements and records for stations nearby.

Maxima. —April-May 1950: Discharge, 2,810 second-feet 5 p.m. May 22; gage height, 20.61 feet, 2 a.m. May 11.

1902-7, 1919, 1929 to February 1950: Discharge, 2,800 second-feet Apr. 18, 1947 (gage height, 20.53 feet).

Remarks. —Flow regulated by Lake Ashtabula above Baldhill Dam (capacity, 70,700 acre-feet to normal full pool) beginning in August 1949. Records do not include overbank discharge (maximum, about 500 second-feet) which leaves Sheyenne River in vicinity of Horace and flows into Red River of the North above Fargo.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	32	770	2,420	2,600	16	60	890	2,700	2,310
2	28	950	2,460	2,560	17	70	1,050	2,700	2,220
3	28	1,000	2,480	2,510	18	110	1,360	2,700	2,040
4	28	1,000	2,490	2,500	19	220	1,670	2,760	1,650
5	35	1,000	2,490	2,480	20	280	1,900	2,780	1,260
6	40	1,120	2,500	2,480	21	250	2,050	2,800	979
7	38	1,220	2,520	2,480	22	200	2,230	2,800	805
8	37	1,300	2,530	2,490	23	180	2,400	2,790	714
9	36	1,250	2,550	2,480	24	150	2,420	2,780	660
10	35	1,200	2,590	2,470	25	130	2,390	2,790	637
11	35	1,120	2,630	2,440	26	150	2,370	2,780	606
12	35	1,100	2,660	2,430	27	170	2,360	2,750	580
13	40	1,080	2,700	2,420	28	190	2,370	2,720	574
14	45	980	2,700	2,430	29	310	2,390	2,690	601
15	50	910	2,700	2,410	30	470	2,400	2,670	737
					31	570	-	2,640	-
Monthly mean discharge, in second-feet						131	1,542	2,654	1,785
Runoff, in acre-feet						8,040	91,740	163,200	106,200
Runoff, in inches						0.03	0.32	0.57	0.37

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 28			Apr. 7			Apr. 18			Apr. 28	
6	7.64	180	N	18.88	1,200	4	13.79	1,300	N	18.35	2,370
N	7.68	180	12	19.00	1,300	8	14.40	1,430	12	18.40	2,380
6	7.93	200		Apr. 8		12	14.93	1,540		Apr. 29	
12	8.24	230	N	19.00	1,300		Apr. 19		N	18.43	2,390
	Mar. 29		12	18.88	1,300	4	15.31	1,630	12	18.46	2,400
6	8.76	270		Apr. 9		8	15.69	1,710		Apr. 30	
N	9.22	310	8	18.77	1,300	12	16.01	1,790	N	18.48	2,400
6	9.67	360	4	18.52	1,200		Apr. 20		12	18.52	2,420
12	10.02	390	12	18.42	1,200	4	16.19	1,830		May 1	
	Mar. 30			Apr. 10		8	16.46	1,890	N	18.51	2,410
8	10.40	430	N	18.34	1,200	N	16.42	1,880	12	18.58	2,430
4	11.22	510	12	17.81	1,200	4	16.56	1,920		May 2	
12	11.57	540		Apr. 11		8	16.73	1,960	N	18.71	2,460
	Mar. 31		N	17.26	1,100	12	16.84	1,990	12	18.80	2,470
8	11.64	530	12	17.08	1,100		Apr. 21			May 3	
4	12.34	590		Apr. 12		8	17.00	2,020	N	18.89	2,480
12	13.19	650	N	16.84	1,100	4	17.15	2,060	12	19.00	2,490
	Apr. 1		12	16.48	1,100	12	17.45	2,140		May 4	
6	13.67	700		Apr. 13			Apr. 22		8	19.04	2,490
N	14.37	770	N	16.08	1,100	N	17.72	2,210	4	19.07	2,490
6	15.12	840	12	15.61	1,000	12	18.29	2,360	12	19.07	2,490
12	15.67	880		Apr. 14			Apr. 23			May 5	
	Apr. 2		N	15.05	990	8	18.47	2,400	8	19.05	2,490
8	16.22	920	12	14.43	950	4	18.53	2,420	4	19.07	2,490
4	16.95	990		Apr. 15		12	18.54	2,420	12	19.19	2,500
12	17.42	1,000	N	13.72	900		Apr. 24			May 6	
	Apr. 3		12	13.12	880	N	18.54	2,420	4	19.30	2,500
8	17.54	1,000		Apr. 16		12	18.52	2,420	8	19.43	2,500
4	17.70	1,000	4	12.86	870		Apr. 25		N	19.50	2,500
12	17.93	1,000	8	12.63	870	8	18.45	2,400	4	19.58	2,500
	Apr. 4		N	12.40	870	4	18.38	2,380	8	19.68	2,510
N	17.95	1,000	4	12.27	890	12	18.39	2,380	12	19.78	2,510
12	18.05	1,000	8	12.22	930		Apr. 26			May 7	
	Apr. 5		12	12.15	960	N	18.34	2,370	8	19.93	2,510
N	17.89	990		Apr. 17		12	18.31	2,360	4	20.07	2,520
12	18.29	1,100	4	12.15	991		Apr. 27		12	20.14	2,520
	Apr. 6		8	12.21	1,000	N	18.32	2,360		May 8	
N	18.60	1,100	N	12.34	1,030	12	18.33	2,370	8	20.19	2,530
12	18.76	1,200	4	12.59	1,070				4	20.31	2,540
			8	12.85	1,120				12	20.32	2,540
			12	13.15	1,180						

Sheyenne River at West Fargo, N. Dak.-Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 9			May 14			May 20			May 25	
8	20.34	2,540	8	20.07	2,700	N	19.89	2,780	N	19.93	2,790
4	20.50	2,560	4	20.02	2,700	12	19.93	2,790	12	19.94	2,790
12	20.48	2,560	12	19.95	2,700		May 21			May 26	
	May 10			May 15		8	19.95	2,790	N	19.90	2,780
8	20.55	2,570	N	19.92	2,700	4	19.98	2,800	12	19.84	2,760
4	20.60	2,600	12	19.88	2,700	12	19.96	2,800		May 27	
12	20.60	2,620		May 16			May 22		8	19.79	2,750
	May 11		8	19.85	2,700	N	19.97	2,800	4	19.79	2,750
2	20.61	2,620	4	19.85	2,700	12	19.97	2,800	12	19.72	2,730
8	20.59	2,620	12	19.84	2,700		May 23			May 28	
4	20.57	2,630		May 17		4	19.97	2,800	8	19.69	2,720
12	20.50	2,650	8	19.82	2,700	8	19.97	2,800	4	19.65	2,710
	May 12		4	19.80	2,690	12	19.95	2,790	12	19.61	2,700
8	20.44	2,660	12	19.77	2,690	4	19.95	2,790		May 29	
4	20.37	2,660		May 18		8	19.85	2,770	8	19.58	2,690
12	20.29	2,690	N	19.73	2,690	12	19.88	2,770	4	19.59	2,690
	May 13		12	19.73	2,730		May 24		12	19.54	2,680
8	20.24	2,690		May 19		8	19.91	2,780		May 30	
4	20.19	2,700	N	19.83	2,760	4	19.87	2,770	N	19.50	2,670
12	20.15	2,700	12	19.86	2,770	12	19.90	2,780	12	19.43	2,650
										May 31	
									N	19.38	2,640
									12	19.32	2,620

Devils Lake near Devils Lake, N. Dak.

Location.—Lat. 48°04'00", long. 98°56'07", in SW¼ sec. 18, T. 153 N., R. 64 W., at Lakewood, on east bank of Creel Bay 4½ miles southwest of the city of Devils Lake. Creel Bay, which is half a mile wide, is an arm of Devils Lake and extends 2 miles north of the lake. Elevations are referred to mean sea level, datum of 1929.

Drainage area.—3,940 square miles (including lake surface).

Gage-height record.—Staff gage read twice weekly.

Maxima.—May-Sept. 1950: Elevation, 1,414.95 feet September 24.
1867 to April 1950: Elevation observed, 1,438.40 feet in 1867.

Remarks.—1950 maximum is highest elevation observed since 1924.

Elevation, in feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1		1,412.52			1,414.85	16		1,413.46	1,414.40		
2				1,414.63	1,414.83	17					1,414.93
3						18					
4		1,412.97	1,414.24			19			1,414.45		
5				1,414.65		20		1,413.63			
6					1,414.80	21			1,414.50	1,414.75	
7						22		1,413.72			1,414.94
8		1,413.07		1,414.70		23					
9			1,414.35		1,414.82	24	1,411.21			1,414.80	1,414.95
10						25			1,414.58		
11		1,413.17				26	1,411.67	1,414.00			
12					1,414.86	27		1,414.05	1,414.60		
13						28	1,412.47				
14			1,414.38			29					1,414.93
15						30		1,414.18	1,414.65	1,414.85	
						31					

Maple River at Mapleton, N. Dak.

Location. – Lat. 46°53'20", long. 97°03'20", in NE¼NE¼ sec. 1, T. 139 N., R. 51 W., at county highway bridge in Mapleton, 10.5 miles upstream from mouth. Datum of gage is 886.68 feet (revised) above mean sea level, datum of 1929.

Drainage area. – 1,480 square miles.

Gage-height record. – Wire-weight gage read twice daily except for the periods Mar. 9, 25, 29, June 5-28, when it was read once daily, and Mar. 1-8, 10-24, 26-28, Apr. 9, 30, May 11, 14, 25, June 3, 4, 18, 20-22, 24, 25, 29, 30 when no readings were obtained. Gage heights for the period Mar. 29 to May 31 obtained from a graph based on gage readings.

Discharge record. – Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1 to Apr. 17.

Maxima. – March-June 1950: Discharge, 1,980 second-feet 12 N. to 6 p.m. Apr. 2; gage height observed, 17.73 feet Apr. 2 (affected by ice).

1944 to February 1950: Discharge, 3,880 second-feet Apr. 14, 1947 (gage height, 18.04 feet, revised).

Remarks. – No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	1,850	256	99	16	0	640	681	38
2	0	1,950	254	90	17	0	730	589	36
3	0	1,850	262	83	18	0	732	487	37
4	0	1,750	298	75	19	0	665	490	38
5	0	1,450	530	68	20	0	590	667	37
6	0	1,600	878	66	21	0	538	687	36
7	0	1,800	1,070	65	22	0	505	610	34
8	0	1,600	1,240	64	23	0.5	468	456	33
9	0	1,400	1,520	60	24	2.0	430	384	40
10	0	1,200	1,730	50	25	0.5	405	320	48
11	0	1,150	1,400	45	26	5.0	371	273	56
12	0	980	1,020	45	27	10	345	222	161
13	0	760	793	45	28	30	332	186	270
14	0	600	760	42	29	230	320	164	260
15	0	500	734	40	30	840	290	142	240
					31	1,550	-	105	-
Monthly mean discharge, in second-feet						86.1	927	620	76.7
Runoff, in acre-feet						5,290	55,140	38,100	4,560
Runoff, in inches						0.07	0.70	0.48	0.06

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 1			Apr. 13			Apr. 26			May 10	
4	17.63	1,850	N	12.52	760	N	8.46	370	8	14.59	1,770
8	17.68	1,900	12	12.11	670	12	8.40	355	4	14.45	1,720
N	17.61	1,850		Apr. 14			Apr. 27		12	14.14	1,630
4	17.47	1,800	8	11.85	630	N	8.36	344		May 12	
8	17.33	1,780	4	11.41	570	12	8.33	336	8	12.32	1,130
12	17.39	1,800	12	10.40	530		Apr. 28		4	11.21	892
	Apr. 2			Apr. 15		N	8.32	333	12	10.85	825
6	17.56	1,950	6	9.83	480	12	8.30	328		May 13	
N	17.73	1,980	N	9.62	460		Apr. 29		N	10.65	790
6	17.67	1,980	6	9.76	520	N	8.29	325	12	10.51	767
12	17.59	1,850	12	10.04	550	12	8.21	303		May 15	
	Apr. 3			Apr. 16			May 1		N	10.32	734
8	17.60	1,850	8	10.46	640	N	8.05	254	12	10.23	719
4	17.67	1,870	4	10.62	670	12	8.03	248		May 16	
12	17.74	1,950	12	10.67	700		May 2		N	10.04	687
	Apr. 4			Apr. 17		N	8.05	254	12	9.72	632
8	17.69	1,850	N	10.60	730	12	8.06	258		May 17	
4	17.47	1,660	12	10.43	753		May 3		N	9.45	586
12	17.40	1,570		Apr. 18		N	8.06	258	12	9.27	552
	Apr. 5		N	10.30	731	12	8.11	273		May 18	
8	17.25	1,440	12	10.20	714		May 4		N	8.99	493
4	17.03	1,450		Apr. 19		N	8.17	291	12	8.63	411
12	16.91	1,460	N	9.91	665	6	8.20	300		May 19	
	Apr. 6		12	9.63	617	12	8.44	365	2	8.62	409
N	16.80	1,600		Apr. 20			May 5		N	8.97	488
12	16.71	1,750	8	9.55	604	8	8.91	475	12	9.46	538
	Apr. 7		4	9.41	579	4	9.43	582		May 20	
6	16.61	1,800	12	9.30	558	12	10.13	702	N	9.92	666
N	16.22	1,800		Apr. 21			May 6		8	10.29	729
6	15.97	1,800	N	9.20	538	8	10.97	847	12	10.24	721
12	15.88	1,750	12	9.10	517	4	11.44	938		May 21	
	Apr. 8			Apr. 22		12	11.70	993	N	10.03	685
N	15.74	1,550	N	9.06	508		May 7		12	9.86	656
12	15.49	1,450	12	8.97	488	N	12.06	1,070		May 22	
	Apr. 10			Apr. 23		12	12.39	1,150	N	9.67	624
N	14.63	1,200	N	8.88	469		May 8		12	9.20	538
12	14.39	1,150	12	8.77	444	8	12.55	1,190		May 23	
	Apr. 11			Apr. 24		4	12.94	1,290	N	8.76	442
8	14.45	1,150	N	8.71	430	12	13.20	1,350	12	8.60	404
4	14.35	1,120	12	8.66	418		May 9			May 24	
12	14.25	1,100		Apr. 25		6	13.34	1,390	N	8.53	387
	Apr. 12		N	8.61	406	N	13.64	1,480	12	8.41	358
N	13.67	980	12	8.54	390	6	14.25	1,660			
12	13.03	860				12	14.52	1,750			

Rush River at Amenia, N. Dak.

Location.—Lat. 47°00'40", long. 97°13'10", on line between sec. 23 and 24, T. 141 N., R. 52 W., on bridge on State Highway 18, 0.4 mile north of Amenia.
Drainage area.—107 square miles.
Gage-height record.—Graph drawn on basis of twice-daily wire-weight gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 300 second-feet and extended to peak discharge. Stage-discharge relation affected by ice Mar. 26 to Apr. 16.
Maxima.—March-June 1950: Discharge, 620 second-feet 8:15 a.m. Apr. 7; gage height observed, 10.96 feet, 8 a.m. Mar. 27 (affected by ice).
July 1946 to February 1950: Discharge, 1,230 second-feet Apr. 14, 1947; gage height, 10.20 feet Apr. 8, 1948 (affected by ice).
Remarks.—Several small diversions for local use.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	0	560	18	5.2	16	0	240	32	2.1
2	0	500	22	5.8	17	0	193	30	2.1
3	0	440	44	7.2	18	0	158	29	2.1
4	0	400	71	4.1	19	0	123	34	1.9
5	0	360	108	3.6	20	0	106	81	1.8
6	0	400	274	3.3	21	0	74	84	1.7
7	0	580	295	3.0	22	0	46	51	1.7
8	0	400	269	2.5	23	0	31	34	1.8
9	0	210	314	1.8	24	0	23	26	1.9
10	0	180	221	2.0	25	0	22	18	70
11	0	190	147	2.0	26	1	19	14	192
12	0	180	106	2.2	27	5	14	11	79
13	0	180	72	2.4	28	10	13	9.0	51
14	0	200	50	2.3	29	100	13	7.7	34
15	0	240	38	2.2	30	300	16	6.0	21
					31	350	-	5.2	-
Monthly mean discharge, in second-feet						24.7	204	81.3	17.1
Runoff, in acre-feet						1,520	12,120	5,000	1,020
Runoff, in inches						0.27	2.13	0.88	0.18

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 24			May 1			May 8	
N	5.02	192	N	2.82	23	N	2.67	17	8	5.54	255
12	4.91	180	12	2.78	21	12	2.71	18	4	5.70	274
	Apr. 18			Apr. 25			May 2		12	5.87	294
N	4.69	156	N	2.81	22	N	2.79	22		May 9	
12	4.52	139	12	2.79	22	12	2.96	28	6	6.01	311
	Apr. 19			Apr. 26			May 3		N	6.11	324
N	4.32	121	N	2.73	19	N	3.28	44	6	6.15	330
12	4.22	112	12	2.67	17	12	3.56	61	12	5.80	286
	Apr. 20			Apr. 27			May 4			May 10	
N	4.19	109	N	2.58	14	N	3.71	72	N	5.20	214
12	4.00	94	12	2.53	12	12	3.80	78	12	4.82	170
	Apr. 21			Apr. 28			May 5			May 11	
N	3.73	73	N	2.54	13	N	4.01	95	N	4.59	146
12	3.52	58	12	2.56	13	12	4.75	162	12	4.39	127
	Apr. 22			Apr. 29			May 6			May 12	
N	3.30	45	N	2.53	12	N	5.86	293	N	4.15	106
12	3.12	36	12	2.60	14	6	6.18	333	12	3.89	85
	Apr. 23			Apr. 30		12	6.10	323		May 13	
N	3.02	31	N	2.66	17		May 7		N	3.70	71
12	2.91	26	12	2.69	18	N	5.88	296	12	3.54	60
						12	5.62	264			

Buffalo River Basin

Buffalo River near Hawley, Minn.

Location. – Lat. 46°51'15", long. 96°19'20", in NE¼SE¼ sec. 14, T. 139 N., R. 45 W., on bridge on State Aid road 7, 1.4 miles south of Hawley.

Drainage area. – 322 square miles.

Gage-height record. – Graph drawn on basis of once-daily chain gage readings Mar. 3, 5, 8, Mar. 24 to Apr. 1, Apr. 4-8, 10, 11, June 9, and once-daily readings for all other periods except Mar. 1, 7, Apr. 9, when no reading was obtained.

Discharge record. – Stage-discharge relation defined by current-meter measurements below 840 second-feet and extended to peak stage. Stage-discharge relation affected by ice, Mar. 1 to Apr. 6, Apr. 8, 10-15. Discharge interpolated for periods of no gage-height record. Gage heights used to hundredths.

Maxima. – March-May 1950: Discharge, 841 second-feet 8 p.m. Apr. 7 (gage height, 9.32 feet, from graph based on gage readings).

1945 to February 1950: Discharge observed, 878 second-feet Apr. 13, 14, 1947; gage height observed, 9.44 feet Mar. 16, 18, 1945.

Remarks. – No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	17	320	222	11	28	440	389	21	28	428	283
2	16	300	218	12	28	420	441	22	28	444	275
3	20	340	225	13	28	460	401	23	28	373	267
4	30	400	233	14	28	550	380	24	28	345	263
5	34	550	239	15	28	600	326	25	55	308	257
6	34	600	251	16	28	626	300	26	170	293	255
7	30	766	259	17	28	594	282	27	220	269	252
8	26	700	271	18	28	555	276	28	200	261	248
9	28	570	282	19	28	518	274	29	190	254	245
10	28	440	320	20	28	450	280	30	280	237	243
								31	320	-	239
Monthly mean discharge, in second-feet									67.4	447	281
Runoff, in acre-feet									4,150	26,600	17,250
Runoff, in inches									0.24	1.55	1.00

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 24			Mar. 28			Apr. 1			Apr. 7	
8	5.33		8	8.50		6	8.60		4	8.76	
4	5.32		4	8.37		N	8.63		8	8.82	
12	5.69		12	8.37		6	8.57		N	8.99	
	Mar. 25			Mar. 29		12	8.45		4	9.26	
6	5.81		8	8.46			Apr. 4		8	9.32	
N	5.95		4	8.57		8	8.17		12	9.31	
6	6.36		12	8.66		4	8.34			Apr. 8	
12	6.92			Mar. 30		12	8.58		8	9.23	
	Mar. 26		8	8.72			Apr. 5		4	9.07	
6	7.65		4	8.73		8	8.73		12	8.96	
N	8.20		12	8.89		4	8.80			Apr. 10	
6	8.50			Mar. 31		12	8.82		8	8.86	
12	8.72		8	8.82			Apr. 6		4	9.10	
	Mar. 27		4	8.65		8	8.82		12	9.30	
6	8.83		12	8.58		4	8.80			Apr. 11	
N	8.87					12	8.74		8	9.00	
6	8.79								4	8.66	
12	8.67								12	8.57	

Supplemental record. - Mar. 28, 8 p.m., 8.35 ft.; Apr. 10, 10 p.m., 9.31 ft.

Buffalo River near Dilworth, Minn.

Location.—Lat. 46°57'40", long. 96°39'40", in SW¼SE¼ sec. 6, T. 140 N., R. 47 W., 6 miles north of U. S. Highway 10, 8 miles northeast of Dilworth, and 9 miles downstream from South Branch.
Drainage area.—1,040 square miles.
Gage-height record.—Water-stage recorder graph except periods 10 p.m. Mar. 27 to 8 a.m. Mar. 28, 5 a.m. to 6 p.m. Mar. 29, 12 m. to 3 p.m. Apr. 5, 6 p.m. Apr. 6 to 10:10 a.m. Apr. 7, for which graphs were drawn based on record before and after period, and 12:01 a.m. Mar. 5 to 5:35 p.m. Mar. 23, 12:30 a.m. Apr. 8 to 10:20 a.m. Apr. 14, when no record was obtained.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 4,000 second-feet and extended to peak stage. Stage-discharge relation affected by ice Mar. 1 to Apr. 15 (discharge for periods of no gage-height record Mar. 5-22, Apr. 8-13, computed on basis of records for station near Hawley). Gage heights used to hundredths.
Maxima.—March-May 1950: Daily discharge, 2,600 second-feet Apr. 7; gage height, 19.75 feet 6-8 p.m. Apr. 2.
1931 to February 1950: Discharge, 4,530 second-feet Apr. 2, 1943 (gage height, 22.60 feet, from floodmark).
Remarks.—No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	4.8	2,200	403	11	8.5	1,800	1,520	21	11	1,300	926
2	4.2	2,400	408	12	8.5	1,600	1,420	22	11	1,140	925
3	4.6	2,400	513	13	8.5	1,400	1,280	23	11	979	928
4	5.5	2,400	549	14	8.5	1,500	1,120	24	11	854	882
5	10	2,400	616	15	8.5	1,700	952	25	36	755	776
6	10	2,400	1,030	16	10	1,870	812	26	85	658	650
7	10	2,600	1,230	17	10	1,750	730	27	340	574	556
8	10	2,500	1,240	18	10	1,650	672	28	650	504	484
9	10	2,200	1,540	19	10	1,530	660	29	850	431	422
10	10	2,000	1,590	20	10	1,410	880	30	1,700	414	374
								31	2,400	-	331
Monthly mean discharge, in second-feet									202	1,577	852
Runoff, in acre-feet									12,450	93,860	52,400
Runoff, in inches									0.22	1.69	0.94

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 24			Mar. 31 (cont'd.)			Apr. 5 (cont'd.)			May 3 (cont'd.)	
6	7.75		8	18.57		8	18.73		8	9.03	546
N	7.90		N	18.87		12	18.65		12	9.12	556
6	8.14		4	18.97			Apr. 6			May 4	
12	8.29		8	18.95		6	18.41		4	9.13	557
	Mar. 25		12	18.91		N	18.31		8	9.10	554
6	8.30			Apr. 1		6	18.31		N	9.04	547
N	8.30		4	18.87		12	18.41		4	9.00	543
6	8.36		8	18.83			Apr. 7		8	8.99	542
12	8.45		N	18.94		6	18.59		12	9.00	543
	Mar. 26		4	19.08		N	18.74			May 5	
4	8.45		8	19.20		6	18.80		4	9.04	547
8	8.45		12	19.25		12	18.65		8	9.12	556
N	8.53			Apr. 2			Apr. 15		N	9.21	566
4	9.05		4	19.30		6	16.25		4	9.78	630
8	9.49		8	19.40		N	16.29		8	10.51	721
12	9.66		N	19.55		6	16.39		12	11.16	812
	Mar. 27		4	19.71		12	16.45			May 6	
6	9.81		8	19.75			Apr. 16		4	11.77	900
N	10.15		12	19.68		6	16.34	1,920	8	12.24	972
6	10.63			Apr. 3		N	16.17	1,870	N	12.65	1,040
12	10.90		4	19.57		6	15.99	1,820	4	12.99	1,090
	Mar. 28		8	19.45		12	15.87	1,790	8	13.25	1,150
6	11.16		N	19.52			Apr. 17		12	13.48	1,190
N	11.38		4	19.60		6	15.78	1,760		May 7	
6	11.56		8	19.54		N	15.74	1,750	4	13.64	1,220
12	11.74		12	19.31		6	15.69	1,740	8	13.72	1,240
	Mar. 29			Apr. 4		12	15.61	1,720	N	13.76	1,250
6	12.00		4	19.14			May 2		4	13.74	1,250
N	12.42		8	19.02		4	7.67	397	8	13.70	1,240
6	13.05		N	19.01		8	7.66	396	12	13.62	1,220
12	14.02		4	19.14		N	7.68	398		May 8	
	Mar. 30		8	19.10		4	7.77	408	4	13.53	1,200
4	14.77		12	18.80		8	7.92	424	8	13.46	1,190
8	15.57			Apr. 5		12	8.11	445	N	13.45	1,190
N	16.40		4	18.60			May 3		4	13.70	1,240
4	17.37		8	18.49		4	8.39	476	8	14.08	1,320
8	17.95		N	18.46		8	8.60	499	12	14.41	1,400
12	18.30		4	18.68		N	8.79	520		May 9	
	Mar. 31					4	8.93	535	4	14.70	1,470
4	18.48										

Buffalo River near Dilworth, Minn.--Continued

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 9 (cont'd.)			May 11			May 19 (cont'd.)			May 22	
8	14.89	1,520	6	14.99	1,550	8	10.39	706	6	11.91	922
N	15.03	1,560	N	14.91	1,520	12	10.83	766	N	11.93	924
4	15.12	1,580	6	14.83	1,500		May 20		6	11.95	928
8	15.18	1,600	12	14.73	1,480	4	11.21	819	12	11.98	932
12	15.20	1,600		May 12		8	11.51	862		May 23	
	May 10		8	14.59	1,440	N	11.74	896	6	11.98	932
4	15.22	1,610	4	14.41	1,400	4	11.89	918	N	11.97	930
8	15.21	1,600	12	14.25	1,360	8	11.99	934	6	11.94	926
N	15.19	1,600		May 19		12	12.01	936	12	11.88	917
4	15.16	1,590	4	9.80	632		May 21			May 24	
8	15.11	1,580	8	9.75	626	6	11.98	932	8	11.75	898
12	15.06	1,560	N	9.82	634	N	11.93	924	4	11.57	870
			4	10.00	656	6	11.90	920	12	11.34	838
						12	11.98	918			

Supplemental record.- Apr. 1, 9 a.m. 18.82 ft.; Apr. 2, 6-8 p.m., 19.75 ft.; Apr. 3, 10 a.m., 19.42 ft.; Apr. 7, 9 p.m., 18.83 ft.; Apr. 15, 10 p.m., 16.48 ft.

South Branch Buffalo River at Sabin, Minn.

Location. —Lat. 46°46'20", long. 96°37'40", in SW¼SW¼ sec. 9, T. 138 N., R. 47 W., at highway bridge, a quarter of a mile downstream from Whiskey Creek, and 1 mile east of Sabin.
Drainage area. —524 square miles.
Gage-height record. —Graph drawn on basis of once or twice-daily chain gage readings Mar. 27 to Apr. 13, Apr. 20-22, 24, 26, May 2-15, 17, 19-26, 28-31, and daily readings or average daily gage heights for all other periods except that of no flow.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Stage-discharge relation affected by ice Mar. 26-31, Apr. 12-14. Gage heights used to hundredths.
Maxima. —March-May 1950: Discharge, 1,460 second-feet 8 p. m. Apr. 1; gage height, 14.15 feet 5-6 p. m. Mar. 29.
1945 to February 1950: Discharge observed, 1,480 second-feet Mar. 18, 1945 (gage height; 14.69 feet).
Remarks. —No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	March	April	May	Day	March	April	May	Day	March	April	May
1	0	1,390	86	11	0	592	648	21	0	281	413
2	0	1,420	102	12	0	600	410	22	0	223	429
3	0	1,330	150	13	0	550	292	23	0	188	322
4	0	1,220	201	14	0	550	235	24	0	164	231
5	0	1,070	242	15	0	549	192	25	0	143	178
6	0	1,100	381	16	0	628	162	26	40	111	143
7	0	1,190	620	17	0	677	165	27	700	86	120
8	0	1,130	670	18	0	672	180	28	1,100	96	96
9	0	816	709	19	0	577	224	29	1,300	103	77
10	0	606	772	20	0	398	303	30	1,300	96	65
								31	1,400	-	54
Monthly mean discharge, in second-feet									188	619	286
Runoff, in acre-feet									11,580	36,810	17,600
Runoff, in inches									0.41	1.32	0.63

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Mar. 27			Apr. 4			Apr. 11			May 7	
6	12.44		4	12.91	1,230	4	10.55	565	4	10.56	567
N	12.79		8	12.81	1,200	8	10.49	553	8	10.57	569
6	13.21		N	12.88	1,220	N	10.49	553	N	10.75	605
12	13.73		4	12.95	1,240	4	10.86	628	4	11.05	668
	Mar. 28		8	12.86	1,220	8	10.94	644	8	11.16	693
4	13.99		12	12.64	1,140	12	10.95	646	12	11.10	679
8	14.11			Apr. 5			Apr. 12			May 8	
N	13.82		4	12.36	1,060	8	10.95		8	10.92	640
4	13.91		8	12.17	994	4	10.95		4	11.08	675
8	14.08		N	12.27	1,030	12	11.02		12	11.23	710
12	13.98		4	12.51	1,100		Apr. 13			May 9	
	Mar. 29		8	12.59	1,130	8	11.07		8	11.19	701
8	13.91		12	12.45	1,080	4	11.04		4	11.23	710
4	14.15			Apr. 6		12	10.93		12	11.28	723
12	14.07		4	12.28	1,030		May 2			May 10	
	Mar. 30		8	12.17	994	8	5.68	93	4	11.31	731
8	14.03		N	12.59	1,130	4	5.91	107	8	11.36	744
4	13.96		4	12.71	1,170	12	6.21	125	N	11.48	776
12	13.91		8	12.69	1,160		May 3		4	11.57	803
	Mar. 31		12	12.69	1,160	8	6.49	141	8	11.61	815
6	13.91			Apr. 7		4	6.76	160	12	11.58	806
N	13.83		N	12.77	1,190	12	6.99	176		May 11	
6	13.66		12	12.86	1,220		May 4		4	11.49	779
12	13.38			Apr. 8		8	7.25	194	8	11.33	736
	Apr. 1		8	12.79	1,190	4	7.47	210	N	10.98	653
4	13.23	1,340	4	12.45	1,080	12	7.66	223	4	10.53	561
8	13.15	1,310	12	12.18	998		May 5		8	10.28	515
N	13.33	1,380		Apr. 9		8	7.78	232	12	10.10	485
4	13.51	1,440	6	11.99	937	4	7.96	247		May 12	
8	13.58	1,460	N	11.61	815	12	8.25	272	6	9.86	450
12	13.55	1,450	6	11.15	691		May 6		N	9.54	409
	Apr. 2		12	10.93	642	4	8.42	287	6	9.21	370
8	13.51	1,440		Apr. 10		8	8.61	306	12	8.90	336
4	13.47	1,420	8	10.77	609	N	8.84	329		May 21	
12	13.31	1,370	4	10.72	599	4	9.56	411	8	9.41	393
	Apr. 3		12	10.63	581	8	10.41	538	4	9.76	437
4	13.16	1,320				12	10.50	555	12	9.91	457
8	13.01	1,260								May 22	
N	13.12	1,300							8	9.84	448
4	13.33	1,380							4	9.63	420
8	13.30	1,360							12	9.32	382
12	13.11	1,300									

Supplemental record. - Mar. 26, 1:30 p.m., 9.51 ft., 4:35 p.m., 9.79 ft., 6:30 p.m., 9.86 ft.; Mar. 28, 2 p.m., 13.62 ft., 6 p.m., 14.14 ft.; Apr. 11, 10 a.m., 10.47 ft., 549 sec.-ft.

Wild Rice River of Minnesota Basin

Wild Rice River at Twin Valley, Minn.

Location.—Lat. 47°16'00", long. 96°14'40", in NE¼ sec. 27, T. 144 N., R. 44 W., three-quarters of a mile northeast of village of Twin Valley, and about 2 miles upstream from a small tributary which enters from the right at Heiberg.

Drainage area.—888 square miles.

Gage-height record.—Water-stage recorder graph except for periods 12:01 to 9:40 a.m. Apr. 1, 12:30-11 a.m. June 15, for which graphs were drawn based on record before and after period, 11:45 a.m. July 24 to 12 m. July 31, when occasional gage readings were obtained, and 11 p.m. Apr. 7 to 11 a.m. Apr. 10, 6 p.m. Apr. 11 to 7 p.m. Apr. 14, when no record was obtained.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 3,100 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-15. Discharge for periods of no gage-height record computed on basis of records for Wild Rice River near Ada and Marsh River below Ada.

Maxima.—April-July 1950: Discharge, 4,380 second-feet 10 a.m. June 26 (gage height, 12.02 feet). 1909-17, 1930 to March 1950: Discharge, 9,200 second-feet July 22, 1909 (gage height, 20.0 feet, site and datum then in use).

Remarks.—Flow partly regulated by Rice Lake and many other small lakes above station. Diurnal fluctuation caused by operation of mill at Faith, 17 miles above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	500	1,720	1,240	1,810	16	2,060	2,200	551	553
2	420	1,680	1,160	1,560	17	2,450	2,140	511	553
3	400	1,840	1,100	1,280	18	2,850	2,050	482	531
4	400	2,000	1,030	1,140	19	2,710	2,020	453	509
5	400	2,140	970	990	20	2,280	2,440	429	478
6	460	2,510	922	890	21	1,940	2,590	407	467
7	460	2,590	875	815	22	1,930	2,560	387	427
8	430	2,740	828	718	23	1,910	2,350	381	407
9	480	3,390	798	670	24	1,900	2,160	365	377
10	600	3,330	754	622	25	1,880	2,040	1,220	350
11	600	3,240	708	694	26	1,790	1,880	3,610	320
12	600	3,000	680	694	27	1,750	1,780	2,830	295
13	575	2,800	660	670	28	1,720	1,670	2,860	262
14	810	2,540	629	646	29	1,710	1,530	2,470	262
15	1,300	2,370	592	576	30	1,740	1,420	2,170	240
					31	-	1,320	-	222
Monthly mean discharge, in second-feet						1,302	2,259	1,069	646
Runoff, in acre-feet						77,460	138,900	63,610	39,720
Runoff, in inches						1.64	2.93	1.34	0.84

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 18			Apr. 22			May 6	
2	7.43		2	9.94	2,780	4	8.53	1,980	4	9.39	2,440
4	7.42		4	10.02	2,830	8	8.48	1,950	8	9.50	2,510
6	7.39		6	9.99	2,810	N	8.40	1,910	N	9.53	2,530
8	7.35		8	10.01	2,830	4	8.34	1,880	4	9.56	2,550
10	7.27		10	10.02	2,830	8	8.37	1,900	8	9.57	2,550
N	6.92		N	10.03	2,840	12	8.38	1,900	12	9.58	2,560
2	7.45		2	10.05	2,850		Apr. 23			May 7	
4	8.44		4	10.09	2,880	8	8.40	1,910	4	9.60	2,570
6	8.02		6	10.12	2,900	4	8.40	1,910	8	9.60	2,570
8	8.42		8	10.15	2,920	12	8.41	1,920	N	9.61	2,580
10	8.10		10	10.15	2,920		May 2		4	9.63	2,590
12	8.19		12	10.10	2,880	6	7.88	1,680	8	9.67	2,610
	Apr. 16			Apr. 19		N	7.87	1,670	12	9.70	2,630
2	8.30	1,860	2	10.08	2,870	6	7.88	1,680		May 8	
4	8.37	1,900	4	10.05	2,850	12	7.93	1,700	4	9.72	2,640
6	8.38	1,900	6	9.99	2,810		May 3		8	9.74	2,650
8	8.43	1,920	8	9.95	2,790	4	8.02	1,730	N	9.76	2,670
10	8.46	1,940	10	9.90	2,760	8	8.15	1,790	4	9.87	2,740
N	8.62	2,020	N	9.82	2,700	N	8.26	1,840	8	10.08	2,870
2	8.64	2,030	2	9.76	2,670	4	8.40	1,910	12	10.41	3,100
4	8.85	2,150	4	9.73	2,650	8	8.50	1,960		May 9	
6	9.07	2,270	6	9.66	2,610	12	8.53	1,980	2	10.51	3,170
8	9.18	2,330	8	9.62	2,580		May 4		4	10.63	3,260
10	9.21	2,350	10	9.56	2,550	4	8.56	1,990	6	10.75	3,360
12	9.42	2,460	12	9.51	2,520	8	8.57	2,000	8	10.71	3,330
	Apr. 17			Apr. 20		N	8.58	2,000	10	10.84	3,430
2	9.49	2,500	6	9.29	2,390	4	8.57	2,000	N	10.86	3,450
4	9.47	2,490	N	9.08	2,270	8	8.58	2,000	2	10.93	3,500
6	9.43	2,470	6	8.87	2,160	12	8.63	2,030	4	10.93	3,500
8	9.38	2,440	12	8.67	2,050		May 5		6	10.90	3,480
10	9.34	2,420		Apr. 21		4	8.68	2,050	8	10.87	3,460
N	9.29	2,390	4	8.49	1,960	8	8.73	2,080	10	10.88	3,460
2	9.31	2,400	8	8.38	1,900	N	8.79	2,110	12	10.92	3,500
4	9.33	2,410	N	8.37	1,900	4	8.87	2,160		May 10	
6	9.33	2,410	4	8.41	1,920	8	9.05	2,260	4	10.86	3,450
8	9.34	2,420	8	8.48	1,950	12	9.26	2,370	8	10.77	3,380
10	9.44	2,470	12	8.52	1,970				N	10.67	3,300
12	9.70	2,630							4	10.62	3,260

Wild Rice River at Twin Valley, Minn. (cont'd.)

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 10 (cont'd.)			May 13 (cont'd.)			June 25 (cont'd.)			June 26 (cont'd.)	
8	10.61	3,250	4	9.88	2,730	6	8.47	1,840	8	10.82	3,420
12	10.58	3,220	8	9.95	2,780	8	8.86	2,070	10	10.59	3,230
	May 11		12	9.79	2,660	10	9.29	2,320	12	10.43	3,110
4	10.58	3,220		May 14		12	9.77	2,650		June 27	
8	10.69	3,310	8	9.67	2,580		June 26		4	10.22	2,960
N	10.68	3,300	4	9.56	2,500	2	10.12	2,890	8	10.09	2,870
4	10.61	3,250	12	9.49	2,450	4	10.44	3,120	N	19.91	2,750
8	10.49	3,150		June 25		6	11.05	3,600	4	9.84	2,700
12	10.38	3,080	2	3.59	365	8	11.84	4,230	8	9.88	2,730
	May 12		4	4.05	457	10	12.02	4,380	12	9.98	2,800
6	10.29	3,010	6	5.07	687	N	11.75	4,160		June 28	
N	10.25	2,980	8	5.18	713	2	11.56	4,010	4	10.17	2,930
6	10.25	2,980	10	5.21	720	4	11.35	3,840	8	10.19	2,940
12	10.18	2,940	N	6.49	1,050	6	11.09	3,630	N	10.19	2,940
	May 13		2	7.18	1,270				4	10.08	2,870
4	10.07	2,860	4	7.88	1,550				8	9.91	2,750
8	10.02	2,820							12	9.77	2,650
N	9.99	2,800									

Supplemental record.- Apr. 15, 4:30 p.m., 8.53 ft., 6:30 p.m., 8.77 ft.; Apr. 18, 8:30 p.m., 10.18 ft., 2,940 sec.-ft.; Apr. 21, 10 a.m., 8.36 ft., 1,890 sec.-ft.; May 9, 5:30 p.m., 10.96 ft., 3,530 sec.-ft.; May 11, 7:15 a.m., 10.84 ft., 3,430 sec.-ft.; June 25, 5 a.m., 5.01 ft., 672 sec.-ft.; June 25, 9 a.m., 5.09 ft., 692 sec.-ft.; June 26, 9 a.m., 11.85 ft., 4,240 sec.-ft.; June 27, 6 a.m., 10.19 ft., 2,940 sec.-ft.

Wild Rice River near Ada, Minn.

Location. —Lat. 47°15'50", long. 96°30'00", in NE¼ sec. 28, T. 144 N., R. 46 W., at highway bridge, 2.3 miles south of Ada.

Gage-height record. —Graph drawn on basis of once-daily readings of staff gage or auxiliary chain gage Apr. 14-21, May 2-10, 19-23, June 26-30, and daily gage heights for all other periods.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 1,400 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-15. Discharge for periods of no gage-height record computed on basis of records for Wild Rice River at Hendrum and Marsh River below Ada.

Maxima. —April-July 1950: Discharge, 1,720 second-feet 12 m. June 26 (gage height, 10.31 feet, from graph based on gage readings).

1948 to March 1950: Discharge observed, 662 second-feet July 8, 1949; gage height, 10.30 feet Mar. 28, 1950 (backwater from ice).

Remarks. — Flow diverted into Marsh River through two overflow sections, the points of divergence being 2¼ and 6 miles above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	380	551	348	681	16	826	705	131	118
2	360	561	330	500	17	861	677	121	113
3	360	687	310	390	18	957	651	103	107
4	340	860	290	300	19	897	644	95	95
5	380	1,090	274	240	20	805	799	89	83
6	440	1,060	244	212	21	678	853	78	78
7	500	1,020	230	194	22	613	812	63	68
8	500	979	216	174	23	600	756	68	56
9	460	1,140	205	155	24	601	722	68	44
10	460	1,060	194	143	25	595	681	1,000	34
11	460	1,010	180	137	26	571	591	1,570	28
12	440	950	168	168	27	525	537	1,560	22
13	420	904	168	149	28	533	480	1,140	18
14	500	860	155	149	29	521	439	949	13
15	750	781	143	125	30	540	411	791	11
					31	-	376	-	8.3
Monthly mean discharge, in second-feet						562	763	376	149
Runoff, in acre-feet						33,470	46,900	22,380	9,150
Runoff, in inches						-	-	-	-

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 14			Apr. 19			May 7			May 22	
4	7.37		8	8.06	906	8	8.56	1,030	8	7.67	821
8	7.34		4	7.99	890	4	8.51	1,010	4	7.57	800
N	7.36		12	7.88	866	12	8.38	981	12	7.50	785
4	7.42			Apr. 20			May 8			May 23	
8	7.51		8	7.72	831	4	8.28	957	4	7.40	764
12	7.62		4	7.50	785	8	8.22	943	8	7.31	745
	Apr. 15		12	7.24	730	N	8.24	948	12	7.25	732
4	7.73			Apr. 21		4	8.35	974		June 26	
8	7.80		8	7.04	689	8	8.53	1,020	4	9.60	1,400
N	7.84		4	6.90	661	12	8.75	1,080	8	10.00	1,580
4	7.84		12	6.78	637		May 9		N	10.14	1,640
8	7.82			May 2		4	8.94	1,140	4	10.22	1,680
12	7.78		8	6.32	545	8	9.03	1,170	8	10.29	1,710
	Apr. 16		4	6.40	561	N	9.04	1,170	12	10.31	1,720
4	7.73	833	12	6.64	609	4	8.99	1,160		June 27	
8	7.69	825		May 3		8	8.51	1,130	4	10.29	1,710
N	7.67	821	8	6.90	661	12	8.83	1,100	8	10.20	1,670
4	7.66	819	4	7.16	714		May 10		N	10.00	1,580
8	7.67	821	12	7.40	764	8	8.71	1,070	4	9.80	1,490
12	7.70	827		May 4		4	8.62	1,040	8	9.60	1,400
	Apr. 17		8	7.60	806	12	8.58	1,030	12	9.40	1,310
4	7.73	833	4	7.98	888		May 19			June 28	
8	7.77	842	12	8.48	1,010	8	6.69	619	8	9.04	1,170
N	7.81	850		May 5		4	4.80	641	4	8.78	1,090
4	7.83	855	4	8.70	1,060	12	7.16	714	12	8.58	1,030
8	8.00	892	8	8.84	1,110		May 20			June 29	
12	8.30	962	N	8.90	1,120	8	7.53	791	8	8.36	976
	Apr. 18		4	8.90	1,120	4	7.70	827	4	8.12	920
4	8.39	984	8	8.78	1,090	12	7.78	844	12	7.90	870
8	8.34	972	12	8.83	1,100		May 21			June 30	
N	8.29	960		May 6		4	7.81	850	8	7.64	814
4	8.23	945	8	8.73	1,070	8	7.83	855	4	7.40	764
8	8.19	936	4	8.62	1,040	N	7.84	857	12	7.18	718
12	8.14	924	12	8.58	1,030	4	7.85	859			
						8	7.83	855			
						12	7.78	844			

Supplemental record. - Apr. 18, 3 a.m., 8.40 ft., 986 sec.-ft.; May 9, 10 a.m., 9.05 ft., 1,180 sec.-ft.

Wild Rice River at Hendrum, Minn.

Location. —Lat. 47°16'05", long. 96°47'50", in SE¼ sec. 19, T. 144 N., R. 48 W., at highway bridge half a mile east of Hendrum, and 4 miles upstream from mouth.

Drainage area. —1,600 square miles.

Gage-height record. —Chain gage readings twice daily except May 21 and June 1 when once-daily readings were obtained and June 24-30 which were computed from graphs.

Discharge record. —Stage-discharge relation not determined for high stages due to backwater from Red River of the North except for period June 26-30 for which relation was defined by current-meter measurements below 2,000 second-feet. Stage-discharge relation affected by ice Apr. 1-16 and by backwater from Red River of the North Apr. 17 to June 25 (discharge computed on basis of 7 discharge measurements and records for station near Ada). Gage heights used to hundredths.

Maxima. —April-June 1950: Daily discharge, 3,000 second-feet May 10; gage height observed, 25.09 feet 8:37 a.m. Apr. 8 (backwater from ice).
1944 to March 1950: Daily discharge, 4,200 second-feet Apr. 15, 16, 1947; gage height observed, 27.70 feet Apr. 15, 1947.

Remarks. —Flow diverted into Marsh River through two overflow sections, the points of divergence being 2½ miles and 6 miles upstream from station near Ada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1,300	750	400	11	1,600	2,800	260	21	2,200	1,400	110
2	1,700	850	380	12	1,700	2,800	240	22	1,800	1,200	95
3	2,000	1,600	360	13	1,800	2,600	240	23	1,600	1,000	85
4	2,200	2,000	340	14	1,800	2,400	260	24	1,200	850	85
5	2,400	2,400	320	15	1,900	2,200	260	25	1,000	800	190
6	2,400	2,800	300	16	2,200	2,000	260	26	800	750	1,200
7	2,400	2,800	280	17	2,200	1,800	220	27	800	700	1,810
8	1,700	2,600	280	18	2,800	1,400	200	28	650	550	1,940
9	1,700	2,800	280	19	2,800	1,200	170	29	700	500	1,840
10	1,700	3,000	260	20	2,400	1,200	130	30	700	460	1,680
								31	-	440	-
Monthly mean discharge, in second-feet									1,738	1,634	482
Runoff, in acre-feet									103,400	100,500	28,710
Runoff, in inches									1.21	1.18	0.33

Goose River Basin

Goose River at Portland, N. Dak.

Location. —Lat. 47°33', long. 97°28', on line between secs. 12 and 13, T. 147 N., R. 54 W., at highway bridge 6½ miles northwest of Portland. Datum of gage is 978.76 feet above mean sea level, datum of 1929.

Drainage area. —544 square miles.

Gage-height record. —Graph based on one or more daily chain gage readings.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-17. Discharge for periods Apr. 17-23, May 6-14, computed by using rate of change of stage as a factor.

Maxima. —April-June 1950: Discharge, 8,090 second-feet 4 a.m. May 9; gage height, 22.98 feet, Apr. 18, May 9.

1939 to March 1950: 4,700 second-feet Apr. 21, 1948 (gage height, 21.30 feet).

Remarks. —Minor regulation and diversions above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	75	221	123	11	250	4,400	40	21	2,970	625	43
2	70	255	107	12	200	3,870	43	22	1,940	558	39
3	65	347	97	13	160	3,140	39	23	1,430	431	35
4	60	379	86	14	160	2,080	36	24	1,090	339	35
5	60	508	77	15	225	1,390	37	25	794	274	38
6	85	1,160	67	16	690	962	43	26	543	241	49
7	210	2,370	61	17	3,400	721	54	27	341	212	90
8	220	4,430	56	18	6,820	596	62	28	221	187	74
9	300	6,800	50	19	5,180	533	53	29	191	163	68
10	320	5,060	44	20	4,130	542	46	30	220	150	49
								31	-	139	-
Monthly mean discharge, in second-feet									1,081	1,390	58
Runoff, in acre-feet									64,300	85,450	3,450
Runoff, in inches									2.22	2.95	0.12

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 25			May 6			May 16	
6	7.04	170	N	10.48	792	N	12.40	1,110	8	11.77	1,010
N	7.35	190	12	9.60	656	12	14.70	1,700	4	11.14	899
6	8.28	270		Apr. 26			May 7		12	10.62	814
12	9.45	380	N	8.77	539	8	16.12	2,290		May 17	
	Apr. 16		12	8.00	439	4	17.10	2,590	8	10.19	745
N	11.81	660		Apr. 27		12	17.67	2,780	4	9.82	689
6	12.87	800	N	7.13	333		May 8		12	9.53	646
12	15.20	1,200	12	6.45	259	6	18.10	3,100		May 18	
	Apr. 17			Apr. 28		N	19.00	3,950	N	9.18	595
6	18.35	2,100	N	6.02	216	6	20.40	5,510	12	8.86	551
N	19.53	3,000	12	5.78	194	12	22.08	7,550		May 19	
6	20.50	5,020		Apr. 29			May 9		N	8.68	527
12	21.28	5,700	8	5.71	188	4	22.82	8,090	12	8.68	527
	Apr. 18		4	5.72	189	8	22.98	7,500		May 20	
6	21.89	6,350	12	5.85	200	N	22.82	6,640	N	8.74	535
N	22.40	7,150		Apr. 30		6	22.46	6,020	6	8.82	546
4	22.72	7,620	6	6.03	217	12	22.06	5,480	12	9.08	581
8	22.98	7,500	N	6.12	226		May 10			May 21	
12	22.70	6,150	12	6.10	224	6	21.74	5,200	4	9.39	625
	Apr. 19			May 1		N	21.51	5,060	8	9.51	642
6	22.08	5,280	4p	6.04	218	12	21.16	4,700	4	9.44	632
N	21.70	5,150	12	6.10	224		May 11		12	9.27	608
12	21.19	4,660		May 2		N	20.80	4,380		May 22	
	Apr. 20		8	6.26	240	12	20.48	4,120	N	8.94	562
N	20.67	4,140	4	6.51	265		May 12		12	8.48	501
12	20.02	3,580	12	6.82	297	N	20.18	3,870		May 23	
	Apr. 21			May 3		12	19.85	3,630	N	7.90	426
N	19.22	3,000	N	7.34	358		May 13		6	7.66	396
6	18.67	2,650	4	7.42	367	8	19.60	3,360	12	7.50	377
12	18.00	2,320	12	7.44	370	4	19.10	2,940		May 24	
	Apr. 22			May 4		12	18.45	2,580	N	7.18	339
N	16.62	1,920	6p	7.53	381		May 14		12	6.86	302
12	15.33	1,620	12	7.66	396	N	17.19	2,060		May 25	
	Apr. 23			May 5		12	15.65	1,630	N	6.56	270
N	14.20	1,420	8	8.01	440		May 15		12	6.40	254
12	13.24	1,260	4	8.75	536	N	13.99	1,400		May 26	
	Apr. 24		12	9.90	701	12	12.56	1,140	N	6.27	241
N	12.25	1,090							12	6.14	228
12	11.35	934								May 27	
									N	5.98	212

Goose River at Hillsboro, N. Dak.

