DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 325

SURFACE WATER SUPPLY OF THE UNITED STATES

1912

PART V. UPPER MISSISSIPPI RIVER AND HUDSON BAY BASINS

BY

A. H. HORTON, W. G. HOYT
AND H. J. JACKSON

WASHINGTON
GOVERNMENT PRINTING OFFICE
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By A. H. Horton, W. G. Hoyt, and H. J. Jackson

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 12 reports presenting results of measurements of flow made on streams in the United States during the calendar year 1912.

The data presented in these reports were collected by the United States Geological Survey under authority implied in the organic law (20 Stat. L., p. 394) which contains the following paragraph:

Provided, That this officer [the Director] shall have the direction of the geological survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

The work was begun in 1888 in connection with special studies of water supply for irrigation. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

Annual appropriations for the fiscal years ending June 30, 1895–1913.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1913, inclusive	150,000

In the execution of the work many private and State organizations have cooperated, either by furnishing data or by assisting in collecting the data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected and of the second kind on page 16.

Measurements of stream flow have been made at about 2,000 points in the United States and also at many points in small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, and in the Hawaiian Islands. During 1912 gaging stations were maintained by the Survey and the cooperating organizations at about 1,500 points, and many discharge measurements were made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in the regular water supply papers from time to time.

PUBLICATIONS.

A report for each calendar year has been prepared embodying the stream-flow data collected during that year. An index to the reports containing stream-flow measurements prior to 1904 has been published as Water-Supply Paper 119. Circulars are also available giving complete lists of the gaging stations maintained by the Survey to date, and a list of the reports relating to the water supply of the country.

Prior to 1902 gage heights and discharge measurements were published in water-supply papers of bulletins and estimates of monthly discharge in annual reports; since 1902 both classes of data have been published in water-supply papers, and they are now being published in 12 parts, as shown in the following table:

Papers on surface water supply of the United States, 1912.

Part.[a]	No.	Title.
I	321	North Atlantic coast basins.
II	322	South Atlantic coast and eastern Gulf of Mexico basins.
III	323	Ohio River basin.
IV	324	St. Lawrence River basin.
V	325	Upper Mississippi River and Hudson Bay basins.
VI	326	Missouri River basin.
VII	327	Lower Mississippi River basin.
VIII	328	Western Gulf of Mexico basins.
IX	329	Colorado River basin.
X	330	Great Basin.
XI	331	Pacific coast basins in California.
XII	332	North Pacific coast basins.

[a] For the purpose of uniformity in the presentation of reports, a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into 12 parts, whose boundaries coincide with natural drainage lines indicated by the parts of the report.

A list of reports containing stream-flow data is presented in the following table:

Stream-flow data in reports of the United States Geological Survey.

[A=Annual Report; B=Bulletin; WS=Water-Supply Paper.]

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge	1884 to Sept., 1890.
12th A, pt. 2	do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
WS 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
WS 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
WS 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
WS 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
WS 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
WS 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
WS 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
WS 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
WS 75	Monthly discharge	1901.
WS 82 to 85	Complete data	1902.
WS 97 to 100	do	1903.
WS 124 to 135	do	1904.
WS 165 to 178	do	1905.
WS 210 to 214	do	1906.
WS 241 to 252	do	1907–8.
WS 261 to 272	do	1909.
WS 281 to 292	do	1910.
WS 301 to 312	do	1911.
WS 321 to 332	do	1912.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The table which follows gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1911. The data for any particular station will be found in the reports covering the years during which the station was maintained. For example, data for any station in the area covered by Part I are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, and 321, which contain records for the New England streams from 1903 to 1912. The year covered by the report is indicated at the head of the column in which the paper is listed.

Numbers of water-supply papers containing results of stream measurements, 1899–1912.

	1899[a]	1900[b]	1901	1902	1903	1904
North Atlantic coast (St. John River to York River)	35	47, [c]48	65, 75	82	97	[d]124, [e]125, [f]126
South Atlantic coast and eastern Gulf of Mexico (James River to the Mississippi)	[g]35, 36	48	65, 75	[g]82, 83	[g]97, 98	[f]126, 127
Ohio River basin	36	48, [h]49	65, 75	83	98	128
St. Lawrence River and Great Lakes	36	49	65, 75	[i]82, 83	97	129
Hudson Bay and upper Mississippi River	36	49	[j]65, 66, 75	[j]83, 85	[j]98, 99, 100	[j]128, 130
Missouri River	[k]36, 37	49, [l]50	66, 75	84	99	130, [m]131
Lower Mississippi River	37	50	[j]65, 66, 75	[j]83, 84	[j]98, 99	[f]128, 131
Western Gulf of Mexico	37	50	66, 75	84	99	132
Colorado River	[n]37, 38	50	66, 75	85	100	133
Great Basin	38, [p]39	51	66, 75	85	100	133, [q]134
Pacific coast in California	38, [r]39	51	66, 75	85	100	134
North Pacific coast	38	51	66, 75	85	100	135

	1905	1906	1907–8	1909	1910	1911	1912
North Atlantic coast (St. John River to York River)	[d]165, [e]166, [f]167	[d]201, [e]202, [f]203	241	261	281	301	321
South Atlantic coast and eastern Gulf of Mexico (James River to the Mississippi)	[f]167, 168	[f]203, 204	242	262	282	302	322
Ohio River basin	169	205	243	263	283	303	323
St. Lawrence River and Great Lakes	170	206	244	264	284	304	324
Hudson Bay and upper Mississippi River	171	207	245	265	285	305	325
Missouri River	172	208	246	266	286	306	326
Lower Mississippi River	[j]169, 173	[j]205, 209	247	267	287	307	327
Western Gulf of Mexico	174	210	248	268	288	308	328
Colorado River	175, [o]177	211	249	269	289	309	329
Great Basin	176, [q]177	212, [q]213	250, [q]251	270, [q]271	290	310	330
Pacific coast in California	177	213	251	271	291	311	331
North Pacific coast	[s]177, 178	214	252	272	292	312	332

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Estimates for 1899 in Twenty-first Annual Report, part 4.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Estimates for 1900 in Twenty-second Annual Report, part 4.
[c] Wissahickon and Schuylkill rivers to James River.
[d] New England rivers only.
[e] Hudson River to Delaware River, inclusive.
[f] Susquehanna River to Yadkin River, inclusive.
[g] James River only.
[h] Scioto River.
[i] Lake Ontario and tributaries to St. Lawrence River proper.
[j] Tributaries of Mississippi from east.
[k] Gallatin River.
[l] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[m] Platte and Kansas rivers.
[n] Green and Gunnison rivers and Grand River above junction with Gunnison.
[o] Below junction with Gila.
[p] Mohave River only.
[q] Great Basin in California, excepting Truckee and Carson drainage basins.
[r] Kings and Kern rivers and south Pacific coast drainage basins.
[s] Rogue, Umpqua, and Siletz rivers only.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below.

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.

3. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

4. Complete sets are available for consultation in the local offices of the water-resources branch of the Geological Survey, as follows:

Albany, N. Y., Room 18, Federal Building.
Atlanta, Ga., Post Office Building.
Newport, Ky., Federal Building.
Madison, Wis., care of the Railroad Commission, Capital Building.
St. Paul, Minn., Old Capitol Building.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 302 Chamber of Commerce Building.
Salt Lake City, Utah, Brooks Arcade.
Boise, Idaho, 615 Idaho Building.
Portland, Oreg., 416 Couch Building.
San Francisco, Cal., 505 Custom House.
Santa Fe, N. Mex., Capitol Building.
Honolulu, Hawaii, Kapiolani Building.

A list of the Geological Survey's publications will be sent on application to the Director of the United States Geological Survey, Washington, D. C.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and discharge in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. The units used in this series of reports are second-feet, second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the unit for the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the following table of equivalents.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off (depth in inches)" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

An "acre-foot" is equivalent to 43,560 cubic feet and is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

Table for converting discharge in second-feet per square mile into run-off in depth in inches over the area.

Discharge in second-feet per square mile.	Run-off in inches.				
	1 day.	28 days.	29 days.	30 days.	31 days.
1	0.03719	1.041	1.079	1.116	1.153
2	.07438	2.083	2.157	2.231	2.306
3	.11157	3.124	3.236	3.347	3.459
4	.14876	4.165	4.314	4.463	4.612
5	.18595	5.207	5.393	5.578	5.764
6	.22314	6.248	6.471	6.694	6.917
7	.26033	7.289	7.550	7.810	8.070
8	.29752	8.331	8.628	8.926	9.223
9	.33471	9.372	9.707	10.041	10.376

NOTE.—For partial month multiply the values for one day by the number of days.

Table for converting discharge in second-feet into run-off in acre-feet.

Discharge in second-feet.	Run-off in acre-feet.				
	1 day.	28 days.	29 days.	30 days.	31 days.
1	1.983	55.54	57.52	59.50	61.49
2	3.967	111.1	115.0	119.0	123.0
3	5.950	166.6	172.6	178.5	184.5
4	7.934	222.1	230.1	238.0	246.0
5	9.917	277.7	287.6	297.5	307.4
6	11.90	333.2	345.1	357.0	368.9
7	13.88	388.8	402.6	416.5	430.4
8	15.87	444.3	460.2	476.0	491.9
9	17.85	499.8	517.7	535.5	553.4

NOTE.—For partial month multiply values for one day by the number of days.

1 second-foot equals 40 California miner's inches (law of Mar. 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,317 gallons for one day.

1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.

1 second-foot for one year equals 31,536,000 cubic feet.

1 second-foot equals about 1 acre-inch per hour.

1 second-foot for one day equals 86,400 cubic feet.

1,000,000,000 (1 United States billion) cubic feet equals 11,570 second-feet for one day.

1,000,000,000 cubic feet equals 414 second-feet for one 28-day month.

1,000,000,000 cubic feet equals 399 second-feet for one 29-day month.

1,000,000,000 cubic feet equals 386 second-feet for one 30-day month.

1,000,000,000 cubic feet equals 373 second-feet for one 31-day month.
100 California miner's inches equals 18.7 United States gallons per second.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-feet.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square miles equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1¼ horsepower equals about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF DATA.

For each regular current-meter gaging station the following data are given: Description of the station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height table is omitted.

In addition to statements regarding the location and installation of current-meter stations, the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting channels, and backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The table of daily gage heights records the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day, usually in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water

above the zero of the gage. All gage heights affected by the presence of ice in the streams or by backwater from obstructions are published as recorded, with suitable footnotes. The rating table is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitary datum and has no relation to zero flow or the bottom of the river. In general the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which rating tables, daily discharge tables, and monthly discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report, but can be determined from the tables of daily gage heights and daily discharge by plotting gage heights in feet as ordinates and discharge in second-feet as abscissas.

The table of daily discharges gives the discharges in second-feet corresponding to the observed gage heights as determined from the rating tables.

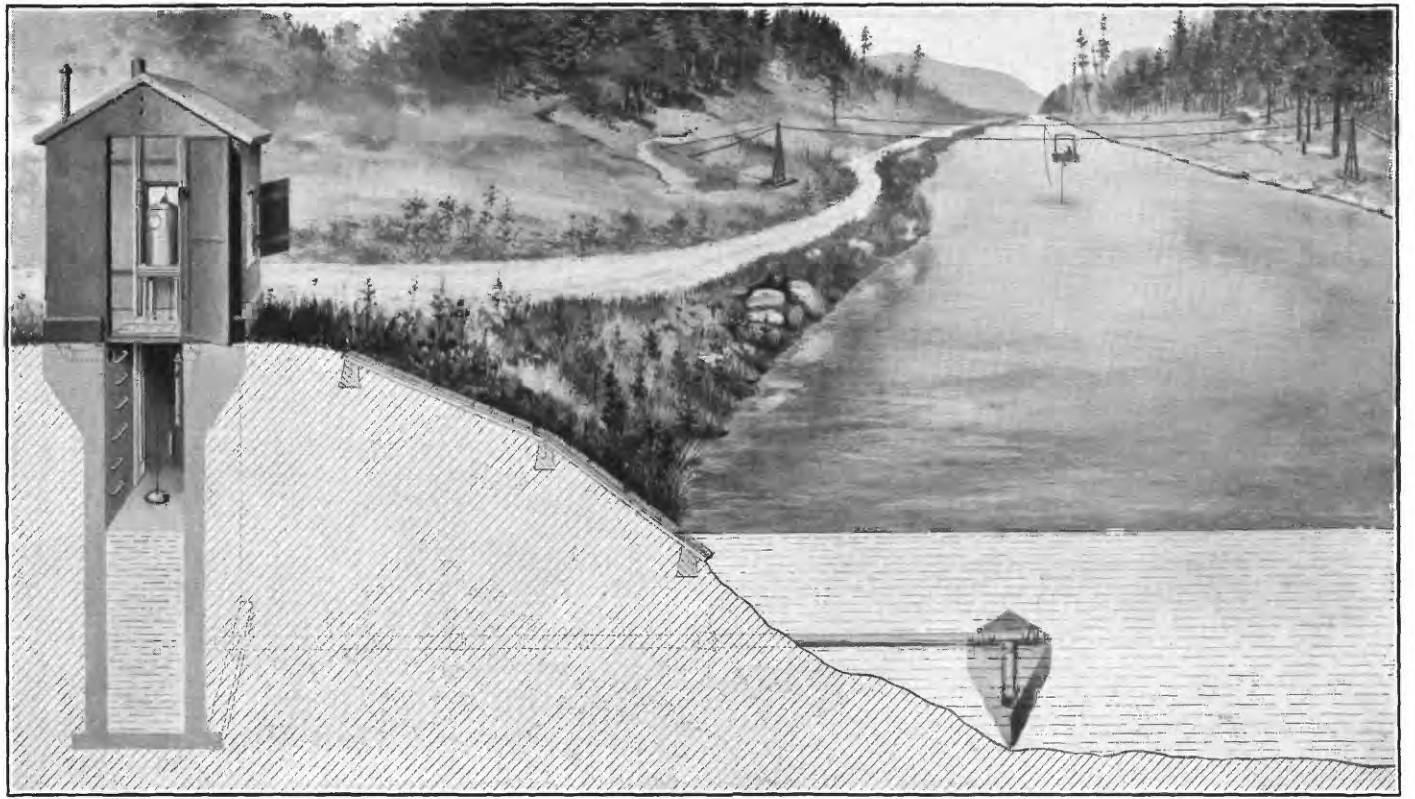
In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 11, are based.

The base data presented in this report, unless otherwise stated in description of station, have been collected by the methods commonly used at current-meter gaging stations and described in standard textbooks.

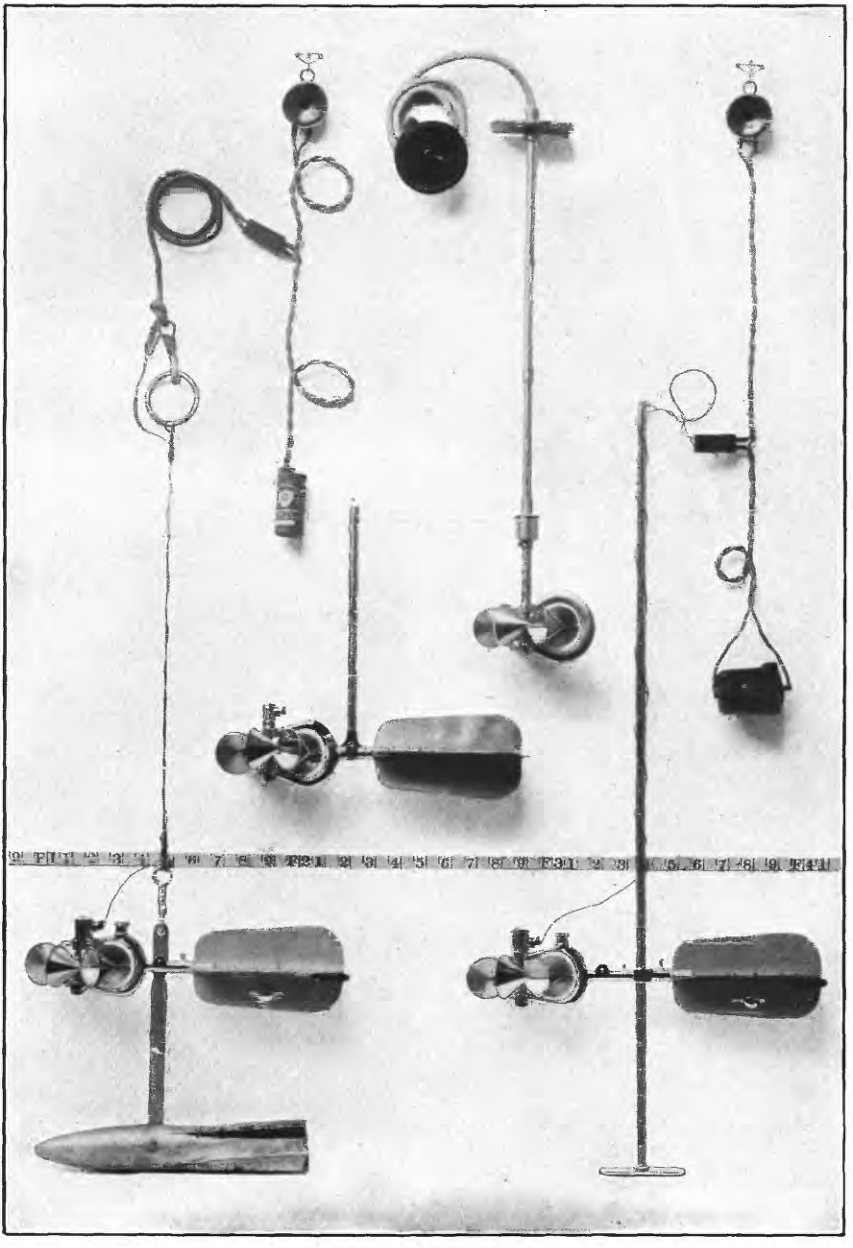
Plate I shows typical gaging stations. Plate II shows current meters used in the work.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

The accuracy of stream-flow data depends primarily on the natural conditions at the gaging station and on the methods and care with which the data are collected. Errors of the first group depend on the degree of permanency of channel and of permanency of the relation between discharge and stage.



TYPICAL GAGING STATIONS.



PRICE CURRENT METERS.

Errors of the second class are due, first, to errors in observation of stage; second, to errors in measurements of flow; and, third, to errors due to misinterpretation of stage and flow data.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the daily discharge tables, stating the probable accuracy of the rating tables used, and an accuracy column is inserted in the monthly discharge table. For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or "approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

Even though the monthly means for any station may represent with a high degree of accuracy the quantity of water flowing past the gage, the figures showing discharge per square mile and depth of runoff in inches may be subject to gross errors which result from including in the measured drainage area large noncontributing districts or omitting estimates of water diverted for irrigation or other use, and they should, therefore, be considered as only approximate, particularly for periods of irrigation or of low water. For these errors it is as a rule not feasible to make adequate correction.

In general, the base data collected each year by the Survey engineers are published, not only to comply with the law, but also to afford any engineer the means of examining and adjusting to his own needs the results of the computations. The table of monthly discharge is so arranged as to give only a general idea of the flow at the station and should not be used for other than preliminary estimates. The determinations of daily discharge allow more detailed studies of the variation in flow by which the period of deficiency may be determined.

It should be borne in mind that the observations in each succeeding year may be expected to throw new light on data already collected and published, and the engineer who makes use of the figures presented in these papers should verify all ratings and make such adjustments for earlier years as may seem necessary.

COOPERATION.

The work in Minnesota during 1912 has been done with State cooperation under terms of an act of the legislature of 1909 as embodied in joint resolution 19, which reads as follows:

Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem, therefore: *Be it resolved by the house of representatives, the senate concurring*, That the State Drainage Commission be, and is hereby, directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of soil problem in this State.

The work has been carried on in conjunction with the State Drainage Commission, George A. Ralph, chief engineer.

The State of Illinois cooperated in stream-gaging work in that State, the appropriation being under the control of the Rivers and Lakes Commission, Robert R. McCormick, chairman.

DIVISION OF WORK.

The field data in the Hudson Bay drainage basin, except in Minnesota, were collected under the direction of W. A. Lamb, district engineer, Helena, Mont., by E. F. Chandler, R. R. Randell, George Ebner, Goric Monley, and W. B. Stevenson. The ratings and studies of the completed data were made by W. A. Lamb, E. F. Chandler, G. C. Stevens, and B. E. Jones. Estimates of flow during periods when the relation of gage height to discharge was affected by ice were made by G. C. Stevens, B. E. Jones, and E. F. Chandler.

The field data in the Hudson Bay drainage basin in Minnesota were collected under the direction of W. G. Hoyt, district engineer, St. Paul, Minn., by E. F. Chandler, S. B. Soulé, George Ebner, Goric Monley, W. B. Stevenson, and E. J. Budge. The ratings and studies of the completed data were made by W. G. Hoyt, E. F. Chandler, and H. J. Jackson. The estimates of flow during periods when the relation of gage height to discharge was affected by ice were made by W. G. Hoyt and E. F. Chandler.

The field data for the upper Mississippi River drainage basin, except in Illinois, were collected under the direction of W. G. Hoyt, district engineer, St. Paul, Minn., by S. B. Soulé, B. J. Peterson, and M. J. Orbeck. The ratings and studies of the completed data were made by W. G. Hoyt and H. J. Jackson. Estimates of flow when the relation of gage height to discharge was affected by ice were made by W. G. Hoyt.

In the upper Mississippi River drainage basin in Illinois the field data were collected under the direction of A. H. Horton, district engi-

neer, Newport, Ky., by P. S. Monk. The ratings and studies of the completed data were made by A. H. Horton and H. J. Jackson. Estimates of flow during periods when the relation of gage height to discharge was affected by ice were made by H. J. Jackson.

The completed data for the report, except the stations in Montana and North Dakota, were prepared for publication by H. J. Jackson, assistant engineer. Data for stations in Montana and North Dakota were prepared for publication by G. C. Stevens, assistant engineer.

The computations were made under the direction of H. J. Jackson and G. C. Stevens, by J. G. Mathers, H. D. Padgett, H. J. Dean, C. L. Batchelder, and M. I. Walters.

The report was edited by Mrs. B. D. Wood.

STATION RECORDS.

HUDSON BAY DRAINAGE AREA IN THE UNITED STATES.

ST. MARY RIVER NEAR BABB, MONT.[1]

Location.—Near dam site a quarter of a mile below the outlet of Lower St. Mary Lake, 1 mile above the mouth of Swiftcurrent Creek, and about 2 miles south of Babb, Mont.

Records available.—April 9, 1902, to December 31, 1912.

Drainage area.—177 square miles.

Gage.—Chain gage on the right bank of the stream; datum unchanged. A temporary low-water gage has been used during the winter months.

Channel.—Practically permanent.

Discharge measurements.—Made from cable 300 feet below the gage. In September, 1909, the cable was moved from a point 300 feet farther downstream. Low-water measurements are made by wading one-fourth mile above the gage.

Winter flow.—The channel freezes over at the gage and considerable ice exists in the stream, but records are not believed to be seriously affected thereby.

Floods.—The flood of June 5, 1908, reached a stage of about 9.4 feet.

Accuracy.—Rating curve is well defined except for winter months. Inaccuracies in datum of temporary gage and possible effect from ice affect the winter records. The winter estimates are believed to be fair, however.

Discharge measurements of St. Mary River near Babb, Mont., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 16[a]	W. A. Lamb	0.68	49
July 2	R. R. Randell	3.58	1,330
Dec. 16[b]	W. A. Lamb	1.16	117

[a] By wading 200 yards above gage. Ice along both banks at gage and at control; channel open at control.
[b] From cable. Ice on edges at gage and at cable.

[1] The records for this station were published in Water-Supply Papers 85 and 100 as "St. Mary River at dam site near St. Mary," and in Water-Supply Paper 130 as "St. Mary River near St. Mary."

Daily gage height, in feet, of St. Mary River near Babb, Mont., for 1912.

[Carl Giruin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.8	0.90	0.78	0.78	1.6	3.6	3.6	2.7	1.9	1.5	1.5	1.4
2	.8	.90	.78	.78	1.7	3.6	3.6	2.6	1.9	1.4	1.55	1.3
3	.8	.90	.78	.80	1.8	3.6	3.5	2.6	1.85	1.4	1.5	1.3
4	.8	.87	.78	.80	1.9	3.6	3.4	2.6	1.9	1.35	1.5	1.35
5	.8	.87	.78	.83	1.9	3.5	3.4	2.6	1.8	1.4	1.5	1.3
6	.8	.85	.78	.86	1.9	3.4	3.3	2.6	1.85	1.4	1.5	1.3
7	.8	.85	.78	.90	1.95	3.4	3.3	2.6	1.8	1.35	1.5	1.3
8	.8	.83	.78	.90	2.0	3.4	3.2	2.6	1.85	1.4	1.45	1.25
9	.8	.80	.78	.92	2.1	3.4	3.1	2.6	1.85	1.4	1.5	1.3
10	.8	.80	.75	.95	2.1	3.5	3.0	2.5	1.85	1.3	1.45	1.3
11	.8	.80	.75	1.05	2.2	3.6	3.0	2.5	1.9	1.35	1.45	1.2
12	.8	.80	.72	1.1	2.3	3.8	2.9	2.45	1.85	1.3	1.5	1.2
13	.85	.78	.72	1.15	2.5	3.8	2.8	2.45	1.9	1.35	1.5	1.2
14	.9	.78	.70	1.07	2.6	3.8	2.8	2.4	1.9	1.3	1.6	1.2
15	.9	.78	.70	1.10	3.0	3.8	2.8	2.35	1.8	1.4	1.55	1.15
16	.9	.78	.68	1.30	3.2	3.8	2.8	2.3	1.85	1.4	1.55	1.2
17	.9	.78	.68	1.32	3.4	3.7	2.7	2.3	1.85	1.4	1.6	1.2
18	.9	.78	.68	1.38	3.6	3.6	2.7	2.25	1.8	1.4	1.55	1.2
19	.9	.78	.68	1.42	3.7	3.6	2.7	2.2	1.8	1.5	1.6	1.15
20	.9	.78	.68	1.48	3.8	3.6	2.6	2.2	1.75	1.5	1.6	1.15
21	.9	.78	.68	1.50	4.0	3.6	2.6	2.2	1.8	1.55	1.5	1.1
22	.9	.78	.68	1.5	4.0	3.6	2.7	2.1	1.7	1.5	1.5	1.1
23	.9	.78	.68	1.6	4.0	3.6	2.8	2.1	1.7	1.6	1.5	1.1
24	.9	.78	.68	1.6	3.9	3.6	2.8	2.1	1.7	1.55	1.5	1.1
25	.9	.78	.68	1.65	3.8	3.6	2.8	2.1	1.6	1.6	1.45	1.1
26	.9	.78	.70	1.7	3.8	3.6	2.9	2.1	1 65	1.55	1.5	1.05
27	.9	.78	.70	1.7	3.8	3.6	2.9	2.1	1.6	1.5	1.4	1.0
28	.9	.78	.70	1.7	3.7	3.6	2.8	2.0	1.6	1.6	1.4	1.0
29	.9	.78	.72	1.75	3.7	3.6	2.8	2.0	1.55	1.55	1.4	1.0
30	.9	.....	.72	1.65	3.6	3.6	2.8	2.0	1.55	1.6	1.35	.95
31	.9	.....	.72	.....	3.6	.....	2.7	1.95	.....	1.55	.....	.95

NOTE.—Temporary gage used Jan. 1 to Apr. 13. Ice present in the stream from Jan. 1 to about Mar. 25.

Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	38	73	57	57	253	1,360	1,360	755	366	217	217	183
2	42	73	57	57	290	1,360	1,360	700	366	183	235	153
3	46	73	57	59	328	1,360	1,280	700	347	183	217	153
4	50	69	57	59	366	1,360	1,200	700	366	168	217	168
5	54	69	57	63	366	1,280	1,200	700	328	183	217	153
6	59	66	57	67	366	1,200	1,130	700	347	183	217	153
7	59	66	57	73	386	1,200	1,130	700	328	168	217	153
8	59	63	57	73	405	1,200	1,060	700	347	183	200	140
9	59	59	57	76	445	1,200	995	700	347	183	217	153
10	59	59	53	81	445	1,280	935	645	347	153	200	153
11	59	59	53	98	490	1,360	935	645	366	168	200	128
12	59	59	49	107	540	1,520	875	618	347	153	217	128
13	66	57	49	118	645	1,520	815	618	366	168	217	128
14	73	57	47	102	700	1,520	815	590	366	153	253	128
15	73	57	47	107	935	1,520	815	565	328	183	235	118
16	73	57	45	153	1,060	1,520	815	540	347	183	235	128
17	73	57	45	159	1,200	1,440	755	540	347	183	253	128
18	73	57	45	177	1,360	1,360	755	515	328	183	235	128
19	73	57	45	190	1,440	1,360	755	490	328	217	253	118
20	73	57	45	210	1,520	1,360	700	490	309	217	253	118
21	73	57	45	217	1,680	1,360	700	490	328	235	217	107
22	73	57	45	217	1,680	1,360	755	445	290	217	217	107
23	73	57	45	253	1,680	1,360	815	445	290	253	217	107
24	73	57	45	253	1,600	1,360	815	445	290	235	217	107
25	73	57	45	272	1,520	1,360	815	445	253	253	200	107
26	73	57	47	290	1,520	1,360	875	445	272	235	217	89
27	73	57	47	290	1,520	1,360	875	445	253	217	183	89
28	73	57	47	290	1,440	1,360	815	405	253	253	183	89
29	73	57	49	309	1,440	1,360	815	405	235	235	183	89
30	73	.....	49	272	1,360	1,360	815	405	235	253	168	81
31	73	.....	49	.....	1,360	.....	755	386	.....	235	.....	81

NOTE.—Daily discharge determined from a rating curve well defined except for the winter months. Discharge Jan. 1 to 5 interpolated because of doubtful accuracy of gage heights from temporary gage and possible backwater from ice.

Monthly discharge of St. Mary River near Babb, Mont., for 1912.

[Drainage area, 177 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	73	.....	65.3	0.369	0.43	4,020	D.
February	73	57	60.6	.342	.37	3,490	C.
March	57	45	50.0	.282	.33	3,070	C.
April	309	57	158	.893	1.00	9,400	B.
May	1,680	253	979	5.53	6.38	60,200	A.
June	1,520	1,200	1,360	7.68	8.57	80,900	A.
July	1,360	700	920	5.20	6.00	56,600	A.
August	755	386	560	3.16	3.64	34,400	A.
September	366	235	321	1.81	2.02	19,100	A.
October	253	153	201	1.14	1.31	12,400	A.
November	253	168	217	1.23	1.37	12,900	A.
December	183	81	125	.706	.81	7.690	B.
The year	1,680	.....	419	2.37	32.23	304,000	

ST. MARY RIVER BELOW SWIFTCURRENT CREEK, AT BABB, MONT.[1]

Location.—At Babb, Mont., about 1 mile below the mouth of Swiftcurrent Creek.

Records available.—July 14, 1901, to October 18, 1902, and May 13, 1910, to December 31, 1912.

Drainage area.—298 square miles.

Gage.—The original gage was a staff nailed to a pier of the highway bridge at Babb. This gage was used in 1901 and 1902, and was destroyed by the flood of June 5, 1908. On May 13, 1910, a staff gage was installed on the left bank about 75 feet below the old site, and at a different datum. A temporary chain gage was also installed for low-water readings. On July 19, 1911, a new chain gage was installed on the right bank, about 100 feet farther downstream, and at a different datum. On May 1, 1912, a gage was established on an overflow channel from Swiftcurrent Creek and gage readings obtained from May 2 to November 24. This overflow discharges into St. Mary River below the gage.

Channel.—Likely to change.

Discharge measurements.—In 1901 and 1902, made from highway bridge; in 1910, from a footbridge 100 feet above the gage; in 1911, from a cable, 50 feet above the gage. Low-water measurements are made by wading. The overflow from Swiftcurrent Creek is measured from a footbridge.

Floods.—Probably the highest stage was reached June 5, 1908. No records of this flood were obtained at this point.

Winter flow.—Gage heights are affected by ice during the winter months.

Accuracy.—Rating curves for the main stream and for Swiftcurrent Creek overflow are well defined and records are excellent except during the winter months.

Discharge measurements of St. Mary River below Swiftcurrent Creek, at Babb, Mont., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 16	W. A. Lamb	3.45	58	Aug. 17	W. A. Lamb	4.88	687
May 1	.....do	4.65	514	Sept. 19	.....do	4.52	458
June 8	R. R. Randell	6.05	1,580	Dec. 16	.....do	3.89	177
July 2	.....do	6.38	1,740				

NOTE.—These measurements do not include the overflow from Swiftcurrent Creek.

[1] The records at this station for 1901 and 1902 were published in Water-Supply Paper 66 as for "St. Mary River at Main, Mont."

Discharge measurements of Swiftcurrent Creek overflow at Babb, Mont., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 1	W. A. Lamb	5.55	44.7	Aug. 17	W. A. Lamb	5.45	40.2
June 8	do	6.25	108	Sept. 19	do	[a]5.0	12.7
July 2	R. R. Randell	6.37	110	Dec. 16	do	4.4	[b]2.0

[a] Approximate. [b] Estimated.

Daily gage height, in feet, of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1912.

[Carl Giruin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	3.75	3.6	3.65	4.6	6.6	6.5	5.6	4.5	4.25	4.3	4.2
2	3.8	3.75	3.6	3.68	4.7	6.6	6.5	5.7	4.55	4.2	4.3	4.2
3	3.8	3.75	3.6	3.9	4.7	6.5	6.5	5.5	4.5	4.2	4.3	4.2
4	4.0	3.73	3.6	3.95	4.7	6.4	6.4	5.4	4.5	4.2	4.3	4.15
5	4.2	3.73	3.6	3.85	4.75	.....	6.3	5.3	4.45	4.2	4.3	4.15
6	4.2	3.7	3.6	3.9	4.75	.....	6.2	5.35	4.45	4.15	4.25	4.15
7	4.15	3.7	3.6	3.9	4.9	.....	6.2	5.25	4.5	4.15	4.25	4.05
8	4.1	3.7	3.6	4.03	5.1	6.3	6.1	5.3	4.5	4.2	4.2	4.05
9	4.0	3.68	3.6	4.13	5.4	6.4	6.0	5.2	4.55	4.15	4.2	4.05
10	4.1	3.68	3.58	4.2	5.6	6.4	5.9	5.05	4.55	4.1	4.2	4.05
11	4.3	3.65	3.58	4.32	5.6	6.6	5.8	5.1	4.55	4.05	4.2	4.05
12	4.0	3.65	3.55	4.33	5.7	6.7	5.7	4.95	4.6	4.05	4.25	3.95
13	3.7	3.62	3.52	4.33	5.8	6.7	5.7	4.9	4.6	4.1	4.3	3.95
14	3.7	3.6	3.5	4.35	5.9	6.8	5.6	4.9	4.65	4.05	4.35	3.95
15	3.75	3.6	3.48	4.35	6.1	6.8	5.6	4.85	4.6	4.15	4.35	3.85
16	3.75	3.6	3.48	4.38	6.45	6.7	5.6	4.85	4.6	4.2	4.35	3.85
17	3.75	3.6	3.48	4.4	6.6	6.6	5.5	4.8	4.6	4.25	4.4	3.85
18	3.75	3.6	3.48	4.42	6.6	6.5	5.5	4.75	4.55	4.3	4.35	3.85
19	3.75	3.6	3.48	4.45	6.7	6.4	5.5	4.8	4.55	4.4	4.35	3.8
20	3.75	3.6	3.48	4.48	6.8	6.4	5.5	4.75	4.5	4.35	4.35	3.8
21	3.75	3.6	3.48	4.5	6.8	6.4	5.5	4.75	4.5	4.35	4.3	3.8
22	3.75	3.6	3.48	4.5	6.8	6.4	5.6	4.7	4.55	4.4	4.3	3.8
23	3.75	3.6	3.48	4.55	6.7	6.4	5.6	4.75	4.45	4.4	4.3	3.8
24	3.75	3.6	3.48	4.6	6.6	6.4	5.7	4.75	4.5	4.4	4.3	3.8
25	3.75	3.6	3.48	4.6	6.6	6.4	5.8	4.75	4.35	4.35	4.3	3.8
26	3.75	3.6	3.5	4.65	6.6	6.4	5.8	4.7	4.3	4.3	4.25	3.75
27	3.75	3.6	3.5	4.65	6.6	6.4	5.8	4.65	4.3	4.3	4.25	3.75
28	3.75	3.6	3.5	4.65	6.6	6.4	5.8	4.65	4.3	4.4	4.25	3.75
29	3.75	3.6	3.52	4.65	6.6	6.5	5.8	4.6	4.3	4.35	4.2	5.75
30	3.75	.....	3.55	4.65	6.6	6.5	5.7	4.6	.....	4.35	4.2	3.7
31	3.75	.....	3.55	.....	6.6	.....	5.7	4.6	.....	4.35	.....	3.7

NOTE.—Relation of gage height to discharge probably affected by ice Jan. 1 to about Feb. 5.

Daily discharge, in second-feet, of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1912.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	91	104	525	1,960	1,880	1,180	447	324	347	307
2	.....	91	113	562	1,960	1,880	1,260	475	302	347	307
3	.....	91	184	562	1,880	1,880	1,100	447	302	347	307
4	.....	91	203	562	1,800	1,800	1,030	447	302	347	285
5	.....	91	167	593	1,780	1,720	961	421	302	347	285
6	118	91	184	593	1,760	1,640	997	421	281	324	285
7	118	91	184	688	1,740	1,640	926	447	281	324	242
8	118	91	234	822	1,720	1,560	961	447	302	302	242
9	113	91	276	1,030	1,800	1,480	891	475	281	302	242
10	113	86	307	1,180	1,800	1,400	788	475	260	302	242

Daily discharge, in second-feet, of St. Mary River below Swiftcurrent Creek, at Babb., Mont., for 1912—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	104	86	367	1,180	1,960	1,330	822	475	240	302	242
12	104	80	372	1,260	2,040	1,260	721	503	240	324	203
13	96	73	372	1,330	2,040	1,260	688	503	260	347	203
14	91	68	382	1,400	2,120	1,180	688	532	240	371	203
15	91	64	382	1,560	2,120	1,180	656	503	281	371	167
16	91	64	398	1,840	2,040	1,180	656	503	302	371	167
17	91	64	409	1,960	1,960	1,100	624	503	324	395	167
18	91	64	420	1,960	1,880	1,100	593	475	347	371	167
19	91	64	437	2,040	1,800	1,100	624	475	395	371	150
20	91	64	454	2,120	1,800	1,100	593	447	371	371	150
21	91	64	465	2,120	1,800	1,100	593	447	371	347	150
22	91	64	465	2,120	1,800	1,180	562	475	395	347	150
23	91	64	495	2,040	1,800	1,180	593	421	395	347	150
24	91	64	525	1,960	1,800	1,260	593	447	395	347	150
25	91	64	525	1,960	1,800	1,330	593	371	371	356	150
26	91	68	557	1,960	1,800	1,330	562	347	347	332	134
27	91	68	557	1,960	1,800	1,330	532	347	347	332	134
28	91	68	557	1,960	1,800	1,330	532	347	395	332	134
29	91	73	557	1,960	1,880	1,330	503	347	371	307	134
30	.....	80	557	1,960	1,880	1,260	503	336	371	307	118
31	.....	80	.....	1,960	.....	1,260	503	.....	371	.....	118

NOTE.—Daily discharge previous to May 2 and after Nov. 24 computed from a well-defined rating curve based on discharge measurements that include the flow in Swiftcurrent overflow channel. Discharge May 2 to Nov. 24 computed from a well-defined rating curve based on measurements that do not include the flow in the Swiftcurrent overflow channel.

Daily gage height, in feet, of Swiftcurrent Creek overflow at Babb, Mont., for 1912.

[Carl Giruin, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	6.5	6.4	5.8	5.0	4.9	5.0
2	5.45	6.55	6.4	5.75	5.0	4.9	4.95
3	5.42	6.45	6.4	5.7	5.0	4.9	4.95
4	5.4	6.45	6.35	5.7	5.0	4.85	4.9
5	5.35	6.4	6.3	5.7	4.95	4.85	4.85
6	5.5	6.3	6.2	5.65	4.95	4.8	4.8
7	5.8	6.3	6.1	5.6	4.9	4.8	4.7
8	6.0	6.25	6.1	5.6	4.95	4.8	4.7
9	6.35	6.35	6.1	5.5	4.95	4.8	4.65
10	6.5	6.55	6.0	5.4	5.0	4.75	4.6
11	6.4	6.6	6.0	5.4	5.0	4.75	4.7
12	6.5	6.6	6.1	5.35	5.0	4.75	4.8
13	6.5	6.7	6.05	5.35	5.1	4.75	4.9
14	6.55	6.6	6.2	5.3	5.1	4.8	5.0
15	6.7	6.6	6.1	5.3	5.1	4.9	5.1
16	6.75	6.55	6.0	5.35	5.1	5.0	5.2
17	6.85	6.55	6.0	5.25	5.1	5.1	5.25
18	6.8	6.5	5.95	5.35	5.1	5.2	5.25
19	6.8	6.4	5.9	5.3	5.0	5.3	5.25
20	6.75	6.45	5.9	5.3	5.0	5.3	5.25
21	6.8	6.4	5.9	5.25	5.0	5.3	5.25
22	6.75	6.4	5.95	5.25	5.0	5.25	5.25
23	6.6	6.35	6.0	5.25	5.0	5.25	5.1
24	6.55	6.35	6.1	5.25	5.0	5.2	5.0
25	6.6	6.3	6.2	5.25	4.95	5.2	.....
26	6.7	6.3	6.25	5.25	4.95	5.1	.....
27	6.7	6.4	6.25	5.25	4.9	5.1	.....
28	6.7	6.4	6.2	5.2	4.9	5.1	.....
29	6.6	6.4	6.05	5.2	4.9	5.1	.....
30	6.6	6.4	5.0	5.1	4.9	5.1	.....
31	6.6	.....	5.9	5.1	.....	5.0	.....

Daily discharge, in second-feet, of Swiftcurrent Creek overflow at Babb, Mont., for 1912.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	125	116	66	14	10	14
2	39	130	116	62	14	10	12
3	36	120	116	58	14	10	12
4	35	120	112	58	14	9.2	10
5	32	116	107	58	12	9.2	9.2
6	42	107	98	54	12	8.0	8.0
7	66	107	90	50	10	8.0	6.0
8	82	102	90	50	12	8.0	6.0
9	112	112	90	42	12	8.0	5.2
10	125	130	82	35	14	7.0	4.4
11	116	134	82	35	14	7.0	6.0
12	125	134	90	32	14	7.0	8.0
13	125	144	86	32	18	7.0	10
14	130	134	98	28	18	8.0	14
15	144	134	90	28	18	10	18
16	149	130	82	32	18	14	22
17	159	130	82	25	18	18	25
18	154	125	78	32	18	22	25
19	154	116	74	28	14	28	25
20	149	120	74	28	14	28	25
21	154	116	74	25	14	28	25
22	149	116	78	25	14	25	25
23	134	112	82	25	14	25	18
24	130	112	90	25	14	22	14
25	134	107	98	25	12	22	.....
26	144	107	102	25	12	18	.....
27	144	116	102	25	10	18	.....
28	144	116	98	22	10	18	.....
29	134	116	86	22	10	18	.....
30	134	116	82	18	10	18	.....
31	134	.....	74	18	.....	14	.....

NOTE.—Daily discharge determined from a rating curve well defined above 20 second-feet and fairly well defined below. Discharge estimated for July 30 as gage height is believed to be in error.

Combined daily discharge, in second-feet, of St. Mary River and Swiftcurrent Creek overflow at Babb, Mont., for 1912.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	91	104	525	2,080	2,000	1,250	461	334	361	307
2	.....	91	113	601	2,090	2,000	1,320	489	312	359	307
3	.....	91	184	598	2,000	2,000	1,160	461	312	359	307
4	.....	91	203	597	1,920	1,910	1,090	461	311	357	285
5	.....	91	167	625	1,900	1,830	1,020	433	311	356	285
6	118	91	184	635	1,870	1,740	1,050	433	289	332	285
7	118	91	184	754	1,850	1,730	976	457	289	330	242
8	118	91	234	904	1,820	1,650	1,010	459	310	308	242
9	113	91	276	1,140	1,910	1,570	933	487	289	307	242
10	113	86	307	1,300	1,930	1,480	823	489	267	306	242
11	104	86	367	1,300	2,090	1,410	857	489	247	308	242
12	104	80	372	1,380	2,170	1,350	753	517	247	332	203
13	96	73	372	1,460	2,180	1,350	720	521	267	357	203
14	91	68	382	1,530	2,250	1,280	716	550	248	385	203
15	91	64	382	1,700	2,250	1,270	784	521	291	389	167
16	91	64	398	1,990	2,170	1,260	688	521	316	393	167
17	91	64	409	2,120	2,090	1,180	649	521	342	420	167
18	91	64	420	2,110	2,000	1,180	625	493	369	396	167
19	91	64	437	2,190	1,920	1,170	652	489	423	396	150
20	91	64	454	2,270	1,920	1,170	621	461	399	396	150
21	91	64	465	2,270	1,920	1,170	618	461	399	372	150
22	91	64	465	2,270	1,920	1,260	587	489	420	372	150
23	91	64	495	2,170	1,910	1,260	618	435	420	365	150
24	91	64	525	2,090	1,910	1,350	618	461	417	361	150
25	91	64	525	2,090	1,910	1,430	618	483	393	356	150
26	91	68	557	2,100	1,910	1,430	587	359	365	332	134
27	91	68	557	2,100	1,920	1,430	557	357	365	332	134
28	91	68	557	2,100	1,920	1,430	554	357	413	332	134
29	91	73	557	2,090	2,000	1,420	525	357	389	307	134
30	.....	80	557	2,090	2,000	1,340	521	346	389	307	118
31	.....	80	.....	2,090	.....	1,330	521	.....	385	.....	118

Combined monthly discharge of St. Mary River and Swiftcurrent Creek overflow at Babb, Mont., for 1912.

[Drainage area, 298 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	98.4	0.330	0.38	6,050	D.
February	118	.....	99.7	.335	.36	5,730	C.
March	91	64	75.9	.255	.29	4,670	B.
April	557	104	374	1.26	1.41	22,300	B.
May	2,270	525	1,590	5.34	6.16	97,800	A.
June	2,250	1,820	1,990	6.68	7.45	118,000	A.
July	2,000	1,170	1,460	4.90	5.65	89,800	A.
August	1,320	521	775	2.60	3.00	47,700	A.
September	550	346	461	1.55	1.73	27,400	A.
October	423	247	340	1.14	1.31	20,900	A.
November	420	306	353	1.18	1.32	21,000	B.
December	307	118	196	.658	.76	12,100	B.
The year	2,270	64	653	2.19	29.82	473,000	

NOTE.—Mean discharge Jan. 1 to 12 estimated at 80 second-feet; mean discharge Jan. 13 to Feb. 5 estimated at 110 second-feet.

ST. MARY RIVER NEAR CARDSTON, ALBERTA.

Location.—At Henry Cook's ranch, about half a mile north of the boundary line between the United States and Canada, about a mile below the mouth of Boundary Creek, and about 17 miles southeast of Cardston.

Records available.—September 4, 1902, to December 31, 1912.

Drainage area.—452 square miles.

Gage.—The gage installed when the station was established was destroyed during the high water of June, 1908, and a new chain gage was installed July 19, 1908, about one-fourth mile downstream. No determined relation between the two gages.

Channel.—Shifting.

Discharge measurements.—Made from a cable one-fourth mile above the gage.

Floods.—The flood of June 5, 1908, reached a gage height of about 12.75 feet above the old gage datum.

Winter flow.—Gage heights are affected by ice during the winter.

Accuracy.—Conditions in the channel remained fairly permanent during 1912, and records are good.

Discharge measurements of St. Mary River near Cardston, Alberta, in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 30	W. A. Lamb	1.80	675	Aug. 16	W. A. Lamb	2.00	786
June 7	do	3.45	1,870	Sept. 19	do	1.40	529
30	R. R. Randell	3.80	2,090				

Daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1912.

[Mrs. H. F. Cook, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	2.0	2.0	4.1	3.8	2.6	1.5	1.0	1.15	0.9
2	.....	2.0	.....	2.0	3.9	3.7	.....	1.5	1.0	.....	.9
3	.....	.....	1.05	2.0	3.8	3.5	2.7	1.5	1.0	.....	.8
4	.....	2.0	1.05	2.0	3.8	3.4	2.6	1.4	1.0	1.15	.8
5	.....	.....	1.05	2.0	3.7	.....	2.6	1.4	1.0	1.15	.75
6	.....	1.4	1.0	2.0	3.6	3.2	2.6	1.4	.95	1.1	.....
7	.....	.....	1.0	2.0	3.4	3.2	2.6	1.4	.95	1.1	.7
8	.....	1.4	1.0	2.2	3.6	3.2	2.5	1.5	.95	1.1	.7
9	.....	1.5	1.0	2.3	3.8	3.2	2.4	1.5	.....	1.1	.7
10	.....	1.5	1.15	2.5	4.0	3.1	2.4	.....	1.0	1.15	.....
11	1.0	.....	1.2	2.7	4.2	3.1	2.3	.....	1.0	1.2	.....
12	.....	1.65	1.3	3.0	.....	3.1	.....	.....	1.0	1.2	.65
13	1.0	.....	.....	3.1	4.4	3.1	2.2	1.6	1.0	.....	.....
14	.....	.....	1.6	3.2	4.6	3.1	2.0	1.6	1.0	.....	.65
15	1.2	1.7	.....	3.5	4.5	3.1	.....	1.6	1.0	.....	.6
16	.....	1.7	1.3	4.0	4.5	3.0	2.0	1.6	1.1	1.4	.6
17	1.2	1.85	1.5	4.5	.....	2.9	2.0	1.5	1.2	1.3	.6
18	.....	1.9	.....	4.5	3.9	2.8	2.0	1.4	1.2	1.2	.6
19	1.2	.....	1.75	4.5	3.8	2.8	2.0	1.4	.....	1.2	.6
20	.....	1.8	1.75	4.8	.....	2.8	2.0	1.4	.....	1.15	.65
21	1.4	.....	1.75	5.2	.....	2.9	2.0	1.4	1.3	1.15	.....
22	.....	1.65	1.75	5.2	4.0	3.4	1.9	1.3	1.3	1.1	.6
23	1.4	.....	1.75	4.8	4.0	3.4	1.9	1.3	1.35	1.05	.55
24	.....	3.0	1.75	4.7	4.1	.....	1.9	1.25	1.2	.....	.5
25	2.0	3.0	1.85	4.5	4.2	.....	1.8	1.2	1.2	1.0	.5
26	.....	3.0	1.85	4.5	4.15	.....	1.7	1.2	1.2	1.0	.....
27	2.0	3.0	1.85	4.6	4.1	2.9	1.7	1.15	.....	1.0	.5
28	2.0	2.0	1.85	4.8	.....	2.8	1.65	1.1	.....	1.0	.....
29	2.0	.....	1.85	4.6	.....	2.8	1.6	1.1	1.2	1.0	.....
30	.....	2.0	1.9	4.3	3.8	2.6	1.5	1.05	1.2	.....	.5
31	.....	2.0	.....	.....	.....	2.6	1.5	.....	1.2	.....	.5

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 2 and probably also Dec. 12 to 31.

Daily discharge, in second-feet, of St. Mary River near Cardston, Alberta, for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	150	801	2,430	2,160	1,190	561	388	436	359
2	200	801	2,250	2,070	1,220	561	388	436	359
3	404	801	2,160	1,900	1,260	561	388	436	331
4	404	801	2,160	1,820	1,190	522	388	436	331
5	404	801	2,070	1,740	1,190	522	388	436	318
6	388	801	1,980	1,650	1,190	522	374	419	311
7	388	801	1,820	1,650	1,190	522	374	419	304
8	388	918	1,980	1,650	1,120	561	374	419	304
9	388	982	2,160	1,650	1,050	561	381	419	304
10	436	1,120	2,340	1,570	1,050	571	388	436	300
11	452	1,260	2,520	1,570	982	582	388	452	236
12	486	1,490	2,610	1,570	950	593	388	452	.....
13	545	1,570	2,700	1,570	918	604	388	470	.....
14	604	1,650	2,900	1,570	801	604	388	487	.....
15	545	1,900	2,800	1,570	801	604	388	504	.....
16	486	2,340	2,800	1,490	801	604	419	522	.....
17	561	2,800	2,520	1,420	801	561	452	486	.....
18	618	2,800	2,250	1,340	801	522	452	452	.....
19	674	2,800	2,160	1,340	801	522	463	452	.....
20	674	3,080	2,220	1,340	801	522	475	436	.....
21	674	3,480	2,280	1,420	801	522	486	436	.....
22	674	3,480	2,340	1,820	748	486	486	419	.....
23	674	3,080	2,340	1,820	748	486	504	404	.....
24	674	2,990	2,430	1,720	748	469	452	396	.....
25	723	2,800	2,520	1,620	698	452	452	388	.....
26	723	2,800	2,480	1,520	650	452	452	388	.....
27	723	2,900	2,430	1,420	650	436	452	388	.....
28	723	3,080	2,340	1,340	627	419	452	388	.....
29	723	2,900	2,250	1,340	604	419	452	388	.....
30	748	2,610	2,160	1,190	561	404	452	374	.....
31	.....	2,520	.....	1,190	561	.....	452	.....	.....

NOTE.—Daily discharge determined from a rating curve well defined below 3,000 second-feet. Discharge Apr. 1 to 2 and Dec. 11–12 estimated. Discharges interpolated for days of no gage height between Apr. 13 and Dec. 6. Mean discharge Dec. 12 to 31 estimated because of belief that gage heights were affected by ice.

Monthly discharge of St. Mary River near Cardston, Alberta, for 1912.

[Drainage area, 452 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January	.....	.....	[a]130	0.288	0.33	7,990
February	.....	.....	[a]120	.265	.29	6,900
March	.....	.....	[a]110	.243	.28	6,760
April	748	150	542	1.20	1.34	32,300
May	3,480	801	2,030	4.49	5.18	125,000
June	2,900	1,820	2,350	5.20	5.80	140,000
July	2,160	1,190	1,580	3.50	4.04	97,200
August	1,260	561	887	1.96	2.26	54,500
September	604	404	524	1.16	1.29	31,200
October	504	374	423	.936	1.08	26,000
November	522	374	432	.956	1.07	25,700
December	359	.....	249	.551	.64	15,300
The year	3,480	.....	783	1.73	23.60	569,000

[a] Estimated by comparison with other stations on St. Mary River.

NOTE.—Mean discharge Dec. 12 to 31 estimated at 210 second-feet.

SWIFTCURRENT CREEK AT McDERMOTT LAKE, MONT.

Location.—In sec. 12, T. 35 N., R. 16 W., at the outlet of McDermott Lake, about 14 miles southwest of Babb, Mont.

Records available.—June 6 to November 8, 1912.

Drainage area.—31.4 square miles.

Gage.—Vertical staff attached to post on left bank at the lake outlet.

Channel.—Practically permanent. The control is a limestone reef at the lake outlet.

Discharge measurements.—Made by wading or from a cable across the outlet.

Winter flow.—Station not maintained during winter. Ice exists at the gage but control section probably remains unobstructed.

Accuracy.—A curve well defined below 500 second-feet was developed for 1912. Gage heights during low water may be affected by wind action on the lake and therefore may not represent the mean flow for the day.

Discharge measurements of Swiftcurrent Creek at McDermott Lake, Mont., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 6	W. A. Lamb	2.53	280
Aug. 8	do	2.06	117
Dec. 15[a]	do	1.39	26

[a] Ice at gage and along edges at measuring section. Control not obstructed.

Daily gage height, in feet, of Swiftcurrent Creek at McDermott Lake, Mont., for 1912.

[G. L. Roberts, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.7	2.2	2.0	1.8	1.8	16	2.65	2.3	2.1	1.9	1.8	.....
2	.....	2.6	2.2	2.0	1.8	1.8	17	2.6	2.3	2.1	1.9	1.8	.....
3	.....	2.6	2.1	2.0	1.8	1.8	18	2.6	2.3	2.1	1.9	1.8	.....
4	.....	2.5	2.1	2.0	1.8	1.8	19	2.7	2.3	2.1	1.9	1.8	.....
5	.....	2.5	2.1	2.0	1.8	1.8	20	2.8	2.5	2.1	1.9	1.8	.....
6	2.53	2.5	2.1	2.0	1.8	1.8	21	2.8	2.7	2.1	1.8	1.8	.....
7	2.5	2.4	2.1	2.0	1.8	1.8	22	2.9	2.6	2.1	1.8	1.8	.....
8	2.7	2.4	2.1	2.0	1.8	1.8	23	2.9	2.5	2.1	1.8	1.8	.....
9	2.9	2.4	2.1	2.0	1.9	.....	24	3.1	2.4	2.1	1.8	1.8	.....
10	3.0	2.4	2.1	2.0	1.9	.....	25	2.9	2.3	2.1	1.8	1.8	.....
11	2.9	2.4	2.1	2.0	1.8	.....	26	2.8	2.3	2.1	1.8	1.8	.....
12	3.2	2.4	2.1	2.0	1.8	.....	27	2.7	2.3	2.1	1.8	.....	.....
13	3.0	2.3	2.1	2.0	1.8	.....	28	2.6	2.3	2.1	1.8	.....	.....
14	3.0	2.3	2.1	2.0	1.8	.....	29	2.6	2.3	2.0	1.8	.....	.....
15	2.85	2.3	2.1	1.9	1.8	.....	30	2.8	2.2	2.0	1.8	.....	.....
							31	.....	2.2	2.0	.....	.....	.....

NOTE.—Gage heights at low stages may be affected by wind action on the lake and therefore may not represent the mean flow for the day.

Daily discharge, in second-feet, of Swiftcurrent Creek at McDermott Lake, Mont., for 1912.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	364	155	103	68	68	16	338	188	127	84	68	.....
2	.....	312	155	103	68	68	17	312	188	127	84	68	.....
3	.....	312	127	103	68	68	18	312	188	127	84	68	.....
4	.....	266	127	103	68	68	19	364	188	127	84	68	.....
5	.....	266	127	103	68	68	20	422	266	127	84	68	.....
6	280	266	127	103	68	68	21	422	364	127	68	68	.....
7	266	225	127	103	68	68	22	485	312	127	68	68	.....
8	364	225	127	103	68	68	23	485	266	127	68	68	.....
9	485	225	127	103	84	.....	24	628	225	127	68	68	.....
10	554	225	127	103	84	.....	25	485	188	127	68	68	.....
11	485	225	127	103	68	.....	26	422	188	127	68	68	.....
12	706	225	127	103	68	.....	27	364	188	127	68	68	.....
13	554	188	127	103	68	.....	28	312	188	127	68	68	.....
14	554	188	127	103	68	.....	29	312	188	103	68	68	.....
15	454	188	127	84	68	.....	30	422	155	103	68	68	.....
							31	.....	155	103	.....	68	.....

NOTE.—Daily discharge determined from a rating curve well defined below 500 second-feet.

Monthly discharge of Swiftcurrent Creek at McDermott Lake, Mont., for 1912.

[Drainage area, 31.4 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
June 6–30	706	266	431	13.7	12.75	21,400	A.
July	364	155	230	7.32	8.44	14,100	A.
August	155	103	126	4.01	4.62	7,750	A.
September	103	68	87.5	2.79	3.11	5,210	B.
October	84	68	69.0	2.20	2.54	4,240	B.
November 1–8	68	68	68.0	2.17	.65	1,080	B.
The period	.....	.....	.....	.....	.....	53,800	

SWIFTCURRENT CREEK AT SHERBURNE LAKE, MONT.

Location.—In sec. 35, T. 36 N., R. 15 W., at the outlet of lower Sherburne Lake, just above the boundary line between Glacier National Park and Blackfeet Indian Reservation.

Records available.—July 1 to December 15, 1912.

Drainage area.—64.0 square miles.

Gage.—Vertical staff on left bank near the outlet of the lake.

Channel.—Apparently permanent.

Discharge measurements.—By wading or from a cable located below the gage.

Winter flow.—Affected by ice.

Diversion.—No artificial storage or diversion above the station.

Accuracy.—A rating table well defined between 90 and 500 second-feet has been developed. Accuracy of gage heights may be affected by wave action on the lake.

Discharge measurements of Swiftcurrent Creek at Sherburne Lake, Mont., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
July 1	R. R. Randell	4.42	453	Sept. 18	W. A. Lamb	[a] 2.7	103
Aug. 15	W. A. Lamb	3.10	151	Dec. 15[b]	do	2.53	47

[a] Gage height approximate because of waves. [b] Frozen over. Gage height affected.

Daily gage height, in feet, of Swiftcurrent Creek at Sherburne Lake, Mont., for 1912.

[F. M. Stevenson, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.4	3.7	2.85	2.44	2.39	2.30	16	3.85	3.15	2.95	2.39	2.7	.....
2	4.4	3.65	3.0	2.40	2.32	2.33	17	3.8	3.2	2.8	2.5	2.55	.....
3	4.25	3.65	3.0	2.32	2.26	2.36	18	3.65	3.2	2.6	2.85	2.44	.....
4	4.05	3.7	3.0	2.35	2.20	2.40	19	3.45	3.1	2.6	3.0	2.5	.....
5	4.05	3.7	2.95	2.36	2.26	2.5	20	3.9	3.0	2.7	3.0	2.7	.....
6	4.05	3.5	2.9	2.40	2.28	2.6	21	4.5	3.0	2.7	3.05	2.9	.....
7	3.95	3.35	2.9	2.42	2.32	2.7	22	4.8	3.05	2.6	2.95	2.8	.....
8	3.85	3.3	2.9	2.38	2.45	2.7	23	4.8	3.15	2.6	3.05	2.6	.....
9	3.85	3.25	3.05	2.40	2.7	2.75	24	5.1	3.2	2.6	2.85	2.49	.....
10	3.8	3.25	3.2	2.40	2.95	2.75	25	4.8	3.2	2.5	2.8	2.65	.....
11	3.85	3.25	3.25	2.38	2.95	2.8	26	4.4	3.2	2.5	2.6	2.55	.....
12	4.05	3.2	3.25	2.36	2.8	.....	27	4.15	3.1	2.5	2.55	2.41	.....
13	4.05	3.15	3.2	2.34	2.85	.....	28	4.0	3.0	2.5	2.6	2.38	.....
14	4.1	3.15	3.25	2.26	2.8	.....	29	3.9	2.9	2.5	2.7	2.32	.....
15	3.95	3.1	3.1	2.28	2.8	2.55	30	3.85	2.9	2.45	2.6	2.28	.....
							31	3.75	2.65	.....	2.55	.....	.....

NOTE.—Gage heights after Dec. 1 affected by ice.

Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne Lake, Mont., for 1912.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	449	266	120	80	76	71	16	302	158	132	76	103	.....
2	449	254	138	77	72	70	17	290	166	114	86	88	.....
3	407	254	138	72	69	69	18	254	166	93	120	80	.....
4	353	266	138	74	66	68	19	212	151	93	138	84	.....
5	353	266	132	75	69	67	20	315	138	103	138	103	.....
6	353	222	126	77	70	66	21	478	138	103	144	126	.....
7	328	192	126	78	72	65	22	571	144	93	132	114	.....
8	302	183	126	76	80	64	23	571	158	93	144	93	.....
9	302	174	144	77	103	63	24	672	166	93	120	83	.....
10	290	174	166	77	132	62	25	571	166	84	114	98	.....
11	302	174	174	76	132	59	26	449	166	84	93	88	.....
12	353	166	174	75	114	56	27	380	151	84	88	78	.....
13	353	158	166	73	120	53	28	340	138	84	93	76	.....
14	366	158	174	69	114	50	29	315	126	84	103	72	.....
15	328	151	151	70	114	47	30	302	126	80	93	70	.....
							31	278	98	.....	88	.....	.....

NOTE.—Daily discharge determined from a rating curve well defined between 90 and 500 second-feet. Discharge Dec. 2 to 15 estimated from measurement Dec. 15.

Monthly discharge of Swiftcurrent Creek at Sherburne Lake, Mont., for 1912.

[Drainage area, 64 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
July	672	212	374	5.84	6.73	23,000	A.
August	266	98	175	2.74	3.16	10,800	A.
September	174	80	120	1.88	2.10	7,140	A.
October	144	69	93.4	1.46	1.68	5,740	B.
November	132	66	91.9	1.44	1.61	5,470	B.
December 1–15	71	47	62.0	.969	.54	1,840	C.
The period						54,000	

OTTERTAIL RIVER NEAR FERGUS FALLS, MINN.

Location.—At Three-mile Bridge, 3½ miles northeast of Fergus Falls, between secs. 18 and 19, T. 133 N., R. 42 W., several miles above the outlet of Wall Lake, and 20 miles below Ottertail Lake, through which the river flows.

Records available.—May 9, 1904, to December 31, 1912. A gaging station was maintained from May 1, 1899, to May 14, 1904, by the Engineer Corps, United States Army, at the outlet of Ottertail Lake, where the drainage area is about 12 per cent less than at the Geological Survey station, with no important tributaries intervening. The observations at Fergus Falls in connection with those at the outlet of Ottertail Lake furnish a 13-year record of flow of the river below Ottertail Lake.

Drainage area.—1,310 square miles.

Gage.—Chain attached to the bridge; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Discharge measurements are made from the bridge except at extreme low stages, when they are made at a wading section.

Winter flow.—The river is frozen over from December to March and measurements are made to determine the winter flow.

Artificial control.—Ottertail Lake, about 22 square miles in area, forms a natural reservoir which regulates the flow of the river to such an extent that the recorded range of stage has not exceeded 2 feet. On the upper part of the river are a number of dams used in driving logs to the sawmill at Frazee, where the lowest dam is built. The next dam below Frazee is at Maine, several miles below Ottertail Lake, about sec. 35, T. 134 N., R. 41 W. During the low-water season the closing of the turbine gates at Maine may have an effect on the flow immediately below the dam. Small lakes through which the river flows before reaching the gaging station tend to equalize the flow at the latter point. Below the station there are a number of power plants, but owing to the fall of the river their influence is not observable at the gage.

Discharge measurements of Ottertail River near Fergus Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
Jan. 25[a]	S. B. Soulé	3.75	60	Aug. 11[c]	W. G. Hoyt	2.78	221
Feb. 29[b]	do	3.69	72	Dec. 17[d]	S. B. Soulé	3.23	152
May 7	W. G. Hoyt	2.95	301				

[a] Complete ice cover; average thickness of ice, 1.79 feet; average distance from water surface to top of ice, 0.06 foot.
[b] Complete ice cover; average thickness of ice, 2.14 feet; average distance water surface to top of ice, 0.29 foot.
[c] Measurement made by wading at section above gage.
[d] Complete ice cover at measuring section and at gage; average thickness of ice, 0.81 foot; average distance from water surface to top of ice, 0.05 foot. Partly open at controlling section.

Daily gage height, in feet, of Ottertail River near Fergus Falls, Minn., for 1912.

[H. G. Evensen, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	3.75	.....	3.9	2.8	3.05	2.9	2.65	2.6	2.7	2.7	2.8
2	.....	.....	3.8	3.9	2.8	3.05	3.0	2.65	2.7	2.7	2.7	2.8
3	.....	.....	.....	3.6	2.9	3.05	2.95	2.75	2.7	2.7	2.7	2.9
4	.....	.....	.....	3.5	3.0	3.05	2.85	2.65	2.7	2.7	2.7	.....
5	.....	.....	3.85	2.8	3.05	3.05	2.95	2.85	2.7	2.7	2.65	.....
6	3.3	3.8	.....	2.7	3.0	3.05	2.95	2.75	2.7	2.7	2.65	.....
7	.....	.....	.....	2.7	3.0	3.05	2.85	2.9	2.7	2.65	2.65	.....
8	3.4	.....	3.9	2.65	2.95	3.05	3.2	2.85	2.7	2.65	2.7	.....
9	.....	3.8	.....	2.6	2.95	3.05	3.15	2.9	2.7	2.7	2.6	.....
10	.....	.....	.....	2.5	2.85	2.95	3.0	2.8	2.6	2.6	2.7	2.85
11	.....	.....	.....	2.6	2.95	3.0	3.05	2.8	2.75	2.7	2.7	.....
12	3.4	.....	3.85	2.55	2.95	3.0	3.0	2.8	2.75	2.7	2.7	.....
13	.....	4.0	.....	2.55	2.9	3.0	2.9	2.85	2.75	2.7	2.7	.....
14	.....	.....	.....	2.6	2.9	3.0	3.0	2.85	2.75	2.7	2.7	.....
15	3.35	.....	.....	2.6	2.9	3.05	2.95	2.8	2.75	2.7	2.7	.....
16	.....	.....	4.0	2.65	2.9	3.05	2.95	2.8	2.75	2.65	2.7	.....
17	.....	4.1	.....	2.65	2.9	3.05	2.85	2.8	2.7	2.65	2.7	3.25
18	.....	.....	.....	2.7	2.9	3.05	2.95	2.8	2.7	2.65	2.7	.....
19	.....	.....	4.4	2.7	2.9	3.05	2.9	2.75	2.65	2.65	2.7	3.3
20	3.6	4.0	.....	2.6	2.7	2.95	2.8	2.65	2.55	2.65	2.6	.....
21	.....	.....	.....	2.7	2.95	3.05	2.9	2.7	2.65	2.65	2.75	.....
22	3.7	.....	.....	2.7	2.95	3.05	2.9	2.7	2.65	2.65	2.75	.....
23	.....	.....	4.4	2.7	2.95	3.05	2.75	2.65	2.7	2.65	2.75	.....
24	.....	4.1	.....	2.75	2.95	3.05	2.85	2.65	2.7	2.7	2.75	.....
25	3.75	.....	.....	2.8	2.9	3.0	2.85	2.65	2.8	2.7	2.75	.....
26	.....	.....	4.2	2.8	2.9	3.0	2.85	2.65	2.8	2.7	2.7	3.4
27	.....	3.95	.....	2.8	3.0	3.0	2.75	2.65	2.75	2.7	2.7	.....
28	.....	.....	.....	2.8	3.0	3.0	2.85	2.65	2.75	2.7	2.8	.....
29	3.7	3.7	.....	2.8	3.0	3.0	2.8	2.65	2.75	2.7	2.7	.....
30	.....	.....	3.85	2.7	2.9	2.9	2.7	2.7	2.75	2.6	2.8	.....
31	.....	.....	.....	.....	2.95	.....	2.75	2.7	.....	2.7	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 5, and about Nov. 30 to Dec. 31.

Daily discharge, in second-feet, of Ottertail River near Fergus Falls, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	236	336	274	184	168	201	201
2	.....	236	336	315	184	201	201	201
3	.....	274	336	294	218	201	201	201
4	.....	315	336	255	184	201	201	201
5	.....	336	336	294	255	201	201	184
6	201	315	336	294	218	201	201	184
7	201	315	336	255	274	201	184	184
8	184	294	336	402	255	201	184	201
9	168	294	336	380	274	201	201	168
10	138	255	294	315	236	168	168	201
11	168	294	315	336	236	218	201	201
12	153	294	315	315	236	218	201	201
13	153	274	315	274	255	218	201	201
14	168	274	315	315	255	218	201	201
15	168	274	336	294	236	218	201	201
16	184	274	336	294	236	218	184	201
17	184	274	336	255	236	201	184	201
18	201	274	336	294	236	201	184	201
19	201	274	336	274	218	184	184	201
20	168	201	294	236	184	153	184	168
21	201	294	336	274	201	184	184	218
22	201	294	336	274	201	184	184	218
23	201	294	336	218	184	201	184	218
24	218	294	336	255	184	201	201	218
25	236	274	315	255	184	236	201	218
26	236	274	315	255	184	236	201	201
27	236	315	315	218	184	218	201	201
28	236	315	315	255	184	218	201	236
29	236	315	315	236	184	218	201	201
30	201	274	274	201	201	218	168	.....
31	.....	294	.....	218	201	.....	201	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Jan. 1 to Apr. 5 and Nov. 30 to Dec. 31, 1912, estimated, because of ice, from discharge measurements, observer's records, and climatologic records as follows: Jan. 1–31, 80 second-feet, varying from about 90 to 60 second-feet; Feb. 1–29, 70 second-feet; Mar. 1–31, 70 second-feet; Apr. 1–5, 120 second-feet, varying from about 90 to 160 second-feet; Nov. 30, 200 second-feet; Dec. 1–31, 164 second-feet, varying from about 200 to 128 second-feet.

Monthly discharge of Ottertail River near Fergus Falls, Minn., for 1912.

[Drainage area, 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	80	0.061	0.07	4,920	C.
February	.....	.....	70	.053	.06	4,030	B.
March	.....	.....	70	.053	.06	4,300	C.
April	236	138	181	.138	.15	10,800	B.
May	336	201	284	.217	.25	17,500	A.
June	336	274	325	.248	.28	19,300	A.
July	402	201	278	.212	.24	17,100	A.
August	274	184	216	.165	.19	13,300	A.
September	236	153	204	.156	.17	12,100	A.
October	201	168	193	.147	.17	11,900	A.
November	236	168	201	.153	.17	12,000	A.
December	.....	.....	164	.125	.14	10,100	B.
The year	.....	.....	189	.144	1.95	137,000	

RED RIVER AT FARGO, N. DAK.

Location.—At the highway bridge connecting Front Street, Fargo, N. Dak., with Moorhead, Minn., 10 miles above the mouth of Sheyenne River.

Records available.—May 27, 1901, to December 31, 1912.

Drainage area.—6,020 square miles.

Gage.—Vertical staff attached to the breakwater for the center pier of the Front Street Bridge; read from the bridge or the river banks by the aid of a field glass; datum unchanged since establishment.

Channel.—Clay and silt; slightly shifting.

Discharge measurements.—From the Front Street Bridge and the Northern Pacific Railway bridge.

Artificial control.—There is a low dam of steel sheet piling a few rods below the footbridge at Fargo Waterworks, one-half mile above the gage. This dam, a tight overflow weir without sluices, was built in August, 1910, for the purpose of maintaining a sufficient depth of water for the intake pipe of the waterworks, and raises the water about 5 feet at lowest stage. Conditions of flow at the gage are not affected by this dam.

Winter flow.—The relation of gage height to discharge is affected by ice from about the middle of November to the first of April, and during this time observations are discontinued. At the spring break-up, on account of the comparatively sluggish current and the fact that the river flows northward into a colder district, a pronounced backwater effect is usually caused by ice jams and partial ice jams.

Accuracy.—Because of the inaccessibility of the gage, the relatively poor conditions for making accurate discharge measurements, and the slightly shifting channel, the records are not considered better than fair.

Discharge measurements of Red River at Fargo, N. Dak., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 25	E. F. Chandler	8.78	576
Aug. 30	do	7.11	179
Oct. 30	W. B. Stevenson	7.53	228

NOTE.—Measurements made from Front Street Bridge.

Daily gage height, in feet, of Red River at Fargo, N. Dak., for 1912.

[E. H. Grasse, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	8.4	8.2	9.0	8.5	7.9	7.3	8.0	7.7	7.1
2	.....	8.5	8.2	8.9	8.4	7.8	7.3	7.9	7.6	7.1
3	.....	8.7	8.3	8.7	8.4	7.6	7.5	7.9	7.7	7.2
4	.....	9.1	8.3	8.6	8.4	7.6	7.5	7.8	7.7	7.2
5	.....	9.4	8.6	8.5	8.4	7.5	7.6	7.7	7.8	7.1
6	.....	9.5	9.0	8.5	8.5	7.3	7.5	7.6	7.7	7.1
7	.....	9.9	9.7	8.5	8.5	7.3	7.4	7.6	7.5	7.1
8	.....	10.4	9.9	8.4	8.4	7.5	7.5	7.7	7.4	.....
9	.....	10.2	10.2	8.4	8.5	7.6	7.4	7.7	7.5	.....
10	.....	9.4	10.4	8.5	8.5	7.5	7.4	7.7	7.5	.....
11	.....	9.0	10.4	8.5	8.7	7.6	7.3	7.6	7.6	.....
12	.....	8.8	10.4	8.5	8.9	7.8	7.2	7.6	7.6	.....
13	.....	8.6	10.5	8.6	9.0	8.1	7.2	7.6	7.5	.....
14	.....	8.4	10.6	8.6	9.1	8.8	7.3	7.6	7.4	.....
15	.....	8.4	10.4	8.5	8.8	8.7	7.2	7.7	7.3	.....
16	.....	8.3	10.3	8.4	8.5	8.5	7.2	7.7	7.2	.....
17	.....	8.2	10.0	8.4	8.5	8.5	7.1	7.7	7.1	.....
18	.....	8.4	9.8	8.5	8.6	8.5	7.1	7.6	7.1	.....
19	.....	8.6	9.4	8.5	8.6	8.5	7.2	7.5	7.2	.....
20	.....	8.8	9.1	8.5	8.5	8.5	7.3	7.5	7.3	.....

Daily gage height, in feet, of Red River at Fargo, N. Dak., for 1912—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	.....	8.6	8.9	8.6	8.4	8.0	7.4	7.6	7.4	.....
22	.....	8.4	8.8	9.0	8.4	7.8	7.4	7.6	7.4	.....
23	.....	8.3	8.8	8.9	8.3	7.6	7.5	7.6	7.4	.....
24	.....	8.2	8.8	8.8	8.2	7.5	7.6	7.6	7.3	.....
25	.....	8.2	8.8	8.8	8.1	7.4	7.6	7.5	7.2	.....
26	7.3	8.2	8.8	8.7	8.2	7.3	7.7	7.5	7.0	.....
27	7.3	8.1	8.8	8.7	8.1	7.2	7.8	7.5	6.9	.....
28	7.4	8.2	8.8	8.6	8.0	7.2	7.8	7.5	7.0	.....
29	7.4	8.3	8.9	8.6	8.0	7.2	7.9	7.5	7.0	.....
30	7.4	8.3	8.9	8.6	7.9	7.3	7.9	7.6	7.1	.....
31	7.8	.....	8.9	.....	7.9	7.3	.....	7.6	.....	.....

NOTE.—Relation of gage height to discharge believed to have been affected by ice from Mar. 26 to 31 and from Nov. 19 to Dec. 7. No records obtained before and after these dates.

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	475	426	630	500	355	222	326	261	93
2	.....	500	426	603	475	332	220	304	240	78
3	.....	551	450	551	475	288	260	304	261	93
4	.....	657	450	525	475	288	258	282	261	78
5	.....	740	525	500	475	266	277	261	282	64
6	.....	768	630	500	500	224	253	240	261	64
7	.....	885	826	500	500	224	230	240	220	64
8	.....	1,040	885	475	475	266	249	261	200	.....
9	.....	976	976	475	500	288	226	261	220	.....
10	.....	740	1,040	500	500	266	224	261	220	.....
11	.....	630	1,040	500	551	288	202	240	240	.....
12	.....	577	1,040	500	603	332	181	240	240	.....
13	.....	525	1,070	525	630	402	179	240	220	.....
14	.....	475	1,100	525	657	577	196	240	200	.....
15	.....	475	1,040	500	577	551	175	261	181	.....
16	.....	450	1,010	475	500	500	173	261	162	.....
17	.....	426	915	475	500	500	153	261	144	.....
18	.....	475	855	500	525	500	151	240	144	.....
19	.....	525	740	500	525	500	168	220	144	.....
20	.....	577	657	500	500	500	185	220	162	.....
21	.....	525	603	525	475	378	200	240	162	.....
22	.....	475	577	630	475	332	200	240	162	.....
23	.....	450	577	603	450	288	220	240	162	.....
24	.....	426	577	577	426	266	240	240	144	.....
25	.....	426	577	577	402	245	240	220	126	.....
26	120	426	577	551	426	224	261	220	94	.....
27	120	402	577	551	402	204	282	220	78	.....
28	140	426	577	525	378	204	282	220	93	.....
29	140	450	603	525	378	204	304	220	93	.....
30	150	450	603	525	355	224	304	240	93	.....
31	230	.....	603	.....	355	224	.....	240	.....	.....

NOTE.—Discharge determined from two fairly well defined rating curves, applicable from Apr. 1 to Aug. 31, and from Sept. 21 to Nov. 18. Shifting channel methods used from Sept. 1 to 20. Discharge estimated because of ice from Mar. 26 to 31 and from Nov. 19 to Dec. 7.

Monthly discharge of Red River at Fargo, N. Dak., for 1912.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 26-31	230	120	150	1,790	D.
April	1,040	402	564	33,600	B.
May	1,100	426	727	44,700	B.
June	630	475	528	31,400	B.
July	657	355	483	29,700	B.
August	577	204	330	20,300	B.
September	304	151	224	13,300	C.
October	326	220	248	15,200	B.
November	282	78	182	10,800	C.
December 1-7	93	64	76.3	1,060	D.
The period				202,000	

RED RIVER AT GRAND FORKS, N. DAK.

Location.—At the Northern Pacific Railway bridge between Grand Forks, N. Dak., and East Grand Forks, Minn., about half a mile below the mouth of Red Lake River.

Records available.—May 26, 1901, to December 31, 1912. Gage-height records have, however, been kept by the United States Engineer Corps for about 30 years at this point.

Drainage area.—25,000 square miles.

Gages.—Staff and chain, attached to Northern Pacific Railway bridge; datum same for both and unchanged since establishment. As a rule the chain gage is read only during periods of extremely low water. The United States Engineer Corps gage is located on the breakwater to which the United States Geological Survey staff gage is attached, but at a datum 5 feet higher.

Channel.—Clay and silt; shifts slightly.

Discharge measurements.—Made from the Great Northern Railway bridge about one-fifth mile above the gage.

Artificial control.—There are no dams or other obstructions below, nor rapids, the channel being fairly uniform for miles. Above there are no power plants, dams, or reser voirs affecting the flow nearer than Crookston, on Red Lake River, 25 miles above Grand Forks, along the general course of the valley; about half the water comes from Red Lake River, but the storage at the Crookston plant is so small that no fluctuations caused by it have been discovered at Grand Forks. On the other branch, the Red River proper, and its tributaries above Grand Forks, there are no reservoirs or power plants for a hundred miles above.

Winter flow.—The river flows under smooth ice from about the middle of November to the middle of April; the flow during the winter fluctuates little, and since 1895 enough discharge measurements have been made each winter to give fairly satisfactory summaries for the winter.

When the ice breaks up in the spring, because the river has only a gentle current and because it flows north into cooler regions where the river is not yet open, the gage reading is usually excessively and disproportionately high for a few days or weeks, so that the figures for quantity of flow must depend largely on estimation; actual measurements when the river appeared entirely open and clear of ice at this point have sometimes shown the gage reading to be 5 feet greater than would have been needed for the same discharge later in the season, after the whole length of the river was entirely open.

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Discharge measurements of Red River at Grand Forks, N. Dak., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 9	Goric Monley	[a] 3.50	175	Nov. 8	W. B. Stevenson	5.12	923
Feb. 12	do	[b] 3.00	115	12	do	5.02	942
May 14	Chandler and Budge	8.72	2,370	Dec. 12	do	[c] 5.00	473
Oct. 12	Chandler and Stevenson	6.30	1,210				

[a] Mean lower surface of ice equals 2.41 feet on gage.
[b] Mean lower surface of ice equals 1.64 feet on gage.
[c] Mean lower surface of ice equals 4.24 feet on gage.
NOTE.—Discharge relation on Jan. 9, Feb. 12, and Dec. 12 affected by ice. All measurements made at Great Northern Ry. bridge.

Daily gage height, in feet, of Red River at Grand Forks, N. Dak., for 1912.

[J. F. Hayes, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	7.2	5.9	7.0	4.8	4.4	4.0	9.0	5.7	.....
2	.....	.....	2.9	7.6	5.8	7.0	4.8	4.5	4.4	8.8	5.6	.....
3	.....	2.7	.....	8.9	5.7	6.9	4.8	5.1	4.0	8.6	5.2	.....
4	.....	.....	.....	9.8	5.6	6.9	4.6	4.6	3.6	8.3	5.2	.....
5	.....	.....	.....	10.3	5.8	6.8	4.5	4.1	3.7	7.8	5.2	.....
6	3.4	.....	.....	11.5	5.8	6.8	4.5	4.2	3.7	7.4	5.1	.....
7	.....	.....	.....	12.0	6.0	6.7	4.5	4.2	3.8	7.0	5.0	5.2
8	.....	.....	.....	12.6	6.3	6.6	4.6	4.3	3.9	6.8	5.1	.....
9	3.5	.....	3.3	12.7	6.8	6.4	4.8	4.3	4.0	6.7	5.2	.....
10	.....	2.6	.....	12.5	7.6	6.1	4.7	4.2	4.0	6.6	5.2	.....
11	.....	.....	.....	11.8	8.1	6.0	4.5	4.2	3.8	6.4	5.2	.....
12	.....	3.0	.....	11.3	8.3	5.9	4.6	4.4	3.8	6.3	5.0	5.0
13	3.0	.....	.....	10.6	.....	5.8	4.6	4.2	4.2	6.0	5.0	.....
14	.....	.....	.....	10.1	8.7	5.6	5.0	4.0	4.0	5.9	4.9	4.8
15	.....	.....	.....	9.7	8.4	5.5	5.0	4.1	4.2	5.8	4.8	.....
16	.....	.....	3.7	9.1	8.6	5.5	5.0	4.5	4.2	5.6	4.5	.....
17	.....	2.8	3.7	8.4	8.5	5.5	5.2	5.3	4.0	5.5	4.6	.....
18	.....	.....	3.6	8.0	8.4	5.8	5.2	4.9	4.1	5.6	4.0	.....
19	.....	.....	3.8	7.7	8.2	5.6	5.0	4.6	4.4	5.5	4.4	.....
20	3.0	.....	3.8	7.2	8.0	5.9	5.1	4.5	4.3	5.5	4.6	.....
21	.....	.....	4.0	7.0	7.8	5.8	5.2	4.3	4.6	5.4	4.5	4.7
22	.....	.....	4.0	7.0	7.8	5.8	5.3	4.5	4.6	5.3	5.2	.....
23	.....	.....	4.0	6.8	7.6	6.2	5.3	4.7	4.8	5.4	4.8	.....
24	.....	2.8	4.1	6.6	7.5	6.3	5.2	4.4	5.1	5.6	5.0	.....
25	.....	.....	4.2	6.4	7.4	6.5	5.0	4.2	5.6	5.7	4.5	.....
26	.....	.....	4.3	6.2	7 2	6.2	4.8	4.1	5.7	5.7	4.5	.....
27	2.9	.....	4.4	6.0	7.1	5.5	4.8	4.1	7.3	5.7	5.0	.....
28	.....	.....	4.8	5.8	7.1	5.2	4.8	4.4	8.0	5.7	4.7	4.6
29	.....	.....	5.2	5.7	7.1	5.0	4.8	4.0	8.6	5.7	4.8	.....
30	.....	.....	5.6	5.6	7.0	5.0	4.8	3.8	9.2	5.7	4.4	.....
31	.....	.....	5.7	.....	6.9	.....	4.8	3.8	.....	5.6	.....	.....

NOTE.—Relation of gage height to discharge affected by ice from Jan. 1 to Mar. 31 and from Nov. 19 to Dec. 31.

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1,610	1,050	1,520	678	566	470	2,520	1,150
2	1,800	1,010	1,520	678	592	566	2,410	1,120
3	2,470	976	1,480	678	772	470	2,310	974
4	2,960	940	1,480	620	620	385	2,150	974
5	3,240	1,010	1,430	592	493	405	1,900	974
6	3,950	1,010	1,430	592	517	405	1,700	939
7	4,260	1,090	1,390	592	517	426	1,520	905
8	4,640	1,210	1,340	620	541	448	1,430	939
9	4,710	1,430	1,260	678	541	470	1,390	974
10	4,580	1,800	1,130	648	517	470	1,340	974
11	4,140	2,050	1,090	592	517	426	1,260	974
12	3,830	2,150	1,050	620	566	426	1,210	905
13	3,410	2,260	1,010	620	517	517	1,090	905
14	3,130	2,360	940	740	470	470	1,050	872
15	2,900	2,200	905	740	493	517	1,010	840
16	2,570	2,310	905	740	592	517	940	750
17	2,200	2,250	905	804	837	470	905	779
18	2,000	2,200	1,010	804	708	493	940	615
19	1,850	2,100	940	740	620	566	905	.....
20	1,610	2,000	1,050	772	592	541	905	.....
21	1,520	1,900	1,010	804	541	620	885	.....
22	1,520	1,900	1,010	837	592	620	864	.....
23	1,430	1,800	1,170	837	648	678	912	.....
24	1,340	1,750	1,210	804	566	772	998	.....
25	1,260	1,700	1,300	740	517	940	1,050	.....
26	1,170	1,610	1,170	678	493	976	1,070	.....
27	1,090	1,570	905	678	493	1,660	1,080	.....
28	1,010	1,570	804	678	566	2,000	1,100	.....
29	976	1,570	740	678	470	2,310	1,110	.....
30	940	1,520	740	678	426	2,630	1,130	.....
31	.....	1,480	.....	678	426	.....	1,110	.....

NOTE.—Discharge determined from two curves, the first applicable from Apr. 1 to Oct. 20, and well defined above 1,000 second-feet and fairly well defined between 600 and 1,000 second-feet; the second applicable from Nov. 1 to 18 and well defined above 800 second-feet. Shifting-channel method used from Oct. 21 to 31. Mean discharge for periods affected by ice estimated from discharge measurements, observer's notes, and weather reports. Mean discharge from Nov. 19 to 30 estimated at 650 second-feet.

Monthly discharge of Red River at Grand Forks, N. Dak., for 1912.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	140	8,610	D.
February	.....	.....	110	6,330	D.
March	.....	.....	300	18,400	D.
April	4,710	940	2,470	147,000	B.
May	2,360	940	1,670	103,000	A.
June	1,520	740	1,130	67,200	A.
July	837	592	698	42,900	B.
August	837	426	559	34,400	C.
September	2,630	385	755	44,900	C.
October	2,520	864	1,300	79,900	B.
November	1,150	.....	812	48,300	B.
December	.....	.....	422	25,900	C.
The year	4,710	.....	863	627,000	

NOTE.—See footnote to table of daily discharge.

PELICAN RIVER NEAR FERGUS FALLS, MINN.

Location.—At the private highway bridge 6 miles northwest of Fergus Falls, in sec. 18, T. 134 N., R. 42 W., about 5 miles above junction with Red River.

Records available.—June 19, 1909, to December 31, 1912.

Drainage area.—433 square miles.

Gage.—Vertical staff; datum unchanged. Gage is read twice a day and the mean of the readings is recorded as the mean for the day.

Channel.—Apparently permanent, but measurements made in 1912 indicate that the channel will shift during times of high stage. At low stages the channel is probably permanent.

Winter flow.—Discharge measurements are made to determine the flow from the middle of November to the first of April, when ice is present.

Artificial control.—The nearest dam is at Elizabeth, 6 to 8 miles above; the intermittent operation of the mill at Elizabeth causes a slight daily fluctuation in gage heights.

Accuracy.—Conditions of flow are excellent, except for fluctuations caused by operation of mill at Elizabeth. Backwater from Red River does not extend to station, as the range in stage of that stream is small.

Discharge measurements of Pelican River near Fergus Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 7	W. G. Hoyt	6.31	125	Aug. 11[a]	W. G. Hoyt	6.09	69
Do	S. B. Soulé	6.31	119	Do[a]	do	6.09	70

[a] Wading measurement.

Daily gage height, in feet, of Pelican River near Fergus Falls, Minn., for 1912.

[Henry W. Luther, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1			6.1		6.34	6.60	5.90	5.95	5.70	6.11	5.95
2	5.7	5.3		7.2	6.39	6.50	5.90	5.88	5.70	6.30	5.96
3					6.50	6.44	5.90	5.62	5.86	5.75	5.58
4	5.8			6.8	6.49	6.34	5.86	5.60	5.70	5.60	5.85
5			6.2	6.45	6.49	6.30	5.90	5.90	5.94	5.90	5.90
6		5.4		6.10	6.50	6.28	5.90	5.90	5.90	5.60	5.96
7				6.22	6.50	6.22	5.90	6.00	5.85	6.05	5.96
8			5.7	6.20	6.50	6.20	5.90	6.31	5.60	6.10	5.95
9	6.0	6.2		6.05	6.50	6.20	5.86	6.40	5.60	5.99	5.92
10				6.00	6.50	6.20	5.90	6.25	5.80	5.99	5.60
11				6.05	6.49	6.20	5.90	6.11	5.80	5.98	5.90
12	6.1		5.6	6.10	6.50	6.20	5.85	6.02	5.80	5.91	5.92
13		5.6		6.10	6.49	6.15	5.90	5.91	5.80	5.53	5.95
14				5.98	6.50	6.38	5.90	5.88	5.80	5.88	5.95
15			5.8	6.05	6.50	6.48	6.05	5.80	5.60	5.91	5.99
16	5.4	7.4		6.11	6.50	6.42	5.89	5.78	5.95	5.90	5.95
17				6.00	6.50	6.40	5.60	5.76	5.95	5.92	5.98
18				6.06	6.50	6.30	5.60	5.70	5.95	5.94	5.90
19	5.5		7.2	6.05	6.50	6.30	6.00	5.70	5.98	5.92	5.94
20		7.6		6.06	6.55	6.26	5.69	5.80	6.00	5.60	5.90
21				6.00	6.60	6.16	5.60	5.76	6.02	5.90	5.92
22			5.9	6.15	6.60	6.08	5.60	5.80	5.61	5.94	6.30
23	5.9	5.7		6.20	6.60	6.00	5.75	5.72	5.60	5.94	6.29
24				6.22	6.60	5.90	5.62	5.70	5.69	6.00	6.41
25				6.18	6.60	5.90	5.72	5.70	6.10	5.99	6.08
26	6.0		7.5	6.14	6.60	5.91	5.68	5.70	6.05	5.96	6.29
27		5.9		6.20	6.65	5.90	5.62	5.70	6.05	5.65	6.35
28				6.11	6.70	5.90	5.60	5.72	5.80	6.02	6.45
29			7.3	6.14	6.70	5.90	5.60	5.75	5.80	5.95	6.55
30	5.8			6.24	6.65	5.80	5.88	6.00	5.80	5.95	6.40
31					6.65		5.92	5.70		5.95	

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 5, and about Nov. 22 to Dec. 31.

Daily discharge, in second-feet, of Pelican River near Fergus Falls, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	126	200	42	49	22	75	49
2	.....	139	170	42	40	22	116	50
3	.....	170	153	42	16	38	26	13
4	.....	167	126	38	14	22	14	36
5	.....	167	116	42	42	48	42	42
6	73	170	111	42	42	42	14	50
7	98	170	98	42	56	36	64	50
8	93	170	93	42	119	14	73	49
9	64	170	93	38	142	14	55	45
10	56	170	93	42	104	31	55	14
11	64	167	93	42	75	31	53	42
12	73	170	93	36	59	31	43	45
13	73	167	104	42	43	31	13	49
14	53	170	137	42	40	31	40	49
15	64	170	164	64	31	14	43	55
16	75	170	148	41	29	49	42	49
17	56	170	142	14	27	49	45	53
18	66	170	116	14	22	49	48	42
19	64	170	116	56	22	53	45	48
20	66	185	107	21	31	56	14	42
21	56	200	85	14	27	59	42	45
22	83	200	70	14	31	15	48	.....
23	93	200	56	26	24	14	48	.....
24	98	200	42	16	22	21	56	.....
25	89	200	42	24	22	73	55	.....
26	81	200	43	20	22	64	50	.....
27	93	215	42	16	22	64	18	.....
28	75	230	42	14	24	31	59	.....
29	81	230	42	14	26	31	49	.....
30	102	215	31	40	56	31	49	.....
31	.....	215	.....	45	22	.....	49	.....

NOTE.—Daily discharge computed from a rating curve not well defined.

Discharge Jan. 1 to Apr. 5 and Nov. 22 to Dec. 31 estimated, because of ice, from climatologic records, discharge measurements, gage heights, and discharge of adjacent drainage areas, as follows: Jan. 1–31, 2 second-feet, varying from about 5 to 1 second-feet, Feb. 1–29, 2 second-feet; Mar. 1–31, 8 second-feet; Apr. 1–5, 50 second-feet; Nov. 22–30, 40 second-feet; Dec. 1–31, 20 second-feet.

Monthly discharge of Pelican River near Fergus Falls, Minn., for 1912.

[Drainage area, 433 square miles.][a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	2.0	
February	.....	.....	2.0	
March	.....	.....	8.0	
April	.....	.....	71.3	C.
May	230	126	182	B.
June	200	31	98.9	B.
July	64	14	33.1	C.
August	142	14	42.0	B.
September	73	14	36.2	C.
October	116	13	46.5	C.
November	.....	13	42.6	C.
December	.....	.....	20	
The year	.....	.....	48.8	

[a] "Discharge per square mile" and "run-off (depth in inches on drainage area)" have not been published for this station, because such values are affected by the storage on Melissa Lake for the power plant at Kinsbury Locks and by the diurnal fluctuation of discharge at the gaging station caused by the operation of the plant at Elizabeth, and would therefore be misleading.

NOTE.—See footnotes to table of daily discharge.

WILD RICE RIVER AT TWIN VALLEY, MINN.

Location.—At the highway bridge at Twin Valley, 2 miles above the nearest tributary which enters at Heiberg.

Records available.—June 30, 1909, to December 31, 1912.

Drainage area.—805 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Practically permanent. The river overflows at a stage of 12 feet on the gage and covers an area several hundred feet wide.

Discharge measurements.—Made from the bridge except at extreme low stages, when they are made at a wading section.

Floods.—An exceptionally severe flood occurred in July, 1909, which overflowed the lower part of the valley and wrecked the power dam at Faith by cutting around the end and greatly increasing the width of the channel. The maximum stage of the flood at Twin Valley was 20 feet and the discharge about 9,200 second-feet.

Artificial control.—There is a dam across the river at Heiberg, but the highest point affected by the backwater is more than a mile below Twin Valley. Discharge at the station is affected by the storage created by the dams at the lower end of Lower Rice Lake and at the outlet of Twin Lakes.

Accuracy.—The estimate for the flood discharge in 1911 above stage 14 feet was made by Kutter's formula in connection with the known area of the cross section and may be somewhat in error, but the error probably does not exceed 10 per cent.

Discharge measurements of Wild Rice River at Twin Valley, Minn., for 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 5	Gorie Monley	[a]4.95	10	Sept. 19	E. F. Chandler	5.12	112
Mar. 16	George Ebner	[b]5.55	17	Dec. 24[d]	W. B. Stevenson	5.23	16
17	do	[c]5.55	20				

[a] Complete ice cover.
[b] Complete ice cover; average thickness of ice, 1.87 feet.
[c] Complete ice cover; average thickness of ice, 1.80 feet.
[d] Complete ice cover; average thickness of ice, 0.65 foot.

Daily gage height, in feet, of Wild Rice River at Twin Valley, Minn., for 1912.

[Alex. Johnson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	6.8	5.10	6.0	4.60	4.75	4.60	5.40	5.30	.....
2	.....	4.95	.....	6.5	5.00	5.95	4.60	4.75	4.60	5.30	5.25	.....
3	.....	.....	.....	6.4	5.02	5.82	4.60	4.60	4.60	5.25	5.25	.....
4	.....	.....	5.75	6.3	5.02	5.75	4.60	4.60	4.60	5.15	5.20	.....
5	.....	4.50	.....	6.2	5.28	5.65	4.65	4.55	4.55	5.10	5.20	.....
6	.....	.....	.....	6.2	5.9	5.45	4.65	4.55	4.50	5.10	5.20	.....
7	.....	.....	.....	6.0	6.2	5.32	4.60	4.60	4.50	5.10	5.20	.....
8	5.00	.....	.....	5.7	6.35	5.28	4.60	4.60	4.50	5.00	5.20	.....
9	.....	.....	.....	5.7	6.6	5.28	4.60	4.60	4.50	4.90	5.20	5.0
10	.....	.....	.....	5.55	6.8	5.18	4.60	4.60	4.50	4.90	5.00	.....
11	.....	.....	5.7	5.42	7.4	5.20	4.60	4.60	4.90	4.90	4.90	.....
12	.....	4.40	.....	5.40	7.3	5.18	4.60	4.60	4.92	4.90	4.85	.....
13	.....	.....	.....	5.40	7.0	5.10	4.60	4.55	5.30	4.90	4.80	.....
14	.....	.....	.....	5.35	6.7	5.10	4.60	4.50	5.30	4.90	4.70	.....
15	.....	.....	.....	5.38	6.8	5.12	4.60	4.50	5.30	4.80	4.70	.....

Daily gage height, in feet, of Wild Rice River at Twin Valley, Minn., for 1912—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	7.7	.....	5.55	5.20	6.8	5.10	4.60	4.50	5.25	4.80	4.70	5.1
17	.....	.....	5.55	4.90	6.7	5.00	4.60	4.70	5.25	5.00	4.80	.....
18	.....	.....	5.6	5.00	6.8	4.90	4.60	4.70	5.20	6.05	4.80	.....
19	.....	4.40	.....	5.00	6.8	4.90	4.70	4.80	5.10	5.88	4.70	.....
20	.....	.....	.....	4.95	7.2	4.90	4.80	4.70	5.10	5.90	4.60	.....
21	.....	.....	.....	4.92	7.0	4.85	5.00	4.70	5.20	5.90	4.70	.....
22	5.15	.....	.....	4.95	6.9	4.80	5.10	4.60	5.30	5.90	4.70	.....
23	.....	.....	.....	4.85	6.9	4.75	5.10	4.60	5.30	5.90	4.60	5.2
24	.....	.....	.....	4.82	6.7	4.75	5.00	4.60	5.40	5.90	4.65	5.2
25	.....	.....	5.6	4.80	6.9	4.75	4.90	4.55	5.5	5.80	4.70	.....
26	.....	6.0	.....	4.88	6.9	4.70	4.90	4.50	5.5	5.70	4.90	.....
27	.....	.....	.....	4.90	6.6	4.70	4.85	4.40	5.5	5.60	4.90	.....
28	.....	.....	.....	4.92	6.3	4.70	4.80	4.50	5.5	5.60	5.10	.....
29	4.95	.....	.....	5.00	6.3	4.65	4.70	4.50	5.40	5.55	5.15	.....
30	.....	.....	.....	5.00	6.1	4.60	4.80	4.60	5.40	5.50	4.7	5.2
31	.....	.....	.....	.....	6.05	.....	4.80	4.60	.....	5.40	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 31, and about Nov. 17 to Dec. 31.

Daily discharge, in second-feet, of Wild Rice River at Twin Valley, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	501	110	295	32	52	32	168	148
2	419	92	284	32	52	32	148	138
3	393	96	254	32	32	32	138	138
4	367	96	239	32	32	32	120	129
5	343	144	218	38	28	28	110	129
6	343	272	178	38	28	23	110	129
7	295	343	152	32	32	23	110	129
8	228	380	144	32	32	23	92	129
9	228	445	144	32	32	23	75	129
10	198	501	125	32	32	23	75	92
11	172	688	129	32	32	75	75	75
12	168	654	125	32	32	78	75	67
13	168	560	110	32	28	148	75	59
14	158	473	110	32	23	148	75	44
15	164	501	114	32	23	148	59	44
16	129	501	110	32	23	138	59	44
17	75	473	92	32	44	138	92	.....
18	92	501	75	32	44	129	307	.....
19	92	501	75	44	59	110	268	.....
20	84	622	75	59	44	110	272	.....
21	78	560	67	92	44	129	272	.....
22	84	530	59	110	32	148	272	.....
23	67	530	52	110	32	148	272	.....
24	62	473	52	92	32	168	272	.....
25	59	530	52	75	28	188	250	.....
26	72	530	44	75	23	188	228	.....
27	75	445	44	67	17	188	208	.....
28	78	367	44	59	23	188	208	.....
29	92	367	38	44	23	168	198	.....
30	92	319	32	59	32	168	188	.....
31	.....	307	.....	59	32	.....	168	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between discharges 23 and 3,400 second-feet. Discharge Jan. 1 to Mar. 31 and Nov. 17 to Dec. 31 estimated, because of ice, from climatologic records, weekly gage heights, four discharge measurements, and discharge of adjacent drainage areas, as follows: Jan. 1–31, 31 second-feet, varying from about 50 to 20 second-feet; Feb. 1–28, 13 second-feet, varying from about 10 to 25 second-feet; Mar. 1–31, 25 second-feet; Nov. 17–30, 30 second-feet, varying from about 44 to 17 second-feet; Dec. 1–31, 19 second-feet.