Location. —Lat. 47°24', long. 97°03', in NW¼ sec. 5, T. 145 N., R. 50 W., 50 feet upstream from city water supply dam in Hillsboro.

Drainage area. —1,200 square miles.

Gage-height record. —Water-stage recorder graph except for periods Apr. 8-21, 23, 24, May 7-16, when graph was drawn on basis of one to four daily readings from reference point, and Apr. 22, May 5, 6, when there was no record.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-17; discharge computed on basis of five discharge measurements, gage heights, weather records, and records for station near Portland. No gage-height record Apr. 22, May 5, 6; discharge computed on basis of weather records and records for station near Portland. Discharge for Apr. 18-21, 23-25, May 7-17 computed using rate of change of stage as a factor. Shifting-control method used June 10-30.

Maxima. —April-June 1950: Discharge, 9,420 second-feet 12 N. Apr. 19; gage height, 14.94 feet, 4 p. m. Apr. 19.

1931 to March 1950: Discharge, 4,180 second-feet Apr. 16, 1948 (gage height, 10.65 feet).

Remarks. —No diversions. Minor regulation at low stage by several small dams.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	220	471	251	11	1,350	6,920	110	21	5,970	1,130	106
2	270	530	230	12	1,000	5,960	106	22	5,100	1,170	106
3	280	626	201	13	900	5,250	103	23	4,240	1,090	106
4	300	842	196	14	900	4,620	100	24	2,780	859	103
5	340	1,500	183	15	1,600	3,650	100	25	2,080	688	113
6	550	2,700	166	16	2,450	2,540	97	26	1,490	563	126
7	1,050	4,430	155	17	3,200	1,920	97	27	1,030	481	136
8	1,800	4,780	144	18	4,820	1,360	103	28	712	422	140
9	2,000	5,200	129	19	8,340	1,130	106	29	522	373	151
10	2,000	7,590	120	20	7,290	1,100	106	30	462	330	159
								31	-	289	-
Monthly mean discharge, in second-feet									2,168	2,275	135
Runoff, in acre-feet									129,000	139,900	8,030
Runoff, in inches									2.02	2.19	0.13

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	April 18			April 25			May 3			May 12	
N	11.52	4,960	6	5.98	2,220	N	1.53	613	N	13.64	5,980
6	11.87	5,200	N	5.25	2,110	12	1.63	688	12	13.30	5,570
12	12.32	5,650	6	4.50	1,950		May 4			May 13	
	April 19		12	3.75	1,780	N	1.78	809	N	12.93	5,240
4	12.79	6,990		April 26		12	2.07	1,060	12	12.48	4,940
8	14.26	9,150	6	3.14	1,640		May 7			May 14	
N	14.76	9,420	N	2.64	1,480	6	9.74	4,430	N	12.00	4,640
4	14.94	9,130	6	2.39	1,340	N	10.30	4,420	12	11.46	4,270
8	14.84	8,500	12	2.25	1,220	6	10.67	4,500		May 15	
12	14.73	8,110		April 27		12	10.98	4,590	6	11.04	3,920
	April 20		N	2.03	1,030		May 8		N	10.48	3,700
N	14.36	7,240	12	1.83	850	N	11.42	4,800	2	10.41	3,620
12	14.01	6,560		April 28		12	11.80	4,950	12	9.23	2,960
	April 21		N	1.65	704		May 9			May 16	
N	13.66	5,920	12	1.50	591	N	12.15	5,170	N	7.55	2,490
12	13.25	5,470		April 29		8	12.39	5,340	12	5.90	2,220
	April 23		N	1.39	514	12	12.58	5,670		May 17	
6	12.07	4,600	12	1.32	467		May 10		N	4.40	1,930
N	11.70	4,360		April 30		4	12.89	6,120	12	2.97	1,590
6	11.30	3,920	N	1.31	461	8	13.66	7,910		May 18	
12	10.52	3,400	12	1.31	461	N	14.40	8,520	6	2.56	1,440
	April 24			May 1		5	14.64	8,200	N	2.38	1,330
6	9.65	3,010	N	1.32	467	12	14.56	7,750	12	2.22	1,200
N	8.74	2,710	12	1.35	488		May 11			May 19	
6	7.82	2,530		May 2		N	14.16	6,800	N	2.13	1,120
12	6.88	2,310	N	1.40	521	12	13.84	6,330	12	2.10	1,090
			12	1.50	591						

Marsh River Basin

Marsh River below Ada, Minn.

Location.—Lat. 47°17'50", long. 96°33'50", in NW¼NW¼ sec. 18, T. 144 N., R. 46 W., at bridge on farm lane 1.9 miles west of Ada.

Gage-height record.—Graph drawn on basis of twice daily chain gage readings Apr. 15-20, May 2-5, 19-21, June 24 to July 4 except for period June 26 to July 2 when graph was based on one reading and the highwater mark, and average daily gage heights for all other periods.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 1,700 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-14.

Maxima.—April-July 1950: Discharge, 1,850 second-feet about 8 p. m. June 27 (gage height, 14.57 feet, from floodmark).

1949 to March 1950: Discharge observed, 683 second-feet June 1, 1949 (gage height, 10.80 feet).

Remarks.—No regulation. Unknown amount of water from Wild Rice River enters Marsh River about 5 miles above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	200	830	782	1,490	16	644	1,500	459	495
2	200	835	757	1,340	17	1,310	1,450	426	494
3	200	906	729	1,150	18	1,580	1,430	408	480
4	200	1,210	699	940	19	1,560	1,420	387	469
5	190	1,440	674	811	20	1,510	1,540	367	449
6	220	1,560	644	745	21	1,380	1,620	345	424
7	320	1,600	620	685	22	1,210	1,570	316	413
8	340	1,610	597	633	23	1,090	1,560	324	384
9	340	1,660	570	588	24	1,040	1,520	317	356
10	400	1,750	557	552	25	1,020	1,480	489	332
11	420	1,700	536	525	26	977	1,370	1,000	314
12	420	1,670	524	557	27	909	1,220	1,740	297
13	440	1,620	517	553	28	866	1,060	1,740	276
14	460	1,570	500	552	29	840	950	1,660	259
15	517	1,530	483	531	30	830	882	1,580	222
					31	-	823	-	218
Monthly mean discharge, in second-feet						721	1,383	692	566
Runoff, in acre-feet						42,910	85,060	41,150	34,800
Runoff, in inches						-	-	-	-

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 18 (cont'd.)			May 4			June 24	
8	8.32	510	4	14.28	1,590	8	13.56	1,090	8	6.72	313
4	8.38	516	12	14.21	1,530	4	13.99	1,350	4	6.68	307
12	8.72	550		Apr. 19		12	14.08	1,420	12	6.93	340
	Apr. 16		8	14.22	1,540		May 5			June 25	
4	8.98	576	4	14.26	1,580	8	14.05	1,400	4	7.22	378
8	9.32	610	12	14.26	1,580	4	14.11	1,450	8	7.62	429
N	9.61	639		Apr. 20		12	14.20	1,520	N	8.04	479
4	9.97	671	8	14.19	1,520		May 19		4	8.56	534
8	10.47	713	4	14.15	1,480	8	14.04	1,390	8	9.24	602
12	11.09	761	12	14.13	1,470	4	14.09	1,430	12	10.12	685
	Apr. 17			May 2		12	14.12	1,460		July 3	
4	12.02	837	8	11.95	830		May 20		8	13.77	1,190
8	13.47	1,070	4	11.99	834	8	14.13	1,470	4	13.58	1,100
N	14.21	1,530	12	12.14	852	4	14.26	1,580	12	13.29	1,020
4	14.32	1,630		May 3		12	14.34	1,650		July 4	
8	14.31	1,620	8	12.39	882		May 21		8	12.99	962
12	14.30	1,610	4	12.70	921	8	14.31	1,620	4	12.63	912
	Apr. 18		12	13.07	977	4	14.30	1,610	12	12.31	872
8	14.28	1,590				12	14.28	1,590			

Supplemental record.—Apr. 19, 8 p. m., 14.28 ft., 1,590 sec.-ft.; June 26, 5:30 a. m., 12.74 ft., 926 sec.-ft.; June 27, about 8 p. m., 14.57 ft., 1,850 sec.-ft.

Marsh River near Shelly, Minn.

Location.—Lat. 47°24'45", long. 96°45'50", in NE¼NE¼ sec. 3, T. 145 N., R. 48 W., at bridge, 3-3/4 miles southeast of Shelly and 10 miles upstream from mouth.
Drainage area.—151 square miles.
Gage-height record.—Graph drawn on basis of twice-daily chain gage readings Apr. 14-27, May 2-29, June 21 to July 6 except for period May 10-12 when graph was based on once-daily reference marks, and average daily gage heights for all other periods.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 3,800 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-15.
Maxima.—April-July 1950: Discharge, 4,660 second-feet about 12 m. May 11 (gage height, 18.96 feet, from floodmark).
1944 to March 1950: Discharge, 4,150 second-feet Apr. 14, 1947 (gage height, 17.80 feet, from floodmark).
Remarks.—No regulation. Unknown amount of water from Wild Rice River enters Marsh River about 5 miles above gaging station below Ada.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	650	1,480	1,230	2,990	16	1,910	2,690	564	602
2	700	1,540	1,170	2,440	17	2,120	2,450	527	570
3	700	1,930	1,100	2,060	18	2,750	2,220	490	554
4	700	2,250	1,030	1,700	19	3,620	2,060	455	522
5	700	2,470	975	1,430	20	3,530	2,120	439	490
6	700	3,060	937	1,280	21	3,280	2,250	410	474
7	700	3,530	882	1,080	22	2,950	2,500	381	458
8	700	3,680	832	924	23	2,520	2,540	356	442
9	700	3,980	783	828	24	2,120	2,470	346	410
10	700	4,380	734	733	25	1,900	2,340	636	378
11	700	4,640	708	686	26	1,740	2,150	926	346
12	700	4,350	683	660	27	1,650	1,920	1,690	330
13	700	3,760	658	635	28	1,510	1,730	3,180	298
14	1,000	3,330	632	652	29	1,470	1,570	3,990	298
15	1,500	2,980	602	635	30	1,480	1,410	3,560	267
					31	-	1,340	-	252
Monthly mean discharge, in second-feet						1,537	2,617	1,030	820
Runoff, in acre-feet						91,440	160,900	61,300	50,430
Runoff, in inches						11	20	7.6	6.3

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 14			Apr. 21			May 4			May 11 (cont'd.)	
4	9.94		8	16.52	3,320	8	13.02	2,230	8	18.92	4,640
8	9.91		4	16.32	3,250	4	13.20	2,280	12	18.88	4,610
N	9.94		12	15.94	3,110	12	13.37	2,320		May 12	
4	10.08			Apr. 22			May 5		8	18.66	4,470
8	10.30		8	15.57	2,990	8	13.58	2,380	4	18.35	4,270
12	10.62		4	15.37	2,920	4	14.02	2,510	12	17.96	4,030
	Apr. 15		12	15.12	2,840	12	14.72	2,720		May 13	
4	10.93			Apr. 23			May 6		8	17.62	3,820
8	11.22		4	14.78	2,730	4	15.05	2,830	4	17.35	3,680
N	11.47		8	14.38	2,610	8	15.47	2,950	12	17.02	3,520
4	11.57		N	13.98	2,490	N	15.80	3,060		May 14	
8	11.61		4	13.68	2,410	4	16.12	3,180	8	16.72	3,400
12	11.64		8	13.42	2,340	8	16.40	3,280	4	16.38	3,270
	Apr. 16		12	13.21	2,280	12	16.62	3,360	12	15.96	3,120
8	11.72	1,680		Apr. 24			May 7			May 15	
4	11.90	1,930	8	12.82	2,170	4	16.80	3,430	8	15.74	3,040
12	12.15	1,990	4	12.46	2,070	8	16.98	3,500	4	15.42	2,940
	Apr. 17		12	12.14	1,990	N	17.10	3,560	12	15.06	2,820
8	12.46	2,070		Apr. 25		4	17.20	3,600		May 16	
4	12.78	2,160	8	11.89	1,920	8	17.24	3,620	8	14.76	2,730
12	13.22	2,280	4	11.68	1,870	12	17.26	3,630	4	14.46	2,640
	Apr. 18		12	11.45	1,810		May 8		12	14.20	2,560
4	13.60	2,390		Apr. 26		8	17.28	3,640		May 17	
8	14.12	2,540	8	11.20	1,750	4	17.38	3,690	8	13.93	2,480
N	14.66	2,700	4	11.06	1,720	12	17.62	3,820	4	13.68	2,410
4	15.34	2,910	12	10.97	1,690		May 9		12	13.42	2,340
8	16.05	3,150		Apr. 27		8	17.85	3,960		May 18	
12	16.66	3,370	8	10.88	1,670	4	17.96	4,030	8	13.15	2,260
	Apr. 19		4	10.78	1,640	12	18.08	4,100	4	12.84	2,180
4	17.10	3,560	12	10.62	1,600		May 10		12	12.52	2,090
8	17.28	3,640		May 2		8	18.40	4,300		May 19	
N	17.36	3,680	8	10.17	1,490	4	18.68	4,480	4	12.42	2,060
4	17.36	3,680	4	10.34	1,540	12	18.84	4,590	8	12.37	2,050
8	17.34	3,670	12	10.90	1,680		May 11		N	12.33	2,040
12	17.28	3,640		May 3		4	18.90	4,620	4	12.34	2,040
	Apr. 20		8	11.60	1,850	8	18.94	4,650	8	12.40	2,060
8	17.12	3,560	4	12.25	2,020	N	18.96	4,660	12	12.44	2,070
4	16.98	3,500	12	12.76	2,150	4	18.94	4,650			
12	16.76	3,410									

Marsh River near Shelly, Minn.—Continued.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 20			May 24 (cont'd.)			June 27			July 1	
8	12.56	2,100	4	13.94	2,480	4	9.16	1,260	8	15.90	3,100
4	12.69	2,140	8	13.92	2,480	8	10.05	1,460	4	15.22	2,870
12	12.84	2,180	12	13.82	2,450	N	10.96	1,690	12	14.58	2,670
	May 21			May 25		4	11.82	1,910		July 2	
8	13.00	2,220	8	13.52	2,370	8	12.62	2,120	8	14.00	2,500
4	13.16	2,260	4	13.30	2,300	12	13.58	2,380	4	13.54	2,370
12	13.46	2,350	12	13.12	2,250		June 28		12	13.08	2,240
	May 22			May 26		4	14.50	2,650		July 3	
4	13.76	2,430	8	12.88	2,190	8	15.38	2,920	8	12.62	2,120
8	13.92	2,480	4	12.60	2,110	N	16.18	3,200	4	12.20	2,000
N	14.06	2,520	12	12.30	2,030	4	16.92	3,480	12	11.74	1,880
4	14.12	2,540		May 27		8	17.35	3,680		July 4	
8	14.17	2,550	8	12.02	1,960	12	17.74	3,890	8	11.24	1,760
12	14.20	2,560	4	11.74	1,880		June 29		4	10.78	1,640
	May 23		12	11.48	1,820	4	17.98	4,040	12	10.35	1,540
4	14.22	2,570		May 28		8	18.02	4,060		July 5	
8	14.21	2,560	8	11.22	1,760	N	18.00	4,050	8	10.00	1,450
N	14.18	2,550	4	10.98	1,700	4	17.92	4,000	4	9.76	1,390
4	14.10	2,530	12	10.76	1,640	8	17.80	3,930	12	9.58	1,350
8	14.02	2,510		May 29		12	17.62	3,820		July 6	
12	13.94	2,480	8	10.55	1,590		June 30		8	9.42	1,310
	May 24		4	10.38	1,540	8	17.28	3,640	4	9.20	1,260
4	13.86	2,460	12	10.28	1,520	4	16.90	3,470	12	8.90	1,200
8	13.82	2,450				12	16.48	3,310			
N	13.88	2,470									

Supplemental record.- Apr. 14, 9 a.m., 9.90 ft., Apr. 22, 8 p.m., 15.28 ft., 2,890 sec.-ft.
May 24, 6 p.m., 13.95 ft., 2,490 sec.-ft.

Sand Hill River Basin

Sand Hill River at Beltrami, Minn.

Location. —Lat. 47°32'50", long. 96°32'00", in NE¼SW¼ sec. 16, T. 174 N., R. 46 W., at highway bridge in Beltrami, a quarter of a mile north of post office. Datum of gage is 896.80 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Drainage area. —324 square miles (includes that of Sand Hill ditch as the two are cross-connected).

Gage-height record. —Graph drawn on basis of daily staff gage readings Apr. 4-7, 16, 17, 19, 20. Daily staff gage readings at various other periods.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 250 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-16. Discharge for periods of no gage-height record computed on basis of records for Sand Hill ditch at Beltrami were interpolated.

Maxima. —April-June 1950: Discharge, 291 second-feet about 2 p.m. Apr. 19 (gage height, 5.97 feet, from floodmark).

1943 to March 1950: Discharge observed, 167 second-feet June 12, 1947; gage height observed, 5.40 feet Apr. 4, 1943.

Remarks. —Diversion through Sand Hill ditch from point 5 miles above station returns to river 4 miles below station. Flow affected by storage in lakes above station. Gage heights furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	65	15	11	1.0	106	6.7	21	144	95	6.4
2	0	66	14	12	.8	81	6.7	22	131	65	6.1
3	0	68	13	13	.7	87	6.7	23	69	53	6.1
4	0	80	13	14	1.4	87	6.7	24	69	49	8.0
5	0	144	12	15	3.8	87	6.4	25	61	45	20
6	.3	162	10	16	13	87	5.9	26	59	36	35
7	3.6	160	8.5	17	46	108	5.9	27	58	26	48
8	6.0	135	7.9	18	85	106	6.3	28	58	23	34
9	3.0	154	7.3	19	151	121	6.7	29	58	21	19
10	1.5	130	6.7	20	167	128	6.7	30	58	19	13
								31	-	17	-
Monthly mean discharge, in second-feet									41.6	84.2	12.3
Runoff, in acre-feet									2,480	5,180	729
Runoff, in inches									0.14	0.30	0.04

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 4			Apr. 6			Apr. 16			Apr. 19 (cont'd.)	
6	3.77		6	4.19		4	3.50		8	4.28	98
N	3.77		N	4.37		8	3.23		N	6.67	249
6	3.79		6	4.50		N	3.10		4	5.60	239
12	3.81		12	4.58		4	3.06		8	4.72	137
	Apr. 5			Apr. 7		8	3.07		12	4.41	109
6	3.81		4	4.62		12	3.08			Apr. 20	
N	3.82		8	4.60			Apr. 17		4	4.26	97
6	3.90		N	4.58		N	3.22	46	8	4.20	92
12	4.02		4	4.52		12	3.35	51	N	5.12	177
			8	4.47			Apr. 19		4	5.61	240
			12	4.40		4	3.86	72	8	5.56	233
									12	5.43	216

Supplemental record. - Apr. 19, about 2 p.m., 5.97 ft., 291 sec.-ft.

Sand Hill ditch at Beltrami, Minn.

Location.—Lat. 47°32'10", long. 96°32'00", in SE¼NW¼ sec. 21, T. 147 N., R. 46 W., at highway bridge in Beltrami, a quarter of a mile south of post office. Datum of gage is 890.88 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Drainage area.—324 square miles.

Gage-height record.—Graph drawn on basis of daily gage readings Apr. 16-20, 22-27, May 5-12, and average daily gage heights during rest of period except Mar. 1-9, 11-18, 20-26, Mar. 28 to Apr. 4, Apr. 6-14, 21, May 14, when no readings were made.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1 to Apr. 19. Discharge for periods of no gage-height record computed on basis of weather records and records for adjacent days.

Maxima.—April-June 1950: Discharge observed, 2,460 second-feet 11:50 a.m.-12 m. Apr. 20; gage height, 11.59 feet about 4 p.m. Apr. 19, from floodmark (backwater from ice).

1943 to March 1950: Discharge observed, 1,220 second-feet Apr. 16, 1947; gage height, 10.69 feet Apr. 3, 1943, present datum (backwater from ice).

Remarks.—No diversions. Ditch diverts from Sand Hill River 4½ miles above station and returns to river 3½ miles below station. No means of control at the point of diversion. Flow affected by storage in lakes above station. Gage heights furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	24	467	163	11	4	1,110	88	21	1,670	416	63
2	24	476	157	12	4	992	88	22	1,120	414	63
3	24	467	142	13	4	809	82	23	1,020	414	63
4	24	469	133	14	4	662	82	24	1,010	443	65
5	17	464	127	15	22	516	79	25	848	358	68
6	10	771	120	16	130	458	75	26	704	245	74
7	10	1,300	114	17	480	416	74	27	562	245	95
8	10	1,520	106	18	1,000	420	72	28	505	245	200
9	10	1,490	102	19	1,700	424	70	29	472	222	200
10	10	1,210	95	20	2,220	416	65	30	467	200	242
								31	-	168	-
Monthly mean discharge, in second-feet									470	588	106
Runoff, in acre-feet									27,980	36,150	6,280
Runoff, in inches									1.62	2.09	0.36

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 20			Apr. 25			May 8	
6	9.43		2	10.42	2,270	8	6.07	876	6	7.99	1,490
N	9.73		4	10.34	2,240	4	5.88	816	N	8.10	1,530
6	9.96		6	10.31	2,230	12	5.73	769	6	8.18	1,550
12	10.17		8	10.33	2,240		Apr. 26		12	8.18	1,550
	Apr. 17		10	10.60	2,330	8	5.58	724		May 9	
6	10.35		N	10.99	2,460	4	5.46	688	6	8.12	1,530
N	10.47		2	10.41	2,270	12	5.28	634	N	8.03	1,500
6	10.51		4	10.20	2,200		Apr. 27		6	7.89	1,460
12	10.48		6	10.00	2,130	8	5.07	574	12	7.65	1,380
	Apr. 18		8	9.74	2,050	4	4.93	534		May 10	
6	10.41		10	9.67	2,030	12	4.88	521	6	7.36	1,290
N	10.35		12	9.51	1,980		May 5		N	7.03	1,180
6	10.33			Apr. 22		6	4.66	467	6	6.88	1,140
12	10.43		6	7.18	1,230	N	4.60	454	12	6.80	1,110
	Apr. 19		N	6.71	1,080	6	4.58	450		May 11	
2	10.51		6	6.42	988	12	4.80	500	6	6.81	1,110
4	10.64		12	6.36	969		May 6		N	6.81	1,110
6	10.80		d			Apr. 23		6	5.20	610	6	6.80	1,110
8	11.04		6	6.40	982	N	5.72	766	12	6.71	1,080
10	11.25		N	6.51	1,020	6	6.20	918		May 12	
N	11.40		6	6.60	1,050	12	6.71	1,080	6	6.57	1,040
2	11.52		12	6.61	1,050		May 7		N	6.81	1,110
4	11.59			Apr. 24		6	7.17	1,230	6	6.80	1,110
6	11.50		8	6.59	1,040	N	7.46	1,320	12	6.17	1,080
8	11.15		4	6.50	1,010	6	7.68	1,390			
10	10.85		12	6.26	937	12	7.85	1,450			
12	10.60										

Supplemental record.—Apr. 18, 9 p.m., 10.34 ft.; Apr. 20, 9 a.m., 10.36 ft., 2,250 sec.-ft., 11 a.m., 10.94 ft., 2,450 sec.-ft.

Sand Hill River at Climax, Minn.

Location.—Lat. 47°36'10", long. 96°47'40", in SE¼SE¼ sec. 29, T. 148 N., R. 48 W., at county highway bridge, a quarter of a mile southeast of Climax. Datum of gage is 833.69 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Drainage area.—405 square miles.

Gage-height record.—Graph drawn on basis of chain gage readings Mar. 28-31, Apr. 4-15, Apr. 18-22, Apr. 24 to May 4, May 6-19. Readings from temporary staff gage Apr. 21-24. Once-daily readings for other periods except those of no gage-height record.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 2,900 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Mar. 1 to Apr. 18. Discharge for periods of no gage-height record interpolated or computed on basis of records for Sand Hill ditch at Beltrami.

Maxima.—April-June 1950: Discharge, 3,040 second-feet about 5 a.m. Apr. 22 (gage height, 16.31 feet, from floodmark).

1943 to March 1950: Discharge observed, 1,790 second-feet Apr. 19, 1947 (gage height, 13.24 feet).

Remarks.—No diversions. Flow affected by storage in lakes above station. Gage heights furnished by Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	55	869	190	11	150	2,160	92	21	2,860	580	74
2	65	1,210	190	12	160	2,030	92	22	2,890	580	60
3	75	1,620	190	13	160	1,770	92	23	2,420	580	65
4	990	1,460	163	14	240	1,590	92	24	1,980	580	70
5	100	1,770	159	15	400	1,350	92	25	1,440	580	80
6	130	2,080	143	16	650	1,000	74	26	1,010	350	81
7	200	2,270	128	17	900	762	74	27	742	350	84
8	180	2,310	116	18	1,300	580	74	28	560	350	155
9	170	2,490	108	19	1,860	596	74	29	569	350	239
10	160	2,240	107	20	2,400	688	74	30	640	350	229
								31	-	350	-
Monthly mean discharge, in second-feet									819	1,156	115
Runoff, in acre-feet									48,710	71,100	6,860
Runoff, in inches									2.26	3.29	0.32

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 4			Apr. 14			Apr. 27			May 9	
6	6.76		6	10.50		N	8.75	750	8	14.68	2,520
N	6.79		N	10.80		12	8.06	612	4	14.70	2,530
6	6.88		6	11.34			Apr. 28		12	14.28	2,400
12	7.02		12	11.41		8	7.67	550		May 10	
	Apr. 5			Apr. 15		4	7.64	546	8	13.85	2,260
6	7.16		6	11.31		12	7.69	554	4	13.59	2,180
N	7.29		N	11.17			Apr. 29		12	13.50	2,160
6	7.41		6	11.03		8	7.75	562		May 11	
12	7.50		12	11.00		4	7.82	573	8	13.52	2,160
	Apr. 6			Apr. 18		12	7.94	591	4	13.52	2,160
6	7.56		6	12.55			Apr. 30		12	13.43	2,130
N	7.72		N	12.57		8	8.08	616		May 12	
6	8.12		6	12.53		4	8.25	650	8	13.26	2,080
12	8.77		12	12.48		12	8.58	716	4	12.98	1,990
	Apr. 7			Apr. 19			May 1		12	12.68	1,900
6	9.43		6	12.41	1,820	8	9.00	805		May 13	
N	9.72		N	12.36	1,800	4	9.45	918	8	12.38	1,810
6	9.62		6	12.64	1,890	12	9.90	1,050	4	12.13	1,730
12	9.28		12	13.08	2,020		May 2		12	11.89	1,660
	Apr. 8			Apr. 20		8	10.23	1,150		May 14	
6	8.92		6	13.63	2,200	4	10.56	1,250	8	11.72	1,600
N	8.69		N	14.30	2,400	12	11.14	1,420	4	11.63	1,580
6	8.58		6	14.95	2,600		May 3		12	11.44	1,520
12	8.47		12	15.43	2,760	8	11.82	1,630		May 15	
	Apr. 9			Apr. 21		4	12.00	1,690	8	11.09	1,410
N	8.29		6	15.65	2,830	12	11.70	1,600	4	10.70	1,290
12	8.19		N	15.78	2,870		May 4		12	10.31	1,170
	Apr. 10		6	15.82	2,880	8	11.38	1,500		May 16	
N	8.10		12	16.00	2,940	4	11.08	1,400	8	9.90	1,050
12	8.00			Apr. 22		12	11.03	1,390	4	9.56	948
	Apr. 11		6	16.29	3,030		May 6		12	9.24	865
N	7.94		N	15.90	2,910	8	13.12	2,040		May 17	
12	8.00		6	15.54	2,790	4	13.44	2,140	8	8.93	788
	Apr. 12		12	15.22	2,690	12	13.72	2,220	4	8.68	736
6	8.03			Apr. 24			May 7		12	8.30	660
N	8.14		N	12.95	1,980	8	13.89	2,280		May 18	
6	8.46		12	12.11	1,720	4	13.92	2,290	8	7.89	584
12	8.59			Apr. 25		12	13.88	2,270	4	7.68	552
	Apr. 13		N	11.17	1,430		May 8		12	7.74	561
6	8.69		12	10.40	1,200	8	13.83	2,260		May 19	
N	8.92			Apr. 26		4	14.04	2,320	8	7.89	584
6	9.43		N	9.68	984	12	14.38	2,430	4	8.03	606
12	10.00		12	9.20	855				12	8.19	638

Supplemental record.- Apr. 6, 10 a.m., 9.70 ft., 2 p.m., 9.72 ft.; Apr. 13, 8 p.m., 11.44 ft.

Red Lake River Basin

Lower Red Lake near Red Lake, Minn.

Location.—Lat. 47°57', long. 95°17', in NW¼ sec. 28, T. 152 N., R. 36 W., just upstream from dam at outlet, 18 miles northwest of village of Red Lake. Datum of gage is 1,169.00 feet above mean sea level, adjustment of 1912 (levels and adjustments by Corps of Engineers).
Drainage area.—1,950 square miles.
Gage-height record.—Water-stage recorder graph except periods Apr. 17 to May 2 when readings from gage on Red Lake River below the dam, corrected for fall through the dam, were used.
Maxima.—April-July 1950: Gage height, 9.53 feet at 11 a.m., June 25.
1930 to March 1950: Gage height, 8.25 feet June 10, 1947.
Remarks.—Water level subject to fluctuation caused by change in direction and velocity of wind and by seiches.

Elevations, in feet, 1950

Day	April	May	June	Day	April	May	June
1	5.83	6.42	7.83	16	5.84	7.57	7.97
2	5.84	6.46	7.80	17	5.87	7.61	7.88
3	5.83	6.46	7.81	18	5.88	7.65	7.84
4	5.82	6.53	7.87	19	5.90	7.65	7.71
5	5.84	6.62	7.93	20	5.94	7.72	7.82
6	5.84	6.72	7.96	21	6.00	7.71	7.83
7	5.84	6.82	8.01	22	6.04	7.79	7.81
8	5.84	6.91	7.91	23	6.10	7.84	7.64
9	5.84	7.02	7.67	24	6.16	7.82	7.82
10	5.84	7.13	7.82	25	6.25	7.87	8.26
11	5.84	7.26	7.88	26	6.29	7.88	7.84
12	5.84	7.34	7.90	27	6.32	7.90	8.02
13	5.84	7.40	7.89	28	6.34	7.90	8.04
14	5.83	7.43	7.91	29	6.37	7.92	8.04
15	5.84	7.48	7.91	30	6.40	7.87	8.13
				31		7.82	

Red Lake River near Red Lake, Minn.

Location.—Lat. 47°57', long. 95°17', in NW¼ sec. 28, T. 152 N., R. 36 W., just downstream from dam at outlet of Lower Red Lake, 18 miles northwest of village of Red Lake. Datum of gage is 1,169.00 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).
Drainage area.—1,950 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relations defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-18. Shifting-control method used June 10 to July 31 due to aquatic vegetation.
Maxima.—April-July 1950: Daily discharge, 2,210 second-feet May 29; gage height 8.93 feet 1 p.m. June 25.
1933 to March 1950: Discharge, 1,960 second-feet 1:45 p.m. June 10, 1947; gage height 7.47 feet 2:40 p.m. Aug. 8, 1947.
Remarks.—Flow completely regulated by Red Lake. No diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	600	935	2,120	11	700	1,390	2,030	21	779	1,880	1,920
2	600	952	2,070	12	650	1,470	2,030	22	792	1,980	1,840
3	600	952	2,080	13	650	1,510	2,010	23	813	2,080	1,740
4	650	964	2,100	14	700	1,590	2,020	24	836	2,110	1,840
5	650	1,000	2,150	15	700	1,660	2,010	25	875	2,150	2,190
6	650	1,060	2,200	16	700	1,700	2,070	26	890	2,170	1,970
7	700	1,130	2,190	17	700	1,720	1,990	27	901	2,180	2,090
8	700	1,180	2,090	18	750	1,750	1,970	28	906	2,190	2,090
9	700	1,260	1,890	19	748	1,780	1,880	29	917	2,210	2,090
10	700	1,330	1,990	20	759	1,840	1,930	30	929	2,130	2,150
								31	-	2,100	-
Monthly mean discharge, in second-feet									742	1,624	2,025
Runoff, in acre-feet									44,120	99,870	120,500
Runoff, in inches									0.42	0.96	1.15

Red Lake River at High Landing near Goodridge, Minn.

Location.—Lat. 48°03', long. 95°48', on line between secs. 28 and 29, T. 153 N., R. 40 W., at bridge at High Landing, 7 miles south of Goodridge and 33 miles upstream from Thief River.

Drainage area.—2,300 square miles.

Gage-height record.—Water-stage recorder graph except for periods, 4 a.m. to 12 M. Apr. 20, 8 a.m. to 3 p.m. and 5 to 8 p.m. Apr. 21, 3 to 8:30 a.m. Apr. 28, 9 a.m. to 2 p.m. Apr. 29, 12 M. to 6:30 a.m. Apr. 30, for which graphs were drawn on basis of record before and after period, and 11:30 p.m. July 1 to 2:30 p.m. July 6, when no record was obtained.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 3,500 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-23. Discharge for period of no gage-height record computed on basis of records for station near Red Lake.

Maxima.—April-July 1950: Discharge, 3,720 second-feet 12 M. May 10 to 7 a.m. May 11 (gage height, 13.42 feet).

1930 to March 1950: Discharge, 3,390 second-feet Apr. 20, 1948 (gage height, 9.20 feet, former datum 4.00 feet higher).

Remarks.—Flow partly regulated by Red Lake. No diversions except at high stages, when the country between the Red Lake and Clearwater Rivers is flooded in a section several miles upstream from High Landing.

Mean discharge, in second-feet, 1950

Day	Apr.	May	June	July	Day	Apr.	May	June	July
1	650	3,080	2,480	2,300	16	800	3,400	2,040	1,940
2	650	3,060	2,440	2,300	17	900	3,290	2,040	1,930
3	700	3,060	2,410	2,300	18	1,000	3,180	2,020	1,880
4	700	3,110	2,380	2,200	19	1,200	3,160	2,000	1,840
5	700	3,250	2,340	2,200	20	1,300	3,190	1,960	1,780
6	700	3,390	2,320	2,170	21	1,800	3,130	1,940	1,720
7	700	3,470	2,320	2,150	22	2,600	3,090	1,920	1,660
8	700	3,550	2,280	2,120	23	3,000	3,000	1,940	1,630
9	700	3,660	2,220	2,080	24	3,410	2,940	1,900	1,580
10	700	3,690	2,170	2,060	25	3,530	2,880	1,940	1,550
11	700	3,700	2,150	2,000	26	3,390	2,830	2,120	1,540
12	700	3,670	2,120	1,980	27	3,470	2,760	2,240	1,500
13	750	3,620	2,110	1,940	28	3,380	2,690	2,290	1,490
14	750	3,530	2,090	1,920	29	3,270	2,640	2,300	1,450
15	750	3,470	2,060	1,940	30	3,160	2,560	2,300	1,400
					31	-	2,510	-	1,390
Monthly mean discharge, in second-feet						1,559	3,179	2,161	1,869
Runoff, in acre-feet						92,750	195,500	128,600	114,900
Runoff, in inches						0.76	1.60	1.05	0.94

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 22			May 1			May 10	
6	9.27		6	12.26		6	12.30	3,100	6	13.33	3,670
N	9.28		N	12.28		N	12.25	3,080	N	13.38	3,700
6	9.34		6	12.30		6	12.23	3,070	6	13.38	3,700
12	9.39		12	12.32		12	12.21	3,060	12	13.42	3,720
	Apr. 16			Apr. 23			May 2			May 11	
6	9.43		6	12.30		6	12.20	3,050	6	13.42	3,720
N	9.47		N	12.30		N	12.20	3,050	N	13.40	3,710
6	9.58		6	12.45		6	12.23	3,070	6	13.36	3,690
12	9.62		12	12.52		12	12.21	3,060	12	13.35	3,680
	Apr. 17			Apr. 24			May 3			May 12	
4	9.65		6	12.71	3,330	6	12.19	3,040	6	13.35	3,680
8	9.66		N	12.86	3,410	N	12.18	3,040	N	13.34	3,680
N	9.69		6	13.01	3,500	6	12.26	3,080	6	13.30	3,660
4	9.78		12	13.09	3,540	12	12.29	3,100	12	13.28	3,640
8	9.89			Apr. 25			May 4			May 13	
12	9.95		6	13.08	3,530	6	12.29	3,100	6	13.26	3,630
	Apr. 18		N	13.04	3,540	N	12.28	3,090	N	13.25	3,630
4	9.99		6	13.07	3,530	6	12.34	3,130	6	13.23	3,620
8	10.02		12	13.07	3,530	12	12.43	3,180	12	13.20	3,600
N	10.12			Apr. 26			May 5			May 14	
4	10.36		6	12.78	3,370	6	12.48	3,200	6	13.13	3,560
8	10.49		N	12.61	3,280	N	12.51	3,220	N	13.08	3,530
12	10.48		6	12.89	3,430	6	12.65	3,300	6	13.00	3,490
	Apr. 19		12	13.00	3,490	12	12.76	3,360	12	13.00	3,490
4	10.42			Apr. 27			May 6			May 15	
8	10.34		6	12.96	3,470	6	12.78	3,370	6	12.99	3,480
N	10.38		N	12.97	3,470	N	12.79	3,370	N	12.99	3,480
4	10.50		6	12.94	3,460	6	12.86	3,410	6	12.96	3,470
8	10.63		12	12.91	3,440	12	12.90	3,440	12	12.91	3,440
12	10.62			Apr. 28			May 7			May 16	
	Apr. 20		6	12.84	3,400	6	12.93	3,450	6	12.87	3,420
4	10.54		N	12.80	3,380	N	12.96	3,470	N	12.84	3,400
8	10.52		6	12.77	3,360	6	13.01	3,500	6	12.79	3,370
N	10.59		12	12.72	3,340	12	13.02	3,500	12	12.75	3,350
4	10.81			Apr. 29			May 8			May 17	
8	10.94		6	12.70	3,320	6	13.05	3,520	6	12.70	3,320
12	10.99		N	12.60	3,270	N	13.06	3,520	N	12.65	3,300
	Apr. 21		6	12.52	3,230	6	13.22	3,610	6	12.59	3,260
4	11.00		12	12.49	3,210	12	13.28	3,640	12	12.53	3,230
8	11.07			Apr. 30			May 9			May 18	
N	11.23		6	12.44	3,180	6	13.33	3,670	6	12.47	3,200
4	11.44		N	12.39	3,150	N	13.33	3,670	N	12.36	3,140
8	11.87		6	12.36	3,140	6	13.32	3,670	6	12.43	3,180
12	12.22		12	12.33	3,120	12	13.31	3,660	12	12.38	3,150

Red Lake River at High Landing nr. Goodridge, Minn. - (Cont'd.)

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 19			May 20			May 21			May 22	
6	12.33	3,120	6	12.50	3,210	6	12.35	3,130	6	12.25	3,080
N	12.37	3,140	N	12.46	3,190	N	12.34	3,130	N	12.28	3,090
6	12.45	3,190	6	12.42	3,170	6	12.35	3,130	6	12.24	3,070
12	12.49	3,210	12	12.38	3,150	12	12.29	3,100	12	12.19	3,040

Red Lake River at Crookston, Minn.

Location.—Lat. 47°47', long. 96°36', in sec. 30, T. 150 N., R. 46 W., at highway bridge in Crookston, a quarter of a mile downstream from dam and power-house of Crookston Light and Power Co. Datum of gage is 832.72 feet (revised) above mean sea level, datum of 1929.

Drainage area.—5,280 square miles.

Gage-height record.—Water-stage recorder graph.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 22,600 second-feet and extended to peak stage on the basis of logarithmic plotting. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-19.

Maxima.—April-June 1950: Discharge, 27,400 second-feet 12 p.m. May 6 to 2 p.m. May 7 (gage height, 25.70 feet).

1901 to March 1950: Discharge, 14,600* second-feet Apr. 15, 1906.

Remarks.—No diversions. Flow regulated by power plant one quarter of a mile upstream, and another about 5 miles upstream, and also by storage reservoirs on headwaters.

* See W.S.P. 847
Revision made since.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	850	11,600	7,510	11	800	22,200	4,640	21	6,580	16,500	3,420
2	1,000	12,000	7,100	12	850	20,200	4,410	22	11,100	15,800	3,360
3	800	12,000	6,770	13	800	18,700	4,180	23	19,100	14,200	3,310
4	850	13,100	6,460	14	750	17,600	4,200	24	17,500	12,700	3,270
5	1,000	15,700	6,190	15	1,200	16,500	4,210	25	17,100	11,700	3,220
6	900	20,500	5,970	16	2,200	15,600	4,160	26	15,300	10,800	3,430
7	650	26,700	5,650	17	4,200	14,900	4,060	27	12,000	10,100	4,470
8	1,200	23,500	5,440	18	5,500	14,500	3,900	28	11,300	9,470	4,810
9	1,000	21,100	5,210	19	7,500	14,000	3,680	29	11,200	8,930	4,820
10	1,000	22,500	4,970	20	7,270	14,500	3,560	30	11,300	8,450	4,690
								31	-	8,030	-
Monthly mean discharge, in second-feet									5,760	15,290	4,702
Runoff, in acre-feet									342,700	940,300	279,800
Runoff, in inches									1.22	3.34	0.99

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 21 (cont'd.)			Apr. 25			May 2 (cont'd.)	
4	6.07		6	13.22	6,580	4	22.64	17,300	12	18.77	12,100
8	6.12		8	13.21	6,570	8	22.60	17,200		May 3	
N	6.14		10	13.18	6,540	N	22.57	17,100	6	18.70	12,000
4	6.39		N	13.18	6,540	4	22.52	17,100	N	18.63	12,000
8	6.47		2	13.24	6,590	8	22.46	17,000	6	18.68	12,000
12	6.74		4	13.11	6,490	12	22.32	16,700	12	18.80	12,200
	Apr. 16		6	13.11	6,490		Apr. 26			May 4	
4	8.17		8	13.19	6,550	4	22.12	16,400	6	19.07	12,500
8	8.86		10	13.39	6,710	8	21.83	15,900	N	19.45	12,900
N	9.16		12	13.43	6,740	N	21.49	15,400	6	19.98	13,600
4	9.23			Apr. 22		4	21.18	15,000	12	20.54	14,200
8	9.30		2	13.79	7,030	8	20.46	14,200		May 5	
12	9.67		4	14.28	7,450	12	19.90	13,500	4	20.88	14,700
	Apr. 17		6	14.72	7,850		Apr. 27		8	21.22	15,100
4	10.53		8	15.23	8,310	4	19.30	12,800	N	21.56	15,500
8	11.06		10	15.84	8,860	8	18.82	12,200	4	22.00	16,200
N	11.72		N	17.40	10,500	N	18.51	11,800	8	22.42	16,900
4	11.88		2	19.10	12,500	4	18.31	11,600	12	22.80	17,500
8	11.90		4	20.47	14,200	8	18.18	11,400		May 6	
12	11.83		6	20.78	14,500	12	18.12	11,300	4	23.30	18,500
	Apr. 18		8	21.10	14,900		Apr. 28		8	23.76	16,300
4	11.64		10	21.76	15,800	6	18.07	11,300	N	24.18	20,700
8	11.61		12	22.43	16,900	N	18.06	11,300	4	24.61	22,100
N	12.22			Apr. 23		6	18.03	11,200	8	24.98	23,600
4	12.91		2	22.86	17,700	12	17.97	11,200	12	25.29	25,000
8	13.42		4	23.19	18,300		Apr. 29			May 7	
12	13.91		6	23.53	19,000	6	17.90	11,100	2	25.42	25,800
	Apr. 19		8	23.94	20,000	N	17.89	11,100	4	25.52	26,300
4	14.12		10	24.06	20,400	6	17.96	11,200	6	25.59	26,700
8	14.22		N	24.05	20,300	12	18.02	11,200	8	25.63	27,000
N	14.47		2	23.96	20,100		Apr. 30		10	25.68	27,300
4	14.69		4	23.80	19,700	6	18.09	11,300	N	25.69	27,300
8	14.64		6	23.62	19,200	N	18.12	11,300	2	25.70	27,400
12	14.56		8	23.43	18,800	6	18.18	11,400	4	25.66	27,200
	Apr. 20		10	23.27	18,400	12	18.25	11,500	6	25.63	27,000
4	14.51	7,660	12	23.10	18,100		May 1		8	25.59	26,700
8	14.47	7,620		Apr. 24		6	18.29	11,500	10	25.53	26,400
N	14.18	7,360	4	22.80	17,500	N	18.33	11,600	12	25.45	25,900
4	13.82	7,060	8	22.66	17,300	6	18.43	11,700		May 8	
8	13.44	6,750	N	22.70	17,400	12	18.53	11,800	4	25.29	25,000
12	13.32	6,660	4	22.70	17,400		May 2		8	25.10	24,200
	Apr. 21		8	22.70	17,400	6	18.58	11,900	N	24.91	23,300
2	13.29	6,630	12	22.70	17,400	N	18.67	12,000	4	24.78	22,800
4	13.23	6,580				6	18.73	12,100	8	24.61	22,100

Red Lake River at Crookston, Minn.-Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 8 (cont'd.)			May 11 (cont'd.)			May 16			May 21 (cont'd.)	
12	24.45	21,600	N	24.65	22,300	N	21.57	15,500	4	22.36	16,800
	May 9		4	24.55	21,900	12	21.30	15,200	8	22.35	16,800
4	24.35	21,200	8	24.45	21,600		May 17		12	22.27	16,600
8	24.24	20,900	12	24.32	21,100	N	21.07	14,900		May 22	
N	24.23	20,800		May 12		12	20.89	14,700	8	21.96	16,100
4	24.24	20,900	8	24.11	20,500		May 18		4	21.56	15,500
8	24.32	21,100	4	23.91	20,000	N	20.71	14,500	12	21.10	14,900
12	24.43	21,500	12	23.70	19,400	12	20.50	14,200		May 23	
	May 10			May 13			May 19		8	20.67	14,400
4	24.54	21,900	N	23.40	18,700	N	20.31	14,000	4	20.25	13,900
8	24.66	22,300	12	23.12	18,100	12	20.18	13,800	12	19.83	13,400
N	24.76	22,700		May 14			May 20			May 24	
4	24.82	22,900	N	22.80	17,500	N	20.62	14,300	8	19.38	12,900
8	24.84	23,000	12	22.53	17,100	12	21.65	15,700	4	19.09	12,500
12	24.84	23,000		May 15			May 21		12	18.78	12,100
	May 11		N	22.20	16,500	4	21.95	16,100		May 25	
4	24.78	22,800	12	21.89	16,000	8	22.16	16,500	N	18.40	11,700
8	24.73	22,600				N	22.31	16,700	12	18.01	11,200

Thief River near Thief River Falls, Minn.

Location.—Lat. 48°11', long. 96°10', in sec. 3, T. 154 N., R. 43 W., 5 miles north of city of Thief River Falls and 7 miles upstream from mouth. Datum of gage is 1,112.33 feet above mean sea level, datum of 1929 (levels by Minnesota Highway Department).

Drainage area.—959 square miles.

Gage-height record.—Water-stage recorder graph except periods Apr. 8-13, 15, 16 when no record was obtained and Apr. 14 when staff gage was read.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 5,250 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-24.

Discharge for periods of no gage-height record, Apr. 15, 16 was interpolated, and that for the period Apr. 8-13 was computed on the basis of records for the Red Lake River at Crookston and Clearwater River at Red Lake Falls and Plummer.

Maxima.—April-June 1950: Discharge, 5,610 second-feet 9 a.m. May 13 (gage height, 17.38 feet). 1909-17, 1920-21, 1922-24, 1928 to March 1950: Discharge observed, 4,080 second-feet Apr. 23, 1916 (gage height, 14.5 feet).

Remarks.—Small amount of regulation by swamp storage and storage in Thief and Mud Lakes above gage. Water is diverted from Thief River into Mud Lake for use in game preserve.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1.3	2,360	2,600	11	14	5,410	1,020	21	1,300	4,980	719
2	1.5	2,400	2,400	12	14	5,560	966	22	1,700	4,620	701
3	1.7	2,510	2,250	13	14	5,580	1,080	23	2,000	4,470	671
4	1.9	2,830	2,110	14	55	5,490	1,030	24	2,400	4,380	641
5	3.6	3,240	2,000	15	58	5,480	960	25	2,260	4,220	794
6	3.2	3,730	1,900	16	62	5,340	956	26	2,080	4,010	1,330
7	4.8	4,050	1,800	17	65	5,230	895	27	2,080	3,800	1,320
8	14	4,480	1,700	18	340	5,190	834	28	2,080	3,570	1,200
9	14	4,930	1,550	19	500	5,030	766	29	2,160	3,340	1,110
10	14	5,190	1,280	20	700	5,180	738	30	2,270	3,070	1,050
								31	-	2,820	-
Monthly mean discharge, in second-feet									740	4,274	1,279
Runoff, in acre-feet									44,060	262,800	76,110
Runoff, in inches									0.86	5.13	1.49

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 23(cont'd.)			May 1 (cont'd.)			May 9	
4	7.04		N	12.59		8	11.81	2,370	4	16.19	4,830
8	6.99		4	12.23		12	11.83	2,380	8	16.29	4,900
N	7.00		8	12.03			May 2		N	16.36	4,940
4	7.01		12	11.90		8	11.83	2,380	4	16.38	4,960
8	7.13			Apr. 24		N	11.86	2,400	8	16.47	5,020
12	7.33		4	11.88		6	11.90	2,420	12	16.54	5,060
	Apr. 18		8	11.98		12	11.85	2,390		May 10	
4	7.61		N	12.02			May 3		4	16.55	5,070
8	7.92		4	12.03		4	11.87	2,400	8	16.66	5,140
N	8.17		8	11.99		8	11.90	2,420	N	16.77	5,210
4	8.52		12	11.89		N	11.97	2,450	4	16.87	5,280
8	8.89			Apr. 25		4	12.18	2,550	8	16.88	5,280
12	9.03		4	11.75	2,350	8	12.43	2,680	12	16.93	5,310
	Apr. 19		8	11.58	2,270	12	12.55	2,740		May 11	
4	8.99		N	11.48	2,230		May 4		8	17.03	5,380
8	8.82		4	11.44	2,210	4	12.58	2,750	4	17.14	5,450
N	8.69		8	11.43	2,200	8	12.60	2,760	12	17.23	5,510
4	8.85		12	11.38	2,180	N	12.63	2,780		May 12	
8	9.25			Apr. 26		4	12.70	2,810	6	17.28	5,540
12	9.32		4	11.29	2,140	8	13.04	2,980	N	17.32	5,570
	Apr. 20		8	11.18	2,090	12	13.22	3,080	6	17.35	5,590
4	9.23		N	11.07	2,040		May 5		12	17.37	5,600
8	9.03		4	11.07	2,040	4	13.28	3,110		May 13	
N	9.07		8	11.10	2,060	8	13.31	3,130	4	17.37	5,600
4	9.73		12	11.14	2,070	N	13.40	3,180	8	17.37	5,600
8	10.51			Apr. 29		4	13.50	3,240	N	17.36	5,590
12	10.72		4	11.28	2,140	8	13.81	3,410	4	17.33	5,570
	Apr. 21		8	11.28	2,140	12	14.15	3,610	8	17.28	5,540
4	10.86		N	11.32	2,150		May 6		12	17.23	5,510
8	10.90		4	11.35	2,170	6	14.24	3,660		May 14	
N	11.32		8	11.44	2,210	N	14.33	3,720	4	17.16	5,460
4	12.01		12	11.49	2,230	6	14.46	3,800	8	17.21	5,500
8	12.71			Apr. 30		12	14.60	3,880	N	17.24	5,520
12	12.89		4	11.50	2,240		May 7		4	17.17	5,470
	Apr. 22		8	11.50	2,240	8	14.75	3,970	8	17.18	5,480
4	12.95		N	11.53	2,250	4	15.00	4,120	12	17.22	5,500
8	13.00		4	11.60	2,280	12	15.23	4,260		May 15	
N	13.01		8	11.70	2,320		May 8		4	17.24	5,520
4	12.91		12	11.74	2,340	4	15.37	4,340	8	17.23	5,510
8	12.93			May 1		8	15.47	4,400	N	17.21	5,500
12	13.22		4	11.76	2,350	N	15.54	4,440	4	17.17	5,470
	Apr. 23		8	11.75	2,350	4	15.70	4,540	8	17.13	5,440
4	13.65		N	11.76	2,350	8	15.90	4,660	12	17.10	5,420
8	13.31		4	11.76	2,350	12	16.05	4,750			

Thief River near Thief River Falls, Minn. -Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 16			May 18			May 20			May 22 (cont'd.)	
4	17.07	5,410	6	16.66	5,140	8	16.50	5,040	12	15.62	4,490
8	17.02	5,370	N	16.56	5,070	4	16.42	4,980		May 23	
N	16.95	5,330	6	16.46	5,010	12	16.35	4,940	6	15.61	4,490
4	16.90	5,300	12	16.37	4,950		May 21		N	15.57	4,460
8	16.89	5,290		May 19		6	16.30	4,900	6	15.59	4,470
12	16.88	5,280	4	16.31	4,910	N	16.26	4,880	12	15.56	4,460
	May 17		8	16.28	4,890	6	16.14	4,800		May 24	
6	16.85	5,260	N	16.26	4,880	12	16.05	4,750	4	15.50	4,420
N	16.80	5,230	4	16.40	4,970		May 22		8	15.46	4,400
6	16.75	5,200	8	16.51	5,040	4	16.00	4,720	N	15.46	4,400
12	16.71	5,170	12	16.56	5,070	8	15.96	4,700	4	15.42	4,370
						N	15.85	4,630	8	15.36	4,340
						4	15.71	4,550	12	15.29	4,290
						8	15.63	4,500			

Clearwater River at Plummer, Minn.