Monthly discharge of Wild Rice River at Twin Valley, Minn., for 1912.

[Drainage area, 805 square miles.] [a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January			31	D.
February			13	D.
March			25	D.
April	501	59	179	C.
May	688	92	416	B.
June	295	32	118	B.
July	110	32	49.5	C.
August	59	17	33.0	C.
September	188	23	106	B.
October	307	59	163	B.
November	148		68.1	C.
December			19	D.
The year			102	

[a] "Discharge per square mile" and "Run-off (depth in inches on drainage area)" are not published for this station because of the effect of the dams noted under "Artificial control." These dams are closed during the winter and are used during the spring and early summer to assist log driving to the mills at Ada. The dam on Lower Rice Lake is said to store water to a depth of about 8 feet in the lake, representing a storage capacity of about 895 million cubic feet.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

DEVILS LAKE NEAR DEVILS LAKE, N. DAK.[1]

Location.—At the Chautauqua grounds steamer landing, 6 miles southwest of the city of Devils Lake.

Records available.—June 8, 1901, to September 30, 1911; fragmentary gage heights.

Drainage area.—Theoretically somewhat more than 3,500 square miles; surveys made about 25 years ago showed the lake to be about 35 miles long, the width ranging from 1 to 15 miles and the area being approximately 120 square miles; because of its many bays and slender arms the shore line measures more than 200 miles. The present area of the lake is not given but is estimated at not more than 60 square miles; as the lake has no outlet its size depends entirely on the relations between evaporation from its surface and the rainfall upon it and inflow from the surrounding country.

Gage.—A staff attached to piles of the pier at the steamer landing; read occasionally by E. E. Heerman and J. M. Brannon. The gage zero [2] is 1,416.2 feet above sea level, and 22.90 feet below a standard United States survey bench-mark post which is set in the bank directly behind the gage and about 8 rods distant.

Gage height of Devils Lake, N. Dak., in 1912.

Date.	Feet.	Date.	Feet.	Date.	Feet.	Date.	Feet.
May 8	8.82	June 14	9.10	July 11	9.60	Aug. 7	9.69
20	9.12	30	9.36	21	9.63	14	9.70
30	8.78	July 8	9.58	Aug. 2	9.68	24	9.70

RED LAKE RIVER AT THIEF RIVER FALLS, MINN.

Location.—One-third mile below the dam at Thief River Falls, and a mile or more below the mouth of Thief River.

Records available.—July 2, 1909, to December 31, 1912.

Drainage area.—3,430 square miles.

Gage.—Vertical and inclined staff; read morning and evening; datum unchanged.

[1] For description of Devils Lake and all data available from 1867 to 1908 see Water-Supply Paper U. S. Geol. Survey No. 245, pp. 51–54.

[2] In the descriptions of the station published in Water-Supply Paper U. S. Geol. Survey No. 66, p. 14, and No. 85, p. 238, the statement of the elevation of the bench mark above mean sea level was in error.

Channel.—Practically permanent. The control is changed temporarily by log jams that form below.

Discharge measurements.—Made from a car and cable at the gage.

Winter flow.—The river is frozen over from the latter part of November to the first of April, and measurements are made through the ice to determine the winter flow.

Artificial control.—A short distance above the station is the dam used by the Hansen & Barzen Milling Co. and the city lighting plant. The fluctuating loads on the turbines, produced by the operation of the lighting plant at night and of the mill chiefly during the day time, cause fluctuations in the river stage below the dam.

Accuracy.—Logs floated down the river may jam below the station and cause backwater. Conditions at this station are not satisfactory and similar conditions exist at all points on the upper river. Therefore, the records can not be considered better than fair.

Discharge measurements of Red Lake River at Thief River Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 7[a]	G. Monley	.....	(*b*)	Nov. 14	W. B. Stevenson	4.01	231
Mar. 19[a]	Geo. Ebner	2.70	0.4	Dec. 22[c]	.....do	3.43	25
Sept. 17	E. F. Chandler	4.27	229				

a Measurements under complete ice cover 2 feet thick.
b Estimated less than 10 second-feet.
c Partial ice cover.

Daily gage height, in feet, of Red Lake River at Thief River Falls, Minn., for 1912.

[C. P. Quist, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	2.6	3.7	3.10	3.70	4.05	3.65	3.30	4.55	4.45	3.65
2	3.8	2.8	.....	4.4	3.25	3.20	4.05	3.75	4.0	4.6	4.05	4.4
3	.....	.....	.....	4.5	3.05	3.70	3.70	3.80	4.05	4.35	3.75	4.4
4	.....	.....	.....	4.8	2.70	3.30	3.20	3.78	4.05	4.4	4.5	4.25
5	2.8	.....	2.6	4.9	3.40	3.30	3.30	4.15	3.95	4.35	4.55	4.3
6	.....	2.7	.....	5.2	4.45	3.28	3.05	4.0	4.1	4.15	4.35	4.2
7	.....	.....	.....	4.4	3.70	3.25	3.20	4.15	3.92	4.45	4.2	4.25
8	.....	.....	2.6	3.85	3.60	3.08	3.10	3.75	3.60	4.4	4.35	3.55
9	3.6	2.6	.....	3.95	3.65	2.80	3.35	3.80	4.15	4.4	4.4	4.5
10	3.8	.....	.....	3.70	3.60	3.25	4.15	4.2	4.1	4.35	3.95	4.5
11	.....	.....	.....	4.05	3.60	3.35	3.65	3.40	3.95	4.35	4.5	4.55
12	2.4	.....	2.6	3.85	3.25	3.25	3.45	4.2	3.80	4.3	4.45	4.5
13	.....	2.6	.....	3.40	3.15	3.30	3.40	4.1	4.05	4.0	4.45	4.5
14	.....	.....	.....	2.85	3.45	3.40	3.90	4.15	4.15	4.35	4.45	4.25
15	.....	.....	2.6	3.55	3.38	3.65	4.6	4.2	3.82	4.25	4.4	.....
16	2.8	2.7	.....	3.60	3.40	3.35	4.1	4.15	4.2	4.15	4.2	.....
17	.....	.....	.....	3.28	3.45	3.80	4.1	4.15	4.15	4.2	3.50	.....
18	.....	.....	.....	3.50	3.40	3.95	4.3	3.30	4.25	4.2	4.3	4.3
19	3.5	.....	2.6	3.20	3.20	3.85	3.60	4.0	4.3	4.15	4.4	.....
20	.....	2.7	.....	3.00	3.72	3.80	4.4	4.15	4.35	3.80	4.3	.....
21	.....	.....	.....	2.60	3.55	3.82	3.9	4.0	4.3	4.3	4.4	4.4
22	.....	.....	2.6	3.00	3.85	3.82	4.55	4.05	3.60	4.3	4.4	3.45
23	2.9	2.6	.....	3.65	3.80	3.55	4.1	4.1	4.3	4.2	4.4	.....
24	.....	.....	.....	2.65	3.65	3.90	4.1	4.1	5.6	4.2	3.2	4.3
25	.....	.....	.....	2.65	3.80	3.60	4.6	3.35	5.2	4.2	4.15	.....
26	2.9	.....	4.6	3.10	3.35	3.70	4.05	4.2	4.6	4.4	4.3	.....
27	.....	2.6	.....	3.65	3.58	3.65	3.90	4.3	5.2	4.0	4.3	4.3
28	.....	.....	.....	2.58	3.60	3.68	3.85	4.2	5.3	4.3	4.1	.....
29	.....	.....	3.0	2.65	3.48	3.70	4.1	3.95	5.2	4.3	4.25	.....
30	2.8	.....	.....	2.65	3.05	3.05	4.0	3.80	5.2	4.45	4.25	.....
31	.....	.....	.....	.....	3.30	.....	4.05	4.0	.....	4.4	.....	4.3

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Apr. 7, and Nov. 21 to Dec. 31, and by logs about July 10 to Oct. 2. The gage observer made the following notes: June 19, log drive nearing Thief River; July 10, 15, 20, and 25, sluicing logs; Oct. 3, river cleared by a Crookston drive.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	32	132	212	90	38	310	372
2	.....	50	43	212	110	165	325	248
3	.....	28	132	132	121	176	340	166
4	.....	8	57	43	117	176	356	389
5	.....	72	57	57	200	154	340	406
6	.....	325	54	28	165	188	278	340
7	.....	132	50	43	200	147	372	293
8	165	110	30	32	110	81	356	340
9	188	121	12	64	121	200	356	356
10	132	110	50	225	212	188	340	220
11	212	110	64	110	50	154	340	389
12	165	50	50	72	212	121	324	372
13	72	38	57	64	188	176	234	372
14	14	81	72	165	200	200	340	372
15	100	69	121	358	212	125	308	356
16	110	72	64	212	200	212	278	293
17	54	81	154	200	200	200	293	102
18	90	72	188	252	38	225	293	324
19	43	43	165	90	165	238	278	356
20	23	136	154	280	200	252	179	324
21	6	100	158	154	165	238	324	.....
22	23	165	158	325	176	81	324	.....
23	121	154	100	200	188	238	293	.....
24	7	121	176	188	188	718	293	.....
25	7	154	110	325	43	540	293	.....
26	32	64	132	176	212	325	356	.....
27	121	106	121	143	238	540	234	.....
28	5.8	110	128	132	212	582	324	.....
29	7	86	132	188	154	540	324	.....
30	7	28	28	165	121	540	372	.....
31	.....	57	.....	176	165	.....	356	.....

NOTE.—Daily discharge computed from 3 rating curves fairly well defined. Effects of logs upon the relation of gage height to discharge necessitated the use of more than one rating curve. Discharge July 10 to 31 computed by indirect methods. See footnotes to table of daily gage height. Discharge Jan. 1 to Apr. 7 and Nov. 21 to Dec. 31 estimated, because of ice, from discharge measurements, semi-weekly gage heights, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 1–31, 4 second-feet, varying from about 1 to 50 second-feet; Feb. 1–29, 4 second-feet, varying from about 1 to 50 second-feet; Mar. 1–31, 7 second-feet, varying from about 1 to 50 second-feet; Apr. 1–7, 123 second-feet, varying from about 40 to 200 second-feet; Nov. 21–30, 200 second-feet; Dec. 1–31, 125 second-feet.

Monthly discharge of Red Lake River at Thief River Falls, Minn., for 1912.

[Drainage area, 3,430 square miles.] [a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	4	
February	.....	.....	4	
March	.....	.....	7	
April	212	5.8	85.5	C.
May	325	8	93.1	B.
June	188	12	98.3	B.
July	358	28	162	C.
August	238	38	160	B.
September	718	38	259	C.
October	372	179	314	B.
November	406	.....	280	C.
December	.....	.....	125	
The year	718	.....	133	

[a] Of the 2,420 square miles of this drainage area above the mouth of Thief River, at least three-fourths is said to be composed of swamp and lake area. Although the natural discharge is not controlled at this point, a considerable part of the land in the drainage basin probably does not contribute directly to the flow past the gaging station except possibly during high water. Estimates of "Discharge per square mile" and "Run-off (depth in inches on drainage area)" would therefore be misleading and are not published.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

RED LAKE RIVER AT CROOKSTON, MINN.

Location.—At new Sampson's addition highway bridge in Crookston, less than one-fourth mile below the dam and power house of the Crookston Waterworks, Power & Light Co.; no tributaries within several miles.

Records available.—May 19, 1901, to December 31, 1912.

Drainage area.—5,320 square miles.

Gage.—Automatic gage installed in September, 1911, replacing the chain gage which was attached to the new Sampson's addition bridge July 1, 1909. The chain gage was set to read the same as the original gage which was fastened to the bridge 20 rods above. A vertical staff near the automatic reads to the same datum as the gages previously used.

Channel.—Changes slightly from year to year.

Discharge measurements.—Made from new bridge.

Winter flow.—During the winter of 1911 and 1912 the flow in the river was so small that the percentage variation caused by the power plant was greater than ever before. During periods of low flow the ice accumulated to such an extent that when the gates were opened the open channels worn through the ice were inadequate for carrying the flow and the gage heights rose rapidly. When the gates were closed the gage heights remained high usually for a long time, as there was not free passage for the water to drain away. Hence, if the power plant was in operation for several hours so as to raise the water to a nearly unchanging gage height, it took 20 to 40 hours for the gage heights to change to the minimum when the gates were closed.

Accuracy.—The operation of the power plant causes fluctuations in the water surface at the station, but the use of the automatic gage should give excellent results.

Discharge measurements of Red Lake River at Crookston, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 27[a]	Monley and Ebner	2.59	10	July 22[d]	E. F. Chandler	2.52	136
27[a]	do	4.06	18	Sept. 19[d]	do	2.42	55
Mar. 2[b]	E. F. Chandler	2.72	14	27	do	6.24	1,610
2[c]	do	4.92	182	Oct. 1	W. B. Stevenson	6.18	1,650
17[d]	Geo. Ebner	2.87	18	Dec. 23[e]	do	4.57	438

[a] Measurement made under complete ice cover. Average thickness, 1.4 feet.
[b] Measurement made under complete ice cover. Average thickness, 1.4 feet. Average distance water surface to top of ice, 0.35 foot.
[c] Power house in operation. Ice cover.
[d] Measurement made by wading.
[e] Measurement made under complete ice cover.

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.63	2.40	3.45	4.5	3.0	2.85	3.25	.....	3.4	6.2	3.8	.....
2	2.84	2.58	3.5	4.7	2.90	3.4	2.55	.....	2.72	6.0	3.75	3.45
3	2.73	3.3	3.5	4.9	2.88	2.80	2.53	2.83	2.64	5.6	3.6	3.45
4	2.75	3.9	3.1	5.2	2.90	3.15	3.8	3.0	2.78	.....	3.65	3.2
5	2.83	3.6	3.35	6.1	3.15	3.1	3.15	2.85	2.91	4.8	3.6	3.8
6	2.82	2.93	3.45	6.4	3.1	3.0	2.99	3.6	4.2	4.5	3.7	.....
7	3.1	3.3	3.45	6.4	3.05	2.97	3.2	3.5	3.05	4.9	3.65	.....
8	2.65	3.45	3.55	7.1	3.35	2.96	2.81	2.91	3.1	4.6	3.7	3.25
9	2.60	3.65	3.55	6.8	3.35	3.4	2.70	3.0	2.75	4.6	3.7	3.45
10	2.94	3.5	3.5	5.4	3.45	2.70	2.53	3.7	3.1	4.4	3.6	3.6

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	3.65	3.25	4.6	3.5	2.63	2.82	3.85	3.9	4.3	3.7	3.15
12	.....	3.55	3.3	4.5	3.4	2.69	2.54	2.75	2.81	4.4	3.7	3.45
13	.....	3.6	3.25	4.4	3.65	2.94	3.9	2.86	3.25	3.9	3.7	3.8
14	.....	3.95	3.35	4.4	3.75	2.55	2.83	3.3	4.0	4.3	.....	3.0
15	.....	3.8	3.4	4.4	3.8	2.91	2.47	.....	.....	4.1	3.85	3.45
16	.....	3.5	3.5	3.85	3.6	3.15	3.4	.....	.....	4.3	3.8	3.25
17	2.91	3.6	3.5	3.65	3.6	3.25	3.15	.....	.....	4.0	3.6	3.25
18	2.75	3.6	3.15	2.83	3.75	3.25	3.15	.....	.....	4.6	3.7	3.55
19	2.55	3.3	3.25	3.2	3.45	3.15	4.1	.....	4.0	4.0	.....	3.35
20	3.1	3.55	3.25	3.15	3.5	3.15	3.5	.....	3.05	3.65	.....	3.1
21	2.92	3.5	3.35	3.1	3.3	.....	3.65	.....	.....	3.75	3.75	3.4
22	.....	3.4	3.35	2.83	3.2	.....	3.7	.....	.....	3.8	3.5	3.4
23	.....	3.5	3.5	3.0	3.3	.....	3.4	3.25	4.2	3.6	3.35	3.7
24	2.72	3.65	3.65	2.68	3.3	4.0	3.3	2.90	3.95	3.7	.....	3.55
25	2.90	3.4	3.5	2.96	3.0	2.82	3.25	3.45	4.3	3.85	2.85	3.6
26	2.81	3.25	3.6	2.76	3.35	2.75	3.7	4.4	6.3	3.7	3.25	4.0
27	2.92	3.5	3.9	2.96	3.75	3.45	3.55	3.55	5.8	3.6	2.87	3.7
28	2.79	3.5	3.7	3.0	3.3	2.99	3.6	2.93	6.7	3.65	2.86	3.65
29	2.76	3.45	4.3	2.60	3.25	2.62	3.7	2.98	6.8	3.65	3.45	3.8
30	2.86	.....	5.2	2.76	3.2	3.85	.....	2.92	6.6	3.7	3.6	3.85
31	2.39	.....	5.4	.....	3.0	.....	.....	4.1	.....	3.8	.....	3.65

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 10 and about Nov. 16 to Dec. 31.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	217	178	288	320	332	1,720	466
2	.....	191	332	104	330	145	1,590	448
3	.....	186	165	100	173	126	1,350	395
4	.....	191	259	466	217	160	1,100	412
5	.....	259	245	259	178	194	910	395
6	.....	245	217	214	395	625	760	430
7	.....	231	209	273	363	231	965	412
8	.....	317	207	168	194	245	810	430
9	.....	317	332	140	217	152	810	430
10	.....	348	140	100	430	245	715	395
11	810	363	123	170	484	502	670	430
12	760	332	138	102	152	168	715	430
13	715	412	201	502	181	288	502	430
14	715	448	104	173	302	540	670	450
15	715	466	194	87	320	540	580	484
16	484	395	259	332	290	540	670	.....
17	412	395	288	259	300	540	540	.....
18	173	448	288	259	270	540	810	.....
19	273	348	259	580	190	540	540	.....
20	259	363	259	363	240	231	412	.....
21	245	302	260	412	260	450	448	.....
22	173	273	240	430	290	540	466	.....
23	217	302	160	332	288	625	395	.....
24	135	302	540	302	191	521	430	.....
25	207	217	170	288	348	670	484	.....
26	155	317	152	430	715	1,780	430	.....
27	207	448	348	379	379	1,470	395	.....
28	217	302	214	395	199	2,050	412	.....
29	116	288	121	430	212	2,120	412	.....
30	155	273	484	450	196	1,980	430	.....
31	.....	217	.....	810	580	.....	466	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined. Daily discharge estimated June 21 to 23; July 30 to Aug. 2; Aug. 15 to 22; Sept. 15 to 18, 21 and 22; Oct. 4 and Nov. 14. Discharge Jan. 1 to Apr. 10 and Nov. 16 to Dec. 31, estimated, because of ice, from discharge measurements, gage heights, observer's reports, and climatologic records, as follows: Jan. 1–31, 31 second-feet, varying from about 63 to 15 second-feet; Feb. 1–29, 37 second-feet, varying from about 42 to 15 second-feet; Mar. 1–31, 43 second-feet, varying from about 25 to 117 second-feet; Apr. 1–10, 460 second-feet, varying from about 100 to 1,200 second-feet; Nov. 16–30, 295 second-feet; Dec. 1–31, 165 second-feet.

Monthly discharge of Red Lake River at Crookston, Minn., for 1912.

[Drainage area, 5,320 square miles.[a]]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	.....	.....	31	1,910	D.
February	.....	.....	37	2,130	D.
March	.....	.....	43	2,640	D.
April	.....	.....	391	23,300	C.
May	466	186	313	19,200	B.
June	540	104	236	14,000	B.
July	810	87	310	19,100	C.
August	715	152	297	18,300	C.
September	2,120	126	636	37,800	B.
October	1,720	395	697	42,900	B.
November	484	.....	362	21,500	C.
December	.....	.....	165	10,100	C.
The year	2,120	.....	293	213,000	

[a] "Second-feet per square mile" and "Run-off (depth in inches)" computed from this drainage area are not published because of the effect of the four power plants above the gaging station at Crookston and the fact that a large portion of the drainage area is swamp land.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

Location.—At the Drybrooke ford, 6 miles north of Thief River Falls, in sec. 3, T. 154 N., R. 43 W. The nearest tributary is the outlet of Mud Lake which enters Thief River in the northeastern part of T. 156 N., R. 42 W.

Records available.—July 1, 1909, to December 31, 1912.

Drainage area.—1,010 square miles.

Gage.—Inclined staff; datum unchanged since establishment. When this inclined staff gage was installed on August 19, 1909, its reading (6.36 feet) was made to agree with that of the temporary vertical staff gage which had been used from July 1 to August 18, 1909. On June 29, 1911, and September 18, 1912, it was found by wye levels that the gage was in error (the amounts being the same), probably the result of a mistake in graduating or setting the gage at the time of its installation. Assuming the 6.4 point to be correct, the results of the levels are as follows:

Inclined-rod gage readings	5.2	6.0	7.0	8.0	9.0	10.0	11.0
True elevations	5.28	6.03	6.96	7.90	8.85	9.80	10.75

As the whole record at this station (except July 1, to Aug. 18, 1909) is referred to this inclined-rod gage and is therefore consistent in itself, no correction has been made in published gage heights because of the above discrepancy.

Channel.—Practically permanent.

Discharge measurements.—Made by means of a boat and cable a short distance below the gage.

Winter flow.—From the middle of November to the first of April the river is entirely frozen over, and discharge measurements are made to determine the winter discharge.

Artificial control.—The dam at Thief River Falls, at the mouth of Thief River, backs up the water in Thief River for several miles, but the station is protected by the rapids below from the influence of the dam. During 1910 and 1911 drainage work has been carried on extensively in Thief River Basin and the effect will be to modify the regimen of the river. The extremely low flow of 1910 and 1911 was due partly to the holding back of the run-off by temporary dams for use of the floating dredges above the station.

Accuracy.—See remarks under "Gage" above.

Discharge measurements of Thief River near Thief River Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Sept. 18	E. F. Chandler	3.77	3.7
Dec. 21[a]	W. B. Stevenson	5.00	16.7

[a] Measurement made under partial ice cover.

Daily gage height, in feet, of Thief River near Thief River Falls, Minn., for 1912.

[H. J. Maland, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.12	3.85	3.75	3.45	3.55	3.49	4.84	5.1	.....
2	4.31	3.85	3.80	3.63	3.49	3.48	4.72	4.80	.....
3	4.61	3.81	3.80	3.61	3.48	3.46	4.76	4.77	.....
4	4.63	3.77	3.75	3.56	3.45	3.45	4.74	4.70	.....
5	4.84	3.87	3.79	3.48	3.48	3.45	4.65	4.65	4.3
6	4.80	3.94	4.15	3.45	3.55	3.45	4.70	4.60	.....
7	4.63	3.90	3.83	3.45	3.55	3.42	4.77	4.07	.....
8	4.42	3.93	3.76	3.45	3.55	3.42	4.76	4.75	.....
9	4.38	3.85	3.67	3.73	3.48	3.45	4.70	4.67	.....
10	4.40	3.81	3.61	3.74	3.46	3.46	4.80	4.70	.....
11	4.30	3.75	3.67	3.71	3.45	3.60	4.75	4.70	.....
12	4.32	3.66	3.67	3.66	3.45	3.65	4.70	4.67	.....
13	4.22	3.59	3.65	3.70	3.44	3.85	4.70	4.65	.....
14	4.22	3.55	3.65	3.76	3.42	3.89	4.65	4.65	.....
15	4.12	3.57	3.70	3.77	3.40	3.90	4.63	4.77	.....
16	4.04	3.60	3.75	3.73	3.40	3.85	4.60	4.90	.....
17	4.00	3.55	3.70	3.67	3.46	3.79	4.59	4.77	.....
18	3.89	3.49	3.69	3.63	3.49	3.77	4.32	4.75	.....
19	3.85	3.77	3.64	3.59	3.55	3.75	4.65	5.0	.....
20	3.76	4.15	3.63	3.56	3.56	3.93	4.65	4.65	.....
21	3.74	4.08	3.63	3.60	3.56	4.01	4.73	4.73	5.0
22	3.73	4.12	3.61	3.73	3.49	4.02	4.57	4.87	.....
23	3.69	4.22	3.57	3.70	3.49	4.02	4.13	4.77	.....
24	3.67	4.28	3.48	3.65	3.57	4.85	4.38	4.65	.....
25	3.69	4.22	3.42	3.63	3.55	5.1	5.15	4.58	.....
26	3.81	4.05	3.40	3.59	3.48	5.1	4.80	4.62	.....
27	3.85	3.77	3.40	3.67	3.45	5.35	4.55	4.60	.....
28	3.87	3.77	3.40	3.71	3.48	5.30	4.69	.....	.....
29	3.79	3.79	3.38	3.63	3.55	5.15	4.72	.....	.....
30	3.80	3.80	3.35	3.59	3.55	5.35	4.57	.....	.....
31	.....	3.77	.....	3.56	3.55	.....	4.70	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 7 and about Nov. 16 to Dec. 31.

Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.0	3.1	1.2	1.7	1.4	55	84
2	.....	4.0	3.5	2.2	1.4	1.3	45	51
3	.....	3.6	3.5	2.1	1.3	1.2	48	49
4	.....	3.3	3.1	1.8	1.2	1.2	46	43
5	.....	4.1	3.4	1.3	1.3	1.2	39	39
6	.....	4.8	9.8	1.2	1.7	1.2	43	35
7	.....	4.4	3.8	1.2	1.7	1.0	49	6.9
8	23	4.7	3.2	1.2	1.7	1.0	48	47
9	21	4.0	2.5	2.9	1.3	1.2	43	41
10	22	3.6	2.1	3.0	1.2	1.2	51	43
11	17	3.1	2.5	2.8	1.2	2.0	47	43
12	18	2.4	2.5	2.4	1.2	2.4	43	41
13	13	1.9	2.4	2.7	1.1	4.0	43	39
14	13	1.7	2.4	3.2	1.0	4.3	39	39
15	8.4	1.8	2.7	3.3	.9	4.4	37	49

Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for 1912— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	6.3	2.0	3.1	2.9	.9	4.0	35	.....
17	5.5	1.7	2.7	2.5	1.2	3.4	34	.....
18	4.3	1.4	2.6	2.2	1.4	3.3	18	.....
19	4.0	3.3	2.3	1.9	1.7	3.1	39	.....
20	3.2	9.8	2.2	1.8	1.8	4.7	39	.....
21	3.0	7.1	2.2	2.0	1.8	5.7	45	.....
22	2.9	8.4	2.1	2.9	1.4	5.9	33	.....
23	2.6	13	1.8	2.7	1.4	5.9	8.8	.....
24	2.5	16	1.3	2.4	1.8	56	21	.....
25	2.6	13	1.0	2.2	1.7	84	90	.....
26	3.6	6.5	.9	1.9	1.3	84	51	.....
27	4.0	3.3	.9	2.5	1.2	119	32	.....
28	4.1	3.3	.9	2.8	1.3	111	42	.....
29	3.4	3.4	.8	2.2	1.7	90	45	.....
30	3.5	3.5	.6	1.9	1.7	119	33	.....
31	.....	3.3	.....	1.8	1.7	.....	43	.....

NOTE.—Daily discharge computed from a rating curve well defined above 3 second-feet. Discharge Jan. 1 to Apr. 7 and Nov. 16 to Dec. 31, estimated, because of ice, from observer's notes, gage heights, and climatologic records, as follows: No flow Jan. 1 to Mar. 26; Mar. 27–31, 3 second-feet, varying from about 1 to 5 second-feet; Apr. 1–7, 10 second-feet; Nov. 16–30, 22 second-feet, varying from about 10 to 51 second-feet; Dec. 1–31, 14 second-feet. Where no flow is noted the discharge is estimated to have been less than 0.1 second-foot.

Monthly discharge of Thief River near Thief River Falls, Minn., for 1912.

[Drainage area, 1,010 square miles.[a]]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	0.00	
February	.....	.....	.00	
March	.....	.....	.5	
April	23	.....	8.70	C.
May	16	1.4	4.85	B.
June	9.8	.6	2.53	C.
July	3.3	1.2	2.23	C.
August	1.8	.9	1.42	C.
September	119	1.0	24.3	B.
October	90	8.8	41.4	B.
November	84	.....	32.7	C.
December	.....	.....	14	
The year	119	.....	11.0	

[a] "Second-feet per square mile" and "Run-off (depth in inches)" are not published for this station, because such values are rendered misleading by the large amount of swamp and recently drained land in the basin of Thief River.

NOTE.—See footnote to table of daily discharge.

CLEARWATER RIVER AT RED LAKE FALLS, MINN.

Location.—At Great Northern Railway bridge at Red Lake Falls, Minn., about 1½ miles above the mouth of the river and 2 miles below the nearest tributary.

Records available.—June 18, 1909, to December 31, 1912.

Drainage area.—1,310 square miles.

Gage.—Vertical staff about half a mile farther downstream than the original gage. Staff was placed September 12, 1911, on account of the building of a dam which will cause several feet of backwater at the original section. The new gage was set to read 2.23 feet when the original gage read 5.83 feet. Owing to the fact that the new gage is at a different section, measurements referred to the old gage can not be used to rate the new section.

Channel.—Practically permanent.

Discharge measurements.—Made from the railroad bridge or by wading.

Winter flow.—The river is usually frozen over from the middle of November to the 1st of April. Measurements are made through the ice to determine the winter discharge.

Accuracy.—Backwater from the Healy dam on Red Lake River may slightly affect the relation of gage height to discharge at this new site if flashboards are put in place at the Healy dam. Because of the large amount of swamp land, some of which is being drained artificially, in the area above this station estimates of "run-off in second-feet per square mile" and "run-off (depth in inches on drainage area)" would be misleading if computed from the drainage area given above. Sufficient data have not been collected at the new section to permit estimates of discharge to be made.

Discharge measurements of Clearwater River at Red Lake Falls, Minn., for 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 6[a]	Gorie Monley	2.10	45	July 22	E. F. Chandler	2.61	151
Mar. 19[b]	Geo. Ebner	6.40	22	Oct. 18	E. J. Budge	2.79	215
27	E. J. Budge	2.74	190	Dec. 20[c]	W. B. Stevenson	3.01	45

[a] Complete ice cover; average thickness, 2.2 feet.
[b] Measurement made by wading 1,000 feet above gage.
[c] Measurement made under ice.

Daily gage height, in feet, of Clearwater River at Red Lake Falls, Minn., for 1912.

[Leo Steinert, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	7.6	2.75	2.5	2.1	2.45	2.0	4.4	2.3	2.6
2	.....	.....	7.7	2.7	2.5	2.1	2.45	2.05	4.65	2.25	2.6
3	.....	.....	8.0	2.7	2.6	2.1	2.35	2.5	4.0	2.2	2.7
4	.....	.....	8.2	2.75	2.6	2.1	2.15	2.45	3.7	2.25	2.55
5	.....	.....	8.6	2.8	2.55	2.1	2.15	2.25	3.4	2.3	2.7
6	2.1	.....	8.6	2.9	2.45	2.0	2.15	2.0	3.4	2.3	2.45
7	.....	.....	8.4	2.95	2.5	2.0	2.1	1.95	3.4	2.3	2.55
8	.....	.....	8.0	3.05	2.6	2.0	2.1	1.9	3.2	2.3	2.8
9	.....	.....	7.6	3.05	2.45	2.0	3.05	1.9	3.1	2.25	2.35
10	.....	.....	7.5	3.05	2.35	2.15	2.1	1.9	3.0	2.2	3.5
11	.....	.....	6.6	3.05	2.3	2.3	2.1	2.0	3.1	2.3	3.15
12	.....	.....	3.75	3.1	2.35	2.2	2.1	2.15	3.2	2.3	3.15
13	.....	.....	3.8	3.2	2.35	2.4	2.1	2.7	3.2	2.3	3.15
14	.....	.....	3.8	3.15	2.25	2.8	2.1	3.15	3.2	2.3	3.1
15	.....	.....	3.15	3.15	2.4	2.8	3.05	3.15	3.05	2.3	3.0
16	.....	.....	2.95	3.05	2.45	2.8	2.1	3.2	2.9	2.3	3.15
17	.....	.....	2.9	2.95	2.45	2.8	2.1	3.15	2.9	2.0	3.3
18	.....	.....	2.8	2.95	2.45	2.8	2.1	3.1	3.0	2.0	3.25
19	.....	6.4	2.75	2.95	2.55	2.8	2.1	3.05	3.0	2.0	3.35
20	.....	.....	2.7	2.85	2.5	2.7	2.1	2.95	3.1	2.0	3.05
21	.....	.....	2.7	2.8	2.5	2.6	2.15	3.0	3.1	1.9	3.1
22	.....	.....	2.6	2.85	2.9	2.65	2.35	2.5	3.2	1.9	.....
23	.....	.....	2.6	2.8	2.25	2.8	2.1	2.85	3.2	1.8	.....
24	.....	.....	2.6	2.7	2.25	3.0	2.1	3.65	2.95	2.3	.....
25	.....	.....	2.5	2.7	2.25	3.0	2.1	3.75	2.25	2.4	.....
26	.....	.....	2.6	2.75	2.25	3.0	2.1	3.75	2.2	2.3	.....
27	.....	.....	2.5	2.75	2.35	3.0	2.1	4.2	2.2	2.5	.....
28	.....	.....	2.8	2.65	2.3	3.0	2.1	4.4	2.2	2.8	3.05
29	.....	.....	2.75	2.6	2.25	3.0	2.25	4.4	2.15	2.6	.....
30	.....	.....	2.7	2.5	2.15	3.55	2.1	4.3	2.4	2.15	.....
31	.....	.....	.....	2.55	.....	4.0	2.0	.....	2.35	.....	.....

NOTE.—For 1911 gage heights see Water-Supply Paper 305, p. 42. Relation of gage height to discharge affected by ice about Nov. 11, 1911, to Apr. 11, 1912, and Nov. 15 to Dec. 31, 1912.

SOUTH BRANCH OF TWO RIVERS AT HALLOCK, MINN.

Location.—At private wagon bridge on farm of John Ross, in sec. 12, T. 161 N., R. 49 W., half a mile north of Hallock; a mile below the nearest tributary, a small creek that enters from the west.

Records available.—April 29, 1911, to November 30, 1912.

Drainage area.—776 square miles.

Gage.—Vertical staff.

Channel.—Probably permanent, as the control point is an abandoned loose-rock dam 4 feet high, a mile or more below the station. The dam was formerly used to raise the water level for a railroad water tank.

Discharge measurements.—Made from the bridge.

Winter flow.—From November to April the river is frozen over and gage readings are discontinued.

The following discharge measurements were made by E. F. Chandler:

March 12: Discharge estimated at 0.01 second-foot, as the stream was "frozen to bottom" for almost entire width; slight seepage under ice at one portion.

September 16: Gage height, 1.53 feet; discharge, 8.3 second-feet. Made by wading.

Daily gage height, in feet, of South Branch of Two Rivers at Hallock, Minn., for 1912.

[John Ross, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Dec.
1	2.4	2.0	2.8	1.0	2.0	1.8	4.3	2.9
2	2.75	2.3	2.8	1.1	2.0	1.7	4.3	2.9
3	3.0	2.0	2.7	1.1	1.9	1.6	4.5	2.9
4	2.9	2.0	2.5	1.2	1.8	1.6	4.6	3.0
5	2.75	1.9	2.4	1.2	1.8	1.8	4.6	3.0
6	3.0	1.8	2.3	1.2	2.5	1.9	4.6	2.9
7	3.3	1.9	2.3	1.3	2.8	1.7	4.7	2.9
8	3.6	1.8	2.2	1.2	2.5	1.7	4.4	3.0
9	3.1	1.9	2.1	1.2	2.3	1.6	4.2	3.0
10	2.7	2.0	2.0	1.3	2.2	1.5	4.0	3.0
11	2.7	1.9	1.8	1.4	2.2	1.5	3.9	3.0
12	2.4	2.0	1.7	1.4	2.0	1.4	3.8	2.9
13	2.3	1.9	1.6	1.5	2.0	1.4	3.6	2.8
14	2.7	2.3	1.5	1.5	1.7	1.5	3.4	2.8
15	2.2	2.3	1.5	1.4	1.7	1.5	3.4	2.8
16	1.9	2.0	1.5	1.4	1.7	1.55	3.1	2.8
17	2.0	1.8	1.5	1.3	1.7	1.55	3.0	2.8
18	2.0	1.8	1.5	1.3	1.6	1.5	2.9	2.8
19	2.0	1.8	1.5	1.2	1.6	1.5	2.8	2.8
20	2.0	1.8	1.4	1.1	1.5	1.9	2.8	2.8
21	1.5	1.8	1.3	1.1	1.5	2.2	2.8	2.6
22	1.8	1.8	1.3	1.1	1.5	2.4	2.65	2.5
23	2.0	1.9	1.3	1.1	1.5	2.5	2.6	2.45
24	2.6	1.9	1.3	1.1	1.5	2.6	2.6	2.2
25	3.1	2.0	1.3	1.1	1.5	2.7	2.4	2.2
26	2.8	2.1	1.3	1.7	1.5	3.1	2.4	2.1
27	2.3	2.2	1.2	2.0	1.6	3.35	2.4	2.1
28	2.0	2.1	1.2	2.3	1.6	3.5	2.4	2.2
29	1.8	2.3	1.1	2.7	1.7	3.6	2.6	2.2
30	1.8	2.5	1.1	2.3	1.7	3.7	2.6	2.3
31	.....	2.7	.....	2.0	1.8	.....	2.8	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 31, and about Nov. 16 to 30.

Daily discharge, in second-feet, of South Branch of Two Rivers at Hallock, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	39	20	63	1	20	13	179	69
2	60	34	63	1.5	20	10	179	69
3	76	20	57	1.5	16	8	197	69
4	69	20	45	2	13	8	206	76
5	60	16	39	2	13	13	206	76
6	76	13	34	2	45	16	206	69
7	97	16	34	3	63	10	215	69
8	120	13	29	2	45	10	188	76
9	83	16	24	2	34	8	170	76
10	57	20	20	3	29	6	152	76
11	57	16	13	4.5	29	6	144	76
12	39	20	10	4.5	20	4.5	136	69
13	34	16	8	6	20	4.5	120	63
14	57	34	6	6	10	6	104	63
15	29	34	6	4.5	10	6	104	63
16	16	20	6	4.5	10	7	83	.....
17	20	13	6	3	10	7	76	.....
18	20	13	6	3	8	6	69	.....
19	20	13	6	2	8	6	63	.....
20	20	13	4.5	1.5	6	16	63	.....
21	6	13	3	1.5	6	29	63	.....
22	13	13	3	1.5	6	39	54	.....
23	20	16	3	1.5	6	45	51	.....
24	51	16	3	1.5	6	51	51	.....
25	83	20	3	1.5	6	57	39	.....
26	63	24	3	10	6	83	39	.....
27	34	29	2	20	8	100	39	.....
28	20	24	2	34	8	112	39	.....
29	13	34	1.5	57	10	120	51	.....
30	13	45	1.5	34	10	128	51	.....
31	.....	57	.....	20	13	.....	63	.....

NOTE.—Daily discharge computed from a fairly well defined rating curve. Discharge Jan. 1 to Mar. 31 estimated, because of ice, by Prof. E. F. Chandler, from climatologic records, discharge of adjacent drainage areas, one discharge measurement made Mar. 12, and observer's reports on marked variation in discharge, as follows: Jan. 1–31, 3 second-feet; Feb. 1–28, 0.5 second-foot; Mar. 1–31, 0.5 second-foot. It should be noted that these estimates are based on less data than estimates at most stations in this report and that they represent simply the best available values. Discharge Nov. 16–30 estimated, because of ice, from daily gage height, climatologic records, and discharge of adjacent areas, at 30 second-feet, varying from about 57 to 10 second-feet.

Monthly discharge of South Branch of Two Rivers at Hallock, Minn., for 1912.

[Drainage area, 776 square miles.] [a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
April	120	6	45.5	C.
May	57	13	21.6	D.
June	63	1.5	16.8	D.
July	57	1	7.81	D.
August	63	6	16.6	D.
September	128	4.5	31.2	C.
October	215	39	110	B.
November	76	.....	50.3	C.

[a] "Second-feet per square mile" and "run-off (depth in inches)" are not published for this station, because the large number of swamps (some of which have been drained artificially) included in the drainage area render such values misleading.

NOTE.—See footnotes to table of daily discharge.

PEMBINA RIVER AT NECHE, N. DAK.

Location.—At the highway bridge 20 rods east of the Great Northern Railway bridge, two-thirds of a mile north of Neche, N. Dak.

Records available.—April 29, 1903, to December 31, 1912.

Drainage area.—2,940 square miles.

Gage.—Vertical staff in two sections for medium and low stage, attached to the abutment and a piling under the bridge, at the north end of the highway bridge. This gage was installed July 31, 1911. The original gage, which can be read at medium and high stage, is a vertical staff attached to the abutment of the railway bridge. The zeros of the two gages are at the same elevation, this elevation having been unchanged since the first establishment; at low stage the slope of the water surface between the bridges is inappreciable; at highest stage the readings at the railway bridge would probably be from 0.03 to 0.06 foot greater than at the highway bridge.

Channel.—Clay and silt; slightly shifting.

Discharge measurements.—From the highway bridge. At very low stage made by wading at a section below the Great Northern dam.

Artificial control.—The water is raised at low stage from 1 to 2 feet at the gage by a loose-rock dam about 3 feet high one-third mile below, constructed to give sufficient depth of water for the intake of the Great Northern Railway water tank. There is considerable leakage through the dam, but no permanent determination of the effect of this dam can be made because it is liable to be changed by ice run or spring flood in any year. There are no reservoirs or power plants that affect the flow.

Winter flow.—The ordinary winter discharge is less than the leakage through the dam, hence estimates can not be made from gage observations without numerous discharge measurements.

Accuracy.—On account of the varying effect at low stage of the dam, the records are not considered better than fair.

Discharge measurements of Pembina River at Neche, N. Dak., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 16	Goric Monley	3.68	184
July 23	E. F. Chandler	2.35	31
Sept. 12	do	3.65	143

NOTE.—The measurement on July 23 was made by wading at a section below the Great Northern Railway's dam.

Daily gage height in feet, of Pembina River at Neche, N. Dak., for 1912.

[George Stainthorp, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.2	3.5	4.6	2.9	4.6	.....	4.0	4.6
2	.....	4.3	3.6	4.7	3.0	4.0	.....	4.0	4.9
3	.....	4.4	3.9	4.6	2.9	3.7	.....	4.1	4.6
4	.....	4.5	3.9	4.5	2.8	3.5	.....	4.0	4.5
5	.....	4.7	3.8	4.0	2.8	3.2	.....	4.0	4.4
6	.....	4.8	4.0	3.9	2.8	3.3	.....	4.1	4.3
7	.....	5.0	4.0	3.9	2.6	3.4	.....	4.0	4.2
8	.....	3.8	3.9	3.8	2.6	3.3	3.05	4.0	4.0
9	.....	3.7	3.8	3.7	2.6	3.3	3.6	4.1	4.0
10	.....	3.7	3.9	3.7	2.7	3.3	3.45	4.1	4.0

Daily gage height, in feet, of Pembina River at Neche, N. Dak., for 1912—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	3.9	3.8	3.8	2.7	3.0	3.3	4.2	4.2
12	.....	4.0	3.8	3.7	2.8	2.8	3.25	4.2	4.7
13	.....	3.9	3.7	3.7	2.9	2.6	3.0	4.1	4.7
14	.....	3.8	3.7	3.6	2.9	2.6	2.0	4.0	4.7
15	.....	3.8	3.7	3.6	2.9	2.4	4.0	4.0	4.7
16	.....	3.9	3.7	3.6	3.0	2.0	5.0	4.0	4.7
17	.....	3.8	3.7	3.5	2.9	3.0	5.0	4.0	4.7
18	.....	3.7	3.6	3.5	2.8	2.8	4.9	4.0	4.7
19	.....	3.6	3.6	3.4	2.8	2.75	4.0	4.0	4.5
20	.....	3.6	3.5	3.3	2.7	2.5	4.0	4.0	4.5
21	.....	3.6	3.5	3.2	2.7	2.4	4.0	4.0	4.5
22	.....	3.5	3.5	3.1	2.8	2.0	4.0	4.0	4.5
23	.....	3.5	3.4	3.0	2.8	2.3	4.8	4.0	4.5
24	.....	3.5	3.7	2.9	2.7	2.4	5.0	4.0	.....
25	.....	3.5	3.7	2.9	2.7	3.0	4.9	3.8	.....
26	.....	3.4	3.5	2.9	2.7	2.8	4.8	3.8	.....
27	4.1	3.4	3.8	2.8	2.8	2.7	4.6	3.8	.....
28	4.2	3.4	3.9	2.8	3.0	2.8	4.4	3.7	.....
29	4.2	3.6	4.0	2.8	8.0	2.7	4.4	3.6	.....
30	4.2	3.6	5.0	2.8	7.3	2.6	4.2	3.6	.....
31	4.2	.....	4.8	.....	5.6	2.6	.....	3.6	.....

NOTE.—The observer reported that during the first three weeks of March the river remained at a stage of 4 feet, and that there was water over the ice during the last week. The ice began moving on Apr. 1 and on Apr. 7 a jam above the dam went out. The high stage on July 29 was caused by heavy rains and the failure of a dam at Wallhalla.

The discharge relation was affected by ice from Mar. 27 to Apr. 7, from Nov. 1 to 6 and from Nov. 12 to 23, river froze completely over on Nov. 23 and readings were stopped.

Daily discharge, in second-feet, of Pembina River at Neche, N. Dak., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	150	140	274	80	274	58	195	250
2	.....	150	150	288	90	195	63	195	300
3	.....	150	183	274	80	161	68	208	250
4	.....	160	183	260	71	140	74	195	240
5	.....	160	172	195	71	110	79	195	230
6	.....	180	195	183	71	120	84	208	230
7	.....	180	195	183	53	130	90	195	221
8	.....	172	183	172	53	120	95	195	195
9	.....	161	172	161	53	120	150	208	195
10	.....	161	183	161	62	120	135	208	195
11	.....	183	172	172	62	90	120	221	221
12	.....	195	172	161	71	71	115	221	200
13	.....	183	161	161	80	53	90	208	200
14	.....	172	161	150	80	53	10	195	200
15	.....	172	161	150	80	37	195	195	200
16	.....	183	161	150	90	10	330	195	180
17	.....	172	161	140	80	90	330	195	180
18	.....	161	150	140	71	71	316	195	180
19	.....	150	150	130	71	66	195	195	160
20	.....	150	140	120	62	45	195	195	160
21	.....	150	140	110	62	37	195	195	150
22	.....	140	140	100	71	10	195	195	150
23	.....	140	130	90	71	30	302	195	150
24	.....	140	161	80	62	37	330	195	.....
25	.....	140	161	80	62	90	316	172	.....
26	.....	130	140	80	62	71	302	172	.....
27	80	130	172	71	71	62	274	172	.....
28	90	130	183	71	90	71	247	161	.....
29	100	150	195	71	870	62	247	150	.....
30	100	150	330	71	730	53	221	150	.....
31	100	.....	302	.....	420	53	.....	150	.....

NOTE.—Daily discharge determined from a fairly well defined rating curve. Discharge estimated from Mar. 27 to Apr. 7, from Nov. 1 to 6, and from Nov. 12 to 23. Discharge interpolated for period from Sept. 1 to 7.

Monthly discharge of Pembina River at Neche, N. Dak., for 1912.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 27-31	100	80	94.0	932	D.
April	195	130	158	9,400	C.
May	330	130	174	10,700	C.
June	288	71	148	8,810	C.
July	870	53	129	7,930	C.
August	274	10	85.5	5,260	C.
September	330	10	181	10,800	C.
October	221	150	191	11,700	C.
November 1-23	300	150	202	9,220	D.
The period				74,800	

NOTE.—Accuracy has been reduced on account of poor gage reading, and slight changes in rating caused by changes in top of the loose-rock dam below the gage.

ROSEAU RIVER AT DOMINION CITY, CANADA.

Location.—At the traffic bridge at the northeast limit of Dominion City.

Records available.—May 21 to December 31, 1912.

Drainage area.—2,280 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Made from bridge.

Artificial control.—During December, 1912, a dam was built 1½ miles below causing serious backwater and a new station was established.

Cooperation.—All data for this station were furnished by the water-power branch of the Canadian Department of the Interior.

Mean daily discharge in feet per second of Roseau River at Dominion City, Canada, for 1912.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		410	41	83	103	577	1,248
2		336	36	97	104	634	1,193
3		344	35	113	109	676	1,141
4		341	35	121	129	702	1,115
5		318	33	125	133	733	1,027
6		332	30	131	129	962	936
7		316	35	132	131	795	884
8		304	32	127	127	839	860
9		292	38	110	126	839	837
10		276	40	101	131	884	806
11		263	31	91	132	936	787
12		238	44	91	122	1,000	754
13		235	44	110	126	1,030	720
14		222	51	119	129	1,060	673
15		214	59	126	132	1,090	691
16		200	68	122	134	1,120	777
17		182	71	127	133	1,150	834
18		163	71	129	134	1,180	650
19		129	73	129	133	1,211	754
20	408	138	77	132	146	1,188	795
21	410	126	81	132	177	1,224	761
22	410	107	86	125	211	1,266	951
23	416	95	93	113	219	1,248	741
24	405	83	98	104	224	1,279	668
25	390	74	90	101	235	1,326	707
26	371	66	82	98	278	1,297	640
27	379	60	75	96	323	1,300	580
28	418	53	75	99	384	1,297	527
29	468	45	82	100	457	1,344	416
30	468	45	79	110	527	1,354	369
31	444	.....	81	117	.....	1,274	.....

Monthly discharge of Roseau River at Dominion City, Canada, for 1912.

[Drainage area, 2,280 square miles.]

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
May 20–31	468	371	416	September	527	103	186
June	410	45	200	October	1,354	577	1,059
July	98	30	60	November	1,248	369	795
August	132	83	113	December			[a] 80

[a] Estimated.

WEST BRANCH OF ROSEAU RIVER NEAR MALUNG, MINN.

Location.—At the highway bridge near the center of sec. 7, T. 161 N., R. 39 W., 6¼ miles south of Roseau, 1 mile west of Malung post office, and half a mile above the mouth of the East Branch.

Records available.—May 6, 1911, to November 15, 1912.

Drainage area.—265 square miles.

Gage.—Vertical staff.

Channel.—Probably fairly permanent, although there is a possibility of temporary backwater from the East Branch.

Discharge measurements.—Made at the bridge except during low stages, when they are made at a wading section. Discharge measurements are also made on the East Branch a short distance above the junction and on Roseau River at Roseau for the purpose of determining the portion of the flow at Roseau that comes from the East Branch, and to estimate the entire flow below that point, as conditions of flow below the junction of the two branches are very unfavorable for the establishment of a regular station.

Winter flow.—From November to April the river is frozen over and observations are discontinued.

Artificial control.—Much of the area drained by Roseau River is so swampy that it can not be cultivated without drainage. In connection with this work the river channel has been straightened and widened to 80 feet for a distance of 40 miles; a drainage system benefiting 90,000 acres of land south of the river discharges into the Roseau by 10 ditches 1 mile apart in T. 163, Rs. 43 and 44. Another ditch system, draining about 20,000 acres, enters Roseau River in sec. 6, T. 162 N., R. 39 W.

Discharge measurements of West Branch of Roseau River near Malung, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Sept. 17[a]	E. F. Chandler	2.40	6.8
Oct. 9	W. B. Stevenson	7.22	387

[a] Wading measurement.

Discharge measurements of East Branch of Roseau River near Malung, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Sept. 17	E. F. Chandler	2.99	110
Oct. 9	W. B. Stevenson	6.43	344

Discharge measurements of Roseau River at Roseau, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Sept. 18	E. F. Chandler	3.49	101
Oct. 10	W. B. Stevenson	8.43	755

Daily gage height, in feet, of West Branch of Roseau River near Malung, Minn., for 1912.

[August Hedin, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.45	2.5	2.05	2.2	2.2	11.5	4.5
2	3.7	2.8	2.6	2.05	2.2	2.2	11.4	4.4
3	4.3	2.7	2.6	2.05	2.2	2.15	10.8	4.3
4	4.5	2.7	2.6	2.0	2.1	2.15	10.1	4.0
5	4.45	2.8	2.55	2.0	2.1	2.15	9.2	4.0
6	4.05	2.8	2.5	2.0	2.1	2.1	8.2	3.9
7	3.55	2.8	2.45	2.0	2.1	2.1	7.5	3.9
8	3.4	3.2	2.45	2.2	2.2	2.1	7.3	3.9
9	3.2	3.15	2.4	2.15	2.3	2.1	7.2	4.0
10	2.65	3.15	2.4	2.15	2.35	2.1	7.0	4.2
11	2.7	3.1	2.35	2.1	2.3	2.1	6.7	4.2
12	2.8	3.0	2.3	2.1	2.25	2.1	6.6	4.1
13	2.8	3.05	2.3	2.1	2.25	2.1	6.5	4.0
14	2.7	2.9	2.25	2.1	2.2	2.1	6.4	3.9
15	2.6	2.9	2.2	2.1	2.2	2.1	6.1	3.8
16	2.6	2.8	2.2	2.1	2.15	2.2	5.8	3.6
17	2.6	2.8	2.2	2.1	2.1	2.4	5.5	3.6
18	2.5	2.8	2.2	2.1	2.1	2.5	5.2	3.6
19	2.5	2.75	2.2	2.1	2.1	2.5	5.0	3.6
20	2.5	2.7	2.2	2.1	2.1	2.6	4.8	3.4
21	2.45	2.6	2.15	2.05	2.1	2.6	4.6	3.2
22	2.45	2.6	2.15	2.05	2.1	2.7	4.4	3.3
23	2.45	2.6	2.1	2.0	2.1	3.5	4.2	3.5
24	2.4	2.6	2.1	2.0	2.1	4.05	4.0	3.2
25	2.4	2.6	2.1	2.0	2.1	5.1	3.9	3.0
26	2.5	2.55	2.1	2.0	2.1	6.6	3.8	3.0
27	2.5	2.55	2.1	2.2	2.1	8.5	3.7	2.9
28	2.45	2.55	2.1	2.2	2.1	9.15	3.6	2.9
29	2.5	2.5	2.1	2.2	2.2	9.9	3.7	2.8
30	2.5	2.5	2.1	2.2	2.2	10.65	4.0	2.7
31	.....	2.5	.....	2.2	2.2	.....	4.5	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 6 and about Nov. 18 to 30.

Daily discharge, in second-feet, of West Branch of Roseau River near Malung, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	8.7	9.8	1.5	3.8	3.8	1,040	115
2	.....	18	12	1.5	3.8	3.8	1,030	108
3	.....	15	12	1.5	3.8	3.0	926	101
4	.....	15	12	.8	2.2	3.0	807	80
5	.....	18	11	.8	2.2	3.0	660	80
6	.....	18	9.8	.8	2.2	2.2	514	73
7	52	18	8.7	.8	2.2	2.2	421	73
8	43	33	8.7	3.8	3.8	2.2	396	73
9	33	31	7.6	3.0	5.6	2.2	384	80
10	14	31	7.6	3.0	6.6	2.2	360	94
11	15	29	6.6	2.2	5.6	2.2	325	94
12	18	25	5.6	2.2	4.7	2.2	314	87
13	18	27	5.6	2.2	4.7	2.2	303	80
14	15	21	4.7	2.2	3.8	2.2	292	73
15	12	21	3.8	2.2	3.8	2.2	260	67
16	12	18	3.8	2.2	3.0	3.8	230	55
17	12	18	3.8	2.2	2.2	7.6	200	55
18	9.8	18	3.8	2.2	2.2	9.8	173	.....
19	9.8	16	3.8	2.2	2.2	9.8	155	.....
20	9.8	15	3.8	2.2	2.2	12	138	.....
21	8.7	12	3.0	1.5	2.2	12	122	.....
22	8.7	12	3.0	1.5	2.2	15	108	.....
23	8.7	12	2.2	.8	2.2	49	94	.....
24	7.6	12	2.2	.8	2.2	84	80	.....
25	7.6	12	2.2	.8	2.2	164	73	.....
26	9.8	11	2.2	.8	2.2	314	67	.....
27	9.8	11	2.2	3.8	2.2	556	61	.....
28	8.7	11	2.2	3.8	2.2	652	55	.....
29	9.8	9.8	2.2	3.8	3.8	773	61	.....
30	9.8	9.8	2.2	3.8	3.8	900	80	.....
31	.....	9.8	.....	3.8	3.8	.....	115	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between 29 and 486 second-feet (gage heights, 3.1 and 8.0 feet). Above discharge 486 second-feet (gage height, 8.0 feet) the rating curve is an extension, but is probably accurate within about 10 per cent at discharge 960 second-feet (gage height, 11.0 feet). Discharge Jan. 1 to Apr. 6 estimated, because of ice, by Prof. E. F. Chandler, from climatologic records, discharge of adjacent drainage areas, and observer's notes concerning any marked variation in discharge, as follows: Jan. 1–31, 0.4 second-foot; Feb. 1–29, 0.2 second-foot; Mar. 1–31, 0.5 second-foot; Apr. 1–6, 42 second-feet, varying from about 1 to 62 second-feet. It should be noted that these estimates are based on less data than estimates at most stations in this report and that they simply represent the best values available for publication. Discharge Nov. 18–30 estimated, because of ice, from gage heights and climatologic records at 27 second-feet, varying from about 49 to 10 second-feet.

Monthly discharge of West Branch of Roseau River near Malung, Minn., for 1912.

[Drainage area, 265 square miles. [a]]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	0.4	
February	.....	.....	.2	
March	.....	.....	.5	
April	.....	.....	20.5	C.
May	33	8.7	17.3	B.
June	12	2.2	5.60	C.
July	3.8	.8	2.09	D.
August	6.6	2.2	3.21	D.
September	900	2.2	120	C.
October	1,040	55	318	C.
November	115	.....	58.0	C.

[a] "Second-feet per square mile" and "Run-off (depth in inches)" are not published for this station because the large number of swamps, some of which are artificially drained, in the drainage area render such values misleading.

NOTE.—See footnote to table of daily discharge.

MOUSE RIVER AT MINOT, N. DAK.

Location.—At the Anne Street footbridge northeast of the Great Northern Railway roundhouse at Minot, N. Dak.

Records available.—May 5, 1903, to December 31, 1912.

Drainage area.—8,400 square miles.

Gage.—Vertical staff attached to pier of the Anne Street Bridge. The original gage, superseded in 1910 by this gage, was at a bridge about 40 rods farther upstream. At low stage, because the water is ponded by a dam below, there is no appreciable slope in the water surface and the gage zeros at the old and present sites have the same elevation; at high stage there is a slight slope in the water surface; hence, at highest stage the present gage would read slightly less than the original gage would have done, but the difference is probably less than 0.1 foot, even at extreme high water. Datum unchanged.

Channel.—Clay and silt; slightly shifting.

Discharge measurements.—Made from the Anne Street Bridge at medium and high stages. At low stage made by wading some rods below the dam at the Minneapolis, St. Paul & Sault Ste. Marie Railway water tank.

Winter flow.—The relation of gage height to discharge is somewhat affected by ice from about the middle of November to the middle of April; if the river is low enough to be controlled at the gage entirely by the weir formula due to the dam, the effect of the ice is not so considerable. In most winters the discharge is very small, as has been found by actual discharge measurements occasionally. Thus, from a few gage readings each winter estimates of flow may be made which are not in error to the amount of a large quantity of water.

Artificial control.—A dam 4 feet high at the Minneapolis, St. Paul & Sault Ste. Marie Railway water tank, 1 mile below the gage (along the channel), raises the water at the gage about 3 feet at ordinary low stage. The dam has no sluices, being designed merely to give enough depth of water for the intake-pipe suction; but it is not absolutely tight. When the discharge is less than about 6 second-feet the water level falls below the crest of the dam. The crest of the dam is nearly level and can be considered as a broad-crested weir until (at gage reading about 6 feet) corrections for submergence of the weir by the filling of the channel below the weir need be applied. The dam was raised about 0.7 foot in March, 1911; previous to that time ordinary low-water level at the gage was 0.7 foot less than now.

Accuracy.—The percentage errors of the results for the low-water period may be largely due to small errors by the gage observer and the undetermined leakage through the dam, although the error is but a few second-feet. At medium stages the results are good.

Discharge measurements of Mouse River at Minot, N. Dak., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 9	George Ebner	7.10	613
10	do	7.12	581
Sept. 13[a]	E. F. Chandler	4.41	16.0

[a] Wading measurement.

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1912.

[Ephraim Cox and F. G. Bennewitz, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		6.5	5.8	6.7	4.8	4.75	4.65	4.55	4.8
2		6.4	5.7	6.6	4.8	4.7	4.65	4.5	4.8
3		6.4	5.65	6.4	4.8	4.7	4.6	4.5	4.75
4		6.4	5.6	6.4	4.8	4.7	4.6	4.5	4.75
5		6.4	5.65	6.4	4.8	4.7	4.55	4.5	4.7
6		6.5	5.8	6.4	4.8	4.7	4.55	4.5	4.7
7		6.9	5.75	6.2	4.8	4.7	4.55	4.5	4.7
8		7.1	5.8	6.1	4.8	4.7	4.55	4.5	4.7
9		7.1	5.85	6.0	4.8	4.7	4.55	4.55	4.7
10		7.2	5.9	5.9	4.8	4.7	4.55	4.6	4.7
11		7.4	5.9	5.8	4.8	4.7	4.5	4.65	4.7
12		7.6	6.0	5.7	4.8	4.7	4.5	4.7	4.7
13		7.7	6.1	5.6	4.8	4.65	4.5	4.75	4.65
14		7.8	6.2	5.5	4.8	4.65	4.5	4.75	4.65
15		8.6	6.4	5.45	4.8	4.65	4.5	4.8	4.65
16		9.0	6.6	5.45	4.75	4.6	4.5	4.8	4.65
17		9.5	6.8	5.4	4.75	4.6	4.5	4.75	4.65
18		9.9	7.1	5.4	4.75	4.6	4.5	4.75	4.65
19		10.2	7.4	5.3	4.75	4.6	4.5	4.75	4.65
20		10.4	7.7	5.25	4.75	4.6	4.5	4.75	4.65
21		10.1	8.1	5.2	4.75	4.6	4.5	4.75	4.6
22		9.7	8.7	5.1	4.75	4.6	4.55	4.75	4.6
23		8.6	8.8	5.05	4.8	4.6	4.55	4.7	4.6
24	4.85	7.4	8.9	5.0	4.8	4.6	4.6	4.7	4.6
25	4.95	7.1	8.8	5.0	4.8	4.6	4.65	4.7	4.6
26	5.2	6.8	8.0	5.0	4.8	4.55	4.7	4.7	4.6
27	5.35	6.5	7.5	4.95	4.8	4.55	4.7	4.7	4.6
28	5.55	6.3	7.1	4.9	4.8	4.55	4.7	4.75	4.6
29	5.95	6.1	6.9	4.8	4.8	4.55	4.7	4.75	4.6
30	6.4	5.9	6.8	4.8	4.8	4.6	4.7	4.75	4.6
31	6.6	.....	6.7	.....	4.75	4.65	.....	4.8	.....

NOTE.—Severe ice conditions existed during the winter months and no gage heights were read. The records from Mar. 24 to 31 and from Nov. 14 to 31 are believed to have been affected by ice. On Feb. 15 the observer reported that there was no water running.

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		450	282	498	69	60	44	30	69
2		426	258	474	69	52	44	24	69
3		426	246	426	69	52	36	24	60
4		426	235	426	69	52	36	24	60
5		426	246	426	69	52	30	24	52
6		450	282	426	69	52	30	24	52
7		546	270	378	69	52	30	24	52
8		594	282	354	69	52	30	24	52
9		594	294	330	69	52	30	30	52
10		618	306	306	69	52	30	36	52
11		666	306	282	69	52	24	44	52
12		714	330	258	69	52	24	52	52
13		737	354	235	69	44	24	60	44
14		760	378	212	69	44	24	60	36
15		929	426	201	69	44	24	69	36
16		1,000	474	201	60	36	24	69	36
17		1,080	522	190	60	36	24	60	36
18		1,140	594	190	60	36	24	60	36
19		1,180	666	168	60	36	24	60	36
20		1,200	737	158	60	36	24	60	36

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for 1912—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	.....	1,160	827	147	60	36	24	60	30
22	.....	1,110	947	126	60	36	30	60	30
23	.....	929	965	116	69	36	30	52	30
24	13	666	983	106	69	36	36	52	30
25	20	594	965	106	69	36	44	52	30
26	52	522	805	106	69	30	52	52	30
27	78	450	690	96	69	30	52	52	30
28	136	402	594	87	69	30	52	60	30
29	246	354	546	69	69	30	52	60	30
30	390	306	522	69	69	36	52	60	30
31	450	.....	498	.....	60	44	.....	69	.....

NOTE.—Discharge determined from a rating curve that is fairly well defined for medium and high stages. Discharges from Mar. 24 to 31 and from Nov. 14 to 30 were estimated from observer's notes and weather reports. The flow previous to about Mar. 20 was very low and is believed to have been 1 second-foot or less. The mean flow during December was probably about 10 or 15 second-feet.

Monthly discharge of Mouse River at Minot, N. Dak., for 1912.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 24-31	450	13	173	2,750	D.
April	1,200	306	695	41,400	B.
May	983	235	511	31,400	B.
June	498	69	239	14,200	B.
July	69	60	66.7	4,100	C.
August	60	30	42.7	2,630	C.
September	52	24	33.5	1,990	C.
October	69	24	48.0	2,950	C.
November	69	30	42.3	2,520	C.
The period	.....	.....	.....	104,000	

EVAPORATION AT UNIVERSITY, N. DAK.[1]

The evaporation gage at University, N. Dak., was established April 17, 1905. It is located on a pool in a ravine called English Coulee, which runs through the campus of the University of North Dakota, which is immediately west of Grand Forks, N. Dak., and 2 miles west of the Minnesota boundary.

The records at this station were continued in 1912, daily observations being made during the entire open season, except the first 10 days. The gage was protected from disturbance, and the records of observations are reliable.

The coulee drains about 60 square miles of very level prairie. Except for brief freshets the flow in the coulee is small, varying from 1 second-foot or less to 20 second-feet. In very dry weather the water lies in pools with scarcely any perceptible flow.

A heavy galvanized-iron tank, 3 feet square and 18 inches deep, is placed in the center of an anchored raft, so that the water in the tank is at the same level as the water surface outside. The tank is filled nearly to the top, to a height precisely marked by the pointed tip of a vertical rod in the center of the tank. Once each day, after the change produced by evaporation or rainfall, the water level is restored to the original height, the precise amount of water transferred being measured with a cup of such size that one cupful of water is equivalent to 0.01 inch depth in the tank.

[1] For complete description of this station and records of evaporation, rainfall, and temperature for 1905 to 1908, see U. S. Geol. Survey Water-Supply Paper 245, pp. 64-67, 1910.

A standard rain gage is located on the open prairie about 10 rods distant. On days of rainfall the difference (which is usually small) between the quantity measured by the rain gage and the surplus in the tank is considered the total evaporation for the day.

Observations were made usually about half an hour before sunset. The temperature of the water recorded is the observation of the water in the tank; as the tank is a metal tank, it has been found that at that time of the day there is rarely a perceptible difference in temperature reading between the water within and without the tank. The temperature of the air as recorded is the mean of the readings of the standard self-recording maximum and the self-recording minimum thermometers for the preceding 24 hours.

The following table shows for each 10-day period during 1912 the gross evaporation, the total rainfall, and the mean temperatures for the 10 observations of the water and of the air.

Evaporation, rainfall, and temperature at University, N. Dak., for 1912.

[T. T. Quirke and Thos. G. Johnson, observers.]

Date.	Evaporation.	Rainfall.	Mean temperature.		Date.	Evaporation.	Rainfall.	Mean temperature.	
			Water.	Air.				Water.	Air.
	Inches.	*Inches.*	°F.	°F.		*Inches.*	*Inches.*	°F.	°F.
Apr. 19–20	0.19	0.00	54	43	Aug. 11–20	1.32	0.75	68	62
21–30	.75	.78	49	44	21–31	1.38	.98	65	62
May 1–10	1.84	1.85	54	51	Sept. 1–10	1.41	1.66	68	67
11–20	1.20	.16	57	50	11–20	1.33	1.10	57	52
21–31	1.94	.91	64	61	21–30	1.49	2.40	44	42
June 1–10	1.52	.00	63	57	Oct. 1–10	.57	.26	47	50
11–20	1.63	.06	68	59	11–20	.61	.00	42	48
21–30	2.64	.00	84	73	21–31	.48	.03	37	40
July 1–10	1.97	2.71	77	70	Nov. 1– 9	.15	.05	32	33
11–20	1.86	1.17	69	61					
21–31	1.93	1.41	73	69	Total for period	27.45	17.25		
Aug. 1–10	1.24	.97	67	61					

RAINY RIVER AT INTERNATIONAL FALLS, MINN.

Location.—At the steamboat dock half a mile below the dam at International Falls.

Records available.—March 1, 1907, to December 31, 1912.

Drainage area.—14,600 square miles.

Gage.—Vertical staff installed by the United States Geological Survey April 20, 1911, at the American steamboat dock below the falls. Prior to this date gage heights furnished through the courtesy of the Minnesota & Ontario Power Co. were read on a gage located just below the dam, first on the Canadian side but later on the American side. The zero of the Survey gage is 460.99 feet above that of the power company's gage, when the slope [1] of the river between the two points is considered.

Channel.—Practically permanent.

Discharge measurements.—Discharge measurements prior to 1911 were made by means of a boat and cable at a section several hundred yards below the gage, where an island divides the river into two channels. Since 1911 measurements have been made above the island, where the river flows in one channel and the velocities are better distributed.

[1] Slope determined at gage height 2.65 feet.

Winter flow.—Ice rarely forms in the long stretch of water below the dam, but it does form at the rapids below the open stretch, causing serious backwater at the gage, amounting at times to more than 2 feet. During 1909 and 1910 the monthly flow during the winter has been estimated indirectly from records of flow through the turbines as kept by the power company. During 1911 and 1912 the winter flow has been estimated directly from records of flow through the turbines as computed by the Canadian Department of Public Works. Winter estimates for periods previous to 1910 can be considered only approximate.

Artificial control.—The dam above the gaging station raises the water level in Rainy Lake to such an extent as to cause a large increase in the storage. Since the dam and power house have been in operation practically no water has passed over the crest, the entire flow of the river going through the turbines and sluice gates. The plant is run on a 24-hour basis, however, so that with the exception of the Sunday flow the discharge is fairly uniform, though it does not represent the natural flow.

Accuracy.—Studies of the records at this station made by Mr. Adolph Meyer, consulting engineer of the International Joint Commission, based on more complete data than were available when Water-Supply Paper 305 and the report of the water resources investigations of Minnesota for 1909–1912 were prepared, indicate that the estimates of monthly discharge published in those reports are in error. The percentage of error deduced by comparison with Mr. Meyer's results is as follows:

Estimated errors in published tables of monthly discharge.

Year.	Period.	Error (per cent).	Year.	Period.	Error (per cent).
1907....	March and April.....	+12	1909....	January and February.....	+16
	May.....	+40		April to May.....	−11
	August to November.....	−12 to −14		December.....	−50
1908....	February to April.....	+27 to +37	1910....	January to March.....	−50 to −57
	May.....	+60		November.....	+14
	June.....	+19	1911....	April.....	+20
	July to September.....	+8		June.....	+10
	December.....	−14			

Values for all other months, 1907–1912, are within the accuracy ratings as published.

Cooperation.—Estimates of flow through the power house and results of discharge measurements furnished by Canadian Department of Public Works. Results of current-meter measurements by the Canadian Department of the Interior, water-power branch.

Discharge measurements of Rainy River at International Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 20[a]	S. B. Soulé.....	3.99	6,090	Aug. 5	S. S. Scovil [b].....	4.16	[d] 9,080
Feb. 16[a]	A. A. Anderson [b].....	3.18	5,680	7	Hoyt and Soulé.....	4.46	9,960
Mar. 13[a]	W. J. Stewart [b].....	2.72	5,040	Sept. 3	A. Pierce [b].....	3.33	[d] 7,700
May 7[c]	.....do.....	3.38	6,980	9	.....do.....	3.33	[d] 7,760
June 1	.....do.....	2.62	6,680	19	[e].....	2.65	[d] 6,440
13	S. B. Soulé.....	2.26	5,880	Oct. 2	A. Pierce [b].....	2.23	[d] 5,160
July 23	W. J. Stewart [b].....	3.80	8,880	Nov. 6	R. H. Nelson [b].....	2.88	[d] 6,420

[a] River open at measuring section. Backwater at gage from ice below.
[b] Canadian engineers.
[c] Backwater from Big Fork and Little Fork rivers.
[d] The results of these measurements were not available when the computations and studies of the discharge data for this station were made. The measurements were made with current meters which had to be rerated before the results could be obtained.
[e] Canadian Department of Public Works.

Daily gage height, in feet, of Rainy River at International Falls, Minn., for 1912.

[Robert Caple, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	3.1	3.1	1.40	3.0	2.6	1.70	4.6	2.4	3.4	2.8	2.8
2	3.0	3.6	3.1	1.8	2.9	2.2	2.0	4.7	2.1	3.3	2.8	3.6
3	3.4	3.9	2.5	1.8	2.8	2.5	2.0	4.7	2.5	3.2	2.2	4.0
4	3.4	3.0	2.4	1.85	3.0	2.5	1.65	4.2	3.5	3.1	2.1	4.0
5	3.4	2.8	3.0	1.7	2.4	2.5	1.80	4.1	3.6	3.2	2.9	4.0
6	3.4	3.3	3.0	1.6	2.5	2.5	2.0	4.3	3.8	2.7	2.9	4.0
7	3.0	3.5	2.9	.55	3.5	2.5	1.55	4.5	3.6	2.8	2.9	3.8
8	2.5	3.4	3.0	1.10	3.9	2.4	1.9	4.4	3.4	2.9	2.9	3.4
9	3.4	3.4	3.1	1.7	3.8	2.1	2.6	4.3	3.4	3.0	2.8	3.4
10	3.7	3.3	2.4	2.0	4.0	2.2	2.8	4.3	3.7	3.0	2.2	4.3
11	3.8	2.8	2.2	2.0	3.9	2.4	3.3	3.8	3.6	3.0	2.2	4.4
12	4.1	2.8	2.8	2.0	3.1	2.4	3.2	3.6	3.4	3.1	2.6	4.5
13	4.2	3.4	2.7	2.0	2.8	2.3	3.3	3.5	3.4	2.5	2.8	4.5
14	2.0	3.4	2.7	1.5	3.7	2.3	2.9	3.5	3.4	2.8	2.8	4.4
15	3.1	3.3	2.8	1.3	3.9	2.2	3.0	3.4	2.8	2.9	2.8	3.6
16	3.7	3.2	2.6	2.1	3.9	1.9	3.6	2.7	3.0	2.9	2.7	3.4
17	3.9	3.0	1.80	1.9	3.8	2.0	3.8	3.0	3.2	2.8	2.2	4.2
18	3.9	2.3	1.70	1.85	3.6	2.1	3.4	2.9	3.0	2.8	2.4	4.3
19	3.9	2.1	2.2	1.85	2.6	2.1	2.7	3.1	2.7	2.9	2.8	4.4
20	4.0	2.7	2.6	1.9	2.5	2.2	3.2	3.5	2.7	2.5	2.8	4.4
21	3.2	2.9	2.6	1.05	3.3	2.2	3.6	3.3	2.4	2.2	3.0	4.2
22	3.0	2.9	2.7	.9	3.2	2.4	3.6	2.8	2.3	2.7	2.9	3.3
23	3.8	2.9	2.6	1.75	3.2	2.0	3.8	2.6	2.3	2.8	2.8	3.2
24	3.9	2.8	1.7	1.9	3.3	2.0	3.9	2.7	2.6	2.8	2.3	3.4
25	3.8	2.2	1.9	2.0	3.0	2.2	3.9	2.3	3.2	2.8	2.3	3.0
26	3.8	2.4	2.2	2.2	1.9	2.0	3.9	2.6	4.4	2.8	2.7	2.8
27	3.6	3.0	2.3	2.4	2.1	2.0	3.9	2.4	4.0	2.1	2.8	3.5
28	2.7	3.1	2.2	1.9	2.7	1.9	3.8	2.6	3.5	2.1	2.8	3.2
29	2.3	3.1	2.0	1.9	2.7	1.9	4.6	2.6	3.2	2.7	2.8	3.2
30	3.2	.....	1.9	2.8	2.6	1.5	4.6	2.8	3.4	2.8	2.7	3.1
31	3.2	.....	1.30	.....	2.6	.....	4.6	2.7	.....	2.8	.....	3.8

NOTE.—Relation of gage height to discharge affected by backwater about Jan. 1 to May 31 and about Dec. 1 to 31.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1912.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6,650	5,300	10,200	6,330	7,990	6,970	16	5,580	8,350	6,810	7,300	7,130	6,810
2	6,020	5,720	10,400	5,870	7,810	6,970	17	5,720	8,720	7,300	7,640	6,970	6,020
3	6,490	5,720	10,400	6,490	7,640	6,020	18	5,870	7,990	7,130	7,300	6,970	6,330
4	6,490	5,230	9,480	8,170	7,470	5,870	19	5,870	6,810	7,470	6,810	7,130	6,970
5	6,490	5,440	9,290	8,350	7,640	7,130	20	6,020	7,640	8,170	6,810	6,490	6,970
6	6,490	5,720	9,670	8,720	6,810	7,130	21	6,020	8,350	7,810	6,330	6,020	7,300
7	6,490	5,100	10,000	8,350	6,970	7,130	22	6,330	8,350	6,970	6,170	6,810	7,130
8	6,330	5,580	9,860	7,990	7,130	7,130	23	5,720	8,720	6,650	6,170	6,970	6,970
9	5,870	6,650	9,670	7,990	7,300	6,970	24	5,720	8,910	6,810	6,650	6,970	6,170
10	6,020	6,970	9,670	8,530	7,300	6,020	25	6,020	8,910	6,170	7,640	6,970	6,170
11	6,330	7,810	8,720	8,350	7,300	6,020	26	5,720	8,910	6,650	9,860	6,970	6,810
12	6,330	7,640	8,350	7,990	7,470	6,650	27	5,720	8,910	6,330	9,100	5,870	6,970
13	6,170	7,810	8,170	7,990	6,490	6,970	28	5,580	8,720	6,650	8,170	5,870	6,970
14	6,170	7,130	8,170	7,990	6,970	6,970	29	5,580	10,200	6,650	7,640	6,810	6,970
15	6,020	7,300	7,990	6,970	7,130	6,970	30	5,030	10,200	6,970	7,990	6,970	6,810
							31	.....	10,200	6,810	.....	6,970	.....

NOTE.—Daily discharge June 1 to Nov. 30 computed from a rating curve well defined between 3,820 and 12,000 second-feet (gage heights 0.5 and 5.5 feet) and from daily gage heights obtained by the United States Geological Survey. This rating curve, as the result of additional data, differs from that used in Water-Supply Paper 305 for 1907–1911 by the following amounts in per cent, referred to the 1912 curve:

Discharge.	Gage height.	Difference.	Discharge.	Gage height.	Difference.
Second-feet.	*Feet.*	*Per cent.*	*Second-feet.*	*Feet.*	*Per cent.*
3,300	0.0	+ 5	9,100	4.0	+ 3
4,380	1.0	− 2	11,000	5.0	+ 5
5,720	2.0	− 2	13,000	6.0	+ 8
7,300	3.0	0	15,200	7.0	+10

NOTE.—For daily discharge values for entire year see record furnished by the Canadian department of public works. See also table of daily discharge furnished by S. B. Johnson, hydraulic engineer, Department of Public Works, Canada.

Monthly discharge of Rainy River at International Falls, Minn., for 1912.

[Drainage area, 14,600 square miles.][a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
June	6,650	5,030	6,030	A.
July	10,200	5,100	7,580	A.
August	10,400	6,170	8,110	A.
September	9,860	5,870	7,590	A.
October	7,990	5,870	7,010	A.
November	7,300	5,870	6,740	A.

[a] Discharge in "second-feet per square mile" and "Run-off (depth in inches)" are not published for this drainage area, because such values are believed to be misleading in that they do not represent the natural flow at this station. See "Artificial control."

NOTE.—This table was computed from discharge values obtained entirely from the interpretation of the base data at this gaging station by engineers of the United States Geological Survey. See also table computed from daily discharge furnished by S. B. Johnson, hydraulic engineer, Department of Public Works, Canada.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1912.

[Canadian Department of Public Works.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,490	5,085	4,856	3,953	5,880	6,315	6,078	10,091	6,448	7,279	7,087	5,801
2	5,695	5,440	4,888	5,022	5,885	5,440	5,650	10,072	5,892	7,202	7,122	6,433
3	5,665	5,845	4,197	5,028	5,915	5,235	5,940	10,077	6,470	7,039	6,184	6,725
4	5,695	4,620	4,102	4,997	6,190	6,370	5,460	9,462	8,408	7,089	6,095	7,001
5	5,640	3,995	5,101	5,002	5,250	6,382	5,150	8,953	8,498	7,078	7,199	6,968
6	5,815	5,105	5,037	4,984	4,795	6,410	5,540	9,825	8,363	6,199	7,146	6,655
7	4,450	5,090	5,090	3,725	6,185	6,305	5,394	9,837	7,997	6,543	7,100	6,149
8	3,995	5,050	5,102	3,616	6,570	6,159	5,835	9,714	7,254	7,060	7,073	5,828
9	5,725	4,985	5,063	5,049	6,600	5,971	6,932	9,333	7,266	7,060	6,791	5,860
10	5,720	4,870	4,205	5,068	6,692	5,889	7,064	9,332	8,057	7,039	6,175	6,913
11	5,725	4,105	4,108	5,096	6,734	6,267	7,480	8,442	7,962	7,045	5,998	6,973
12	5,940	3,990	5,105	5,119	5,435	6,239	7,760	8,299	7,799	7,100	6,568	6,972
13	6,220	5,030	5,060	5,052	4,800	6,283	7,910	8,208	7,831	a6,880	6,923	6,962
14	3,700	5,035	5,025	4,031	6,690	6,312	7,576	8,246	7,880	6,664	7,020	6,675
15	5,030	5,000	5,046	4,409	6,695	6,255	7,494	7,965	7,260	7,083	6,955	5,412
16	5,855	5,009	4,960	5,100	6,690	5,570	8,613	7,048	7,234	7,044	7,041	5,532
17	5,930	5,017	3,828	5,060	6,350	5,730	8,835	7,528	7,812	7,047	5,261	7,267
18	5,900	4,119	3,890	5,045	6,355	6,042	8,148	7,720	7,479	6,852	6,511	6,987
19	5,915	3,976	4,812	5,055	4,855	6,093	6,981	7,530	6,996	6,987	6,999	6,850
20	5,915	5,035	5,045	5,048	5,200	6,180	7,604	8,416	6,923	6,594	7,015	6,989
21	4,700	5,044	5,096	4,130	6,730	6,261	8,633	8,194	6,588	5,824	7,089	6,762
22	4,320	5,057	5,095	3,950	6,743	6,415	8,405	6,865	5,910	7,076	7,033	5,900
23	5,915	5,063	5,004	5,045	6,720	5,823	8,936	6,728	6,063	7,111	7,050	4,650
24	5,920	5,014	3,560	5,055	6,770	5,693	9,012	6,932	6,930	7,070	6,174	6,581
25	5,875	4,169	4,429	5,385	6,577	6,190	8,940	5,885	7,315	7,056	5,978	5,011
26	5,760	4,080	5,070	5,800	4,892	5,835	9,061	6,166	8,892	7,078	7,002	4,591
27	5,495	5,068	5,022	5,900	5,175	5,969	9,105	6,614	8,223	6,135	7,054	5,995
28	4,255	5,066	5,057	4,597	6,680	5,853	8,572	6,839	7,179	5,927	7,047	6,549
29	3,935	5,056	5,090	4,348	6,495	5,775	9,946	7,055	6,980	6,968	6,687	5,762
30	5,080	.....	4,910	5,865	6,350	5,267	9,979	7,152	7,024	7,076	6,422	5,137
31	5,085	.....	4,012	.....	5,776	.....	10,087	7,177	.....	7,112	.....	6,751

[a] Interpolated by engineers of United States Geological Survey.

NOTE.—Daily discharge record furnished by S. B. Johnson, hydraulic engineer, department of public works, Canada, and were computed from power-house records. See also table of daily discharge June 1 to Nov. 30, 1912, computed from United States Geological Survey gage records.

Monthly discharge of Rainy River at International Falls, Minn., for 1912.

[Drainage area, 14,600 square miles.] [a]

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
January	6,220	3,700	5,330	August	10,100	5,880	8,120
February	5,840	3,980	4,830	September	8,890	5,890	7,360
March	5,100	3,560	4,740	October	7,280	5,820	6,880
April	5,900	3,620	4,850	November	7,200	5,260	6,730
May	6,770	4,800	6,090	December	7,270	4,590	6,280
June	6,420	5,240	6,020				
July	10,100	5,150	7,680	The year	10,100	3,560	6,250

[a] "Discharge in second-feet per square mile" and "Run-off (depth in inches)" are not published for this drainage area, because such values are believed not to represent the natural flow at this station. See "Artificial control" in station description.

NOTE.—Discharge computed by engineers of the United States Geological Survey from the daily discharge record furnished by S. B. Johnson, hydraulic engineer, Department of Public Works, Canada.

RAINY LAKE AT RANIER, MINN.

Location.—At the foot of Rainy Lake at the foot of the Ranier wharf.

Records available.—January 1, 1910, to December 31, 1912.

Gage.—Vertical staff. Prior to August 19, 1911, the gage heights were taken at the upper gage of the Minnesota & Ontario Power Co., just above the dam at International Falls, 2 miles below Ranier. Comparative readings taken on the two gages during 1911 indicated a slope of 0.50 foot between the two points, and, to make the records at the two points comparable the readings on the Minnesota & Ontario gage were reduced by 488.50 feet. Recent studies by Mr. Meyer, an engineer of the International Joint Commission, indicate that the actual slope between the two gages varied from 0.3 to 1.2 feet during the period January 1, 1910, to August 18, 1911, so that the readings on the Minnesota & Ontario Power Co.'s gage should have been reduced by an amount ranging from 488.70 to 487.80 feet instead of by 488.50 feet. Gage heights from January 1, 1910, to August 18, 1911, published in Water-Supply Papers 285 and 305 are therefore in error as referred to the correct datum by an unknown amount varying from +0.2 to +0.7 foot. The dam at International Falls controls the level of Rainy Lake which has an area of approximately 344 square miles. Owing to the great number of small islands in the lake its effective capacity is somewhat uncertain, as the existing maps are too small to show this accurately. Beginning August 19, 1911, the gage heights refer to the gage established by the Canadian Department of Public Works. The 1912 gage heights have been referred to the original datum of the gage which had its elevation 489.00 feet above that of the Minnesota & Ontario Power Co.'s gage. The gage was maintained at the following elevations during 1912:

	Feet.
Jan. 1 to Sept. 21	489.00
Sept. 22 to Oct. 9	488.77
Oct. 15 to Dec. 31	489.25

The records at this station, by indicating the change of water level, show the gain or loss in storage due to the control of the flow at the International Falls dam, and when used in connection with the records of the flow of the Rainy at International Falls are of value in determining the natural run-off.

Cooperation.—Gage is owned and maintained by the Canadian Department of Public Works.

Daily gage height, in feet, of Rainy Lake at Ranier, Minn., for 1912.

[G. A. Schiller, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.12	2.36	1.74	0.91	1.41	3.91	6.45	7.38	7.34	7.28	7.03	6.45
2	3.10	2.32	1.72	.87	1.48	4.06	6.50	7.34	7.33	7.26	7.02	6.45
3	3.08	2.30	1.70	.83	1.56	4.12	6.56	7.31	7.36	7.26	7.01	6.45
4	3.06	2.28	1.68	.81	1.61	4.24	6.61	7.29	7.36	7.27	7.00	6.41
5	3.04	2.26	1.64	.80	1.71	4.34	6.66	7.30	7.38	7.27	6.98	6.37
6	3.02	2.24	1.62	.78	1.75	4.42	6.68	7.32	7.39	7.25	6.98	6.35
7	3.00	2.22	1.59	.78	1.77	4.54	6.78	7.31	7.34	7.25	6.96	6.33
8	2.98	2.20	1.56	.79	1.89	6.62	6.83	7.29	7.41	7.26	6.86	6.31
9	2.96	2.20	1.54	.75	2.01	4.71	6.86	7.28	7.32	7.27	6.92	6.28
10	2.94	2.19	1.52	.75	2.08	4.81	6.88	7.26	7.30	.....	6.90	6.25
11	2.92	2.18	1.50	.75	2.16	4.92	6.91	7.24	7.29	.....	6.90	6.22
12	2.90	2.18	1.48	.75	2.24	5.00	6.98	7.18	7.28	.....	6.89	6.19
13	2.88	2.16	1.45	.76	2.31	5.05	7.02	7.15	7.28	.....	6.87	6.16
14	2.86	2.12	1.41	.78	2.37	5.12	7.03	7.20	7.26	.....	6.84	6.12
15	2.84	2.10	1.37	.78	2.46	5.21	7.02	7.20	7.27	7.25	6.81	6.10
16	2.81	2.08	1.33	.82	2.55	5.28	7.06	7.22	7.56	7.23	6.77	6.09
17	2.76	2.06	1.31	.87	2.57	5.38	7.08	7.27	7.24	7.25	6.75	6.07
18	2.72	2.05	1.30	.90	2.66	5.48	7.08	7.24	7.20	7.19	6.73	6.05
19	2.69	2.04	1.27	.91	2.80	5.58	7.09	7.23	7.21	7.20	6.73	6.03
20	2.64	2.03	1.23	.91	2.88	5.65	7.16	7.22	7.17	7.23	6.71	6.01
21	2.63	2.02	1.20	.93	2.96	5.72	7.19	7.19	7.17	7.17	6.65	5.99
22	2.62	2.00	1.18	.95	3.02	5.78	7.23	7.20	7.09	7.16	6.65	5.98
23	2.60	1.98	1.16	.97	3.10	5.83	7.28	7.22	7.11	7.15	6.65	5.97
24	2.56	1.96	1.14	.99	3.21	5.90	7.28	7.27	.....	7.11	6.61	5.95
25	2.54	1.91	1.11	1.03	3.26	6.00	7.28	7.27	.....	7.10	6.59	5.93
26	2.50	1.86	1.07	1.10	3.42	6.06	7.29	7.27	7.24	7.09	6.55	5.91
27	2.48	1.81	1.03	1.20	3.55	6.14	7.29	7.26	7.26	7.08	6.53	5.89
28	2.45	1.78	1.00	1.22	3.66	6.19	7.40	7.30	7.26	7.07	6.49	5.87
29	2.42	1.76	.98	1.29	3.71	6.27	7.39	7.31	7.27	7.05	6.41	5.85
30	2.40	.....	.96	1.35	3.76	6.42	7.38	7.33	7.27	7.05	6.44	5.85
31	2.38	.....	.93	.....	3.81	.....	7.38	7.33	.....	7.05	.....	5.83

NOTE.—Gage heights here published refer to the same datum, the readings Sept. 21 to Oct. 9 having been corrected by −0.23 foot and Oct. 15 to Dec. 31 by +0.25 foot because the original elevation of the datum of the gage was 489.00 feet and the elevation of the zero of gage was changed on Sept. 21 to 488.77 feet, remained at that elevation until Oct. 9, and on Oct. 15 was changed to 489.25 feet. These changes were made by the Canadian Department of Public Works. On Oct. 10 the observer reported: "Gage out of commission."

VERMILION RIVER BELOW LAKE VERMILION, NEAR TOWER, MINN.

Location.—Just below the dam at outlet of Lake Vermilion in sec. 2, T. 63 N., R. 17 W., in St. Louis County, 4 miles above the mouth of Two Mile Creek, which enters from the west.

Records available.—May 17, 1911, to December 31, 1912.

Drainage area.—507 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Made from car and cable just below the gage section.

Artificial control.—At the outlet of Vermilion Lake, a few hundred feet above the gage, there is a dam which is used to raise the elevation of the lake for aid in navigation. There are no gates in the dam, but on July 19, 1912, it was repaired. For a period after this date the flow was lower than normal as there was less leakage. The lake has a slightly greater storage capacity, at the present time, so that the flow during the winter period of 1912–13 will probably be somewhat larger than it would have been had not the dam been repaired.

Winter flow.—Owing to the heavy fall at the gage section, amounting to 20 feet in 200 yards, there is little or no backwater from ice during the winter months.

Accuracy.—Conditions are favorable for fairly accurate results, the only uncertainty being some inaccuracy in the discharge measurements owing to the very rocky section.

Discharge measurements of Vermilion River below Lake Vermilion, near Tower, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 16[a]	S. B. Soulé	0.69	140	Mar. 7[a]	W. G. Hoyt	0.52	103
Mar. 7[a]	do	.52	97.6	Oct. 16	S. B. Soulé	.58	105

[a] Open water; regular section.

Daily gage height, in feet, of Vermilion River below Lake Vermilion, near Tower, Minn., for 1912.

[C. M. Everett, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.70	0.65	0.54	0.45	1.10	2.0	1.55	0.65	0.55	0.6	0.5	0.5
2	.70	.65	.52	.45	1.2	2.0	1.5	.65	.55	.6	.5	.5
3	.70	.65	.52	.45	1.3	2.0	1.5	.65	.55	.6	.5	.5
4	.70	.65	.52	.45	1.4	1.95	1.45	.6	.55	.6	.5	.5
5	.70	.65	.52	.45	1.5	1.95	1.4	.6	.6	.6	.5	.5
6	.70	.65	.52	.45	1.6	1.95	1.4	.6	.6	.6	.5	.5
7	.70	.65	.52	.45	1.7	1.9	1.4	.6	.6	.6	.5	.5
8	.70	.65	.50	.48	1.75	1.9	1.35	.6	.6	.6	.5	.5
9	.70	.65	.50	.50	1.8	1.9	1.35	.55	.6	.6	.5	.5
10	.70	.65	.50	.50	1.9	1.9	1.3	.55	.6	.6	.5	.5
11	.70	.64	.50	.50	1.9	1.95	1.25	.55	.6	.6	.5	.5
12	.70	.63	.50	.52	2.0	1.95	1.25	.55	.6	.6	.5	.5
13	.70	.63	.50	.54	2.0	1.9	1.25	.55	.6	.6	.5	.5
14	.70	.62	.46	.55	2.05	1.85	1.3	.5	.6	.6	.5	.5
15	.70	.62	.44	.55	2.05	1.85	1.25	.5	.6	.6	.5	.5
16	.70	.61	.42	.55	2.05	1.8	1.25	.5	.6	.6	.5	.5
17	.70	.61	.42	.57	2.05	1.8	1.25	.5	.6	.6	.5	.5
18	.68	.60	.42	.60	2.05	1.8	.8	.5	.6	.6	.5	.5
19	.68	.60	.42	.63	2.1	1.8	.8	.5	.6	.6	.5	.5
20	.68	.60	.42	.65	2.1	1.75	.7	.5	.6	.55	.5	.5
21	.68	.60	.42	.68	2.1	1.75	.7	.5	.6	.55	.5	.5
22	.65	.60	.42	.70	2.1	1.75	.7	.5	.6	.55	.5	.5
23	.65	.60	.42	.70	2.05	1.75	.7	.5	.6	.55	.5	.5
24	.65	.60	.42	.70	2.05	1.7	.7	.5	.6	.55	.5	.5
25	.65	.60	.42	.75	2.05	1.7	.65	.5	.6	.55	.5	.5
26	.65	.60	.43	.80	2.05	1.65	.65	.55	.6	.55	.5	.5
27	.65	.58	.44	.85	2.05	1.65	.65	.55	.6	.55	.5	.5
28	.65	.56	.45	.85	2.0	1.6	.65	.55	.6	.55	.5	.5
29	.65	.54	.45	.90	2.0	1.55	.65	.55	.6	.55	.5	.5
30	.65	.....	.45	.95	2.0	1.55	.65	.55	.6	.55	.5	.5
31	.65	.....	.45	.....	2.0	.....	.65	.55	.....	.55	.....	.5

Daily discharge, in second-feet, of Vermilion River below Lake Vermilion, near Tower, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	130	122	106	93	208	540	340	122	107	114	100	100
2	130	122	103	93	231	540	321	122	107	114	100	100
3	130	122	103	93	257	540	321	122	107	114	100	100
4	130	122	103	93	287	515	304	114	107	114	100	100
5	130	122	103	93	321	515	287	114	114	114	100	100
6	130	122	103	93	358	515	287	114	114	114	100	100
7	130	122	103	93	398	490	287	114	114	114	100	100
8	130	122	100	97	420	490	272	114	114	114	100	100
9	130	122	100	100	442	490	272	107	114	114	100	100
10	130	122	100	100	490	490	257	107	114	114	100	100
11	130	120	100	100	490	515	244	107	114	114	100	100
12	130	119	100	103	540	515	244	107	114	114	100	100
13	130	119	100	106	540	490	244	107	114	114	100	100
14	130	117	94	107	568	466	257	100	114	114	100	100
15	130	117	92	107	568	466	244	100	114	114	100	100

Daily discharge, in second-feet, of Vermilion River below Lake Vermilion, near Tower, Minn., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	130	116	89	107	568	442	244	100	114	114	100	100
17	130	116	89	110	568	442	244	100	114	114	100	100
18	127	114	89	114	568	442	148	100	114	114	100	100
19	127	114	89	119	595	442	148	100	114	114	100	100
20	127	114	89	122	595	420	130	100	114	107	100	100
21	127	114	89	127	595	420	130	100	114	107	100	100
22	122	114	89	130	595	420	130	100	114	107	100	100
23	122	114	89	130	568	420	130	100	114	107	100	100
24	122	114	89	130	568	398	130	100	114	107	100	100
25	122	114	89	139	568	398	122	100	114	107	100	100
26	122	114	90	148	568	378	122	107	114	107	100	100
27	122	111	92	158	568	378	122	107	114	107	100	100
28	122	108	93	158	540	358	122	107	114	107	100	100
29	122	106	93	167	540	340	122	107	114	107	100	100
30	122	.....	93	177	540	340	122	107	114	107	100	100
31	122	.....	93	.....	540	.....	122	107	.....	107	.....	100

NOTE.—Daily discharge computed from a well-defined rating curve.

Monthly discharge of Vermilion River below Lake Vermilion, near Tower, Minn., for 1912.

[Drainage area, 507 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	130	122	127	0.250	0.29	A.
February	122	106	117	.231	.25	A.
March	106	89	95.3	.188	.22	A.
April	177	93	117	.231	.26	A.
May	595	208	490	.966	1.11	A.
June	540	340	454	.895	1.00	A.
July	340	122	209	.412	.48	B.
August	122	100	107	.211	.24	B.
September	114	107	113	.223	.25	B.
October	114	107	111	.219	.25	B.
November	100	100	100	.197	.22	B.
December	100	100	100	.197	.23	B.
The year	595	89	178	.351	4.80	

LITTLE FORK RIVER AT LITTLE FORK, MINN.

Location.—At the lower of the two highway bridges in Little Fork in sec. 9, T. 68 N., R. 25 W., 1½ miles above the mouth of Beaver Brook.

Records available.—June 23, 1909, to December 31, 1912.

Drainage area.—1,720 square miles.

Gage.—Vertical staff—datum unchanged since establishment.

Channel.—Practically permanent, except for temporary backwater from log jams at the railroad bridge below the station.

Discharge measurements.—Made from the bridge.

Artificial control.—The river is used throughout the spring and summer for log driving. There are, however, no logging dams on the river, so that the flow is natural.

Winter flow.—The river is completely frozen over at the station from November to April.

Accuracy.—Conditions at the station are favorable and the records of flow should be reliable.

Discharge measurements of Little Fork River at Little Fork, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 21[a]	S. B. Soulé	5.52	64	June 14	S. B. Soulé	6.83	610
Feb. 26[b]	do	5.76	73	14	do	6.83	605
Mar. 30[c]	do	5.94	67	Aug. 6[e]	W. G. Hoyt	5.28	131
May 20[d]	do	12.34	2,290	Dec. 19[f]	S. B. Soulé	5.82	113
20[d]	do	12.23	2,230				

[a] Complete ice cover; average thickness of ice, 1.19 feet; average distance water surface to top of ice, 0.28 foot.
[b] Complete ice cover; average thickness of ice, 1.60 feet; average distance water surface to top of ice, 0.07 foot.
[c] Complete ice cover; average thickness of ice, 1.78 feet; average distance water surface to top of ice, 0.00 foot.
[d] Log jam on railway bridge about 2 miles below gage.
[e] Backwater from logs held in boom just below railway bridge.
[f] Complete ice cover; average thickness of ice, 0.68 foot.

Daily gage height, in feet, of Little Fork River at Little Fork, Minn., for 1912.

[Herman I. Mous, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.45	.....	5.95	11.0	.....	6.2	5.45	5.8	8.0	6.0	.....
2	.....	.....	.....	.....	11.1	.....	7.3	5.35	5.85	7.9	6.0	.....
3	.....	.....	5.75	.....	10.4	8.0	7.2	5.4	5.8	7.6	6.0	.....
4	.....	.....	.....	6.1	10.6	7.4	6.6	5.3	5.75	7.4	6.0	.....
5	5.95	5.45	.....	.....	11.6	7.4	6.3	5.2	8.8	7.2	6.0	6.0
6	.....	.....	.....	.....	11.7	7.4	6.0	5.3	8.2	7.1	6.0	.....
7	.....	.....	.....	11.7	12.4	7.5	6.0	5.3	8.7	7.1	6.0	.....
8	5.8	5.45	5.75	12.0	12.7	7.3	6.1	5.3	8.6	6.8	6.0	.....
9	.....	.....	.....	12.4	12.5	7.4	6.0	5.3	8.7	6.6	6.0	.....
10	.....	.....	.....	12.0	12.6	7.2	6.0	5.3	8.6	6.8	6.0	.....
11	5.8	.....	5.70	11.8	12.5	6.2	5.8	5.3	8.4	6.8	6.0	.....
12	.....	5.45	.....	10.9	12.6	6.5	5.8	5.3	7.6	6.7	5.95	5.75
13	.....	.....	.....	10.5	12.9	6.7	6.0	5.3	7.8	6.8	5.95	.....
14	.....	.....	5.80	10.0	12.8	6.8	6.3	5.2	7.5	6.6	5.9	.....
15	5.8	5.45	.....	9.8	13.6	6.7	6.2	5.2	7.2	6.7	5.9	.....
16	.....	.....	.....	9.3	14.1	6.6	5.9	5.1	7.0	6.7	5.9	.....
17	.....	.....	.....	8.9	13.6	6.5	5.8	5.2	6.8	6.6	6.2	.....
18	5.7	.....	5.8	9.0	13.1	6.5	5.8	5.25	6.6	6.5	6.4	.....
19	.....	5.8	.....	8.8	12.5	6.6	5.7	5.3	6.2	6.4	6.4	5.7
20	.....	.....	.....	8.7	12.5	6.7	5.6	5.3	5.9	6.4	6.4	.....
21	5.5	.....	5.8	8.5	12.0	6.9	5.65	5.3	5.9	6.2	6.3	.....
22	5.5	.....	.....	8.4	11.4	6.8	5.6	5.3	6.0	6.3	6.2	.....
23	.....	5.8	.....	8.1	11.1	6.6	5.7	5.3	6.3	6.3	6.1	.....
24	.....	.....	.....	7.4	10.6	6.5	5.8	5.3	6.6	6.2	6.1	.....
25	.....	.....	5.85	7.2	9.9	6.3	5.6	5.3	6.9	6.1	6.2	.....
26	5.5	5.8	.....	7.7	8.9	6.2	5.6	5.3	7.2	6.1	6.3	5.9
27	.....	.....	.....	9.2	8.5	6.0	5.65	5.3	7.3	5.95	6.3	.....
28	.....	.....	.....	9.9	8.4	5.8	5.6	5.4	7.7	5.8	6.3	.....
29	5.5	5.8	5.9	10.5	8.1	5.7	5.6	5.7	7.9	6.1	6.3	.....
30	.....	.....	5.9	10.8	7.4	5.7	5.6	5.9	7.0	6.1	6.2	.....
31	.....	.....	.....	.....	.....	.....	5.6	5.9	.....	6.0	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 12, and about Nov. 17 to Dec. 31; by log jams Apr. 29 to May 2 and May 15 to 25, and by floating logs held in boom below station about July 13 to Aug. 31.