Location. – Lat. 47°55', long. 96°03', in SE¼SE¼ sec. 4, T. 151 N., R. 42 W., on U. S. Highway 59, three-quarters of a mile northwest of Plummer. Datum of gage is 1,099.12 feet, adjustment of 1912 (levels by Corps of Engineers).

Drainage area. – 512 square miles.

Gage-height record. – Water-stage recorder graph.

Discharge record. – Stage-discharge relation defined by current-meter measurements below 2,700 second-feet and extended to peak discharge by contracted-opening method. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-23.

Maxima. – April-June 1950: Discharge, 3,630 second-feet 1 p. m. May 6 (gage height, 11.33 feet).
1939 to March 1950: Discharge, 1,870 second-feet June 1, 1949 (gage height, 9.08 feet).

Remarks. – No diversions. Flow regulated slightly by dams at Clearwater Lake and Nine Lakes.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	70	1,950	968	11	80	2,140	631	21	800	2,150	364
2	70	1,920	937	12	75	2,040	606	22	1,300	1,870	341
3	70	1,930	907	13	75	2,050	606	23	1,500	1,690	341
4	70	2,140	849	14	75	2,100	581	24	1,490	1,560	306
5	70	2,830	820	15	75	2,060	556	25	1,200	1,440	341
6	70	3,520	791	16	75	2,030	507	26	967	1,360	423
7	70	2,970	763	17	100	1,990	471	27	1,070	1,280	435
8	75	2,450	735	18	280	1,920	435	28	1,360	1,180	411
9	75	2,690	708	19	380	1,950	411	29	1,680	1,100	399
10	80	2,440	656	20	600	2,370	387	30	1,860	1,070	364
								31	-	1,000	-
Monthly mean discharge, in second-feet									52.5	1,974	568
Runoff, in acre-feet									31,260	121,400	33,820
Runoff, in inches									1.14	4.45	1.24

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 23			Apr. 29			May 6 (cont'd.)	
6	4.77		4	9.17		6	8.46	1,620	6	11.23	3,540
N	4.79		8	8.84		N	8.61	1,690	8	11.19	3,500
6	4.89		N	8.64		6	8.72	1,740	10	11.13	3,450
12	5.00		4	8.54		12	8.79	1,780	12	11.07	3,390
	Apr. 17		8	8.50			Apr. 30			May 7	
6	5.01		12	8.51		6	8.85	1,810	6	10.81	3,160
N	5.14			Apr. 24		N	8.95	1,860	N	10.57	2,960
6	5.52		4	8.39	1,580	6	9.06	1,920	6	10.32	2,760
12	5.87		8	8.20	1,490	12	9.11	1,950	12	10.13	2,610
	Apr. 18		N	8.07	1,430		May 1			May 8	
4	6.02		4	8.00	1,400	6	9.13	1,960	6	9.97	2,490
8	6.07		8	7.95	1,380	N	9.13	1,960	N	9.82	2,380
N	6.26		12	7.88	1,350	6	9.11	1,950	6	9.82	2,380
4	6.71			Apr. 25		12	9.07	1,920	12	9.97	2,490
8	7.00		6	7.70	1,280		May 2			May 9	
12	7.00		N	7.48	1,200	6	9.04	1,910	4	10.06	2,560
	Apr. 19		6	7.27	1,130	N	9.05	1,910	8	10.18	2,650
4	6.98		12	7.09	1,070	6	9.10	1,940	N	10.32	2,760
8	6.96			Apr. 26		12	9.12	1,950	4	10.37	2,800
N	7.05		2	7.00	1,040		May 3		8	10.35	2,780
4	7.08		4	6.90	1,000	8	9.09	1,930	12	10.26	2,710
8	7.35		6	6.76	956	4	9.07	1,920		May 10	
12	7.66		8	6.60	907	12	9.09	1,930	6	10.07	2,570
	Apr. 20		10	6.42	855		May 4		N	9.87	2,420
4	7.88		N	6.35	834	6	9.25	2,020	6	9.69	2,290
8	7.99		2	6.42	855	N	9.44	2,130	12	9.58	2,220
N	7.96		4	6.69	934	6	9.61	2,240		May 11	
4	8.33		6	6.94	1,010	12	9.84	2,400	6	9.50	2,170
8	8.67		8	7.09	1,070		May 5		N	9.44	2,130
12	8.93		10	7.12	1,080	4	10.01	2,520	6	9.40	2,110
	Apr. 21		12	7.04	1,050	8	10.20	2,660	12	9.35	2,080
4	9.10			Apr. 27		N	10.36	2,790		May 12	
8	9.10		4	6.96	1,020	4	10.59	2,980	6	9.30	2,050
N	9.08		8	7.00	1,040	8	10.85	3,100	N	9.28	2,040
4	9.49		N	7.05	1,050	12	11.04	3,370	6	9.27	2,030
8	9.81		4	7.12	1,080		May 6		12	9.26	2,030
12	10.32		8	7.28	1,130	2	11.11	3,430		May 13	
	Apr. 22		12	7.45	1,190	4	11.15	3,460	8	9.27	2,030
4	10.43			Apr. 28		6	11.19	3,500	4	9.31	2,060
8	10.37		6	7.71	1,280	8	11.24	3,550	12	9.35	2,080
N	10.29		N	7.93	1,370	10	11.28	3,580		May 14	
4	10.14		6	8.10	1,440	N	11.33	3,630	8	9.39	2,100
8	10.01		12	8.28	1,530	2	11.32	3,620	4	9.39	2,100
12	9.67					4	11.29	3,590	12	9.38	2,090

Clearwater River at Plummer, Minn. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 15			May 18			May 20			May 22	
8	9.33	2,070	8	9.08	1,930	4	9.73	2,320	8	9.02	1,900
4	9.31	2,060	4	9.02	1,900	8	9.84	2,400	4	8.89	1,830
12	9.29	2,040	12	8.97	1,870	N	9.88	2,430	12	8.77	1,770
	May 16			May 19		4	9.86	2,410		May 23	
6	9.27	2,030	6	8.93	1,850	8	9.81	2,380	N	8.58	1,680
N	9.25	2,020	N	8.98	1,880	12	9.73	2,320	12	8.49	1,630
6	9.27	2,030	6	9.29	2,040		May 21			May 24	
12	9.23	2,010	12	9.57	2,220	8	9.55	2,200	N	8.36	1,560
	May 17					4	9.36	2,090	12	8.49	1,490
8	9.20	2,000				12	9.19	1,990		May 25	
4	9.19	1,990							N	8.08	1,440
12	9.15	1,970							12	7.95	1,380

Clearwater River at Red Lake Falls, Minn.

Location. —Lat. 47°53', long. 96°17', in sec. 22, T. 151 N., R. 44 W., at Great Northern Railway bridge at Red Lake Falls, 1½ miles upstream from mouth and 2 miles downstream from nearest tributary which enters from left. Datum of gage is 949.49 feet above mean sea level, datum of 1912 (levels by Corps of Engineers).

Drainage area. —1,370 square miles.

Gage-height record. —Water-stage recorder graph.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 8,600 second-feet. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-21.

Maxima. —April-June 1950: Discharge, 9,310 second-feet 2:30 p.m. May 6 (gage height, 11.28 feet). 1909-17, 1934 to March 1950: Discharge, 5,430 second-feet Apr. 15, 1947; gage height observed, 17.5 feet Apr. 5, 1913 (backwater from ice).

Remarks. —Flow partly regulated by Clearwater Lake and several smaller lakes. Diurnal fluctuation caused by mill 600 feet above station. No diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	70	4,420	1,840	11	85	7,660	982	21	7,000	5,410	565
2	85	4,380	1,730	12	85	7,400	958	22	7,750	4,520	530
3	75	4,410	1,640	13	80	6,260	958	23	7,680	4,020	506
4	75	4,940	1,560	14	80	5,710	988	24	6,840	3,530	484
5	75	6,600	1,470	15	100	5,170	1,000	25	5,620	3,170	525
6	80	9,060	1,380	16	300	4,620	952	26	4,250	2,860	705
7	80	8,560	1,310	17	700	4,420	864	27	3,890	2,620	952
8	85	7,490	1,240	18	1,400	4,200	754	28	3,970	2,400	1,010
9	90	8,450	1,130	19	3,200	4,180	665	29	4,190	2,230	1,030
10	85	8,490	1,050	20	5,500	5,620	605	30	4,340	2,090	1,000
								31	-	1,940	-
Monthly mean discharge, in second-feet									2,262	5,059	1,013
Runoff, in acre-feet									134,600	311,100	60,260
Runoff, in inches									1.84	4.25	0.82

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 20 (cont'd.)			Apr. 22 (cont'd.)			May 5	
4	3.76		10	9.65		10	10.35		4	8.83	5,680
8	3.52		N	9.41		12	10.41		8	9.02	5,950
N	3.54		2	9.65			Apr. 23		N	9.31	6,360
4	4.39		4	9.30		2	10.43	8,040	4	9.74	7,000
8	6.85		6	8.45		4	10.39	7,980	8	10.22	7,720
12	7.22		8	9.26		6	10.28	7,810	12	10.58	8,260
	Apr. 17		10	9.53		8	10.18	7,660		May 6	
4	7.02		12	10.00		10	10.09	7,520	2	10.73	8,480
8	6.47			Apr. 21		N	10.07	7,500	4	10.88	8,710
N	6.15		1	9.96		2	10.07	7,500	6	11.01	8,900
4	6.78		2	10.20		4	10.04	7,450	8	11.15	9,120
8	8.60		3	11.32		6	10.05	7,460	10	11.22	9,220
12	9.98		4	11.00		8	10.14	7,600	N	11.26	9,280
	Apr. 18		5	10.92		10	10.27	7,800	2	11.28	9,310
2	10.30		6	11.09		12	10.24	7,750	4	11.28	9,310
4	10.48		7	11.22			Apr. 24		6	11.25	9,260
6	10.44		8	11.40		6	9.82	7,120	8	11.21	9,200
8	10.38		9	11.47		N	9.59	6,780	10	11.20	9,190
10	10.50		10	11.51		6	9.40	6,490	12	11.14	9,100
N	10.37		11	7.85		12	9.21	6,210		May 7	
2	10.29		N	7.76			Apr. 25		6	11.01	8,900
4	10.62		1	7.79		6	9.05	5,990	N	10.79	8,580
6	9.96		2	13.76		N	8.83	5,680	6	10.58	8,260
8	10.67		3	12.41		6	8.52	5,250	12	10.37	7,940
10	11.32		4	9.67		12	8.30	4,950		May 8	
12	10.96		5	8.78			Apr. 26		4	10.21	7,700
	Apr. 19		6	8.63		4	8.08	4,660	8	10.09	7,520
2	11.18		7	8.64		8	7.87	4,400	N	9.95	7,320
4	11.22		8	8.78		N	7.64	4,130	4	9.91	7,260
6	11.19		9	8.89		4	7.47	3,920	8	10.00	7,370
8	11.08		10	9.16		8	7.50	3,960	12	10.12	7,570
10	10.87		11	9.32		12	7.47	3,920		May 9	
N	10.57		12	9.43			May 3		4	10.32	7,870
2	10.52			Apr. 22		6	7.80	4,320	8	10.60	8,290
4	10.49		2	9.72		N	7.81	4,330	N	10.89	8,720
6	10.18		4	10.19		6	7.94	4,490	4	10.94	8,800
8	10.40		6	10.24		12	8.05	4,620	8	10.94	8,800
10	10.41		8	10.33			May 4		12	10.95	8,820
12	10.38		10	10.42		4	8.11	4,700		May 10	
	Apr. 20		N	10.37		8	8.15	4,760	8	10.84	8,650
2	10.42		2	10.35		N	8.20	4,820	4	10.66	8,380
4	10.44		4	10.39		4	8.30	4,950	12	10.45	8,060
6	10.24		6	10.33		8	8.57	5,320		May 11	
8	9.96		8	10.29		12	8.72	5,530	8	10.27	7,800

Clearwater River at Red Lake Falls, Minn.-Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 11 (cont'd.)			May 13 (cont'd.)			May 18 (cont'd.)			May 21 (cont'd.)	
4	10.08	7,510	4	8.39	5,070	8	7.55	4,020	12	8.23	4,860
12	9.92	7,270	12	8.24	4,870	N	7.58	4,060		May 22	
	May 12			May 16		4	7.68	4,180	6	8.07	4,650
8	10.75	8,520	8	8.05	4,620	8	7.84	4,370	N	7.95	4,500
4	9.58	6,760	4	8.00	4,560	12	8.16	4,770	6	7.85	4,380
12	9.45	6,560	12	7.96	4,510		May 20		12	7.76	4,270
	May 13			May 17		4	8.49	5,210		May 23	
8	9.30	6,340	8	7.91	4,450	8	8.74	5,560	8	7.61	4,090
4	9.17	6,160	4	7.87	4,400	N	8.92	5,810	4	7.48	3,940
12	9.05	5,990	12	7.80	4,320	4	9.00	5,920	12	7.33	3,760
	May 14			May 18		8	9.00	5,920		May 24	
8	8.95	5,850	8	7.73	4,240	12	8.97	5,880	8	7.15	3,540
4	8.75	5,570	4	7.66	4,150		May 21		4	7.10	3,490
12	8.66	5,440	12	7.60	4,080	6	8.82	5,670	12	6.98	3,360
	May 15			May 19		N	8.68	5,470		May 25	
8	8.55	5,290	4	7.57	4,040	6	8.44	5,140	8	6.85	3,220
									4	6.74	3,100
									12	6.64	3,000

Turtle River Basin

Turtle River at Manvel, N. Dak.

Location.—Lat. 48°05', long. 97°11', in SE¼ sec. 10, T. 153 N., R. 51 W., at bridge on State Highway 33, 0.3 mile west of Manvel and 10 miles upstream from mouth.
Drainage area.—602 square miles.
Gage-height record.—Graph based on once or twice-daily gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 4,000 second-feet and extended to peak stage on basis of contracted-opening measurement including discharge over railroad fill. Affected by ice Apr. 1-18. Shifting-control method used June 8-30.
Maxima.—April-June 1950: Discharge, 28,000 second-feet 6 p.m. Apr. 19 (gage height, 21.5 feet, from floodmark).
1945 to March 1950: Discharge, 3,450 second-feet Apr. 19, 1948 (gage height, 17.88 feet).
Remarks.—No diversion or regulation above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	403	86	11	1	3,710	41	21	7,260	510	30
2	0	382	83	12	1	2,640	40	22	3,690	506	33
3	0	360	80	13	1	2,270	37	23	2,900	402	32
4	0	656	73	14	20	1,920	28	24	2,230	298	27
5	0	1,000	66	15	60	1,610	34	25	1,770	235	34
6	0	1,590	60	16	100	1,290	36	26	1,540	196	45
7	0	3,600	53	17	150	960	37	27	1,200	160	69
8	0	4,520	49	18	2,200	632	41	28	848	141	80
9	0	7,390	46	19	20,700	486	35	29	595	124	69
10	0	6,430	43	20	13,900	506	32	30	454	109	49
								31	-	94	-
Monthly mean discharge, in second-feet									1,987	1,456	48.9
Runoff, in acre-feet									118,300	89,510	2,910
Runoff, in inches									3.69	2.79	0.09

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 18			Apr. 26 (cont'd.)			May 6			May 13	
N	16.15	830	4	15.29	1,490	4	14.77	1,350	8	16.20	2,310
12	18.80	6,800	12	15.06	1,370	8	15.04	1,470	4	16.13	2,230
	Apr. 19			Apr. 27		N	15.26	1,580	12	16.07	2,160
6	19.94	16,400	8	14.83	1,260	4	15.43	1,680		May 14	
N	21.00	23,800	4	14.56	1,140	8	15.64	1,810	8	15.97	2,060
6	21.50	28,000	12	14.27	1,000	12	16.04	2,130	4	15.59	1,780
12	20.87	22,700		Apr. 28			May 7		12	15.44	1,680
	Apr. 20		8	13.95	890	4	16.50	2,850		May 15	
4	20.25	18,300	4	13.67	800	8	16.78	3,580	8	15.42	1,670
8	19.77	15,500	12	13.30	710	N	16.86	3,810	4	15.25	1,580
N	19.37	13,400		Apr. 29		4	16.93	4,020	12	15.10	1,500
4	19.02	11,700	8	12.93	635	8	16.97	4,140		May 16	
8	18.40	9,090	4	12.38	548	12	17.00	4,230	8	14.90	1,380
12	18.24	8,470	12	11.97	495		May 8		4	14.52	1,190
	Apr. 21			Apr. 30		4	17.01	4,260	12	14.33	1,100
4	18.41	9,130	8	11.67	464	8	17.02	4,290		May 17	
6	18.50	9,490	4	11.41	440	N	17.04	4,350	N	14.05	970
8	18.40	9,090	12	11.19	420	4	17.10	4,530	12	13.71	800
N	17.95	7,380		May 1		8	17.18	4,780		May 18	
4	17.54	5,950	8	11.04	405	12	17.43	5,580	N	13.24	610
8	17.33	5,260	4	10.93	400		May 9		12	12.72	510
12	17.13	4,620	12	10.80	390	4	17.71	6,520		May 19	
	Apr. 22			May 2		8	18.00	7,560	N	12.32	471
4	16.94	4,050	6	10.70	382	N	18.06	7,780	12	12.12	490
8	16.81	3,670	N	10.68	380	4	18.08	7,860		May 20	
11	17.04	4,350	6	10.72	384	8	18.10	7,930	N	12.00	518
N	16.90	3,930	12	10.64	376	12	18.07	7,820	12	11.95	500
4	16.66	3,250		May 3			May 10			May 21	
8	16.62	3,140	4	10.54	372	4	18.02	7,630	N	11.97	508
12	16.60	3,090	8	10.43	364	8	17.94	7,340	12	12.03	524
	Apr. 23		N	10.29	356	N	17.74	6,630		May 22	
8	16.60	3,090	4	10.13	348	4	17.47	5,710	N	11.98	510
4	16.50	2,850	8	10.02	344	8	17.27	5,060	12	11.86	478
12	16.35	2,460	12	10.12	375	12	17.14	4,650		May 23	
	Apr. 24			May 4			May 11		N	11.53	398
8	16.27	2,280	6	10.66	526	8	16.90	3,930	12	11.23	336
4	16.22	2,180	N	11.37	690	4	16.70	3,360		May 24	
12	16.05	1,990	6	11.97	794	12	16.57	3,020	N	10.95	298
	Apr. 25		12	12.37	854		May 12		12	10.66	262
8	15.78	1,770		May 5		8	16.47	2,790		May 25	
4	15.69	1,710	6	12.80	912	4	16.29	2,440	N	10.37	234
12	15.60	1,660	N	13.33	982	12	16.23	2,360	12	10.08	210
	Apr. 26		6	13.88	1,070						
8	15.49	1,600	12	14.43	1,220						

Forest River Basin

Forest River near Fordville, N. Dak.

Location. —Lat. 48°12', long. 97°44', on line between sec. 32 and 33, T. 155 N., R. 55 W., at highway bridge, half a mile downstream from South Branch and 3 miles southeast of Fordville.

Drainage area. —497 square miles (revised).

Gage-height record. —Graph based on one or more daily chain gage readings. Gage not read Apr. 1-12, May 25-27, June 13, 16-18, 20-22, 25, 28, 30. Average of daily readings used Apr. 13, May 21 to June 30. Doubtful gage-height record May 30, June 1-3, 5-7.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 6,000 second-feet and extended to peak stage on basis of contracted-opening and slope-area measurements. Discharge for periods of no gage-height record and doubtful gage-height record, computed on basis of weather records, engineers' notes, and records for station at Minto. Shifting-control method used June 19-27. Gage heights used to hundredths.

Maxima. —April-June 1950: Discharge, 16,400 second-feet about 5 a.m. Apr. 18 (gage height, 14.48 feet, from floodmark), by contracted-opening and slope-area method.

1940 to March 1950: Discharge, 14,600 second-feet Apr. 18, 1948 (gage height, 14.15 feet, from floodmark), by contracted-opening and slope-area method, revised.

Remarks. —No diversions. Minor regulation by small dam at Fordville.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	20	328	46	11	34	4,000	19	21	2,380	216	15
2	20	359	42	12	34	2,120	19	22	2,170	160	14
3	20	247	38	13	34	1,190	18	23	1,530	141	14
4	20	289	35	14	32	875	17	24	894	123	14
5	25	438	34	15	35	594	16	25	430	100	15
6	25	1,490	32	16	1,230	385	16	26	192	85	22
7	25	3,140	30	17	7,480	327	16	27	178	70	29
8	30	6,550	29	18	10,900	271	16	28	187	65	25
9	30	3,870	24	19	4,550	303	16	29	177	59	23
10	32	3,960	20	20	2,560	290	16	30	192	55	21
								31	-	50	-
Monthly mean discharge, in second-feet									1,182	1,037	23.2
Runoff, in acre-feet									70,350	63,770	1,380
Runoff, in inches									2.66	2.41	0.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 21			Apr. 30			May 7	
6	2.30	119	6	7.83	2,840	N	2.42	190	6	7.57	2,670
10	2.70	230	N	6.99	2,290	6	2.43	193	9	7.68	2,740
4	3.85	633	6	6.68	2,090	12	2.48	207	2	7.64	2,710
6	5.40	1,340	12	6.88	2,220		May 1		6	8.70	3,480
8	7.20	2,420		Apr. 22		6	2.73	278	8	9.30	4,020
10	9.70	4,400	6	7.34	2,520	N	3.00	358	10	10.00	4,700
12	12.50	8,660	N	6.81	2,170	6	3.11	391	12	10.80	5,610
	Apr. 17		6	6.40	1,920	12	3.03	367		May 8	
1:30	14.00	13,800	12	6.36	1,890		May 2		2	11.70	6,910
6	12.30	8,170		Apr. 23		6	2.94	340	4	12.40	8,410
N	10.25	4,980	6	6.32	1,870	N	3.10	388	5:30	12.54	8,760
2	10.22	4,940	N	5.69	1,500	6	3.02	364	8	12.25	8,180
6	10.55	5,310	6	5.22	1,240	12	2.87	319	10	11.80	7,390
12	12.70	9,170	12	4.93	1,100		May 3		N	11.35	6,700
	Apr. 18			Apr. 24		6	2.52	218	4	10.50	5,640
2	13.60	12,000	N	4.49	892	N	2.58	234	8	9.94	5,080
5	14.48	16,400	12	3.99	691	2	2.54	223	12	9.48	4,640
8	14.00	13,800		Apr. 25		6	2.58	234		May 9	
N	13.21	10,600	N	3.12	394	12	2.80	298	N	8.46	3,740
6	12.50	8,660	12	2.60	240		May 4		8	8.00	3,360
12	11.63	6,780		Apr. 26		6	2.96	346	12	8.51	3,780
	Apr. 19		N	2.36	175	N	2.61	243		May 10	
8	10.62	5,390	4	2.33	167	6	2.70	269	6	9.11	4,310
11	9.32	4,040	12	2.43	193	12	2.81	301	N	8.82	4,050
5	8.64	3,430		Apr. 27			May 5		6	8.16	3,490
7	8.76	3,530	6	2.44	196	N	3.13	397	12	8.99	4,200
12	8.49	3,310	N	2.27	152	6	3.36	469		May 11	
	Apr. 20		12	2.42	190	12	4.20	772	6	9.73	4,880
6	8.06	3,000		Apr. 28			May 6		N	9.00	4,210
N	7.34	2,520	N	2.43	193	6	5.29	1,280	6	8.08	3,420
4	6.56	2,010	12	2.35	172	N	5.61	1,460	12	7.29	2,820
6	6.49	1,970		Apr. 29		6	6.10	1,740		May 12	
12	7.08	2,350	N	2.36	175	12	6.85	2,200	N	6.26	2,130
			12	2.40	185				12	5.06	1,410
										May 13	
									N	4.58	1,150
									12	4.38	1,040

Forest River at Minto, N. Dak.

Location. – Lat. 48°16'10", long. 97°22'10", in SE¼ sec. 31, T. 156 N., R. 52 W., in Minto.
Drainage area. – 735 square miles.
Gage-height record. – Graph based on one or more daily wire-weight or staff gage readings Apr. 12 to May 29. Once-daily wire-weight gage readings Apr. 1-11, May 30 to June 30.
Discharge record. – Stage-discharge relation defined by current-meter measurements below 8,000 second-feet and extended to peak stage on basis of contracted-opening method. Discharge for period of ice effect Apr. 1-18 computed on basis of five discharge measurements, gage heights, weather records, and records for station near Fordville. Shifting-control method used Apr. 26 to May 3. Gage heights used to hundredths.
Maxima. – April-June 1950: Discharge, 17,000 second-feet about 8 p.m. Apr. 18 (gage height, 11.80 feet, from floodmark), by contracted-opening method.
1944 to March 1950: Discharge, 12,000 second-feet Apr. 19, 1948 (gage height, 11.80 feet, from floodmark), by contracted-opening method.
Remarks. – No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1.7	361	97	11	40	4,070	52	21	5,210	430	40
2	1.7	446	90	12	40	3,840	52	22	4,290	362	40
3	1.7	645	83	13	40	2,450	48	23	3,310	295	40
4	1.7	1,040	76	14	50	1,730	46	24	2,460	250	36
5	6.0	2,100	72	15	60	1,140	44	25	1,640	209	42
6	30	4,340	67	16	80	796	44	26	720	179	48
7	42	5,080	63	17	220	590	42	27	369	146	46
8	40	7,660	59	18	11,500	468	42	28	315	117	57
9	40	5,330	57	19	12,200	444	42	29	303	109	52
10	36	4,440	55	20	6,550	459	42	30	333	112	50
								31	-	102	-
Monthly mean discharge, in second-feet									1,664	1,605	54.1
Runoff, in acre-feet									99,040	98,660	3,220
Runoff, in inches									2.53	2.52	0.08

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 18			Apr. 24			May 4			May 10	
4	10.60	6,200	N	6.41	2,450	N	3.60	954	8	8.12	4,720
6	10.81	8,600	12	5.68	2,090	6	4.02	1,210	4	7.89	4,200
9	10.90	10,600		Apr. 25		12	4.68	1,600	12	7.83	4,080
2	11.28	13,600	N	4.77	1,650		May 5			May 11	
3	11.80	17,000	12	3.94	1,160	6	5.22	1,900	7p	7.81	4,040
12	11.38	15,600		Apr. 26		10	5.32	1,950	12	7.87	4,160
	Apr. 19		N	3.15	654	2	5.54	2,040		May 12	
4	10.54	12,800	12	2.68	411	8	6.42	2,460	7	7.92	4,260
10	10.00	10,900		Apr. 27		12	7.00	2,920	N	7.79	4,000
1	10.48	12,600	N	2.57	362		May 6		12	7.07	2,990
3	10.56	12,800	12	2.52	340	6	7.77	3,970		May 13	
7	10.34	12,100		Apr. 28		10	8.20	4,930	N	6.30	2,380
12	9.60	9,600	N	2.46	315	4	8.03	4,500	12	5.57	2,050
	Apr. 20		12	2.40	290	12	8.16	4,830		May 14	
6	8.21	4,960		Apr. 29			May 7		N	4.93	1,740
9	8.26	5,110	N	2.42	299	11	8.34	5,360	12	4.33	1,400
5	8.89	7,210	12	2.48	324	6	8.18	4,880		May 15	
12	8.77	6,800		Apr. 30		12	8.26	5,110	N	3.86	1,110
	Apr. 21		N	2.51	336		May 8		12	3.57	935
N	8.12	4,720	12	2.51	336	8	8.68	6,490		May 16	
12	8.07	4,600		May 1		2	9.30	8,590	N	3.33	790
	Apr. 22		N	2.57	362	6	9.76	10,100	12	3.13	671
N	7.98	4,390	12	2.62	384	7:30	9.81	10,300		May 17	
12	7.67	3,790		May 2		12	8.90	7,240	N	3.00	598
	Apr. 23		N	2.73	435		May 9		12	2.80	493
N	7.34	3,300	12	2.92	529	4a	8.46	5,760			
12	6.91	2,840		May 3		8a	8.30	5,230			
			N	3.16	660	12	8.13	4,750			
			12	3.28	730						

Park River Basin

South Branch Park River near Park River, N. Dak.

Location.—Lat. 48°24', long. 97°50', on line between sec. 15 and 16, T. 157 N., R. 56 W., at bridge on N. Dak. Highway 32, half a mile upstream from small tributary and 4½ miles northwest of Park River.

Drainage area.—214 square miles (revised).

Gage-height record.—Graph based on several daily chain gage readings Apr. 16 to May 24, June 25, 26, 29. Chain gage readings rest of period except Apr. 2, 9, 10 and 26, when gage was not read.

Discharge record.—Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-17. Gage height used to hundredths. Discharge for Apr. 26, when gage was not read, interpolated.

Maxima.—April-June 1950: Discharge, 5,970 second-feet about 2 a.m. Apr. 19 (gage height, 10.1 feet). 1940 to March 1950: Discharge, 11,000 second-feet Apr. 18, 1948 (gage height, 11.80 feet), from rating curve extended above 6,600 second-feet.

Remarks.—No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2.5	514	32	11	4.0	1,830	12	21	2,140	178	7.1
2	2.5	469	29	12	4.0	989	11	22	2,180	150	9.5
3	2.7	232	26	13	4.0	723	12	23	1,490	132	6.8
4	3.0	158	24	14	4.5	598	12	24	855	98	7.1
5	3.2	383	20	15	5.0	412	10	25	370	84	17
6	3.6	868	20	16	20	281	15	26	170	63	36
7	3.7	2,350	20	17	1,480	235	9.5	27	116	54	30
8	4.0	3,630	19	18	4,700	201	9.1	28	158	47	24
9	4.0	2,190	16	19	3,120	289	8.7	29	276	43	10
10	4.0	2,300	12	20	1,790	234	7.9	30	335	40	7.9
								31	-	40	-
Monthly mean discharge, in second-feet									642	639	16
Runoff, in acre-feet									38,190	39,300	953
Runoff, in inches									3.35	3.45	0.08

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 22 (cont'd.)			May 5			May 11	
6	2.96	235	4	7.28	2,110	N	2.68	383	4	5.87	2,090
N	4.16	570	9	7.24	2,090	12	3.19	570	8	5.54	1,920
4	5.55	1,060	12	6.84	1,920		May 6		2	5.35	1,820
6	7.40	2,180		Apr. 23		8	3.55	704	6	5.07	1,680
8	9.70	5,070	6	6.27	1,710	2	3.98	863	10	4.38	1,320
9	10.00	5,740	N	5.62	1,470	8	4.84	1,180	12	4.20	1,220
10	9.25	4,200	6	5.04	1,250	12	5.08	1,270		May 12	
12	8.95	3,780	12	4.74	1,140		May 7		6	3.86	1,050
	Apr. 18			Apr. 24		6	5.45	1,410	N	3.66	943
4	8.77	3,540	8	4.30	981	10	5.92	1,580	12	3.54	881
8	8.75	3,520	4	3.64	737	2	6.80	1,910		May 13	
10	9.60	4,850	12	3.15	556	6	8.55	3,280	6	3.37	792
2	9.70	5,070		Apr. 25		8	9.25	4,200	N	3.09	647
6	9.95	5,620	N	2.58	347	10	9.40	4,460	6	3.14	673
12	10.05	5,860	12	2.26	232	12	9.40	4,460	12	3.15	678
	Apr. 19			Apr. 27			May 8			May 14	
2	10.10	5,970	N	1.92	116	6	9.34	4,360	8	3.08	642
6	8.60	3,330		Apr. 28		8	9.10	3,970	4	2.88	538
N	7.77	2,460	N	2.05	158	10	8.48	3,450	8	2.91	553
8	7.46	2,220	12	2.17	200	N	8.23	3,320	12	2.86	528
12	7.07	2,010		Apr. 29		4	8.02	3,210		May 15	
	Apr. 20		8	2.30	246	8	7.94	3,170	N	2.60	401
6	5.97	1,600	4	2.50	318	10	7.84	3,120	12	2.40	316
9	5.69	1,500	12	2.52	325	12	7.45	2,910		May 16	
N	5.72	1,510		Apr. 30			May 9		N	2.30	278
2	5.83	1,550	8	2.53	329	6	6.02	2,170	12	2.23	253
4	6.20	1,680	6	2.51	322	10	5.84	2,080		May 17	
8	7.47	2,230	12	2.73	401	5	5.74	2,020	N	2.19	239
9	7.56	2,290		May 1		6	5.90	2,110	12	2.10	208
12	7.34	2,140	8	3.05	518	7	6.01	2,170		May 18	
	Apr. 21		2	3.14	552	12	5.64	1,970	N	2.05	193
8	6.50	1,800	12	3.10	537		May 10		12	2.11	211
N	6.90	1,940		May 2		4	5.46	1,880		May 19	
4	7.29	2,120	8	3.02	507	8	5.45	1,870	6	2.22	249
8	7.94	2,620	4	2.86	448	N	6.15	2,240	10	2.37	305
11	8.00	2,680	12	2.64	368	6	7.35	2,860	6	2.44	332
12	7.98	2,660		May 3		8	7.42	2,900	12	2.37	305
	Apr. 22		N	2.22	217	12	6.62	2,480		May 20	
4	7.78	2,470	6	2.05	158				N	2.13	218
8	7.43	2,200	12	2.04	155				12	2.05	193
N	6.90	1,940		May 4							
2	6.98	1,970	6p	2.03	151						
			12	2.16	196						

South Branch Park River below Homme Dam, N. Dak.

Location. —Lat. 48°24', long. 97°47', in sec. 19, T. 157 N., R. 55 W., half a mile downstream from Homme Dam, 2 miles west of city of Park River.
Drainage area. —229 square miles.
Gage-height record. —Water-stage recorder graph except June 22, when no gage-height record was obtained.
Discharge record. —Stage-discharge relation defined by current-meter measurements below 5,500 second-feet and extended to peak stage. Discharge for day of no gage-height record computed on basis of records for station near Park River. Stage-discharge relation affected by ice Apr. 1-6.
Maximum. —April-June 1950: Discharge, at time of dam washout, about 13,000 second-feet 11 a.m. Apr. 24 (gage height, 37.52 feet), from rating curve extended above 5,500 second-feet. Continuous low flow December 1949 to March 1950.
Remarks. —No diversions. Flow partly regulated by Homme Dam and Reservoir to Apr. 24 when dam washed out; usable capacity 3,600 acre-feet.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	4.6	481	42	11	7.6	2,070	21	21	2,750	212	12
2	4.2	481	37	12	10	1,170	20	22	2,970	175	11
3	3.9	292	32	13	11	845	19	23	2,150	152	11
4	3.9	218	32	14	11	711	18	24	1,500	126	10
5	3.9	365	29	15	12	460	17	25	466	108	17
6	4.2	971	27	16	50	297	18	26	231	91	33
7	5.4	2,490	25	17	887	250	17	27	185	80	24
8	5.4	3,940	24	18	4,330	212	15	28	221	66	21
9	6.8	2,400	23	19	3,630	292	14	29	293	56	18
10	7.3	2,470	23	20	2,380	303	13	30	335	51	16
								31	-	46	-
Monthly mean discharge, in second-feet									749	706	21.3
Runoff, in acre-feet									44,590	43,400	1,270
Runoff, in inches									3.65	3.55	0.10

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 23 (cont'd.)			May 3			May 10 (cont'd.)	
2	26.41	603	4	28.93	1,860	4p	25.15	246	2	28.98	1,890
6	26.47	623	8	28.56	1,640	12	25.03	217	6	30.63	2,880
10	26.41	603	12	28.43	1,570		May 4		10	31.29	3,270
4	26.53	643		Apr. 24		10	25.01	212	12	31.21	3,230
8	28.13	1,400	6	28.12	1,400	8	25.05	222		May 11	
12	29.73	2,340	8	28.10	1,390	12	25.12	239	4	30.40	2,740
	Apr. 18		10:45	28.43	1,570		May 5		8	29.63	2,280
4	31.53	3,420	11:00	37.52	13,000	6	25.41	313	N	28.95	1,870
8	32.83	4,270	11:30	33.33	4,620	N	25.55	350	4	28.45	1,580
10	32.70	4,180	N	31.33	3,300	12	26.08	501	12	28.39	1,550
2	33.52	4,750	12:30	27.73	1,180		May 6			May 12	
4	33.88	5,010	6	27.26	937	N	27.08	852	6	27.93	1,290
6	34.03	5,120	12	26.75	718	10	28.40	1,550	N	27.57	1,090
9	34.13	5,200		Apr. 25		12	28.52	1,620	2	27.41	1,010
12	33.94	5,060	N	25.85	434		May 7		10	27.50	1,060
	Apr. 19		12	25.27	276	4	28.82	1,800	12	27.35	974
4	33.23	4,550		Apr. 26		10	28.89	1,840		May 13	
8	32.03	3,740	N	25.06	224	N	29.05	1,930	6	27.21	899
10	31.63	3,480	12	24.95	199	2	29.43	2,160	N	26.99	784
N	31.26	3,260		Apr. 27		6	31.33	3,300	6	26.98	779
6	30.85	3,010	10	24.91	190	8	32.33	3,940	12	27.14	862
12	31.07	3,140	2	24.79	166	10	32.43	4,000		May 14	
	Apr. 20		12	24.92	192	12	32.39	3,980	8	26.94	758
4	30.45	2,770		Apr. 28			May 8		4	26.65	612
8	29.23	2,040	6	25.06	224	1	33.70	4,880	10	26.75	661
11	28.81	1,790	2	24.97	203	3	33.47	4,720	12	26.69	631
4	29.22	2,030	8	25.16	249	3	33.91	5,030		May 15	
8	30.08	2,550	12	25.15	246	6	33.47	4,720	6p	26.02	361
12	30.88	3,030		Apr. 29		6	32.93	4,340	12	25.95	341
	Apr. 21		6	25.32	289	7	32.65	4,150		May 16	
2	30.92	3,050	2	25.28	279	8	32.69	4,170	6p	25.67	270
6	30.33	2,700	7	25.48	332	9	32.93	4,340	12	25.68	273
9	29.81	2,390	12	25.43	318	N	32.63	4,130		May 17	
2	30.17	2,600		Apr. 30		4	31.73	3,550	N	25.57	249
8	30.57	2,840	2	25.49	334	8	31.00	3,100	12	25.48	230
12	31.09	3,150	7	25.46	326	12	30.50	2,800		May 18	
	Apr. 22		N	25.52	342		May 9		7p	25.31	197
3	31.15	3,190	12	25.50	337	6	30.00	2,500	12	25.43	220
N	30.80	2,980		May 1		N	29.43	2,160		May 19	
4	30.34	2,700	2	25.76	409	4	29.34	2,100	6	25.57	249
10	30.67	2,900	6	25.91	452	8	29.90	2,440	N	25.83	309
12	30.67	2,900	8	25.92	455	12	30.23	2,640	12	25.97	347
	Apr. 23		6	26.20	537		May 10			May 20	
4	30.28	2,670	12	26.19	534	2	30.18	2,610	6a	25.96	344
8	29.80	2,380		May 2		8	29.33	2,100	8p	25.60	255
N	29.38	2,130	4p	25.98	472	N	28.83	1,800	12	25.58	251
			12	25.73	400						

Park River at Grafton, N. Dak.

Location. —Lat. 48°25', long. 97°24', in NE¼ sec. 13, T. 157 N., R. 53 W., in Grafton. Datum of gage is 807.39 feet above mean sea level, datum of 1929.

Drainage area. —742 square miles (revised).

Gage-height record. —Graph based on one or more daily wire-weight gage readings. Gage not read Apr. 1. Average of daily readings used Apr. 2-17, May 19 to June 30.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 9,000 second-feet and extended to peak stage on basis of previous rating. Affected by ice Apr. 1-18 (no gage height record Apr. 1); discharge computed on basis of three discharge measurements, gage heights and engineers' notes.

Maxima. —April-June 1950: Discharge, 12,600 second-feet 6 a.m. to 11 a.m. Apr. 19 (gage height, 20.13 feet), from rating curve extended above 9,000 second-feet.

1931 to March 1950: Discharge, 11,700 second-feet Apr. 19, 1948 (gage height, 20.06 feet).

Remarks. —No diversions. Flow partly regulated by Homme Dam, and reservoir until Apr. 24, when dam broke; usable capacity about 3,600 acre-feet.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0.5	812	141	11	0.6	5,100	59	21	8,560	742	36
2	.6	1,020	130	12	.6	4,230	49	22	7,660	692	37
3	.6	1,100	118	13	.6	3,540	50	23	6,970	582	33
4	.6	1,240	102	14	.6	2,810	47	24	5,590	460	33
5	.6	1,940	94	15	4.0	2,190	46	25	4,060	369	69
6	.6	3,300	82	16	15	1,560	44	26	2,450	318	81
7	.6	5,490	78	17	30	1,070	43	27	1,590	268	84
8	.6	7,340	73	18	1,430	771	40	28	1,120	230	71
9	.6	8,370	64	19	11,700	724	39	29	833	198	58
10	.6	6,630	61	20	8,730	772	37	30	780	168	50
								31	-	160	-
Monthly mean discharge, in second-feet									2,051	2,071	65
Runoff, in acre-feet									122,000	127,300	3,870
Runoff, in inches									3.09	3.22	0.10

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 18			Apr. 24			May 3			May 10	
6	9.84	200	6	18.66	6,080	N	10.74	1,100	6	18.89	6,980
N	10.78	360	N	18.43	5,300	12	10.82	1,120	N	18.79	6,580
4	13.60	960	10	18.35	5,100		May 4		6	18.66	6,080
8	16.90	2,600	12	18.30	4,990	6	10.92	1,140	12	18.60	5,850
10	18.34	5,080		Apr. 25		N	11.22	1,190		May 11	
12	19.40	9,130	8	17.84	4,280	6	11.93	1,330	6	18.28	4,950
	Apr. 19		4	17.42	3,780	12	12.84	1,510	N	18.20	4,810
2	19.94	11,600	12	16.84	3,240		May 5		4	18.37	5,140
4	20.08	12,300		Apr. 26		6	13.72	1,740	7	18.39	5,190
6	20.13	12,600	6	16.22	2,720	N	14.28	1,900	12	18.26	4,920
11	20.13	12,600	N	15.44	2,290	4	14.73	2,040		May 12	
6	19.93	11,600	6	15.20	2,200	8	15.30	2,230	6	17.90	4,360
8	19.68	10,400	12	14.34	1,920	12	15.90	2,510	N	17.71	4,120
10	19.70	10,500		Apr. 27			May 6		12	17.55	3,930
12	19.55	9,810	6	13.26	1,620	6	16.43	2,880		May 13	
	Apr. 20		N	12.95	1,540	N	16.88	3,270	8	17.29	3,650
4	19.02	7,500	6	12.80	1,500	6	17.28	3,640	4	17.02	3,400
7	18.67	6,120	8	12.87	1,520	12	17.87	4,320	12	16.78	3,180
9	18.65	6,040	12	12.33	1,400		May 7			May 14	
N	18.98	7,340		Apr. 28		8	18.25	4,900	8	16.48	2,920
2	19.52	9,670	N	10.70	1,100	N	18.52	5,570	4	16.16	2,680
4	19.72	10,600	6	10.08	977	4	18.64	6,000	12	15.85	2,480
6	19.77	10,800	12	9.65	896	8	18.67	6,120		May 15	
10	19.73	10,600		Apr. 29		10	18.84	6,780	8	15.41	2,280
12	19.64	10,200	8	9.33	835	12	18.85	6,820	4	14.90	2,100
	Apr. 21		4	9.21	812		May 8		12	14.24	1,890
8	19.20	8,250	12	9.19	808	8	18.87	6,900		May 16	
N	19.18	8,170		Apr. 30		8	19.13	7,960	8	13.37	1,650
3	19.24	8,430	N	9.00	772	12	19.15	8,040	4	12.48	1,430
7	19.21	8,290	12	8.99	770		May 9		12	11.66	1,280
12	19.12	7,910		May 1		6	19.18	8,170		May 17	
	Apr. 22		8	9.06	783	N	19.28	8,600	N	10.51	1,060
6	19.02	7,500	4	9.24	818	3	19.31	8,730	12	9.65	896
N	19.05	7,620	12	9.67	899	9	19.24	8,430		May 18	
6	19.09	7,790		May 2		12	19.12	7,910	N	8.90	753
12	19.03	7,540	6	10.09	979				6	8.66	707
	Apr. 23		N	10.33	1,020				12	8.67	709
N	18.87	6,900	8	10.66	1,090						
12	18.78	6,540	12	10.72	1,100						

Two Rivers Basin

Two Rivers below Hallock, Minn.

Location. —Lat. 48°46' 50", long. 97°02'25", in NE¼SE¼ sec. 7, T. 161 N., R. 49 W., 4 miles west of Hallock and 5 miles upstream from North Branch Two Rivers.

Drainage area. —644 square miles.

Gage-height record. —From graph drawn on basis of twice-daily staff gage readings Apr. 2, 3, 9, 10, 13, 14, 22, 23, 26, 27, May 9, 28, June 2, 4, 8-10, 13-15, 18, 21, 22, 25, 28 and 30. Average of twice-daily staff gage readings all other days.

Discharge record. —Stage-discharge relation not determined for high stages due to backwater from Red River, but defined below 1,010 second-feet by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-21 and by backwater from Red River of the North Apr. 22 to June 16.

Maxima. —April-June 1950: Daily discharge, 3,600 second-feet May 10-13 (gage height, 25.70 feet, affected by backwater).

1945 to March 1950: Daily discharge, 2,200 second-feet Apr. 26, 27, 1948; gage height, 22.84 feet Apr. 25, 1948.

Remarks. —No diversions or regulation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2.2	3,200	1,100	11	2.2	3,600	600	21	900	1,900	396
2	2.6	3,000	1,000	12	2.2	3,600	600	22	1,200	1,800	377
3	7.0	3,000	1,000	13	2.4	3,600	550	23	1,600	1,700	353
4	7.5	3,000	950	14	3.0	3,400	550	24	2,000	1,600	337
5	3.5	3,000	900	15	7.0	3,200	500	25	2,400	1,600	366
6	3.0	3,200	850	16	38	3,000	480	26	2,800	1,500	428
7	3.0	3,200	800	17	70	2,600	463	27	3,000	1,400	520
8	2.8	3,400	750	18	150	2,400	444	28	3,200	1,400	662
9	2.6	3,400	700	19	340	2,200	424	29	3,200	1,300	664
10	2.4	3,600	650	20	650	2,000	406	30	3,200	1,200	555
								31	-	1,200	-
Monthly mean discharge, in second-feet									827	2,523	612
Runoff, in acre-feet									49,190	155,100	36,450
Runoff, in inches									1.43	4.52	1.06

North Branch Two Rivers near Lancaster, Minn.

Location.—Lat. 48°53'21", long. 96°40'01", in NW¼ sec. 6, T. 162 N., R. 46 W., 8 miles northeast of Lancaster. Datum of gage is 963.69 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Drainage area.—32 square miles.

Gage-height record.—Gage read once daily except Apr. 1-16 when no readings were made. Record Apr. 18 to May 24, June 25-27 from graph based on gage readings.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 743 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-22.

Maxima.—April-June 1950: Discharge observed, 912 second-feet 9 a.m. May 20 (gage height, 6.25 feet).

1928-38; 1941 to March 1950: Discharge observed, 290 second-feet Apr. 25, 1941; gage height observed, 4.69 feet Mar. 26, 1942 affected by ice.

Remarks.—No regulation.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	308	412	11	0	664	219	21	110	880	162
2	0	366	372	12	0	752	205	22	240	803	176
3	0	420	347	13	0	780	192	23	298	746	162
4	0	467	332	14	0	771	176	24	286	669	145
5	0	683	312	15	0	700	218	25	252	588	162
6	0	803	290	16	0	685	195	26	238	537	276
7	0	686	264	17	0	739	182	27	270	507	283
8	0	618	256	18	0	760	178	28	242	467	256
9	0	612	245	19	0	832	169	29	209	437	243
10	0	606	234	20	60	904	162	30	218	460	224
								31	-	432	-
Monthly mean discharge, in second-feet									80.8	635	235
Runoff, in acre-feet									4,810	39,040	13,980
Runoff, in inches									2.82	22.87	8.19

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 18			Apr. 26 (cont'd.)			May 5 (cont'd.)			May 15 (cont'd.)	
8	0.94		4	3.48	237	4	5.55	730	4	5.34	675
4	1.11		12	3.56	250	12	5.83	803	12	5.30	665
12	1.32			Apr. 27			May 6			May 16	
	Apr. 19		8	3.69	270	6	5.92	826	8	5.32	670
8	1.57		4	3.74	279	N	5.90	821	4	5.42	696
4	1.92		12	3.71	274	6	5.78	790	12	5.48	712
12	2.47			Apr. 28		12	5.62	748		May 17	
	Apr. 20		8	3.59	254		May 7		8	5.55	730
6	2.86		4	3.44	230	N	5.36	681	4	5.62	748
N	3.16		12	3.33	213	12	5.18	634	12	5.69	766
6	3.32			Apr. 29			May 8			May 18	
12	3.32		8	3.28	205	N	5.10	613	8	5.68	764
	Apr. 21		4	3.31	210	12	5.10	613	4	5.63	751
6	3.28		12	3.33	213		May 9		12	5.68	764
N	3.22			Apr. 30		N	5.10	613		May 19	
6	3.37		8	3.32	211	12	5.08	608	8	5.83	803
12	3.80		4	3.33	213		May 10		4	6.06	863
	Apr. 22		12	3.53	245	N	5.05	600	12	6.20	899
6	4.20			May 1		12	5.12	618		May 20	
N	4.20		8	3.79	288		May 11		8	6.23	907
6	4.07		4	4.00	337	N	5.28	660	4	6.22	904
12	3.97		12	4.07	354	12	5.50	717	12	6.20	899
	Apr. 23			May 2			May 12			May 21	
8	3.87	305	8	4.07	354	8	5.62	748	8	6.18	894
4	3.78	286	4	4.12	367	4	5.68	764	4	6.10	873
12	3.72	276	12	4.24	397	12	5.71	772	12	5.99	844
	Apr. 24			May 3			May 13			May 22	
6	3.77	285	8	4.32	417	8	5.73	777	N	5.82	800
N	3.83	297	4	4.38	432	4	5.76	785	12	5.70	769
6	3.78	286	12	4.34	422	12	5.76	785		May 23	
12	3.70	272		May 4			May 14		N	5.63	751
	Apr. 25		8	4.39	434	8	5.73	777	12	5.49	714
N	3.57	251	4	4.56	477	4	5.70	769		May 24	
12	3.47	235	12	4.88	557	12	5.62	748	N	5.31	668
	Apr. 26			May 5			May 15		12	5.15	626
8	3.46	234	8	5.20	639	8	5.50	717		May 25	
									N	5.00	587
									12	4.87	554

North Branch Two Rivers near Northcote, Minn.

Location. - Lat. 48°49'06", long. 97°03'11", in NE¼NW¼ sec. 31, T. 162 N., R. 49 W., at highway bridge, 3 miles southwest of Northcote, and 3.8 miles upstream from mouth. Datum of gage is 769.03 feet above mean sea level, adjustment of 1912 (levels by Corps of Engineers).

Drainage area. - 386 square miles.

Gage-height record. - Staff gage readings once or twice-daily except Apr. 1-4, 23, 24, May 25 to June 2, when no gage-height readings were obtained and Apr. 18-20, 22, May 1, 2, 5, 8, 9, 13-19, 21, 22, 24, June 5, 6, 16, 25, 28, which were computed from graphs.

Discharge record. - Stage-discharge relation not determined for high stages because of backwater from Red River. Stage-discharge relation affected by ice Apr. 5-22 and by backwater from Red River Apr. 25 to June 23. Gage heights used to hundredths.

Maxima. - April-June 1950: Discharge observed, 2,600 second-feet May 13-17; gage height, 26.54 feet 4:53 p.m. May 13.

1941-42, 1945 to March 1950: Daily discharge, 1,700 second-feet Apr. 2, 1942; gage height observed, 23.52 feet Apr. 26, 1948, backwater from Red River.

Remarks. - Small amount of regulation by storage in swamps near headwaters. Some diversion from Roseau River during high stage to headwaters of Two Rivers.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	2,200	1,500	11	0	2,400	700	21	440	2,200	320
2	0	2,000	1,500	12	1.0	2,400	650	22	1,100	2,000	320
3	0	2,000	1,300	13	2.0	2,600	600	23	1,400	1,900	450
4	0	2,000	1,200	14	3.0	2,600	550	24	1,700	1,800	488
5	0	2,000	1,100	15	5.0	2,600	500	25	1,900	1,500	515
6	0	2,000	1,000	16	10	2,600	450	26	2,000	1,500	535
7	0	2,000	950	17	20	2,600	420	27	2,000	1,500	569
8	0	2,200	850	18	30	2,400	380	28	2,200	1,500	699
9	0	2,200	850	19	51	2,400	360	29	2,200	1,500	853
10	0	2,400	750	20	80	2,200	340	30	2,200	1,500	871
								31	-	1,500	-
Monthly mean discharge, in second-feet									578	2,071	719
Runoff, in acre-feet									34,400	127,300	42,780
Runoff, in inches									1.67	6.18	2.08

State ditch 85 near Lancaster, Minn.

Location.—Lat. 48°52'02", long. 96°41'01", in southwest corner of sec. 6, T. 162 N., R. 46 W., 7 miles northeast of Lancaster. Datum of gage is 969.28 feet above mean sea level, datum of 1929 (levels by Corps of Engineers).

Drainage area.—95 square miles.

Gage-height record.—Graph drawn on basis of once-daily staff gage readings for period Apr. 19 to May 24. No gage-height readings Apr. 1-18. Once-daily readings used May 25 to June 30.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 879 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-25.

Maxima.—April-June 1950: Discharge observed, 1,480 second-feet 8:30 a.m. May 20 (gage height, 5.90 feet).

1929-38, 1942 to March 1950: Discharge, 298 second-feet Apr. 5, 1942; gage height observed, 6.30 feet Mar. 29, 1942, affected by ice.

Remarks.—This ditch drains a portion of the large Roseau swamp by a network of feeder ditches. During high stages of Roseau River, many of these ditches flow directly across ditch 85, and divert water to the south.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	377	359	11	0	626	298	21	4.0	1,260	270
2	0	423	348	12	0	896	290	22	22	966	275
3	0	458	343	13	0	1,110	282	23	70	719	270
4	0	430	340	14	0	1,050	278	24	140	491	263
5	0	562	322	15	0	1,040	288	25	260	443	278
6	0	937	322	16	0	1,110	282	26	293	416	298
7	0	762	317	17	0	1,220	275	27	269	396	298
8	0	470	315	18	0	1,200	270	28	261	385	298
9	0	458	315	19	0	958	270	29	253	366	288
10	0	488	308	20	0.4	1,400	270	30	278	366	278
								31	-	366	-
Monthly mean discharge, in second-feet									61.7	714	297
Runoff, in acre-feet									3,670	43,930	17,670
Runoff, in inches									0.72	8.67	3.69

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 19			Apr. 28			May 7			May 16	
8	4.30		6	5.07	258	6	5.80	930	6	5.83	1,100
4	4.31		N	5.09	262	N	5.77	765	N	5.83	1,100
12	4.35		6	5.11	264	6	5.74	605	6	5.84	1,150
	Apr. 20		12	5.10	263	12	5.72	515	12	5.85	1,200
8	4.38			Apr. 29			May 8			May 17	
4	4.41		6	5.07	258	6	5.71	490	6	5.85	1,200
12	4.43		N	5.02	251	N	5.70	470	N	5.86	1,260
	Apr. 21		6	4.98	245	6	5.68	443	6	5.85	1,200
8	4.42		12	5.03	252	12	5.68	443	12	5.85	1,200
4	4.32			Apr. 30			May 9			May 18	
12	4.02		6	5.10	263	6	5.68	443	6	5.86	1,260
	Apr. 22		N	5.18	275	N	5.69	455	N	5.86	1,260
6	3.70		6	5.26	290	6	5.70	470	6	5.84	1,150
N	3.55		12	5.36	312	12	5.71	490	12	5.82	1,040
6	3.60			May 1			May 10			May 19	
12	3.82		6	5.48	343	6	5.71	490	6	5.80	930
	Apr. 23		N	5.58	378	N	5.70	470	N	5.78	820
6	4.16		6	5.64	409	6	5.71	490	6	5.81	985
N	4.46		12	5.68	443	12	5.72	515	12	5.84	1,150
6	4.68			May 2			May 11			May 20	
12	4.87		6	5.69	455	6	5.73	555	6	5.88	1,370
	Apr. 24		N	5.62	396	N	5.75	655	N	5.90	1,480
6	4.99		6	5.64	409	6	5.75	655	6	5.90	1,480
N	5.12		12	5.66	423	12	5.77	765	12	5.89	1,420
6	5.21			May 3			May 12			May 21	
12	5.30		6	5.68	443	6	5.78	820	6	5.88	1,370
	Apr. 25		N	5.70	470	N	5.79	875	N	5.86	1,260
6	5.36		6	5.70	470	6	5.81	985	6	5.84	1,150
N	5.40		12	5.70	470	12	5.82	1,040	12	5.83	1,100
6	5.38			May 4			May 13			May 22	
12	5.31		6	5.68	443	6	5.83	1,100	6	5.83	1,100
	Apr. 26		N	5.66	423	N	5.83	1,100	N	5.80	930
6	5.22	282	6	5.64	409	6	5.84	1,150	6	5.79	875
N	5.28	294	12	5.66	423	12	5.84	1,150	12	5.78	820
6	5.31	300		May 5			May 14			May 23	
12	5.26	290	6	5.69	455	6	5.83	1,100	6	5.78	820
	Apr. 27		N	5.72	515	N	5.82	1,040	N	5.77	765
6	5.18	275	6	5.75	655	6	5.81	985	6	5.74	605
N	5.12	260	12	5.78	820	12	5.81	985	12	5.73	555
6	5.08	260		May 6			May 15			May 24	
12	5.07	258	6	5.78	820	6	5.82	1,040	6	5.71	490
			N	5.81	985	N	5.83	1,100	N	5.70	470
			6	5.82	1,040	6	5.82	1,040	6	5.71	490
			12	5.81	985	12	5.81	985	12	5.70	470

Pembina River Basin

Pembina River near Walhalla, N. Dak.

Location. —Lat. 48°53'32", long. 97°59'09", in SE¼SW¼ sec. 35, T. 163 N., R. 57 W., 1½ miles downstream from Little Pembina River and 3½ miles southwest of Walhalla.

Drainage area. —3,109 square miles (revised).

Gage-height record. —Water-stage recorder graph except for periods 7 p.m. Apr. 17 to 1 p.m. Apr. 27, and 11:15 a.m. May 9 to 10:30 a.m. May 12, for which graph was drawn based on floodmarks and occasional gage readings; and for periods of no record, 2:30 p.m. Apr. 2 to 4:30 p.m. Apr. 8, 11 p.m. Apr. 10 to 2 p.m. Apr. 14 and 4 p.m. May 1 to 11:45 a.m. May 9.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 7,000 second-feet and extended to peak stage on basis of contracted-opening measurement. Affected by ice Apr. 1 to 7:15 p.m. Apr. 16. Discharge for periods of no gage-height record computed on basis of record for station at Neche.

Maxima. —April-May 1950: Discharge, 20,400 second-feet about 6 a.m. Apr. 18 (gage height, 19.2 feet, from floodmark), by contracted-opening method.

1939 to March 1950: Discharge, 7,280 second-feet Apr. 19, 1948 (gage height, 14.94 feet).

Remarks. —Slight regulation and diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	50	1,770	1,530	11	100	6,640	1,190	21	5,150	2,830	908
2	50	1,800	1,500	12	110	4,950	1,150	22	4,510	2,520	904
3	50	1,800	1,470	13	120	4,040	1,110	23	3,560	2,340	864
4	50	2,000	1,450	14	140	3,780	1,080	24	2,440	2,160	832
5	100	2,400	1,420	15	210	3,190	1,070	25	1,950	1,980	820
6	250	3,000	1,390	16	1,950	2,800	1,060	26	1,760	1,860	884
7	200	4,000	1,350	17	7,670	2,590	1,020	27	1,670	1,770	860
8	177	6,000	1,300	18	13,800	2,420	1,010	28	1,630	1,710	836
9	144	7,000	1,270	19	6,680	2,680	980	29	1,700	1,670	820
10	120	7,590	1,220	20	5,940	3,000	944	30	1,750	1,630	797
								31	-	1,570	-
Monthly mean discharge, in second-feet									2,134	3,080	1,101
Runoff, in acre-feet									127,000	189,400	65,530
Runoff, in inches									0.77	1.14	0.40

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 14			Apr. 17 (cont'd.)			Apr. 26			May 10	
2p	4.60	140	10	17.17	11,800	8	7.00	1,770	4	15.40	7,580
4	4.64	150	12	17.95	13,500	4	6.94	1,740	8	13.53	5,980
6	4.71	160		Apr. 18		12	6.87	1,700	N	13.40	5,890
8	4.66	150	2	18.67	17,000		Apr. 27		4	14.55	6,800
10	4.65	150	4	19.10	19,700	4	6.86	1,700	8	16.40	9,050
12	4.66	150	6	19.20	20,400	8	6.84	1,690	11	16.87	10,100
	Apr. 15		8	19.13	19,900	N	6.81	1,680	12	16.82	9,960
4	4.76	170	10	18.67	17,000	4	6.77	1,660		May 11	
8	4.65	150	N	18.00	13,700	8	6.72	1,630	4	15.68	7,910
N	4.63	140	2	17.44	11,600	12	6.67	1,610	8	14.27	6,580
2	5.08	260	4	16.97	10,300		Apr. 28		N	13.67	6,100
4	5.19	290	6	16.55	9,360	4	6.65	1,600	4	13.34	5,830
6	5.21	290	8	16.15	8,600	8	6.68	1,610	8	13.13	5,660
8	5.19	290	10	15.78	8,030	N	6.71	1,620	12	12.98	5,540
10	5.19	290	12	15.45	7,640	4	6.72	1,630		May 12	
12	5.31	320		Apr. 19		8	6.79	1,660	4	12.85	5,440
	Apr. 16		8	14.48	6,740	12	6.87	1,700	8	12.63	5,260
4	5.29	320	4	13.99	6,350		Apr. 29		N	12.27	4,980
8	5.39	350	12	13.88	6,260	4	6.88	1,710	4	11.90	4,680
10:30	5.44	360		Apr. 20		8	6.82	1,680	8	11.62	4,460
N	9.98	1,000	8	13.70	6,120	N	6.82	1,680	12	11.38	4,260
1:40	10.96	1,500	4	13.34	5,850	4	6.84	1,690		May 13	
1:40	10.96	4,200	12	12.80	5,470	8	6.94	1,740	4	11.14	4,080
2:40	8.44	2,500		Apr. 21		12	6.89	1,720	8	11.05	4,020
4	9.08	2,900	8	12.43	5,210		Apr. 30		N	11.04	4,010
6	9.90	3,400	4	12.22	5,060	4	6.84	1,690	4	11.03	4,000
7:20	12.29	4,000	12	11.96	4,870	8	6.84	1,690	8	11.03	4,000
7:20	12.29	5,100		Apr. 22		N	6.88	1,710	12	11.01	3,990
8	11.94	4,870	8	11.65	4,660	4	6.90	1,720		May 14	
9:40	11.44	4,520	4	11.26	4,390	8	7.25	1,900	8	10.89	3,900
12	11.79	4,760	12	10.84	4,100	12	7.12	1,830	4	10.61	3,710
	Apr. 17			Apr. 23			May 1		12	10.27	3,470
2	13.76	6,170	8	10.38	3,780	4	7.02	1,780		May 15	
4	15.19	7,360	4	9.83	3,390	8	6.95	1,740	N	9.84	3,170
5:30	15.40	7,580	12	9.10	2,930	N	7.04	1,790	12	9.49	2,950
6	15.34	7,510		Apr. 24		4	7.15	1,840		May 16	
8	14.98	7,160	8	8.45	2,540		May 9		N	9.18	2,770
10	14.33	6,620	4	7.98	2,260	N	13.40	5,890	12	9.07	2,700
N	13.88	6,260	12	7.66	2,100	4	14.70	6,920		May 17	
1	13.73	6,140		Apr. 25		8	17.16	10,800	N	8.88	2,590
2	13.89	6,270	8	7.42	1,980	9:30	17.23	12,000	12	8.71	2,490
4	14.72	6,940	4	7.25	1,900	12	16.93	10,200			
6	15.65	7,870	12	7.10	1,820						
8	16.38	9,010									

Pembina River near Walhalla, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 18			May 19 (cont'd.)			May 21			May 24	
N	8.57	2,420	4	9.23	2,800	N	9.29	2,830	N	8.06	2,160
10	8.46	2,360	8	9.24	2,800	12	8.99	2,650	12	7.85	2,060
12	8.46	2,360	12	9.29	2,830		May 22			May 25	
	May 19			May 20		8	8.82	2,550	N	7.69	1,980
4	8.64	2,450	8	9.52	2,970	4	8.68	2,470	12	7.55	1,900
8	8.98	2,650	4	9.71	3,090	12	8.57	2,420		May 26	
N	9.19	2,770	8	9.70	3,080		May 23		N	7.45	1,860
			12	9.60	3,020	N	8.44	2,350	12	7.34	1,800
						12	8.27	2,260			

Pembina River at Neche, N. Dak.

Location. — Lat. 48°59'20", long. 97°33'05", in SE¼NW¼ sec. 31, T. 164 N., R. 53 W., 60 feet upstream from concrete dam in Neche.

Drainage area. — 3,189 square miles (revised).

Gage-height record. — Water-stage recorder graph except 1:30 a.m. May 29 to 7 a.m. May 30, and 10:30 a.m. June 4 to 12 m. June 7, when record is computed from graph based on partial record and observer's readings.

Discharge record. — Stage-discharge relation defined by current-meter measurements below 5,300 second-feet and extended to peak stage. Affected by ice Apr. 1-22.

Maxima. — April-May 1950: Discharge, 10,700 second-feet 9:30 a.m. Apr. 20 (gage height, 21.58 feet).

1903-15, 1919 to March 1950: 5,010 second-feet Apr. 22, 1949 (gage height, 20.83 feet).

Remarks. — Slight regulation and diversion. Overbank discharge upstream from Neche bypasses gage, some returning to Pembina River via Louden Coulee and Tongue River and some going to Red River via Plum Creek.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	8	1,770	1,690	11	130	4,980	1,330	21	6,500	2,790	1,020
2	8	1,840	1,650	12	120	5,170	1,290	22	6,600	2,960	993
3	8	1,900	1,610	13	120	4,770	1,250	23	4,820	2,880	957
4	7	1,860	1,570	14	150	4,180	1,210	24	4,340	2,640	916
5	34	1,870	1,540	15	180	3,710	1,190	25	3,640	2,430	880
6	210	2,130	1,510	16	180	3,400	1,150	26	3,010	2,220	880
7	160	2,580	1,480	17	260	3,140	1,140	27	2,330	2,050	927
8	200	3,020	1,450	18	1,700	2,880	1,100	28	1,880	1,920	936
9	200	4,760	1,410	19	6,000	2,670	1,090	29	1,720	1,840	892
10	180	5,020	1,370	20	7,700	2,600	1,050	30	1,720	1,780	854
								31	-	1,750	-
Monthly mean discharge, in second-feet									1,804	2,887	1,211
Runoff, in acre-feet									107,300	177,500	72,070
Runoff, in inches									0.63	1.04	0.42

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 13			Apr. 19 (cont'd.)			Apr. 26 (cont'd.)			May 6	
12	6.66	130	6	21.07	6,200	4	18.11	2,910	8	14.36	2,060
	Apr. 14		8	21.06	6,200	8	17.63	2,780	4	14.96	2,180
6	6.67	130	8:30	20.99	6,200	12	17.14	2,660	12	15.70	2,340
N	6.71	140	10	20.97	6,200		Apr. 27			May 7	
6	6.78	160	12	21.05	6,700	4	16.62	2,540	8	16.46	2,500
12	6.82	180		Apr. 20		8	16.09	2,420	4	17.17	2,670
	Apr. 15		4	21.29	8,300	N	15.62	2,320	12	17.75	2,820
N	6.82	180	8	21.54	10,300	4	15.15	2,220		May 8	
12	6.82	180	9:30	21.58	10,700	8	14.70	2,130	8	18.20	2,930
	Apr. 16		N	21.33	8,600	12	14.32	2,050	4	18.70	3,070
8	6.81	170	4	20.99	6,400		Apr. 28		12	19.42	3,330
4	6.85	190	8	20.89	5,900	8	13.63	1,920		May 9	
12	6.89	200	12	20.92	6,000	4	13.12	1,810	4	20.08	3,940
	Apr. 17			Apr. 21		12	12.81	1,750	8	20.48	4,770
4	6.90	200	4	21.00	6,400		Apr. 29		N	20.59	5,110
8	6.91	200	8	21.12	7,200	8	12.68	1,730	4	20.62	5,210
N	6.93	210	9	21.13	7,200	4	12.51	1,700	8	20.63	5,250
4	7.01	240	N	20.97	6,300	12	12.45	1,690	12	20.61	5,180
8	7.13	280	4	20.94	6,100		Apr. 30			May 10	
12	7.80	610	8	21.03	6,600	8	12.50	1,700	N	20.56	5,010
	Apr. 18		12	21.08	6,900	4	12.66	1,730	12	20.52	4,880
2	8.76	940		Apr. 22		12	12.76	1,740		May 11	
4	10.00	1,150	4	21.13	7,200		May 1		8	20.53	4,920
6	11.06	1,350	8	21.17	7,500	8	12.87	1,770	4	20.55	4,980
8	11.97	1,500	N	21.12	7,300	4	12.93	1,780	12	20.62	5,210
10	12.60	1,600	4	20.91	6,300	12	13.00	1,790		May 12	
N	13.11	1,650	8	20.67	5,400		May 2		5	20.65	5,320
2	13.53	1,700	12	20.58	5,080	8	13.17	1,820	8	20.64	5,290
4	14.18	1,800		Apr. 23		4	13.33	1,860	4	20.59	5,110
6	15.03	1,950	4	20.51	4,850	12	13.45	1,880	12	20.54	4,950
8	16.70	2,200	8	20.48	4,770		May 3			May 13	
10	18.60	2,600	12	20.43	4,630	8	13.55	1,900	8	20.51	4,850
12	19.83	3,000		Apr. 24		4	13.58	1,910	4	20.47	4,740
	Apr. 19		4	20.36	4,460	12	13.53	1,900	12	20.38	4,500
2	20.52	3,700	8	20.26	4,240		May 4			May 14	
4	20.84	4,600	12	20.11	3,990	8	13.42	1,870	N	20.22	4,170
6	21.05	5,700		Apr. 25		4	13.28	1,850	12	20.04	3,890
8	21.16	6,700	4	19.92	3,740	12	13.25	1,840		May 15	
10	21.27	7,500	8	19.69	3,520		May 5		N	19.88	3,700
N	21.22	7,300	12	19.38	3,310	8	13.27	1,840	12	19.72	3,550
2	21.10	6,600		Apr. 26		4	13.40	1,870		May 16	
4	21.01	6,200	4	19.16	3,220	12	13.82	1,950	N	19.53	3,400
4:30	20.98	6,200	8	18.88	3,120				12	19.30	3,270
5	21.08	6,200	N	18.53	3,020						

Pembina River at Neche, N. Dak. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 17			May 20			May 23			May 26	
N	18.95	3,140	8	16.74	2,570	N	18.03	2,890	N	15.15	2,220
12	18.47	3,010	4	16.91	2,610	12	17.53	2,760	12	14.67	2,120
	May 18		12	17.22	2,680		May 24			May 27	
N	17.98	2,870		May 21		N	17.04	2,640	N	14.29	2,050
12	17.51	2,750	N	17.67	2,790	12	16.60	2,540	12	13.93	1,980
	May 19		12	18.08	2,900		May 25				
N	17.18	2,670		May 22		N	16.15	2,430			
12	16.82	2,590	8	18.32	2,960	12	15.68	2,330			
			4	18.42	2,990						
			12	18.37	2,980						

Tongue River at Akra, N. Dak.

Location. - Lat. 48°46'40", long. 97°44'00", in SE¼ sec. 10, T. 161 N., R. 55 W., 0.3 mile northwest of Akra. Datum of gage is 900.00 feet above mean sea level, datum of 1929.
Drainage area. - 147 square miles.
Gage-height record. - Graph drawn on basis of once-daily readings Apr. 16 to June 1; once-daily readings Apr. 10-15, June 2-30. Readings made at 6 p.m.
Discharge record. - Stage-discharge relation defined by current-meter measurements below 1,500 second-feet and extended to peak stage on basis of contracted-opening measurement. Affected by ice Apr. 10-17.
Maximum. - April-June 1950: Discharge, 11,800 second-feet about noon Apr. 18 (gage height, 48.7 feet, from floodmark).
No previous record. The flood of Apr. 18 is the highest known.
Remarks. - No diversions above station. Gage-height record supplied by the Corps of Engineers.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	2	224	85	11	2	1,110	27	21	1,020	260	20
2	2	274	72	12	2	903	25	22	1,340	214	22
3	2	190	69	13	3	732	25	23	1,160	180	13
4	2	217	63	14	5	580	25	24	746	158	14
5	2	320	60	15	10	404	20	25	358	139	17
6	2	658	57	16	15	312	20	26	182	128	134
7	2	1,240	51	17	460	277	22	27	107	110	87
8	2	4,640	48	18	5,240	261	25	28	87	104	51
9	2	2,100	39	19	1,620	407	25	29	110	100	33
10	2	1,420	27	20	885	345	19	30	155	97	25
								31	-	91	-
Monthly mean discharge, in second-feet									451	587	40.7
Runoff, in acre-feet									26,830	36,090	2,420
Runoff, in inches									3.42	4.60	0.31

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 25 (cont'd.)			May 5			May 15	
6	34.87	10	12	37.05	252	N	37.75	312	N	38.60	396
12	35.53	50		Apr. 26		6	38.17	353	6	38.17	353
	Apr. 17		N	36.05	176	12	38.70	407	12	38.00	336
N	38.16	200	6	35.67	149		May 6			May 16	
6	41.21	700	12	35.40	130	N	40.20	596	N	37.70	308
12	44.70	1,600		Apr. 27		6	41.57	820	12	37.55	294
	Apr. 18		N	35.00	105	12	42.55	1,020		May 17	
6	47.00	3,590	6	34.86	97		May 7		N	37.35	276
N	48.70	11,800	12	34.75	90	N	43.35	1,210	12	37.18	262
6	47.00	3,590		Apr. 28		6	43.68	1,300		May 18	
12	46.08	2,370	N	34.67	85	12	44.70	1,610	N	37.05	252
	Apr. 19		6	34.65	84		May 8		6	37.12	258
N	44.30	1,480	12	34.75	90	7	48.00	6,600	12	37.55	294
6	43.80	1,330		Apr. 29		9	48.10	7,070		May 19	
12	43.00	1,120	N	35.10	111	2	47.67	5,320	N	38.80	418
	Apr. 20		6	35.24	119	6	47.10	3,790	6	39.42	491
N	41.60	825	12	35.43	132	12	46.45	2,770	12	38.95	434
6	41.33	776		Apr. 30			May 9			May 20	
12	41.55	816	N	35.75	154	N	45.60	2,000	N	38.00	336
	Apr. 21		6	35.93	167	6	45.20	1,790	6	37.62	301
N	42.55	1,020	12	36.15	182	12	44.95	1,700	12	37.40	281
6	43.08	1,140		May 1			May 10			May 21	
12	43.35	1,210	N	36.65	220	N	43.95	1,380	N	37.15	260
	Apr. 22		6	37.02	250	6	43.68	1,300	6	37.02	250
8	43.85	1,340	12	37.30	272	12	43.45	1,230	12	36.90	240
1	44.50	1,550		May 2			May 11			May 22	
6	43.77	1,320	6	37.45	286	N	42.95	1,110	N	36.55	212
12	43.35	1,210	N	37.50	290	12	42.40	983	12	36.30	193
	Apr. 23		6	37.22	266		May 12			May 23	
9	43.20	1,170	12	36.90	240	N	42.00	902	N	36.10	179
6	43.16	1,160		May 3		12	41.60	825	12	35.95	168
12	42.80	1,070	N	36.00	172		May 13			May 24	
	Apr. 24		6	35.97	170	N	41.05	728	N	35.80	158
N	41.05	728	12	36.15	182	12	40.55	648	12	35.65	148
6	40.09	581		May 4			May 14			May 25	
12	39.35	482	N	36.60	216	N	40.10	582	N	35.50	137
	Apr. 25		6	36.82	234	6	39.87	550	12	35.45	134
N	38.15	351	12	37.10	256	12	39.50	501		May 26	
6	37.58	297							N	35.40	130
									12	35.20	117

Tongue River at Cavalier, N. Dak.

Location. —Lat. 48°47'55", long. 97°37'35", in SE¼NE¼ sec. 4, T. 161 N., R. 54 W., half a mile upstream from State Highway 5 in Cavalier. Datum of gage is 880.98 feet above mean sea level, datum of 1929, Emerson-Crookston supplementary adjustment of 1941.

Drainage area. —153 square miles (revised).

Gage-height record. —Graph based on once or twice-daily readings of staff gage Apr. 14 to May 24; once-daily readings Apr. 1-13, May 25 to June 30, except no readings on Apr. 1, 2, 5, 7, 8, 10-12, 27, 28, May 1, 14, 25, 26, 29, June 5, 12, 16, 18.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Apr. 1-17. Shifting-control method used June 1-30. Discharge for periods of no gage-height record computed on basis of weather records and records for streams nearby.

Maxima. —April-May 1950: Discharge observed, 1,340 second-feet, 12:30 p.m. May 8 (gage height, 4.58 feet).

1938 to March 1950: Discharge, 1,300 second feet Apr. 21, 1948 (gage height, 4.38 feet, from floodmarks).

Remarks. —Slight regulation and diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1	150	84	11	2	928	40	21	561	291	27
2	1	220	79	12	2	863	38	22	899	218	32
3	1	189	70	13	3	668	36	23	890	186	33
4	1	178	64	14	3	600	33	24	644	164	24
5	1	350	59	15	3	437	32	25	358	140	21
6	1	712	54	16	3	334	39	26	178	120	43
7	2	928	46	17	18	286	46	27	100	109	102
8	2	1,240	43	18	464	260	38	28	100	100	70
9	2	957	40	19	399	313	30	29	130	96	46
10	2	895	40	20	437	464	27	30	136	91	30
								31	-	95	-
Monthly mean discharge, in second-feet									178	406	45.5
Runoff, in acre-feet									10,600	24,960	2,710
Runoff, in inches									1.30	3.06	0.33

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 14			Apr. 20			May 1			May 11	
N	0.92	3	4	2.51	389	12	1.72	162	N	3.79	918
12	.92	3	8	2.50	386		May 2		12	3.91	978
	Apr. 15		N	2.62	427	8	1.95	219		May 12	
N	.92	3	4	2.74	471	4	2.03	240	8	3.72	885
12	.92	3	8	2.80	493	12	2.02	238	4	3.60	828
	Apr. 16		12	2.81	497		May 3		12	3.48	773
N	.92	3		Apr. 21		8	1.92	211		May 13	
12	.92	3	4	2.81	497	4	1.75	169	4	3.37	724
	Apr. 17		8	2.83	504	12	1.62	138	8	3.25	672
2	.92	3	N	2.94	547		May 4		N	3.14	626
4	.92	3	4	3.05	590	8	1.69	155	4	3.08	602
6	.92	3	8	3.17	639	4	1.81	184	8	3.25	672
8	.92	3	12	3.27	680	12	2.06	249	12	3.20	651
10	.92	3		Apr. 22			May 5			May 15	
N	.92	3	4	3.40	737	8	2.28	315	N	2.65	438
2	.93	4	8	3.55	805	4	2.45	370	12	2.50	386
4	.96	7	N	3.72	885	12	2.77	482		May 16	
6	1.00	12	4	4.10	1,080		May 6		N	2.33	331
8	1.16	36	5	4.15	1,100	4	3.06	594	12	2.20	290
10	1.35	75	7	3.94	994	8	3.30	693		May 17	
12	1.57	126	8	4.06	1,060	N	3.43	750	N	2.19	287
	Apr. 18		12	3.97	1,010	4	3.48	773	12	2.17	281
2	1.82	186		Apr. 23		8	3.54	800		May 18	
4	2.11	263	4	3.85	948	12	3.62	837	N	2.10	260
6	2.44	366	8	3.77	909		May 7		12	2.02	238
8	2.83	504	N	3.77	909	4	3.67	861		May 19	
10	3.30	693	4	3.67	861	8	3.74	894	8	2.17	281
N	3.60	828	8	3.58	819	N	3.80	923	4	2.35	337
2	3.38	728	12	3.48	773	4	3.82	933	12	2.55	403
4	3.04	586		Apr. 24		8	3.96	1,000		May 20	
6	2.68	449	8	3.30	693	12	4.11	1,080	8	2.75	474
8	2.46	373	4	3.08	602		May 8		2	2.88	523
10	2.40	353	12	2.83	504	4	4.29	1,180	8	2.70	456
12	2.36	340		Apr. 25		8	4.48	1,280	12	2.53	396
	Apr. 19		8	2.52	393	N	4.58	1,340		May 21	
2	2.35	337	4	2.25	306	4	4.51	1,300	8	2.22	296
4	2.37	343	12	2.05	246	8	4.37	1,220	4	2.10	260
6	2.41	356		Apr. 26		12	4.20	1,130	12	2.03	240
8	2.45	370	8	1.86	196		May 9			May 22	
10	2.50	386	4	1.69	155	4	4.04	1,050	N	1.94	216
N	2.56	406	12	1.54	119	8	3.87	958	12	1.87	198
2	2.61	424		Apr. 29		N	3.78	913		May 23	
4	2.66	442	8	1.56	123	4	3.77	909	N	1.82	186
6	2.70	456	4	1.62	138	8	3.75	899	12	1.78	176
8	2.68	449	12	1.66	147	12	3.74	894		May 24	
10	2.64	434		Apr. 30			May 10		N	1.73	164
12	2.60	420	8	1.65	145	N	3.74	894	12	1.68	152
			4	1.59	131	12	3.75	899			
			12	1.52	114						

Roseau River Basin

Roseau River below South Fork near Malung, Minn.

Location. —Lat. 48°47'30", long. 95°44'40", in SW¼ sec. 6, T. 161 N., R. 39 W., a quarter of a mile downstream from South Fork and 1½ miles northwest of Malung.
Drainage area. —573 square miles.
Gage-height record. —Water-stage recorder graph.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-23 and by backwater from beaver dams June 15-26.
Maxima. —April-June 1950: Discharge, 3,650 second-feet 5-7 a.m. Apr. 24 (gage height, 22.51 feet).
1946 to March 1950: Discharge, 3,190 second-feet June 13, 1947 (gage height, 20.20 feet).
Remarks. —No regulation or diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	6.5	1,990	395	11	6.5	2,490	159	21	1,400	1,280	60
2	6.5	1,940	380	12	6.5	2,330	147	22	2,400	1,370	95
3	6.5	1,950	344	13	6.0	2,080	139	23	3,200	1,400	110
4	6.5	1,990	307	14	7.5	1,820	130	24	3,620	1,270	140
5	7.0	2,180	275	15	10	1,600	130	25	3,430	1,070	154
6	7.0	2,610	249	16	16	1,370	130	26	2,940	862	785
7	7.0	2,810	226	17	24	1,210	120	27	2,470	709	1,260
8	7.0	2,700	202	18	36	1,070	95	28	2,140	580	1,640
9	7.0	2,540	184	19	55	1,020	80	29	1,980	478	2,200
10	7.0	2,510	171	20	460	1,210	65	30	1,970	427	2,080
								31	-	408	-
Monthly mean discharge, in second-feet									875	1,589	415
Runoff, in acre-feet									52,060	97,730	24,700
Runoff, in inches									1.70	3.20	0.81

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 19			Apr. 25			May 1			May 7	
4	5.05		4	22.08	3,560	4	14.69	2,000	4	18.43	2,790
8	5.12		8	21.89	3,520	8	14.70	2,010	8	18.49	2,800
N	5.26		N	21.53	3,440	N	14.68	2,000	N	18.57	2,820
4	5.67		4	21.14	3,360	4	14.64	1,990	4	18.59	2,820
8	6.59		8	20.89	3,310	8	14.58	1,980	8	18.58	2,820
12	6.94		12	20.60	3,250	12	14.53	1,970	12	18.51	2,810
	Apr. 20			Apr. 26			May 2			May 8	
4	7.26		4	20.13	3,150	4	14.47	1,960	4	18.38	2,780
8	7.52		8	19.53	3,020	8	14.40	1,940	8	18.21	2,740
N	7.87		N	19.07	2,920	N	14.34	1,930	N	18.01	2,700
4	9.07		4	18.62	2,830	4	14.30	1,920	4	17.80	2,660
8	10.29		8	18.28	2,760	8	14.28	1,920	8	17.61	2,620
12	11.58		12	18.00	2,700	12	14.32	1,930	12	17.44	2,580
	Apr. 21			Apr. 27			May 3			May 9	
4	11.98		4	17.65	2,630	4	14.36	1,940	4	17.31	2,560
8	12.12		8	17.24	2,540	8	14.38	1,940	8	17.26	2,540
N	12.73		N	16.81	2,450	N	14.41	1,950	N	17.24	2,540
4	13.65		4	16.45	2,370	4	14.46	1,960	4	17.23	2,540
8	14.91		8	16.21	2,320	8	14.53	1,970	8	17.20	2,530
12	16.01		12	16.02	2,280	12	14.61	1,990	12	17.15	2,520
	Apr. 22			Apr. 28			May 4			May 10	
4	16.83		4	15.75	2,230	4	14.66	2,000	4	17.13	2,520
8	17.09		8	15.45	2,160	8	14.65	2,000	8	17.08	2,510
N	17.59		N	15.26	2,120	N	14.61	1,990	N	17.06	2,500
4	18.18		4	15.13	2,100	4	14.56	1,980	4	17.05	2,500
8	18.92		8	15.05	2,080	8	14.63	1,990	8	17.08	2,510
12	19.05		12	14.98	2,040	12	14.86	2,040	12	17.12	2,520
	Apr. 23			Apr. 29			May 5			May 11	
4	20.17		4	14.83	2,030	4	15.11	2,090	4	17.12	2,520
8	20.72		8	14.63	1,990	8	15.34	2,140	8	17.09	2,510
N	21.33		N	14.50	1,960	N	15.54	2,180	N	17.02	2,490
4	21.86		4	14.44	1,950	4	15.68	2,210	4	16.94	2,480
8	22.32		8	14.46	1,960	8	15.94	2,270	8	16.85	2,460
12	22.47		12	14.52	1,970	12	16.37	2,360	12	16.73	2,430
	Apr. 24			Apr. 30			May 6			June 25	
4	22.50	3,640	4	14.54	1,970	4	16.90	2,470	2	4.75	129
8	22.50	3,640	8	14.50	1,960	8	17.40	2,570	4	4.73	127
N	22.47	3,640	N	14.47	1,960	N	17.72	2,640	6	4.72	126
4	22.35	3,610	4	14.49	1,960	4	17.94	2,690	8	4.72	126
8	22.24	3,590	8	14.54	1,970	8	18.13	2,730	10	4.72	126
12	22.20	3,580	12	14.63	1,990	12	18.32	2,770	N	4.74	128

Roseau River below South Fork near Malung, Minn. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 25 (cont'd.)			June 27 (cont'd.)			June 29 (cont'd.)			July 2 (cont'd.)	
2	4.76	137	N	11.04	1,270	2	15.75	2,230	N	12.10	1,480
4	4.82	148	4	11.17	1,300	4	15.72	2,220	6	11.87	1,430
6	4.90	169	8	11.31	1,320	6	15.66	2,210	12	11.64	1,390
8	5.04	189	12	11.49	1,360	8	15.59	2,190		July 3	
10	5.28	240		June 28		10	15.52	2,180	6	11.47	1,350
12	5.61	286	4	11.68	1,400	12	15.43	2,160	N	11.33	1,330
	June 26		8	11.94	1,450		June 30		6	11.24	1,310
4	6.67	448	N	12.48	1,560	6	15.12	2,100	12	11.21	1,300
8	7.84	667	4	13.38	1,740	N	15.79	2,240		July 4	
N	8.81	849	8	14.44	1,950	6	14.42	1,950	6	11.23	1,310
4	9.48	976	12	15.10	2,090	12	14.03	1,870	N	11.22	1,310
8	9.92	1,060		June 29			July 1		6	11.18	1,300
12	10.29	1,130	2	15.32	2,140	6	13.66	1,790	12	11.09	1,280
	June 27		4	15.49	2,170	N	13.29	1,720		July 5	
4	10.58	1,190	6	15.61	2,200	6	13.95	1,850	6	10.94	1,250
8	10.83	1,230	8	15.70	2,220	12	12.62	1,580	N	10.73	1,210
			10	15.74	2,230		July 2		6	10.49	1,170
			N	15.76	2,230	6	12.32	1,520	12	10.21	1,110

Roseau River near Roseau, Minn.

Location. – Lat. 48°55'24", long. 95°46'02", in SW¼ sec. 24, T. 163 N., R. 40 W., on steel highway bridge, 1½ miles upstream from Mud Creek and 5½ miles north of Roseau. Datum of gage is 1,023.21 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Gage-height record. – Staff-gage readings once daily except Apr. 20 to May 10, May 12-15, June 28-30 which are from graphs based on gage readings, and Apr. 1, 3-8, 10-14, 17-19, May 11, 17-31, June 2-26 when no gage heights were obtained.

Maxima. – April-June 1950: Elevation, 1,037.68 feet at 12 M., April 24, from floodmark.
1930 to March 1950: Elevation observed, 1,037.49 feet Mar. 29, 1942.

Remarks. – Small amount of regulation by dam in Roseau. At high stages, some Roseau River water is diverted around the station by overflowing the banks upstream.

Elevation, * in feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1		36.41	34.54	11				21	32.36		
2	25.31	36.44		12		37.31		22	35.21		
3		36.45		13		37.24		23	36.69		
4		36.47		14		37.13		24	37.54		
5		36.60		15	25.31	37.00		25	37.64		
6		36.95		16	25.31	36.82		26	37.50		
7		37.04		17				27	37.03		32.33
8		37.18		18				28	36.61		33.00
9	25.31	37.27		19				29	36.44		34.21
10		37.34		20	30.04			30	36.38		34.42
								31	-		-

* Add 1,000 feet to obtain elevation above mean sea level.

Roseau River at Roseau Lake, Minn.

Location. — Lat. 48°54'22", long. 95°49'55", in SW¼SW¼ sec. 28, T. 163 N., R. 40 W., at Roseau Lake, 3½ miles upstream from Pine Creek, 3-3/4 miles downstream from Mud Creek, and 7 miles northwest of Roseau. Datum of gage is 1,018.59 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.
Gage-height record. — Staff gage readings once daily except Apr. 1-5, 7-21, 23-26, May 5-7, 11, 12, 14, 17 to June 3 when no readings were obtained. Readings June 25, 26, 28, 29 are from graph based on gage readings.
Maxima. — April-July 1950: Elevation observed, 1,036.86 feet 4:05 p.m. May 13.
1939 to March 1950: Elevation observed, 1,034.83 feet Apr. 28, 1948.
Remarks. — Small amount of regulation by swamp storage above gage. No diversions.

Elevation,* in feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1		35.24		31.22	16		36.54	30.16	29.74
2		35.34		31.40	17			29.82	29.58
3		35.44		31.52	18			29.46	29.36
4		35.51	33.68	31.58	19			29.12	29.16
5			33.52	31.62	20			28.72	28.92
6	23.07		33.32	31.62	21			28.24	28.54
7			33.06	31.50	22	30.83		27.80	28.12
8		35.37	32.76	31.32	23			27.56	27.69
9		35.59	32.46	31.06	24			27.22	27.18
10		36.79	32.16	30.82	25			27.08	26.53
11			31.82	30.54	26			28.33	25.90
12			31.46	30.38	27	34.62		29.34	25.27
13		36.86	31.12	30.20	28	34.82		29.85	25.70
14			30.76	30.02	29	34.96		30.52	24.21
15		36.71	30.46	29.78	30	35.10		30.92	23.77
					31	-		- -	23.44

* Add 1,000 feet to obtain elevation above mean sea level.

Roseau River at Ross, Minn.

Location. — Lat. 48°54'37", long. 95°55'18", in SE¼ sec. 27, T. 163 N., R. 41 W., a quarter of a mile north of Ross. Datum of gage is 1,018.44 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada.
Drainage area. — 1,220 square miles.
Gage-height record. — Water-stage recorder graph.
Discharge record. — Stage-discharge relation defined by current-meter measurements below 6,350 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-27.
Maxima. — April-July 1950: Discharge, 6,560 second-feet 5 a.m. May 12 (gage height, 18.25 feet).
1928 to March 1950: Discharge, 3,220 second-feet Apr. 29, 1948 (gage height, 15.88 feet).
Known stage, 17.5 feet in July 1919, from information by local residents; 1896 flood about 1.5 feet higher; 1927 flood about 1.5 feet lower.
Remarks. — Flow partly regulated by natural storage in Roseau Lake. No diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	18	3,120	2,390	1,400	16	50	5,970	1,260	1,180
2	19	3,460	2,320	1,460	17	60	5,620	1,190	1,140
3	19	3,640	2,250	1,500	18	85	5,370	1,120	1,080
4	19	3,820	2,200	1,540	19	140	5,000	1,040	1,050
5	20	4,080	2,130	1,560	20	260	4,810	971	1,000
6	20	4,390	2,070	1,560	21	550	4,660	887	933
7	20	4,800	2,010	1,540	22	850	4,480	808	855
8	22	5,270	1,910	1,500	23	1,000	4,320	752	792
9	24	5,670	1,790	1,460	24	1,200	4,100	703	709
10	26	6,110	1,720	1,410	25	1,400	3,880	689	601
11	28	6,350	1,640	1,360	26	1,900	3,600	887	502
12	32	6,510	1,560	1,310	27	2,400	3,260	994	414
13	38	6,420	1,480	1,280	28	2,650	2,970	1,070	346
14	42	6,210	1,390	1,250	29	2,830	2,830	1,180	294
15	46	6,250	1,330	1,220	30	2,990	2,600	1,290	252
					31	-	2,490	-	227
Monthly mean discharge, in second-feet						625	4,582	1,434	1,056
Runoff, in acre-feet						37,210	281,800	85,350	64,910
Runoff, in inches						0.57	4.34	1.31	1.00

Roseau River near Badger, Minn.

Location. – Lat. 48°54'42", long. 96°00'24", in SW¼ sec. 30, T. 163 N., R. 41 W., 9 miles north of Badger. Datum of gage is 1,016.90 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.
Gage-height record. – Water-stage recorder graph.
Maxima. – April-July 1950: Elevation 1,032.65 feet at 9 p.m. May 13.
1928 to March 1950: Elevation 1,031.37 feet Apr. 29, 1948.
Remarks. – No regulation except by natural storage in Roseau Lake at high stages.

Elevation,* in feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	20.71	31.73	30.96	27.76	16	21.52	32.51	27.33	27.01
2	20.77	31.82	30.82	28.06	17	21.65	32.43	27.02	26.87
3	20.81	31.90	30.68	28.25	18	21.94	32.36	26.75	26.71
4	20.84	31.95	30.54	28.37	19	22.72	32.28	26.45	26.55
5	20.90	32.04	30.36	28.45	20	23.97	32.20	26.15	26.34
6	20.96	32.15	30.18	28.47	21	25.68	32.13	25.80	26.09
7	21.02	32.25	29.98	28.43	22	26.74	32.06	25.49	25.77
8	21.09	32.37	29.72	28.33	23	27.20	32.01	25.24	25.47
9	21.17	32.47	29.38	28.18	24	28.12	31.92	24.99	25.09
10	21.23	32.55	29.14	27.96	25	28.81	31.87	24.97	24.61
11	21.27	32.60	28.82	27.76	26	29.85	31.80	26.06	24.08
12	21.30	32.63	28.53	27.57	27	30.95	31.67	26.34	23.56
13	21.34	32.63	28.21	27.42	28	31.58	31.54	26.58	23.04
14	21.37	32.56	27.88	27.29	29	31.61	31.41	26.90	22.56
15	21.43	32.54	27.61	27.15	30	31.69	31.26	27.32	22.01
					31	-	31.11	-	21.71

* Add 1,000 feet to obtain elevation above mean sea level.

Roseau River near Haug, Minn.

Location. – Lat. 48°55'28", long. 96°12'26", in SE¼ sec. 21, T. 163 N., R. 43 W., 5 miles south of international boundary and 8½ miles northwest of Haug. Datum of gage is 1,014.02 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.
Gage-height record. – Water-stage recorder graph except periods Apr. 1 to 12:40 p.m. Apr. 27.
Maxima. – April-June 1950: Elevation, 1,024.64 feet 5 a.m. May 15.
1932 to March 1950: Elevation recorded, 1,023.76 feet Apr. 29, 1948.

Elevation,* in feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1		23.91	23.98	11		24.42	23.55	21		24.38	22.71
2		23.98	23.95	12		24.48	23.48	22		24.32	22.63
3		24.05	23.90	13		24.55	23.42	23		24.28	22.48
4		24.08	23.87	14		24.59	23.34	24		24.21	22.35
5		24.16	23.84	15		24.61	23.28	25		24.17	22.26
6		24.22	23.80	16		24.57	23.19	26		24.12	22.41
7		24.23	23.76	17		24.55	23.09	27	23.32	24.08	22.51
8		24.25	23.69	18		24.51	23.01	28	23.50	24.06	22.56
9		24.27	23.62	19		24.46	22.91	29	23.71	24.05	22.57
10		24.36	23.59	20		24.45	22.82	30	23.88	24.05	22.59
								31	-	24.00	-

* Add 1,000 feet to obtain elevation above mean sea level.

Roseau River at Oak Point, Minn.

Location. – Lat. 48°58'48", long. 96°24'19", in SE¼SE¼ sec. 36, T. 164 N., R. 45 W., at Oak Point, 2 miles east of Caribou. Datum of gage is 1,005.30 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Gage-height record. – Staff gage readings once or twice daily except Apr. 5-8, 14, 15, June 7, Aug. 1-3, 7-13, 15-23.

Maxima. – April-August 1950: Elevation observed, 1,019.64 feet 9:45 a.m. May 19.
1933 to March 1950: Elevation observed, 1,016.76 feet May 3, 1948.

Remarks. – Some natural regulation by swamp and storage in Roseau Lake during high stages. During times of high stages part of Roseau River water is diverted to the southwest to the headwaters of the various forks of Two Rivers.

Elevations,* in feet, 1950

Day	April	May	June	Day	April	May	June
1	6.96	15.77	17.76	16	8.23	19.38	15.74
2	6.98	16.76	17.48	17	8.25	19.48	15.66
3	6.98	17.16	17.35	18	8.42	19.60	15.44
4	7.00	17.64	17.28	19	8.74	19.64	15.32
5	-	18.28	17.18	20	9.38	19.62	15.13
6	-	18.54	17.00	21	9.86	19.38	15.00
7	-	18.66	-	22	11.22	19.26	14.90
8	-	18.88	16.78	23	13.10	19.12	14.78
9	8.00	18.92	16.50	24	13.08	18.80	14.62
10	8.10	18.92	16.38	25	12.78	18.60	14.58
11	8.42	18.98	16.30	26	12.94	18.50	14.86
12	8.74	19.03	16.14	27	13.18	18.44	14.68
13	9.38	19.06	16.06	28	13.58	18.28	14.54
14	-	19.10	15.94	29	13.97	18.18	14.34
15	-	19.18	15.88	30	14.94	18.06	14.26
				31	-	17.86	-

* Add 1,000 feet to obtain elevation above mean sea level.

Roseau River below State ditch 51, near Caribou, Minn.

Location. – Lat. 48°58'54", long. 96°27'46", in SE¼SW¼ sec. 34, T. 164 N., R. 145 W., 400 feet downstream from State ditch 51 (known locally as Caribou cut-off ditch) and 0.6 mile west of Caribou. Datum of gage is 1,002.14 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada.

Drainage area. – 1,570 square miles (revised).

Gage-height record. – Water-stage recorder graph.

Discharge record. – Stage-discharge relation defined by current-meter measurements below 3,740 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1 to May 14.

Maxima. – April-July 1950: Discharge, 4,080 second-feet 8:30 p.m. May 19 (gage height, 11.81 feet).
1929 to March 1950: Discharge, 2,460 second-feet May 2-5, 1948; gage height, 9.85 feet Apr. 1, 1942, affected by ice.

Remarks. – At high stages some flow is diverted above the gage to the southwest to the headwaters of Two Rivers. Flow regulated by natural storage in Roseau Lake and swamp area, at high stages.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	20	1,600	2,860	1,480	16	50	3,760	2,040	1,400
2	20	1,700	2,770	1,440	17	70	3,880	1,980	1,400
3	20	1,800	2,690	1,440	18	100	3,920	1,920	1,360
4	20	2,000	2,650	1,440	19	140	4,020	1,860	1,360
5	20	2,000	2,600	1,400	20	200	4,010	1,800	1,360
6	22	2,200	2,550	1,400	21	380	3,880	1,760	1,320
7	22	2,400	2,500	1,400	22	700	3,760	1,720	1,280
8	22	2,600	2,460	1,400	23	850	3,630	1,670	1,280
9	24	2,800	2,390	1,440	24	950	3,430	1,600	1,250
10	26	2,800	2,310	1,440	25	1,000	3,280	1,600	1,220
11	28	3,000	2,250	1,440	26	1,000	3,220	1,700	1,180
12	30	3,000	2,200	1,400	27	1,000	3,160	1,660	1,110
13	36	3,000	2,160	1,400	28	1,100	3,080	1,590	1,110
14	40	3,400	2,110	1,400	29	1,200	3,020	1,540	935
15	46	3,650	2,080	1,440	30	1,300	2,990	1,490	800
					31	-	2,900	-	695
Monthly mean discharge, in second-feet						348	3,029	2,084	1,304
Runoff, in acre-feet						20,700	186,200	124,000	80,170
Runoff, in inches						0.25	2.22	1.48	0.86

Roseau River at international boundary near Caribou, Minn.

Location. —Lat. 48°59'57", long. 96°30'20", near center of sec. 29, T. 164 N., R. 45 W., 400 feet upstream from last international boundary crossing and 3 miles northwest of Caribou. Datum of gage is 1,002.59 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada. Gage readings have been reduced to elevations above mean sea level.

Drainage area. —1,590 square miles.

Gage-height record. —Water-stage recorder graph except Apr. 1 to 1:20 p.m. Apr. 26, 29, 30.

Maxima. —April-August 1950: Elevation 1,007.02 feet 3 p.m. May 20.
1933 to March 1950: Elevation 1,007.06 feet Mar. 24, 1945.