Daily discharge, in second-feet, of Little Fork River at Little Fork, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2,000	910	395	160	289	1,030	341
2	.....	2,040	970	756	140	302	989	341
3	.....	2,080	1,030	719	150	289	870	341
4	.....	2,180	793	513	130	276	793	341
5	.....	2,660	793	423	112	1,360	719	341
6	.....	2,710	793	341	130	1,110	683	341
7	.....	3,060	831	341	130	1,320	683	341
8	.....	3,210	756	368	130	1,280	578	341
9	.....	3,110	793	341	130	1,320	513	341
10	.....	3,160	719	341	130	1,280	578	341
11	.....	3,110	395	289	130	1,190	578	341
12	.....	3,160	482	289	130	870	545	328
13	2,130	3,310	545	289	130	949	578	328
14	1,900	3,260	578	368	112	831	513	315
15	1,820	2,910	545	341	112	719	545	315
16	1,590	3,160	513	264	97	647	545	315
17	1,410	2,910	482	240	112	578	513	.....
18	1,460	2,660	482	240	121	513	482	.....
19	1,360	2,360	513	216	130	395	452	.....
20	1,320	2,360	545	193	130	315	452	.....
21	1,230	2,130	612	204	130	315	395	.....
22	1,190	1,860	578	193	130	341	423	.....
23	1,070	1,720	513	193	130	423	423	.....
24	793	1,500	482	193	130	513	395	.....
25	719	1,190	423	193	130	612	368	.....
26	909	1,410	395	193	130	719	368	.....
27	1,540	1,230	341	204	130	756	328	.....
28	1,860	1,190	289	193	150	909	289	.....
29	1,900	1,070	264	193	216	989	368	.....
30	1,950	793	264	193	264	647	368	.....
31	.....	850	.....	193	264	.....	341	.....

NOTE.—Daily discharge computed from a discharge rating table that is well defined for unobstructed channel conditions. Daily discharge interpolated Apr. 29 to May 2 and July 23 and 24 and daily gage heights as published reduced 1.5 feet to enter discharge rating table May 15 to 25 because of log jams. Gage heights reduced 0.2 foot to enter discharge rating table July 13 to Aug. 31 because of effect of floating logs. Discharge interpolated May 31 to June 2. Discharge Jan. 1 to Apr. 12 and Nov. 17 to Dec. 31 estimated, because of ice, from climatologic records, discharge measurements and observer's reports, as follows: Jan. 1–31, 85 second-feet, varying from about 130 to 60 second-feet; Feb. 1–29, 75 second-feet, varying from about 80 to 70 second-feet; Mar. 1–31, 70 second-feet; Apr. 1–12, 650 second-feet, varying from about 70 to 2,000 second-feet; Nov. 17–30, 300 second-feet, varying from about 315 to 285 second-feet; Dec. 1–31, 150 second-feet, varying from about 250 to 100 second-feet.

Monthly discharge of Little Fork River at Little Fork, Minn., for 1912.

[Drainage area, 1,720 square miles.[a]]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	85	0.049	0.06	C.
February	.....	.....	75	.044	.05	C.
March	.....	.....	70	.041	.05	B.
April	.....	.....	1,130	.657	.73	C.
May	3,310	793	2,270	1.32	1.52	B.
June	1,030	264	588	.342	.38	B.
July	756	193	304	.177	.20	C.
August	264	97	140	.081	.09	C.
September	1,360	276	735	.427	.48	C.
October	1,030	289	539	.313	.36	B.
November	.....	.....	318	.185	.21	C.
December	.....	.....	150	.087	.10	C.
The year	3,310	.....	535	.311	4.23	

[a] Although there is considerable swamp land in this drainage area it is still in its natural state, and it is believed, therefore, that the estimates "Discharge in second-feet per square mile" and "Run-off (depth in inches)" are not misleading.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

BIG FORK RIVER AT BIG FALLS, MINN.

Location.—At Big Falls, about 500 feet below the lower end of the rapids.

Records available.—August 27, 1909, to September 30, 1912.

Drainage area.—1,320 square miles.

Gage.—Vertical staff. The gage was originally located at the Minnesota and International bridge above the falls, but jams at that point caused so much trouble that on June 10, 1911, the station was moved to its present site, the new gage being set to read approximately 1 foot lower than the old gage. Gage heights for 1911 have been referred to the present gage and gage heights for 1912 were taken at this gage.

Channel.—Although the channel is practically permanent in itself, it is for the greater part of the year full of logs.

Discharge measurements.—Made from a car and cable one-fourth mile below the gage.

Winter flow.—Daily discharge January 1 to March 31 estimated, because of ice, from discharge measurements, gage heights, climatologic records, and discharge of adjacent drainage areas, as follows: January 1–31, 30 second-feet, varying from about 40 to 25 second-feet; February 1–29, 30 second-feet, varying from about 25 to 40 second-feet; March 1–31, 35 second-feet, varying from about 40 to 30 second-feet.

Accuracy.—The formation of log jams throughout the river's course makes it impossible to so place a gage that the relation between gage heights and discharge will be constant for any extended period. Owing to the inability to secure weekly measurements, no estimates of flow can be given except during the period of ice when the effect of log jams is relatively unimportant, and the mean monthly discharge can be estimated from the current meter measurements. The discharge for the entire year can be approximately estimated by determining the relation between the discharge of Little Fork and Big Fork rivers at the times of discharge measurements, assuming such relation to hold at other times and then using it in conjunction with the gage heights at Big Falls to estimate the flow of the Big Fork.

Discharge measurements of Big Fork River at Big Falls, Minn., in 1912.

[Hydrographer, S. B. Soulé.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 23 [a]	2.33	26.9	May 21	5.06	951
Feb. 27 [b]	2.39	37.2	Aug. 8 [e]	3.13	97
Apr. 1 [c]	2.24	27.0	Dec. 20 [f]	2.40	46
Apr. 1 [d]	2.24	28.6			

[a] Complete ice cover; average thickness of ice, 1.24 feet; average distance water surface to top of ice, 0.29 foot.

[b] Complete ice cover; average thickness of ice, 1.27 feet; average distance water surface to top of ice, 0.32 foot.

[c] Section about 40 feet below downstream edge of highway bridge; measurement in open water; complete ice cover at gage.

[d] Section about 25 feet below downstream edge of highway bridge; measurement in open water; complete ice cover at gage.

[e] A great many logs in channel, causing considerable backwater.

[f] Complete ice cover at gage; open at measuring section at foot of rapids.

Daily gage height, in feet, of Big Fork River at Big Falls, Minn., for 1912.

[Ferne Butler, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.75	2.2	.....	2.25	5.2	4.8	4.7	3.4	4.6
2	.....	.....	.....	.....	5.2	4.7	4.6	3.3	4.4
3	.....	.....	.....	.....	5.0	4.6	4.6	3.3	4.2
4	2.7	.....	2.5	.....	5.2	4.4	4.5	3.1	3.4
5	.....	2.2	.....	2.25	5.4	4.4	4.4	3.2	3.1
6	.....	.....	.....	.....	5.4	4.4	4.0	3.3	3.1
7	.....	.....	2.35	.....	5.4	4.6	3.8	3.3	3.2
8	2.65	2.3	.....	4.4	5.4	4.4	4.2	3.2	3.1
9	.....	.....	.....	4.6	5.6	4.4	4.4	3.2	3.1
10	.....	.....	.....	4.7	5.8	4.5	4.1	3.1	3.0
11	2.65	.....	2.4	5.1	6.2	4.4	4.0	3.2	2.9
12	.....	2.25	.....	5.0	6.0	4.4	4.0	3.3	2.9
13	.....	.....	.....	5.0	5.8	4.6	3.8	3.3	2.9
14	.....	.....	2.3	4.8	5.7	4.8	4.4	3.2	2.9
15	2.55	2.3	.....	4.6	6.0	4.9	4.2	3.2	2.85
16	.....	.....	.....	4.4	6.2	5.0	4.0	3.2	2.9
17	.....	.....	.....	4.2	6.0	5.0	4.0	3.2	2.9
18	.....	.....	2.3	4.2	6.1	4.8	3.9	3.3	2.9
19	.....	2.25	.....	4.0	5.9	4.8	4.0	3.3	2.9
20	.....	.....	.....	3.9	5.2	4.7	4.0	3.4	2.8
21	.....	.....	2.3	4.0	5.0	4.6	4.2	3.5	2.75
22	2.3	2.3	.....	3.9	4.9	4.5	3.9	3.8	2.8
23	2.3	.....	.....	3.8	4.9	4.6	3.7	4.2	3.0
24	.....	.....	.....	3.8	4.8	4.6	3.7	4.8	3.2
25	2.3	.....	2.3	4.0	4.8	4.4	3.6	4.6	3.3
26	.....	2.35	.....	4.3	4.8	4.6	3.5	4.2	3.6
27	.....	2.4	.....	4.5	4.8	4.8	3.5	4.3	4.2
28	.....	.....	2.2	4.6	4.8	5.1	3.6	4.7	4.6
29	2.25	2.4	.....	4.8	4.7	4.8	3.4	4.1	4.7
30	.....	.....	.....	5.2	4.7	5.2	3.4	4.2	4.8
31	.....	.....	.....	.....	4.7	.....	3.4	4.6	.....

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Apr. 7.

UPPER MISSISSIPPI RIVER DRAINAGE BASIN.

MISSISSIPPI RIVER ABOVE SANDY RIVER, NEAR LIBBY, MINN.

Location.—A short distance above the mouth of Sandy River in sec. 25, T. 50 N., R. 24 W., near Libby post office, in Aitkin County.

Records available.—September 1, 1895, to December 31, 1912.

Drainage area.—4,510 square miles.

Gage.—Vertical staff.

Discharge measurements.—Made by an employee of the United States Corps of Engineers, stationed at Sandy Lake dam.

Artificial control.—Flow at this station is controlled in the interest of navigation by three reservoirs, namely, Lake Winnibigoshish, Leech Lake, and Pokegama Falls.

Cooperation.—Station maintained by United States Corps of Engineers for the purpose of determining the flow of the river above Sandy Lake reservoir.

Daily discharge, in second-feet, of Mississippi River above Sandy River, near Libby, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	684	396	542	671	1,060	1,520	1,540	1,350	1,310	2,440	1,460	918
2	659	411	538	687	1,120	1,540	1,570	1,360	1,380	2,340	1,420	885
3	634	426	534	703	1,190	1,570	1,600	1,370	1,460	2,240	1,380	853
4	609	441	530	718	1,250	1,590	1,630	1,380	1,530	2,140	1,340	820
5	583	456	527	734	1,320	1,610	1,660	1,400	1,600	2,040	1,300	787
6	557	471	524	750	1,380	1,640	1,700	1,410	1,670	a1,940	1,260	755
7	a 532	486	521	765	1,450	1,660	1,730	1,420	1,740	1,930	1,220	722
8	528	501	518	781	1,510	a1,680	a1,760	a1,430	1,810	1,930	1,180	690
9	523	517	515	796	1,580	1,690	1,740	1,440	1,880	1,930	1,150	657
10	519	533	a 512	812	1,640	1,700	1,720	1,450	1,960	1,930	1,110	624
11	514	a 548	516	827	1,700	1,710	1,710	1,460	2,030	1,920	1,070	592
12	510	544	519	843	a1,770	1,720	1,690	1,470	2,100	1,920	1,030	559
13	505	540	523	a 859	1,760	1,730	1,680	1,480	2,170	1,920	a 990	a 523
14	500	537	527	867	1,740	1,740	1,660	1,490	2,240	1,920	988	522
15	496	534	530	875	1,730	1,750	1,650	1,500	a2,310	1,920	986	521
16	491	531	a 534	883	1,710	1,760	a1,630	1,510	2,300	a1,910	983	521
17	487	528	543	891	1,700	1,760	1,620	a1,520	2,280	1,850	981	520
18	482	525	552	899	a1,680	a1,770	1,610	1,510	2,270	1,780	979	519
19	478	521	561	907	1,670	1,760	1,600	1,490	2,250	1,720	976	518
20	473	518	570	915	1,640	1,750	1,590	1,470	2,240	1,650	974	517
21	a 468	a 515	580	923	1,620	1,730	1,580	1,460	2 220	1,590	972	a 516
22	460	518	589	931	1,590	1,720	a1,570	1,440	a2,210	a1,520	970	520
23	451	522	a 598	940	1,570	a1,710	1,540	1,430	2,250	1,520	967	525
24	443	526	605	948	1,540	1,680	1,520	1,410	2,290	1,520	965	530
25	434	530	612	956	a1,510	1,650	1,490	a1,400	2,330	1,510	963	534
26	426	534	620	964	1,500	1,620	1,470	1,370	2,380	1,510	960	538
27	417	537	627	a 972	1,500	1,600	1,440	1,340	2,420	1,510	958	548
28	409	541	635	980	1,500	1,570	1,420	1,320	2,460	1,500	955	543
29	400	a 545	642	988	1,500	1,540	1,390	1,290	2,500	1,500	953	552
30	390	.....	649	a 995	1,500	a1,510	1,360	1,270	a2,540	1,500	950	557
31	a 381	.....	a 656	.....	a1,500	.....	a1,340	a1,240	.....	a1,500	.....	a 563

a Discharge measurement.

Monthly discharge of Mississippi River above Sandy River, near Libby, Minn., for 1912.

[Drainage area, 4,510 square miles.] a

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
January	684	381	498	1,330
February	548	396	508	1,270
March	656	512	563	1,510
April	995	671	859	2,230
May	1,770	1,060	1,530	4,100
June	1,770	1,510	1,670	4,330
July	1,760	1,340	1,590	4,260
August	1,520	1,240	1,420	3,800
September	2,540	1,310	2,070	5,370
October	2,440	1,500	1,810	4,850
November	1,460	950	1,080	2,800
December	918	516	611	1,640
The year	2,540	381	1,180	37,500

a Discharge in "Second-feet per square mile" and "Run-off (depth in inches)" not published for this drainage area because the flow at the station is modified by the operation of six reservoirs in the interest of navigation, as noted under "Artificial control" in station description.

NOTE.—Computed by engineers of the United States Geological Survey from daily discharge record furnished by the Corps of Engineers, U. S. Army.

MISSISSIPPI RIVER AT ANOKA, MINN.

Location.—At highway bridge connecting Anoka with Champlain, Minn., a short distance above the mouth of Rum River.

Records available.—November 3, 1896, to September 10, 1897 (United States Engineer Corps records); May 8, 1905, to December 31, 1912.

Drainage area.—17,100 square miles.

Gage.—Chain gage; staff gage prior to 1909; datum, unchanged since establishment of station, is the same as that used by the United States Engineer Corps in 1896 and 1897.

Channel.—Practically permanent. Control temporarily changed for a few days at a time by log jams.

Discharge measurements.—Made from bridge.

Winter flow.—The river is frozen and regular observations are discontinued from December to March. The monthly discharge for this period during 1912 is based on the records of flow kept by the United States Enigneer Corps records at Lock and Dam No. 2, below Minneapolis, an allowance being made for the increase in flow between the two points.

Artificial control.—The nearest dam is located at Minneapolis, but on account of the fall between the two points, its influence does not extend to the Anoka station. The first dam above Anoka is at St. Cloud. The flow of the river is controlled by Government dams on the upper river at Lake Winnibigoshish, Leech Lake, Pokegama Falls, Sandy Lake, Pine River, and Gull Lake, for the purpose of increasing the low-water open-season flow in the interest of navigation. Although the river is used extensively for log driving there is very little backwater from log jams forming below the station, except for a few days at a time.

Accuracy.—Although no measurements were made during 1907 and 1908, those made subsequently indicate that there has been no great change in the discharge rating curve as developed in 1897, 1905, and 1906, and therefore, it can be applied to all gage heights since the establishment of the station. This permanence of conditions indicates that the records of flow are reliable.

The following discharge measurement was made by Hoyt and Soulé:

June 5, 1912; gage height, 1.40 feet; discharge, 8,480 second-feet.

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1912.

[B. J. Witte, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.9	0.8	2.4	0.0	0.5	0.3	0.1	—0.2
2	1.0	.8	2.2	.0	.4	.3	.1	—.2
3	1.2	1.0	1.9	.0	.6	.3	.2	—.2
4	1.4	1.6	1.8	.1	.6	.2	.2	—.2
5	1.5	2.8	1.6	.0	.6	.2	.2	—.2
6	1.8	5.0	1.4	.3	.6	.2	.2	—.3
7	1.7	6.2	1.2	.3	.2	.1	.2	—.3
8	1.5	6.4	1.0	.2	—.1	.1	.1	—.2
9	1.2	6.2	.9	.8	.1	.0	.1	—.3
10	1.0	5.8	.8	.4	.2	—.1	.2	—.4
11	1.0	5.4	.8	.4	.1	—.2	.2	—.4
12	.8	4.8	.4	.5	.1	—.1	.3	—.3
13	.7	4.3	.5	.5	.2	—.1	.2	—.4
14	.6	3.9	.4	.4	.2	—.2	.1	—.5
15	.6	3.2	.5	.3	.3	—.2	.1	—.4
16	.5	3.1	.4	.3	.3	—.1	.0	—.4
17	.7	2.5	.4	.2	.2	.0	.1	—.4
18	.8	2.3	.3	.3	.3	.1	.1	—.5
19	.6	2.1	.5	.4	.3	.1	.1	—.4
20	.5	2.0	.5	.4	.2	.2	.2	—.4
21	.....	1.9	.5	.4	.2	.1	.2	—.4
22	.4	2.0	.....	.4	.2	.1	.3	—.4
23	.4	1.9	.5	.8	.2	.1	.2	—.4
24	.2	2.2	.5	.5	.2	.1	.3	—.5
25	.3	2.0	.4	1.0	.2	.1	.1	—.6
26	.4	2.1	.1	.9	.1	.2	.0	—.8
27	.4	2.2	.0	.9	.....	.1	—.1	—.7
28	.5	2.4	.1	.8	.....	.2	—.2	—.8
29	.6	2.4	.0	.7	.2	.2	—.2	—.8
30	.6	2.6	.0	.6	.4	.1	—.3	—.6
31	.....	2.6	.....	.6	.4	.....	—.2	.....

Daily discharge, in second-feet, of Mississippi River at Anoka, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6,440	6,110	12,400	4,080	5,240	4,740	4,290	3,690
2	6,780	6,110	11,600	4,080	4,980	4,740	4,290	3,690
3	7,520	6,780	10,300	4,080	5,510	4,740	4,510	3,690
4	8,300	9,100	9,910	4,290	5,510	4,510	4,510	3,690
5	8,700	14,200	9,100	4,080	5,510	4,510	4,510	3,690
6	9,910	24,600	8,300	4,740	5,510	4,510	4,510	3,510
7	9,500	30,700	7,520	4,740	4,510	4,290	4,510	3,510
8	8,700	31,800	6,780	4,510	3,880	4,290	4,290	3,690
9	7,520	30,700	6,440	6,110	4,290	4,080	4,290	3,510
10	6,780	28,700	6,110	4,980	4,510	3,880	4,510	3,340
11	6,780	26,600	6,110	4,980	4,290	3,690	4,510	3,340
12	6,110	23,600	4,980	5,240	4,290	3,880	4,740	3,510
13	5,800	21,200	5,240	5,240	4,510	3,880	4,510	3,340
14	5,510	19,300	4,980	4,980	4,510	3,690	4,290	3,180
15	5,510	16,000	5,240	4,740	4,740	3,690	4,290	3,340
16	5,240	15,500	4,980	4,740	4,740	3,880	4,080	3,340
17	5,800	12,800	4,980	4,510	4,510	4,080	4,290	3,340
18	6,110	12,000	4,740	4,740	4,740	4,290	4,290	3,180
19	5,510	11,200	5,240	4,980	4,740	4,290	4,290	3,340
20	5,240	10,700	5,240	4,980	4,510	4,510	4,510	3,340
21	5,110	10,300	5,240	4,980	4,510	4,290	4,510	3,340
22	4,980	10,700	5,240	4,980	4,510	4,290	4,740	3,340
23	4,980	10,300	5,240	6,110	4,510	4,290	4,510	3,340
24	4,510	11,600	5,240	5,240	4,510	4,290	4,740	3,180
25	4,740	10,700	4,980	6,780	4,510	4,290	4,290	3,030
26	4,980	11,200	4,290	6,440	4,290	4,510	4,080	2,760
27	4,980	11,600	4,080	6,440	4,360	4,290	3,880	2,890
28	5,240	12,400	4,290	6,110	4,430	4,510	3,690	2,760
29	5,510	12,400	4,080	5,800	4,510	4,510	3,690	2,760
30	5,510	13,300	4,080	5,510	4,980	4,290	3,510	3,030
31	.....	13,300	.....	5,510	4,980	.....	3,690	.....

NOTE.—Daily discharge computed from a rating curve well defined between 3,180 and 29,700 second-feet (gage heights —0.5 and 6 feet). Discharge Jan. 1 to Mar. 31 and Dec. 1-31 estimated, because of ice, from the flow of the Mississippi at Dam No. 2 as determined by the United States Engineer Corps, minus the flow of Rum River at Cambridge, and the estimated inflow from the remaining drainage area between Anoka and dam No. 2, as follows: Jan 1-31, 2,340 second-feet; Feb. 1-29, 2,330 second-feet; Mar. 1-31, 2,640 second-feet; Dec. 1-31, 2,640 second-feet.

Monthly discharge of Mississippi River at Anoka, Minn., for 1912.

[Drainage area, 17,100 square miles. [a]]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	2,340	D.
February	.....	.....	2,330	D.
March	.....	.....	2,640	D.
April	9,910	4,510	6,280	B.
May	31,800	6,110	15,700	A.
June	12,400	4,080	6,230	A.
July	6,780	4,080	5,120	A.
August	5,510	3,880	4,680	B.
September	4,740	3,690	4,260	B.
October	4,740	3,510	4,300	B.
November	3,690	2,760	3,320	C.
December	.....	.....	2,640	D.
The year	31,800	.....	5,000	

[a] "Discharge in second-feet per square mile" and "Run-off (depth in inches)" not computed for this drainage area, because the flow past the station is controlled, in the interest of navigation, by reservoirs as noted under "Artificial control" in station description.

NOTE.—See footnote to table of daily discharge.

MISSISSIPPI RIVER AT ST. PAUL, MINN.

Location.—Near foot of Wabasha Street, St. Paul, 6 miles below the mouth of Minnesota River.

Records available.—Gage heights by United States Signal Service (later United States Weather Bureau), 1873 to 1912. Many discharge measurements by United States Engineer Corps prior to 1900. Measurements made by United States Geological Survey, 1909 to 1912. Daily discharge March 1, 1892, to December 31, 1912.

Drainage area.—35,700 square miles.

Gage.—Vertical staff; datum unchanged. In 1911 the gage was moved upstream several hundred yards, but it was set to read the same as at the original location. Gage read once a day. Near the same site is the gage of the United States Engineer Corps, the datum of which is 0.5 foot higher. All data herein refer to the Weather Bureau gage.

Channel.—Somewhat shifting from year to year.

Discharge measurements.—Made from the Omaha Railway bridge 2 miles above the station.

Winter flow.—From December to March the river is frozen and the open-channel rating curve is not applicable. Monthly estimates of flow for this period are based on the records of the St. Anthony Falls Water Power Co. at Minneapolis, and the records of the United States Engineer Corps at lock and dam No. 2 below Minneapolis, an allowance being made for the flow of the Minnesota River.

Artificial control.—The river is controlled to a certain extent by the Government reservoirs on the headwaters at Lake Winnibigoshish, Leech Lake, Pokegama Falls, Sandy Lake, Pine River, and Gull Lake, but the effect of these reservoirs is felt very gradually at St. Paul. The nearest dam is at Minneapolis, and it is possible that the shutting of the wheel gates at that point may cause some daily fluctuations of stage at St. Paul during extreme low water.

Maximum and minimum flow.—The highest recorded discharge occurred July 22, 1867, and amounted to 117,000 second-feet. Since 1892 the highest discharge has been 80,800 second feet. The winter flow has fallen nearly as low as 1,000 second-feet.

Accuracy.—As the Weather Bureau gage is read once a day, the recorded mean gage height for the day may be somewhat in error, although occasional additional readings have shown this error was not serious, largely because of the natural storage of the river channel between the Minneapolis dam and St. Paul. Previous to 1900 the United States Engineer Corps made many discharge measurements at St. Paul, the results of which are published by the Mississippi River Commission. Although the base data for estimating the daily flow of the river are available for years prior to 1892, the reservoir system was not then in complete operation, and as this system has had a marked influence on the regimen of the river, it is evident that the earlier records have lost much of their value as indications of probable future flow.

Cooperation.—Gage heights furnished by United States Weather Bureau; data on which estimates of mean monthly flow from December to March have been based furnished by the United States Engineer Corps.

Discharge measurements of Mississippi River at St. Paul, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 3	Soulé and Orbeck	6.28	16,200	July 30	Hoyt and Soulé	2.09	6,610
July 11	Soulé and Peterson	2.32	6,820	Sept. 13	do	1.21	4,920

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	1.1	4.5	4.2	5.8	1.3	1.5	2.1	1.4	0.8	−0.3
2	1.2	.....	.....	5.0	4.2	5.7	1.6	1.5	2.0	1.4	.8	.2
3	.....	0.3	.....	5.9	4.2	5.4	1.5	1.4	2.0	1.4	.9	.0
4	.....	.....	.....	6.5	4.6	5.1	1.5	1.2	2.0	1.3	.9	.0
5	.....	.....	.....	6.4	5.3	4.6	1.8	1.0	1.9	1.4	.7	.2
6	.....	.6	.8	6.3	7.1	4.3	1.7	1.1	1.9	1.4	.6	.0
7	.7	.....	.....	6.2	9.1	4.2	2.0	1.1	1.6	1.3	.7	−1.0
8	.....	.....	.....	5.9	10.4	4.0	1.8	1.0	1.6	1.3	.6	− .5
9	.....	.....	.....	5.7	11.0	3.8	2.0	1.1	1.7	1.3	.5	1.1
10	.....	.3	.....	5.2	11.2	3.6	2.3	1.2	1.3	1.3	.5	.5
11	.....	.....	.....	4.8	10.9	3.4	2.0	1.4	1.0	1.2	.5	.8
12	.....	.....	.....	4.7	10.6	3.3	2.0	1.3	1.0	1.4	.5	.8
13	.7	.....	.4	4.5	10.1	2.8	2.6	1.3	1.0	1.4	.4	1.1
14	.....	.....	.....	4.4	9.7	2.9	2.3	1.4	1.0	1.4	.4	1.0
15	.....	.....	.....	4.2	9.0	3.0	2.1	1.4	.9	1.3	.4	1.0
16	.....	.5	− .5	4.3	8.3	2.8	2.0	1.4	1.0	1.3	.5	1.5
17	.....	.....	.....	4.2	7.9	2.7	1.8	1.5	.9	1.3	.6	.2
18	.....	.....	− .6	4.1	7.1	2.8	1.5	1.7	.8	1.2	.5	.0
19	.7	.....	− .1	4.0	6.7	2.7	1.6	1.6	.9	1.1	.5	− .2
20	.....	.....	.....	3.9	6.4	2.7	1.6	1.6	.9	1.2	.4	− .2
21	.....	.4	.....	3.8	6.0	2.7	1.4	1.8	1.2	1.2	.4	.1
22	.....	.....	.....	3.9	5.8	2.8	1.2	1.7	1.3	1.2	.4	.7
23	.6	.....	.1	3.9	5.7	2.7	1.2	1.7	1.2	1.0	.5	.9
24	.....	.....	.2	4.0	5.9	2.6	1.8	1.6	1.2	1.0	.5	.7
25	.....	.....	.3	4.0	5.9	2.6	2.1	1.6	1.3	1.1	.4	.5
26	.....	.....	.4	4.0	5.8	2.5	2.3	1.4	1.4	1.2	.3	.4
27	1.1	.....	.6	4.2	5.7	2.2	2.2	1.5	1.3	1.1	.0	.4
28	.....	.....	.9	4.1	6.0	1.8	2.0	1.5	1.3	1.1	− .2	.1
29	.....	.....	1.4	3.9	6.1	1.8	1.7	1.4	1.4	1.2	− .2	− .1
30	.7	.....	2.4	4.0	6.2	1.6	1.8	2.1	1.3	1.0	− .3	.2
31	.....	.....	3.9	.....	6.1	.....	1.8	2.2	.....	.9	.....	.1

NOTE.—Some of the gage heights were read by the observer on a gage which is in error 0.2 foot, notably Apr. 1 to Sept. 30; records for October and November probably correct. Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 31 and about Dec. 1 to 31.

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	10,900	10,000	15,300	5,000	5,340	6,410	5,170	4,290
2	12,400	10,000	15,000	5,510	5,340	6,230	5,170	4,290
3	15,300	10,000	14,000	5,340	5,170	6,230	5,170	4,420
4	17,400	11,200	13,100	5,340	4,840	6,230	5,000	4,420
5	17,000	13,300	11,700	5,870	4,550	6,050	5,170	4,160
6	16,700	19,700	11,000	5,690	4,690	6,050	5,170	4,040
7	16,300	28,500	10,800	6,230	4,690	5,510	5,000	4,160
8	15,300	34,800	10,300	5,870	4,550	5,510	5,000	4,040
9	14,600	37,900	9,840	6,230	4,690	5,690	5,000	3,920
10	13,000	39,000	9,400	6,780	4,840	5,000	5,000	3,920
11	11,800	37,400	8,980	6,230	5,170	4,550	4,840	3,920
12	11,500	35,800	8,770	6,230	5,000	4,550	5,170	3,920
13	10,900	33,300	7,750	7,350	5,000	4,550	5,170	3,800
14	10,600	31,400	7,950	6,780	5,170	4,550	5,170	3,800
15	10,000	28,100	8,150	6,410	5,170	4,420	5,000	3,800

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1912— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	10,300	24,900	7,750	6,230	5,170	4,550	5,000	3,920
17	10,000	23,200	7,550	5,870	5,340	4,420	5,000	4,040
18	9,780	19,900	7,750	5,340	5,690	4,290	4,840	3,920
19	9,520	18,400	7,550	5,510	5,510	4,420	4,690	3,920
20	9,270	17,400	7,550	5,510	5,510	4,420	4,840	3,800
21	9,030	16,000	7,550	5,170	5,870	4,840	4,840	3,800
22	9,270	15,300	7,750	4,840	5,690	5,000	4,840	3,800
23	9,270	15,000	7,550	4,840	5,690	4,840	4,550	3,920
24	9,520	15,600	7,350	5,870	5,510	4,840	4,550	3,920
25	9,520	15,600	7,350	6,410	5,510	5,000	4,690	3,800
26	9,520	15,300	7,160	6,780	5,170	5,170	4,840	3,680
27	10,000	15,000	6,590	6,590	5,340	5,000	4,690	3,330
28	9,780	16,000	5,870	6,230	5,340	5,000	4,690	3,120
29	9,270	16,300	5,870	5,690	5,170	5,170	4,840	3,120
30	9,520	16,700	5,510	5,870	6,410	5,000	4,550	3,030
31	.....	16,300	.....	5,870	6,590	.....	4,420	.....

NOTE.—Daily discharge computed from two well-defined rating curves. Shift occurred during May flood. Some error may have been introduced into the daily discharge by the fact that at times the observer read the wrong gage, which is in error 0.2 foot. This condition is known to have existed Apr. 1 to Sept. 30, but October and November records are believed to be reliable. See footnote to table of daily gage heights for possible source of error in the above daily discharge. Discharge Jan. 1 to Mar. 31, and Dec. 1 to 31 estimated, because of ice, from discharge at lock and dam No. 2, from records of United States Engineer Corps, and flow at Mankato, as follows: Jan. 1–31, 2,800 second-feet; Feb. 1–29, 2,700 second-feet; Mar. 1–31, 3,800 second-feet; Dec. 1–31, 3,170 second-feet.

Monthly discharge of Mississippi River at St. Paul, Minn., for 1912.

[Drainage area, 35,700 square miles.[a]]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	2,800	D.
February	.....	.....	2,700	D.
March	.....	.....	3,800	D.
April	17,400	9,030	11,600	C.
May	39,000	10,000	21,200	C.
June	15,300	5,510	8,960	C.
July	7,350	4,840	5,920	C.
August	6,590	4,550	5,280	C.
September	6,410	4,290	5,120	C.
October	5,170	4,420	4,910	C.
November	4,420	3,030	3,870	C.
December	.....	.....	3,170	D.
The year	39,000	.....	6,620	

[a] "Discharge in second-feet per square mile" and "Run-off (depth in inches)" not computed for this drainage area because the flow past the station is affected by the operation (in the interest of navigation) of reservoirs as noted under "Artificial control" in station description.

NOTE.—See footnotes to table of daily discharge.

SANDY RIVER BELOW SANDY LAKE RESERVOIR, MINN.

Location.—At the Sandy Lake dam, near Libby post office, in Aitkin County, 1 mile above the mouth of Sandy River.

Records available.—July 7, 1893, to December 31, 1912.

Area of reservoir behind dam.—At low stage 8 square miles; at high stage 16.5 square miles; these areas with a range of 9.4 feet give a capacity of 3,127,900,000 cubic feet.

Discharge.—The discharge over the dam is computed from the flow through the openings and from frequent discharge measurements made by an employee who resides near the dam. At extreme flood stages the Mississippi drowns out the

dam and fills Sandy Lake reservoir as much as 3 feet higher than was intended. If the Mississippi is at fairly high stage and the dam is open there is frequently a considerable reverse flow into the reservoir, but the amount of this flow has not been computed.

Cooperation.—Station maintained by the United States Engineer Corps for the purpose of measuring the flow from the Sandy Lake reservoir, which is one unit in the Government reservoir system at the headwaters of the Mississippi.

Daily discharge, in second-feet, of Sandy River below Sandy Lake dam, Minn., for 1912.

[0=No flow from reservoir.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	10	10	10	10	10	502	502	205	0	5	5
2	10	10	10	10	10	10	500	501	212	0	5	5
3	10	10	10	10	10	10	501	498	192	5	5	5
4	10	10	10	10	10	10	503	500	166	5	5	5
5	10	10	10	10	10	10	500	500	170	5	5	5
6	10	10	10	10	10	10	502	500	165	5	5	5
7	10	10	10	10	10	10	500	501	144	5	5	5
8	10	10	10	10	10	10	499	498	120	5	5	5
9	10	10	10	10	10	10	502	502	125	5	5	5
10	10	10	10	10	10	10	500	500	62	5	5	5
11	10	10	10	10	10	10	501	499	0	5	5	5
12	10	10	10	10	10	10	501	501	0	5	5	5
13	10	10	10	10	10	10	499	501	0	5	5	5
14	10	10	10	10	10	10	502	499	0	5	5	5
15	10	10	10	10	10	10	501	502	0	5	5	5
16	10	10	10	10	10	10	498	499	0	5	5	5
17	10	10	10	10	10	10	500	502	0	5	5	5
18	10	10	10	10	10	10	500	500	0	5	5	5
19	10	10	10	10	10	10	499	500	0	5	5	5
20	10	10	10	10	10	10	501	501	0	5	5	5
21	10	10	10	10	10	10	502	450	0	5	5	5
22	10	10	10	10	10	10	498	264	0	5	5	5
23	10	10	10	10	10	10	502	280	0	5	5	5
24	10	10	10	10	319	328	501	326	0	5	5	5
25	10	10	10	10	497	492	500	288	0	5	5	5
26	10	10	10	10	483	505	501	258	0	5	5	5
27	10	10	10	10	480	499	501	270	0	5	5	5
28	10	10	10	10	76	507	499	242	0	5	5	5
29	10	10	10	10	474	503	502	212	0	5	5	5
30	10	.....	10	10	475	499	500	245	0	5	5	5
31	10	.....	10	.....	120	.....	501	218	.....	5	.....	5

Monthly discharge of Sandy River below Sandy Lake dam, Minn., for 1912.

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
January	10	10	10	26.8
February	10	10	10	25.1
March	10	10	10	26.8
April	10	10	10	25.9
May	497	10	102	273
June	507	10	119	308
July	503	498	501	1,340
August	502	212	421	1,130
September	212	0	52.0	135
October	5	0	4.7	12.6
November	5	5	5	13.0
December	5	5	5	13.4
The year	507	0	105	3,330

NOTE.—Computed by engineers of the United States Geological Survey from record of daily discharge furnished by the United States Engineer Corps. "Discharge in second-feet per square mile" and "Run-off (depth in inches)" not computed for this drainage area because the flow past the station is affected by the operation (in the interest of navigation) of reservoirs.

PINE RIVER BELOW PINE RIVER RESERVOIR, MINN.

Location.—Just below the dam at the outlet of Cross Lake, which is 15 miles above the mouth of Pine River in the central part of Crow Wing County, in T. 137 N., R. 27 W.

Records available.—March, 1886, to December 31, 1912.

Drainage area.—452 square miles.

Area of reservoir surface above dam.—At low water 18 square miles, at high water 24 square miles. These areas, with a range of 16.15 feet, give a capacity of 7,732,900,000 cubic feet. The dam raises the water level in Cross, Pine, Daggett, Rush, Whitefish, Trout, and Hay lakes by varying amounts.

Discharge.—Determined from daily gage heights representing the head at the dam and from the various sized openings in the dam.

Artificial control.—Flow past gaging station is controlled by the operation of Pine River reservoir in the interest of navigation.

Cooperation.—Station maintained by the United States Engineer Corps for the purpose of measuring the flow from Pine River reservoir, the lowest in the present system of Government reservoirs on the headwaters of the Mississippi. Although the discharge of the dam represents the flow from the reservoir, it does not represent the entire flow of Pine River at its mouth because between the two points the drainage area of the river is increased from 452 to 691 square miles by Little Pine River and one or two other minor tributaries.

Daily discharge, in second-feet, of Pine River below Pine River reservoir, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	59	65	70	66	320	a 59	507	490	295	145	80	59
2	59	65	a 69	66	322	59	508	485	290	144	a 77	59
3	60	a 65	69	67	324	60	509	a 479	285	144	75	58
4	59	65	69	67	a 327	60	510	480	275	143	71	58
5	60	66	70	67	325	61	511	485	265	a 143	68	58
6	a 60	66	70	a 67	320	61	a 512	488	255	142	65	57
7	60	66	70	67	80	62	510	490	a 249	141	60	a 57
8	60	67	71	67	75	a 63	508	492	249	141	55	57
9	60	67	a 71	68	72	62	506	495	249	140	a 51	57
10	60	a 68	66	68	70	62	504	a 502	250	140	51	57
11	60	68	65	68	a 68	61	502	495	250	139	51	57
12	60	68	65	69	68	60	500	490	250	a 138	51	57
13	a 60	68	64	a 69	68	59	a 498	485	251	135	51	58
14	61	68	64	69	69	59	495	480	a 251	130	52	a 58
15	61	68	63	70	69	a 58	490	478	248	57	52	58
16	61	69	a 63	524	69	58	488	475	245	58	a 52	59
17	61	a 69	63	485	70	59	484	a 471	241	59	53	59
18	62	69	64	488	a 70	59	480	410	237	60	53	59
19	62	69	64	384	70	60	475	400	235	a 59	54	60
20	a 62	70	64	175	71	60	a 473	380	234	59	55	60
21	63	70	65	317	71	61	468	375	a 234	30	55	a 61
22	63	70	65	317	71	a 61	460	370	205	21	56	61
23	63	71	a 65	317	72	63	458	365	195	12	a 57	60
24	64	a 71	65	317	72	65	456	a 362	180	15	57	59
25	64	71	65	318	a 72	515	454	355	170	16	57	58
26	64	71	65	318	72	512	450	350	160	17	58	57
27	a 65	71	65	a 318	73	510	a 447	340	156	78	58	56
28	65	72	66	318	73	508	445	330	a 154	80	58	a 55
29	65	72	66	319	73	a 506	442	320	150	a 81	59	56
30	66	.....	a 66	319	74	506	440	310	145	81	a 59	56
31	66	.....	66	.....	74	.....	438	300	.....	82	.....	57

a Discharge measurement.

NOTE.—Daily discharge for November differs from that published in the Report of the water-resources investigation of Minnesota, 1911–12, p. 122, which is erroneous, having been estimated from record of gate openings, whereas the figures here given are based on discharge measurements.

Monthly discharge of Pine River below Pine River reservoir, Minn., for 1912.

[Drainage area, 452 square miles.[a]]

Month.	Discharge in second-feet.			Run-off (total in millions of cubic feet).
	Maximum.	Minimum.	Mean.	
January	66	59	61.8	166
February	72	65	68.4	171
March	71	63	66.2	177
April	524	66	208	539
May	327	68	120	321
June	515	58	150	389
July	512	438	482	1,290
August	502	300	427	1,140
September	295	145	228	591
October	145	12	91.3	245
November	80	51	[b] 58.4	151
December	61	55	58.0	155
The year	515	12	169	5,340

[a] "Discharge in second-feet per square mile" and "Run-off (depth in inches)" not computed for this drainage area because flow past the gaging station is controlled in the interest of navigation, as noted in the station description.

[b] See footnote to table of daily discharge.

NOTE.—Computed by engineers of the United States Geological Survey from record of daily discharge furnished by the United States Engineer Corps.

CROW WING RIVER AT NIMROD, MINN.

Location.—At the steel highway bridge at Nimrod post office, in sec. 32, T. 137 N., R. 33 W., about 12 miles east of Sebeka, the nearest railroad point, 1 mile above the mouth of Cat River, and 1 mile below the mouth of Willow Creek.

Records available.—April 15, 1910, to November 30, 1912.

Drainage area.—1,010 square miles.

Gage.—Chain gage, attached to the bridge. On May 19, 1910, the gage datum was lowered 1.20 feet and the readings prior to that date were corrected to agree with the present datum.

Channel.—Probably permanent.

Discharge measurements.—Made from the bridge.

Artificial control.—The river is used for log driving, and a dam at the outlet of Lower Crow Wing Lake controls the water from that portion of the drainage area. There is comparatively little log driving at the present time and it is believed that the flow past the station is practically natural. Since the establishment of the station there has been no trouble from log jams. Crow Wing River has considerable fall near the station and 1 mile above makes a rapid descent of 12 feet, known as Western Rapids.

Winter flow.—The river is frozen over and observations are discontinued from November to March.

The following discharge measurement was made by W. G. Hoyt:

May 8, 1912: Gage height, 5.21 feet; discharge, 608 second-feet.

Daily gage height, in feet, of Crow Wing River at Nimrod, Minn., for 1912.

[W. H. Wintermute, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.80	5.0	4.60	4.68	4.96	5.0	4.80
2	6.2	4.85	4.98	4.60	4.70	4.91	5.0	4.80
3	6.2	4.86	4.90	4.60	4.70	4.89	5.0	4.80
4	6.2	5.0	4.94	4.64	4.70	4.88	5.0	4.80
5	6.35	5.1	4.90	4.65	4.70	4.88	5.0	4.80
6	5.15	5.15	4.90	4.61	4.71	4.88	5.0	4.80
7	5.1	5.15	4.90	4.60	4.76	4.88	5.0	4.80
8	5.1	5.2	4.88	4.60	4.82	4.88	5.0	4.80
9	5.1	5.2	4.88	4.60	4.85	4.88	5.0	4.80
10	5.1	5.15	4.85	4.62	4.82	4.88	4.98	4.80
11	5.05	5.1	4.82	4.65	4.80	4.88	4.95	4.80
12	5.0	5.1	4.80	4.70	4.78	4.86	4.93	4.80
13	5.0	5.15	4.80	4.70	4.78	4.91	4.98	4.82
14	4.95	5.05	4.80	4.71	4.78	4.94	4.95	4.85
15	4.94	5.0	4.82	4.74	4.79	4.89	4.95	4.89
16	4.90	5.0	4.85	4.72	4.80	4.88	4.92	4.86
17	4.90	4.98	4.82	4.70	4.84	4.89	4.90	4.82
18	4.89	4.95	4.80	4.68	4.81	4.90	4.88	4.80
19	4.86	4.92	4.80	4.68	4.82	4.90	4.88	4.80
20	4.82	4.92	4.80	4.66	4.82	4.90	4.88	4.78
21	4.78	4.90	4.80	4.65	4 82	4.90	4.88	4.78
22	4.75	4.90	4.80	4.65	4.81	4.92	4.88	4.75
23	4.75	4.92	4.80	4.65	4.80	4.95	4.85	4.75
24	4.75	4.96	4.78	4.65	4.80	4.95	4.85	4.90
25	4.76	5.0	4.76	4.65	4.80	4.98	4.85	5.4
26	4.80	5.0	4.75	4.65	4.80	5.0	4.85	5.05
27	4.84	5.05	4.71	4.65	4.80	5.0	4.82	5.1
28	4.85	5.05	4.66	4.65	4.88	5.0	4.82	5.1
29	4.82	5.0	4.62	4.65	4.94	5.0	4.80	5.2
30	4.80	5.0	4.62	4.65	5.00	5.0	4.80	5.4
31	.....	5.0	.....	4.65	5.00	.....	4.80	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 5, and about Nov. 24 to Dec. 31.

Daily discharge, in second-feet, of Crow Wing River at Nimrod, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	324	457	208	253	429	457	324
2	.....	356	443	208	264	395	457	324
3	.....	362	388	208	264	382	457	324
4	.....	457	416	230	264	375	457	324
5	.....	530	388	236	264	375	457	324
6	567	567	388	214	270	375	457	324
7	530	567	388	208	300	375	457	324
8	530	604	375	208	337	375	457	324
9	530	604	375	208	356	375	457	324
10	530	567	356	219	337	375	443	324
11	494	530	337	236	324	375	422	324
12	457	530	324	264	312	362	443	324
13	457	567	324	264	312	395	443	337
14	422	494	324	270	312	416	422	356
15	416	457	337	288	318	382	422	382
16	388	457	356	276	324	375	402	362
17	388	443	337	264	350	382	388	337
18	382	422	324	253	330	388	375	324
19	362	402	324	253	337	388	375	324
20	337	402	324	242	337	388	375	312

Daily discharge, in second-feet, of Crow Wing River at Nimrod, Minn., for 1912—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	312	388	324	236	337	388	375	312
22	294	388	324	236	330	402	375	294
23	294	402	324	236	324	422	356	294
24	294	429	312	236	324	422	356	.....
25	300	457	300	236	324	443	356	.....
26	324	457	294	236	324	457	356	.....
27	350	494	270	236	324	457	337	.....
28	356	494	242	236	375	457	337	.....
29	337	457	219	236	416	457	324	.....
30	324	457	219	236	457	457	324	.....
31	.....	457	.....	236	457	.....	324	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between 160 and 678 second-feet (gage heights 4.5 and 5.3 feet). Slush ice reported running Nov. 1–11, 1911, but no reduction in discharge made to allow for it. Discharge Nov. 24–30, 1912, estimated, because of ice, from climatologic records and discharge of adjacent drainage areas at 294 second-feet.

Monthly discharge of Crow Wing River at Nimrod, Minn., for 1912.

[Drainage area, 1,010 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
April 6–30	567	294	399	0.395	0.37	A.
May	604	324	468	.463	.53	A.
June	457	219	337	.334	.37	A.
July	288	208	237	.235	.27	A.
August	457	253	328	.325	.37	A.
September	457	362	401	.397	.44	A.
October	457	324	401	.397	.46	A.
November	382	.....	319	.316	.35	C.

NOTE.—See footnote to table of daily discharge.

CROW WING RIVER AT PILLAGER, MINN.

Location.—At highway bridge one-half mile south of Pillager, in sec. 20, T. 133 N., R. 30 W., a short distance above the mouth of Pillager Creek.

Records available.—May 25 to September 1, 1903, June 11, 1909, to December 31, 1912.

Drainage area.—3,230 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Probably permanent except during high water.

Discharge measurements.—Made from bridge.

Artificial control.—The influence of a logging dam at the outlet of Lower Crow Wing Lake is observable at times at the gaging station. The natural flow has a tendency to be uniform due to the natural lake control in the headwaters.

Winter flow.—The river is frozen over at the gage from December to March and during that period measurements are made through the ice to determine the winter discharge.

Accuracy.—Conditions at this station are favorable for good results, although the shifting of the river bed during high water necessitated the use of more than one rating curve in 1912.

Discharge measurements of Crow Wing River at Pillager, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 24[a]	S. B. Soulé	6.22	326	Aug. 9	W. G. Hoyt	6.15	907
Feb. 28[b]	do	6.54	368	30	do	6.08	849
May 9	W. G. Hoyt	9.32	4,530	Dec. 18[c]	S. B. Soulé	6.14	440

[a] Under complete ice cover; average thickness of ice, 1.14 feet; average distance water surface to top ice 0.08 foot.

[b] Under complete ice cover; average thickness of ice, 1.34 feet; average distance water surface to top of ice, 0.02 foot.

[c] Complete ice cover; average thickness of ice, 0.74 foot; average distance water surface to top of ice, 0.00 foot.

Daily gage height, in feet, of Crow Wing River at Pillager, Minn., for 1912.

[Eureka Holmgren, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	7.75	6.4	7.2	5.5	5.6	6.2	6.1	5.7	.....
2	.....	.....	6.5	.....	6.3	7.1	6.5	5.6	6.15	6.1	5.6	.....
3	6.2	6.4	.....	7.75	6.6	7.0	5.7	5.6	6.1	6.1	5.6	.....
4	.....	.....	.....	.....	8.4	6.8	5.6	5.55	6.05	6.0	5.65	.....
5	.....	.....	.....	8.0	10.1	6.7	5.6	5.6	5.95	5.95	5.7	5.8
6	6.2	.....	6.5	7.7	11.0	6.6	5.65	5.7	5.9	5.95	5.7	.....
7	.....	6.45	.....	7.2	10.0	6.5	5.65	5.8	5.8	5.9	5.7	.....
8	.....	.....	.....	6.8	9.8	6.3	5.7	5.9	5.8	5.9	5.7	.....
9	.....	.....	6.5	6.7	9.4	6.2	5.8	6.1	5.8	5.9	5.7	.....
10	6.15	6.4	.....	6.6	9.1	6.2	6.0	6.25	5.8	5.9	5.7	.....
11	.....	.....	.....	6.4	9.0	6.1	6.0	6.3	5.75	5.9	5.7	.....
12	.....	.....	.....	6.3	8.4	6.1	6.0	6.3	5.8	5.9	5.7	5.9
13	.....	.....	6.5	6.3	8.0	6.0	6.0	6.2	5.8	5.9	5.7	.....
14	.....	6.4	.....	6.3	7.9	6.0	5.9	6.15	5.8	5.85	5.65	.....
15	.....	.....	.....	6.3	7.8	6.1	5.8	6.1	5.8	5.8	5.6	.....
16	.....	.....	6.5	6.3	7.6	6.4	5.9	6.05	5.9	5.8	5.75	.....
17	.....	6.4	.....	6.2	7.1	6.6	5.8	6.05	5.95	5.8	5.7	.....
18	.....	.....	.....	6.2	7.0	6.6	5.8	6.0	5.9	5.8	5.65	6.15
19	.....	.....	.....	6.15	6.9	6.5	5.7	6.0	5.85	5.8	5.6	6.15
20	.....	.....	6.55	6.1	6.9	6.4	5.7	6.0	5.85	5.75	5.6	.....
21	.....	6.5	.....	6.05	6.9	6.3	5.7	6.0	5.85	5.75	5.65	.....
22	.....	.....	.....	6.05	6.8	6.2	5.7	5.9	5.9	5.75	5.65	.....
23	.....	.....	6.6	5.9	6.8	6.1	5.8	5.85	5.95	5.75	5.6	.....
24	6.2	6.5	.....	5.9	6.8	5.9	5.8	5.8	5.95	5.75	5.5	.....
25	.....	.....	.....	5.9	6.8	5.9	5.7	5.7	6.1	5.75	5.55	.....
26	.....	.....	.....	6.1	6.8	5.8	5.6	5.7	6.1	5.75	6.25	6.2
27	6.25	.....	6.75	6.35	6.9	5.7	5.6	5.7	6.1	5.7	.....	.....
28	.....	6.55	.....	6.5	7.2	5.7	5.6	5.65	6.1	5.75	.....	.....
29	.....	.....	.....	6.4	7.2	5.7	5.65	5.7	6.15	5.75	.....	.....
30	.....	.....	7.9	6.45	7.1	5.6	5.6	6.1	6.1	5.75	.....	.....
31	6.3	.....	.....	.....	7.1	.....	5.6	6.1	.....	5.75	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 4, and about Nov. 26 to Dec. 31.