Remarks. —No regulation. A dam on the Canadian side of the boundary and about 2 miles north of boundary has as its object the diversion of excess water into a floodway which returns to the river 7 miles northwest.

Elevations,* in feet, 1950

Day	April	May	June	Day	April	May	June
1		6.71	6.95	16		6.94	6.83
2		6.79	6.95	17		6.97	6.81
3		6.83	6.95	18		6.97	6.79
4		6.86	6.95	19		6.97	6.78
5		6.91	6.95	20		7.01	6.75
6		6.92	6.94	21		7.00	6.71
7		6.93	6.94	22		7.00	6.69
8		6.93	6.94	23		6.99	6.67
9		6.94	6.92	24		6.99	6.61
10		6.94	6.91	25		6.96	6.61
11		6.94	6.90	26	6.49	6.96	6.70
12		6.94	6.89	27	6.53	6.96	6.66
13		6.94	6.88	28	6.57	6.97	6.62
14		6.93	6.87	29		6.97	6.56
15		6.92	6.85	30		6.97	6.51
				31		6.95	

* Add 1,000 feet to obtain elevation above mean sea level.

Roseau River near Dominion City, Manitoba

Location.—Lat. 49°11'53", long. 97°03'15", in SE¼ sec. 12, T. 3, R. 3 E., at Langside Traffic Bridge, 8 miles northeast of Dominion City. Datum Geodetic Survey of Canada, adjustment of 1923.

Drainage area.—1,840 square miles.

Gage-height record.—Chain gage read twice daily.

Discharge record.—Stage-discharge relation defined by current-meter measurements and extended to peak stage. Ice effect prior to Apr. 24. Gage heights to hundredths.

Maxima.—April-June, 1950: Discharge, 8,130 second-feet 7:10 p.m. May 6 (gage height, 796.83 feet). 1913 to March, 1950: Discharge, 5,030 second-feet May 10, 1927 (gage height, 794.37 feet).

Remarks.—Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	23	2,780	2,950	11	30	6,620	2,260	21	800	5,410	1,860
2	23	3,210	2,860	12	30	6,210	2,210	22	1,500	5,270	1,830
3	23	3,930	2,750	13	35	5,830	2,150	23	1,850	4,930	1,820
4	24	4,800	2,690	14	35	5,530	2,100	24	2,460	4,570	1,770
5	25	6,680	2,600	15	40	5,170	2,080	25	3,020	4,160	1,740
6	26	8,110	2,540	16	40	4,890	2,060	26	2,460	3,740	1,770
7	27	7,760	2,480	17	70	4,700	2,010	27	2,230	3,440	1,880
8	28	7,440	2,410	18	200	4,740	1,980	28	2,290	3,250	1,910
9	29	7,120	2,370	19	300	4,840	1,940	29	2,340	3,140	1,870
10	30	6,940	2,310	20	500	5,200	1,900	30	2,440	3,070	1,800
								31	-	3,020	-
Monthly mean discharge, in second-feet									764	5,050	2,160
Runoff, in acre-feet									45,480	310,400	128,700
Runoff, in inches									0.46	3.17	1.31

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	April 17			May 1			May 15			May 29	
1:45p	781.77	70	7:00a	792.21	2,660	7:15a	795.23	5,240	7:00a	793.15	3,140
6:30p	781.90	80	7:10p	792.69	2,900	7:45p	795.13	5,100			
	April 18			May 2			May 16			May 30	
7:20a	785.62	150	7:00a	793.13	3,130	7:20a	795.03	4,960	7:30a	793.04	3,070
7:00p	785.47	250	6:50p	793.38	3,280	7:45p	794.94	4,840	8:00p	793.01	3,060
	April 19			May 3			May 17			May 31	
7:15a	784.15	280	7:10a	793.84	3,630	7:45a	794.85	4,720	7:10a	792.98	3,040
7:10p	784.39	320	7:15p	794.48	4,270	7:40p	794.80	4,660	8:15p	792.89	3,000
	April 20			May 4			May 18			June 1	
7:00a	784.55	400	7:05a	794.78	4,630	7:10a	794.83	4,700	7:30a	792.83	2,970
7:00p	785.92	600	7:10p	795.03	4,960	7:00p	794.89	4,780	8:00p	792.76	2,930
	April 21			May 5			May 19			June 2	
7:20a	786.74	700	7:15a	795.99	6,440	7:15a	794.94	4,840	7:15a	792.68	2,890
7:15p	788.48	900	7:20p	796.25	6,930				7:15p	792.57	2,830
	April 22			May 6			May 20			June 3	
7:30a	789.62	1,400	7:30a	796.81	8,080	7:30a	795.17	5,160	7:20a	792.43	2,770
7:10p	789.83	1,600	7:10p	796.83	8,130	7:25p	795.23	5,240	7:30p	792.35	2,730
	April 23			May 7			May 21			June 4	
7:20a	789.94	1,780	7:20a	796.68	7,800	7:00a	795.34	5,400	8:00a	792.29	2,710
7:00p	790.24	1,920	7:30p	796.63	7,690	7:30p	795.36	5,420	7:00p	792.20	2,660
	April 24			May 8			May 22			June 5	
7:30a	790.88	2,110	7:15a	796.53	7,480	7:10a	795.29	5,330	6:45a	792.11	2,620
6:30p	792.50	2,800	7:20p	796.49	7,400	7:45p	795.21	5,210	7:20p	791.97	2,570
	April 25			May 9			May 23			June 6	
7:15a	793.15	3,140	7:30a	796.37	7,160	7:30a	795.08	5,030	6:00a	791.93	2,550
7:00p	792.75	2,920	6:45p	796.33	7,080	7:00p	794.93	4,830	7:45p	791.84	2,520
	April 26			May 10			May 24			June 7	
7:10a	792.04	2,600	7:45a	796.29	7,000	7:15a	794.78	4,630	7:30a	791.78	2,490
7:10p	791.38	2,340	6:50p	796.23	6,890	7:10p	794.67	4,490	8:00p	791.71	2,460
	April 27			May 11			May 25			June 8	
6:45a	791.01	2,220	7:30a	796.15	6,740	7:10a	794.49	4,280	7:00a	791.60	2,420
7:00p	791.03	2,230	7:20p	796.03	6,510	7:15p	794.27	4,040	7:00p	791.52	2,400
	April 28			May 12			May 26			June 9	
7:00a	791.00	2,220	7:20a	795.93	6,330	7:50a	794.08	3,850	6:45a	791.48	2,380
7:15p	791.39	2,350	7:15p	795.79	6,090	8:00p	793.85	3,630	7:30p	791.40	2,350
	April 29			May 13			May 27			June 10	
6:50a	791.24	2,300	7:20a	795.67	5,890	6:40a	793.69	3,500	6:15a	791.33	2,330
7:20p	791.51	2,390	7:10p	795.58	5,750	7:45p	793.52	3,350	7:45p	791.23	2,300
	April 30			May 14			May 28				
7:10a	791.44	2,370	7:10a	795.48	5,600	7:30a	793.41	3,300			
6:50p	791.88	2,530	7:30p	795.37	5,440	7:00p	793.27	3,210			

Mud Creek near Sprague, Manitoba

Location. —Lat. 48°59'33", long. 95°39'43", in NE¼ sec. 34, T. 164 N., R. 39 W., half a mile south of international boundary, 3½ miles south of Sprague, Manitoba, 8 miles upstream from mouth, and 14 miles northeast of Roseau, Minn. Datum of gage is 1,038.4 feet above mean sea level, adjustment of 1928 by Geodetic Survey of Canada.

Drainage area. —151 square miles (revised).

Gage-height record. —Water-stage recorder graph except period Apr. 6 to 2 p.m. Apr. 16, 9 a.m. Apr. 21 to 2:30 a.m. Apr. 29, May 1 to 12:55 p.m. May 15, when no record was obtained.

Discharge record. —Stage-discharge relation defined by current-meter measurement below 923 second-feet, and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-20. Discharge for periods of no record were estimated.

Maxima. —April-June 1950: Discharge, 1,470 second-feet p.m. May 12 (gage height, 13.69 feet, from floodmark).

1928 to March 1950: Discharge, 2,070 second-feet Sept. 1, 1942, from rating curve extended above 960 second-feet.

Remarks. —No regulation or diversions. This station is one of the international gaging stations maintained by the United States under agreement with Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	5.0	565	255	11	6.0	1,300	105	21	620	811	76
2	5.5	565	253	12	6.0	1,300	93	22	620	724	75
3	5.5	565	228	13	6.0	1,300	85	23	620	601	79
4	5.5	565	212	14	6.0	1,300	76	24	620	506	67
5	6.0	565	196	15	25	932	76	25	620	419	91
6	6.5	1,030	177	16	60	762	93	26	500	356	284
7	6.5	1,030	158	17	85	622	80	27	500	308	334
8	6.5	1,030	142	18	130	533	68	28	500	267	304
9	6.5	1,030	127	19	180	517	60	29	410	239	295
10	6.5	1,030	115	20	240	707	84	30	416	241	287
								31	-	246	-
Monthly mean discharge, in second-feet									208	708	152
Runoff, in acre-feet									12,360	43,570	9,070
Runoff, in inches									1.53	5.41	1.13

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 19			May 17			May 20	
2	6.28		2	8.90		6	10.90	646	6	10.90	646
4	6.28		4	8.94		N	10.77	621	N	11.17	703
6	6.29		6	8.97		6	10.63	595	6	11.52	785
8	6.29		8	9.00		12	10.49	572	12	11.60	804
10	6.30		10	9.01			May 18			May 21	
N	6.35		N	8.93		6	10.36	552	4	11.61	807
2	6.41		2	8.89		N	10.24	534	8	11.62	809
4	6.56		4	8.94		6	10.09	513	N	11.64	814
6	8.54		6	9.06		12	9.98	497	4	11.65	817
8	8.85		8	9.33			May 19		8	11.64	814
10	9.10		10	9.36		2	9.94	492	12	11.60	804
12	9.25		12	9.36		4	9.92	489		May 22	
	Apr. 18			Apr. 20		6	9.91	487	4	11.52	785
2	9.33		6	9.36		8	9.90	486	8	11.33	739
4	9.33		N	9.38		10	9.91	487	N	11.25	721
6	9.33		6	9.40		N	9.94	492	4	11.15	699
8	9.26		12	9.40		2	10.03	504	8	11.04	675
10	9.14			May 16		4	10.20	528	12	10.95	656
N	9.03		4	11.69	827	6	10.32	546			
2	8.93		8	11.59	802	8	10.43	563			
4	8.85		N	11.37	749	10	10.53	579			
6	8.82		4	11.26	723	12	10.64	597			
8	8.80		8	11.15	699						
10	8.80		12	11.05	677						
12	8.84										

Pine Creek near Pine Creek, Minn.

Location.—Lat. 48°59'35", long. 95°55'04", in SW¼SW¼ sec. 26, T. 164 N., R. 41 W., half a mile south of international boundary, 2 miles northeast of village of Pine Creek, and 6 miles upstream from mouth. Datum of gage is 1,038.42 feet above mean sea level, adjustment of 1928 of Geodetic Survey of Canada.

Drainage area.—74.6 square miles (revised).

Gage-height record.—Water-stage recorder graph except periods of no record, Apr. 6-15, Apr. 20 to 10 a.m. Apr. 22, 6 a.m. Apr. 23 to 2 p.m. Apr. 24, 7:30 p.m. Apr. 27 to 10 a.m. Apr. 28.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 251 second-feet and extended to peak stage. Gage height used to hundredths. Stage-discharge relation affected by ice Apr. 1-19. Discharge for periods of no gage-height record estimated.

Maxima.—April-June 1950: Discharge, 632 second-feet 4 a.m. Apr. 24 (gage height, 10.18 feet).
1928 to March 1950: Discharge, 706 second-feet Sept. 25, 1941 (gage height, 9.79 feet) from rating curve extended above 450 second-feet.

Remarks.—No regulation or diversions. This station is one of the international gaging stations maintained by the United States under agreement with Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	15	242	143	11	-	316	35	21	306	234	21
2	16	241	152	12	-	296	31	22	400	234	26
3	16	238	130	13	18	271	29	23	480	197	42
4	16	244	114	14	-	244	24	24	504	156	41
5	16	304	95	15	-	214	34	25	374	128	56
6	-	419	69	16	40	179	46	26	321	111	129
7	-	403	54	17	70	160	39	27	297	94	150
8	15	342	46	18	110	140	32	28	245	78	200
9	-	335	40	19	120	152	26	29	230	68	213
10	-	328	38	20	213	203	23	30	233	96	184
								31	-	107	-
Monthly mean discharge, in second-feet									140	219	75.4
Runoff, in acre-feet									8,300	13,440	4,490
Runoff, in inches									2.09	3.38	1.13

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 25 (cont'd.)			May 4			May 19 (cont'd.)	
6	4.27		8	9.30	313	4	8.80	241	N	6.49	136
N	4.29		12	9.33	320	8	8.79	240	2	6.80	148
6	4.46			Apr. 26		N	8.79	240	4	7.28	167
12	4.60		6	9.33	320	4	8.81	242	6	7.62	181
	Apr. 17		N	9.35	326	8	8.91	251	8	7.83	189
4	4.66		6	9.33	320	12	9.00	261	10	7.95	194
8	4.69		12	9.32	318		May 5		12	8.02	197
N	4.73			Apr. 27		4	9.09	274		May 20	
4	4.92		4	9.32	318	8	9.14	282	4	8.07	200
8	5.20		8	9.32	318	N	9.20	292	8	8.09	200
12	5.41		N	9.32	318	4	9.28	309	N	8.11	201
	Apr. 18		4	9.18	289	8	9.41	341	4	8.16	204
4	5.54		8	8.93	253	12	9.55	386	8	8.24	208
8	5.61		12	8.84	245		May 6		12	8.37	214
N	5.68			Apr. 28		4	9.61	407		May 21	
4	5.76		6	8.90	250	8	9.63	414	6	8.58	227
8	5.84		N	8.85	246	N	9.65	422	N	8.74	237
12	5.91		6	8.82	243	4	9.67	429	6	8.81	242
	Apr. 19		12	8.76	238	8	9.68	433	12	8.83	244
4	5.94			Apr. 29		12	9.68	433		May 22	
8	5.96		6	8.67	232		May 7		6	8.79	240
N	5.97		N	8.58	227	4	9.66	425	N	8.73	236
4	6.03		6	8.60	228	8	9.62	410	6	8.62	229
8	6.05		12	8.53	224	N	9.61	407	12	8.48	221
12	6.01			Apr. 30		4	9.58	396		May 23	
	Apr. 23		6	8.64	230	8	9.54	382	8	8.19	206
4	9.65	422	N	8.68	233	12	9.49	365	4	7.80	188
8	9.72	448	6	8.74	237		May 8		12	7.45	174
N	9.82	488	12	8.78	240	4	9.44	350		May 24	
4	9.94	536		May 1		8	9.41	341	8	7.13	161
8	10.04	576	6	8.80	241	N	9.39	336	4	6.88	151
12	10.12	608	N	8.82	243	4	9.39	336	12	6.62	141
	Apr. 24		6	8.83	244	8	9.40	338		May 29	
4	10.18	632	12	8.82	243	12	9.40	338	4	4.32	69
8	10.01	564		May 2			May 9		8	4.38	70
N	9.80	480	6	8.83	244	8	9.39	336	N	4.23	66
4	9.68	433	N	8.80	241	4	9.38	333	4	4.20	65
8	9.62	410	6	8.78	240	12	9.38	333	8	4.20	65
12	9.58	396	12	8.75 •	238		May 19		12	4.71	80
	Apr. 25			May 3		2	6.33	129		May 30	
4	9.68	433	6	8.73	236	4	6.31	128	8	5.28	97
8	9.70	440	N	8.73	236	6	6.31	128	4	5.28	97
N	9.50	368	6	8.78	240	8	6.31	128	12	5.33	99
4	9.31	316	12	8.80	241	10	6.37	131			

Pine Creek near Pine Creek, Minn. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 31			June 1 (cont'd.)			June 2 (cont'd.)			June 4	
6	5.43	102	N	6.78	147	N	6.91	152	8	5.83	114
N	5.60	107	4	6.94	154	4	6.84	150	4	5.61	107
6	5.74	111	8	7.01	156	8	6.75	146	12	5.42	102
12	5.98	118	12	7.02	157	12	6.65	142		June 5	
	June 1			June 2			June 3		8	5.22	96
4	6.23	126	4	7.02	157	8	6.45	134	4	4.97	88
8	6.52	137	8	6.98	155	4	6.23	126	12	4.69	80
						12	6.02	120			

Rat River Basin

Rat River near Otterburne, Manitoba

Location.—Lat. 49°27'42", long. 97°00'26", in SE¼ sec. 8, T. 6, R. 4 E., at Traffic Bridge, 4 miles southeast of Otterburne. Datum assumed.
Drainage area.—704 square miles.
Gage-height record.—Staff gage read daily.
Discharge record.—Stage-discharge relation defined by current-meter measurements and extended to peak stage. Ice effect prior to Apr. 24. Backwater effect from Red River of the North and debris at control from May 5 to June 10. Gage heights to hundredths.
Maxima.—April-June 1950: Discharge, 5,850 second-feet May 6 (gage height, 107.29 feet).
May 1912 to March 1950: Discharge, 4,600 second-feet May 14, 1927 (gage height, 105.25 feet).
Remarks.—Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	10	2,230	555	11	15	3,920	400	21	350	1,200	152
2	10	2,400	530	12	16	3,300	356	22	600	1,160	158
3	10	2,660	505	13	18	3,260	304	23	1,150	1,080	167
4	11	2,810	485	14	20	2,570	280	24	1,530	978	165
5	11	4,030	460	15	22	1,980	258	25	1,680	916	171
6	12	5,850	440	16	25	1,900	227	26	1,630	802	182
7	12	5,340	420	17	35	1,610	229	27	1,630	763	195
8	13	4,380	410	18	200	1,340	220	28	1,810	690	265
9	14	4,180	410	19	300	1,280	156	29	1,920	646	367
10	14	3,980	400	20	300	1,240	154	30	2,140	601	392
								31	-	575	-
Monthly mean discharge, in second-feet									517	2,250	314
Runoff, in acre-feet									30,760	138,200	18,670
Runoff, in inches									0.82	3.69	0.50

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 29			May 13			May 27	
4:30p	91.63	25	11:45a	101.30	1,920	9:45a	104.66	3,260	2:15p	100.67	763
	Apr. 17			Apr. 30			May 14			May 28	
2p	92.66	35	10a	101.71	2,140	10:30a	103.81	2,630	4p	100.30	690
	Apr. 18			May 1		4:45	103.62	2,500		May 29	
2p	96.34	200	10a	101.81	2,200		May 15		3:15p	100.11	646
	Apr. 19		4	101.93	2,270	5:15p	102.81	1,980		May 30	
5:30p	97.40	300		May 2			May 16		3p	98.80	601
	Apr. 20		10:15a	102.07	2,350	11:15a	102.77	1,900		May 31	
9:45a	97.41	300	5	102.22	2,440		May 17		11:30a	99.43	575
	Apr. 21			May 3		8:45a	102.30	1,610		June 1	
10:30a	97.63	350	3:20p	102.56	2,660		May 18		9:10a	99.10	555
	Apr. 22			May 4		11:40a	101.80	1,340		June 2	
5p	98.82	600	4p	102.78	2,810		May 19		10:15a	98.61	530
	Apr. 23			May 5		5p	101.78	1,280		June 3	
11:45a	99.94	1,120	5:15p	104.81	4,030		May 20		6p	98.16	505
6	100.16	1,180		May 6		3:15p	101.79	1,240		June 4	
	Apr. 24		10a	107.29	5,850		May 21		11:15a	98.12	485
10a	100.47	1,530		May 7		4:30p	101.77	1,200		June 5	
	Apr. 25		10a	106.79	5,340		May 22		9a	98.10	460
11:30a	100.80	1,680		May 8		2:30p	101.80	1,160		June 6	
	Apr. 26		10a	105.87	4,380		May 23		11:45a	97.78	440
1:30p	100.69	1,630		May 9		11:15a	101.67	1,080		June 7	
	Apr. 27		10a	105.71	4,180		May 24		12p	96.16	420
9:45a	100.69	1,630		May 10		3:15p	101.42	978		June 8	
4:30	100.70	1,630	10a	105.54	3,980		May 25		3p	96.37	410
	Apr. 28			May 11		1:45p	101.28	916		June 9	
10:30a	101.07	1,800	10a	105.46	3,920		May 26		3:45p	95.80	410
5	101.09	1,820		May 12		1p	100.80	802		June 10	
			10a	104.72	3,300				12:10p	95.36	410

Seine River Basin

Seine River near Prairie Grove, Manitoba

Location.—Lat. 49°46'15", long. 96°56'10", River lot 34, Parish of Lorette at Traffic Bridge, 2¼ miles southeast of Post Office, Prairie Grove. Datum assumed.
Drainage area.—495 square miles.
Gage-height record.—Staff gage or measuring point and tape, read once or twice daily.
Discharge record.—Stage-discharge relation defined by current-meter measurements and extended to peak stage. Ice effect prior to Apr. 21. Gage height to hundredths.
Maxima.—April-June 1950: Discharge, 2,840 second-feet 5:45 p.m. May 7 (gage height, 104.33 feet). May 1915 to Sept. 1936 and May 1942 to March 1950: Discharge, 1,980 second-feet May 11, 1927 (gage height, 825.89 feet, datum Geodetic Survey of Canada, adjustment of 1929) at Ste. Anne (drainage area 310 sq. miles).
Remarks.—Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	9	804	306	11	18	2,340	130	21	1,900	782	116
2	10	786	306	12	19	2,050	127	22	1,710	788	93
3	11	775	308	13	19	1,820	117	23	1,360	788	87
4	13	851	324	14	19	1,500	112	24	1,120	771	76
5	15	1,100	279	15	60	1,190	108	25	971	741	67
6	16	2,160	233	16	200	1,050	111	26	849	666	71
7	16	2,840	207	17	400	914	117	27	768	580	140
8	16	2,720	194	18	800	794	124	28	791	544	173
9	18	2,660	178	19	1,000	752	132	29	778	420	279
10	18	2,440	152	20	1,370	684	138	30	756	361	300
								31	-	331	-
Monthly mean discharge, in second-feet									502	1,190	170
Runoff, in acre-feet									29,870	73,390	10,120
Runoff, in inches									1.14	2.79	0.38

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 28			May 10			May 23	
10:30a	97.92	150	10:45a	99.78	787	10a	104.13	2,440	1p	99.32	788
5	98.92	250	5:20	99.83	795	4:45	104.12	2,420		May 24	
	Apr. 17			Apr. 29			May 11		1p	99.21	771
11a	101.02	300	10a	99.78	787	9:15a	104.07	2,340		May 25	
5:15	101.85	500	4:30	99.65	768	5	104.06	2,330	1:30p	99.01	741
	Apr. 18			Apr. 30			May 12			May 26	
10:30a	103.82	730	10:30a	99.56	754	10:10a	103.87	2,090	1:45p	98.51	666
5:20	104.12	870	5:30	99.58	757	5:30	103.79	2,010		May 27	
	Apr. 19			May 1			May 13		1:30p	97.92	580
10a	104.35	950	11a	99.85	797	9:20a	103.57	1,860		May 28	
5	104.07	1,050	5:30	99.92	808	5	103.42	1,780	2p	97.66	544
	Apr. 20			May 2			May 14			May 29	
10:30a	104.21	1,300	11a	99.80	790	9:30a	102.97	1,580	2p	96.68	420
5:30	103.82	1,450	4:45	99.74	781	5:45	102.52	1,420		May 30	
	Apr. 21			May 3			May 15		1:30p	96.16	361
10:20a	103.67	1,920	10:45a	99.69	774	10a	101.74	1,230		May 31	
5:15	103.64	1,890	5	99.71	776	5:15	101.43	1,160	1:15p	95.89	331
	Apr. 22			May 4			May 16			June 1	
11a	103.42	1,740	11a	99.74	781	9a	101.04	1,080	2p	95.65	306
5	103.32	1,680	5:15	100.68	922	5:30	100.75	1,020		June 2	
	Apr. 23			May 5			May 17		1:30p	95.65	306
10a	102.74	1,420	11a	101.10	1,000	9:30a	100.23	935		June 3	
5:30	102.37	1,310	5:30	102.02	1,210	5:45	99.95	890	2:15p	95.67	308
	Apr. 24			May 6			May 18			June 4	
11:30a	101.67	1,130	10a	103.77	2,000	10a	99.47	814	2:30p	95.83	324
5:30	101.62	1,110	5	104.08	2,340	6	99.25	777		June 5	
	Apr. 25			May 7			May 19		1:30p	95.37	279
10a	100.80	945	9:50a	104.33	2,840	9:45a	99.50	820		June 6	
5:15	101.05	995	5:45	104.33	2,840	5:45	98.65	687	1p	94.88	233
	Apr. 26			May 8			May 20			June 7	
10:30a	100.28	862	9:45a	104.28	2,720	9:30a	98.51	666	1p	94.58	207
5:30	100.10	835	5	104.27	2,700	6	98.75	702		June 8	
	Apr. 27			May 9			May 21		1p	94.42	194
10:30a	99.75	782	10a	104.27	2,700	1p	99.28	782		June 9	
5	99.55	753	5:15	104.22	2,600		May 22		1:30p	94.24	178
						1:45p	99.32	788		June 10	
									1p	43.92	152

Assiniboine River Basin

Assiniboine River at Brandon, Manitoba

Location. – Lat. 49°51'01", long. 99°56'07", in NW¼ sec. 24, T. 10, R. 19 W., on First Street Bridge, Trans-Canada Highway. Datum Geodetic Survey of Canada, adjustment of 1923.
Drainage area. – 35,550 square miles.
Gage-height record. – Chain gage read twice daily Apr. 1 to June 17 and daily at other times.
Discharge record. – Stage-discharge relation defined by current-meter measurements. Ice effect prior to Apr. 18. Gage heights used to hundredths.
Maxima. – April-June 1950: Discharge, 5,120 second-feet 11:30 a.m. Apr. 23 (gage height, 1,168.60 feet).
1912 to March 1950: Discharge, 23,000 second-feet May 7, 1923 (gage height, 1,177.74 feet).
Remarks. – Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	905	3,730	2,670	11	1,200	3,460	2,320	21	3,240	3,950	2,180
2	995	3,740	2,530	12	1,160	3,350	2,400	22	3,590	3,960	2,030
3	960	3,820	2,400	13	1,090	3,360	2,600	23	5,010	3,710	1,920
4	960	3,850	2,310	14	1,160	3,410	2,550	24	4,380	3,730	1,800
5	955	3,850	2,170	15	1,430	3,430	2,460	25	4,160	3,830	1,660
6	1,050	3,910	2,080	16	1,730	3,340	2,920	26	4,070	3,710	1,820
7	1,260	3,750	1,990	17	1,970	3,240	2,750	27	4,000	3,540	1,920
8	1,150	3,670	2,020	18	2,360	3,240	2,610	28	3,830	3,310	1,890
9	1,170	3,650	2,290	19	2,600	3,540	2,470	29	3,770	3,140	1,920
10	1,100	3,500	2,260	20	2,780	3,910	2,290	30	3,790	3,060	1,920
								31	-	2,850	-
Monthly mean discharge, in second-feet									2,260	3,565	2,240
Runoff, in thousand acre-feet									134.5	219.3	133.2
Runoff, in inches									0.07	0.12	0.07

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge

Assiniboine River at Headingley, Manitoba

Location. —Lat. 49°52'09", long. 97°24'10", River lot 52 at Traffic Bridge, ½ mile south of Canadian Pacific Railway Station. Datum Topographical Survey of Canada.
Drainage area. —62,510 square miles.
Gage-height record. —Chain gage read twice daily.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Ice effect prior to Apr. 25. Backwater effect May 20-28. Gage heights used to hundredths.
Maxima. —April-June 1950: Discharge, 9,970 second-feet at various times May 10-16 (gage height, 765.82 feet).
1913 to March 1950: Discharge, 21,700 second-feet Apr. 27, 1916 (gage height, 769.75 feet).
Remarks. —Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	306	6,630	6,750	11	2,000	9,680	5,110	21	7,040	7,480	6,070
2	476	6,600	6,520	12	2,190	9,910	5,200	22	6,520	7,060	5,830
3	1,300	6,600	6,330	13	2,340	9,810	5,300	23	8,500	6,880	5,490
4	1,360	6,570	6,150	14	2,200	9,810	5,270	24	8,990	6,960	5,200
5	1,460	7,030	5,940	15	2,200	9,840	5,280	25	6,740	7,180	4,940
6	1,720	9,010	5,760	16	2,670	9,920	5,300	26	6,280	7,180	4,870
7	2,050	8,610	5,590	17	3,400	9,270	5,450	27	6,700	7,180	4,720
8	2,100	8,730	5,480	18	4,670	8,550	5,570	28	7,230	7,030	4,670
9	1,990	9,460	5,350	19	5,480	8,200	5,680	29	7,000	7,090	4,650
10	1,840	9,890	5,190	20	5,590	7,930	5,870	30	6,700	7,050	4,790
								31	-	6,960	-
Monthly mean discharge, in second-feet									3,970	8,070	5,480
Runoff, in acre-feet									236,100	496,100	325,900
Runoff, in inches									0.07	0.15	0.10

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	April 16			April 30			May 14			May 28	
7:45a	762.47	2,400	9a	763.69	6,730	7a	765.62	9,650	8a	764.06	7,060
6:30p	763.00	2,940	6:30p	763.64	6,660	6:30p	765.82	9,970	6:30a	764.00	7,030
	April 17			May 1			May 15			May 29	
6:15a	763.06	3,010	6:45a	763.62	6,630	6:45a	765.72	9,810	6:45a	763.95	7,110
6:30p	763.75	3,790	6:30p	763.62	6,630	6:30p	765.75	9,860	6:30p	763.92	7,060
	April 18			May 2			May 16			May 30	
6:15a	764.20	4,370	6:45a	763.60	6,600	6:45a	765.82	9,970	6:45a	763.92	7,060
6:30p	764.65	4,970	6:30p	763.59	6,590	6:30p	765.75	9,860	6:30p	763.90	7,030
	April 19			May 3			May 17			May 31	
6:15a	764.80	5,200	6:45a	763.60	6,600	6:45a	765.52	9,490	6:45a	763.88	7,000
6:30p	765.07	5,720	6:30p	763.60	6,600	6:45a	765.24	9,040	6:30p	763.82	6,910
	April 20			May 4			May 18			June 1	
6:15a	764.67	5,300	6:45a	763.55	6,530	6:45a	765.00	8,680	6:45a	763.76	6,820
7:30p	765.07	5,880	6:30p	763.60	6,600	6:30p	764.82	8,410	6:45p	763.66	6,680
	April 21			May 5			May 19			June 2	
6:15a	765.62	6,530	6:45a	763.65	6,670	6:45a	764.72	8,260	6:45a	763.58	6,570
6:30p	766.45	7,550	6:30p	764.14	7,390	6:45p	764.64	8,140	6:45p	763.50	6,460
	April 22			May 6			May 20			June 3	
6:15a	764.60	6,520	6:45a	765.25	9,060	6:45a	764.60	8,050	6:45a	763.44	6,380
6:30p	764.60	6,520	6:30p	765.20	8,980	6:45p	764.52	7,810	6:45p	763.38	6,290
	April 23			May 7			May 21			June 4	
6:15a	765.18	7,600	7a	765.00	8,680	7:00a	764.46	7,580	7:30a	763.32	6,210
6:30p	766.12	9,400	6:30p	764.90	8,530	6:30p	764.40	7,380	6:45p	763.24	6,100
	April 24			May 8			May 22			June 5	
6:15a	766.05	9,700	6:45a	764.94	8,590	6:45a	764.38	7,140	6:45a	763.18	6,010
6:30p	764.82	8,280	6:30p	765.12	8,860	6:45p	764.32	6,980	6:45p	763.08	5,870
	April 25			May 9			May 23			June 6	
6:15a	763.90	7,030	6:45a	765.35	9,220	6:45a	764.30	6,930	6:45a	763.04	5,820
6:30p	763.50	6,460	6:30p	765.64	9,680	6:45p	764.28	6,830	6:45p	762.96	5,700
	April 26			May 10			May 24			June 7	
6:15a	763.36	6,260	6:45a	765.82	9,970	6:45a	764.30	6,960	6:45a	762.90	5,620
6:30p	763.38	6,290	6:30p	765.72	9,810	6:30p	764.30	6,960	6:45p	762.85	5,550
	April 27			May 11			May 25			June 8	
6:15a	763.52	6,490	6:45a	765.65	9,700	6:45a	764.36	7,180	6:45a	762.82	5,520
6:30p	763.82	6,910	6:30p	765.62	9,650	6:30p	764.36	7,180	6:45p	762.75	5,420
	April 28			May 12			May 26			June 9	
6:15a	763.99	7,170	6:45a	765.75	9,860	6:45a	764.36	7,180	6:45a	762.72	5,400
6:30p	764.06	7,270	6:30p	765.80	9,940	7:00p	764.30	7,180	6:45p	762.65	5,300
	April 29			May 13			May 27			June 10	
6:15a	763.95	7,110	6:45a	765.82	9,970	6:45a	764.25	7,180	6:45a	762.60	5,230
6:30p	763.80	6,880	6:30p	765.62	9,650	6:30p	764.15	7,180	6:45p	762.54	5,150

Souris River near Sherwood, N. Dak.

Location. —Lat. 48°59', long. 101°58', in NE¼ sec. 33, T. 164 N., R. 87 W., three-quarters of a mile south of international boundary and 16 miles northwest of Sherwood. Datum of gage is 1,604.00 feet above mean sea level, datum of 1929.
Drainage area. —9,570 square miles.
Gage-height record. —Water-stage recorder graph except for Apr. 13.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Affected by ice Mar. 1 to Apr. 16.
Maxima. —March-June 1950: Discharge, 1,610 second-feet 5 p.m. Apr. 18 (gage height, 14.25 feet).
1930 to February 1950: Discharge, 7,400 second-feet Apr. 28, 1948 (gage height, 23.80 feet).
Remarks. —Some small diversions and storage above station.

Mean discharge, in second-feet, 1950

Day	March	April	May	June	Day	March	April	May	June
1	2	300	588	159	16	2	1,300	389	133
2	2	300	493	149	17	2	1,520	370	152
3	2	350	416	131	18	2	1,600	348	131
4	2	350	362	118	19	2	1,570	335	140
5	3	350	323	108	20	3	1,520	338	138
6	3	400	295	97	21	3	1,460	325	120
7	4	450	278	88	22	8	1,360	301	190
8	4	500	274	91	23	60	1,290	284	257
9	4	550	276	104	24	100	1,260	262	221
10	3	550	304	118	25	150	1,240	246	182
11	2	550	320	104	26	200	1,220	228	160
12	2	550	346	106	27	200	1,180	206	149
13	2	550	404	106	28	200	1,080	197	133
14	2	700	444	104	29	220	913	192	120
15	2	1,000	412	102	30	250	729	179	114
					31	280	-	169	-
Monthly mean discharge, in second-feet						55.5	890	319	134
Runoff, in acre-feet						3,410	52,940	19,640	7,980
Runoff, in inches						0.01	0.10	0.04	0.02

Souris River near Westhope, N. Dak.

Location. —Lat. 49°00', long. 100°57', in SW¼SE¼ sec. 30, T. 164 N., R. 79 W., 1,200 feet upstream from international boundary, 1 mile downstream from Fish and Wildlife Service dam 357, and 7 miles northeast of Westhope. Datum of gage is 1,401.74 feet above mean sea level, datum of 1929.
Drainage area. —17,600 square miles.
Gage-height record. —Water-stage recorder graph except for Apr 1-13 and May 26 to June 7.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Discharge for periods of no gage-height record computed on basis of stage and gate operation record at dam 1 mile upstream. Backwater due to wind and tributaries Apr. 15-25, May 2-13, 18-25, June 7-12.
Maxima. —April-June 1950: Discharge, 2,650 second-feet 10 p.m. May 17; gage height, 12.31 feet 9 a.m. May 23.
1929 to March 1950: Discharge, 6,400 second-feet Apr. 18, 1949; gage height 16.9 feet (from floodmark) Apr. 20, 1949.
Remarks. —Flow regulated by Fish and Wildlife Service dams on Souris and Des Lacs Rivers.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	15	1,780	1,900	11	200	1,680	2,020	21	730	2,430	1,180
2	20	1,720	1,800	12	250	1,860	1,920	22	762	2,460	1,150
3	22	1,550	1,800	13	700	2,330	2,100	23	829	2,500	1,100
4	25	1,420	1,700	14	1,030	2,480	1,950	24	1,060	2,460	1,040
5	25	1,450	1,600	15	966	2,500	1,900	25	1,420	2,440	1,030
6	50	1,210	1,400	16	966	2,620	1,730	26	1,680	2,400	997
7	100	1,250	1,200	17	921	2,630	1,550	27	1,720	2,400	602
8	150	1,410	1,050	18	943	2,560	1,430	28	1,760	2,300	78
9	150	1,530	1,100	19	885	2,490	1,340	29	1,800	2,200	31
10	200	1,570	1,160	20	779	2,360	1,250	30	1,820	2,100	51
								31	-	2,000	-
Monthly mean discharge, in second-feet									733	2,067	1,305
Runoff, in acre-feet									43,590	127,100	77,670
Runoff, in inches									0.05	0.14	0.08

Souris River at Wawanesa, Manitoba

Location. —Lat. 49°35'49", long. 99°40'43", in NW¼ sec. 26, T. 7, R. 17 W., at Traffic Bridge, ¼ mile north of Wawanesa. Datum is mean sea level, White's Altitudes 1915.
Drainage area. —24,150 square miles
Gage-height record. —Chain gage read twice daily at 9:00 a.m. and 6:00 pm.
Discharge record. —Stage-discharge relation defined by current-meter measurements. Ice effect prior to Apr. 12. Gage heights used to hundredths.
Maxima. —April-June, 1950: Discharge, 3,980 second-feet 6:00 p.m. May 11 (gage height, 1,160.94 feet).
October 1912 to March 1950: Discharge, 8,280 second-feet April 11, 1949 (gage height, 1,168.78 feet).
Remarks. —Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	815	1,820	2,870	11	910	3,790	2,610	21	1,510	2,970	2,310
2	895	1,880	2,860	12	1,140	3,770	2,620	22	1,500	3,010	2,220
3	595	1,940	2,840	13	1,260	3,140	2,810	23	1,510	3,010	2,100
4	535	1,990	2,780	14	1,430	2,860	2,870	24	1,550	2,990	1,990
5	800	2,080	2,730	15	1,750	2,730	3,050	25	1,600	2,990	1,950
6	755	2,190	2,670	16	1,670	2,700	2,950	26	1,630	2,980	2,330
7	700	2,170	2,520	17	1,430	2,710	2,720	27	1,620	2,970	2,120
8	680	2,150	2,880	18	1,570	2,750	2,610	28	1,630	2,970	2,040
9	667	2,570	2,730	19	1,440	2,860	2,540	29	1,650	2,960	1,930
10	810	2,970	2,610	20	1,500	2,900	2,380	30	1,730	2,930	1,790
								31	-	2,870	-
Monthly mean discharge, in second-feet									1,240	2,730	2,510
Runoff, in acre-feet									73,950	167,800	149,600
Runoff, in inches									0.06	0.13	0.12

Winnipeg River Basin

Basswood River near Winton, Minn.
(International gaging station)

Location. —Lat. 48°05', long. 91°39', in sec. 30, T. 65 N., R. 10 W., on Jackfish Bay of Basswood Lake used to determine discharge at outlet (lat. 48°06', long. 91°39', in sec. 19, T. 65 N., R. 10 W., on international boundary 14 miles northeast of Winton). Datum of gage is 1,299.80 feet above mean sea level.
Drainage area. —1,740 square miles (above outlet of Basswood Lake).
Gage-height record. —Water-stage recorder graph.
Discharge record. —Stage-discharge relation defined by current-meter measurements below 8,180 second-feet and extended to peak stage by logarithmic plotting. Gage heights used to hundredths.
Maxima. —April-August 1950: Discharge, 15,600 second-feet 12:30 a.m. May 24 (gage height, 6.94 feet).
1931 to March 1950: Discharge, 9,230 second-feet May 10, 1948 (gage height, 4.82 feet).
Remarks. —No diversion. Some regulation from power plant on Kawishiwi River with storage in numerous lakes. No fluctuation due to power plant operation on account of many miles of intervening lakes.
This station is one of the international gaging stations maintained by the United States under agreement with Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Aug.	Day	April	May	June	July	Aug.
1	676	2,020	12,800	4,150	3,020	16	636	9,100	6,710	3,450	2,120
2	676	2,100	12,300	4,090	3,060	17	644	9,960	6,310	3,360	2,030
3	668	2,270	11,800	4,070	3,060	18	684	11,100	5,880	3,270	1,960
4	652	2,360	11,400	4,090	3,010	19	727	12,300	5,520	3,210	1,880
5	636	2,720	11,000	4,050	2,940	20	763	13,300	5,240	3,140	1,830
6	636	3,290	10,600	4,030	2,840	21	840	14,200	4,880	3,090	1,810
7	620	3,720	10,200	3,990	2,770	22	934	14,800	4,600	3,010	1,760
8	605	4,160	9,880	3,900	2,720	23	1,080	15,100	4,430	2,970	1,720
9	605	4,680	9,420	3,840	2,630	24	1,230	15,200	4,280	2,960	1,790
10	652	5,240	8,960	3,830	2,510	25	1,400	15,200	4,200	2,940	1,850
11	676	5,780	8,560	3,770	2,390	26	1,560	15,000	4,200	2,920	1,810
12	668	6,400	8,100	3,680	2,300	27	1,670	14,700	4,220	2,900	1,780
13	660	7,030	7,670	3,570	2,210	28	1,750	14,300	4,260	2,900	1,750
14	652	7,620	7,260	3,520	2,160	29	1,830	13,800	4,220	2,900	1,710
15	644	8,380	6,870	3,520	2,180	30	1,920	13,500	4,180	2,920	1,670
						31	-	13,200	-	2,900	1,620
Monthly mean discharge, in second-feet							913	9,114	7,332	3,450	2,222
Runoff, in acre-feet							54,330	560,400	436,300	212,112	136,641
Runoff, in inches							0.59	6.05	4.70	2.29	1.48

Namakan River at outlet of Lac la Croix, Ontario

Location. —Lat. 48°24', long. 92°11', at Cambell's Camps, 2½ miles west of Outlet of Lac la Croix. Datum is mean sea level, United States and Canada Boundary Survey.

Drainage area. —5,165 square miles.

Gage-height record. —Staff gage read twice daily to half-tenths.

Discharge record. —Stage-discharge relation defined by current-meter measurements.

Maxima. —May-Sept. 1950: Discharge, 28,200 second-feet 6:00 p.m. May 30 to 6:00 p.m. June 2 (gage height, 1,193.30 feet).

August 1921 to April 1950: Discharge, 18,500 second-feet May 12-17, 1938 (gage height, 1,190.35 feet).

Remarks. —Records furnished by Water Resources Division, Department of Resources and Development, Canada. This station is one of the International gaging stations maintained by Canada under agreement with the United States.

Mean discharge, in second-feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1	2,680	28,200	16,800	10,300	7,210	16	16,000	21,800	14,400	8,590	5,970
2	2,990	28,200	16,500	10,300	7,100	17	17,200	21,100	14,100	8,540	5,970
3	3,600	27,900	16,400	10,100	6,980	18	18,200	20,500	13,800	8,480	5,970
4	4,280	27,600	16,200	9,990	6,870	19	18,800	19,900	13,300	8,250	5,860
5	4,740	27,200	16,100	9,890	6,750	20	19,600	19,300	13,100	8,080	5,820
6	5,440	26,700	16,100	9,640	6,590	21	20,800	18,700	12,800	7,850	5,760
7	6,300	26,300	16,000	9,690	6,480	22	22,100	18,100	12,600	7,620	5,650
8	7,210	25,700	15,900	9,690	6,340	23	23,400	17,500	12,400	7,390	5,650
9	8,360	25,400	15,900	9,560	6,300	24	24,400	17,300	12,400	7,490	5,550
10	9,560	24,800	15,900	9,560	6,260	25	25,600	17,500	12,000	7,720	5,480
11	10,600	24,200	15,700	9,440	6,190	26	26,300	17,900	11,800	7,790	5,440
12	11,600	23,700	15,500	9,310	6,190	27	26,900	18,100	11,500	7,670	5,340
13	12,700	23,200	15,200	9,190	6,080	28	27,300	17,600	11,300	7,560	5,340
14	13,800	22,700	15,000	9,020	6,040	29	27,700	17,200	11,000	7,440	5,230
15	14,900	22,100	14,700	8,760	5,970	30	28,000	17,100	10,800	7,330	5,230
						31	28,200	-	10,500	7,260	-
Monthly mean discharge, in second-feet							15,800	22,100	14,100	8,690	6,050
Runoff, in thousand acre-feet							970.4	1,316	864.2	534.5	360.2
Runoff, in inches							3.53	4.78	3.15	1.94	1.31

Namakan Lake at Kettle Falls, Minnesota

Location.—Lat. 48°30'10", long. 92°38'40", about ¼ mile above Kettle Falls Dam, international channel. Datum of gage is mean sea level, United States and Canada Boundary Survey.
Gage-height record.—Staff gage read daily.
Maxima.—May-Sept. 1950: Elevation, 1,122.69 feet June 7 and 9.
August 1912 to April 1950: Elevation, 1,122.86 feet May 23, 1916.
Remarks.—Elevation of lake is controlled for power purposes. This station is one of the international gaging stations maintained by Canada under agreement with the United States. Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Elevation,* in feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1	11.81	22.61	20.86	19.42	19.14	16	19.51	22.15	20.21	19.11	18.73
2	11.98	22.63	20.76	19.43	19.11	17	19.86	22.09	20.19	19.06	18.70
3	12.11	22.64	20.72	19.41	19.07	18	20.11	22.01	20.15	19.09	18.72
4	12.26	22.66	20.74	19.39	19.03	19	20.21	21.76	20.07	19.11	18.69
5	12.56	22.66	20.61	19.35	19.01	20	20.46	21.51	20.01	19.07	18.67
6	13.40	22.65	20.53	19.31	18.95	21	20.61	21.39	19.96	19.03	18.63
7	14.21	22.69	20.44	19.27	18.91	22	20.81	21.33	19.89	19.01	18.61
8	15.03	22.64	20.36	19.21	18.91	23	21.01	21.33	19.80	19.00	18.55
9	15.56	22.69	20.36	19.15	18.89	24	21.26	21.21	19.73	19.01	18.50
10	16.21	22.64	20.34	19.08	18.83	25	21.41	21.10	19.71	19.18	18.45
11	16.66	22.61	20.30	19.13	18.79	26	21.61	21.28	19.71	19.19	18.40
12	17.21	22.51	20.37	19.13	18.80	27	21.76	21.19	19.65	19.19	18.31
13	17.91	22.41	20.28	19.11	18.80	28	22.01	21.12	19.59	19.19	18.29
14	18.41	22.31	20.26	19.10	18.79	29	22.26	21.03	19.52	19.21	18.21
15	19.01	22.19	20.23	19.11	18.76	30	22.30	20.93	19.44	19.21	18.17
						31	22.56	-	19.37	19.19	-

* Add 1,100 feet to obtain elevation above mean sea level.

Rainy Lake at Fort Frances, Ontario

Location.—Lat. 48°37'15", long. 93°21'20", at Canadian Government Dock at Rainy Lake, about 2 miles east of Canadian National Railway station. Datum of gage is mean sea level, United States and Canada Boundary Survey.
Gage-height record.—Staff gage read daily.
Maxima.—May-Sept. 1950: Elevation, 1,112.97 feet July 5.
August 1911 to April 1950: Elevation, 1,112.51 feet June 8, 1916 at Ranier, Minnesota.
Remarks.—Elevation of lake is controlled for power purposes. This station is one of the international gaging stations maintained by Canada under agreement with the United States. Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Elevation,* in feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1	5.76	11.58	12.91	11.32	8.41	16	9.25	12.60	12.41	9.30	8.31
2	5.83	11.67	12.91	11.05	8.37	17	9.38	12.59	12.47	9.20	8.31
3	5.93	11.77	12.93	10.98	8.35	18	9.53	12.57	12.43	9.10	8.37
4	6.01	11.98	12.93	10.87	8.35	19	9.68	12.51	12.37	8.90	8.42
5	6.29	12.05	12.97	10.72	8.30	20	9.82	12.51	12.28	8.80	8.42
6	6.75	12.15	12.94	10.58	8.28	21	9.99	12.50	12.23	8.75	8.46
7	7.12	12.20	12.93	10.46	8.26	22	10.14	12.53	12.13	8.60	8.44
8	7.29	12.25	12.90	10.35	8.25	23	10.28	12.50	12.07	8.57	8.45
9	7.66	12.33	12.85	10.24	8.27	24	10.47	12.47	12.00	8.65	8.44
10	7.92	12.39	12.80	10.12	8.38	25	10.65	12.70	11.91	8.67	8.48
11	8.12	12.46	12.75	9.97	8.38	26	10.81	12.65	11.79	8.60	8.52
12	8.42	12.46	12.64	9.82	8.26	27	10.97	12.72	11.69	8.55	8.53
13	8.64	12.49	12.55	9.70	8.24	28	11.11	12.77	11.59	8.52	8.46
14	8.82	12.49	12.56	9.55	8.23	29	11.24	12.76	11.49	8.52	8.48
15	9.07	12.48	12.53	9.44	8.27	30	11.32	12.82	11.44	8.46	8.55
						31	11.43	-	11.38	8.44	-

* Add 1,100 feet to obtain elevation above mean sea level.

Rainy River at Manitou Rapids, Minn.
(International gaging station)

Location.—Lat. 48°38'04", long. 93°54'47", in sec. 36, T. 160 N., R. 26 W., at Manitou Rapids, 3½ miles east of Manitou post office, and 4 miles west of Indus.

Drainage area.—19,360 square miles.

Gage-height record.—Water-stage recorder graph except periods 11 a.m. May 5 to 1 p.m. May 7, 3 p.m. July 24 to 1:30 p.m. July 26, 8 p.m. Aug. 18 to 10 a.m. Aug. 19, for which graph was drawn based on fragmentary record and trend of chart before and after each period.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 68,230 second-feet. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-4.

Maxima.—April-Aug. 1950: Discharge, 71,600 second-feet 9 a.m. May 12 (gage height, 21.04 feet). 1933 to March 1950: Discharge, 65,400 second-feet May 8, 1938 (gage height, 19.80 feet).