Daily discharge, in second-feet, of Crow Wing River at Pillager, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1,230	1,920	490	544	940	865	601
2	.....	1,150	1,810	1,190	544	902	865	544
3	.....	1,390	1,700	601	544	865	865	544
4	.....	3,330	1,490	544	517	829	793	572
5	2,840	5,640	1,390	544	544	759	759	601
6	2,480	6,920	1,290	572	601	725	759	601
7	1,940	5,500	1,190	572	661	661	725	601
8	1,560	5,220	1,020	601	725	661	725	601
9	1,470	4,660	940	661	865	661	725	601
10	1,390	4,240	940	793	980	661	725	601
11	1,230	4,110	865	793	1,020	631	725	601
12	1,150	3,330	865	793	1,020	661	725	601
13	1,150	2,840	793	793	940	661	725	601
14	1,150	2,720	793	725	902	661	693	572
15	1,150	2,600	865	661	865	661	661	544
16	1,150	2,360	1,100	725	829	725	661	631
17	1,070	1,810	1,290	661	829	759	661	601
18	1,070	1,700	1,290	661	793	725	661	572
19	1,040	1,590	1,190	601	793	693	661	544
20	1,000	1,590	1,100	601	793	693	631	544
21	966	1,590	1,020	601	793	693	631	572
22	966	1,490	940	601	725	725	631	572
23	863	1,490	865	661	693	759	631	544
24	863	1,490	725	661	661	759	631	490
25	863	1,490	725	601	601	865	631	517
26	1,000	1,490	661	544	601	865	631	.....
27	1,190	1,590	601	544	601	865	601	.....
28	1,310	1,920	601	544	572	865	631	.....
29	1,230	1,920	601	572	601	902	631	.....
30	1,270	1,810	544	544	865	865	631	.....
31	.....	1,810	.....	544	865	.....	631	.....

NOTE.—Daily discharge computed from two rating curves fairly well defined between 600 and 5,500 second-feet. Shift occurred during May flood. Discharge Jan. 1 to Apr. 4 and Nov. 26 to Dec. 31, estimated, because of ice, from discharge measurements, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 1–31, 350 second-feet, varying from about 420 to 320 second-feet; Feb. 1–29, 340 second-feet, varying from about 320 to 370 second-feet; Mar. 1–31, 390 second-feet, varying from about 370 to 1,500 second-feet; Nov. 26–30, 465 second-feet, varying from about 490 to 440 second-feet; Dec. 1–31, 450 second-feet.

Monthly discharge of Crow Wing River at Pillager, Minn., for 1912.

[Drainage area, 3,230 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	350	0.108	0.12	C.
February	.....	.....	340	.105	.11	C.
March	.....	.....	390	.121	.14	C.
April	2,840	863	1,350	.418	.47	C.
May	6,920	1,150	2,650	.820	.95	B.
June	1,920	544	1,040	.322	.36	A.
July	1,190	490	645	.200	.23	B.
August	1,020	517	738	.228	.26	A.
September	940	631	757	.234	.26	A.
October	865	601	694	.215	.25	B.
November	631	.....	557	.172	.19	C.
December	.....	.....	450	.139	.16	C.
The year	6,920	.....	831	.257	3.50	

NOTE.—See footnotes to table of daily discharge.

LONG PRAIRIE RIVER NEAR MOTLEY, MINN.

Location.—100 yards above the highway bridge which is 1 mile south of Motley, in sec. 19, T. 133 N., R. 31 W., and 2 miles above the mouth of the river.

Records available.—June 10, 1909, to December 31, 1912.

Drainage area.—973 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Made from the bridge at all except low stages; low-water measurements made by wading at a short distance upstream.

Winter flow.—River is frozen over at the gage and observations are discontinued from November to March. There seems to be a close relation between the open-water discharge at this station and the flow of the Crow Wing at Pillager. The flow during the winter has therefore been estimated from the flow at Pillager, which is determined by current-meter measurements.

Accuracy.—Conditions at this station are favorable and the records should be reliable. There are no dams on the river to affect its flow at the gaging station. Backwater caused by ice gorges in Crow Wing River may possibly affect gage heights for a few days in the spring.

Discharge measurements of Long Prairie River near Motley, Minn., in 1912.

[W. G. Hoyt, hydrograher.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 10	7.80	1,530
Aug. 10	5.70	320

Daily gage height, in feet, of Long Prairie River near Motley, Minn., for 1912.

[John Green, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.0	5.55	6.25	5.15	5.32	5.55	5.32	5.19
2	6.05	5.41	6.3	5.15	5.35	5.55	5.32	5.12
3	6.1	5.6	6.3	5.18	5.35	5.55	5.31	5.15
4	5.95	6.8	6.3	5.16	5.34	5.50	5.30	5.15
5	6.6	8.7	6.3	5.20	5.34	5.50	5.26	5.12
6	5.85	9.95	6.2	5.28	5.36	5.48	5.29	5.18
7	5.9	9.15	6.0	5.29	5.35	5.45	5.25	5.18
8	5.9	8.7	5.8	5.24	5.42	5.42	5.25	5.16
9	5.7	8.3	5.7	5.30	5.58	5.40	5.24	5.16
10	5.55	7.8	5.6	5.34	5.70	5.40	5.25	5.16
11	5.45	7.3	5.6	5.35	5.80	5.36	5.26	5.15
12	5.40	7.0	5.5	5.31	5.85	5.34	5.29	5.16
13	5.35	6.7	5.5	5.29	5.80	5.36	5.29	5.11
14	5.38	6.5	5.5	5.30	5.75	5.35	5.29	5.08
15	5.41	6.35	5.6	5.24	5.75	5.35	5.28	5.11
16	5.55	6.15	5.7	5.21	5.70	5.36	5.25	5.14
17	5.50	6.0	5.8	5.20	5.70	5.38	5.25	5.20
18	5.45	5.9	5.75	5.20	5.65	5.36	5.26	5.14
19	5.40	5.85	5.7	5.16	5.65	5.35	5.22	5.14
20	5.35	5.8	5.6	5.15	5.60	5.35	5.22	5.12
21	5.32	5.8	5.55	5.16	5.55	5.34	5.22	5.12
22	5.31	5.8	5.5	5.19	5.55	5.32	5.21	5.15
23	5.30	5.85	5.41	5.21	5.50	5.32	5.20	5.11
24	5.28	5.85	5.38	5.30	5.46	5.32	5.20	.....
25	5.28	5.8	5.34	5.42	5.45	5.35	5.20	.....
26	5.34	5.8	5.29	5.50	5.42	5.35	5.19	.....
27	5.48	5.95	5.25	5.50	5.38	5.38	5.19	.....
28	5.5	6.0	5.24	5.44	5.36	5.36	5.21	.....
29	5.55	6.05	5.21	5.35	5.32	5.35	5.22	.....
30	5.55	6.1	5.20	5.31	5.49	5.35	5.20	.....
31	.....	6.2	.....	5.31	5.51	.....	5.20	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 31, and about Nov. 24 to Dec. 31.

Daily discharge, in second-feet, of Long Prairie River near Motley, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	480	270	612	135	185	270	185	145
2	505	216	640	135	195	270	185	127
3	530	290	640	143	195	270	181	135
4	455	920	640	138	192	250	178	135
5	805	2,100	640	148	192	250	166	127
6	405	2,960	585	172	198	242	175	143
7	430	2,400	480	175	195	231	163	143
8	430	2,100	380	160	220	220	163	138
9	333	1,840	333	178	282	212	160	138
10	270	1,520	290	192	333	212	163	138
11	231	1,220	290	195	380	198	166	135
12	212	1,040	250	181	405	192	175	138
13	195	860	250	175	380	198	175	125
14	205	750	250	178	356	195	175	117
15	216	668	290	160	356	195	172	125
16	270	558	333	151	333	198	163	132
17	250	480	380	148	333	205	163	148
18	231	430	356	148	312	198	166	132
19	212	405	333	138	312	195	154	132
20	195	380	290	135	290	195	154	127
21	185	380	270	138	270	192	154	127
22	181	380	250	145	270	185	151	135
23	178	405	216	151	250	185	148	125
24	172	405	205	178	235	185	148	.....
25	172	380	192	220	231	195	148	.....
26	192	380	175	250	220	195	145	.....
27	242	455	163	250	205	205	145	.....
28	250	480	160	227	198	198	151	.....
29	270	505	151	195	185	195	154	.....
30	270	530	148	181	246	195	148	.....
31	.....	585	.....	181	254	.....	148	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Daily discharge Jan. 1 to Mar. 31 and Nov. 24 to Dec. 31, estimated, because of ice, from climatologic records and open-water relation between Crow Wing River at Pillager and Long Prairie River near Motley, as follows: Jan. 1–31, 105 second-feet; Feb. 1–29, 100 second-feet; Mar. 1–31, 120 second-feet; Nov. 24–30, 120 second-feet; varying from about 125 to 115 second-feet; Dec. 1–31, 100 second-feet. Discharge at Motley taken as 0.30 time discharge at Pillager, except for December.

Monthly discharge of Long Prairie River near Motley, Minn., for 1912.

[Drainage area, 975 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	105	0.108	0.12	
February	.....	.....	100	.103	.11	
March	.....	.....	120	.123	.14	
April	805	172	299	.307	.34	B.
May	2,960	216	848	.870	1.00	A.
June	640	148	340	.349	.39	A.
July	250	135	171	.175	.20	A.
August	405	185	265	.272	.31	A.
September	270	185	211	.216	.24	A.
October	185	145	162	.166	.19	A.
November	148	.....	130	.133	.15	B.
December	.....	.....	100	.103	.12	
The year	2,960	.....	238	.244	3.31	

NOTE.—See footnotes to table of daily discharge.

SAUK RIVER NEAR ST. CLOUD, MINN.

Location.—At highway bridge 3 miles west of St. Cloud in sec. 9, T. 124 N., R. 28 W., 10 miles below the nearest tributary, which enters at Rockville.

Records available.—July 8, 1909, to December 31, 1912.

Drainage area.—816 square miles.

Gage.—Chain gage, attached to bridge; datum unchanged. Gage is read twice a day, and the mean of the readings is recorded as the mean for the day.

Channel.—Shifting during high water.

Discharge measurements.—Made from bridge.

Artificial control.—At Cold Spring, about 15 miles above the gaging station, the Farmers Milling Co. has an 8-foot masonry dam. During the fall of the year the plants are operated continuously, at other times about 10 hours each day. The fluctuation caused by the operation of the dam is observable at the gage.

Winter flow.—Owing to the fluctuation of stage caused by the operation of the power plant, alternate freezing and flooding causes ice to form to such an extent that it is impossible to obtain accurate measurements. The flow is also so irregular that it is believed that monthly means deduced from measurements and gage heights would be apt to be in error, as would also monthly means based on flow of adjoining streams. Winter gage-height readings and measurements have therefore been discontinued, beginning with December 1, 1912.

Accuracy.—Owing to the various conditions mentioned above, the records can not be considered better than fair.

Discharge measurements of Sauk River near St. Cloud, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 26[a]	S. B. Soulé	8.46	30.8	Oct. 15	W. G. Hoyt	6.16	165
Mar. 1[b]	do	8.12	16.4	15	do	6.13	156
Aug. 15	do	6.35	199	Nov. 20	do	5.97	116
15[c]	do	6.27	168				

[a] Complete ice cover; average distance water surface to bottom of ice, 3.08 feet; average thickness of ice, 3.37 feet.
[b] Complete ice cover; average distance water surface to top of ice, 0.24 foot.
[c] Measurement made under bridge by wading.

Daily gage height, in feet, of Sauk River near St. Cloud, Minn., for 1912.

[Ida Waite, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.6		8.1		7.2	7.2	5.52	5.98	5.68	6.35	
2		8.5			7.4	7.2	5.82	6.20	5.60	6.30	
3					7.4	7.1	5.95	6.02	5.40	6.35	
4			8.1		7.4	7.0	5.65	6.45	5.40	6.30	
5	8.0	8.2			7.4	6.85	5.68	6.18	5.25	6.30	
6				6.10	7.4	6.8	5.85	6.45	5.38	6.40	
7				6.32	7.4	7.0	5.95	6.60	5.46	6.35	6.00
8	6.8			6.25	7.4	6.60	5.75	6.50	5.50	6.25	6.05
9		8.2	8.1	6.7	7.4	6.42	6.00	6.45	5.80	6.20	5.95
10				6.7	7.6	6.40	5.90	6.32	5.80	6.05	5.85
11				6.60	8.7	6.42	6.02	6.28	5.95	6.10	5.40
12	8.2	8.1	8.1	6.45	8.3	6.32	6.08	6.28	6.15	6.15	6.10
13				6.65	8.4	6.60	5.98	6.22	6.05	5.30	5.85
14				6.65	8.2	6.42	5.90	6.39	6.10	5.35	5.70
15	7.9			6.6	8.3	6.42	5.62	6.32	6.15		5.75

Daily gage height, in feet, of Sauk River near St. Cloud, Minn., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	.....	8.0	8.4	6.50	8.4	6.40	5.55	6.50	6.60	.....	5.90
17	.....	.....	.....	6.45	8.1	6.18	5.90	5.98	6.60	.....	5.65
18	.....	.....	.....	6.8	8.1	6.10	5.92	6.05	6.60	.....	5.50
19	8.8	8.0	8.9	6.75	8.2	6.08	5.95	6.14	6.60	.....	5.75
20	.....	.....	.....	6.50	8.2	6.15	6.00	6.70	6.60	.....	5.90
21	.....	.....	.....	6.45	8.2	6.10	6.08	6.60	6.45	.....	6.05
22	8.6	.....	.....	6.30	8.2	6.12	5.62	6.60	6.25	.....	6.00
23	.....	.....	.....	6.45	8.2	6.10	6.10	6.45	6.45	.....	6.15
24	.....	8.3	.....	6.C5	8.2	5.90	6.15	6.32	6.35	.....	6.56
25	.....	.....	.....	6.55	8.2	6.00	6.22	6.20	6.20	.....	5.50
26	8.5	.....	.....	6.55	8.2	6.07	6.20	6.05	6.05	.....	6.15
27	.....	8.1	.....	6.7	8.3	6.02	6.10	6.05	6.20	.....	6.60
28	.....	.....	.....	6.C0	8.4	5.97	6.20	6.12	6.20	.....	.....
29	7.9	.....	.....	6.C5	8.2	5.95	6.10	6.25	6.35	.....	.....
30	.....	.....	.....	6.7	7.8	5.92	5.95	6.40	6.45	.....	.....
31	.....	.....	.....	.....	7.3	.....	6.05	5.95	.....	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 5, and about Nov. 21 to Dec. 31.

Daily discharge, in second-feet, of Sauk River near St. Cloud, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	610	565	24	98	54	231	.....
2	.....	730	565	68	149	42	215	.....
3	.....	730	510	92	106	18	231	.....
4	.....	730	455	41	224	18	215	.....
5	.....	730	381	45	144	5	215	.....
6	166	730	358	73	224	16	248	.....
7	226	730	455	92	277	24	231	120
8	206	730	277	56	241	29	199	132
9	356	730	215	102	224	75	183	109
10	356	860	208	82	183	75	142	88
11	317	1,620	215	106	171	104	155	20
12	266	1,320	183	120	171	152	169	144
13	336	1,400	277	98	155	126	14	88
14	336	1,250	215	82	205	139	19	61
15	317	1,320	215	37	183	152	.....	69
16	282	1,400	208	28	252	312	.....	98
17	266	1,180	144	82	104	312	.....	53
18	400	1,180	124	86	120	312	.....	32
19	378	1,250	120	92	142	312	.....	69
20	282	1,250	136	102	333	312	.....	98
21	266	1,250	124	120	289	255	.....	.....
22	220	1,250	129	37	289	189	.....	.....
23	266	1,250	124	124	234	255	.....	.....
24	336	1,250	64	136	192	221	.....	.....
25	300	1,250	102	155	157	174	.....	.....
26	300	1,250	117	149	120	134	.....	.....
27	356	1,320	106	124	120	174	.....	.....
28	317	1,400	96	149	136	174	.....	.....
29	336	1,250	92	124	171	221	.....	.....
30	356	955	86	92	218	255	.....	.....
31	.....	625	.....	113	98	.....	.....	.....

NOTE.—Daily discharge computed from rating curves fairly well defined between 100 and 700 second-feet. A change in rating curve was made on May 11 and the new curve used by indirect methods from Aug. 16 to Oct. 14. Discharge Oct. 15 to Nov. 6 estimated, because gage was not read, from the discharge measurements made Oct. 15 and Nov. 20, and a study of the records of flow at Rockford and Watson, Minn. Mean discharge Oct. 15 to 31 estimated 150 second-feet, varying from about 160 to 130 second-feet. Mean discharge Nov. 1 to 6 estimated 125 second-feet, varying from about 130 to 120 second-feet. Discharge Jan. 1 to Apr. 5, and Nov. 20 to Dec. 31 estimated, because of ice, from discharge measurements, observer's records, and climatologic records, as follows: Jan. 1–31, 60 second-feet; Feb. 1–29, 30 second-feet; Mar. 1–31, 80 second-feet; Apr. 1–5, 100 second-feet; Nov. 20–30, 1912, 75 second-feet; Dec. 1–31, 80 second-feet.

Monthly discharge of Sauk River near St. Cloud, Minn., for 1912.

[Drainage area, 816 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	60	0.074	0.09	C.
February	.....	.....	30	.037	.04	D.
March	.....	.....	80	.098	.11	C.
April	400	.....	268	.328	.37	B.
May	1,620	610	1,080	1.32	1.52	C.
June	565	64	229	.281	.31	B.
July	155	24	91.3	.112	.13	B.
August	333	98	185	.227	.26	B.
September	312	5	155	.190	.21	C.
October	248	14	162	.199	.23	C.
November	.....	.....	89.4	.110	.12	C.
December	.....	.....	80	.098	.11	D.
The year	1,620	.....	210	.257	3.50	

NOTE.—See footnotes to table of daily discharge.

ELK RIVER NEAR BIG LAKE, MINN.

Location.—At the highway bridge 4 miles east of Big Lake and one-half mile east of Bailey station on the Northern Pacific Railway, in sec. 23, T. 33 N., R. 27 W., one-half mile above Tibbett's Brook and 4 miles below mouth of St. Francis River.

Records available.—April 15, 1911, to December 31, 1912.

Drainage area.—615 square miles.

Gage.—Vertical staff.

Channel.—The channel is apt to shift in periods of extremely high water. During low water the relation of gage height to discharge is practically permanent, except for periods of extremely low water, when backwater may possibly be caused by the growth of vegetation.

Discharge measurements.—Made from highway bridge at all stages except low, when measurements are made by wading near by.

Winter flow.—From December to March the relation between gage height and discharge is affected by ice, and during that period measurements are made to determine the winter discharge.

Artificial control.—The flow of the river above the station is entirely uncontrolled, as the only dam on the river is near the mouth, about 8 miles below.

Discharge measurements of Elk River near Big Lake, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 27[a]	S. B. Soulé	0.97	39	May 9	S. B. Soulé	7.99	3,650
Mar. 14[b]	W. G. Hoyt	1.34	73	9	do	7.86	3,770
14[b]	S. B. Soulé	1.34	72	15	W. G. Hoyt	3.30	1,030
Apr. 3[c]	C. J. Emerson	2.99	849	Aug. 2[d]	S. B. Soulé	.91	183
9	W. G. Hoyt	2.73	807	2[e]	do	.88	166
9	do	2.71	778	Dec. 21[f]	do	.84	95
17	S. B. Soulé	1.79	460	21[f]	do	.84	94
17	do	1.79	443				

[a] Complete ice cover; average thickness of ice, 0.92 foot; average distance water surface to top of ice, 0.09 foot.

[b] Measurement made about 600 feet below the gage. Complete ice cover; average thickness of ice, 0.77 foot; average distance water surface to top of ice, 0.02 foot.

[c] Open channel. Measurement at bridge section.

[d] Wading measurement 300 feet below gage.

[e] Wading measurement 50 feet above gage.

[f] Complete ice cover; average thickness of ice, 0.60 foot.

Daily gage height, in feet, of Elk River near Big Lake, Minn., for 1912.

[Michael Tracy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.05	1.1	.....	2.3	1.7	2.8	0.70	0.94	1.2	0.85	0.72	0.70
2	.....	.....	.....	3.1	1.65	2.6	.74	.89	1.1	.82	.72	.79
3	.....	.....	.....	3.0	1.9	2.3	.74	.88	1.2	.82	.72	.79
4	1.1	.....	1.25	3.0	2.2	2.1	.76	.88	1.25	.81	.72	.79
5	.....	1.15	.....	3.0	2.9	1.9	.81	.86	1.25	.80	.71	.70
6	.....	.....	.....	3.0	5.0	1.7	.76	.85	1.2	.79	.70	.50
7	.....	.....	1.3	3.0	9.8	1.5	.71	.84	1.1	.78	.70	.....
8	1.0	1.2	.....	2.9	9.3	1.4	.69	.82	1.15	.79	.70	.....
9	.....	.....	.....	2.7	7.8	1.3	.70	.82	1.1	.80	.70	.....
10	.....	.....	.....	2.5	6.2	1.2	.72	.82	1.05	.79	.70	.....
11	.95	.....	1.3	2.3	5.5	1.1	.69	.82	1.05	.78	.70	.....
12	.....	1.25	.....	2.2	4.8	1.05	.74	.81	1.0	.85	.70	.74
13	.....	.....	.....	2.1	4.1	1.05	.79	.78	.96	.90	.70	.....
14	.....	.....	1.35	2.2	3.7	1.1	.78	.76	.95	.86	.70	.....
15	.95	1.25	.....	1.9	3.3	1.1	.75	.74	.95	.85	.71	.....
16	.....	.....	.....	1.85	2.9	1.05	.75	.74	.95	.81	.70	.....
17	.....	.....	.....	1.8	2.6	1.0	.74	1.0	.94	.80	.70	.....
18	.95	.....	1.35	1.8	2.4	.99	.71	1.1	.92	.80	.70	.....
19	.....	1.25	.....	1.8	2.2	1.0	.69	.98	.91	.80	.70	1.0
20	.....	.....	.....	1.7	2.1	.98	.68	.92	.96	.78	.70	.....
21	.....	.....	1.4	1.7	2.1	.95	.68	.90	.96	.78	.70	.84
22	.90	1.3	.....	1.65	2.2	.92	.68	.86	.94	.78	.70	.....
23	.....	.....	.....	1.6	2.6	.92	.89	.84	.91	.76	.70	.....
24	.....	.....	.....	1.55	2.8	.91	.95	.79	.90	.75	.59	.....
25	.95	.....	1.45	1.5	2.8	.89	.88	.76	.94	.75	.50	.....
26	.....	1.3	.....	1.6	2.9	.84	.81	.74	.94	.75	.61	.9
27	.95	.....	.....	1.55	3.4	.79	.86	.71	.91	.75	.90	.....
28	.....	.....	1.8	1.5	3.8	.76	1.05	.84	.89	.74	1.1	.....
29	1.05	1.25	2.1	1.65	3.7	.74	1.2	.81	.88	.72	.92	.....
30	.....	.....	2.4	1.7	3.4	.71	1.1	1.3	.86	.72	.98	.....
31	.....	.....	2.3	.....	3.1	.....	1.0	1.25	.....	.72	.....	.....

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Apr. 3, Nov. 15, and Nov. 27 to Dec. 31. The observer reported as follows: Mar. 28, ice began to break up; Mar. 31, ice broke up, but did not jam; Apr. 1, ice jam above gage; Apr. 3, river open; Nov. 27, river partly frozen over; backwater at gage.

Daily discharge, in second-feet, of Elk River near Big Lake, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	500	426	805	124	184	260	161	129
2	700	410	735	134	171	230	153	129
3	850	491	630	134	169	260	153	129
4	885	595	560	138	169	276	151	129
5	885	845	491	151	164	276	148	126
6	885	1,860	423	138	161	260	146	124
7	885	4,970	356	126	158	230	143	124
8	845	4,620	324	122	153	245	146	124
9	770	3,600	292	124	153	230	148	124
10	700	2,570	260	129	153	215	146	124
11	630	2,150	230	122	153	215	143	124
12	595	1,740	215	134	151	200	161	124
13	560	1,380	215	146	143	190	174	124
14	595	1,180	230	143	138	187	164	124
15	491	1,000	230	136	134	187	161	124
16	474	845	215	136	134	187	151	124
17	458	735	200	134	200	184	148	124
18	458	665	197	126	230	179	148	124
19	458	595	200	122	195	177	148	124
20	426	560	195	119	179	190	143	124

Daily discharge, in second-feet, of Elk River near Big Lake, Minn., for 1912—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	426	560	187	119	174	190	143	124
22	410	595	179	119	164	184	143	124
23	395	735	179	171	158	177	138	124
24	380	805	177	187	146	174	136	98
25	365	805	171	169	138	184	136	78
26	395	845	158	151	134	184	136	102
27	380	1,050	146	164	126	177	136	100
28	365	1,230	138	215	158	171	134	98
29	410	1,180	134	260	151	169	129	96
30	426	1,050	126	230	292	164	129	94
31	.....	925	.....	200	276	.....	129	.....

NOTE.—Daily discharge computed from a rating table well defined between 100 and 1,300 second-feet and fairly well defined between 1,300 and 4,000 second-feet. Discharge Jan. 1 to Apr. 3, Nov. 15 (backwater from anchor ice in morning), and Nov. 27 to Dec. 31 estimated, because of ice, from climatologic records and records of discharge in adjacent drainage areas, as follows: Jan. 1–31, 60 second-feet, varying from about 110 to 30 second-feet; Feb. 1–29, 50 second-feet, varying from about 40 to 60 second-feet; Mar. 1–31, 90 second-feet, varying from about 60 to 400 second-feet; Dec. 1–31, 95 second-feet.

Monthly discharge of Elk River near Big Lake, Minn., for 1912.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	60	0.098	0.11	C.
February	.....	.....	50	.081	.09	C.
March	.....	.....	90	.146	.17	C.
April	885	365	567	.922	1.03	A.
May	4,970	410	1,320	2.15	2.48	A.
June	805	126	287	.467	.52	A.
July	260	119	149	.242	.28	A.
August	292	126	168	.273	.31	A.
September	276	164	205	.333	.37	A.
October	174	129	146	.237	.27	A.
November	129	78	118	.192	.21	B.
December	.....	.....	95	.154	.18	C.
The year	4,970	.....	272	.442	6.02	

NOTE.—See footnotes to tables of daily gage height and daily discharge.

CROW RIVER AT ROCKFORD, MINN.

Location.—At the highway bridge at Rockford, a little more than a mile below the junction of the North and South branches. Between the junction and the station are the outlets of Rebecca Lake and Lake Sarah, both very small streams.

Records available.—June 4, 1909, to December 31, 1912.

Drainage area.—2,520 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—During high and medium stages discharge measurements are made from the bridge, but during low stages measurements are made by wading at various sections several hundred yards downstream.

Winter flow.—Prior to the winter of 1911 and 1912, ice formed very little, and the open-water rating curve was applicable throughout the year. During the winter periods 1911–12, 1912–13 ice has destroyed the relation between stage and discharge, making it necessary to base estimates on discharge measurements. A possible reason for the present formation of ice is that before the dam was de-

stroyed the larger body of water back of the dam was at a temperature considerably above freezing, and as it was released did not freeze quickly. Since the dam was destroyed natural conditions are present and ice forms.

Artificial control.—On the North, Middle, and South forks of Crow River are seven small power plants. These plants have small storage, and the flow at the various points is so small that no appreciable effect of their operation is observable at the gage. A dam immediately above the gage was partly destroyed May 31, 1911, and has not as yet been repaired.

Accuracy.—Conditions at this station are favorable for excellent results, and therefore the records should be reliable.

Discharge measurements of Crow River at Rockford, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 2[a]	Hoyt and Soulé	5.06	55
Mar. 15[b]	Soulé and Murphy	5.13	[c] 83
May 16	W. G. Hoyt	8.55	[c] 2,330

[a] Complete ice cover; average thickness of ice, 0.83 foot; average distance water surface to top of ice, 0.00 foot.
[b] Complete ice cover; average thickness of ice, 0.81 foot; average distance water surface to top of ice, 0.03 foot.
[c] Measurement made about 400 feet downstream from gage.

Daily gage height, in feet, of Crow River at Rockford, Minn., for 1912.

[G. W. Florida, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.15	4.80	5.5	10.3	6.1	7.5	5.24	5.7	6.6	5.6	5.18	5.25
2	5.15	4.80	5.40	8.4	6.05	7.4	5.19	5.65	6.6	5.55	5.16	5.20
3	5.15	4.80	5.25	7.7	6.25	7.2	5.16	5.6	6.6	5.5	5.14	5.12
4	5.10	4.80	5.25	7.5	7.0	7.0	5.20	5.52	6.5	5.49	5.11	5.04
5	5.10	4.85	5.25	7.4	8.0	6.6	5.24	5.52	6.5	5.45	5.10	5.00
6	5.05	4.85	5.20	7.1	8.7	6.3	5.34	5.54	6.4	5.41	5.08	5.00
7	5.00	4.80	5.30	6.8	9.2	6.2	5.28	5.6	6.3	5.36	5.08	5.08
8	5.00	4.80	5.40	6.5	9.6	6.1	5.24	5.75	6.2	5.32	5.08	5.15
9	4.90	4.80	5.35	6.35	9.9	6.0	5.31	6.0	6.15	5.32	5.08	5.30
10	4.90	4.75	5.35	6.2	10.2	5.85	5.36	6.1	6.1	5.30	5.08	5.04
11	4.85	4.75	5.25	6.1	10.0	5.7	5.40	6.3	6.0	5.45	5.12	5.04
12	4.80	4.75	5.10	6.0	9.9	5.6	5.46	6.6	5.9	5.5	5.12	5.04
13	4.80	4.75	5.05	5.9	9.7	5.65	5.9	6.9	5.8	5.49	5.12	5.04
14	4.70	4.75	5.00	6.1	9.3	5.75	5.85	6.8	5.8	5.45	5.08	4.99
15	4.65	4.80	5.00	6.25	9.0	5.85	5.8	6.8	5.8	5.41	5.04	4.98
16	4.65	4.80	4.90	6.2	8.6	5.85	5.7	6.7	5.8	5.40	5.02	5.00
17	4.65	4.80	4.95	6.1	8.4	5.75	5.6	6.9	5.8	5.36	5.02	5.01
18	4.65	4.80	4.95	6.0	8.1	5.7	5.48	7.1	5.8	5.34	5.02	4.99
19	4.65	4.80	5.00	5.9	7.8	5.7	5.42	7.2	5.75	5.32	5.04	4.98
20	4.65	4.80	5.10	5.8	7.6	5.65	5.5	7.3	5.75	5.30	5.06	4.97
21	4.65	4.85	5.45	5.8	7.4	5.65	5.5	7.2	5.7	5.30	5.08	4.98
22	4.65	4.85	5.9	5.9	7.4	5.6	5.55	7.2	5.7	5.28	5.08	4.98
23	4.65	4.85	5.85	5.85	7.2	5.6	5.95	7.1	5.7	5.26	5.09	4.98
24	4.70	4.85	5.75	5.85	7.1	5.55	6.25	7.0	5.7	5.24	5.06	4.96
25	4.70	4.90	5.75	5.8	7.1	5.5	6.25	6.9	5.7	5.23	5.04	4.95
26	4.75	4.90	6.15	5.9	7.2	6.0	6.2	6.8	5.65	5.22	5.02	4.94
27	4.70	4.90	6.65	6.1	7.3	5.9	6.1	6.7	5.65	5.22	5.02	4.95
28	4.70	5.00	7.80	6.25	7.4	5.65	6.0	6.6	5.6	5.22	5.00	4.96
29	4.75	5.55	8.70	6.25	7.4	5.46	6.0	6.6	5.6	5.23	4.98	4.97
30	4.80	.....	9.20	6.2	7.5	5.30	5.9	6.7	5.6	5.22	4.99	4.98
31	4.80	.....	9.65	.....	7.5	.....	5.85	6.7	.....	5.20	.....	4.98

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 1, Dec. 7 to 13 and 29 to 31.

Daily discharge, in second-feet, of Crow River at Rockford, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,500	665	1,570	233	445	965	395	209	237
2	2,270	638	1,500	213	420	965	370	202	217
3	1,710	755	1,360	202	395	965	345	194	187
4	1,570	1,220	1,220	217	355	905	340	183	158
5	1,500	1,950	965	233	355	905	322	179	144
6	1,290	2,510	785	274	365	845	304	172	144
7	1,100	2,950	725	249	395	785	283	172	144
8	905	3,310	665	233	472	725	266	172	144
9	815	3,580	610	261	610	695	266	172	144
10	725	3,850	528	283	665	665	257	172	143
11	665	3,670	445	300	785	610	322	187	143
12	610	3,580	395	327	965	555	345	187	142
13	555	3,400	420	555	1,160	500	340	187	142
14	665	3,040	472	528	1,100	500	322	172	141
15	755	2,770	528	500	1,100	500	304	158	138
16	725	2,430	528	445	1,030	500	300	151	144
17	665	2,270	472	395	1,160	500	283	151	148
18	610	2,030	445	336	1,290	500	274	151	141
19	555	1,790	445	309	1,360	472	266	158	138
20	500	1,640	420	345	1,430	472	257	165	134
21	500	1,500	420	345	1,360	445	257	172	138
22	555	1,500	395	370	1,360	445	249	172	138
23	528	1,360	395	582	1,290	445	241	176	138
24	528	1,290	370	755	1,220	445	233	165	131
25	500	1,290	345	755	1,160	445	229	158	128
26	555	1,360	610	725	1,100	420	225	151	125
27	665	1,430	555	665	1,030	420	225	151	128
28	755	1,500	420	610	965	395	225	144	131
29	755	1,500	327	610	965	395	229	138	131
30	725	1,570	257	555	1,030	395	225	141	131
31	.....	1,570	.....	528	1,030	.....	217	.....	130

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Jan. 1 to Apr. 1, Dec. 7 to 13, and Dec. 29 to 31 estimated, because of ice, on basis of climatologic records, discharge measurements, and gage heights, as follows: Jan. 1–13, 100 second-feet, varying from about 110 to 80 second-feet; Jan. 14–31, 60 second-feet, varying from about 70 to 55 second-feet; Feb. 1–29, 70 second-feet, varying from about 55 to 100 second-feet; Mar. 1–15, 90 second-feet, varying from about 100 to 83 second-feet; Mar. 16–31, 630 second-feet, varying from about 80 to 3,000 second-feet.

Monthly discharge of Crow River at Rockford, Minn., for 1912.

[Drainage area, 2,520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	60	0.024	0.03	C.
February	.....	.....	70	.028	.03	C.
March	.....	.....	380	.151	.17	C.
April	[a] 3,500	500	925	.367	.41	B.
May	3,850	638	2,060	.817	.94	A.
June	1,570	257	620	.246	.27	A.
July	755	202	417	.165	.19	A.
August	1,430	355	915	.363	.42	A.
September	965	395	593	.235	.26	A.
October	395	217	281	.112	.13	A.
November	209	138	169	.067	.07	A.
December	.....	.....	146	.058	.07	B.
The year	3,850	.....	556	.221	2.99	

[a] Estimated.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

SOUTH FORK OF CROW RIVER NEAR ROCKFORD, MINN.

Location.—At the highway bridge 3½ miles southwest of Rockford in sec. 1, T. 118 N., R. 25 W.; no tributaries within several miles.

Records available.—June 15, 1909, to March 31, 1912. Station discontinued March 31, 1912.

Drainage area.—1,160 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Slightly shifting.

Discharge measurements.—Made from the bridge except at low stages, when they are made by wading at a short distance upstream.

Winter flow.—Ice forms, varying in thickness from 1 to 2 feet. Winter estimates based on gage heights, climatological data, and results of discharge measurements.

Artificial control.—The nearest dam is that at Delano, which is merely used as diversion dam by the Great Northern Railway Co.

The following discharge measurement was made by Hoyt and Soulé:

February 2, 1912: Gage height, 1.42 feet; discharge, 5.6 second-feet. This measurement was made under complete ice cover; average thickness of ice, 1.03 feet; average distance water surface to top of ice, 0.01 foot.

Daily gage height, in feet, of South Fork of Crow River near Rockford, Minn., for 1912.

[Jacob Horsch, observer.]

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	1.60	1.40	.....	16	.....	.....	.....
2	.....	.....	.....	17	.....	.....	.....
3	.....	.....	.....	18	1.50	.....	1.80
4	1.55	.....	2.0	19	.....	1.40	.....
5	.....	1.40	.....	20	.....	.....	.....
6	.....	.....	.....	21	.....	.....	3.3
7	.....	.....	2.15	22	1.50	1.40	.....
8	1.60	1.40	.....	23	.....	.....	.....
9	.....	.....	.....	24	.....	.....	.....
10	.....	.....	.....	25	1.45	.....	3.0
11	1.55	.....	1.90	26	.....	1.40	.....
12	.....	1.35	.....	27	.....	.....	.....
13	.....	.....	.....	28	.....	.....	4.6
14	.....	.....	2.0	29	1.45	2.7	5.4
15	1.60	1.35	.....	30	.....	.....	5.65
				31	.....	.....	5.85

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to Mar. 31.

Monthly discharge of South Fork of Crow River near Rockford, Minn., for 1912.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.		Run-off (depth in inches on drainage area).	Accuracy.
	Mean.	Per square mile.		
January	20	0.017	0.02	C.
February	10	.0086	.009	C.
March	110	.095	.11	C.

NOTE.—Monthly discharge Jan. 1 to Mar. 30 estimated, because of ice, from climatologic records, discharge of adjacent drainage areas, discharge measurements, and semiweekly gage heights, as follows: Jan. 1–31, 20 second-feet, varying from about 35 to 6 second-feet. Feb. 1–29, 10 second-feet, varying from about 6 to 15 second-feet. Mar. 1–18, 20 second-feet, varying from about 15 to 25 second-feet. Mar. 19–31, 120 second-feet, varying from about 25 to 600 second-feet.

RUM RIVER AT ONAMIA, MINN.

Location.—At the steel highway bridge at Onamia, 200 yards below the outlet of Lake Onamia and 5 miles above the mouth of Bradbury Brook.

Records available.—September 24, 1909, to December 31, 1912.

Drainage area.—414 square miles, of which 207 square miles are taken up by the water surface of Mille Lacs Lake.

Gage.—Vertical staff. The gage was located originally at the wooden highway bridge just below the Soo Railway bridge, but May 4, 1910, this bridge was destroyed and the gage moved 200 yards downstream to the steel highway bridge. The new gage was set to read the same as the old one.

Channel.—The bed of the river is mostly sand or fine gravel filled with débris, logs and grass.

Discharge measurements.—Made from the steel highway bridge.

Winter flow.—During the winter period of 1911 and 1912 the river froze solid to the bottom and there was no flow.

Artificial control.—Two miles below Onamia is an abandoned logging dam which raises the water level about 3 feet but does not control the flow. As there is a good fall to the river the influence of this dam does not reach the gaging station. Owing to the natural storage afforded by the lakes the range of stage at Onamia is slight.

Accuracy.—Because of very poor natural conditions, the great liability of the channel to shift, and backwater caused by growth of grass, the records are not considered better than fair.

Discharge measurements of Rum River at Onamia, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 11	S. B. Soulé	1.31	172	June 27[a]	S. B. Soulé	.72	30.5
11	do	1.31	174	Nov. 20[a]	W. G. Hoyt	.17	5.7
June 27[a]	do	.72	32.9				

[a] Measurements made by wading at a short distance below the Soo Railway bridge.

Daily gage height, in feet, of Rum River at Onamia, Minn., for 1912.

[R. Swedburg, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	0.20	0.65	0.88	0.70	0.45	0.50	0.35	0.25
2	.32	.68	.88	.70	.42	.50	.35	.25
3	.35	.75	.88	.68	.40	.50	.32	.25
4	.42	.85	.85	.68	.40	.50	.32	.25
5	.45	.95	.82	.65	.38	.50	.32	.25
6	.50	1.2	.82	.65	.40	.48	.30	.25
7	.52	1.3	.80	.62	.42	.48	.30	.22
8	.55	1.4	.78	.60	.45	.48	.30	.22
9	.60	1.35	.78	.58	.48	.45	.30	.22
10	.65	1.3	.75	.58	.50	.45	.30	.22
11	.68	1.3	.72	.55	.50	.45	.30	.20
12	.68	1.25	.72	.52	.50	.42	.32	.20
13	.70	1.2	.72	.50	.48	.42	.32	.20
14	.70	1.2	.72	.50	.48	.42	.32	.20
15	.70	1.15	.75	.50	.48	.40	.30	.20

Daily gage height, in feet, of Rum River at Onamia, Minn., for 1912—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	0.72	1.1	0.78	0.50	0.48	0.40	0.30	0.20
17	.72	1.1	.78	.50	.50	.40	.30	.20
18	.70	1.05	.80	.50	.48	.38	.30	.20
19	.70	1.0	.80	.48	.48	.38	.30	.18
20	.70	.98	.80	.48	.48	.35	.30	.18
21	.72	.92	.78	.48	.48	.35	.28	.18
22	.72	.92	.78	.48	.48	.32	.28	.18
23	.75	.95	.78	.50	.48	.32	.28	.15
24	.78	.92	.75	.52	.48	.30	.28	.15
25	.78	.90	.75	.50	.48	.30	.28	.15
26	.80	.90	.75	.50	.48	.32	.25	.12
27	.78	.90	.72	.50	.48	.32	.25	.12
28	.75	.90	.72	.48	.45	.35	.25	.10
29	.70	.90	.70	.48	.48	.35	.25	.10
30	.68	.90	.70	.45	.50	.32	.25	.08
31	.....	.90	.....	.45	.50	.....	.25	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 31, and about Dec. 1 to 31.

Daily discharge, in second-feet, of Rum River at Onamia, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2	24	62	29	14	15	10	7.5
2	4.6	27	62	29	13	15	10	7.5
3	5.5	38	62	27	12	15	10	7.5
4	7.8	56	56	27	12	15	10	7.5
5	9	78	51	24	11	15	10	7.5
6	11	140	51	24	12	14	9	7.5
7	12	170	47	22	13	14	9	6.6
8	14	210	43	20	14	14	9	6.6
9	18	190	43	19	14	14	9	6.6
10	24	170	38	19	15	14	9	6.6
11	27	170	33	18	15	14	9	6.0
12	27	155	33	16	15	13	10	6.0
13	29	140	33	15	14	13	10	6.0
14	29	140	33	15	14	13	10	6.0
15	29	127	38	15	14	12	9	6.0
16	33	114	43	15	14	12	9	6.0
17	33	114	43	15	15	12	9	6.0
18	29	102	47	15	14	11	9	6.0
19	29	89	47	14	14	11	9	5.6
20	29	84	47	14	14	10	9	5.6
21	33	71	43	14	14	10	8.4	5.6
22	33	71	43	14	14	10	8.4	5.6
23	38	78	43	15	14	10	8.4	5.0
24	43	71	38	16	14	9	8.4	5.0
25	43	66	38	15	14	9	8.4	5.0
26	47	66	38	15	14	10	7.5	4.4
27	43	66	33	15	14	10	7.5	4.4
28	38	66	33	14	14	10	7.5	4.0
29	29	66	29	14	14	10	7.5	4.0
30	27	66	29	14	15	10	7.5	3.6
31	.....	66	.....	14	15	.....	7.5	.....

NOTE.—Daily discharge computed from 2 rating curves fairly well defined, between 29 and 210 second-feet. Discharge Jan. 1 to Mar. 31, 1912, and Dec. 1 to 31, estimated, because of ice, from climatologic records, records of discharge of adjacent drainage areas, and observer's reports, as follows: Jan. 1 to Feb. 29, 0 second-foot; Mar. 1–31, 2 second-feet, varying about 0 to 4 second-feet; Dec. 1–31, 2 second-feet.

Monthly discharge of Rum River at Onamia, Minn., for 1912.

[Drainage area, 414 square miles.][a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January			0.00	
February			.00	
March			2.0	
April	47	2	25.9	D.
May	210	24	99.7	B.
June	62	29	42.6	B.
July	29	14	17.8	C.
August	15	11	13.8	D.
September	15	9	12.1	D.
October	10	7.5	8.87	C.
November	7.5	3.6	5.91	C.
December			2.0	
The year	210		19.3	

[a] "Discharge in second-feet per square mile" and "Run-off (depth in inches)" computed from this drainage area are considered misleading, especially during low-water periods, because of the large amount of lake storage, and are therefore not published.

NOTE.—See footnotes to table of daily discharge.

RUM RIVER AT CAMBRIDGE, MINN.

Location.—At highway bridge one-half mile west of Cambridge. No tributary within several miles.

Records available.—June 12, 1909, to December 31, 1912.

Drainage area.—1,160 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Shifting.

Discharge measurements.—Made from the bridge.

Winter flow.—From December to March discharge measurements are made through ice to determine the winter flow.

Artificial control.—At St. Francis, 20 miles below Cambridge by river, there is a 10-foot dam and a power plant. Between the crest of the dam and the water surface at the gaging station there is a difference in elevation of about 6 feet. The fact that morning and evening gage heights during the low-water period show no consistent change, being for the most part the same, indicates that the St. Francis dam has very little effect on the flow at this station, even though the flow may fall below the crest during certain portions of the day. The only dam above Cambridge is at Milaca, which is used to form a pool from which water is pumped. Flow at Cambridge, especially during periods of low water, is controlled by the storage in and evaporation from the lakes in the drainage area above Onamia.

Accuracy.—During the summer of 1911 and 1912 grass grew in the channel to such an extent that it caused backwater in varying amount at the gage. Therefore during that period the records can not be considered better than fair. Records for the remainder of the year are believed to be good.

Discharge measurements of Rum River at Cambridge, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 30[a]	S. B. Soulé	3.61	66.0	Aug. 1	S. B. Soulé	3.85	177
Mar. 13[b]	Hoyt and Soulé	3.61	74	Sept. 12[c]	do	3.80	168
13[b]	do	3.61	74	12[d]	do	3.79	165
Apr. 18	S. B. Soulé	6.30	983	Oct. 11	W. G. Hoyt	3.12	121
18	do	6.32	978	Nov. 23	do	2.99	116
May 14	W. G. Hoyt	10.36	2,370	Dec. 30[e]	S. B. Soulé	3.34	84

[a] Complete ice cover; average thickness of ice, 1.18 feet; average distance water surface to top of ice, 0.06 foot.
[b] Six per cent open water, 94 per cent ice cover; average thickness of ice 1.28 feet; average distance water surface to top of ice, 0.09 foot.
[c] Wading measurement about 500 feet above gage.
[d] Wading measurement about 75 feet above gage.
[e] Complete ice cover at gage and control; 90 per cent ice cover at measuring section.

Daily gage height, in feet, of Rum River at Cambridge, Minn., for 1912.

[Joseph Lofstrom, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.70	.....	6.1	7.1	8.3	3.55	3.85	4.0	3.4	3.0	3.0
2	3.50	.....	.....	7.1	6.7	7.5	3.50	3.7	4.4	3.4	3.0	3.1
3	.....	.....	.....	8.0	6.4	6.6	3.50	3.6	5.0	3.35	3.0	3.1
4	.....	.....	3.60	8.6	6.7	6.1	3.55	3.55	5.4	3.3	3.0	.....
5	3.40	3.7	.....	8.0	7.8	5.8	3.65	3.5	5.5	3.25	3.0	3.1
6	.....	.....	.....	7.6	9.4	5.6	3.60	3.6	5.3	3.2	3.0	.....
7	.....	.....	3.6	7.4	12.7	5.3	3.55	3.6	4.9	3.15	2.99	.....
8	3.45	3.70	.....	7.2	15.5	5.1	3.50	3.6	4.6	3.15	3.0	.....
9	.....	.....	.....	7.0	16.2	4.9	3.45	3.6	4.3	3.15	3.0	.....
10	.....	.....	.....	6.7	15.7	4.7	3.45	3.65	4.1	3.1	3.0	.....
11	3.50	.....	3.60	6.4	14.4	4.5	3.40	3.6	3.9	3.15	2.99	.....
12	.....	3.70	.....	6.0	13.1	4.4	3.50	3.6	3.8	3.2	2.96	3.1
13	.....	.....	3.6	5.7	11.7	4.3	3.45	3.55	3.7	3.3	2.98	.....
14	.....	.....	3.60	5.6	10.4	4.3	3.40	3.55	3.65	3.25	2.98	.....
15	3.45	3.70	.....	5.6	9.1	4.3	3.40	3.5	3.55	3.25	2.96	.....
16	.....	.....	.....	5.7	8.1	4.3	3.40	3.5	3.55	3.25	2.98	.....
17	.....	.....	.....	6.0	7.4	4.2	3.40	3.75	3.55	3.2	2.95	.....
18	3.50	.....	3.6	6.3	6.9	4.2	3.35	3.9	3.5	3.2	2.95	.....
19	.....	3.7	.....	6.3	6.5	4.3	3.30	3.85	3.5	3.15	2.96	3.25
20	.....	.....	.....	6.2	6.2	4.3	3.35	3.85	3.5	3.15	2.98	.....
21	.....	.....	3.60	5.8	6.0	4.2	3.30	3.8	3.5	3.1	2.98	.....
22	3.5	3.70	.....	5.6	6.5	4.1	3.30	3.7	3.5	3.1	2.98	.....
23	.....	.....	.....	5.4	7.4	4.0	3.60	3.7	3.5	3.1	2.98	.....
24	.....	.....	.....	5.4	8.0	3.9	3.80	3.6	3.45	3.1	2.68	.....
25	3.55	.....	3.60	5.5	8.5	3.9	3.80	3.6	3.5	3.05	2.92	.....
26	.....	3.65	.....	5.4	8.8	3.8	4.00	3.5	3.55	3.05	3.05	3.35
27	.....	.....	.....	5.4	9.2	3.7	4.40	3.45	3.5	3.05	3.1	.....
28	.....	.....	3.85	6.0	9.2	3.7	4.60	3.45	3.45	3.0	3.1	.....
29	3.6	3.60	4.30	6.8	9.0	3.7	4.50	3.4	3.4	3.05	3.0	.....
30	3.6	.....	4.60	7.1	9.0	3.6	4.30	3.65	3.4	3.05	3.0	3.35
31	.....	.....	5.00	.....	8.8	.....	4.00	3.9	.....	3.0	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 2 and about Nov. 24 to Dec. 31.