Remarks.—No diversion. Flow partly regulated by power plant at Fort Frances and by Rainy, Namakan, and many smaller lakes. This station is one of the international gaging stations maintained by the United States under agreement with Canada.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Aug.	Day	April	May	June	July	Aug.
1	12,000	20,100	49,500	56,500	43,400	16	10,100	65,400	47,600	47,000	33,900
2	13,000	20,900	49,200	55,600	44,700	17	10,400	63,600	48,100	46,800	33,200
3	11,000	21,500	49,000	55,000	45,100	18	14,000	60,200	47,800	46,800	31,700
4	12,000	22,300	48,800	55,100	44,100	19	16,200	57,800	47,400	46,600	29,000
5	12,500	26,800	48,500	55,000	42,800	20	17,200	57,000	47,200	46,100	27,800
6	12,300	37,800	48,400	54,700	41,300	21	18,900	56,000	47,000	45,500	26,900
7	11,800	49,600	48,300	54,100	39,900	22	21,400	55,500	47,200	45,000	26,000
8	11,800	59,700	48,200	52,800	38,900	23	23,200	54,600	47,400	44,300	24,200
9	11,500	67,200	48,000	51,300	38,000	24	25,100	54,500	47,500	43,700	23,100
10	9,980	70,200	47,700	50,100	37,400	25	26,500	54,800	49,500	43,200	23,300
11	10,100	71,300	47,600	49,400	36,600	26	27,200	54,900	54,200	42,800	24,500
12	10,500	71,300	47,400	48,600	35,900	27	27,100	54,200	57,200	42,300	25,600
13	10,300	70,600	47,300	48,100	35,200	28	25,900	53,100	58,400	41,800	25,600
14	10,100	69,100	47,200	47,600	34,700	29	24,000	51,700	58,200	41,200	25,100
15	10,100	67,000	47,200	47,300	34,300	30	22,100	50,700	57,500	41,000	24,900
						31	-	49,800	-	41,800	24,600
Monthly mean discharge, in second-feet							15,940	52,880	49,480	49,970	32,960
Runoff, in thousand acre-feet							948.6	3,251.3	2,944.4	2,949.6	2,026.5
Runoff, in inches							0.92	3.15	2.85	2.86	1.96

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			May 3			May 11 (cont'd.)			June 26	
6	5.20	9,840	6	9.39	21,400	6	20.98	71,300	6	17.25	53,000
N	5.18	9,800	N	9.41	21,400	12	21.02	71,500	N	17.49	54,100
6	5.69	11,000	6	9.48	21,600		May 12		6	17.78	55,500
12	6.22	12,300	12	9.59	22,000	6	21.02	71,500	12	17.99	56,500
	Apr. 18			May 4		N	21.02	71,500		June 27	
6	6.58	13,200	6	9.63	22,100	6	20.95	71,200	N	18.15	57,300
N	6.84	14,000	N	9.67	22,200	12	20.86	70,700	12	18.27	57,900
6	7.23	15,000	6	9.72	22,400		May 13			June 28	
12	7.48	15,700	12	9.97	23,100	6	20.86	70,700	6	18.37	58,300
	Apr. 19			May 5		N	20.86	70,700	N	18.39	58,400
6	7.53	15,900	N	11.02	26,400	6	20.82	70,500	6	18.40	58,500
N	7.61	16,100	12	12.42	31,600	12	20.74	70,100	12	18.41	58,500
6	7.76	16,500		May 6			May 14			June 29	
12	7.87	16,900	8	13.38	35,600	6	20.62	69,500	6	18.40	58,500
	Apr. 20		4	14.37	39,900	N	20.51	69,000	N	18.32	58,100
6	7.86	16,800	12	15.32	44,100	6	20.44	68,600	6	18.30	58,000
N	7.85	16,800		May 7		12	20.37	68,200	12	18.31	58,000
6	8.15	17,600	8	16.12	47,700		May 15			June 30	
12	8.31	18,100	4	16.95	51,600	N	20.06	66,700	6	18.25	57,800
	Apr. 21		12	17.62	54,700	12	19.98	66,300	N	18.19	57,500
6	8.36	18,300		May 8			May 16		6	18.13	57,200
N	8.46	18,600	6	18.16	57,300	N	19.74	65,100	12	18.06	56,800
6	8.76	19,500	N	18.61	59,500	12	19.68	64,800		July 1	
12	9.01	20,200	6	19.22	62,500		May 17		6	18.01	56,600
	Apr. 22		12	19.61	64,400	N	19.46	63,700	N	17.97	56,400
6	9.19	20,800		May 9		12	19.12	62,000	6	17.97	56,400
N	9.31	21,100	6	19.84	65,600		May 18		12	17.92	56,200
6	9.65	22,200	N	20.25	67,600	N	18.73	60,100		July 2	
12	9.95	23,000	6	20.46	68,700	12	18.45	58,700	N	17.81	55,600
	May 1		12	20.57	69,200		May 19		12	17.69	55,100
N	8.80	19,600		May 10		N	18.21	57,600		July 3	
12	9.11	20,500	6	20.68	69,800	12	18.20	57,500	6	17.64	54,800
	May 2		N	20.76	70,200		June 25		N	17.68	55,000
6	9.18	20,700	6	20.82	70,500	6	16.18	48,000	6	17.71	55,200
N	9.22	20,900	12	20.92	71,000	N	16.39	49,000	12	17.72	55,200
6	9.28	21,000		May 11		6	16.80	50,900			
12	9.34	21,200	6	20.95	71,200	12	17.10	52,200			
			N	20.98	71,300						

Lake of the Woods at Warroad, Minn.

Location.—Lat. 48°54'16", long. 95°19'00", on north side Warroad River at revetment near foot of Main St., Warroad. Datum of gage is at mean sea lvel, adjustment of 1912.
Gage-height record.—Water-stage recorder graph.
Maximum.—April-Sept. 1950: Elevation, 1,064.56 feet 6 p.m. June 25 (result of strong north wind). Elevation, 1,064.05 feet 6 p.m. July 18 (unaffected by wind).
Remarks.—Lake level regulated by International Joint Commission. Readings in the following tabulation of gage heights furnished by Corps of Engineers.

Elevation, in feet, 1950

Day	April		May		June	
	8:00 a.m.	6:00 p.m.	8:00 a.m.	6:00 p.m.	8:00 a.m.	6:00 p.m.
1	1,059.44	1,059.48	1,060.22	1,060.26	1,062.97	1,062.97
2	1,059.48	1,059.48	1,060.32	1,060.38	1,063.20	1,062.92
3	1,059.48	1,059.50	1,060.39	1,060.43	1,062.96	1,063.00
4	1,059.46	1,059.50	1,060.52	1,060.50	1,063.18	1,063.12
5	1,059.47	1,059.47	1,060.58	1,060.66	1,063.12	1,063.16
6	1,059.48	1,059.48	1,060.75	1,060.81	1,063.22	1,063.18
7	1,059.50	1,059.50	1,060.90	1,060.92	1,063.42	1,063.38
8	1,059.52	1,059.50	1,061.10	1,061.16	1,063.36	1,062.86
9	1,059.54	1,059.48	1,061.28	1,061.30	1,062.78	1,062.82
10	1,059.48	1,059.46	1,061.43	1,061.47	1,062.07	1,062.15
11	1,059.43	1,059.45	1,061.54	1,061.68	1,063.10	1,063.14
12	1,059.46	1,059.46	1,060.79	1,060.81	1,063.17	1,063.15
13	1,059.45	1,059.45	1,061.90	1,061.94	1,063.16	1,063.16
14	1,059.44	1,059.46	1,062.01	1,062.03	1,063.12	1,063.08
15	1,059.45	1,059.45	1,062.15	1,062.21	1,063.12	1,063.32
16	1,059.43	1,059.39	1,062.28	1,062.30	1,063.64	1,063.28
17	1,059.44	1,059.46	1,062.33	1,062.39	1,063.18	1,063.22
18	1,059.42	1,059.44	1,062.44	1,062.50	1,063.20	1,063.08
19	1,059.41	1,059.43	1,062.45	1,062.49	1,063.07	1,063.05
20	1,059.44	1,059.44	1,062.56	1,062.60	1,063.32	1,063.28
21	1,059.48	1,059.50	1,062.70	1,062.60	1,063.10	1,063.20
22	1,059.52	1,059.52	1,062.72	1,062.66	1,063.20	1,063.12
23	1,059.64	1,059.68	1,062.76	1,062.82	1,062.96	1,062.78
24	1,059.74	1,059.78	1,062.82	1,062.86	1,063.17	1,063.19
25	1,059.84	1,059.86	1,062.87	1,062.87	1,063.64	1,064.56
26	1,059.86	1,059.88	1,062.89	1,062.93	1,063.44	1,063.60
27	1,059.92	1,059.92	1,062.90	1,062.90	1,063.37	1,063.35
28	1,059.98	1,060.00	1,062.94	1,062.88	1,063.55	1,063.55
29	1,060.05	1,060.09	1,062.96	1,062.92	1,063.48	1,063.78
30	1,060.15	1,060.19	1,062.86	1,062.98	1,063.61	1,063.65
31	-	-	1,062.94	1,062.80	-	-

Elevation, in feet, 1950

Day	July		August		September	
	8:00 a.m.	6:00 p.m.	8:00 a.m.	6:00 p.m.	8:00 a.m.	6:00 p.m.
1	1,063.72	1,063.78	1,064.04	1,063.94	1,062.73	1,062.71
2	1,063.68	1,063.72	1,063.92	1,063.92	1,062.65	1,062.63
3	1,063.75	1,063.77	1,063.88	1,063.88	1,062.72	1,062.66
4	1,063.70	1,063.82	1,063.84	1,063.88	1,062.56	1,062.54
5	1,063.80	1,063.82	1,063.84	1,063.84	1,062.33	1,062.39
6	1,063.80	1,063.78	1,063.75	1,063.63	1,062.32	1,062.20
7	1,063.78	1,063.82	1,063.56	1,063.64	1,062.08	1,062.20
8	1,063.82	1,063.82	1,063.69	1,063.67	1,062.30	1,062.20
9	1,063.86	1,063.92	1,063.74	1,063.80	1,062.38	1,062.52
10	1,063.78	1,063.78	1,063.74	1,063.72	1,062.78	1,063.10
11	1,063.82	1,063.92	1,063.61	1,063.69	1,062.44	1,062.32
12	1,063.73	1,063.63	1,063.58	1,063.64	1,062.24	1,062.24
13	1,063.95	1,064.03	1,063.54	1,063.50	1,062.20	1,062.18
14	1,063.95	1,064.01	1,063.40	1,063.38	1,062.08	1,062.04
15	1,063.98	1,064.04	1,063.53	1,063.55	1,062.02	1,062.02
16	1,064.02	1,063.98	1,063.38	1,063.42	1,062.10	1,062.02
17	1,063.94	1,063.92	1,063.48	1,063.44	1,061.86	1,061.84
18	1,064.03	1,064.05	1,063.26	1,063.12	1,061.83	1,061.83
19	1,064.01	1,064.01	1,063.40	1,063.44	1,061.80	1,061.70
20	1,063.96	1,063.88	1,062.84	1,062.88	1,061.72	1,061.86
21	1,063.75	1,063.57	1,063.14	1,063.14	1,061.70	1,061.46
22	1,063.75	1,063.81	1,062.68	1,062.98	1,061.48	1,061.62
23	1,064.02	1,064.02	1,062.98	1,063.04	1,061.70	1,061.54
24	1,063.94	1,063.90	1,063.08	1,063.16	1,060.96	1,061.34
25	1,063.90	1,063.92	1,063.02	1,063.02	1,061.30	1,061.32
26	1,063.86	1,063.86	1,062.86	1,062.84	1,061.24	1,061.14
27	1,063.84	1,063.90	1,062.73	1,062.91	1,061.15	1,060.71
28	1,063.82	1,063.74	1,062.94	1,062.98	1,060.48	1,060.66
29	1,063.78	1,063.86	1,062.83	1,062.83	1,061.00	1,061.00
30	1,063.99	1,063.93	1,062.63	1,062.69	1,061.50	1,061.52
31	1,063.91	1,063.99	1,062.72	1,062.76	-	-

Winnipeg River, total outflow Lake of the Woods, Ontario

Location. - Lat. 49°47', long. 94°31'. All outlets of Lake of the Woods in vicinity of Kenora and Keewatin, Ontario.
Drainage area. - 27,170 square miles.
Discharge record. - Discharge is the combined flow through power-houses at different outlets and is computed from the hourly operation at each plant plus the flow through the waste sluices of the Norman Dam during periods of excessive run-off.
Maxima. - May-Sept. 1950: Discharge, 56,300 second-feet August 3.
October 1892 to April 1950: Discharge, 51,600 second-feet July 6, 1927.
Remarks. - The Lake of the Woods level and outflow regulated by the Lake of the Woods Control Board, International Joint Commission. Records furnished by the Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1	14,800	52,100	53,700	55,700	51,100	16	48,600	52,200	54,200	55,000	48,300
2	15,000	51,900	53,000	56,100	52,000	17	48,800	51,100	55,700	54,500	48,300
3	17,500	50,700	53,300	56,300	49,700	18	50,000	51,100	55,700	55,400	48,100
4	17,600	51,000	54,600	56,200	49,500	19	50,200	53,000	55,700	51,800	47,900
5	23,900	53,100	54,600	56,000	51,700	20	48,700	52,700	55,700	52,700	44,300
6	24,200	52,900	54,900	54,700	51,400	21	48,800	53,000	55,700	53,300	41,900
7	23,300	52,500	54,900	54,900	51,300	22	50,200	52,800	54,900	54,200	40,800
8	26,300	52,600	55,000	55,800	49,500	23	50,300	53,400	54,600	53,100	40,900
9	36,500	53,300	55,200	55,400	49,100	24	50,700	50,900	55,500	52,800	40,000
10	44,900	50,700	55,400	55,300	47,200	25	51,000	50,900	55,300	52,600	41,000
11	45,700	50,900	55,400	55,100	49,300	26	51,300	52,400	55,300	51,100	34,800
12	48,000	53,100	55,200	55,000	49,500	27	50,200	53,000	55,700	50,700	23,400
13	46,400	52,900	55,100	53,200	49,300	28	50,200	53,000	55,500	51,600	14,800
14	46,900	53,000	55,400	55,400	49,200	29	50,900	53,300	54,700	51,700	14,900
15	48,400	52,900	54,200	55,000	48,700	30	51,400	54,900	54,300	51,600	14,500
						31	51,800		56,200	51,300	
Monthly mean discharge, in second-feet							41,400	52,400	55,000	54,000	43,100
Runoff, in thousand acre-feet							2,539	3,111	3,377	3,312	2,559
Runoff, in inches							1.70	2.15	2.33	2.29	1.77

Winnipeg River at Slave Falls, Manitoba

Location. - Lat. 50°14', long. 95°34', at City of Winnipeg Power Plant. Datum Geodetic Survey of Canada, adjustment of 1923.
Drainage area. - 48,880 square miles.
Gage-height record. - Water-stage recorder gages in forebay and tailrace.
Discharge record. - Discharge is the flow through power-house and spillways computed from the hourly plant operation.
Maxima. - May-Sept. 1950: Discharge, 98,100 second-feet June 19 and 23.
1907 to April 1950: Discharge, 86,600 second-feet July 1927.
Remarks. - Records furnished by the City of Winnipeg Hydro-Electric System.

Mean discharge, in second-feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1	28,600	90,000	96,100	91,700	80,600	16	59,800	97,500	94,000	90,900	74,600
2	29,200	90,400	96,100	91,900	79,900	17	63,900	97,500	95,100	90,400	72,800
3	29,100	90,600	96,300	92,100	79,200	18	67,200	97,500	93,900	89,900	73,000
4	30,400	91,700	96,400	92,000	78,700	19	72,500	98,100	93,500	89,400	71,200
5	33,200	92,500	95,900	92,500	78,000	20	74,600	97,300	92,800	88,600	71,800
6	35,400	92,900	96,100	92,000	77,200	21	76,700	97,300	92,500	87,000	69,700
7	35,500	93,300	95,800	93,100	77,400	22	78,900	97,500	91,600	87,100	67,100
8	37,500	93,400	95,400	94,100	76,100	23	81,100	98,100	90,300	85,800	66,000
9	39,700	95,100	94,900	94,000	76,000	24	82,600	96,600	91,000	85,300	65,700
10	42,200	94,600	95,400	93,200	75,000	25	84,500	96,600	89,900	83,700	65,100
11	44,100	95,200	95,200	92,800	75,200	26	85,400	97,300	90,500	83,400	63,800
12	44,900	96,200	94,700	91,800	78,800	27	86,700	97,900	90,500	82,400	62,900
13	49,300	96,500	93,700	91,900	76,600	28	87,800	97,000	90,800	82,200	60,900
14	48,400	96,900	94,000	91,800	76,300	29	89,100	96,600	91,000	81,500	57,700
15	51,200	97,300	93,900	92,000	75,800	30	89,400	96,800	91,200	82,000	57,900
						31	89,800	-	92,700	81,400	-
Monthly mean discharge, in second-feet							59,600	95,500	93,600	89,000	72,000
Runoff, in thousand acre-feet							3,667	5,685	5,755	5,470	4,286
Runoff, in inches							1.41	2.18	2.21	2.10	1.64

Kawishiwi River nr. Winton, Minn.

Location. — Lat. 47°56', long. 91°46', in lot 3, sec. 20, T. 63 N., R. 11 W., at power plant of Minnesota Power and Light Co., just upstream from Fall Lake and 2½ miles east of Winton.
Drainage area. — 1,200 square miles.
Gage-height record. — Power-plant record, no gage heights furnished.
Maxima. — April-June 1950: Daily discharge, 16,000 second-feet May 8.
1905-7, 1912-19, 1923 to March 1950: Daily discharge, 11,200 second-feet May 3, 1948.
Remarks. — Flow entirely regulated by reservoirs. Records furnished by Minnesota Power and Light Co.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	281	1,870	8,670	11	410	7,090	4,390	21	802	14,800	1,690
2	161	1,890	8,330	12	281	8,550	4,060	22	991	14,000	1,610
3	281	1,940	7,780	13	348	9,250	3,760	23	1,540	13,500	1,650
4	352	1,990	7,700	14	352	10,400	4,300	24	1,470	13,000	1,860
5	352	2,400	7,360	15	352	12,500	2,630	25	1,220	12,700	2,400
6	249	3,220	7,140	16	352	13,600	2,490	26	1,310	11,700	1,950
7	249	3,820	6,500	17	563	15,200	2,290	27	1,400	10,700	2,210
8	249	5,040	6,210	18	678	16,000	2,040	28	1,490	10,200	2,110
9	194	5,870	5,350	19	839	15,900	2,020	29	1,640	9,620	2,120
10	398	6,650	4,800	20	701	15,500	1,820	30	1,830	9,590	2,190
								31	-	9,140	-
Monthly mean discharge, in second-feet									711	9,278	3,981
Runoff, in acre-feet									42,310	570,480	236,885
Runoff, in inches									0.81	9.41	3.53

Vermilion River below Lake Vermilion, near Tower, Minn.

Location. —Lat. 47°58', long. 92°28', in sec. 2, T. 63 N., R. 17 W., 200 feet downstream from dam at outlet of Lake Vermilion, 4 miles upstream from Twomile Creek, which enters from the west, and about 18 miles across Lake Vermilion from Tower.
Drainage area. —483 square miles.
Gage-height record. —Water-stage recorder graph.
Discharge record. —Stage-discharge relation defined by current-meter measurements below 1,940 second-feet, and extended to peak stage. Gage heights used to hundredths.
Maxima. —April-July 1950: Discharge, 2,710 second-feet 11 p.m. May 23 (gage height, 4.68 feet).
1911-17, 1928 to March 1950: Discharge observed, 2,290 second-feet May 9, 11, 13, 1938 (gage height, 3.96 feet).
Remarks. —Flow subject to natural regulation by Lake Vermilion. No diversion above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	192	607	2,100	1,160	16	212	2,570	1,430	839
2	196	637	2,040	1,140	17	214	2,580	1,410	828
3	202	684	1,980	1,150	18	222	2,600	1,360	800
4	199	711	1,960	1,120	19	232	2,590	1,280	784
5	196	838	1,900	1,110	20	238	2,560	1,280	763
6	194	1,090	1,880	1,090	21	246	2,550	1,240	741
7	189	1,320	1,820	1,070	22	265	2,540	1,220	715
8	184	1,540	1,800	1,060	23	290	2,520	1,210	699
9	184	1,750	1,730	1,010	24	329	2,480	1,150	689
10	206	1,940	1,650	972	25	388	2,450	1,190	679
11	224	2,110	1,630	953	26	438	2,420	1,170	663
12	222	2,260	1,600	895	27	471	2,370	1,180	653
13	216	2,390	1,550	839	28	500	2,320	1,170	632
14	216	2,480	1,510	867	29	531	2,270	1,150	617
15	214	2,550	1,470	867	30	568	2,220	1,150	617
					31	-	2,160	-	597
Monthly mean discharge, in second-feet						273	2,003	1,507	859
Runoff, in acre-feet						16,220	123,190	89,670	52,798
Runoff, in inches						0.63	4.78	3.48	2.05

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 4			May 10			May 17			May 24 (cont'd.)	
8	2.33	705	8	3.91	1,900	N	4.57	2,590	8	4.47	2,480
4	2.34	710	4	3.98	1,980	12	4.57	2,590	N	4.47	2,480
12	2.39	736	12	4.03	2,020		May 18		4	4.46	2,470
	May 5			May 11		N	4.58	2,600	8	4.45	2,460
4	2.44	763	8	4.08	2,080	12	4.57	2,590	12	4.45	2,460
8	2.46	773	4	4.14	2,140		May 19			May 25	
N	2.56	828	12	4.19	2,180	N	4.57	2,590	N	4.44	2,450
4	2.59	844		May 12		12	4.56	2,580	12	4.42	2,430
8	2.79	959	8	4.25	2,250		May 20			May 26	
12	2.82	978	4	4.29	2,290	N	4.54	2,550	N	4.41	2,420
	May 6		12	4.33	2,330	12	4.53	2,540	12	4.39	2,390
8	2.94	1,060		May 13			May 21			May 27	
4	3.04	1,120	8	4.37	2,370	N	4.54	2,550	N	4.37	2,370
12	3.16	1,220	4	4.40	2,400	12	4.54	2,550	12	4.34	2,340
	May 7		12	4.45	2,460		May 22			May 28	
8	3.24	1,280		May 14		N	4.54	2,550	N	4.32	2,320
4	3.33	1,360	4	4.46	2,470	12	4.51	2,520	12	4.29	2,290
12	3.42	1,440	8	4.45	2,460		May 23			May 29	
	May 8		N	4.46	2,470	4	4.51	2,520	N	4.27	2,270
8	3.50	1,510	4	4.50	2,510	8	4.50	2,510	12	4.24	2,240
4	3.57	1,580	8	4.50	2,510	N	4.50	2,510		May 30	
12	3.64	1,640	12	4.51	2,520	4	4.52	2,530	N	4.23	2,230
	May 9			May 15		8	4.48	2,490	12	4.20	2,200
8	3.73	1,730	N	4.54	2,550	12	4.47	2,480		May 31	
4	3.79	1,790	12	4.56	2,580		May 24		4	4.16	2,160
12	3.85	1,840		May 16		4	4.49	2,500	12	4.15	2,140
			N	4.57	2,590						
			12	4.55	2,560						

Turtle River near Mine Centre, Ontario

Location. —Lat. 48°46'20", long. 92°37'00", on east shore of Little Turtle Lake at site of old saw mill of Canadian National Railway. Datum is mean sea level, Geodetic Survey of Canada, adjustment of 1923.

Drainage area. —1,880 square miles.

Gage-height record. —Staff gage read daily.

Discharge record. —Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths.

Maxima. —May-Sept. 1950: Discharge, 9,060 second-feet May 17 (gage height, 1,140.06 feet).
August 1914 to April 1950: Discharge, 10,700 second-feet Oct. 2-3, 1941 (gage height, 1,141.22 feet).

Remarks. —Records furnished by Water Resources Division, Department of Resources and Development, Canada.

Mean discharge, in second-feet, 1950

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1	2,060	6,430	4,710	3,250	2,130	16	8,990	3,370	5,050	2,410	1,590
2	2,100	6,120	4,800	3,230	2,080	17	9,060	3,340	5,410	2,330	1,570
3	2,130	5,990	4,900	3,170	2,130	18	8,940	3,320	5,510	2,300	1,540
4	2,210	5,680	5,040	3,080	2,150	19	8,770	3,270	5,430	2,280	1,560
5	2,520	5,560	5,040	2,990	2,130	20	8,620	3,180	5,280	2,240	1,490
6	3,770	5,250	5,040	2,970	2,120	21	8,460	3,130	5,000	2,190	1,470
7	5,100	4,990	4,990	2,950	2,060	22	8,210	3,090	4,680	2,130	1,460
8	5,920	4,750	4,900	2,820	2,010	23	8,010	3,080	4,510	2,080	1,450
9	6,470	4,450	4,740	2,740	1,960	24	7,870	3,080	4,290	2,190	1,420
10	6,980	4,290	4,650	2,660	1,860	25	7,800	3,230	4,070	2,210	1,400
11	7,450	4,130	4,490	2,620	1,780	26	7,670	3,600	3,870	2,250	1,370
12	8,010	3,940	4,470	2,560	1,760	27	7,470	3,940	3,720	2,300	1,330
13	8,440	3,750	4,370	2,540	1,730	28	7,270	4,420	3,590	2,260	1,310
14	8,530	3,550	4,250	2,510	1,620	29	7,080	4,240	3,510	2,240	1,280
15	8,710	3,390	4,190	2,470	1,600	30	6,810	4,610	3,380	2,210	1,230
						31	6,630	-	2,270	2,180	-
Monthly mean discharge, in second-feet							6,710	4,170	4,520	2,530	1,690
Runoff, in acre-feet							412,700	248,300	280,000	155,960	100,300
Runoff, in inches							4.12	2.48	2.79	1.56	1.00

Little Fork River at Little Fork, Minn.

Location.—Lat. 48°24', long. 93°34', in NW¼ sec. 9, T. 68 N., R. 25 W., 100 feet downstream from bridge on State Highway 65 at town of Little Fork, and 1½ miles upstream from Beaver Creek.
Drainage area.—1,730 square miles.
Gage-height record.—Water-stage recorder graph.
Discharge record.—Stage-discharge relation defined by current-meter measurements below 19,800 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1 to May 5. Discharge for period of backwater from Rainy River, May 18 to Aug. 31, computed on basis of 5 discharge measurements, gage heights, precipitation records, and records for Rainy River at Manitou Rapids and Big Fork River at Big Falls and rounded to five percent.
Maxima.—April-Aug. 1950: Discharge, 25,000 second-feet 1 a.m. May 11 (gage height, 37.00 feet). 1909-17, 1928 to March 1950: Discharge observed, 19,300 second-feet Apr. 18, 1916 (gage height, 37 feet, affected by backwater).
Remarks.—No diversion above station. Flow partly regulated by several small lakes above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Aug.	Day	April	May	June	July	Aug.
1	120	4,600	3,600	2,800	1,600	16	220	18,000	1,900	1,400	460
2	130	4,800	3,400	2,600	2,800	17	380	15,400	1,900	1,500	420
3	140	5,000	3,200	2,400	2,600	18	850	12,000	1,800	1,500	360
4	140	6,500	3,000	2,600	2,200	19	1,300	10,000	1,700	1,500	320
5	140	12,000	3,000	2,800	1,900	20	1,700	8,500	1,600	1,400	300
6	150	15,700	2,800	2,800	1,600	21	2,400	7,500	1,500	1,300	280
7	150	17,900	2,800	2,600	1,400	22	3,200	7,000	1,400	1,200	280
8	160	19,800	2,600	2,200	1,200	23	4,400	6,500	1,500	1,100	260
9	160	22,600	2,400	2,000	1,000	24	6,000	6,500	1,700	1,000	380
10	160	24,700	2,400	1,800	900	25	7,500	7,000	2,200	900	950
11	160	24,800	2,200	1,700	800	26	8,000	6,500	3,400	850	1,200
12	160	24,300	2,000	1,600	700	27	8,000	6,000	3,600	750	1,000
13	160	23,600	1,900	1,500	600	28	6,500	5,500	3,600	700	900
14	150	22,200	1,800	1,500	550	29	5,500	4,800	3,400	650	800
15	170	20,200	1,800	1,400	500	30	4,800	4,200	3,200	600	850
						31	-	3,800	-	900	900
Monthly mean discharge, in second-feet							2,100	12,190	2,443	1,598	968
Runoff, in acre-feet							124,960	749,550	145,390	98,280	59,520
Runoff, in inches							1.35	8.12	1.58	1.07	0.65

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 24			May 1			May 9	
6	8.00		6	23.10		6	20.66		8	34.76	22,100
N	8.06		N	23.55		N	20.35		4	35.55	23,100
6	8.59		6	24.16		6	20.27		12	36.24	24,000
12	8.94		12	24.81		12	20.25			May 10	
	Apr. 17			Apr. 25			May 2		6	36.60	24,500
6	8.99		6	25.29		6	19.92		N	36.82	24,800
N	9.45		N	25.79		N	19.59		6	36.95	24,900
6	11.13		6	26.22		6	20.53		12	36.99	25,000
12	12.12		12	26.55		12	20.36			May 11	
	Apr. 18			Apr. 26			May 3		6	36.96	24,900
6	12.82		4	26.74		6	20.06		N	36.90	24,900
N	13.08		8	26.87		N	19.79		6	36.80	24,700
6	13.51		N	27.01		6	19.12		12	36.71	24,600
12	13.86		4	27.14		12	19.34			May 12	
	Apr. 19		8	27.20			May 4		8	36.53	24,400
6	14.11		12	27.17		6	19.32		4	36.38	24,200
N	14.40			Apr. 27		N	18.84		12	36.22	24,000
6	14.72		4	27.04		6	19.93			May 13	
12	14.91		8	26.86		12	21.92		8	36.03	23,700
	Apr. 20		N	26.69			May 5		4	35.82	23,500
6	15.11		4	26.46		6	23.62		12	35.50	23,100
N	15.40		8	26.17		N	25.35			May 14	
6	15.97		12	25.84		6	26.42		8	35.08	22,500
12	16.30			Apr. 28		12	27.25		4	34.63	21,900
	Apr. 21		6	25.25			May 6		12	34.11	21,200
6	16.48		N	24.62		8	28.83	15,200		May 15	
N	16.57		6	25.08		4	30.05	16,500	8	33.56	20,600
6	17.17		12	23.56		12	30.64	17,100	4	32.97	19,900
12	17.71			Apr. 29			May 7		12	32.37	19,200
	Apr. 22		6	23.01		8	31.13	17,700		May 16	
6	18.13		N	22.43		4	31.55	18,200	8	31.74	18,400
N	18.44		6	21.97		12	32.01	18,700	4	31.07	17,600
6	19.10		12	21.80			May 8		12	30.35	16,800
12	19.64			Apr. 30		8	32.61	19,400		May 17	
	Apr. 23		6	21.54		4	33.22	20,200	8	29.54	15,900
6	20.17		N	21.33		12	33.94	21,000	4	28.58	15,000
N	20.61		6	21.08					12	27.53	14,000
6	21.27		12	20.95							
12	22.16										

Sturgeon River near Chisholm, Minn.

Location.—Lat. 47°40'30", long. 92°54'00", in NW¼ sec. 20, T. 60 N., R. 20 W., 1,000 feet upstream from highway bridge, half a mile downstream from Little Sturgeon River, and 11½ miles north of Chisholm.

Drainage area.—187 square miles.

Gage-height record.—Water-stage recorder graph.

Discharge record.—Stage-discharge relation defined by current-meter measurements below 1,560 second-feet and extended to peak stage on basis of slope-area measurement. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1 to May 5.

Maxima.—April-June 1950: Discharge, 3,630 second-feet 11 p.m. May 7 (gage height, 6.41 feet).
1942 to March 1950: Discharge observed, 2,120 second-feet Apr. 21, 1948 (gage height, 5.30 feet).

Remarks.—Flow partly regulated by natural storage in lakes above station. No diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	18	550	375	11	19	2,840	375	21	360	951	158
2	18	500	353	12	19	2,950	353	22	650	948	149
3	19	420	328	13	19	2,660	328	23	950	913	149
4	19	500	305	14	19	2,200	305	24	1,300	875	140
5	19	900	281	15	20	1,840	281	25	1,100	790	153
6	20	2,300	262	16	24	1,550	262	26	850	709	198
7	20	3,360	247	17	48	1,360	247	27	750	627	218
8	19	3,530	235	18	100	1,210	235	28	700	545	212
9	19	3,460	223	19	140	1,090	223	29	650	476	198
10	19	3,090	209	20	180	988	209	30	600	433	201
								31	- -	401	-
Monthly mean discharge, in second-feet									290	1,451	215
Runoff, in acre-feet									17,230	89,190	12,820
Runoff, in inches									1.73	8.94	1.29

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 16			Apr. 22 (cont'd.)			Apr. 27 (cont'd.)			May 5 (cont'd.)	
4	0.64		4	3.21		8	3.42		10	4.53	1,470
8	.65		8	3.44		N	3.42		12	4.67	1,590
N	.68		12	3.56		4	3.40			May 6	
4	.73			Apr. 23		8	3.38		2	4.81	1,700
8	.81		2	3.62		12	3.34		4	4.92	1,790
12	.85		4	3.64			Apr. 28		6	5.05	1,900
	Apr. 17		6	3.63		4	3.27		8	5.16	1,990
4	.88		8	3.70		8	3.21		10	5.28	2,100
8	.89		10	3.15		N	3.26		N	5.41	2,220
N	1.06		N	3.73		4	3.25		2	5.59	2,390
4	1.30		2	3.75		8	3.23		4	5.73	2,550
8	1.35		4	3.84		12	3.19		6	5.86	2,710
12	1.38		6	3.94			Apr. 29		8	5.98	2,870
	Apr. 18		8	4.06		4	3.13		10	6.06	2,990
4	1.47		10	4.11		8	3.11		12	6.13	3,100
8	1.56		12	4.09		N	3.13			May 7	
N	1.67			Apr. 24		4	3.21		2	6.17	3,170
4	1.72		2	4.11		8	3.18		4	6.20	3,220
8	1.76		4	4.13		10	3.17		6	6.20	3,220
12	1.78		6	4.15		12	3.16		8	6.21	3,240
	Apr. 19		8	4.16			Apr. 30		10	6.25	3,320
4	1.78		10	4.34		4	3.12		N	6.26	3,330
8	1.77		N	4.63		8	3.08		2	6.30	3,410
N	1.76		2	4.38		N	3.04		4	6.31	3,430
4	1.83		4	4.49		4	3.02		6	6.35	3,510
8	1.82		6	4.52		8	3.02		8	6.38	3,570
12	1.80		8	4.51		12	2.99		10	6.39	3,590
	Apr. 20		10	4.42			May 4		12	6.39	3,590
4	1.80		12	4.39		4	2.73			May 8	
8	1.80			Apr. 25		8	2.72		2	6.39	3,590
N	1.99		4	4.24		N	2.73		4	6.37	3,550
4	2.12		8	4.11		4	2.80		6	6.36	3,530
8	2.15		N	4.00		8	2.87		8	6.36	3,530
12	2.20		4	3.90		12	2.93		10	6.37	3,550
	Apr. 21		8	3.82			May 5		N	6.39	3,590
4	2.27		12	3.73		2	3.04		2	6.39	3,590
8	2.30			Apr. 26		4	3.13		4	6.38	3,570
N	2.59		4	3.64		6	3.18		6	6.36	3,530
4	2.79		8	3.55		8	3.25		8	6.33	3,470
8	2.88		N	3.52		10	3.43		10	6.31	3,430
12	3.02		4	3.54		N	3.52	850	12	6.29	3,390
	Apr. 22		8	3.55		2	3.68	930		May 9	
4	3.07		12	3.53		4	3.91	1,060	2	6.28	3,370
8	3.10			Apr. 27		6	4.16	1,210	4	6.28	3,370
N	3.12		4	3.48		8	4.36	1,350	6	6.29	3,390

Sturgeon River nr. Chisholm, Minn. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 9 (cont'd.)			May 12 (cont'd.)			May 18			May 25	
8	6.32	3,450	8	6.07	3,000	8	4.19	1,230	8	3.42	800
10	6.34	3,490	N	6.04	2,960	4	4.12	1,180	4	3.37	776
N	6.37	3,550	4	6.01	2,920	12	4.05	1,140	12	3.31	750
2	6.37	3,550	8	6.00	2,900		May 19			May 26	
4	6.36	3,530	12	5.97	2,860	8	3.99	1,100	8	3.25	722
6	6.36	3,530		May 13		4	3.93	1,070	4	3.19	696
8	6.34	3,490	8	5.90	2,760	12	3.89	1,048	12	3.13	668
10	6.31	3,430	4	5.76	2,580		May 20			May 27	
12	6.29	3,390	12	5.62	2,420	8	3.82	1,000	8	3.07	642
	May 10			May 14		4	3.77	975	4	3.01	614
4	6.24	3,300	8	5.46	2,260	12	3.70	940	12	2.94	583
8	6.16	3,150	4	5.31	2,130		May 21			May 28	
N	6.08	3,020	12	5.18	2,010	8	3.69	935	8	2.88	556
4	6.04	2,960		May 15		4	3.75	965	4	2.83	534
8	6.02	2,930	8	5.06	1,900	12	3.75	965	12	2.77	507
12	6.01	2,920	4	4.91	1,780		May 22			May 29	
	May 11		12	4.79	1,680	8	3.73	955	8	2.72	486
4	5.99	2,890		May 16		4	3.71	945	4	2.67	465
8	5.95	2,830	8	4.68	1,590	12	3.67	925	12	2.63	448
N	5.93	2,800	4	4.56	1,500		May 23			May 30	
4	5.92	2,790	12	4.48	1,440	8	3.66	920	8	2.61	440
8	5.93	2,800		May 17		4	3.64	910	4	2.58	428
12	6.03	2,940	8	4.40	1,380	12	3.61	895	12	2.54	413
	May 12		4	4.34	1,340		May 24			May 31	
4	6.07	3,000	12	4.27	1,290	8	3.60	890	8	2.51	401
						4	3.56	870	4	2.51	401
						12	3.49	835	12	2.48	390

Dark River near Chisholm, Minn.

Location. – Lat. 47°41'30", long. 92°49'20", in SW¼ sec. 12, T. 60 N., R. 20 W., at highway bridge 12½ miles northeast of Chisholm.

Drainage area. – 54 square miles.

Gage-height record. – Water-stage recorder graph May 7 to June 30. No gage-height record Apr. 1-11, except staff-gage reading Apr. 4. Staff gage read once daily Apr. 12-20 and twice daily Apr. 21 to May 6; graph based on gage readings used Apr. 13 to May 6.

Discharge record. – Stage-discharge relation defined by current-meter measurements below 419 second-feet and extended to peak stage on basis of contracted opening measurement. Gage heights used to hundredths. Discharge for period of no gage-height record computed on basis of one discharge measurement and records for Sturgeon River near Chisholm. Stage-discharge relation affected by ice Apr. 4, 13, 14.

Maxima. – April-June 1950: Discharge, 993 second-feet 8 p.m. May 7 (gage height, 7.10 feet)
1942 to March 1950: Discharge, 709 second-feet Apr. 21, 1948 (gage height, 6.00 feet).

Remarks. – Flow is partly regulated by storage in lakes above station. No diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	9.5	162	103	11	12	715	46	21	86	270	42
2	10	152	96	12	13	720	45	22	96	271	40
3	10	145	87	13	22	712	48	23	162	268	41
4	11	153	80	14	28	616	45	24	278	260	38
5	12	245	74	15	32	518	41	25	304	226	48
6	12	565	68	16	35	436	51	26	294	195	68
7	12	956	62	17	39	382	47	27	206	170	65
8	12	936	59	18	43	333	44	28	182	151	67
9	12	874	54	19	44	294	43	29	170	134	69
10	12	772	49	20	67	263	43	30	166	122	67
								31	-	112	-
Monthly mean discharge, in second-feet									79.7	391	57.7
Runoff, in acre-feet									4,742	24,055	3,433
Runoff, in inches									1.65	8.35	1.19

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 20			Apr. 29			May 6 (cont'd.)			May 10 (cont'd.)	
6	1.74	53	6	2.92	176	4	5.64	635	12	6.17	750
N	1.87	64	N	2.88	171	6	5.82	673		May 11	
6	2.12	88	6	2.83	165	8	6.09	732	4	6.10	734
12	2.08	84	12	2.81	162	10	6.35	793	8	6.03	719
	Apr. 21			Apr. 30		12	6.57	848	N	5.97	705
6	2.03	79	6	2.84	166		May 7		4	5.95	701
N	2.07	83	N	2.86	168	2	6.72	888	8	5.95	701
6	2.16	92	6	2.85	167	4	6.80	910	12	6.00	712
12	2.08	84	12	2.84	166	6	6.88	932		May 12	
	Apr. 22			May 1		8	6.95	951	8	6.04	721
6	2.05	81	6	2.84	166	10	7.01	968	4	6.04	721
N	2.12	88	N	2.83	165	N	7.05	979	12	6.04	721
6	2.34	110	6	2.77	158	2	7.07	985		May 13	
12	2.48	126	12	2.73	153	4	7.09	990	4	6.05	723
	Apr. 23			May 2		6	7.09	990	8	6.05	723
6	2.60	139	6	2.72	152	8	7.10	993	N	6.03	719
N	2.75	156	N	2.71	151	10	7.08	987	4	5.98	708
6	2.97	182	6	2.72	152	12	6.97	957	8	5.93	697
12	3.21	216	12	2.71	151		May 8		12	5.87	684
	Apr. 24			May 3		2	6.90	937		May 14	
6	3.50	260	6	2.68	148	4	6.86	926	4	5.79	667
N	3.72	293	N	2.64	143	6	6.85	924	8	5.60	627
6	3.77	300	6	2.64	143	8	6.85	924	N	5.51	609
12	3.77	300	12	2.60	139	10	6.91	940	4	5.43	593
	Apr. 25			May 4		N	6.99	962	8	5.36	579
6	3.77	300	6	2.59	138	2	6.98	959	12	5.27	561
N	3.79	304	N	2.70	150	4	6.94	948		May 15	
6	3.82	308	6	2.85	167	6	6.90	937	8	5.11	529
12	3.84	311	12	2.92	176	8	6.86	926	4	4.99	505
	Apr. 26			May 5		10	6.82	915	12	4.86	479
6	3.86	314	4	2.90	173	12	6.78	905		May 16	
N	3.81	306	8	2.98	183		May 9		8	4.69	446
6	3.62	278	N	3.36	239	4	6.71	886	4	4.54	420
12	3.42	248	4	3.67	286	8	6.69	880	12	4.43	402
	Apr. 27		8	3.91	322	N	6.70	883		May 17	
6	3.24	221	12	4.16	359	4	6.66	872	8	4.37	392
N	3.07	196		May 6		8	6.59	853	4	4.26	375
6	3.04	192	2	4.29	379	12	6.50	830	12	4.15	358
12	3.00	186	4	4.43	402		May 10			May 18	
	Apr. 28		6	4.58	427	4	6.40	805	8	4.03	340
6	2.98	183	8	4.82	471	8	6.28	776	4	3.93	324
N	2.96	181	10	5.06	519	N	6.21	759	12	3.84	311
6	2.95	180	N	5.24	555	4	6.17	750		May 19	
12	2.94	178	2	5.44	595	8	6.17	750	8	3.76	299

Dark River near Chisholm, Minn. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	May 19 (cont'd.)			May 22			May 24 (cont'd.)			May 28	
4	3.68	287	6	3.58	272	N	3.51	262	8	2.73	153
12	3.63	280	N	3.57	270	4	3.48	257	4	2.69	149
	May 20		6	3.56	269	8	3.44	251	12	2.62	141
8	3.55	268	12	3.56	269	12	3.39	244		May 29	
4	3.49	258		May 23			May 25		8	2.58	137
12	3.42	248	4	3.57	270	8	3.32	233	4	2.52	130
	May 21		8	3.57	270	4	3.23	220	12	2.48	126
4	3.39	244	N	3.57	270	12	3.16	209		May 30	
8	3.49	258	4	3.56	269		May 26		8	2.47	125
N	3.63	280	8	3.53	264	8	3.09	199	4	2.44	121
4	3.69	288	12	3.54	266	4	3.03	190	12	2.40	117
8	3.68	287		May 24		12	2.96	181		May 31	
12	3.63	280	4	3.56	269		May 27		8	2.36	113
			8	3.54	266	8	2.90	173	4	2.34	110
						4	2.85	167	12	2.31	107
						12	2.79	160			

Big Fork River at Big Falls, Minn.

Location. —Lat. 48°12', long. 93°48', in sec. 35, T. 155 N., R. 25 W., at village of Big Falls, 700 feet downstream from falls and 0.3 mile downstream from bridge on U. S. Highway 71.
Drainage area. —1,460 square miles.
Gage-height record. —Water-stage recorder graph.
Discharge record. —Stage-discharge relation defined by current-meter measurements below 13,260 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-24.
Maxima. —April-August 1950: Discharge, 14,800 second-feet 11:30 p.m. May 8 (gage height, 17.08 feet).
1909-12, 1928 to March 1950: Discharge observed, 13,000 second-feet Apr. 26, 1937 (gage height, 15.12 feet, from high-water mark).
Remarks. —Flow partly regulated by power plant a quarter of a mile upstream. No diversions above station.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Aug.	Day	April	May	June	July	Aug.
1	180	2,790	3,100	2,560	2,030	16	280	8,850	1,620	1,160	400
2	180	2,720	2,960	2,280	2,290	17	380	7,840	1,540	1,280	375
3	180	2,710	2,790	2,180	2,020	18	650	7,090	1,430	1,280	360
4	190	2,820	2,630	2,540	1,720	19	1,500	6,550	1,340	1,200	342
5	200	5,590	2,480	2,510	1,400	20	2,400	6,190	1,300	1,060	328
6	220	9,720	2,340	2,260	1,140	21	3,400	5,810	1,260	968	315
7	220	12,900	2,190	2,000	936	22	4,200	5,500	1,190	878	315
8	220	14,600	2,080	1,780	793	23	5,000	5,240	1,290	812	306
9	220	14,800	1,950	1,560	702	24	5,500	5,070	1,370	780	370
10	220	14,400	1,840	1,440	624	25	5,940	5,050	1,630	734	676
11	220	14,000	1,760	1,300	555	26	5,480	4,910	2,480	702	897
12	220	13,500	1,710	1,260	501	27	4,370	4,680	2,560	670	838
13	220	12,600	1,620	1,220	465	28	3,440	4,270	2,700	650	748
14	220	11,400	1,560	1,140	438	29	3,030	3,860	2,820	604	715
15	240	10,100	1,540	1,120	421	30	2,900	3,530	2,810	585	734
						31	-	3,290	-	975	696
Monthly mean discharge, in second-feet							1,721	7,496	1,996	1,338	789
Runoff, in thousand acre-feet							102.4	460.9	118.8	82.3	48.5
Runoff, in inches							1.31	5.92	1.53	1.06	0.62

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 25			May 5 (cont'd.)			May 12	
6	4.64		4	9.43	5,880	2	10.08	6,630	6	16.16	13,700
N	4.81		8	9.49	5,950	4	9.88	6,400	N	16.00	13,500
6	4.98		N	9.53	5,990	6	10.02	6,560	6	15.87	13,400
12	5.30		4	9.53	5,990	8	10.80	7,460	12	15.68	13,100
	Apr. 18		8	9.53	5,990	10	11.17	7,880		May 13	
6	5.54		12	9.53	5,990	12	11.49	8,250	6	15.49	12,900
N	5.80			Apr. 26			May 6		N	15.25	12,600
6	6.21		4	9.48	5,940	6	12.03	8,870	6	14.95	12,300
12	6.63		8	9.38	5,820	N	12.79	9,740	12	14.75	12,000
	Apr. 19		N	9.13	5,530	6	13.46	10,500		May 14	
6	7.01		4	8.75	5,100	12	14.17	11,300	8	14.42	11,600
N	7.37		8	8.65	4,980		May 7		4	14.08	11,200
6	7.70		12	8.68	5,020	4	14.66	11,900	12	13.70	10,800
12	7.95			Apr. 27		8	15.09	12,400		May 15	
	Apr. 20		4	8.48	4,800	N	15.48	12,900	8	13.34	10,400
6	8.15		8	8.34	4,640	4	15.90	13,400	4	12.84	9,800
N	8.22		N	8.10	4,380	8	16.30	13,900	12	12.56	9,480
6	8.42		4	7.80	4,050	12	16.58	14,200		May 16	
12	8.89		8	7.76	4,010		May 8		8	12.19	9,050
	Apr. 21		12	7.61	3,840	4	16.78	14,500	4	11.81	8,620
6	9.07			Apr. 28		8	16.88	14,600	12	11.51	8,270
N	9.01		6	7.38	3,590	N	16.94	14,700		May 17	
6	9.16		N	7.20	3,390	4	16.99	14,700	8	11.24	7,960
12	9.37		6	7.11	3,290	8	17.06	14,800	4	11.02	7,710
	Apr. 22		12	6.97	3,150	12	17.08	14,800	12	10.80	7,460
6	9.59			Apr. 29			May 9			May 18	
N	9.58		6	6.83	3,010	4	17.02	14,800	8	10.55	7,170
6	9.48		N	6.84	3,020	8	17.02	14,800	4	10.38	6,970
12	9.71		6	6.86	3,040	N	17.02	14,800	12	10.21	6,780
	Apr. 23		12	6.80	2,980	4	17.01	14,700		May 19	
6	9.99			May 4		8	16.94	14,700	8	10.08	6,630
N	9.60		6	6.58	2,760	12	16.90	14,600	4	9.93	6,450
6	10.40		N	6.53	2,710		May 10		12	9.86	6,370
12	10.72		6	6.70	2,880	6	16.80	14,500		May 20	
	Apr. 24		12	6.96	3,140	N	16.70	14,400	8	9.77	6,270
4	10.91			May 5		6	16.62	14,300	4	9.63	6,110
8	11.12		2	7.00	3,180	12	16.53	14,200	12	9.54	6,010
N	11.31		4	7.15	3,340		May 11				
4	8.88		6	7.37	3,580	6	16.50	14,100			
8	9.01		8	7.55	3,780	N	16.42	14,000			
12	9.29		10	9.85	6,360	6	16.31	13,900			
			N	10.24	6,810	12	16.23	13,800			

Warroad River near Warroad, Minn.

Location. —Lat. 48°52'00", long. 95°2'20", in NE¼ sec. 12, T. 162 N., R. 37 W., half a mile upstream from Bulldog Run and 2½ miles south of Warroad.

Drainage area. —110 square miles.

Gage-height record. —Graph drawn on basis of twice daily chain gage readings for periods Apr. 20 to June 13, June 23-28, July 9, 11, 19, 31. Daily readings used Apr. 1-19 and average of twice daily readings used June 14-22, June 29 to July 31.

Discharge record. —Stage-discharge relation defined by current-meter measurements below 920 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-23. Shifting control method used Apr. 24 to May 6.

Maxima. —April-July 1950: Discharge observed, 1,170 second-feet 9 p.m. Apr. 24 (gage height, 8.86 feet).

1946 to March 1950: Discharge observed, 1,350 second-feet June 11, 1947 (gage height, 9.45 feet).

Remarks. —No diversions or regulation.

Mean discharge, in second-feet, 1950

Day	April	May	June	July	Day	April	May	June	July
1	1.4	851	96	620	16	1.8	338	22	137
2	1.6	721	103	490	17	2.0	284	29	143
3	1.8	656	83	446	18	2.4	257	25	145
4	1.9	636	64	395	19	8.5	255	21	106
5	1.8	658	54	388	20	70	275	16	74
6	1.8	853	48	324	21	120	416	18	60
7	1.8	986	40	261	22	340	395	16	52
8	1.8	917	35	206	23	460	341	69	41
9	1.9	960	29	131	24	1,080	306	118	37
10	2.0	935	25	99	25	885	250	232	33
11	2.0	964	22	111	26	961	197	194	28
12	1.8	756	19	149	27	685	180	833	27
13	1.6	581	16	143	28	580	146	1,060	22
14	1.2	528	15	134	29	671	108	884	18
15	1.6	402	19	132	30	779	86	726	14
					31	-	91	-	24
Monthly mean discharge, in second-feet						222	494	164	161
Runoff, in acre-feet						13,230	30,400	9,780	9,898
Runoff, in inches						2.26	5.18	1.67	1.69

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 20			Apr. 26			Apr. 30 (cont'd.)			May 9	
6	6.97		4	8.50	964	12	8.21	818	6	8.29	944
N	7.08		8	8.32	865		May 1		N	8.32	962
6	7.20		N	8.35	881	4	8.15	782	6	8.37	992
12	7.23		4	8.61	1,020	8	8.15	782	12	8.30	950
	Apr. 21		8	8.65	1,050	N	8.26	848		May 10	
4	7.23		12	8.43	926	4	8.41	938	6	8.23	908
8	7.22			Apr. 27		8	8.38	920	N	8.27	932
N	7.18		2	8.28	860	12	8.24	836	6	8.30	950
4	7.19		4	8.12	764		May 2		12	8.32	962
8	7.32		6	7.96	676	4	8.12	764		May 11	
12	7.49		8	7.81	600	8	8.00	698	6	8.31	956
	Apr. 22		10	7.77	580	N	7.97	682	N	8.31	956
4	7.67		N	7.78	585	4	7.99	693	6	8.34	974
8	7.96		2	7.83	610	8	8.03	715	12	8.33	968
N	8.35		4	7.91	650	12	8.02	710		May 12	
4	8.59		6	7.99	693		May 3		6	8.15	860
8	8.58		8	8.01	704	6	7.95	671	N	7.88	704
12	8.50		10	8.00	698	N	7.90	645	6	7.80	660
	Apr. 23		12	7.94	666	6	7.88	635	12	7.74	630
4	8.42			Apr. 28		12	7.87	630		May 13	
8	8.38		2	7.83	610		May 4		N	7.64	580
N	8.38		4	7.75	570	6	7.86	625	12	7.54	533
4	8.43		6	7.64	520	N	7.87	630		June 23	
8	8.46		8	7.58	494	6	7.90	645	4	3.29	26
12	8.51		10	7.53	473	12	7.92	655	8	4.17	64
	Apr. 24		N	7.53	473		May 5		N	4.55	87
4	8.56	997	2	7.59	498	6	7.90	645	4	4.59	89
8	8.63	1,040	4	7.75	570	N	7.89	640	8	4.60	90
N	8.73	1,110	6	7.95	671	6	7.93	660	12	4.68	95
4	8.81	1,140	8	8.03	715	12	8.04	720		June 24	
8	8.86	1,170	10	8.02	710		May 6		6	4.86	107
12	8.77	1,120	12	7.92	655	6	8.21	818	N	5.03	119
	Apr. 25			Apr. 29		N	8.34	896	6	5.13	126
2	8.51	970	4	7.72	556	12	8.34	896	12	5.36	143
4	8.26	832	8	7.61	507		May 7			June 25	
6	8.06	725	N	7.67	533	6	8.37	992	2	5.50	154
8	7.97	680	4	8.21	818	N	8.40	1,010	4	5.66	167
10	7.94	665	8	8.30	872	6	8.40	1,010	6	5.83	182
N	7.98	685	12	8.22	818	12	8.33	968	8	6.05	203
2	8.18	788		Apr. 30			May 8		10	6.28	227
4	8.51	970	4	8.10	754	6	8.22	902	N	6.56	260
6	8.68	1,070	8	8.02	710	N	8.21	896	2	6.80	295
8	8.70	1,080	N	8.05	726	6	8.25	920	4	6.86	306
10	8.69	1,070	4	8.23	830	12	8.27	932	6	6.79	293
12	8.65	1,050	8	8.26	848				8	6.62	268

Warroad River near Warroad, Minn. - Cont'd.