Daily discharge, in second-feet, of Rum River at Cambridge, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	500	1,220	1,600	120	178	215	150	110
2	900	1,100	1,320	110	140	320	150	110
3	1,520	1,010	1,000	110	118	500	140	110
4	1,740	1,100	870	120	108	620	140	110
5	1,520	1,460	780	140	98	650	130	110
6	1,380	2,020	710	130	118	590	130	110
7	1,320	3,320	620	120	118	470	120	110
8	1,250	4,550	560	110	118	380	120	110
9	1,190	4,900	500	100	118	290	130	110
10	1,100	4,650	440	100	129	240	120	110

Daily discharge, in second-feet, of Rum River at Cambridge, Minn., for 1912—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	1,010	4,000	390	90	118	190	130	110
12	890	3,480	360	110	118	165	140	110
13	803	2,920	320	100	108	150	160	110
14	774	2,400	320	90	108	140	150	110
15	774	1,880	320	90	98	120	150	110
16	803	1,520	320	90	98	130	160	110
17	890	1,280	290	90	152	130	140	110
18	980	1,160	290	80	190	120	140	110
19	980	1,020	320	70	178	130	130	110
20	950	910	320	80	178	130	130	115
21	832	840	290	70	165	130	120	115
22	774	1,020	260	60	140	140	120	115
23	717	1,280	240	120	140	140	120	115
24	717	1,490	210	160	118	130	120	115
25	745	1,660	210	160	118	150	110	115
26	717	1,770	190	210	98	160	110	115
27	717	1,920	170	320	88	150	110	115
28	890	1,920	160	380	88	150	100	110
29	1,130	1,840	160	350	78	140	110	110
30	1,220	1,840	140	290	129	140	120	110
31	.....	1,770	.....	210	190	.....	110	.....

NOTE.—Daily discharge computed from two fairly well defined rating curves. Shifting channel methods used May 15 to July 31 and Sept. 13 to Nov. 23. Discharge Jan. 1 to Apr. 2 and Nov. 24 to Dec. 31 estimated, because of ice, from semi-weekly gage heights, observer's notes, discharge measurements, climatologic records, and records of discharge of adjacent drainage areas, as follows: Jan. 1–31, 80 second-feet; Feb. 1–29, 70 second-feet; Mar. 1–31, 100 second-feet; Dec. 1–31, 100 second-feet, varying from about 130 to 84 second-feet.

Monthly discharge of Rum River at Cambridge, Minn., for 1912.

[Drainage area, 1,160 square miles.][a]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	80	C.
February	.....	.....	70	C.
March	.....	.....	100	C.
April	1,740	500	991	B.
May	4,900	840	2,040	B.
June	1,600	140	456	C.
July	380	60	141	C.
August	190	78	127	C.
September	650	120	237	C.
October	160	100	129	B.
November	115	110	111	C.
December	.....	.....	100	C.
The year	4,900	.....	383	

[a] Discharge in "second-feet per square mile" and "Run-off (depth in inches)" are not published for this drainage area, because they are believed to be misleading. See "Artificial control" in station description.

NOTE.—See footnotes to table of daily discharge.

MINNESOTA RIVER NEAR ODESSA, MINN.

Location.—At highway bridge 1 mile southwest of Odessa, in sec. 32, T. 121 N., R. 45 W., one-half mile below the mouth of Stony Run, a very small stream entering from the north.

Records available.—July 4, 1909, to December 31, 1912.

Drainage area.—1,560 square miles.

Gage.—Chain gage attached to bridge, datum unchanged.

Channel.—Practically permanent except during periods of high water.

Discharge measurements.—Made from the bridge, except during low stages, when they are made at a wading section.

Winter flow.—The river is frozen over and observations are discontinued from December to March. The flow during that period may be estimated by using the run-off per square mile of adjacent drainage areas.

Artificial control.—The flow at Odessa is entirely uncontrolled. The nearest dam is at Granite Falls. Swamps may regulate the flow to a relatively small extent.

Remarks.—This station was established in order to determine the run-off from Big Stone Lake available for storage and the amount of flood water contributed by the upper valley. As Whetstone River enters Minnesota River above Odessa, a station was established on that stream also for the purpose of determining the amount of water passing Odessa from that source. Owing to its extreme flatness the valley immediately below Big Stone Lake is subject to severe overflow during high water, and it was therefore not possible to select a satisfactory station site above Odessa. Even at this point extremely high water overflows around one end of the bridge, but the amount is only a small percentage of the entire flow, and is estimated at times of high-water measurements.

Discharge measurements of Minnesota River near Odessa, Minn., in 1912.

[S. B. Soulé, hydrographer.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 9	3.46	64.0	May 5	5.10	191
9	3.44	66.5	June 21 [a]	2.76	30.7

[a] Measurement made by wading at regular section.

Daily gage height, in feet, of Minnesota River near Odessa, Minn., for 1912.

[C. P. Shellenbarger, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.9	3.5	2.71	2.28	3.75	.....	2.89	3.05
2	6.2	3.3	2.62	2.28	3.7	.....	2.80	3.0
3	6.0	3.2	2.55	2.32	3.6	2.80	2.86	3.0
4	5.5	4.4	2.46	2.49	3.5	2.76	2.85	2.95
5	4.6	5.0	2.41	3.05	3.4	2.75	2.88	2.95
6	3.85	5.8	2.36	3.2	3.3	2.76	3.0	2.94
7	3.85	6.5	2.35	3.1	3.25	2.74	2.96	2.91
8	3.55	6.0	2.31	2.90	3.2	2.78	2.95	2.90
9	3.45	5.4	2.30	2.90	3.15	2.80	2.91	2.90
10	3.35	4.2	2.30	3.00	3.05	2.78	2.90	.....
11	3.25	3.85	2.54	3.15	3.0	2.75	2.90	.....
12	3.2	3.65	2.49	3.4	3.0	2.78	2.85	.....
13	3.25	3.5	2.58	3.4	3.0	.....	2.80	.....
14	3.55	3.35	2.69	3.6	3.0	.....	2.80	.....
15	4.4	3.25	2.59	3.8	2.78	.....	2.79	.....
16	5.8	3.1	2.81	3.7	2.78	.....	2.84	.....
17	6.6	3.0	3.0	3.7	2.86	.....	2.85	2.80
18	6.1	2.95	3.2	3.5	2.89	.....	3.2	2.78
19	5.1	2.90	3.2	3.45	2.90	.....	3.5	2.75
20	4.0	2.85	2.81	3.5	2.92	.....	3.2	2.80
21	4.2	2.80	2.78	3.3	2.96	.....	2.91	2.80
22	4.0	2.80	2.68	3.3	3.0	.....	2.80	2.80
23	3.9	3.6	2.61	3.4	2.89	.....	2.84	2.80
24	3.75	3.25	2.59	3.55	2.90	3.4	2.85	2.80
25	3.65	3.0	2.54	3.55	2.91	3.3	2.91	2.92
26	4.8	3.0	2.48	3.5	3.0	3.0	2.90	2.92
27	4.5	2.95	2.41	3.5	2.96	2.84	2.88	2.90
28	4.2	2.90	2.38	3.5	2.95	2.80	2.81	2.90
29	3.85	2.80	2.34	3.6	2.90	2.88	3.0	2.90
30	3.7	2.80	2.29	3.65	.....	2.90	3.1	.....
31	.....	2.75	.....	3.7	.....	.....	3.05	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 31 and about Nov. 25 to Dec. 31.

Daily discharge, in second-feet, of Minnesota River near Odessa, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	355	70	28	14	88	34	36	44
2	288	58	25	14	84	33	32	41
3	270	52	22	15	77	32	34	41
4	225	137	19	20	70	30	34	38
5	153	185	17	44	64	30	35	38
6	94	252	16	52	58	30	41	38
7	94	315	16	46	55	30	39	36
8	74	270	14	36	52	31	38	36
9	67	217	14	36	49	32	36	36
10	61	121	14	41	44	31	36	35
11	55	94	22	49	41	30	36	35
12	52	80	20	64	41	31	34	34
13	55	70	23	64	41	30	32	34
14	74	61	28	77	41	25	32	33
15	137	55	24	91	31	22	32	33
16	252	46	32	84	31	20	34	32
17	325	41	41	84	34	18	34	32
18	279	38	52	70	36	15	52	31
19	193	36	52	67	36	13	70	30
20	105	34	32	70	37	12	52	32
21	121	32	31	58	39	15	36	32
22	105	32	27	58	41	35	32	32
23	98	77	24	64	36	50	34	32
24	88	55	24	74	36	64	34	32
25	80	41	22	74	36	58	36	32
26	169	41	20	70	41	41	36	32
27	145	38	17	70	39	34	35	31
28	121	36	16	70	38	32	32	31
29	94	32	15	77	36	35	41	30
30	84	32	14	80	35	36	46	30
31	.....	30	.....	84	35	.....	44	.....

NOTE.—Daily discharge computed from a fairly well-defined rating curve. Daily discharge Aug. 30 to Sept. 2, Sept. 13 to 23 and Nov. 10 to 16 estimated from records of discharge in adjacent drainage areas. Discharge Jan. 1 to Mar. 31 and Nov. 25 to Dec. 31 estimated, because of ice, from climatologic records and relation between open-water flow at Odessa, Lac qui Parle, Watson, and Montevideo, as follows: Jan. 1-30, 5 second-feet; Feb. 1-29, 4 second-feet; Mar. 1-31, 20 second-feet; Nov. 25-30, 31 second-feet, varying from about 32 to 30 second-feet; Dec. 1-31, 25 second-feet.

Monthly discharge of Minnesota River near Odessa, Minn., for 1912.

[Drainage area, 1,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	5	0.0032	0.004	
February	.....	.....	4	.0026	.003	
March	.....	.....	20	.013	.01	
April	355	52	144	.092	.10	B.
May	315	30	86.4	.055	.06	A.
June	52	14	24.0	.015	.02	B.
July	91	14	58.6	.038	.04	A.
August	88	31	45.9	.029	.03	B.
September	64	a 12	31.0	.020	.02	C.
October	70	32	37.9	.024	.03	B.
November	44	30	34.1	.022	.02	C.
December	.....	.....	25	.016	.02	
The year	355	.....	43.0	.028	.36	

a Estimated.

NOTE.—See footnotes to table of daily discharge.

MINNESOTA RIVER NEAR MONTEVIDEO, MINN.

Location.—At the highway bridge 1 mile south of Montevideo, in sec. 19, T. 117 N., R. 40 W., a short distance below the mouth of Chippewa River.

Records available.—July 23, 1909, to December 31, 1912.

Drainage area.—6,300 square miles.

Gage.—Chain gage, attached to bridge. The datum of the gage was lowered 2 feet September 16, 1909, and 1 foot additional July 29, 1910, to avoid negative readings. All gage heights have been referred to the last datum.

Channel.—Practically permanent.

Discharge measurements.—Made from the bridge.

Winter flow.—The river is frozen over from December to March, and measurements are made through the ice to determine the winter discharge.

Artificial control.—The nearest dam is at Granite Falls, but its influence does not extend to the Montevideo station. There is no dam above the station. The discharge of Chippewa River is so much less than that of the Minnesota that the control of the former by a dam at Montevideo has very little effect on the Minnesota gage heights.

Discharge measurements of Minnesota River near Montevideo, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec.-ft.*
Jan. 9[a]	C. J. Emerson	2.47	28.3	Apr. 8	S. B. Soulé	5.06	690
Feb. 9[b]	S. B. Soulé	2.28	6.8	June 20	....do	4.46	537
Mar. 22[c]	....do	3.60	105	20	W. G. Hoyt	4.46	529
Apr. 8	....do	5.10	679	Dec. 28	S. B. Soulé	3.16	128

[a] Complete ice cover; average thickness, 1.30 feet; average distance water surface to top of ice, 0.40 foot.
[b] Complete ice cover; average thickness of ice, 1.92 feet; average distance water surface to top of ice, 0.55 foot.
[c] Complete ice cover; average thickness of ice, 0.52 foot; average depth of water on top of ice, 0.05 foot.

Daily gage height, in feet, of Minnesota River near Montevideo, Minn., for 1912.

[Margaret Hendricks, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	.....	3.1	3.6	6.1	5.4	2.75	2.6	2.5	2.8	2.3	2.35
2	.....	2.4	.....	3.4	6.6	5.2	3.1	2.5	2.6	2.7	2.2	2.8
3	.....	.....	.....	3.7	7.7	5.0	3.1	2.4	2.5	2.4	2.2	2.3
4	.....	.....	3.0	4.0	9.0	4.9	3.2	2.3	2.45	2.45	2.4	2.4
5	3.1	2.4	.....	4.1	.....	4.8	3.2	2.4	2.4	2.7	2.7	2.45
6	.....	.....	.....	5.1	.....	4.7	3.3	2.55	2.4	2.4	2.7	2.35
7	.....	.....	.....	5.0	.....	4.6	3.5	2.6	2.5	2.5	2.7	2.35
8	2.45	.....	3.0	5.1	.....	4.6	3.7	2.55	2.4	2.8	2.35	2.4
9	.....	2.4	.....	5.0	.....	4.3	3.8	2.5	2.4	2.6	2.45	2.3
10	.....	.....	.....	5.0	.....	4.1	3.7	2.4	2.45	2.3	2.4	2.5
11	.....	.....	3.2	4.9	.....	4.1	3.5	2.3	2.35	2.6	2.4	2.7
12	2.85	2.35	.....	4.8	.....	4.2	3.2	2.5	2.3	2.8	2.7	2.45
13	.....	.....	.....	4.6	8.9	4.2	3.1	2.5	2.35	2.5	2.7	2.65
14	.....	.....	.....	4.6	8.6	4.1	2.6	2.5	2.4	2.5	2.5	2.8
15	2.8	.....	3.0	4.7	8.2	4.2	2.7	2.65	2.2	2.8	2.5	2.85
16	.....	2.3	.....	4.7	8.0	4.2	2.85	2.7	2.4	2.75	2.6	3.2
17	.....	.....	.....	4.8	7.9	4.2	3.0	2.6	2.4	2.8	2.3	3.2
18	.....	.....	3.0	4.8	8.0	4.6	3.0	2.45	2.4	2.7	2.4	2.85
19	2.25	2.4	.....	4.8	7.2	4.8	2.85	2.6	2.4	2.7	2.6	3.1
20	.....	.....	.....	4.9	7.0	4.7	2.8	3.0	2.3	2.2	2.6	3.1
21	.....	.....	.....	4.9	6.8	4.4	2.9	3.2	2.3	2.6	2.7	2.9
22	2.3	.....	3.6	4.8	6.6	4.3	2.95	3.1	2.2	2.85	2.6	2.8
23	.....	2.4	.....	4.7	6.5	3.5	3.0	3.0	2.45	2.7	2.3	3.2
24	.....	.....	.....	4.7	6.4	3.4	3.0	2.8*	2.5	2.15	2.4	3.2
25	.....	.....	3.6	4.6	6.4	3.3	3.0	2.7	2.4	2.3	2.3	3.1
26	2.3	3.0	.....	4.9	6.4	3.2	2.9	2.6	2.5	2.75	2.6	3.0
27	.....	.....	.....	5.2	6.3	3.2	2.9	2.5	2.3	2.6	2.8	3.2
28	.....	.....	.....	5.3	5.8	3.0	2.9	2.45	2.6	2.4	2.8	3.2
29	2.35	.....	3.65	5.4	5.6	3.0	3.0	2.6	2.4	2.7	2.65	.....
30	.....	.....	.....	6.0	5.6	2.9	2.75	2.7	2.45	2.9	2.7	.....
31	.....	.....	.....	.....	5.5	.....	2.7	2.8	.....	2.7	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 3, and about Nov. 26 to Dec. 31. Gage not read May 5 to 12, because water was above limits of gage. Observer reported maximum stage about 14 feet.

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	200	1,030	807	174	156	144	181	120
2	250	1,200	745	221	144	156	168	108
3	300	1,610	685	221	132	144	132	108
4	410	2,120	656	236	120	138	138	132
5	436	2,700	627	236	132	132	168	168
6	715	3,500	599	252	150	132	132	168
7	685	4,000	571	292	156	144	144	168
8	715	3,700	571	336	150	132	181	126
9	685	3,300	489	360	144	132	156	138
10	685	2,900	436	336	132	138	120	132
11	656	2,700	436	292	120	126	156	132
12	627	2,300	462	236	144	120	181	168
13	571	2,080	462	221	144	126	144	168
14	571	1,960	436	156	144	132	144	144
15	599	1,810	462	168	162	108	181	144
16	599	1,730	462	188	168	132	174	156
17	627	1,690	462	207	156	132	181	120
18	627	1,730	571	207	138	132	168	132
19	627	1,420	627	188	156	132	168	156
20	656	1,350	599	181	207	120	108	156
21	656	1,280	516	194	236	120	156	168
22	627	1,200	489	200	221	108	188	156
23	599	1,170	292	207	207	138	168	120
24	599	1,140	271	207	181	144	102	132
25	571	1,140	252	207	168	132	120	120
26	656	1,140	236	194	156	144	174	.....
27	745	1,100	236	194	144	120	156	.....
28	776	934	207	194	138	156	132	.....
29	807	870	207	207	156	132	168	.....
30	1,000	870	194	174	168	138	194	.....
31	.....	838	.....	168	181	.....	168	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Daily discharge May 5 to 12 estimated from maximum stage reported by observer and discharge at other stations on the Minnesota. Discharge Jan. 1 to Apr. 3 and Nov. 26 to Dec. 31 estimated, because of ice, from climatologic records, discharge measurements, and observer's notes, as follows: Jan. 1–31, 25 second-feet, varying about 60 to 10 second-feet; Feb. 1–29, 15 second-feet, varying from about 7 to 30 second-feet; Mar. 1–31, 85 second-feet, varying from about 30 to 150 second-feet; Nov. 26–30, 125 second-feet; Dec. 1–31, 125 second-feet.

Monthly discharge of Minnesota River near Montevideo, Minn., for 1912.

[Drainage area, 6,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	25	0.0040	0.005	C.
February	.....	.....	15	.0024	.003	C.
March	.....	.....	85	.014	.02	C.
April	1,000	[a] 200	609	.097	.11	A.
May	[a] 4,000	838	1,820	.289	.33	B.
June	807	194	469	.074	.08	A.
July	360	156	221	.035	.04	A.
August	236	120	158	.025	.03	B.
September	156	108	133	.021	.02	B.
October	194	102	156	.025	.03	B.
November	.....	.....	[b] 139	.022	.02	C.
December	.....	.....	125	.020	.02	
The year	4,000	.....	332	.053	.71	

[a] Estimated.

[b] Differs from value published in "Report of the water-resources investigation of Minnesota, 1911–1912," because of estimate of flow Nov. 26 to 30 made from information obtained after publication of Minnesota report.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

MINNESOTA RIVER NEAR MANKATO, MINN.

Location.—At Sibley Park, 2 miles above the center of Mankato, and a few hundred yards below the mouth of Blue Earth River, the nearest tributary.

Records available.—May 20, 1903, to December 31, 1912.

Drainage area.—14,600 square miles.

Gage.—Chain gage; datum unchanged.

Channel.—Fairly permanent except during periods of high water.

Discharge measurements.—Made from a boat and cable near the gage.

Winter flow.—From December to March measurements are made through the ice to determine the winter discharge.

Artificial control.—The nearest dam on the river is at Minnesota Falls, 140 miles upstream. There is no dam below the station. A dam on Blue Earth River at Rapidan, a few miles above the mouth, controls the flow of that river, but it is such a small part of the entire discharge at the Mankato station that the effect of such control is slight.

Maximum and minimum flow.—The highest known stage of the river occurred in 1881 and is shown by a well-marked line in Mankato. The stage was approximately 27 feet above the zero of the present gage. This estimate was corroborated by M. B. Haynes, city engineer of Mankato, who states that the high water occurred after the ice went out and was not caused by backwater. The corresponding discharge is approximately 65,000 second-feet. Since the establishment of the gage the highest stage recorded was 21.2 feet on June 26, 1908. The lowest stage recorded was 0.5 in 1911, when the flow was about 89 second-feet for a considerable time.

Accuracy.—Measurements made during the earlier years indicated changing conditions of flow, and accordingly the discharge for years previous to 1907 was obtained largely by the indirect method. These results can not be considered so accurate as the later ones, which are based on well-defined rating curves.

Cooperation.—Since 1906 gage heights have been furnished by United States Weather Bureau.

Discharge measurements of Minnesota River near Mankato, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5[a]	C. J. Emerson	2.27	341	Sept. 9[e]	S. B. Soulé	1.50	440
Feb. 7[b]	S. B. Soulé	2.19	201	9[f]	do	1.48	418
June 19[c]	do	2.98	1,160	Dec. 16[g]	do	1.47	234
Aug. 30[d]	do	2.58	1,160				

[a] Complete ice cover; average thickness, 0.75 foot; average distance water surface to top of ice, 0.10 foot.
[b] Complete ice cover; average thickness of ice, 0.97 foot; average distance of water surface to top of ice, 0.00 foot. Measurement made about 600 feet below the gage.
[c] Measurement made from upstream side of highway bridge in town.
[d] Measurement made from upstream side of highway bridge in town. Very rapidly rising stage.
[e] Wading measurement about 30 feet below gage (under cable).
[f] Wading measurement about 200 feet below gage.
[g] Measurement made under complete ice cover; river about 10 per cent open at control.

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	2.1	3.6	8.2	4.5	4.0	2.4	1.9	1.8	1.2	1.3	1.1
2	2.7	2.1	3.5	8.4	4.4	3.9	2.3	1.7	1.6	1.2	1.3	1.1
3	2.6	2.0	3.4	7.7	4.8	3.9	2.5	1.7	1.6	1.2	1.2	1.0
4	2.6	2.0	3.3	7.0	4.6	3.7	2.6	1.7	1.6	1.2	1.2	1.3
5	2.5	2.0	3.2	6.5	5.7	3.6	2.6	1.7	1.6	1.2	1.2	1.3
6	2.4	2.0	3.1	6.0	5.5	3.5	2.4	1.7	1.6	1.2	1.3	1.3
7	2.4	2.0	3.1	6.1	6.8	3.4	2.6	1.7	1.6	1.2	1.3	1.3
8	2.4	2.0	3.0	5.9	7.6	3.3	2.8	1.7	1.5	1.2	1.3	1.3
9	2.3	2.0	3.0	6.2	7.3	3.2	2.6	1.7	1.5	1.3	1.3	1.3
10	2.2	2.0	3.0	5.3	7.5	3.2	2.5	1.7	1.5	1.3	1.2	1.4

Daily gage height, in feet, of Minnesota near Mankato, Minn., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.2	2.0	3.0	5.3	7.2	3.1	2.3	1.6	1.5	1.2	1.1	1.4
12	2.1	2.0	2.7	5.3	7.4	3.1	2.6	1.6	1.4	1.4	1.2	1.4
13	2.1	2.0	2.9	5.3	7.4	3.0	2.7	1.6	1.4	1.4	1.2	1.4
14	2.1	2.0	2.9	5.2	7.3	2.9	2.5	1.5	1.4	1.4	1.3	1.4
15	2.0	2.1	2.9	5.2	7.1	3.0	2.4	1.5	1.3	1.3	1.3	1.4
16	2.0	2.2	2.9	4.9	6.8	3.0	2.4	1.5	1.4	1.3	1.2	1.3
17	2.0	2.3	2.9	4.8	6.2	3.1	2.3	1.5	1.3	1.3	1.2	1.3
18	2.0	2.4	3.5	4.9	6.1	3.0	2.3	1.6	1.4	1.3	1.1	1.4
19	2.0	2.8	3.8	5.0	6.0	3.0	2.2	1.7	1.4	1.3	1.2	1.4
20	2.0	3.1	3.8	5.1	5.5	3.0	2.3	1.6	1.4	1.3	1.2	1.4
21	2.0	3.2	3.7	4.7	5.2	3.0	2.2	1.6	1.3	1.3	1.2	1.4
22	2.0	3.2	3.7	5.1	5.1	2.9	2.1	1.8	1.3	1.3	1.2	1.4
23	2.1	3.3	3.8	5.4	4.9	2.9	2.1	2.2	1.2	1.3	1.2	1.4
24	2.1	3.7	4.0	5.3	4.8	2.8	2.1	2.4	1.2	1.3	1.0	1.3
25	2.1	3.7	4.2	5.9	4.6	2.8	2.1	2.2	1.3	1.3	1.0	1.3
26	2.1	3.7	4.7	5.3	4.6	2.8	2.1	2.1	1.3	1.3	1.1	1.3
27	2.1	3.6	4.6	5.2	4.6	2.8	2.1	2.1	1.3	1.3	1.1	1.3
28	2.1	3.6	4.7	5.3	4.3	2.5	2.1	2.0	1.3	1.3	1.1	1.3
29	2.1	3.6	4.5	5.4	4.2	2.4	2.1	1.8	1.3	1.3	1.2	1.4
30	2.1	.....	6.1	5.3	4.1	2.4	2.1	1.9	1.2	1.3	1.2	1.4
31	2.1	.....	7.3	.....	4.1	.....	2.0	1.8	.....	1.3	.....	1.4

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 24 and about Dec. 1 to 31.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	8,150	2,700	2,180	910	635	580	270	320
2	.....	8,530	2,590	2,080	855	525	470	270	320
3	.....	7,240	3,040	2,080	970	525	470	270	270
4	.....	6,080	2,810	1,890	1,030	525	470	270	270
5	.....	5,310	4,170	1,800	1,030	525	470	270	270
6	.....	4,590	3,900	1,710	910	525	470	270	320
7	.....	4,730	5,760	1,620	1,030	525	470	270	320
8	.....	4,450	7,070	1,540	1,160	525	420	270	320
9	.....	4,870	6,560	1,460	1,030	525	420	320	320
10	.....	3,640	6,900	1,460	970	525	420	320	270
11	.....	3,640	6,400	1,380	855	470	420	270	225
12	.....	3,640	6,730	1,380	1,030	470	370	370	270
13	.....	3,640	6,730	1,300	1,090	470	370	370	270
14	.....	3,520	6,560	1,230	970	420	370	370	320
15	.....	3,520	6,240	1,300	910	420	320	320	320
16	.....	3,160	5,760	1,300	910	420	370	320	270
17	.....	3,040	4,870	1,380	855	420	320	320	270
18	.....	3,160	4,730	1,300	855	470	370	320	225
19	.....	3,280	4,590	1,300	800	525	370	320	270
20	.....	3,400	3,900	1,300	855	470	370	320	270
21	.....	2,920	3,520	1,300	800	470	320	320	270
22	.....	3,400	3,400	1,230	745	580	320	320	270
23	.....	3,770	3,160	1,230	745	800	270	320	270
24	.....	3,640	3,040	1,160	745	910	270	320	180
25	2,380	4,450	2,810	1,160	745	800	320	320	180
26	2,920	3,640	2,810	1,160	745	745	320	320	225
27	2,810	3,520	2,810	1,160	745	745	320	320	225
28	2,920	3,640	2,480	970	745	690	320	320	225
29	2,700	3,770	2,380	910	745	580	320	320	270
30	4,730	3,640	2,280	910	745	635	270	320	270
31	6,560	.....	2,280	.....	690	580	.....	320	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between 180 and 16,600 second-feet (gage heights 1.0 and 12.0 feet). Discharge Jan. 1 to Mar. 24 and Dec. 1 to 31 estimated, because of ice, from climatologic records, and records of discharge in adjacent drainage areas, as follows: Jan. 1–31, 300 second-feet; varying from about 360 to 200 second-feet; Feb. 1–29, 250 second-feet; Mar. 1–24, 770 second-feet, varying from about 400 to 1,800 second-feet; Dec. 1–31, 245 second-feet.

Monthly discharge of Minnesota River near Mankato, Minn., for 1912.

[Drainage area, 14,600 square miles.]

Month.	Discharge in second feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	300	0.021	0.02	C.
February	.....	.....	250	.017	.02	C.
March	6,560	.....	1,400	.096	.11	C.
April	8,530	2,920	4,270	.292	.33	B.
May	7,070	2,280	4,290	.294	.34	B.
June	2,180	910	1,410	.097	.11	B.
July	1,160	690	878	.060	.07	B.
August	910	420	563	.039	.04	A.
September	580	270	379	.026	.03	A.
October	370	270	310	.021	.02	B.
November	320	180	270	.018	.02	B.
December	.....	.....	245	.017	.02	C.
The year	8,530	.....	1,210	.083	1.13	

NOTE.—See footnotes to table of daily discharge.

WHETSTONE RIVER NEAR BIG STONE, S. DAK.

Location.—At the State Line bridge, one-fourth mile southeast of Big Stone and nearly a mile above the mouth.

Records available.—September 18 1909, to November 30, 1912. Records of United States Engineer Corps, September 15, 1899, to May 4, 1904. Station permanently discontinued November 30, 1912.

Drainage area.—441 square miles.

Gage.—Vertical staff.

Channel.—Somewhat shifting during flood periods.

Discharge measurements.—Made from bridge to which gage is attached and by wading.

Winter flow.—During the period 1909–1912 the winter flow has been so low that no attempt has been made to make estimates.

Floods.—The maximum flood during the period which records have been kept occurred on April 22, 1910, and amounted to 1,300 second-feet. The flow has been above 1,000 second-feet only on three days.

Artificial control.—There are no dams on the river and the flow at the gaging station is natural.

Discharge measurements of Whetstone River near Big Stone, S. Dak., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 10	S. B. Soulé	1.48	33.6	May 5	S. B. Soulé	3.24	172
10	....do	1.48	33.7	June 21[a]	W. G. Hoyt	1.20	19.4

[a] Measurement made by wading at about 100 feet above gage.

Daily gage height, in feet, of Whetstone River near Big Stone, S. Dak., for 1912.

[F. W. Thorndike, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.2	1.85	1.5	0.5	0.85	0.5	0.5	0.3
2	3.0	1.6	1.45	.5	.8	.5	.5	.3
3	2.8	1.65	1.25	.5	.65	.5	.5	.3
4	2.45	1.8	1.15	.8	.6	.5	.4	.3
5	2.0	3.6	1.1	1.2	.5	.4	.4	.3
6	1.75	4.5	1.0	1.0	.5	.4	.4	.3
7	1.7	4.0	.95	.85	.5	.4	.4	.3
8	1.6	3.0	.9	1.05	.4	.4	.4	.3
9	1.45	2.4	.9	1.2	.4	.4	.4	.3
10	1.35	2.05	.8	1.2	.4	.4	.4	.3
11	1.3	1.85	.9	1.0	.4	.4	.4	.3
12	1.25	1.8	.9	1.05	.45	.4	.4	.3
13	1.25	1.8	1.0	1.1	.5	.4	.4	.3
14	1.55	1.8	1.1	1.25	.4	.4	.4	.3
15	5.2	1.7	1.2	1.45	.4	.4	.4	.3
16	4.7	1.5	1.4	1.6	.4	.4	.4	.3
17	3.4	1.25	1.65	1.6	.4	.4	.4	.....
18	2.8	1.2	1.55	1.6	.4	.4	.3	.....
19	2.5	1.2	1.35	1.5	.5	.4	.3	.....
20	2.15	1.2	1.25	1.4	.65	.4	.3	.....
21	2.0	1.1	1.15	1.2	.65	.4	.3	.....
22	1.85	1.3	1.0	1.2	.5	.4	.3	.....
23	1.75	1.65	1.0	1.4	.5	.4	.3	.....
24	1.7	2.0	.9	1.45	.5	.4	.3	.....
25	1.75	1.75	.85	1.5	.45	.4	.3	.....
26	1.85	1.55	.7	1.45	.4	.5	.3	.....
27	2.2	1.45	.6	1.65	.4	.5	.3	.....
28	2.8	1.7	.55	1.45	.4	.5	.3	.....
29	2.6	1.95	.5	1.2	.4	.5	.3	.....
30	2.45	1.65	.5	1.0	.5	.5	.3	.....
31	.....	1.55	.....	.9	.5	.....	.3	.....

NOTE.—Relation of gage height to discharge affected by ice about Nov. 17 to 30.

Daily discharge, in second-feet, of Whetstone River near Big Stone, S. Dak., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	174	52	32	4.5	9.0	4.5	4.5	3.5
2	152	37	30	4.5	8.0	4.5	4.5	3.5
3	131	40	21	4.5	5.5	4.5	4.5	3.5
4	98	49	18	8.0	5.0	4.5	4.0	3.5
5	61	227	16	19	4.5	4.0	4.0	3.5
6	46	369	13	13	4.5	4.0	4.0	3.5
7	43	285	12	9.0	4.5	4.0	4.0	3.5
8	37	152	10	14	4.0	4.0	4.0	3.5
9	30	93	10	19	4.0	4.0	4.0	3.5
10	25	64	8.0	19	4.0	4.0	4.0	3.5
11	23	52	10	13	4.0	4.0	4.0	3.5
12	21	49	10	14	4.2	4.0	4.0	3.5
13	21	49	13	16	4.5	4.0	4.0	3.5
14	34	49	16	21	4.0	4.0	4.0	3.5
15	507	43	19	30	4.0	4.0	4.0	3.5
16	407	32	27	37	4.0	4.0	4.0	3.5
17	199	21	40	37	4.0	4.0	4.0	.....
18	131	19	34	37	4.0	4.0	3.5	.....
19	102	19	25	32	4.5	4.0	3.5	.....
20	72	19	21	27	5.5	4.0	3.5	.....

Daily discharge, in second-feet, of Whetstone River near Big Stone, S. Dak., for 1912—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	61	16	18	19	5.5	4.0	3.5	.....
22	52	23	13	19	4.5	4.0	3.5	.....
23	46	40	13	27	4.5	4.0	3.5	.....
24	43	61	10	30	4.5	4.0	3.5	.....
25	46	46	9.0	32	4.2	4.0	3.5	.....
26	52	34	6.0	30	4.0	4.5	3.5	.....
27	76	30	5.0	40	4.0	4.5	3.5	.....
28	131	43	4.8	30	4.0	4.5	3.5	.....
29	111	58	4.5	19	4.0	4.5	3.5	.....
30	98	40	4.5	13	4.5	4.5	3.5	.....
31	.....	34	.....	10	4.5	.....	3.5	.....

NOTE.—Daily discharge computed from a rating curve well defined between 5 and 467 second-feet (gage heights 0.6 and 5.0 feet). Outside of these limits the rating curve is an extension. Discharge Nov. 17 to 30, 1912, estimated, because of ice, from climatologic records and records of discharge of adjacent drainage areas at 3 second-feet.

Monthly discharge of Whetstone River near Big Stone, S. Dak., for 1912.

[Drainage area, 441 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
April	507	21	101	0.229	0.26	C.
May	369	16	69.2	.157	.18	B.
June	40	4.5	15.8	.036	.04	B.
July	40	4.5	20.9	.047	.05	B.
August	9.0	4.0	4.64	.011	.01	C.
September	4.5	4.0	4.15	.0094	.01	C.
October	4.5	3.5	3.82	.0087	.01	D.
November	.....	.....	3.27	.0074	.008	D.

NOTE.—See footnote to table of daily discharge.

LAC QUI PARLE RIVER AT LAC QUI PARLE, MINN.

Location.—At the highway bridge at Lac qui Parle in sec. 26, T. 118 N., R. 42 W., in Lac qui Parle County, a short distance above the mouth of Threemile Creek.

Records available.—April 27, 1910, to December 31, 1912.

Drainage area.—838 square miles.[1]

Gage.—Vertical staff; datum unchanged.

Channel.—Slightly shifting during flood stages.

Discharge measurements.—Made from the bridge.

Winter flow.—Observations are discontinued during the winter. During 1912 the flow has been estimated from the flow of the Minnesota at Montevideo and the Chippewa near Watson and one discharge measurement made Februray 22, 1913, at which time there was no flow.

Artificial control.—There are no dams on the stream which control its flow at the present time.

Accuracy.—Because of slight shifting of the channel and the fact that the rating curves are only fairly well defined, records at this station can not be considered better than fair.

[1] Revised since 1911 report.

Discharge measurements of Lac qui Parle River at Lac qui Parle, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 9	S. B. Soulé	2.08	76
June 21	do	2.10	107
Aug. 28[a]	do	1.10	22.2

[a] Measurement made by wading at section about 150 feet below gage.

Daily gage height, in feet, of Lac qui Parle River at Lac qui Parle, Minn., for 1912.

[Chas. A. Gould, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.5	2.75	1.90	1.15	0.80	1.02	0.80	0.88
2	3.5	2.55	1.80	1.10	.78	1.00	.85	.88
3	4.7	5.1	1.75	1.05	.72	.95	.85	.88
4	3.4	3.9	1.70	1.12	.70	.90	.88	.85
5	2.75	7.6	1.65	1.20	.80	.85	.90	.85
6	2.55	7.6	1.60	1.35	.75	.80	.90	.82
7	2.4	7.2	1.52	1.15	.72	.80	.88	.90
8	2.2	6.4	1.50	1.10	.70	.75	.88	.90
9	2.1	5.4	1.42	1.05	.72	.72	.88	.90
10	2.0	4.4	1.38	1.00	.70	.70	.88	.90
11	1.90	3.9	1.35	.95	.68	.68	.85	.90
12	1.80	3.4	1.30	1.05	.80	.65	.88	.88
13	1.75	3.3	1.32	.95	.78	.62	.85	.88
14	1.75	3.0	1.35	.95	.75	.60	.85	.88
15	1.85	2.9	1.42	.92	.72	.58	.85	.90
16	1.90	2.75	1.55	.92	.75	.60	.85	.90
17	2.25	2.65	2.8	.95	.85	.62	.85	.85
18	2.4	2.6	3.4	.90	.98	.60	.90	.75
19	2.35	2.45	2.85	.85	1.02	.60	.90	.85
20	2.2	2.4	2.35	.88	1.05	.60	.98	.88
21	2.5	2.35	2.1	.85	1.08	.60	.98	.90
22	2.0	2.3	1.95	.85	1.15	.60	.88	.88
23	1.90	2.3	1.82	1.05	1.20	.60	.90	.95
24	1.90	2.25	1.72	1.10	1.12	.60	.90	.82
25	1.90	2.25	1.62	1.08	1.12	.72	.90	.85
26	2.15	2.2	1.52	1.02	1.20	.72	.88	1.00
27	2.3	2.1	1.45	1.02	1.12	.75	.88	.....
28	2.2	2.05	1.35	1.05	1.10	.75	.85	.....
29	3.0	2.0	1.30	1.00	1.05	.78	.88	.....
30	2.85	1.95	1.20	.95	1.02	.75	.82	.....
31	.....	1.90	.....	.88	.98	.....	.85	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 5 and about Nov. 26 to Dec. 31.

Daily discharge, in second-feet, of Lac qui Parle River at Lac qui Parle, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	151	85	24	9	18	9	12
2	.....	124	75	22	9	17	11	12
3	.....	670	70	20	7	15	11	12
4	.....	350	66	23	7	13	12	11
5	.....	1,550	62	27	9	11	13	11
6	124	1,550	57	36	8	9	13	10
7	107	1,390	50	24	7	9	12	13
8	87	1,100	48	22	7	8	12	13
9	77	760	42	20	7	7	12	13
10	68	510	39	17	7	7	12	13
11	60	410	36	15	7	7	11	13
12	53	310	33	20	9	6	12	12
13	50	290	34	15	9	5	11	12
14	50	235	36	15	8	5	11	12
15	56	220	42	14	7	5	11	13

Daily discharge, in second-feet, of Lac qui Parle River at Lac qui Parle, Minn., for 1912—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	60	198	52	14	8	5	11	13
17	92	182	205	15	11	5	11	11
18	107	175	310	13	16	5	13	8
19	102	152	212	11	18	5	13	11
20	87	145	138	12	20	5	16	12
21	118	138	107	11	21	5	16	13
22	68	132	90	11	24	5	12	12
23	60	132	77	20	27	5	13	15
24	60	126	68	22	23	5	13	10
25	60	126	59	21	23	7	13	11
26	82	119	50	18	27	7	12	.....
27	97	107	44	18	23	8	12	.....
28	87	101	36	20	22	8	11	.....
29	188	95	33	17	20	9	12	.....
30	166	90	27	15	18	8	10	.....
31	.....	85	.....	12	16	.....	11	.....

NOTE.—Daily discharge prior to May 6 computed from a rating curve fairly well defined between 12 and 375 second-feet (gage heights 1.0 and 4.0 feet), and after May 7 from a rating curve not well defined. In making the computations the rating tables were used to whole second-feet only. Discharge Jan. 1 to Mar. 31 and Nov. 26 to Dec. 31 estimated, because of ice from climatologic records, discharge measurement and comparison of record of flow at Odessa, Watson, and Montevideo, as follows: Jan. 1–31, 3 second-feet; Feb. 1–29, 2 second-feet; Mar. 1–31, 10 second-feet; Apr. 1–5, 50 second-feet; Nov. 26–30, 9 second-feet, varying from about 10 to 8 second-feet; Dec. 1–31, 5 second-feet. (Discharge measurement made Feb. 22, 1913, showed zero discharge on that date.)

Monthly discharge of Lac qui Parle River at Lac qui Parle, Minn., for 1912.

[Drainage area, 838 square miles.[a]]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	3	0.0036	0.004	
February	.....	.....	2	.0024	.003	
March	.....	.....	10	.012	.01	
April	188	.....	80.5	.096	.11	C.
May	1,550	85	378	.451	.52	C.
June	310	27	76.1	.091	.10	C.
July	36	11	18.2	.022	.03	D.
August	27	7	14.0	.017	.02	D.
September	18	5	7.8	.0093	.01	D.
October	16	9	12.0	.014	.02	D.
November	15	.....	11.4	.014	.02	D.
December	.....	.....	5.0	.0060	.007	
The year	1,550	.....	51.9	.062	1.85	

[a] Revised since 1911 report.

NOTE.—See footnotes to table of daily discharge.

CHIPPEWA RIVER NEAR WATSON, MINN.

Location.—At highway bridge 2½ miles northeast of Watson, on line between secs. 10 and 15, T. 118 N., R. 41 W., 10 miles above the mouth of the river and about 2 miles below the mouth of Dry Weather Creek.

Records available.—July 6, 1909, to December 31, 1912.

Drainage area.—1,940 square miles.

Gage.—Chain gage attached to bridge; datum unchanged.

Channel.—Somewhat shifting.

Discharge measurements.—Made from bridge and by wading.

Winter flow.—The flow during the period of ice in 1912 has been based on the direct relation between the flow at Montevideo and Watson supplemented by a few discharge measurements.

Artificial control.—There was formerly possibly some slight control from a flour mill working under an 8-foot head, but this dam is at present out, so that the flow is natural. There is no backwater at the station from the dam at Montevideo.

Discharge measurements of Chippewa River near Watson, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 9[a]	C. J. Emerson	5.13	6.3	Apr. 9	S. B. Soulé	6.70	360
Feb. 9[b]	S. B. Soulé	5.28	1.7	June 2	W. G. Hoyt	5.24	123
Mar. 24[c]	do	6.07	14.6	Aug. 28[d]	S. B. Soulé	4.42	42.6

[a] Measurement made under complete ice cover; average distance water surface to bottom of ice 1.00 foot; average thickness, 1.10 feet.
[b] Complete ice cover; average thickness of ice, 2.14 feet; average distance water surface to top of ice, 0.56 foot.
[c] Section about 150 feet below gage. Complete ice cover; average thickness of ice, 1.30 feet; average distance water surface to top of ice, 0.10 foot.
[d] Wading measurement, 100 feet above gage.

Daily gage height, in feet, of Chippewa River near Watson, Minn., for 1912.

[Clifford Bonde, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1			5.8	5.95	6.25	6.3	4.60	4.50	4.48	4.70	4.62
2	5.2	5.15		5.8	6.25	6.25	4.60	4.48	4.48	4.70	4.65
3				5.7	9.7	6.2	4.62	4.42	4.45	4.68	4.68
4			5.5	6.7	10.3	6.0	4.60	4.42	4.45	4.65	4.68
5		5.2		7.9	10.7	6.0	4.68	4.50	4.45	4.60	4.65
6	5.2			6.9	10.9	5.9	4.60	4.55	4.42	4.62	4.55
7			5.65	6.9	11.0	5.9	4.72	4.60	4.42	4.65	4.65
8	5.4			6.8	11.1	5.7	4.68	4.50	4.40	4.65	4.60
9	5.1	5.3		6.8	10.9	5.65	4.65	4.55	4.38	4.68	4.60
10				6.6	10.6	5.6	4.60	4.55	4.38	4.68	4.62
11	4.75		5.7	6.45	10.3	5.5	4.52		4.35	4.70	4.61
12		5.2		6.4	10.0	5.5	4.62	4.55	4.40	4.72	4.58
13					9.6	5.6	4.55	4.58	4.38	4.70	4.60
14			5.9		9.1	5.5	4.55	4.52	4.38	4.68	4.62
15	4.65	5.6			8.8	5.5	4.58	4.52	4.40	4.68	4.62
16				6.2	8.6	5.5	4.48	4.55	4.38	4.68	4.60
17				6.15	8.3	5.45	4.48	4.55	4.48	4.68	4.68
18	4.75		5.9	6.15	8.1	5.4	4.42	4.58		4.68	4.70
19				6.15	8.0	5.4	4.50	4.55	4.58	4.70	4.70
20				6.1	7.6	5.35	4.50	4.52	4.40	4.68	4.60
21			6.0	6.1	7.4	5.25	4.48	4.58	4.48	4.65	4.58
22		5.6		6.05	7.3	5.15	4.52	4.58	4.45	4.65	4.55
23				6.0	7.2		4.50	4.52	4.40	4.62	4.60
24	5.3			5.95	7.0	4.98	4.72	4.45	4.42	4.62	4.62
25			6.0	5.9	6.9	4.92	4.68	4.30	4.65	4.62	4.71
26		5.8		6.0	6.6	4.88	4.62	4.28	4.60	4.61	4.70
27	5.2			6.1	6.6	4.80	4.62		4.60	4.61	4.70
28			6.2	6.1	6.6	4.68	4.58	4.50	4.58	4.62	4.68
29				6.2	6.6	4.65	4.58	4.40	4.68	4.60	4.65
30	4.75			6.2	6.5	4.60	4.60	4.42	4.70	4.60	4.62
31					6.4		4.58	4.48		4.65	

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 4 and about Nov. 25 to Dec. 31.

Daily discharge, in second-feet, of Chippewa River near Watson, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	273	282	57	49	48	65	59
2	.....	273	273	57	48	48	65	61
1	.....	1,220	264	59	44	46	63	63
4	.....	1,440	230	57	44	46	61	63
5	650	1,580	230	63	49	46	57	61
6	403	1,640	214	57	53	44	59	53
7	403	1,680	214	67	57	44	61	61
8	381	1,720	184	63	49	43	61	57
9	381	1,640	177	61	53	42	63	57
10	340	1,540	170	57	53	42	63	59
11	310	1,440	156	51	53	40	65	58
12	300	1,330	156	59	53	43	67	55
13	291	1,190	170	53	55	42	65	57
14	282	1,020	156	53	51	42	63	59
15	273	920	156	55	51	43	63	59
16	264	860	156	48	53	42	63	57
17	255	770	149	48	53	48	63	63
18	255	710	142	44	55	52	63	65
19	255	680	142	49	53	55	65	65
20	246	575	136	49	51	43	63	57
21	246	525	124	48	55	48	61	55
22	238	500	112	51	55	46	61	53
23	230	475	102	49	51	43	59	57
24	222	425	93	67	46	44	59	59
25	214	403	87	63	37	61	59	59
26	230	340	83	59	36	57	58	59
27	246	340	75	59	42	57	58	59
28	246	340	63	55	49	55	59	59
29	264	340	61	55	43	63	57	59
30	264	320	57	57	44	65	57	59
31	.....	300	.....	55	48	.....	61	.....

NOTE.—Daily discharge computed from a rating curve well defined between discharges 37 and 830 second-feet (gage heights 4.3 and 8.5 feet). Discharge interpolated for days for which gage heights are missing. Discharge Jan. 1, 1912 to Apr. 4, 1912, and Nov. 25 to Dec. 31 estimated, because of ice, from climatologic records, discharge measurements, gage heights, and comparison with the flow at Montevideo, as follows: Jan. 1–31, 6 second-feet, varying from about 10 to 3 second-feet; Feb. 1–29, 5 second-feet, varying from about 2 to 10 second-feet; Mar. 1–27, 12 second-feet, varying from about 10 to 15 second-feet; Mar. 28 to Apr. 4, 200 second-feet, varying from about 20 to 300 second-feet; Dec. 1–31, 45 second-feet.

Monthly discharge of Chippewa River near Watson, Minn., for 1912.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	6	0.0031	0.004	D.
February	.....	.....	5	.0026	.003	D.
March	.....	.....	20	.010	.01	D.
April	650	.....	283	.146	.16	B.
May	1,720	273	865	.446	.51	A.
June	282	57	154	.079	.09	A
July	67	44	55.6	.029	.03	B.
August	57	36	49.5	.026	.03	B.
September	65	40	47.9	.025	.03	B.
October	67	57	61.5	.032	.04	B.
November	65	.....	58.9	.030	.03	C.
December	.....	.....	45	.023	.03	C.
The year	1,720	.....	138	.071	.97	

NOTE.—See footnotes to tables of daily gage height and daily discharge.

REDWOOD RIVER NEAR REDWOOD FALLS, MINN.

Location.—At the first highway bridge above Redwood Falls, 3 miles distant.

Records available.—July 2, 1909, to December 31, 1912.

Drainage area.—703 square miles.

Gage.—Chain gage attached to bridge—datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Made from the bridge except at low stages when they are made by wading at different sections.

Winter flow.—Ice exists from December to March, and discharge measurements are made to determine the winter flow.

Artificial control.—The flow at the gaging station is natural, as there are no dams above. Below the station a dam at Redwood Falls creates a pond extending for a considerable distance upstream but backwater does not reach the gaging station.

Discharge measurements of Redwood River near Redwood Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 8[a]	C. J. Emerson	1.6	0.40	Aug. 29[c]	S. B. Soulé	1.72	5.4
Apr. 11	S. B. Soulé	2.20	57.7	29	do	[d]1.1	
Aug. 29[b]	do	1.72	6.1				

[a] Complete ice cover. Average thickness, 0.80 foot; average distance water surface to top of ice, 0.00 foot.
[b] Wading measurement, 1,000 feet above gage.
[c] Wading measurement, 1,100 feet above gage.
[d] Point of zero flow.

Daily gage height, in feet, of Redwood River near Redwood Falls, Minn., for 1912.

[Wallace Stuart, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		2.62	2.12	1.70	1.60	1.73	1.75	2.05
2		2.55	2.10	1.85	1.70	1.75	1.85	2.05
3		2.45	2.08	2.05	1.70	1.73	1.90	2.02
4		2.50	2.05	2.65	1.70	1.70	1.90	2.00
5		2.60	2.02	2.00	1.60	1.70	1.75	1.92
6		2.70	2.00	1.90	1.70	1.75	1.95	2.00
7		2.72	1.98	1.87	1.70	1.75	1.95	2.00
8		2.70	1.95	1.80	1.75	1.75	2.00	2.00
9		2.70	1.95	1.85	1.73	1.75	2.00	2.00
10		2.70	1.95	1.70	1.60	1.73	1.88	
11	2.20	2.52	1.90	1.80	1.65	1.75	2.00	1.95
12	2.20	2.45	2.00	1.80	1.65	1.75	2.10	2.00
13	2.25	2.30	1.95	1.77	1.65	1.73	2.10	2.00
14	2.20	2.20	2.00	1.70	1.65	1.73	2.00	1.95
15	2.20	2.25	2.08	1.65	1.55		1.85	1.90
16	1.98	2.30	2.05	1.75	1.75	1.70	1.95	2.00
17	2.20	2.35	2.05	1.73	1.75	1.75	1.95	1.95
18	2.25	2.30	2.00	1.73	1.75	1.80	2.00	1.95
19	2.22	2.30	1.95	1.75	1.85	1.75	2.10	1.95
20	2.20	2.22	1.95	1.63	1.70	1.70	1.95	1.90
21	2.28	2.50	1.95	1.80	1.80	1.73	2.00	1.98
22	2.22	2.50	1.92	1.75	1.80	1.75	2.05	2.00
23	2.25	2.40	1.90	1.80	1.80	1.78	2.05	2.00
24	2.25	2.35	1.88	1.75	1.80	1.75	2.05	1.98
25	2.45	2.20	1.88	1.60	1.70	1.85	1.90	1.90
26	2.45	2.25	1.85	1.77	1.80	1.85	1.96	1.98
27	2.40	2.20	1.85	1.80	1.75	1.85	2.05	1.95
28	2.55	2.15	1.82	1.80	1.73	1.85	2.00	1.98
29	2.55	2.10	1.82	1.77	1.73	1.83	2.05	2.00
30	2.60	2.15	1.80	1.67	1.77	1.85	1.96	1.88
31		2.12		1.70	1.77		2.00	

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 10, and about Dec. 1 to 31.