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	June 25 (cont'd.)			June 26 (cont'd.)			June 27			June 28	
10	6.46	247	N	5.89	187	4	6.89	312	4	8.61	1,140
12	6.30	229	4	5.84	183	8	8.03	788	8	8.52	1,080
	June 26		8	5.83	182	N	8.33	968	N	8.47	1,050
4	6.07	205	12	5.95	193	4	8.53	1,090	4	8.41	1,020
8	5.95	193				8	8.65	1,160	8	8.39	1,000
						12	8.67	1,170	12	8.35	980

Bulldog Run near Warroad, Minn.

Location. - Lat. 48°51'30", long. 95°20'20", in SE¼ sec. 7, T. 162 N., R. 36 W., three-quarters of a mile upstream from mouth and 3 miles south of Warroad.

Drainage area. - 14.2 square miles.

Gage-height record. - Graph drawn on basis of twice-daily staff-gage readings Apr. 17-28, May 19-23, June 23, 24, 28, 29, and average daily gage heights for all other periods except period of no flow.

Discharge record. - Stage-discharge relation defined by current-meter measurements below 264 second-feet and extended to peak stage. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-22 and by aquatic vegetation May 16 to June 30.

Maxima. - April-June 1950: Discharge, 292 second-feet 8 p.m. Apr. 23 (gage height, 6.69 feet).
1946 to March 1950: Discharge, 420 second-feet June 10, 1947, (gage height, 6.91 feet).

Remarks. - No regulation or diversion.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	0	74	0.8	11	0	44	0.2	21	12	16	0.1
2	0	61	.5	12	0	26	.2	22	55	12	.1
3	0	76	.4	13	0	21	.2	23	280	3.9	.2
4	0	76	.4	14	0	17	.2	24	192	3.0	4.7
5	0	124	.3	15	0	13	.4	25	30	2.6	5.9
6	0	175	.3	16	0	7.2	.7	26	31	2.2	6.8
7	0	153	.3	17	0	5.4	.4	27	33	1.6	7.7
8	0	134	.2	18	0	4.5	.2	28	56	1.3	10
9	0	147	.2	19	0	5.4	.1	29	79	1.1	18
10	0	93	.2	20	1.6	12	.1	30	76	0.9	15
								31	-	0.9	-
Mean monthly discharge, in second-feet									28.2	42.4	2.49
Runoff, in acre-feet									1,676	2,602	148
Runoff, in inches									2.21	3.44	0.20

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 17			Apr. 22			Apr. 27			May 22	
6	4.79		8	6.40		4	5.30	38	8	4.28	13
N	4.87		4	6.40		8	5.28	37	4	4.22	12
6	4.98		12	6.46		N	5.19	34	12	3.81	7.9
12	5.02			Apr. 23		4	5.03	29		May 23	
	Apr. 18		4	6.60	270	8	4.94	27	6	3.40	3.5
6	5.03		8	6.67	288	12	4.98	28	N	3.38	3.3
N	5.15		N	6.66	285		Apr. 28		6	3.38	3.3
6	5.26		4	6.51	248	6	5.13	32	12	3.37	3.3
12	5.40		8	6.69	292	N	5.44	46		June 23	
	Apr. 19		12	6.62	275	6	5.77	88	8	2.76	0.2
6	5.44			Apr. 24		12	5.76	86	4	2.77	.2
N	5.58		8	6.36	212		May 19		12	3.06	.8
6	5.76		4	6.16	166	6	3.46	4.8		June 24	
12	5.80		12	5.33	40	N	3.50	5.1	6	3.57	4.8
	Apr. 20			Apr. 25		6	3.54	5.6	N	3.62	5.3
8	5.67		8	5.04	29	12	3.71	7.4	6	3.64	5.4
4	5.47		4	5.04	29		May 20		12	3.65	5.5
12	5.33		12	5.05	30	6	4.02	10		June 28	
	Apr. 21			Apr. 26		N	4.27	13	8	4.16	9.8
4	5.30		8	5.04	29	6	4.42	15	4	4.26	11
8	5.30		4	5.13	32	12	4.45	16	12	4.62	14
N	5.33		12	5.26	36		May 21			June 29	
4	5.52					8	4.46	16	8	5.07	19
8	6.40					4	4.47	16	4	5.02	18
12	6.40					12	4.45	16	12	4.96	18

East Branch Warroad River near Warroad, Minn.

Location.—Lat. 48°51'30", long. 95°18'40", in SE¼SE¼ sec. 8, T. 162 N., R. 36 W., at highway bridge 2 miles upstream from mouth and 3 miles south of Warroad.
Drainage area.—102 aquare miles.
Gage-height record.—Staff-gage readings once or twice daily except Apr. 15 to May 5, June 4, 5, 23-28, which are from graphs based on gage readings.
Discharge record.—Stage-discharge relation defined by current-meter measurements. Gage heights used to hundredths. Stage-discharge relation affected by ice Apr. 1-28.
Maxima.—April-June 1950: Discharge, 554 second-feet 8 a.m. June 27 (gage height, 8.29 feet).
1946 to March 1950: Discharge, 1,340 second-feet June 11, 1947 (gage height, 9.36 feet, from floodmark).
Remarks.—No regulation or diversions.

Mean discharge, in second-feet, 1950

Day	April	May	June	Day	April	May	June	Day	April	May	June
1	1.2	359	41	11	2.6	450	10	21	80	160	5.3
2	1.2	333	37	12	2.0	417	8.5	22	110	140	6.1
3	1.3	302	31	13	1.9	363	5.2	23	120	124	8.7
4	1.3	300	29	14	3.0	306	3.2	24	140	108	29
5	1.4	333	26	15	4.0	284	5.7	25	190	103	73
6	1.8	354	24	16	9.5	232	14	26	220	83	108
7	2.0	333	32	17	12	193	13	27	220	60	464
8	2.2	341	27	18	16	166	9.4	28	260	50	426
9	2.4	450	16	19	20	151	7.1	29	338	45	398
10	2.6	485	12	20	24	176	6.1	30	366	42	344
								31	-	44	-
Monthly mean discharge, in second-feet									71.9	235	74
Runoff, in acre-feet									4,280	14,450	4,420
Runoff, in inches									0.79	2.66	0.81

Gage height, in feet, and discharge, in second-feet, at indicated time, 1950

Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge	Hour	Gage height	Discharge
	Apr. 15			Apr. 22			Apr. 28			June 23	
8	3.01		4	7.19		6	7.62		6	1.70	6.8
4	3.06		8	7.19		N	7.65		N	1.74	7.5
12	3.12		N	7.44		6	7.70		6	1.86	9.5
	Apr. 16		4	7.83		12	7.73		12	2.16	15.
8	3.23		8	7.85			Apr. 29			June 24	
4	3.37		12	7.73		6	7.74	322	4	2.59	23
12	3.49			Apr. 23		N	7.80	338	8	2.79	27
	Apr. 17		4	7.57		6	7.84	350	N	2.96	30
8	3.59		8	7.51		12	7.87	360	4	3.03	32
4	3.68		N	7.68			Apr. 30		8	3.17	35
12	3.78		4	7.84		6	7.86	357	12	3.48	42
	Apr. 18		8	7.81		N	7.88	363		June 25	
8	3.89		12	7.61		6	7.92	376	4	4.02	58
4	4.01			Apr. 24		12	7.92	376	8	4.39	68
12	4.14		4	7.50			May 1		N	4.66	76
	Apr. 19		8	7.52		6	7.88	363	4	4.84	82
8	4.29		N	7.70		N	7.86	357	8	4.98	87
4	4.47		4	7.94		6	7.84	350	12	5.05	90
12	4.66		8	8.10		12	7.85	354		June 26	
	Apr. 20		12	8.18			May 2		4	5.08	91
6	4.83			Apr. 25		6	7.86	357	8	5.14	94
N	5.04		4	8.17		N	7.81	341	N	5.26	98
6	5.30		8	8.13		6	7.70	310	4	5.43	105
12	5.82		N	8.02		12	7.63	295	8	5.82	121
	Apr. 21		4	7.93			May 3		12	6.93	187
2	6.16		8	7.87		6	7.62	293		June 27	
4	6.97		12	7.87		N	7.67	304	4	8.12	456
6	7.46			Apr. 26		6	7.70	311	8	8.29	554
8	7.50		6	7.96		12	7.69	309	N	8.23	514
10	7.46		N	7.97			May 4		4	8.17	480
N	7.43		6	7.95		6	7.67	304	8	8.13	460
2	7.45		12	7.92		N	7.64	297	12	8.10	445
4	7.43			Apr. 27		6	7.64	297		June 28	
6	7.37		6	7.87		12	7.64	297	8	8.05	425
8	7.32		N	7.80			May 5		4	8.04	421
10	7.28		6	7.70		6	7.66	302	12	8.03	417
12	7.23		12	7.63		N	7.78	333			
						6	7.89	366			
						12	7.89	366			

SUMMARY OF FLOOD STAGES AND DISCHARGES

The results of the determinations of maximum flood flows at regular stream-gaging stations and at miscellaneous points in the area reported on are summarized in table 5, "Summary of flood stages and discharges". Standard time is the basis throughout. The reference number shown in table 5 is applicable to plate 12 and will aid in identifying the place where the discharge was determined. Figure 38 shows the size of the 1950 floods compared to those of 1948 at the same selected points in the Red River of the North Basin. The 1948 floods were the largest experienced up to that time on many streams tributary to the Red River of the North.

The discharges for the points listed in table 5 were determined as described under "Stages and discharges at stream-gaging stations". For peak discharges not determined by gaging-station operations, a brief reference is generally made to the method of determination.

Figure 39 shows the flood discharges listed in table 5, in second-feet per square mile plotted against the corresponding drainage area. The discharges listed in table 5 and plotted on figure 39 are as actually measured and may be affected by storage or regulation as mentioned in the station description in the preceding section, "Stages and discharges at stream-gaging stations".

The basic data and computations for the determinations of discharge in the United States are filed in the district offices of the Geological Survey in Bismarck, N. Dak., and St. Paul, Minn.; in Canada the data are filed in the office of the district engineer, Water Resources Division, Department of Resources and Development, Winnipeg, Manitoba. The basic data may be examined in these offices.

FLOOD-CREST STAGES

Records of flood-crest stages collected by the Corps of Engineers for the main stem and tributaries of the Red River of the North are presented in table 6. The stage records presented therein are particularly valuable to those responsible for location of future projects above flood stage. The location of the crest stage is given both by distance above river mouth and, where possible, by distance from local features.

Records of flood-crest stages occurring during the spring of 1950, collected by the major railroads operating in the basin, have been combined in a later section and tabulated in a pictorial manner with records from previous floods.

PREVIOUS FLOODS

Records of previous floods in the area covered by this report are intimately connected with the history of the region. Although white men

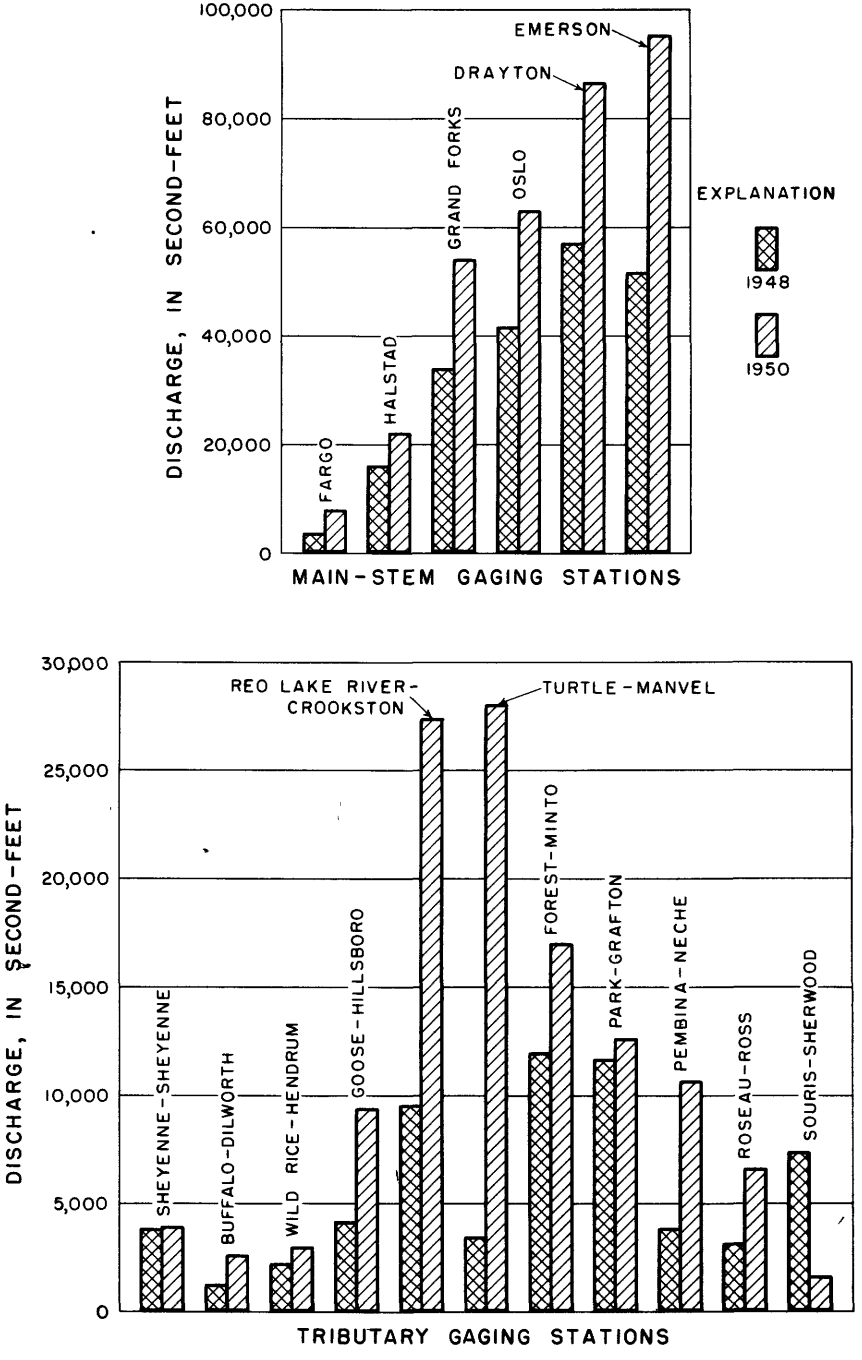

Figure 38.— Comparison of 1948 and 1950 flood-crest discharges in the Red River of the North Basin.

Table 5. --Summary of flood stages and discharges

(Maximum discharges for the floods of March to September 1950 were obtained from gaging-station records, except as otherwise indicated by the following symbols: A, slope-area measurement; B, contracted-opening measurement; C, computed flow over dam; D, computed flow through culvert.)

No. on fig.	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during present flood			
				Date	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile	Time	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile
	RED RIVER OF THE NORTH MAIN STEM										
1	Ottertail River near Detroit Lakes, Minn.	270	1937-	June 26, 1943	-	a 368	1.36	May 29, 30	4.71	332	1.23
2	Ottertail River below Pelican River near Fergus Falls, Minn.	1,810	b 1930-33, 1933-	June 4, 1944	c 4.81	1,200	.66	6 p.m. May 23	d 4.31	1,100	.61
3	Red River of the North at Wahpeton, N. Dak.	4,010	1942-	Apr. 2-6, 1943	e 15.6	a 5,000	1.25	4 p.m. Apr. 2	11.62	4,190	1.04
4	Red River of the North at Fargo, N. Dak.	6,800	1901-	Apr. 7, 1943	f 34.2	17,000	2.50	4 a.m. Apr. 7	g 21.21	7,800	1.15
5	Red River of the North at Halstad, Minn.	h 17,860	1936-37, 1942-	Apr. 16, 1947	i 34.00	24,500	1.37	Apr. 12, 13	j 32.00	22,000	1.23
6	Red River of the North at Grand Forks, N. Dak.	h 26,100	1882-	Apr. 10, 1897	50.2	80,000	3.07	7 a.m. May 12	45.61	54,000	2.07
7	Red River of the North at Oslo, Minn.	h 27,300	1936-37, 1941-	Apr. 17, 1948	k 31.17	a 41,400	1.52	8:15 p.m. May 10	31.83	63,000	2.31
8	Red River of the North at Drayton, N. Dak.	h 30,900	1936-37, 1941-	Apr. 21, 1948	m 41	a 57,000	1.84	3 p.m. May 12	41.58	86,500	2.80
9	Red River of the North at Emerson, Manitoba	n 40,200	1912-	Apr. 27, 1948	787.62	51,800	n1.43	5 p.m. May 13	790.89	95,500	n2.63
14	Red River of the North at Winnipeg, Manitoba	n 111,000	1912-	Apr. 22, 1916	751.33	p 79,900	n0.75	May 18-19	755.86	103,600	n .97
	PELICAN RIVER BASIN										
16	Pelican River near Detroit Lakes, Minn.	123	1942-	July 18, 1946	q 4.04	139	1.13	r 3 p.m. May 19	s 5.10	210	1.71
17	Pelican River near Fergus Falls, Minn.	482	1909-12, 1942-	Mar. 29, 1943	5.53	q 756	1.57	5:30 p.m. May 6	q t 5.60	296	.61
	BOIS DE SIOUX RIVER BASIN										
18	Lake Traverse near White Rock, S. Dak.	-	1940-	Apr. 21, 1943	-	u 212,000	-	May 30	-	u 200,576	-
19	Bois de Sioux River near White Rock, S. Dak.	1,160	1941-	May 24, 1943	v 9.28	q 1,120	.97	6:30 p.m. July 8	9.16	1,060	.91
	MUSTINKA RIVER BASIN										
20	Mustinka River above Wheaton, Minn.	834	w 1916, 1917, 1919-24, 1931-	Apr. 13, 1947	q 14.68	x 2,710	3.25	7:30 a.m. May 11	y 13.82	1,690	2.03
21	West Branch Mustinka River below Mustinka ditch, near Charlesville, Minn.	-	1943-	Apr. 12, 1947	s z 13.57	a 1,500	-	7:25 a.m. Mar. 28	aa 10.51	1,140	-

22	Mustinka ditch above West Branch Mustinka River, near Charlesville, Minn.	-	1943-	July 10, 1949	ab 12.13	422	-	6 a.m.-4 p.m. May 9	aa ac 11.10	440	-
23	Mustinka ditch below West Branch Mustinka River, near Charlesville, Minn.	-	1943-	Apr. 12, 1947	s ad 13.57	580	-	12 M-4 p.m. May 9	aa ae 10.51	374	-
	RABBIT CREEK BASIN										
24	Rabbit Creek at Campbell, Minn	266	1942-	June 4, 1944	s aa af 15.07	q 1,860	6.99	8 a.m. May 9	ag 11.40	1,430	5.38
	WILD RICE RIVER BASIN										
25	Wild Rice River near Mantador, N. Dak.	1,340	1944-	Mar. 20, 1945	9.57	938	.70	2 p.m. Apr. 14	q aa ah 8.75	485	.36
26	Wild Rice River near Abercrombie, N. Dak.	2,170	1932-	Apr. 2, 1943	s 21.02	5,500	2.53	12 p.m. Apr. 3	s 16.28	2,300	1.06
	SHEYENNE RIVER BASIN										
27	Sheyenne River near Harvey, N. Dak.	585	1945-	Apr. 18, 1948	6.45	1,220	2.09	9 a.m. Apr. 18	aa ai 6.95	1,430	2.44
28	Sheyenne River at Sheyenne, N. Dak.	aj 1,830	1929-33, 1939-	Apr. 18, 19, 1948	8.51	3,840	2.10	3:30 a.m. Apr. 18	8.31	3,940	2.15
29	Sheyenne River near Warwick, N. Dak.	2,100	1949-	-	-	-	-	9 p.m. Apr. 17	7.45	3,800	1.81
30	Sheyenne River near Cooperstown, N. Dak.	h 2,840	1945-	Apr. 23, 1948	s 18.10	5,600	1.97	r 4 a.m. Apr. 17	s 18.69	7,830	2.76
31	Lake Ashtabula Reservoir	h 3,960	1950-	-	-	-	-	8 p.m. May 14	1,269.46	u 91,600	-
32	Sheyenne River below Baldhill Dam, N. Dak.	h 3,960	1949-	-	-	(ak)	-	May 23	32.62	3,150	.80
33	Sheyenne River at Valley City, N. Dak.	h aj 4,260	1919, 1938-	Apr. 28, 1948	17.51	4,580	1.08	9 p.m. May 5	14.60	3,050	.72
34	Sheyenne River near Kindred, N. Dak.	h 5,230	1949-	Aug. 2, 1949	aa am 22.1	392	.07	May 13, 14	20.50	3,210	.61
35	Sheyenne River at West Fargo, N. Dak.	h aj 5,330	1902-7, 1919, 1929-	Apr. 18, 1947	20.53	2,800	.53	5 p.m. May 22	am 20.61	2,810	.53
36	Devils Lake near Devils Lake, N. Dak.	ap 3,940	1867-	1867	1,438.40	-	-	Sept. 24	1,414.95	-	-
37	Maple River at Mapleton, N. Dak.	1,480	1944-	Apr. 14, 1947	aj 18.04	3,880	2.62	12 N-6 p.m. Apr. 2	aa 17.73	1,980	1.34
38	Rush River at Amenia, N. Dak.	107	1946	Apr. 14, 1947	aa aq 10.20	1,230	11.5	8:15 a.m. Apr. 7	q aa ar 10.96	620	5.79
	BUFFALO RIVER BASIN										
39	Buffalo River near Hawley, Minn.	322	1945-	Apr. 13,14 1947	as 9.44	q 878	2.73	8 p.m. Apr. 7	9.32	841	2.61
40	Buffalo River near Dilworth, Minn.	1,040	1931-	Apr. 2, 1943	s 22.60	4,530	4.36	Apr. 7	at 19.75	2,600	2.50

See footnotes at end of table, p. 289

Table 5.--Summary of flood stages and discharges--Continued

No. on fig.	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during Mar.-Sept. 1950			
				Date	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile	Time	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile
	BUFFALO RIVER BASIN--Continued										
41	South Branch Buffalo River at Sabin, Minn.	522	1945-	Mar. 18, 1945	14.69	1,480	2.82	8 p.m. Apr. 1	au 14.15	1,460	2.79
	WILD RICE RIVER BASIN										
42	Wild Rice River at Twin Valley, Minn.	888	1909-17, 1930-	July 22, 1909	av 20.0	9,200	10.4	10 a.m. June 26	12.02	4,380	4.93
43	Wild Rice River near Ada, Minn.	-	1948-	July 8, 1949	aw 10.30	q 662	-	12 p.m. June 26	10.31	1,720	-
44	Wild Rice River at Hendrum, Minn.	1,600	1944-	Apr. 15,16,1947	ax 27.70	a 4,200	2.62	May 10	aa ay 25.09	a 3,000	1.88
45	Flow through highway 31 culverts 2½ miles east of Ada, Minn.	-	-	-	-	-	-	May	-	90.5 B	-
46	Flow through highway 31 culverts 1½ miles east of Ada, Minn.	-	-	-	-	-	-	May	-	84 B	-
47	Flow on south side highway 31 1 mile east of Ada, Minn.	-	-	-	-	-	-	-	-	579 BC	-
	GOOSE RIVER BASIN										
48	Goose River near Portland, N. Dak.	544	1939-	Apr. 21, 1948	21.30	4,700	8.64	4 a.m. May 9	22.98	8,090	14.9
49	Goose River at Hillsboro, N. Dak.	1,200	1931-	Mar. 25, 26 1920	11.55	4,800	3.48	12 N Apr. 19	az 14.94	9,420	7.85
	MARSH RIVER BASIN										
50	Marsh River below Ada, Minn.	-	1949-	June 1, 1949	10.80	a 683	-	r 8 p.m. June 27	s 14.57	1,850	-
51	Marsh River near Shelly, Minn.	151	1944-	Apr. 14, 1947	s 17.80	4,150	27.5	r 12 p.m. May 11	s 18.96	4,660	30.9
	SAND HILL RIVER BASIN										
52	Sand Hill River at Fertile, Minn.	-	-	-	-	-	-	May	-	2,470 B	-
53	Sand Hill River at Beltrami, Minn.	ba 324	1943-	June 12, 1947	bb 5.40	q 167	.52	r 2 p.m. Apr. 19	s 5.97	291	.90
54	Sand Hill ditch at Beltrami, Minn.	-	1943-	Apr. 16, 1947	aa bc 10.69	q 1,220	-	11:50 a.m.-12 p.m. Apr. 20	s aa bd 11.59	q 2,460	-
55	Sand Hill River at Climax, Minn.	405	1943-	Apr. 19, 1947	13.24	q 1,790	4.42	r 5 a.m. Apr. 22	s 16.31	3,040	7.51

56	Kittleson Creek at County highway 18 near Melvin, Minn.	-	-	-	-	-	-	May	-	256 B	-
	RED LAKE RIVER BASIN										
57	Lower Red Lake near Red Lake, Minn.	1,950	be 1930-33, 1933-	June 10, 1947	8.25	-	-	11 a.m. June 25	9.53	-	-
58	Red Lake River near Red Lake, Minn.	1,950	1933-	June 10, 1947	bf 7.47	1,960	1.01	May 29	bg 8.93	a 2,210	1.13
59	Red Lake River at High Landing, near Goodridge, Minn.	2,300	1930-	Apr. 20, 1948	bh 9.20	3,390	1.47	12 p.m. May 10 to 7 a.m. May 11	13.42	3,720	1.62
60	Red Lake River at Crookston, Minn.	5,280	1901-	Apr. 15, 1906	-	14,600	2.77	12 p.m. May 6 to 2 p.m. May 7	25.70	27,400	5.19
61	Thief River near Thief Lake, Minn.	-	-	-	-	-	-	May	-	1,100 B	-
62	Thief River near Thief River Falls, Minn.	959	1909-17, 1920-21, 1922-24, 1928-	r July 10, 1919	s 16.3	5,040	5.26	9 a.m. May 13	17.38	5,610	5.85
63	Clearwater River at Plummer, Minn.	512	1939-	June 1, 1949	9.08	1,870	3.65	1 p.m. May 6	11.33	3,630	7.09
64	Clearwater River at Red Lake Falls, Minn.	1,370	1909-17, 1934-	Apr. 15, 1947	aa bi 17.5	5,430	3.96	2:30 p.m. May 6	11.28	9,310	6.80
65	Lost River at Oklee, Minn.	-	-	-	-	-	-	May	-	4,060 B	-
66	Lost River near Brooks, Minn.	-	-	-	-	-	-	May	-	4,160 B	-
67	Hill River near Fosston, Minn.	-	-	-	-	-	-	May	-	801 B	-
68	Hill River at highway 59 at Brooks, Minn.	-	-	-	-	-	-	May	-	4,530 B	-
69	Poplar River near Erskine, Minn.	-	-	-	-	-	-	May	-	1,300 B	-
70	Poplar River near Brooks, Minn.	-	-	-	-	-	-	May	-	1,150 B	-
	TURTLE RIVER BASIN										
71	Turtle River at Manvel, N. Dak.	602	1945-	Apr. 19, 1948	17.88	3,450	5.73	6 p.m. Apr. 19	s 21.5	28,000	46.5
	FOREST RIVER BASIN										
72	Forest River near Fordville, N. Dak.	aj 497	1940-	Apr. 18, 1948	s 14.15	aj 14,600	29.4	r 5 a.m. Apr. 18	s 14.48	16,400	33.0
73	Forest River at Minto, N. Dak.	735	1944-	Apr. 19, 1948	s 11.80	12,000	16.3	8 p.m. Apr. 18	s 11.80	17,000	23.1
	SNAKE RIVER BASIN										
74	Snake River at Warren, Minn.	-	1945	Mar. 30, 1945	10.72	642	-	May	-	3,410 B	-

See footnotes at end of table, p. 289

Table 5.--Summary of flood stages and discharges--Continued

No. on fig.	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during Mar.-Sept. 1950			
				Date	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile	Time	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile
	SNAKE RIVER BASIN--Continued										
75	Snake River at Alvarado, Minn.	-	1945	Mar. 28, 1945	12.59	724	-	May	-	3,260 B	-
	PARK RIVER BASIN										
76	South Branch Park River near Park River, N. Dak.	aj 214	1940-	Apr. 18, 1948	11.80	11,000	51.4	2 a.m. Apr. 19	10.1	5,970	27.9
77	South Branch Park River below Homme dam, N. Dak.	229	1949-	-	-	-	-	11 a.m. Apr. 24	37.52	r bj 13,000	56.8
78	Park River at Grafton, N. Dak.	aj 742	1931-	Apr. 19, 1948	20.06	11,700	15.8	6-11 a.m. Apr.19	20.13	12,600	17.0
	TAMARACK RIVER BASIN										
79	Tamarack River at Stephen, Minn.	-	1945	Mar. 29, 1945	6.14	765	-	May	-	2,730 B	-
80	Tamarack River near Stephen, Minn.	-	1945	Mar. 29, 1945	14.39	827	-	May	18.62	6,620 A B	-
	TWO RIVERS BASIN										
81	Two Rivers below Hallock, Minn.	644	1945-	Apr. 26, 27 1948	bk 22.84	a 2,200	3.42	May 10-13	q bm 25.70	a 3,600	5.59
82	North Branch Two Rivers near Lancaster, Minn.	32	1929-38, 1941-	Sept. 25, 1941	q aa bn 4.69	q 290	9.06	9 a.m. May 20	q 6.25	912	28.5
83	North Branch Two Rivers near Northcote, Minn.	386	1941-42, 1945-	Apr. 2, 1942	q bp 23.52	a 1,700	4.40	May 13-17	q bq 26.54	a 2,600	6.74
84	State ditch 85 near Lancaster, Minn.	95	1929-38, 1942-	Apr. 5, 1942	aa br 6.30	298	3.14	8:30 a.m. May 20	q 5.90	1,480	15.6
	PEMBINA RIVER BASIN										
85	Pembina River near Walhalla, N. Dak.	aj 3,109	1939-	Apr. 19, 1948	14.94	7,280	2.34	6 a.m. Apr. 18	s 19.2	20,400	6.56
86	Pembina River at Neche, N. Dak.	aj 3,189	1903-15, 1919-	Apr. 22, 1949	20.83	5,010	1.57	9:30 a.m. Apr.20	21.58	10,700	3.36
87	Tongue River at Akra, N. Dak.	147	-	-	-	-	-	r 12 p.m. Apr.18	s 48.7	11,800	80.3
88	Tongue River at Cavalier, N. Dak.	aj 153	1938-	Apr. 21, 1948	s 4.38	1,300	8.50	12:30 p.m. May 8	4.58	1,340	8.76

	ROSEAU RIVER BASIN										
89	Roseau River below South Fork, near Malung, Minn.	573	1946-	June 13, 1947	20.20	3,190	5.57	5-7 a.m. Apr. 24	22.51	3,650	6.37
90	Roseau River near Roseau, Minn.	-	1930-	Mar. 29, 1942	q bs 1,037.49	-	-	Apr. 24	s bs 1,037.68	-	-
91	Roseau River at Roseau Lake, Minn.	-	1939-	Apr. 28, 1948	q bs 1,034.83	-	-	4:05 p.m. May 13	q bs 1,036.86	-	-
92	Roseau River at Ross, Minn.	1,220	1926-	Apr. 29, 1948	bu 17.5	3,220	2.64	5 a.m. May 12	18.25	6,560	5.38
93	Roseau River near Badger, Minn.	-	1928-	Apr. 29, 1948	bs 1,031.37	-	-	9 p.m. May 13	bs 1,032.65	-	-
94	Roseau River at Duxby, Minn.	-	1929-	Apr. 24, 1948	q bs 1,027.86	-	-	May 13	q bs bt 1,028.88	-	-
95	Roseau River near Haug, Minn.	-	1932-	Apr. 29, 1948	bs 1,023.76	-	-	5 a.m. May 15	bs 1,024.64	-	-
96	Roseau River at Oak Point, Minn.	-	1933-39, 1941-	May 3, 1948	q bs 1,016.76	-	-	9:45 a.m. May 19	q bs 1,019.64	-	-
97	Roseau River below State ditch 51 near Caribou, Minn.	1,570	1929-	May 2-5, 1948	aa bv 9.85	2,460	1.57	8:30 p.m. May 19	11.81	4,080	2.60
98	Roseau River at international boundary, near Caribou, Minn.	1,590	1933-	Mar. 24, 1945	bs 1,007.06	-	-	3 p.m. May 20	bs 1,007.02	-	-
99	Roseau River near Dominion City, Manitoba	1,840	1913-	May 10, 1927	794.37	5,030	2.73	7:10 p.m. May 6	796.83	8,130	4.42
100	Break in Branch A ditch near Skime, Minn.	-	-	-	-	-	-	-	-	587 B	-
101	Mud Creek near Sprague, Manitoba	151	1928-	Sept. 1, 1942	-	2,070	13.7	p.m. May 12	s 13.69	1,470	9.74
102	Pine Creek near Pine Creek, Minn.	74.6	1928-	Sept. 25, 1941	9.79	706	9.46	4 a.m. Apr. 24	10.18	632	8.47
	RAT RIVER BASIN										
103	Rat River near Otterbourne, Manitoba	704	1912-	May 14, 1927	105.25	4,600	6.53	May 6	107.29	5,850	8.31
	SEINE RIVER BASIN										
104	Seine River near Prairie Grove, Manitoba	495	1915-36, 1942-	May 11, 1927	bw 825.89	bw 1,980	6.39	5:45 p.m. May 7	104.33	2,840	5.74
	ASSINIBOINE RIVER BASIN										
105	Assiniboine River at Brandon, Manitoba	35,550	1912-	May 7, 1923	1,177.74	23,000	.65	11:30 a.m. Apr. 23	1,168.60	5,120	.14
106	Assiniboine River at Headingley, Manitoba	62,510	1913-	Apr. 27, 1916	769.75	21,700	.35	May 10-16	765.82	9,970	.16
107	Souris River near Sherwood, N. Dak.	9,570	1930-	Apr. 28, 1948	23.80	7,400	.77	5 p.m. Apr. 18	14.25	1,610	.17
108	Souris River near Westhope, N. Dak.	17,600	1929-	Apr. 18, 1949	bx 16.9	6,400	.36	10 p.m. May 17	by 12.31	2,650	.15

See footnotes at end of table, p. 289

Table 5.--Summary of flood stages and discharges--Continued

No. on fig.	Stream and place of determination	Drainage area (square miles)	Period of record	Maximum flood previously known				Maximum during Mar.-Sept. 1950			
				Date	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile	Time	Gage height feet	Discharge (sec-ft)	Sec-ft per sq mile
	ASSINIBOINE RIVER BASIN--Continued										
109	Souris River at Wawanesa, Manitoba	24,150	1912-	Apr. 11, 1949	1,168.78	8,280	0.34	6 p.m. May 11	1,160.94	3,980	0.16
	WINNIPEG RIVER BASIN										
110	Basswood River near Winton, Minn.	bz 1,740	1924, 1925-30, 1931-	May 10, 1948	4.82	9,230	5.30	12:30 a.m. May 24	6.94	15,600	8.97
111	Namakan River at outlet of Lac la Croix, Ontario	5,165	1921-	May 12-17, 1938	1,190.35	18,500	3.58	6 p.m. May 30-	1,193.30	28,200	5.46
112	Namakan Lake at Kettle Falls, Minn.	-	1912-	May 23, 1916	1,122.86	-	-	June 7, 9	1,122.69	-	-
113	Rainy Lake at Fort Frances, Ontario	-	1911-	June 8, 1916	ca 1,112.51	-	-	July 5	1,112.97	-	-
114	Rainy River at Manitou Rapids, Minn.	19,360	cb cc 1928-30, cb 1932-34, 1934-	May 8, 1938	19.80	65,400	3.38	9 a.m. May 12	21.04	71,600	3.70
115	Lake of the Woods at Warroad, Minn.	-	-	-	--	-	-	July 18	1,064.04	-	-
116	Winnipeg River, total outflow Lake of the Woods, Ontario	27,170	1892-	July 6, 1927	1,063.11	51,600	1.90	Aug. 3	-	56,300	2.07
117	Winnipeg River at Slave Falls, Manitoba	48,880	1907-	July 1927	-	86,600	1.77	June 19, 23	-	98,100	2.01
118	Rapid River at Clementson, Minn.	-	-	-	-	-	-	May	-	12,000 A	-
119	Kawishiwi River near Winton, Minn.	1,200	1905-07, 1912-19, 1923-	May 3, 1948	-	a 11,200	9.33	May 18	-	a 16,000	13.3
120	Vermilion River below Lake Vermilion, near Tower, Minn.	483	1911-17, 1928-	May 9, 11, 13, 1938	q 3.96	2,290	4.74	11 p.m. May 23	4.68	2,170	4.49
121	Turtle River near Mine Centre, Ontario	1,880	1914-	Oct. 2-3, 1941	1,141.22	10,700	5.69	May 17	1,140.06	9,060	4.82
122	Little Fork River at highway 53 at Cook, Minn.	-	-	-	-	-	-	May 8	-	3,410 B	-
123	Little Fork River at Little Fork, Minn.	1,730	1909-17, 1928-	Apr. 18, 1916	s aa 37.0	19,300	11.2	1 a.m. May 11	37.00	25,000	14.5
124	Sturgeon River near Chisholm, Minn.	187	1942-	Apr. 21, 1948	q 5.30	2,120	11.3	11 p.m. May 7	6.41	3,630	19.4
125	Dark River near Chisholm, Minn.	54	1942-	Apr. 21, 1948	6.00	709	13.1	8 p.m. May 7	7.10	993	18.4

126	Big Fork River at Big Falls, Minn.	1,460	1909-12, 1928-	Apr. 26, 1937	s 15.12	13,000	8.90	11:30 p.m. May 8	17.08	14,800	10.1
127	Warroad River near Warroad, Minn.	110	1946-	July 11, 1947	q 9.45	1,350	12.3	9 p.m. Apr. 24	q 8.86	1,170	10.6
128	Bulldog Run near Warroad, Minn.	14.2	1946-	July 10, 1947	6.91	420	29.6	8 p.m. Apr. 23	6.69	292	20.6
129	East Branch Warroad River near Warroad, Minn.	102	1946-	June 11, 1947	s 9.36	1,340	13.1	8 a.m. June 27	8.29	554	5.43

a Mean daily discharge.
b At site 4 miles downstream.
c Occurred June 10, 1947.
d Occurred July 9.
e Occurred Mar. 31, 1897.
f Occurred Apr. 7, 1897.
g Occurred 12 p.m. April 7.
h Excludes 3,940 square miles of closed Devils Lake Basin.
i Occurred Apr. 17, 1947.
j Occurred 5:30 p.m. April 11.
k Occurred Apr. 15, 1948
m About. Occurred Apr. 20, 1897.
n Includes 3,940 square miles of closed Devils Lake Basin. Discharge in sec-ft per square mile computed on basis of net contributing area.
p Estimated.
q Observed.
r About.
s From floodmark.
t Occurred 8:30 a.m. March 28.
u Contents in acre-feet.
v Occurred June 23, 1944.
w At site 3½ miles downstream.
x Flood of late March or early April 1916 reached a stage of 17.4 ft. former datum, discharge 2,980 sec-ft.
y Occurred 6 p.m. March 30.
z Occurred during period Apr. 1-5, 1943.
aa Affected by ice backwater.
ab Occurred Apr. 11, 1947.
ac Occurred 6:00-6:20 p.m. March 30.
ad Occurred during period Apr. 1-5, 1943.
ae Occurred 7:25 a.m. March 28.
af Occurred Apr. 2, 1943.
ag Occurred 7:15 a.m. April 1.
ah Occurred 6:30 p.m. March 29.
ai Occurred 8:30 a.m. April 17.
aj Revised.
ak Maximum known discharge about 4,580 sec-ft occurred April 27 or 28, 1948.
am Occurred April 1947.
an Occurred 2 a.m. May 11.
ap Including lake surface.
aq Occurred Apr. 8, 1948.
ar Occurred 8 a.m. March 27.
as Occurred Mar. 16, 18, 1945.
at Occurred 6-8 p.m. April 2.
au Occurred 5-6 p.m. March 29.
av Site and datum then in use.
aw Occurred Mar. 28, 1950.
ax Occurred Apr. 15, 1947.
ay Occurred 8:37 a.m. April 8.
az Occurred 4 p.m. April 19.
ba Includes Sand Hill ditch.
bb Occurred Apr. 4, 1943.
bc Occurred Apr. 3, 1943.
bd Occurred about 4 p.m. April 19.
be Records for this period collected on Upper Red Lake near Waskish.
bf Occurred Aug. 8, 1947.
bg Occurred 1 p.m. June 25.
bh Former datum, 4.00 ft. higher.
bi Occurred Apr. 5, 1913.
bj Occurred when dam washed out.
bk Occurred Apr. 25, 1948.
bm Occurred 6 p.m. May 13.
bn Occurred Mar. 26, 1942.
bp Occurred Apr. 26, 1948. Affected by backwater from Red River.
bq Occurred 4:53 p.m. May 13.
br Occurred Mar. 29, 1942.
bs Altitude above mean sea level adjustment of 1928. Geodetic Survey of Canada.
bt Readings furnished by Corps of Engineers.
bu Occurred July 1919.
bv Occurred Apr. 1, 1942.
bw At site at Ste. Anne, drainage area 310 square miles.
bx Occurred Apr. 20, 1949.
by Occurred 9 a.m. May 23.
bz At outlet of Basswood Lake.
ca At Ranier, Minn., same datum.
cb At site 7 miles downstream.
cc Operated by Corps of Engineers.

traveled into the area as early as 1734 (Burpee, 1915, p. 30) on the waterway that forms the international boundary from Lake Superior to Lake of the Woods, they established trading posts of a temporary nature only and left little flood history. One fur-trader, Alexander Henry the younger, left a journal of his stay in the vicinity of Pembina, N. Dak., during the years 1800 to 1808, which is of interest to the flood researcher because it does not mention an outstanding flood during that period.

Rupertsland, the first permanent settlement in the area, was established in 1812 at the junction of the Assiniboine and Red Rivers near the present city of Winnipeg. Its founder was the Earl of Selkirk, who sought haven for dispossessed Scots from the British Isles. Although more settlers "migrated" to Pembina than stayed in Rupertsland (until 1821, when the international boundary west of Lake of the Woods was defined), those who remained constituted a permanent group to whom we are indebted for many glimpses into the past. Excellent written accounts of the great flood of 1826 were left us by at least three of these people--Heron, 1826; Ross, 1856; and Prichard, 1826. (Heron's account may be seen in the Hudson's Bay Co. Archives, London; Ross published his account; and the Pritchard letters have been published).

Settlement of the United States portion of the Red River Valley consisted of scattered fur trading posts until the Sioux Indians were subdued in 1866. Since about 1870, records of events in the Red River of the North Basin have been preserved in newspapers and historical works. Actual gage-records of the Red River at Grand Forks date back to 1882.

Records of past major floods on main stem and tributaries are presented in the following paragraphs and tables. Only the outstanding floods are described; the remainder are given tabular presentation.

Red River of the North, Main Stem

The flood of 1826 is the largest known in the Red River Valley. The flood of 1776 was described by a Mr. Nolin in 1826 as being larger than the one current in that year. Evidence that the winter of 1776 was of extreme severity is found in an account (Quaife, 1921, p. 260) of a journey made from Cumberland House to Fort des Prairies. The account lists such depths of snow, degrees of cold, and thickness of ice as to give credibility to Nolin's claim, which has apparently been accepted by some engineers. This is doubtful, however, and Simons and King (1922, p. 52) list the 1776 crest as about 4 feet lower than that of the 1826 flood.

The descriptions of the 1826 flood were so well made that a rough stage hydrograph can be constructed by referring to them. The following is a condensed version of the 1826 account of the flood as it appeared at the present site of Winnipeg, prepared by Francis Heron, clerk of the Hudson's Bay Company (Hudson's Bay Co., 1950, p. 42). When Heron speaks of the Fort, he refers to Fort Garry built at the junction of the Assiniboine and Red Rivers on the left bank of both streams (see fig. 25).

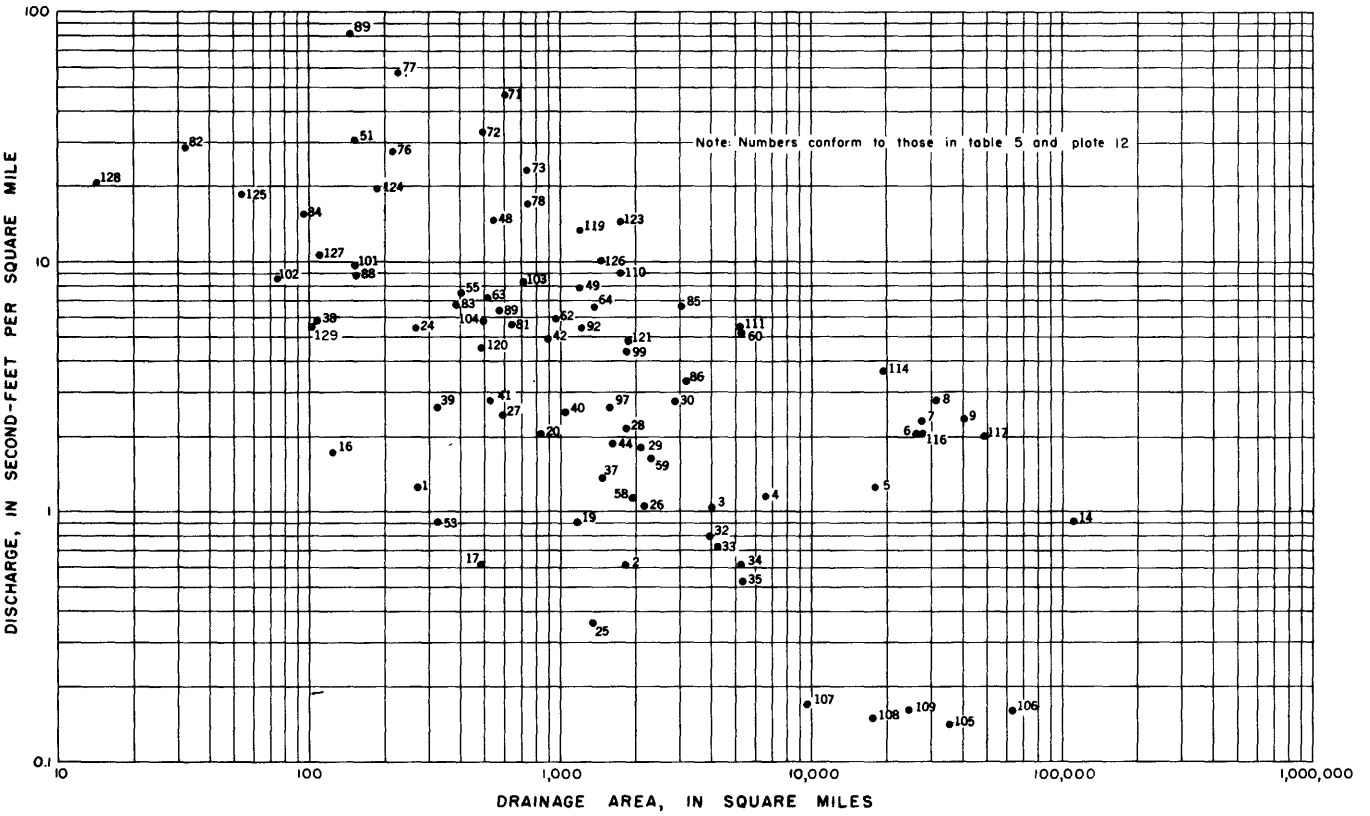

Figure 39.—Maximum discharges in second-feet per square mile for various areas in the Red River of the North and Winnipeg River Basins in the United States and Canada, March-August 1950.

Table 6.--Flood-crest stages
(Furnished by Corps of Engineers.)

Stream and location	Miles above mouth	Date 1950	Altitude in feet
Red River of the North Main Stem			
Red River of the North a/			
Grand Forks, N. Dak., 3 miles above	303.0	May 12	826.85
Grand Forks, N. Dak., in Lincoln Park	301.10	do.	827.01
Grand Forks, N. Dak., at 929 Lincoln Drive	299.81	do.	826.89
Grand Forks, N. Dak., at 11 Lincoln Drive	298.94	do.	826.78
Grand Forks, N. Dak. at 721 South 4th Street	298.41	do.	826.86
Grand Forks, N. Dak., at Lewis Blvd. and R. R. tracks.	297.49	do.	825.50
Grand Forks, N. Dak., at Viets Ave. and Fenton Ave.	296.97	do.	825.13
Grand Forks, N. Dak., at 115 Park Ave., Riverside Park	296.45	do.	824.81
Grand Forks, N. Dak., at sewage disposal plant	295.85	do.	824.52
Grand Forks, N. Dak., 2 miles below	294.00	do.	824.00
Oslo, Minn., about 5 miles above	281.3	May 10	815.20
Oslo, Minn., at Soo Line depot	271.0	do.	810.20
Oslo, Minn., at Hwy. No. 1 bridge	270.8	do.	809.55
Oslo, Minn., at River St. and 2nd Ave.	-	do.	809.23
Oslo, Minn., at Main St. and 2nd Ave.	-	do.	809.21
Oslo, Minn., about 6 miles below	254.8	do.	803.91
Drayton, N. Dak., about 5 miles above	218.0	-	800.50
Drayton, N. Dak.	208.2	May 12	798.75
Bowesmont, N. Dak.	190.4	-	797.01

Pembina, N. Dak., about 6 miles above	164.9	May 13	794.62
Pembina, N. Dak.	157.9	do.	792.98
Emerson, Canada	154.2	do.	791.57
Sheyenne River b/			
Gage no. SH9A	326.28	April 17	1,292.15
Gage no. SH9B	324.74	April 20	1,289.74
Gage no. SH8	315.04	April 17	1,280.38
Gage no. SH7	310.70	do.	1,274.60
Gage no. SH6	306.68	April 18	1,270.06
Baldhill Dam (Pool)	270.50	April 26	1,267.77
Baldhill Dam T.W.	270.50	May 19	1,232.43
Valley City, N. Dak., at 6 St. N.E. bridge	255.6	May 5	1,219.96
Valley City, N. Dak., near 3rd St. N.E. and river	255.3	do.	1,219.86
Valley City, N. Dak., at N. P. Railway bridge	255.10	do.	1,219.74
Valley City, N. Dak., at 5th Ave. S.E.	254.8	do.	1,219.61
Valley City, N. Dak., at end of R. R. spur	254.5	do.	1,219.21
Valley City, N. Dak., at upstream side of mill dam	254.3	do.	1,219.05
Valley City, N. Dak., at 3rd Ave. S.E. bridge	254.28	do.	1,215.79
Valley City, N. Dak., at 4th St. S.W. bridge (east)	253.92	do.	1,215.58
Valley City, N. Dak., at 4th St. S.W. bridge (west)	253.42	do.	1,215.10
Valley City, N. Dak., at 7th St. S.W. bridge	253.04	do.	1,215.01
Valley City, N. Dak., U.S.G.S. gage	253.03	do.	1,214.51
Highway bridge, SE¼ sec. 9, T. 139 N., R. 58 W.	245.9	-	1,206.19

See footnotes at end of table, p. 301

Table 6.--Flood-crest stages--Continued

Stream and location	Miles above mouth	Date 1950	Altitude in feet
Sheyenne River--Con. b/			
Highway bridge between secs. 27 and 28, T. 139 N., R. 58 W.	239.7	-	1,199.27
Highway bridge between secs. 3 and 10, T. 138 N., R. 58 W.	234.4	-	1,192.40
Highway bridge between secs. 15 and 22, T. 138 N., R. 58 W.	230.2	-	1,186.45
Highway bridge between secs. 27 and 34, T. 138 N., R. 58 W.	225.8	-	1,179.99
Kathryn, N. Dak., N. P. Railway trestle, sec. 13, T. 137 N., R. 58 W.	215.0	-	1,165.58
Highway bridge between secs. 13 and 24, T. 137 N., R. 58 W.	214.2	-	1,162.22
Highway bridge between secs. 2 and 36, Tps. 136 and 137 N., R. 58 W.	208.5	-	1,154.91
Highway bridge between secs. 7 and 12, T. 136 N., Rs. 57 and 58 W.	204.1	-	1,148.61
Highway bridge, sec. 19, T. 136 N., R. 57 W.	199.8	-	1,142.17
Highway bridge, sec. 12, T. 135 N., R. 58 W.	189.7	-	1,126.13
Highway bridge, sec. 17, T. 135 N., R. 57 W.	185.9	-	1,120.50
Highway bridge, sec. 10, T. 135 N., R. 57 W.	181.2	-	1,111.70
Highway bridge between secs. 19 and 30, T. 135 N., R. 56 W.	172.0	-	1,096.56
Farm bridge, sec. 32, T. 135 N., R. 56 W.	168.05	-	1,090.08
Lisbon, N. Dak., Corps of Engineers gage	161.7	-	1,080.29
Highway bridge, sec. 12, T. 134 N., R. 56 W.	161.0	-	1,079.46
Township bridge, sec. 24, T. 134 N., R. 56 W.	157.05	-	1,073.16
Highway bridge between secs. 29 and 32, T. 134 N., R. 55 W.	152.4	-	1,065.82
Highway bridge between secs. 2 and 35, Tps. 133 and 134 N., R. 55 W.	147.3	-	1,059.65
Highway bridge between secs. 29 and 32, T. 134 N., R. 54 W.	141.5	-	1,048.40
Highway bridge between secs. 8 and 17, T. 134 N., R. 54 W.	134.95	-	1,035.39
Highway bridge S 27, between secs. 5 and 8, T. 134 N., R. 54 W.	133.9	-	1,034.96

Sheyenne River--Con. b/			
Highway bridge between secs. 29 and 32, T. 135 N., R. 54 W.	131.5	-	1,031.42
Highway bridge between secs. 16 and 17, T. 135 N., R. 54 W.	126.0	-	1,022.85
Highway bridge between secs. 13 and 14, T. 135 N., R. 54 W.	119.5	-	1,013.77
Highway bridge between secs. 7 and 8, T. 135 N., R. 53 W.	113.8	-	1,005.68
Highway bridge, sec. 10, T. 135 N., R. 53 W.	108.1	-	997.86
Highway bridge between secs. 3 and 4, T. 135 N., R. 52 W.	91.8	-	972.17
Highway bridge between secs. 35 and 36, T. 136 N., R. 52 W.	87.5	-	965.95
Highway bridge & wood dam, between secs. 31 and 32, T. 136 N., R. 51 W.	82.8	-	960.42
Highway bridge, sec. 29, T. 136 N., R. 51 W.	81.1	-	958.42
Highway bridge, sec. 23, T. 136 N., R. 51 W.	77.2	-	954.72
Highway bridge between secs. 11 and 14, T. 136 N., R. 51 W.	75.2	-	952.26
Highway bridge between secs. 12 and 7, T. 136 N., Rs. 50 and 51 W.	73.6	-	950.51
Highway bridge S.W. corner sec. 5, T. 136 N., R. 50 W.	71.1	-	948.43
Kindred, N. Dak., G. N. Railway bridge (1 mile south)	68.2	-	945.97
Kindred, N. Dak., highway bridge S46 (1 mile south)	67.9	-	945.67
Highway bridge between secs. 23 and 36, T. 137 N., R. 50 W.	55.5	-	932.65
Highway bridge between secs. 2 and 11, T. 137 N., R. 50 W.	48.2	-	924.43
Highway bridge between secs. 36 and 1, Tps. 137 and 138 N., R. 50 W.	46.2	-	922.89
Highway bridge between secs. 25 and 36, T. 138 N., R. 50 W.	44.4	-	920.57
Highway bridge between secs. 24 and 25, T. 138 N., R. 50 W.	42.4	-	918.17
N. P. Railway bridge, sec. 24, T. 138 N., R. 50 W.	42.3	-	917.78
Highway bridge,between secs. 18 and 19, T. 138 N., R. 49 W.	40.1	-	916.04
Highway bridge between secs. 6 and 5, T. 138 N., R. 49 W.	36.0	-	910.89
Proposed diversion dam with pool alt. 903.00	35.1	-	-
Highway bridge between secs. 5 and 32, Tps. 138 and 139 N., R. 49 W.	35.0	-	909.99

See footnotes at end of table, p. 301

Table 6.--Flood-crest stages--Continued

Stream and location	Miles above mouth	Date 1950	Altitude in feet
Sheyenne River--Con. b/			
Highway bridge between secs. 29 and 32, T. 139 N., R. 49 W.	33.1	-	907.67
Highway bridge between secs. 19 and 30, T. 139 N., R. 49 W.	31.3	-	905.62
Highway bridge	29.51	May 13	904.0
do.	28.49	do.	902.0
do.	27.92	do.	901.6
Highway bridge (U. S. No. 10 and No. 52)	26.53	do.	900.21
Northern Pacific Railway bridge	25.82	do.	899.5
Highway bridge	25.50	do.	899.4
Great Northern Railway bridge	25.49	do.	898.9
Highway bridge	24.50	do.	897.1
do.	23.05	do.	895.8
do.	19.29	do.	892.2
do.	16.62	do.	891.5
do.	14.03	do.	889.0
Highway bridge (U. S. No. 81)	10.91	do.	885.2
Highway bridge	9.67	do.	882.4
do.	7.54	April	882.1
do.	0.92	do.	878.2
Marsh River: b/			
Ada, Minn., 1½ miles north, at G. N. Railway bridge	39.6	-	893.44
Highway bridge, between secs. 5 and 6, T. 144 N., R. 46 W.	38.6	-	893.17
Near highway bridge between secs. 1 and 2, T. 144 N., R. 47 W.	36.5	-	887.47

Marsh River--Con. b/			
Near highway bridge between secs. 2 and 3, T. 144 N., R. 47 W.	34.35	-	884.18
Near highway bridge at S.W. corner sec. 35, T. 145 N., R. 47 W.	33.7	-	882.76
At S.W. corner sec. 35, T. 145 N., R. 47 W.	31.02	-	879.70
Near highway bridge between secs. 28 and 33, T. 145 N., R. 47 W.	28.75	-	879.83
Anthony, Minn. near highway bridge	27.8	-	878.11
At highway bridge in the SW¼ sec. 20, T. 145 N., R. 47 W.	26.1	-	875.96
At highway bridge near center of sec. 19, T. 145 N., R. 47 W.	24.6	-	873.83
At the NW¼ of sec. 19, T. 145 N., R. 47 W.	24.0	-	872.84
At highway bridge, S. center of sec. 13, T. 145 N., R. 48 W.	22.4	-	871.43
At highway bridge, center of sec. 13, T. 145 N., R. 48 W.	21.9	-	870.81
At highway bridge, E. center of sec. 11, T. 145 N., R. 48 W.	18.9	-	868.25
At highway bridge in the N¼ sec. 11, T. 145 N., R. 48 W.	17.65	-	866.74
Sand Hill River a/			
Highway bridge at S.W. corner sec. 23, T. 147 N., R. 46 W.	27.55	-	916.32
Beltrami, Minn., on Sand Hill River	26.3	April 19	907.94
Beltrami, Minn., on Sand Hill ditch, at sec. 21, T. 147 N., R. 46 W.	25.5	-	904.79
Highway bridge between secs. 14 and 23., T. 147 N., R. 47 W.	21.5	-	885.4
Highway bridge at S.W. corner sec. 14, T. 147 N., R. 47 W.	21.0	-	884.53
Near ¼ corner between secs. 16 and 21, T. 147 N., R. 47 W.	19.5	-	880.96
Highway bridge at S.W. corner sec. 18, T. 147 N., R. 47 W.	17.0	-	873.72
Highway bridge at S.W. corner sec. 14, T. 147 N., R. 48 W.	15.0	-	867.53
Near Cattle Pass culvert, sec. 10, T. 147 N., R. 48 W.	12.6	-	861.93
Climax, Minn. on Sand Hill River	2.7	-	-

See footnotes at end of table, p. 301

Table 6.--Flood-crest stages--Continued

Stream and location	Miles above mouth	Date 1950	Altitude in feet
Sand Hill River--Con. a/			
U. S. G. S. gage at S.W. corner sec. 28, T. 148 N., R. 48 W.	6.8	-	850.00
Red Lake River b/			
Crookston, Minn., about 3 miles west	44.3	-	847.35
Crookston, Minn., in NE¼ sec. 35, T. 149 N., R. 47 W.	49.1	-	852.12
Crookston, Minn., at 816 Pleasant Ave.	-	April 23	855.55
Crookston, Minn., at 414 Stuart Ave.	-	do.	855.82
Crookston, Minn. at 302 Maple St.	-	do.	857.54
Crookston, Minn., U. S. G. S. gage	52.25	do.	856.69
Crookston, Minn., at S. Main and S. Central Sts.	-	do.	858.68
Crookston, Minn., 605 Hunter St. (Woods Addition)	-	do.	859.87
Crookston, Minn., 401 Bridge St.	-	do.	860.94
Crookston, Minn., 324 Jefferson St.	-	do.	862.22
Crookston, Minn., Junction Hwy. No. 2 and No. 8	58.0	do.	862.72
Crookston, Minn., about 3 miles east	59.8	-	869.18
Huot, Minn.	77.95	-	900.2
Highlanding, Minn.	159.0	May 11	Stage 13.43
Clearwater River a/			
Red Lake Falls, Minn., U. S. G. S. gage	1.5	May 6	961.39
Plummer, Minn., U. S. G. S. gage	31.8	May 9	1,109.49
Gully, Minn., 10½ miles due north, between secs. 2 and 3, T. 151 N., R. 39 W.	78.5	-	1,166.16

Clearwater River--Con.			
Clearbrook, Minn., 10 miles north, NW¼ sec. 8, T. 150 N., R. 37 W.	108.4	April 19	1,187.48
Clearbrook, Minn., 10 miles north, center sec. 8, T. 150 N., R. 37 W.	109.6	-	1,189.81
Clearbook, Minn., 10 miles north, SE¼ sec. 8, T. 150 N., R. 37 W.	110.5	May 10	1,192.27
Between sections 9 and 16, T. 150 N., R. 37 W.	112.1	April 19	1,192.98
Highway bridge between secs. 26 and 35, T. 150 N., R. 37 W.	121.0	-	1,213.52
Lost River a/			
Oklee, Minn.	24.27	April 21	1,145.64
Gully, Minn. about 5.8miles due north in sec. 34, T. 151 N., R. 39 W.	38.4	-	1,163.74
At NE¼ sec. 18, T. 150 N., R. 38 W.	42.8	-	1,179.29
Gonvick, Minn., about 3 miles north, NW¼ sec. 27, T. 150 N., R. 38 W.	46.2	-	1,192.58
Silver Creek (mouth) in NE¼ sec. 34, T. 150 N., R. 38 W.	47.5	-	-
Gonvick, Minn., about 1½ miles NE., in sec. 2, T. 149 N., R. 38 W.	49.15	-	1,219.86
Ruffy Brook a/			
Highway bridge, between secs. 4 and 33, Tps. 149 and 150 N., R. 37 W.	3	-	1,219.45
Turtle River b/			
Manuel, N. Dak., about 3 miles north, at SE¼ sec. 27, T. 154 N., R. 51W.	-	-	813.61
Manuel, N. Dak., about 2½ miles SW., at NW¼ sec. 27, T. 153 N., R. 51 W.	-	-	824.56
Forest River b/			
Lake Ardoch	-	-	808.35
Minto, N. Dak., 7 miles SW., at NE¼ sec. 21, T. 155 N., R. 53 W.	-	-	851.43

See footnotes at end of table, p. 301

Table 6.--Flood-crest stages--Continued

Stream and location	Miles above mouth	Date 1950	Altitude in feet
Snake River b/			
Alvarado, Minn., 4 miles NW., in SE¼ sec. 13, T. 155 N., R. 50 W.	-	-	802.98
Alvarado, Minn., 4 miles east, between secs. 11 and 12, T. 154 N., R. 49 W.	-	-	823.61
Warren, Minn., 4 miles west, between secs. 3 and 10, T. 154 N., R. 48 W.	-	-	837.32
Warren, Minn., 3 miles NE., in SE¼ sec. 29, T. 155 N., R. 47 W.	-	-	873.29
Park River b/			
Grafton, N. Dak., above dam	30.55	-	829.02
Grafton, N. Dak., U. S. G. S. gage	30.3	-	827.52
Highway bridge, between secs. 10 and 11, T. 157 N., R. 52 W.	18.95	-	807.67
Pembina River b/			
Neche, N. Dak., about 3.5 miles above	37.0	-	849.46
Neche, N. Dak., U. S. G. S. gage	32.0	April 4	831.37
Neche, N. Dak., about 4.5 miles below	25.0	-	814.72
Pembina, N. Dak.	0	-	790.06
Roseau River c/	(d)		
Roseau, Minn., U. S. G. S. gage	9 above	April 24	1,046.69
Richardson's Bridge	1.5 above	do.	1,037.68
Roseau Lake, U. S. G. S. gage	3.8 below	May 12	1,036.80

Roseau River--Con.			
Ross, Minn., U. S. G. S. gage	8.4 below	May 12	1,036.63
Near Badger, Minn., U. S. G. S. gage	13.0 below	May 13	1,032.70
Badger, Minn., 1 mile below	14.5 below	do.	1,030.20
Near Duxby, Minn.	17.4 below	do.	1,028.81
Near Haug, Minn., U. S. G. S. gage	24.4 below	May 15	1,024.59
Oak Point, Minn., U. S. G. S. gage	36.4 below	May 19	1,019.66
Near Caribou, Minn., U. S. G. S. gage	39.5 below	do	1,014.40

a Altitudes are in adjustment with 1912 datum.
b Altitudes are in adjustment with 1929 datum.
c Altitudes are in adjustment with 1928 datum.
d Referred to the mouth of Mud Creek, 133.4 miles above the mouth of the Roseau River.

May 4, 1826 - The water in the rivers rose about 5 feet perpendicular during last 24 hours and the ice is now level with highest banks, but it is still so thick and strong that even the present flush of waters have not sufficient force to break it up * * *.

May 5 - About 2 p.m. the ice * * * broke up * * * carrying away cattle, houses, trees, and everything else * * *. Forty-seven dwelling houses were thus carried off by the first rush * * *.

May 6 - The waters continue to increase * * * boats and canoes were now used in the fort * * *.

May 7 - About 4 a.m. the ice in the Assiniboine River broke up * * *.

May 8 - The rivers have become almost clear of ice, but waters increase apace * * *.

May 9 - The waters still rose * * *.

May 10 - * * * obliged to pitch further up the Assiniboine River to higher ground * * *.

May 13 - Our people encamped on the banks of the Assiniboine River have been obliged to pitch camp some miles higher up that stream. * * * The forts stand like a castle * * * the water extending for at least a mile behind them * * *.

May 14 - Our people were again forced to remove their camp still higher up the Assiniboine, to the vicinity of Sturgeon Creek (about 7 miles from Fort Garry) * * * commenced removing the company's property * * *.

May 15 - * * * transporting the company's property from the fort * * *.

May 16 - * * * The whole face of the country, both below and above our encampment, is covered with water * * *.

May 17 - * * * The seed grain was distributed at our encampment, that the people might not perish for want of food * * *. The waters rise at the rate of two feet in twenty-four hours, but at our encampment we have still an elevation of six feet * * *.

May 18 - The waters continue to rise at the rate of ten inches in the space of twenty-four hours. * * *

May 19 - * * * The water rising at the rate of four inches in twenty-four hours. * * * Some freemen from beyond Pembina also arrived and report the waters to be as high there as here. High winds during the day, with a dreadful storm of rain, thunder and lightning at night. * * *

May 20 - * * * The waters continue rising. * * * Strong North West Wind, with thunder lightning and rain. Almost all the buildings throughout the settlement carried off by the floods and high winds.

May 22 - The inundation seems to have reached, at length, its extreme height, it being imperceptible, whither the water rose or fell during the last thirty-six hours * * * A Demeuron was last night drowned, in a creek close to our encampment, when in quest of his cattle. * * *

May 23 - The happy discovery was made this morning and hailed with joy by the anxious multitude, that the water had fallen two inches during the last night. * * *

May 25 - Early this morning all our people (Mr. McKinzie and the one man excepted) embarked on board the boats * * * and proceeded down the stream to what was once * * * called the bottome of the Settlement, where we pitched our camp * * * From the Forks to this place, and as far as the eye can reach, the country is covered with water and drift wood. * * *

July 5 - The waters are now nearly within the banks of the River in every part * * *

The 1826 flood in the Red River of the North Basin was the result of an extremely severe winter following a very wet fall of 1825. The temperature was often at or near 45° below zero and snow cover was 3 feet deep in the woods. The ice on the River at Winnipeg reached the extraordinary thickness of 5'7". The snow cover must have been deep over the entire basin as Red Lake and Lake Traverse were reported overflowing in the spring.

The 1852 flood at Winnipeg, next in rank to that of 1826, was equally well described by contemporary historians. The height of the 1852 crest relative to those of other floods may be seen on table 7, a tabulation of the known major floods on the main stem Red River.

The 1897 flood reached the highest known stage and discharge at many points along Red River above the mouth of the Turtle River. Below the Turtle River higher stages were reached by the 1950 flood. Although some earlier floods (1852, 1861) are believed to have exceeded the 1897 flood, extremely careful research has not established that fact. Because the 1897 flood has, for years, been used as a measure of other Red River Valley floods a description of it at Fargo and Grand Forks has been included in the following paragraphs.

The winter preceding the great 1897 flood was extremely severe as shown by the following remarks from the Fargo Forum and Daily Republican for March 15, 1897, under the heading "The Coming Flood":

> The present indications are that we will have high water this spring, as high if not higher, than it was in the spring of 1861. If all reports are true there is more snow on the level now than there was in the spring of 1861. That year the entire valley was flooded from Big Stone Lake to Winnipeg, a distance of more than 300 miles. There are but four men living in the valley now that witnessed the great flood of '61 -- the largest body of fresh water in the world at that time * * * R. M. Probesfield is authority for saying that he, a few days ago, measured the snow in his timber, where it was free from drifting and it measured 5 feet. This measurement is two and one-half feet more snow than we had in 1861. Those facts prove that we will have a greater flood this year than in the history of the valley. Old Settler.

The flood forecast by "Old Settler" was not long delayed. The Red crested at Wahpeton on March 31, 2'8" above the 1893 high. By April 1, 1897, the C. M. St. P. & P Railway tracks between Fargo and Wahpeton were covered with water in spots and traffic was suspended. By April 2 the Buffalo River overflowed so a large lake was formed between Glyndon

Table 7.--Altitudes reached by major floods at gage locations along the main-stem Red River 1/

Point	1776	1790	1809	1826	1852	1861	1882	1897	1916	1943	1947	1948	1950
Breckenridge-Wahpeton	-	-	-	-	-	-	-	959	958	958	955	952	955
Fargo-Moorhead	-	-	-	-	-	-	902	904	895	898	893	882	891
Grand Forks	-	-	-	-	a 830	-	828	829	820	817	819	820	824
Emerson	-	-	-	-	-	a 795	790	791	786	777	776	788	791
Winnipeg, at junction of Assiniboine and Red	a 760	b	b	764	762	760	c 754	c 750	-	-	-	-	-
Winnipeg, at James Ave. pumping station d	-	-	-	-	-	-	c 753.3	c 749.6	c 751.6	c 743.9	c 742.5	c 751.0	c 757.9
Winnipeg, at Redwood bridge e	-	-	-	-	-	-	-	-	f 751.3	f 742.5	f 741.0	f 749.0	f 755.9

1 Altitude in feet above mean sea level, datum of 1929.
a Approximate.
b Year in which general overflow occurred.
c City of Winnipeg records.
d About 1 mile below junction Assiniboine and Red Rivers.
e About 3 miles below junction Assiniboine and Red Rivers.
f Canadian government records.

and Moorhead. The Wild Rice (N. Dak.) River was described as 'on a splurge too'. The Sheyenne River was reported rising slowly at Valley City on April 3. The Red crested early on the morning of April 7 at Fargo at a 34.2 foot stage (present datum) exceeding the known high levels of 1871, 1873, and 1882. The Sheyenne River, by April 8, was up so high that water flowed overland from it to the Wild Rice River. The flood of 1897 at Fargo covered most of the business and residential areas of the city.

The 1897 flood crested at Grand Forks about noon on April 10 bringing the water up to a line along Third Street (see fig. 21) and covering Demers Ave. in East Grand Forks. Flooding on all tributaries between Grand Forks and Emerson was reported, and a serious situation developed at Grafton. The crest reached Emerson on April 24 and completely flooded the town. (See fig. 40.) The flood at Winnipeg did not receive mention as an outstanding event.

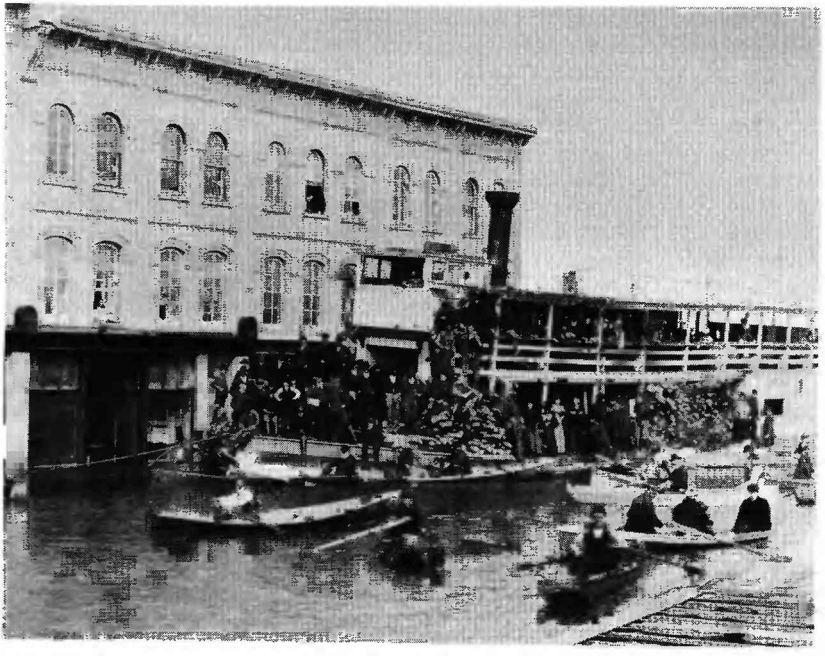

Figure 40.—1897 flood scene at Emerson, Manitoba. Photo from The Beaver, Hudson's Bay Company.

Tributaries of the Red River

In general, years during which major floods passed down the Red River were also years of major flooding on all tributaries. The majority of tributary flooding has resulted from snow melt; however, some important floods have been caused by heavy rains. A few of these rain-caused tributary floods are: Wild Rice River of North Dakota, July 1897; Wild Rice River of Minnesota, July 1909; Goose River, June 1915; Red Lake River, July 1919.

Table 8 presents information on such floods at points where gaging has been done. The tabulation is concise but it is thought adequate for a flood record of the major tributaries. Exceptional floods for which the month, stage and discharge are indeterminate but which were known to have occurred, have been shown by symbol.

Winnipeg River Basin

Stream gaging on the Winnipeg River started about 1907 and reliable data on subsequent basin-wide flood occurrences have been published in the Water-Supply Papers of the Geological Survey or in Canadian Water Resources Papers. Almost all available data on floods prior to 1912 are summarized in a publication of the International Joint Commission (International Joint Commission, 1915). Apparently the highest known stage of Lake of the Woods (which was uncontrolled at the time, and would directly indicate a flood), according to testimony in the hearings before the International Joint Commission, occurred in June 1876. Floodmarks chiseled on rocks at several points in the Lake of the Woods by James Kennedy in 1895 were about one foot higher than the recorded height in 1876. Kennedy's floodmarks were supposed to represent the highest lake stage (possibly 1864) ever known and were probably based on color changes visible years later on the large rocks. Basin-wide floods of less size than that of 1876 were estimated to have occurred in 1896, 1897, 1899, and 1900, according to the International Joint Commission.

Flood Records Collected by Railways

The crest measurements, collected by four major railways at bridge crossings in the United States portion of the Red River of the North and Winnipeg River Basins, for past floods and the 1950 flood have been combined and reproduced on plate 13 (in pocket). The illustration shows by abbreviation: the railway company that furnished the record, the railway company number for the bridge at site of crest stage data, and the record

of crest stages. All data have been published exactly as received. The reference point used to measure the crest observations at arbitrary railway datum may be obtained from the railway concerned. The cooperation of the engineering departments of the Great Northern; the Northern Pacific; the Minneapolis, St. Paul, and Sault Ste. Marie; and the Chicago, Milwaulkee, St. Paul, and Pacific Railways is gratefully acknowledged.

FLUCTUATIONS IN GROUND WATER LEVELS

(Prepared by P. D. Akin, engineer, Ground Water Branch)

The entire basin of the Red River of the North was covered by the great continental ice sheets of the Pleistocene epoch. As a result, the surficial materials of the basin are almost entirely of glacial origin. Only a few places are known where the bedrock is exposed at the surface.

The thickness and character of the glacial materials vary from place to place in the basin. Outside the Red River Valley the material is largely glacial till, a heterogeneous mixture of clay, sand, gravel, and boulders, generally characterized by very low permeability and generally not water bearing. In many places, however, bodies of water-sorted sand and gravel occur in or adjacent to the till and these yield water for the greater part of the farm and domestic needs in the basin. The larger bodies may yield supplies suitable for use for municipal, industrial, and irrigation purposes. In some places these sand and gravel bodies may be sufficiently numerous and interconnected so as to cause the entire till sheet to act as a single water-bearing unit over a considerable area.

In the central part of the Red River Valley proper, the till sheet is overlain by nearly impermeable clay that was deposited in the waters of glacial Lake Agassiz. This clay cover confines the water in the till sheet under pressure so that flowing wells are obtained at many places in the valley.

The clay that forms the confining bed in this area has been referred to as the "clay unit of the Lake Agassiz deposits." It does not yield water to wells. In the central part of the valley it is overlain by a relatively thin deposit of somewhat more permeable material, which has been called the "silt unit of the Lake Agassiz deposits." The silt unit is a weak aquifer in some places and furnishes water for a small number of farm and domestic supplies.

Several deltas, formed where glacial streams discharged into glacial Lake Agassiz, occur along the margins of the Red River Valley. The deltas are composed of sorted materials ranging in grain size from clay to coarse gravel, and some of them cover relatively large areas. They are important sources of water for farm, domestic, and municipal uses.

Table 8.--Known great floods on Red River Tributaries
(Stage and discharge at stream and place of reference)

Year	Mustinka--Wheaton	Wild Rice (N Dak.)--Abercrombie	Sheyenne--Valley City	Wild Rice (Minn.)--Twin Valley	Goose--Hillsboro	Red Lake--Crookston	Forest--Minto	Park--Grafton	Pembina--Neche	Souris--Minto	Assiniboine--Headingley
1873		(F)									
1882		(F)	April 20.0 a b -	April - 6,700 a c	April - 6,700 a c		April - 2,200 a c	April 16 b d -			April 773 b -
1897		April 34-36 b -	April 15.5 b -		April - 5,700 a c	April 11 25.2 b 18,900 c d	April - 1,850 a c	April 15 18.14 a,b 3,480 a c			
1904					April - 5,300 a c	April 24 20.42 b 13,700 c			May 2 20.9 b 3,870 d	April 20 21.9 b 12,000 c	April 774.4 b -
1906						April 15 21.00 b 14,500 c					
1907						April 4 12.04 b 6,330 c	April - 1,750 a,c		May 11 13.2 b 2,190 e	May 28-30 16.0 b 2,190 e	

1909				July 22 20.0 b 9,200 c		July 21 8.77 b 3,660 c				April 14 9.45 b 1,090 c	
1916	Apr -May 17.4 b 2,980 c	(F)	(F)		April - 4 700 a c	April 17 21.8 b 13,900 c	April - 1,600 a c	April 17.64 a b 3,140 a c	April - 4,700 e	May 6, 7 19.05 b 4,260 c	April 27 769.75 b 21,700 c
1917	April 1 14.73 b 2,260 c	(F)				April 11 12.2 b 5,410 c				April 29 11.4 b 1,280 c	
1919			April 18 14.9 b 2,750 c			July 5 21.1 b 13,300 c			April 15 15.1 b 2,430 c	April 18-20 15.0 b 1,860 c	
1942								April 6 15.46 b 4,310 c			
1943	April 3 15.00 b 1 860 c	April 2 21.02 b 5.500 c	Mar.,Apr. - 1,900 c			April 8 16.88 b 9,410 c	July 15 - 1,200 c		Mar. 27,28 - 1,100 c		
1948	April 1 - 2 080 c		April 28 17.51 b 4 580 c		April 16 10.63 b 4,180 c	April 19 - 9,520 c	April 19 11.80 b 12,000 c	April 19 20.06 b 11,700 c	April 21 20.36 b 3,770 c		

F Large flood (stage and discharge indeterminate).
a Determined by the Corps of Engineers.
b Stage (gage height, in feet).
c Discharge (in second-feet).
d Approximate.
e Mean daily discharge.

Although many ground-water supplies in the basin are obtained from the underlying bedrock formations, such as the Pierre shale, Dakota sandstone, Paleozoic sediments, and even from the basal pre-Cambrian "granite," the water-bearing glacial deposits listed above are by far the most important sources of ground water.

In order to determine the nature and magnitude of the recharge to these deposits, the U. S. Geological Survey obtains periodic water-level measurements in about 45 observation wells in the basin in North Dakota in cooperation with the North Dakota State Water Conservation Commission. Measurements are made in five observation wells in Clay County, Minnesota, in cooperation with the Minnesota State Department of Conservation. (Figure 41 shows the locations of 19 of these observation wells, and figures 42, 43, and 44 are the hydrographs showing fluctuations of the water level.

Recharge to these deposits is by downward percolation of rain and water from melted snow. In general, the recharge occurs on a regional scale, although certain local deposits may absorb more water per unit area than is absorbed per unit area on the whole because of greater local permeability or potential storage capacity, or other factors. The water moves downward from the land surface to the water table and thence laterally to discharge into the streams as seeps or springs or into lakes, ponds, or marshes, where it may be disposed of through direct evaporation or through plant transpiration. In some places considerable ground water may be discharged by transpiration of deep-rooted vegetation, even though the water table is several feet below the land surface. Likewise, in some places, capillary forces may lift water several feet above the water table to the land surface, where it is discharged into the air by evaporation.

In any locality a rise in water level will occur when the rate of recharge exceeds the rate of discharge and, conversely, a lowering of the water level will occur when the discharge rate exceeds the recharge rate, as during dry periods when there is little or no recharge but discharge of ground water continues.

It has been found that, except for the confined aquifers in the central part of the Red River Valley, the principal recharge to the glacial deposits occurs quite regularly at the time of the spring break-up. As the frost leaves the ground, some of the temporarily ponded or slowly moving water from the melted snow percolates downward to the water table. Evaporation of water from the soil and open water surfaces is relatively small at this time of the year because of the low temperature. Rainfall at this time will augment the water available from the melting snow and will increase the amount of water available for recharge. Transpiration at this time of the year will be negligible because the vegetation is still dormant.

As a result, water levels usually attain their highest stages during the late spring or early summer. With the advent of warmer, drier weather in the early summer, natural discharge of the ground water is accelerated by increased evaporation and transpiration and the water levels decline.

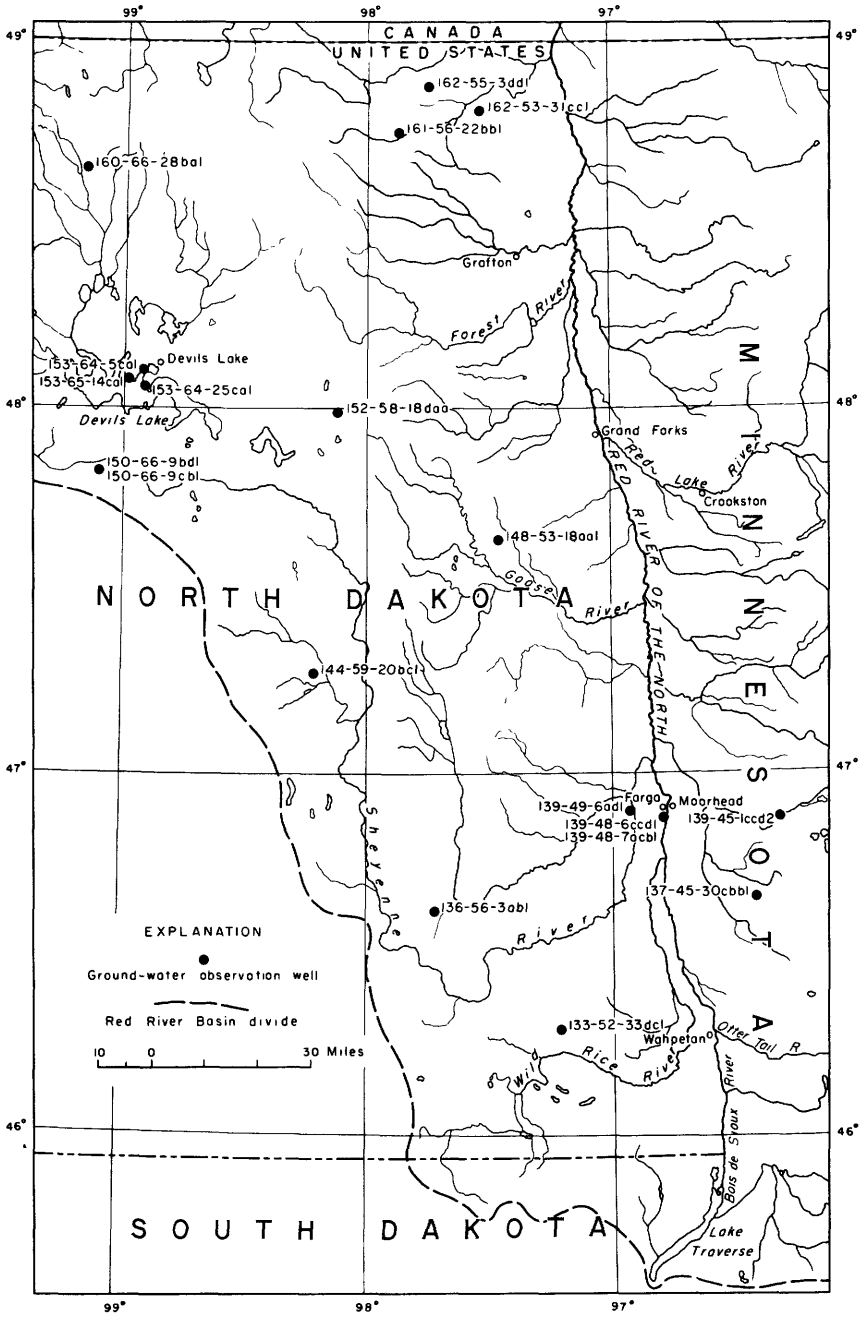

Figure 41.—Location of selected observation wells in the Red River of the North Basin.

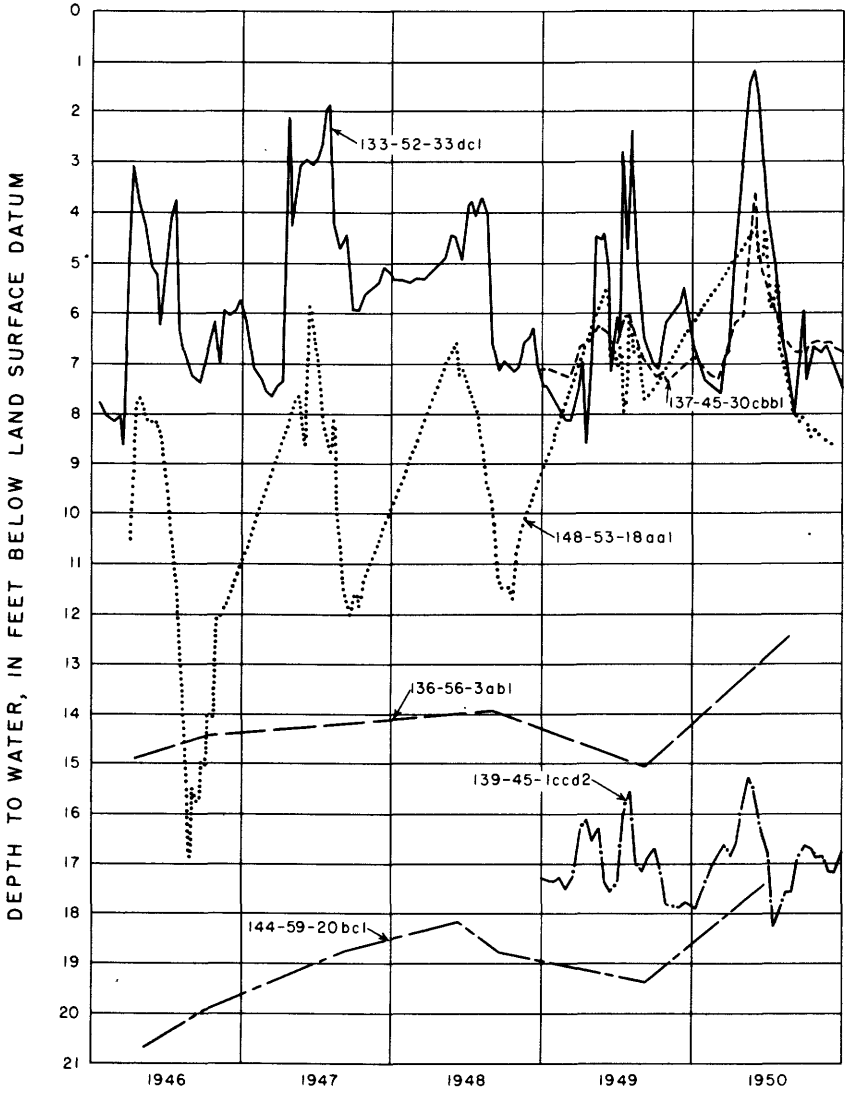

Figure 42.—Water-level fluctuations in six wells in the southern part of the basin of the Red River of the North.

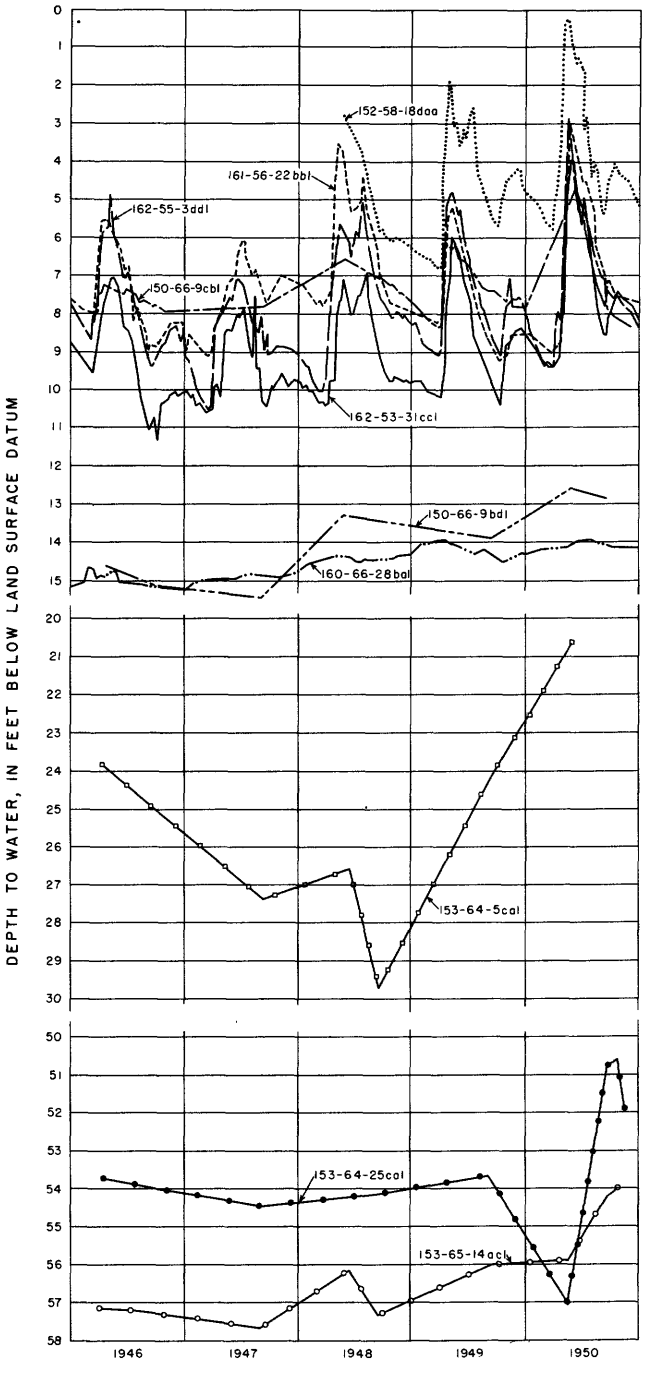

Figure 43.—Water-level fluctuations in ten wells in the northern part of the basin of the Red River of the North.

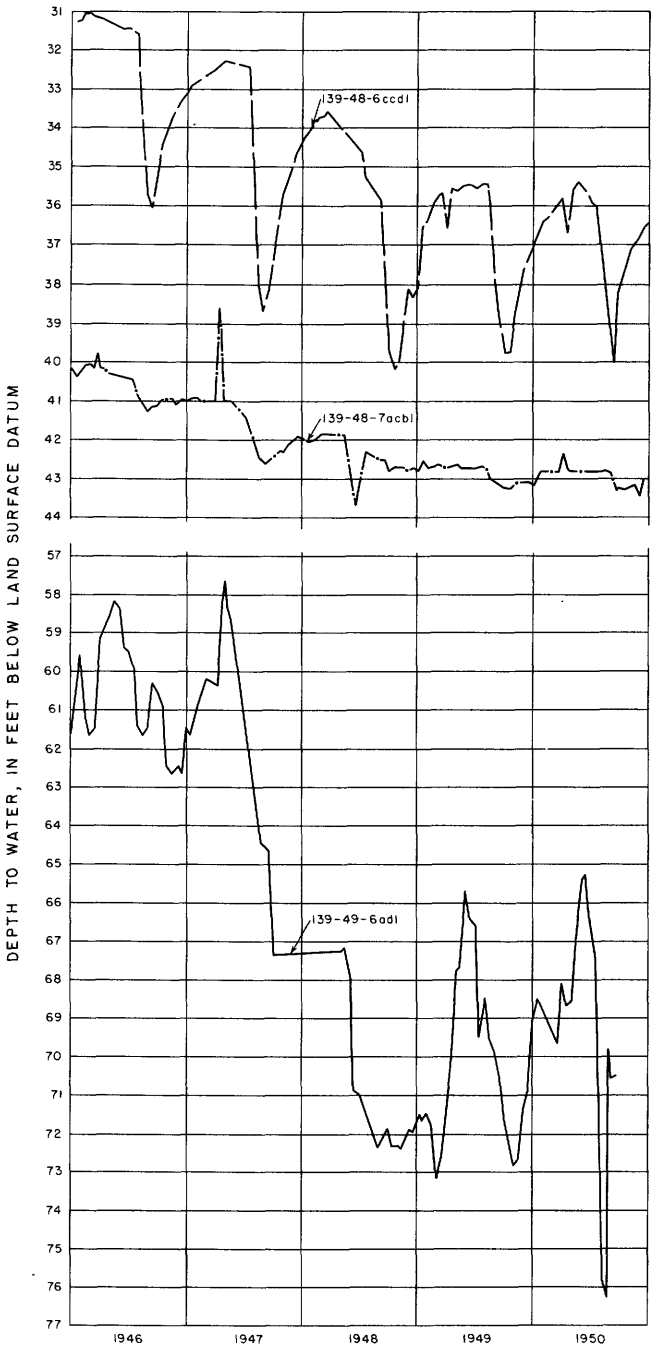

Figure 44.—Water-level fluctuations in three wells near Fargo and West Fargo, N. Dak., in the basin of the Red River of the North.

Significant recharge may occur also from the penetration of rain during the summer and fall months, but much of this precipitation evaporates from the soil surface or is transpired by vegetation and so does not reach the water table. For this reason, only heavy or sustained rains during the summer and fall contribute substantially to ground-water storage.

Little or no recharge occurs during the winter season while the ground is frozen and there is little or no melting of snow.

During the spring of 1950, concurrently with the disastrous floods in the basin of the Red River of the North, ground-water levels in the basin rose, following much the same pattern as in previous years. However, the total rise was greater than previously at most observation wells, and the highest water levels of record were attained at many wells.

It is believed that the high water levels resulted principally from the prolonged conditions favorable to recharge during this season, which were the same conditions that were favorable for the occurrence of a major flood in the basin. These were the melting of an unusually heavy accumulation of snow, accompanied by additional heavy snow and rain during the months of April and May.

The presence of the flood waters in the disaster areas probably did not significantly affect the water levels or the ground-water storage in the basin as a whole, because the flood waters accumulated on the lower ground whereas the principal ground-water recharge is in the higher marginal parts of the basin. On the other hand, the presence of the underground reservoirs must have had a significant effect on the severity of the flood. The absorption of water by the ground, as evidenced by the rises in water levels, prevented a large amount of water from reaching the streams during the flood period that otherwise would have reached the streams by direct runoff and, thereby, would have caused a considerably higher flood stage or an extension of the flood period.

LEVEL OF DEVILS LAKE

A large area of eastern North Dakota centered about Devils Lake does not, at present, drain into any major stream. This area experienced high rates of runoff during the spring of 1950 when the heavy snow-cover thawed. Mauvais Coulee, largest surface supply to Devils Lake, carried the high peak discharge of 660 cfs about June 5, 1950. More steady, although less spectacular, was the contribution of ground-water to building up the Lake level. The combined flow of surface-water and steady inflow from ground-water brought the level up to an annual maximum that had not occurred since 1924. Figure 45 shows the known fluctuations in level of Devils Lake through water year 1950. Further gains were made in the spring of 1951. The change in contents that occurred during water year 1950 is reflected by the following data on the surface area of the main lake:

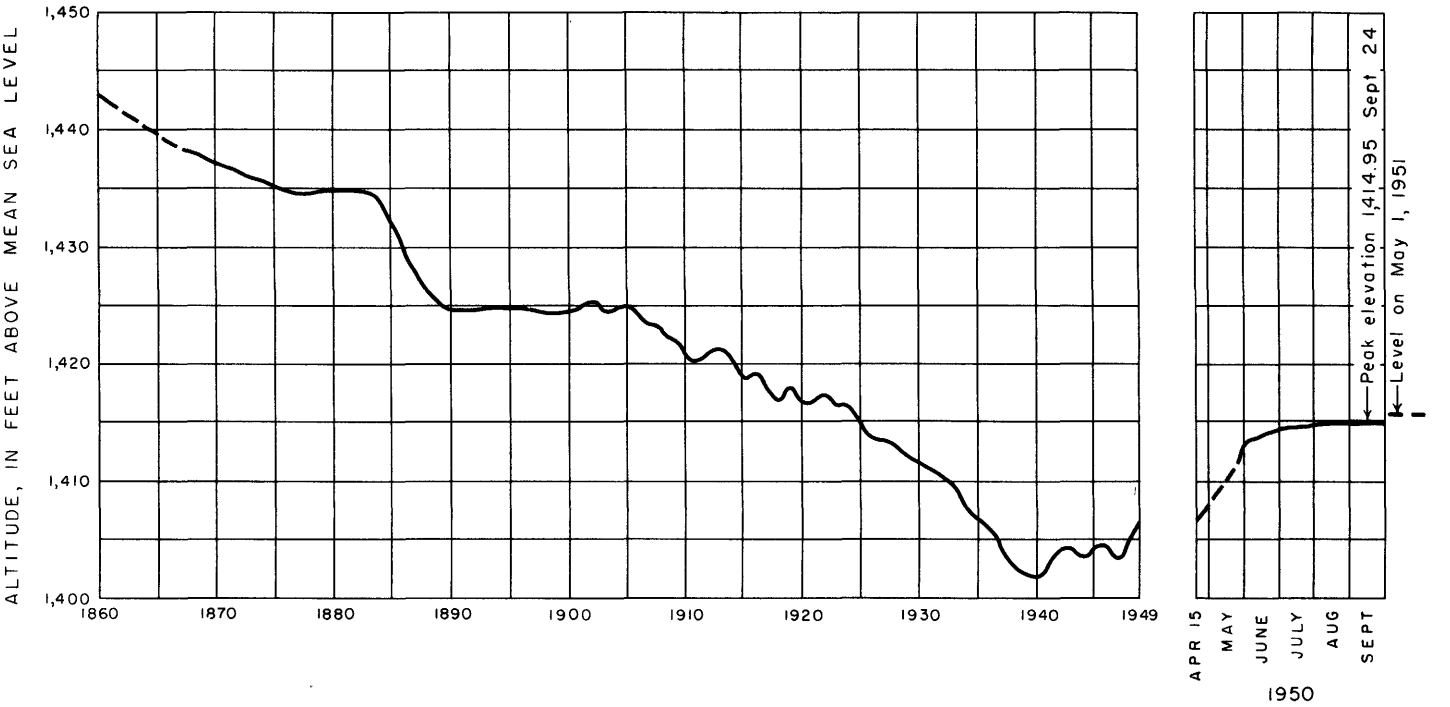

Figure 45.—Variations in the water-level of Devils Lake, N. Dak., 1860-1950, showing rise occurring in 1950.

Level	Approximate area (square miles)
1406.5	13.5
1415.0	21.5

This represents approximately 90,000 acre-feet gain in contents in the main lake. The total increase in contents during 1950 of the body of water known as Devils Lake is difficult to determine. Devils Lake, during 1950, was composed of two major bodies of water: the main lake, west of Fort Totten; and a large body connected with the main lake, lying east of Fort Totten. The two bodies were different in elevation in 1950 with considerable flow from west to east through the small connecting stream between them. No gage record is available for the eastern body of water. Besides the gain registered by the main bodies of water of Devils Lake, numerous minor lakes and ponds in the closed basin showed large increases in contents. A comprehensive report, now being prepared by the Quality of Water Branch, will give more detailed data on the capacity and change of contents of Devils Lake.

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- b 78th Cong., 1st sess., 1943, H. Doc. 345.
- c 60th Cong., 1st sess., 1907, H. Doc. 493.
- d 60th Cong., 1st sess., 1907, H. Doc. 400.
- e 56th Cong., 1st sess., 1899, H. Doc. 67.
- f 53d Cong., 2d sess., 1894, H. Doc. 1335.
- g 65th Cong., 1st sess., 1917, H. Doc. 199.
- h 66th Cong., 1st sess., 1919, H. Doc. 61.
- i 81st Cong., 2d sess., 1950, Hearings on H. R. 8396, 8461, 8420, 8390, and 8435.
- j 81st Cong., 2d sess., 1950, Hearings on S 2415.
- k 78th Cong., 2d sess., 1944, Sen. Doc. 193.

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