Daily discharge, in second-feet, of Redwood River near Redwood Falls, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	152	42	6	4	7.5	8.5	32
2	.....	134	39	14	6	8.5	14	32
3	.....	110	36	32	6	7.5	17	29
4	.....	122	32	160	6	6	17	26
5	.....	146	29	26	4	6	8.5	19
6	.....	174	26	17	6	8.5	22	26
7	.....	180	24	15	6	8.5	22	26
8	.....	174	22	11	8.5	8.5	26	26
9	.....	174	22	14	7.5	8.5	26	26
10	.....	174	22	6	4	7.5	16	24
11	56	127	17	11	5	8.5	26	22
12	56	110	26	11	5	8.5	39	26
13	66	76	22	10	5	7.5	39	26
14	56	56	26	6	5	7.5	26	22
15	56	66	36	5	3.5	7	14	17
16	24	76	32	8.5	8.5	6	22	26
17	56	88	32	7.5	8.5	8.5	22	22
18	66	76	26	7.5	8.5	11	26	22
19	60	76	22	8.5	14	8.5	39	22
20	56	60	22	4.6	6	6	22	17
21	72	122	22	11	11	7.5	26	24
22	60	122	19	8.5	11	8.5	32	26
23	66	99	17	11	11	10	32	26
24	66	88	16	8.5	11	8.5	32	24
25	110	56	16	4	6	14	17	17
26	110	66	14	9.5	11	14	22	24
27	99	56	14	11	8.5	14	32	22
28	134	48	12	11	7.5	14	26	24
29	134	39	12	9.5	7.5	13	32	26
30	146	48	11	5.4	9.5	14	22	16
31	.....	42	.....	6	9.5	.....	26	.....

NOTE.—Daily discharge computed from a fairly well-defined rating curve. Discharge Sept. 15 and Nov. 10 interpolated. Discharge Jan. 1 to Apr. 10 and Dec. 1 to 31 estimated, because of ice and absence of gage reader, from climatologic records, one discharge measurement, and discharge of adjacent drainage areas, as follows: Jan. 1–30, 1 second-foot; Feb. 1–29, 2 second-feet; Mar. 1–31, 10 second-feet; Apr. 1–10, 20 second-feet; Dec. 1–31, 10 second-feet.

Monthly discharge of Redwood River near Redwood Falls, Minn., for 1912.

[Drainage area, 703 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	1	0.0014	0.002	
February	.....	.....	2	.0028	.003	
March	.....	.....	10	.014	.02	
April	146	.....	58.3	.083	.09	C.
May	180	39	101	.144	.17	B.
June	42	11	23.6	.034	.04	B.
July	160	4	15.4	.022	.03	B.
August	14	3.5	7.44	.011	.01	B.
September	14	6	9.12	.013	.01	B.
October	39	8.5	24.2	.034	.04	B.
November	32	16	23.9	.034	.04	C.
December	.....	.....	10.0	.014	.02	
The year	180	.....	23.9	.034	.48	

NOTE.—See footnotes to table of daily discharge.

COTTONWOOD RIVER NEAR NEW ULM, MINN.

Location.—At Alwin highway bridge, 2 miles southeast of New Ulm, in sec. 31, T. 110 N., R. 30 W., 15 miles below the mouth of Sleepy Eye Creek, the nearest tributary.

Records available.—July 2, 1909, to December, 1912.

Drainage area.—1,190 square miles.

Gage.—Chain gage attached to bridge. On August 12, 1909, the datum of the gage was lowered 2.28 feet. All readings prior to that date have been corrected, so that all gage heights refer to the new datum.

Channel.—Slightly shifting, as shown by low-water measurements.

Discharge measurements.—Made from the bridge, except during extreme low water, when they are made by wading.

Winter flow.—Affected by ice.

Artificial control.—There are no dams above the gaging station, so that the flow of the river is natural at the station. Backwater from the dam of New Ulm does not extend to the gaging station.

Discharge measurements of Cottonwood River near New Ulm, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 6[a]	C. J. Emerson	2.09	22.3	June 19[d]	W. G. Hoyt	1.95	89.1
Feb. 8[b]	S. B. Soulé	2.70	13.5	Aug. 29[d]	S. B. Soulé	1.22	18.6
Mar. 19[c]	do	3.75	94.0	29[e]	do	1.22	20.5
Apr. 11	do	2.47	188	Dec. 27[f]	do	1.93	9.7

[a] Complete ice cover; average thickness of ice, 1.00 foot; average distance water surface to top of ice, 0.25 foot.
[b] Complete ice cover; average thickness of ice, 1.83 feet; average distance water surface to top of ice, 0.00 foot.
[c] Measuring section about 200 feet above gage. Complete ice cover; average thickness of ice, 1.46 feet; average distance water surface to top of ice, 0.09 foot.
[d] Wading measurement 60 feet below gage.
[e] Wading measurement 80 feet below gage.
[f] Complete ice cover; average thickness of ice, 0.67 foot.

Daily gage height, in feet, of Cottonwood River near New Ulm, Minn., for 1912.

[Ester Alwin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.55	.....	4.8	2.5	1.75	1.30	1.15	1.28	1.20	1.25	.....
2	.....	.....	.....	4.2	2.45	1.62	1.30	1.15	1.28	1.20	1.25	2.0
3	.....	.....	.....	3.9	2.6	1.60	1.30	1.15	1.28	1.18	1.25	.....
4	2.15	.....	.....	3.75	2.7	1.60	1.30	1.15	1.28	1.12	1.25	.....
5	.....	2.6	.....	3.4	2.65	1.58	1.39	1.18	1.26	1.10	1.25	.....
6	2.1	.....	.....	3.25	2.3	1.56	1.42	1.18	1.25	1.12	1.25	.....
7	.....	.....	.....	3.2	2.25	1.55	1.52	1.19	1.20	1.16	1.25	.....
8	2.15	2.75	.....	2.9	2.2	1.65	1.55	1.20	1.20	1.18	1.25	.....
9	.....	.....	.....	2.75	2.2	1.60	1.62	1.22	1.18	1.14	1.25	2.3
10	.....	.....	.....	2.65	2.2	1.58	1.75	1.22	1.18	1.12	1.25	.....
11	2.2	.....	3.65	2.45	2.15	1.45	1.75	1.15	1.18	1.12	1.25	.....
12	.....	2.9	.....	2.4	2.15	1.42	1.96	1.15	1.14	1.18	1.25	.....
13	.....	.....	.....	2.4	2.1	1.40	1.65	1.14	1.10	1.26	1.25	.....
14	.....	.....	3.75	2.5	2.2	1.51	1.38	1.12	1.05	1.28	1.25	.....
15	2.35	2.9	.....	2.55	2.2	1.80	1.36	1.12	1.05	1.29	1.25	.....
16	.....	.....	.....	2.55	2.2	1.90	1.32	1.11	1.10	1.30	1.25	2.6
17	.....	.....	.....	2.55	2.15	1.88	1.30	1.10	1.12	1.35	1.28	.....
18	2.4	.....	3.9	2.65	2.2	1.85	1.25	1.29	1.18	1.35	1.28	.....
19	.....	.....	3.7	2.65	2.05	1.90	1.28	1.45	1.18	1.30	1.28	.....
20	.....	.....	.....	2.65	2.0	2.0	1.35	1.58	1.15	1.28	1.28	.....
21	.....	.....	3.95	2.55	1.90	1.86	1.30	1.62	1.15	1.28	1.28	.....
22	2.4	.....	.....	2.55	1.85	1.65	1.30	1.60	1.12	1.28	1.28	.....
23	.....	.....	.....	2.45	1.85	1.58	1.30	1.56	1.12	1.28	1.28	2.7
24	.....	.....	.....	2.5	1.85	1.50	1.25	1.52	1.11	1.28	1.39	.....
25	2.4	.....	4.0	2.55	1.85	1.50	1.24	1.50	1.10	1.26	1.48	.....
26	.....	.....	.....	2.6	1.80	1.45	1.22	1.42	1.15	1.25	1.50	.....
27	.....	.....	.....	2.65	1.78	1.38	1.20	1.35	1.18	1.25	1.50	1.93
28	.....	.....	4.15	2.85	1.88	1.38	1.20	1.30	1.18	1.25	1.48	.....
29	2.5	.....	.....	2.8	1.88	1.35	1.18	1.25	1.18	1.25	1.48	.....
30	.....	.....	.....	2.7	1.86	1.30	1.18	1.28	1.19	1.25	1.48	2.8
31	.....	.....	.....	.....	1.85	.....	1.16	1.28	.....	1.25	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 5 and about Nov. 24 to Dec. 31.

Daily discharge, in second-feet, of Cottonwood River near New Ulm, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	197	64	24	14	23	17	20
2	.....	185	50	24	14	23	17	20
3	.....	222	48	24	14	23	16	20
4	.....	250	48	24	14	23	13	20
5	.....	236	46	31	16	21	12	20
6	420	151	45	34	16	20	13	20
7	404	141	44	42	16	17	15	20
8	309	131	53	44	17	17	16	20
9	264	131	48	50	18	16	14	20
10	236	131	46	64	18	16	13	20
11	185	122	36	64	14	16	13	20
12	173	122	34	91	14	14	16	20
13	173	113	32	53	14	12	21	20
14	197	131	41	30	13	10	23	20
15	210	131	70	29	13	10	23	20
16	210	131	83	26	12	12	24	20
17	210	122	80	24	12	13	28	23
18	236	131	76	20	23	16	28	23
19	236	105	83	23	36	16	24	23
20	236	97	97	28	46	14	23	23
21	210	83	78	24	50	14	23	23
22	210	76	53	24	48	13	23	23
23	185	76	46	24	45	13	23	23
24	197	76	40	20	42	12	23	.....
25	210	76	40	20	40	12	21	.....
26	222	70	36	18	34	14	20	.....
27	236	68	30	17	28	16	20	.....
28	294	80	30	17	24	16	20	.....
29	279	80	28	16	20	16	20	.....
30	250	78	24	16	23	16	20	.....
31	.....	76	.....	15	23	.....	20	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Jan. 1 to Apr. 5 and Nov. 24 to Dec. 31 estimated, because of ice, from climatologic records discharge measurements, and gage heights, as follows: Jan. 1–31, 1912, 20 second-feet, varying from about 30 to 18 second-feet; Feb. 1–29, 15 second-feet, varying from about 18 to 13 second-feet; Mar. 1–31, 90 second feet; Apr. 1–5, 200 second-feet; Nov. 24–30, 23 second-feet; Dec. 1–31, 15 second-feet.

Monthly discharge of Cottonwood River near New Ulm, Minn., for 1912.

[Drainage area, 864 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	20	0.023	0.03	D.
February	.....	.....	15	.017	.02	D.
March	.....	.....	90	.104	.12	C.
April	.....	.....	233	.270	.30	C.
May	250	68	123	.142	.16	B.
June	97	24	51.0	.059	.07	B.
July	91	15	31.0	.036	.04	B.
August	50	12	23.6	.027	.03	C.
September	23	10	15.8	.018	.02	C.
October	28	12	19.4	.022	.03	C.
November	.....	.....	21.4	.025	.03	C.
December	.....	.....	15	.017	.02	C.
The year	250	.....	54.8	.063	.87	

NOTE.—See footnotes to tables of daily gage height and daily discharge.

ST. CROIX RIVER NEAR ST. CROIX FALLS, WIS.

Location.—At the power plant of the Minneapolis General Electric Co. on the Wisconsin side of St. Croix River near St. Croix Falls, Wis., about 50 miles above the confluence of St. Croix and Mississippi rivers near Hastings, Minn. Apple River, draining an area wholly in Wisconsin, enters from the left about 2 miles below the station; Snake River enters from the right about 35 miles above the station.

Records available.—January 10, 1902, to June 30, 1905; January 1, 1910, to December 31, 1912. Data for 1903 published in Water-Supply Paper 98, pp. 176–177, under "St. Croix near Taylors Falls, Minn." Daily and monthly discharge January 10, 1902, to June 30, 1905, and January 1, 1910, to October 31, 1912, published also in the report on "Water resources of Minnesota" by the State Drainage Commission.

Drainage area.—5,930 square miles.

Discharge.—Discharge determined from kilowatt output of dynamo and exciters plus the flow over the dam and spillway, considered as a weir.

Cooperation.—Records furnished by the Minneapolis General Electric Co.

Daily discharge, in second-feet, of St. Croix River near St. Croix Falls., Wis., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,470	1,420	1,670	4,790	8,560	8,510	2,260	1,210	1,030	1,830	1,790	1,610
2	2,190	1,110	1,720	5,960	6,890	7,500	1,640	1,940	1,410	1,760	1,920	1,540
3	2,040	1,660	920	6,090	7,050	7,370	1,550	1,790	1,770	1,600	1,510	1,350
4	2,070	1,110	1,820	5,670	10,800	6,880	989	922	2,110	1,780	1,630	1,940
5	1,660	1,460	1,120	8,350	18,900	5,400	1,700	866	2,530	1,960	1,520	1,920
6	1,650	1,260	1,310	9,670	33,500	4,590	1,580	1,710	2,750	1,530	1,780	1,740
7	1,230	1,420	1,370	8,470	28,700	4,100	866	1,700	2,830	1,340	1,630	1,360
8	1,510	1,510	1,670	6,590	24,300	4,340	1,910	1,170	1,900	2,360	1,740	1,070
9	1,620	1,430	1,700	8,040	19,100	4,170	1,820	1,500	1,980	2,060	1,750	1,360
10	1,570	1,580	930	7,420	14,200	4,580	3,830	2,010	2,310	1,740	1,590	1,190
11	1,580	1,180	1,680	4,170	11,400	2,700	2,850	928	4,450	1,750	1,770	1,260
12	1,320	2,000	1,350	5,140	9,830	2,530	1,380	1,880	2,140	1,960	1,600	1,240
13	1,730	1,160	1,220	5,400	8,740	2,570	1,380	2,140	2,280	1,690	1,590	1,230
14	1,280	1,280	1,480	5,340	7,230	2,440	822	2,080	2,120	2,020	1,660	1,430
15	1,010	1,420	1,750	5,780	9,540	2,230	5,160	2,010	1,300	2,090	1,560	1,650
16	1,290	1,460	1,710	5,890	8,330	2,540	2,090	1,760	2,240	2,100	1,740	1,440
17	940	1,750	900	8,260	7,920	3,230	1,720	1,640	2,390	2,090	1,340	1,680
18	1,280	950	1,650	6,420	4,950	3,940	1,670	1,120	2,120	2,060	1,640	1,530
19	1,410	1,860	1,390	7,280	4,040	3,480	1,680	2,170	1,800	2,000	1,560	1,410
20	1,620	1,240	1,420	6,430	4,520	2,300	1,560	2,430	1,900	1,840	1,630	1,610
21	1,120	1,310	1,930	6,070	4,610	2,270	899	2,510	2,010	1,900	1,630	1,790
22	1,440	1,570	1,900	5,480	4,510	2,500	1,940	2,380	1,410	1,720	1,630	1,440
23	1,380	1,470	1,970	5,560	4,760	1,550	1,620	2,080	1,910	1,830	1,720	1,350
24	1,430	1,830	710	5,240	4,870	2,140	1,690	1,690	1,800	1,750	1,460	1,850
25	1,430	970	1,890	5,610	5,220	2,330	1,620	937	1,960	1,840	1,520	1,220
26	1,420	1,980	1,490	5,990	4,330	2,360	1,770	1,820	1,820	2,080	876	1,790
27	1,510	1,520	1,860	9,590	5,130	2,620	1,640	1,910	2,000	1,580	1,190	1,500
28	1,170	1,490	1,950	11,300	5,510	2,650	823	1,860	1,990	1,700	1,300	1,690
29	1,810	1,570	1,910	10,500	5,550	2,450	1,530	1,940	1,300	1,800	949	1,480
30	1,550	.....	1,830	8,910	4,960	1,470	1,900	2,000	2,140	1,760	1,350	1,450
31	1,430	.....	1,460	.....	5,270	.....	1,820	1,930	.....	1,710	.....	1,100

Monthly discharge of St. Croix River near St. Croix Falls, Wis., for 1912.

[Drainage area, 5,930 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	2,190	940	1,490	0.251	0.29
February	2,000	950	1,450	.245	.26
March	1,970	710	1,540	.260	.30
April	11,300	4,170	6,850	1.16	1.29
May	33,500	4,040	9,780	1.65	1.90
June	8,510	1,470	3,590	.605	.68
July	5,160	822	1,800	.304	.35
August	2,510	866	1,740	.293	.34
September	4,450	1,030	2,060	.347	.39
October	2,360	1,340	1,850	.312	.36
November	1,920	876	1,550	.261	.29
December	1,940	1,070	1,490	.251	.29
The year	33,500	710	2,930	.494	6.74

NOTE.—Computed by engineers of the United States Geological Survey from records of daily discharge furnished by the Minneapolis General Electrical Co.

KETTLE RIVER NEAR SANDSTONE, MINN.

Location.—At the quarries of the Barber Asphalt Co. at Benning, 3 miles above Sandstone; no tributaries within several miles.

Records available.—October 18, 1908, to December 31, 1912.

Drainage area.—825 square miles.

Gage.—Staff gage in two sections, fastened to vertical rock walls. Gage datum subsequent to April 25, 1912, may differ not more than about 0.02 foot from datum of previous years.

Channel.—Permanent; bedrock.

Artificial control.—The nearest dam is at Sandstone, 3 miles below, but the station is above its influence.

Winter flow.—The gage is 50 feet above decided rapids which remain open except during periods of extremely cold weather, when they freeze and cause backwater. During January, 1912, backwater existed at the gage ranging from half a foot to 1.2 feet.

Accuracy.—The rating curve used for 1911 has been revised above gage height 3.0 feet on the basis of measurements made by the Geological Survey. The curve used below 3.0 feet is one furnished by the Kettle River Co. Below gage height 1.2 feet the rating curve is an extension and discharge values obtained from it below that point should be used with caution as they may be 100 per cent in error at gage height 0.7 foot.

Cooperation.—Station maintained in cooperation with the Kettle River Co.

Discharge measurements of Kettle River near Sandstone, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 11[a]	S. B. Soulé	2.58	131	May 16[b]	S. B. Soulé	4.02	1,730
Apr. 25[b]	do	3.20	915	16[b]	do	3.99	1,680
May 10[b]	do	5.35	3,140				

[a] Complete ice cover section about 600 feet below gage.
[b] Measurement made from highway bridge about 5,000 feet above gage.

Daily gage height, in feet, of Kettle River near Sandstone, Minn., for 1912.

[D. R. Smith, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2.8	1.9	2.2	2.35	5.6	3.3	1.6	1.4	1.9	1.35	1.3
2	2.8	1.9	2.2	2.4	5.6	3.25	1.55	1.35	1.85	1.3	1.3
3	2.8	1.9	2.15	2.75	5.7	3.3	1.5	1.35	1.75	1.25	1.3
4	2.8	1.9	2.0	3.2	6.4	3.2	1.5	1.35	1.65	1.2	1.3
5	2.7	1.95	1.6	3.6	7.2	3.1	1.65	1.3	1.6	1.3	1.3
6	2.6	1.95	1.4	3.6	7.5	3.1	1.7	1.65	1.6	1.3	1.3
7	2.7	2.0	1.3	3.7	7.6	2.9	1.65	1.7	1.6	1.35	1.3
8	2.6	2.0	1.1	4.0	6.6	2.85	1.7	1.6	1.55	1.3	1.3
9	2.55	2.1	1.1	3.8	6.1	2.7	1.75	1.6	1.55	1.25	1.3
10	2.6	2.1	1.1	3.6	5.3	2.6	1.7	1.5	1.5	1.2	1.3
11	2.58	2.0	1.0	3.6	5.1	2.4	1.65	1.45	1.45	1.25	1.3
12	2.5	2.0	1.1	3.4	5.0	2.35	1.6	1.4	1.45	1.5	1.3
13	2.5	1.9	1.1	3.2	4.8	2.2	1.65	1.4	1.45	1.45	1.3
14	2.45	1.9	1.15	3.1	4.7	2.3	1.6	1.35	1.4	1.4	1.3
15	2.4	2.0	1.15	3.1	4.3	2.4	1.5	1.35	1.4	1.4	1.3
16	2.4	2.1	1.1	3.0	4.0	3.0	1.45	1.4	1.4	1.35	1.3
17	2.3	2.1	1.1	3.1	3.7	2.85	1.4	1.4	1.45	1.35	1.25
18	2.3	2.0	1.15	3.5	3.6	2.8	1.4	1.45	1.45	1.35	1.2
19	2.2	2.0	1.0	3.8	3.6	2.7	1.45	1.5	1.4	1.35	1.2
20	2.2	2.0	1.0	3.8	3.4	2.7	1.5	1.45	1.35	1.35	1.15
21	2.2	2.1	1.05	3.7	3.6	2.5	1.5	1.4	1.35	1.35	1.1
22	2.2	2.1	1.1	3.8	4.2	2.3	1.55	1.35	1.35	1.35	1.05
23	2.1	2.3	1.15	3.7	4.0	2.25	1.5	1.35	1.3	1.3	1.0
24	2.15	2.3	1.1	3.6	3.9	2.1	1.6	1.3	1.35	1.3	1.0
25	2.1	2.35	1.2	3.2	3.8	1.9	1.5	1.3	1.4	1.3	.95
26	2.0	2.35	1.2	4.6	3.7	1.85	1.5	1.35	1.5	1.25	.9
27	2.1	2.3	1.4	5.5	3.7	1.8	1.45	1.3	1.45	1.3	.8
28	2.1	2.3	1.65	5.8	3.6	1.7	1.45	1.6	1.4	1.3	.8
29	2.1	2.25	1.7	5.2	3.4	1.6	1.4	1.65	1.3	1.3	.75
30	2.0	.....	1.8	5.1	3.4	1.6	1.4	1.7	1.3	1.3	.7
31	2.0	.....	2.0	.....	3.3	.....	1.45	1.9	.....	1.3	.....

NOTE.—Gage heights Jan. 3 to Apr. 25, may be in error from 0.05 to 0.1 foot as a result of damage to gage. Gage datum subsequent to Apr. 25 may differ not more than about 0.02 foot from datum of previous years. Gage not read during December as a result of a misunderstanding.

Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 7 and about Dec. 1 to 31.

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	490	3,440	1,090	186	136	288	124	112
2	.....	515	3,440	1,050	173	124	269	112	112
3	.....	705	3,560	1,090	160	124	233	101	112
4	.....	1,010	4,390	1,010	160	124	201	90	112
5	.....	1,340	5,390	935	201	112	186	112	112
6	.....	1,340	5,770	935	216	201	186	112	112
7	.....	1,430	5,900	800	201	216	186	124	112
8	70	1,700	4,640	768	216	186	173	112	112
9	70	1,520	4,030	675	233	186	173	101	112
10	70	1,340	3,100	620	216	160	160	90	112
11	52	1,340	2,860	515	201	148	148	101	112
12	70	1,170	2,750	490	186	136	148	160	112
13	70	1,010	2,530	420	201	136	148	148	112
14	80	935	2,420	465	186	124	136	136	112
15	80	935	1,990	515	160	124	136	136	112
16	70	865	1,700	865	148	136	136	124	112
17	70	935	1,430	768	136	136	148	124	101
18	80	1,260	1,340	735	136	148	148	124	90
19	52	1,520	1,340	675	148	160	136	124	90
20	52	1,520	1,170	675	160	148	124	124	80

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for 1912—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	61	1,430	1,340	565	160	136	124	124	70
22	70	1,520	1,890	465	173	124	124	124	61
23	80	1,430	1,700	442	160	124	112	112	52
24	70	1,340	1,610	375	136	112	124	112	52
25	90	1,010	1,520	288	160	112	136	112	44
26	90	2,310	1,430	269	160	124	160	101	37
27	136	3,320	1,430	250	148	112	148	112	24
28	201	3,670	1,340	216	148	136	136	112	24
29	216	2,980	1,170	186	136	201	112	112	18
30	250	2,860	1,170	186	136	216	112	112	*a* 12
31	330	.....	1,090	.....	148	288	.....	112	.....

a May be 100 per cent in error.

NOTE.—Daily discharge computed from a rating curve well defined between discharges 90 and 3,320 second-feet (gage heights 1.2 and 5.5 feet). Below discharge 90 second-feet (gage height 1.2 feet) and above discharge 3,320 second-feet (gage height 5.5 feet) the rating curve is an extension. Rating curve for stages below 3 feet based on measurements made by the Kettle River Co. Discharge Jan. 1, 1912, to Mar. 7, 1912, and Dec. 1-31 estimated, because of ice, from climatologic records and discharge of adjacent areas especially those of the Rum and the Snake, discharge measurements and gage heights, as follows: Jan. 1-30, 130 second-feet, varying from about 200 to 100 second-feet; Feb. 1-29, 90 second-feet, varying from about 100 to 80 second-feet; Mar. 1-7, 75 second-feet, varying from about 80 to 70 second-feet; Dec. 1-31, 80 second-feet.

Monthly discharge of Kettle River near Sandstone, Minn., for 1912.

[Drainage area, 825 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	130	0.158	0.18	C.
February	.....	.....	90	.109	.12	C.
March	330	.....	96.9	.117	.13	B.
April	3,670	490	1,490	1.81	2.02	B.
May	5,900	1,090	2,540	3.08	3.55	A.
June	1,090	186	611	.741	.83	A.
July	233	136	172	.208	.24	A.
August	288	112	152	.184	.21	A.
September	288	112	158	.192	.21	A.
October	160	90	117	.142	.16	B.
November	112	*a* 12	84.9	.103	.11	C.
December	.....	.....	80	.097	.11	D.
The year	5,900	.....	478	.579	7.87	

a May be 100 per cent in error.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

SNAKE RIVER AT MORA, MINN.

Location.—At the highway bridge, three-fourths of a mile south of Mora, in sec. 14, T. 39 N., R. 24 W., below the mouth of Ann River.

Records available.—June 11, 1909, to December 31, 1912.

Drainage area.—422 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Measurements prior to 1912 showed channel to be practically permanent. During high water of May, 1912, channel shifted badly and was gradually changing throughout the remainder of the year.

Winter flow.—From December to March measurements are made through the ice to determine approximately the winter discharge.

Artificial control.—The flow of the river at the gaging station is unregulated except for a possible slight effect caused by logging dams at Knife Lake outlet and

White Pine. Below Pine City the flow is regulated to some extent by the operation of the power plant at Pine City.

Accuracy.—Owing to shifting channel records can not be considered better than fair.

Discharge measurements of Snake River at Mora, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 10[a]	S. B. Soulé	6.63	31.2	June 25[e]	W. G. Hoyt	6.78	112
Feb. 22[b]	do	6.82	38.2	Aug. 13[e]	S. B. Soulé	6.31	69
Mar. 26[c]	do	6.83	29.6	13[e]	do	6.30	64
Apr. 3[d]	C. J. Emerson	7.97	224	Oct. 24[f]	do	5.94	33
May 10	S. B. Soulé	12.38	1,950	24[g]	do	5.94	36
14	do	9.76	899	Dec. 31[h]	do	6.41	31
15	do	9.53	868				

[a] Complete ice cover; average thickness, 1.14 feet; average distance water surface to top of ice, 0.16 foot.
[b] Complete ice cover; average thickness of ice, 1.59 feet; average distance water surface to top of ice, 0.19 foot.
[c] Complete ice cover; average thickness of ice, 1.22 feet; average distance water surface to top of ice, 0.07 foot.
[d] Floating ice and undoubtedly back water from ice jam.
[e] Wading measurement about 200 feet above gage.
[f] Wading measurement about 500 feet above gage.
[g] Wading measurement about 700 feet above gage.
[h] Complete ice cover at control. Wading measurement about 700 feet above gage.

Daily gage height, in feet, of Snake River at Mora, Minn., for 1912.

[Alice Lasher, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	.....	.....	8.0	9.4	7.8	6.31	6.09	6.65	6.05	5.92	5.95
2	.....	.....	.....	8.1	8.9	7.7	6.35	6.00	6.75	6.00	5.95	.....
3	.....	.....	.....	7.9	10.6	7.8	6.32	6.00	6.70	6.00	5.92	.....
4	6.7	.....	6.75	7.5	.....	7.8	6.40	6.00	6.60	6.00	5.92	.....
5	.....	.....	.....	7.5	.....	7.8	6.42	6.00	6.60	5.95	5.95	5.95
6	.....	.....	.....	7.7	16.7	7.5	6.34	6.09	6.40	5.90	5.94	.....
7	.....	.....	.....	7.9	.....	7.35	6.35	6.11	6.30	5.91	5.92	.....
8	6.65	.....	6.7	7.8	.....	7.2	6.41	6.13	6.20	5.90	5.92	.....
9	.....	.....	.....	7.6	12.6	7.1	6.42	6.32	6.18	5.91	5.92	.....
10	.....	.....	.....	7.5	12.2	7.05	6.36	6.35	6.10	5 92	5.92	.....
11	6.65	.....	6.7	7.4	11.4	7.0	6.29	6.30	6.08	5.90	5.92	.....
12	.....	.....	.....	7.3	10.6	6.95	6.25	6.31	6.00	6.10	5.92	6.1
13	.....	.....	.....	7.3	10.2	6.9	6.32	6.31	6.00	6.05	5.92	.....
14	.....	.....	6.7	8.6	9.8	6.9	6.26	6.21	6.00	6.00	5.90	.....
15	6.65	.....	.....	9.2	9.5	6.9	6.24	6.16	5.95	6.00	5.92	.....
16	.....	.....	.....	9.4	9.3	7.6	6.20	6.10	5.95	6.00	5.95	.....
17	.....	.....	.....	9.6	9.0	8.2	6.20	6.16	5.96	6.00	5.88	.....
18	.....	.....	6.8	10.0	8.8	8.1	6.14	6.16	6.00	6.00	5.90	.....
19	.....	.....	.....	10.6	8.6	7.8	6.10	6.11	6.00	6.00	5.90	.....
20	.....	.....	.....	10.0	8.5	7.5	6.10	6.10	5.98	5.98	5.90	6.5
21	.....	.....	6.7	9.4	8.4	7.3	6.10	6.06	5.95	5.95	5.91	.....
22	.....	6.8	.....	9.5	8.5	7.2	6.10	6.04	5.95	6.00	5.90	.....
23	.....	.....	.....	9.8	8.8	7.0	6.48	6.00	5.95	6.00	5.90	.....
24	.....	.....	.....	8.6	9.0	6.9	6.29	6.00	5.94	5.95	6.08	.....
25	.....	.....	6.8	8.8	8.8	6.8	6.18	6.00	6.00	5.95	6.00	.....
26	.....	6.8	.....	10.0	8.5	6.7	6.11	6.00	6.00	5.95	6.00	6.48
27	.....	.....	.....	11.3	8.4	6.6	6.10	6.00	5.98	5.95	.....	.....
28	.....	.....	7.2	11.1	8.4	6.55	6.04	5.95	5.95	5.95	.....	.....
29	.....	6.8	.....	10.5	8.2	6.5	6.06	6.00	6.00	5.94	.....	.....
30	6.85	.....	7.4	9.9	8.1	6.4	6.05	6.30	6.08	5.91	.....	.....
31	.....	.....	.....	.....	7.9	.....	6.04	6.25	.....	5.91	.....	6.41

NOTE.—May 4 to 8, water over top of gage. Gage height May 6 determined on June 26 by wye levels to a point indicated by the observer as the crest height reached by the flood. Relation of gage height to discharge affected by ice Jan. 1 to about Apr. 12, and about Nov. 24 to Dec. 31.

Daily discharge, in second-feet, of Snake River at Mora, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	990	320	52	36	110	43	34
2	.....	815	295	56	36	125	40	36
3	.....	1,450	320	53	36	118	40	34
4	.....	2,700	320	60	36	113	40	34
5	.....	3,100	320	62	36	113	36	36
6	.....	3,600	245	59	46	77	33	35
7	.....	3,200	211	60	48	66	34	34
8	.....	2,800	179	67	49	56	33	34
9	.....	2,030	160	68	68	54	34	34
10	.....	1,870	151	61	71	47	34	34
11	.....	1,550	142	55	66	45	33	34
12	.....	1,230	134	51	67	40	47	34
13	320	1,080	125	57	67	40	43	34
14	710	938	125	52	56	40	40	33
15	920	850	125	50	52	36	40	34
16	990	780	270	47	47	36	40	36
17	1,060	675	430	47	52	37	40	32
18	1,210	610	400	42	52	40	40	33
19	1,450	550	320	40	48	40	40	33
20	1,210	520	245	40	47	38	38	33
21	990	490	200	40	44	36	36	34
22	1,020	520	179	40	42	36	40	33
23	1,130	610	142	75	40	36	40	33
24	710	675	125	59	40	35	36	.....
25	780	610	110	49	40	40	36	.....
26	1,210	520	96	44	40	40	36	.....
27	1,730	490	83	43	40	38	36	.....
28	1,650	490	77	39	36	36	36	.....
29	1,410	430	71	40	40	40	35	.....
30	1,170	400	60	40	66	45	34	.....
31	.....	345	.....	39	60	.....	34	.....

NOTE.—Daily discharge May 4 to 8, estimated from crest height and observer's notes. Daily discharge computed from a fairly well defined rating curve. Discharge Jan. 1, to Apr. 12 and Nov. 24 to Dec. 31 estimated, because of ice, from climatologic records, discharge measurements, and gage heights, as follows: Jan. 1–31, 30 second-feet, varying from about 40 to 20 second-feet; Feb. 1–29, 35 second-feet, varying from about 20 to 40 second-feet; Mar. 1–31, 40 second-feet, varying from about 40 to 50 second-feet; Apr. 1–12, 250 second-feet, varying from about 230 to 300 second-feet; Nov. 24–30, 33 second-feet; Dec. 1–31, 32 second-feet.

Monthly discharge of Snake River at Mora, Minn., for 1912.

[Drainage area, 422 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	30	0.071	0.08	C.
February	.....	.....	35	.083	.09	C.
March	.....	.....	40	.095	.11	C.
April	1,730	.....	756	1.79	2.00	B.
May	3,600	345	1,190	2.82	3.25	B.
June	430	60	199	.472	.53	A.
July	75	39	51.2	.121	.14	B.
August	71	36	48.5	.115	.13	B.
September	125	35	55.1	.131	.15	A.
October	47	33	37.6	.089	.10	B.
November	.....	.....	33.7	.080	.09	B.
December	.....	.....	32	.076	.09	C.
The year	3,600	.....	209	.495	6.76	

NOTE.—See footnotes to table of daily discharge.

CANNON RIVER AT WELCH, MINN.

Location.—At highway bridge at Welch, just below a very small tributary and 3 miles above the mouth of Belle Creek.

Records available.—June 7, 1909, to December 31, 1912.

Drainage area.—1,290 square miles.

Gage.—Chain, attached to bridge; datum unchanged.

Channel.—Practically permanent.

Winter flow.—Ice is present from December to March, during which period measurements are made to determine the winter discharge.

Artificial control.—The flow at the gaging station is regulated to a greater or less extent at each of the 11 developed power plants above. The flow is also regulated by a dam at the outlet of Cannon Lake.

Maximum flow.—In April, 1888, the high water reached the eaves of the wheelhouse at the mill, 20.1 feet above the datum of the present gage. It is said that this high water was not caused by ice gorging.

Accuracy.—The angle which the current makes at the gaging station necessitates a correction, and, owing to the daily fluctuation of the river during low stage caused by artificial control, the records of flow can not be considered better than fair. On July 31, 1912, it was found by wye levels that the bridge, at the place were the gage is fastened, had settled 0.48 foot. Change has been considered gradual, but because of uncertainty the accuracy ratings in table of monthly discharge, January to July, are low.

Discharge measurements of Cannon River at Welch, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 5[a]	Hoyt and Soulé	[b] 6.90	318	Apr. 8	W. G. Hoyt	[c] 7.84	1,250
20[a]	S. B. Soulé	[b] 6.81	307	July 31	S. B. Soulé	5.61	212
Mar. 23	C. J. Emerson	[c] 6.62	585	Oct. 23	W. G. Hoyt	5.66	217
23	....do	[c] 6.58	531				

[a] Measurement made under complete ice cover.
[b] Originally observed gage height reduced by 0.10 foot. See "Accuracy."
[c] Originally observed gage height reduced by 0.22 foot. See "Accuracy."

Daily gage height, in feet, of Cannon River at Welch, Minn., for 1912.

[Esther J. Norell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.7	.....	9.3	7.2	5.95	5.46	5.65	5.55	5.40	5.48	5.40
2	.....	.....	.....	8.8	7.1	5.85	5.36	6.32	5.7	5.44	5.65	5.5
3	.....	.....	.....	8.5	7.1	5.95	5.55	5.18	5.65	5.44	5.49	5.6
4	6.1	.....	[a] 6.9	8.1	7.2	5.85	5.31	5.15	5.7	5.52	5.31	5.7
5	.....	6.8	.....	7.6	7.2	6.35	5.65	5.5	5.65	5.85	5.5	5.6
6	.....	.....	.....	7.7	6.9	6.45	6.05	5.6	5.65	5.01	5.5	5.5
7	.....	.....	[a] 7.0	7.9	6.55	6.25	5.9	5.6	5.6	5.09	5.5	5.7
8	6.6	6.8	.....	7.8	6.45	6.15	5.75	5.18	5.38	5.5	5.48	5.25
9	.....	.....	.....	7.8	6.35	6.0	5.65	5.12	5.6	5.38	5.55	5.40
10	.....	.....	.....	7.9	6.45	5.95	5.65	5.5	5.65	5.35	5.38	5.65
11	6.4	.....	[a] 6.9	7.7	6.8	5.75	5.6	5.45	5.6	5.5	5.6	5.8
12	.....	6.9	.....	7.7	6.5	5.65	5.8	5.55	5.6	5.7	5.6	5.75
13	.....	.....	.....	7.5	6.25	5.75	5.9	5.6	5.6	5.48	5.65	5.5
14	.....	.....	.....	7.6	5.65	5.7	6.2	5.7	5.65	5.40	5.5	5.65
15	6.45	.....	[a] 5.7	8.0	6.0	5.8	6.05	5.7	5.42	5.7	5.65	5.30

[a] Gage height to top of ice.

Daily gage height, in feet, of Cannon River at Welch, Minn., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	.....	.....	8.0	6.0	5.9	5.95	5.7	5.22	5.5	5.6	5.7
17	.....	.....	.....	7.6	6.2	5.75	6.05	5.6	5.55	5.40	5.30	5.65
18	6.65	.....	7.3	7.4	6.1	5.65	6.05	5.42	5.45	5.39	5.28	5.55
19	.....	.....	.....	7.2	5.65	5.65	5.9	5.35	5.41	5.41	5.6	5.6
20	.....	6.8	8.0	7.0	6.3	5.65	5.9	5.55	5.41	5.28	5.6	5.6
21	.....	.....	7.3	7.3	7.2	5.75	5.85	5.31	5.48	5.5	5.65	5.5
22	6.65	a 6.95	6.85	8.8	7.5	5.43	5.9	5.65	5.22	5.55	5.42	5.5
23	.....	.....	6.75	9.4	7.3	5.03	5.9	5.65	5.25	5.55	5.38	5.45
24	.....	.....	6.75	9.0	7.1	5.33	5.9	5.9	5.65	5.38	5.48	5.5
25	6.65	.....	6.75	8.4	7.0	5.65	5.8	5.9	5.36	5.41	5.5	5.20
26	.....	a 7.05,	6.95	8.4	6.9	5.48	5.7	5.48	5.41	5.41	5.6	5.30
27	.....	.....	7.6	8.0	6.9	5.33	5.75	5.8	5.37	5.30	5.65	5.55
28	.....	.....	8.6	7.8	6.3	5.13	5.75	5.6	5.6	5.5	5.7	5.5
29	6.65	a 6.8	9.0	7.3	6.2	5.28	5.75	5.32	5.21	5.44	5.35	5.25
30	.....	.....	9.2	7.2	6.1	5.18	5.65	5.08	5.06	5.48	5.6	5.20
31	.....	.....	9.5	.....	6.0	.....	5.6	5.25	.....	5.5	.....	5.40

a Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 17; probably little if any backwater from ice during December.

Daily discharge, in second-feet, of Cannon River at Welch, Minn., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2,230	851	306	161	209	182	147	165
2	.....	1,850	800	271	139	446	223	156	209
3	.....	1,630	800	306	182	104	209	156	168
4	.....	1,370	851	271	128	99	223	175	128
5	.....	1,070	851	458	209	170	209	271	170
6	.....	1,120	701	499	342	195	209	78	170
7	.....	1,240	542	418	288	195	195	90	170
8	.....	1,180	499	380	238	104	143	170	165
9	.....	1,180	458	324	209	94	195	143	182
10	.....	1,240	499	306	209	170	209	136	143
11	.....	1,120	654	238	195	158	195	170	195
12	.....	1,120	526	209	254	182	195	223	195
13	.....	1,010	418	238	288	195	195	165	209
14	.....	1,070	209	223	399	223	209	147	170
15	.....	1,360	324	254	342	223	152	223	209
16	.....	1,300	324	288	306	223	111	170	195
17	.....	1,070	399	238	342	195	182	147	126
18	903	956	361	209	342	152	158	145	122
19	1,100	851	209	209	288	136	149	149	195
20	1,300	750	438	209	288	182	149	122	195
21	903	903	851	238	271	128	165	170	209
22	678	1,850	1,110	154	288	209	111	182	152
23	631	2,310	903	81	288	209	116	182	143
24	631	2,000	800	132	288	288	209	143	165
25	631	1,560	750	209	254	288	139	149	170
26	726	1,560	701	165	223	165	149	149	195
27	1,070	1,300	701	132	238	254	141	126	209
28	1,700	1,180	438	96	238	195	195	170	223
29	2,000	903	399	122	238	130	109	156	136
30	2,160	851	361	104	209	88	85	165	195
31	2,390	.....	324	.....	195	116	.....	170	.....

NOTE.—Daily discharge computed from a rating table well defined. Mar. 19, discharge interpolated. Discharge Jan. 1 to Mar. 17 and Dec. 1 to 31, estimated, because of ice, from discharge measurements, observer's records, climatologic records, and the discharge of Zumbro River, as follows: Jan. 1–31, 275 second-feet, varying from about 250 to 300 second-feet; Feb. 1–29, 310 second-feet, varying from about 300 to 320 second-feet; Mar. 1–17, 320 second-feet, varying from about 310 to 330 second-feet; Dec. 1–31, 170 second-feet, varying from about 100 to 250 second-feet.

Monthly discharge of Cannon River at Welch, Minn., for 1912.

[Drainage area, 1,290 square miles.[a]]

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
January	.....	.....	275	D.
February	.....	.....	310	C.
March	2,390	.....	718	C.
April	2,310	750	1,360	C.
May	1,010	209	579	C.
June	499	81	243	D.
July	399	128	254	C.
August	446	88	185	B.
September	223	85	170	C.
October	271	78	160	B.
November	223	122	176	B.
December	.....	.....	170	C.
The year	2,390	.....	378	

[a] Discharge in "second-feet per square mile" and "run-off (depth in inches)" not published for this drainage area because of artificial control. See station description.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

Location.—At the highway bridge at Chippewa Falls, Wis., 2,500 feet below the mouth of Duncan Creek.

Records available.—April, 1899, to December 31, 1912. The gage was originally established by the Chippewa Lumber & Boom Co., which has kept a continuous record since 1899. Since 1904 the United States Weather Bureau has obtained gage heights during the flood season of each year. On June 1, 1906, the United States Geological Survey began making discharge measurements and obtained gage heights when no record was obtained by the Weather Bureau. The gage heights as published have been obtained from the following sources: United States Weather Bureau, March to September, 1905, 1907, 1908; April to July, 1909; Chippewa Lumber & Boom Co., October 1 to December 31, 1911; United States Geological Survey. Gage read from January to June 1912 by Chippewa Lumber & Boom Co.; March to July, 1912, by U. S. Weather Bureau; December, 1912, by Chippewa Valley Railway, Light & Power Co. For the period March to June when there were two individual readings, the mean has been used.

Drainage area.—5,300 square miles.

Gage.—Staff, painted on one of the cylindrical piers at right end of bridge; graduated to feet and inches, but readings published to feet and hundredths; datum unchanged.

Channel.—Probably permanent.

Discharge measurements.—Made from downstream side of bridge.

Floods.—Maximum stage, according to United States Weather Bureau, was 13.5 feet September 16 and 17, 1903.

Winter flow.—Ice forms about 2 feet in thickness and the winter flow is considerably modified by backwater caused by ice below the section. On account of the swift water and the proximity of the dam there is considerable open water at the gage.

Artificial control.—When the electric light plant and sawmill above the gage are in operation, diurnal fluctuation is caused at the gage. These fluctuations modify the flow markedly at times. The operation of small storage reservoirs at the headwaters also modifies the flow past the station.

Accuracy.—The accuracy is affected to a greater or less extent by the operation of the logging reservoirs and power plants and during the winter by ice, but the channel appears to be permanent, and an excellent rating curve has been developed from discharge measurements made during 1906–1909. As the station has not been visited since February 15, 1909, estimates of discharge are withheld until the discharge rating curve and the permanency of the gage are checked by additional measurements.

Cooperation.—Gage heights during 1912 have been furnished through the courtesy of the Chippewa Lumber & Boom Co., United States Weather Bureau, and Chippewa Valley Railway, Light & Power Co.

Daily gage height, in feet, of Chippewa River at Chippewa Falls., Wis., for 1912.

[G. W. Rand, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Dec.
1	.....	.....	1.5	2.2	4.8	4.3	1.2	.....
2	.....	.....	1.5	2.3	4.3	4.0	1.0	.....
3	.....	1.6	1.5	2.7	4.0	3.8	1.0	.....
4	.....	.....	1.5	2.7	4.5	3.2	1.4	.....
5	.....	.....	1.5	3.7	7.2	3.2	1.2	.....
6	2.2	.....	1.5	5.2	9.4	3.0	1.0	.....
7	.....	.....	1.5	6.3	9.4	2.8	1.0	.....
8	.....	.....	1.5	7.7	8.1	2.6	1.0	.....
9	.....	.....	1.5	7.4	7.0	2.6	1.0	.....
10	.....	1.5	1.5	6.3	5.8	2.2	1.2	.....
11	.....	.....	1.5	5.5	5.0	2.0	1.0	.....
12	.....	.....	1.5	5.0	4.2	1.8	1.0	.....
13	2.0	.....	1.6	4.8	3.9	1.65	1.3	.....
14	.....	.....	1.5	4.7	3.4	1.7	1.2	.....
15	.....	.....	1.5	4.9	3.1	1.8	1.2	.....
16	.....	.....	1.5	5.1	3.0	1.7	1.0	1.5
17	.....	1.5	1.5	5.5	2.8	1.85	1.0	.....
18	.....	.....	1.7	4.7	3.0	1.9	.9	.....
19	.....	.....	1.7	4.7	2.7	2.3	.9	.....
20	1.8	.....	1.7	4.2	2.8	2.2	.9	1.5
21	.....	.....	1.7	3.7	2.7	2.2	.7	.....
22	.....	.....	1.8	4.8	2.8	2.0	.7	.....
23	.....	.....	1.7	6.2	8.0	1.8	.7	1.5
24	.....	1.6	1.8	6.0	9.1	1.8	1.2	.....
25	.....	.....	1.8	5.0	7.2	1.8	1.8	.....
26	.....	.....	1.8	5.0	5.6	1.6	4.8	.....
27	1.65	.....	2.0	5.4	4.7	1.45	3.7	1.5
28	.....	.....	1.8	6.0	7.2	1.35	2.7	.....
29	.....	.....	2.0	6.2	8.0	1.25	2.3	.....
30	.....	.....	2.0	5.5	7.2	1.0	1.7	1.5
31	.....	.....	2.2	.....	6.0	.....	1.5	.....

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Apr. 3 and about Dec. 16 to 31.

RED CEDAR RIVER AT CEDAR FALLS, WIS.

Location.—At the highway bridge at the outskirts of Cedar Falls, Wis., 4½ miles above the crossing of the Chicago, St. Paul, Minneapolis & Omaha Railway.

Records available.—April 1, 1909, to December 31, 1912.

Drainage area.—Not measured.

Gage.—Staff fastened to bridge pier; datum unchanged.

Channel.—Probably permanent.

Discharge measurements.—No discharge measurements have been made, and the station has not been visited since the gage was established.

Winter flow.—Winters are severe in this locality, but the gage heights at the section do not appear to be much affected by ice, probably because of the rapids a short distance below the station, which ordinarily do not entirely freeze over.

Artificial control.—The operation of small storage reservoirs at the headwaters of the river, together with storage at power plants above the gaging station, modifies the flow to such an extent that it cannot be considered natural.

Cooperation.—Gage heights furnished by the Chippewa Valley Light & Power Co.

Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for 1912.

[Olaf Oas and Frank Wilkson, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.2	2.2	4.2	3.4	3.4	2.1	2.5	3.2	2.6	2.3	2.2
2	2.5	2.2	2.2	4.0	3.4	3.3	2.1	2.4	3.4	2.6	2.3	2.2
3	2.5	2.2	2.2	3.8	3.6	3.3	2.0	2.4	3.65	2.6	2.4	2.3
4	2.5	2.2	2.2	3.8	3.8	3.2	2.0	2.4	3.65	2.6	2.4	2.3
5	2.5	2.2	2.2	3.8	4.0	3.2	2.0	2.5	3.45	2.6	2.5	2.4
6	2.5	2.2	2.2	3.9	4.45	3.1	2.1	2.5	3.25	2.5	2.5	2.3
7	2.5	2.2	2.2	4.0	4.2	3.1	2.25	2.65	3.1	2.5	2.5	2.2
8	2.5	2.1	2.2	4.0	4.05	3.0	2.45	2.8	3.0	2.5	2.5	2.2
9	2.5	2.1	2.2	3.7	4.0	3.0	2.6	2.8	3.0	2.5	2.5	2.4
10	2.5	2.1	2.1	3.55	3.8	2.9	2.5	2.8	3.0	2.5	2.5	2.3
11	2.5	2.0	2.3	3.25	3.8	2.8	2.4	2.8	2.9	2.5	2.5	2.35
12	2.5	2.1	2.3	3.15	3.65	2.6	2.4	2.75	2.9	2.7	2.6	2.4
13	2.5	2.2	2.3	3.0	3.55	2.4	2.4	2.7	2.9	2.8	2.4	2.4
14	2.5	2.2	2.3	2.9	3.5	2.4	2.4	2.6	2.8	2.9	2.5	2.4
15	2.5	2.2	2.3	2.8	3.4	2.4	2.4	2.6	2.8	2.8	2.5	[a]0.6
16	2.5	2.2	2.3	2.8	3.25	2.5	2.55	2.5	2.8	2.8	2.5	2.4
17	2.5	2.2	2.3	2.8	3.1	2.6	2.6	2.5	2.8	2.7	2.4	2.4
18	2.4	2.2	2.4	2.8	3.0	2.7	2.6	2.4	2.8	2.6	2.4	2.4
19	2.4	2.2	2.4	2.8	2.9	2.8	2.45	2.4	2.8	2.6	2.4	2.3
20	2.4	2.2	2.4	2.8	2.8	2.95	2.25	2.5	2.8	2.6	2.4	2.4
21	2.4	2.2	2.5	2.8	2.8	3.2	2.2	2.5	2.8	2.5	2.4	2.5
22	2.3	2.2	2.5	3.1	3.0	3.25	2.2	2.6	2.7	2.4	2.4	2.4
23	2.3	2.2	2.6	3.3	3.8	3.1	2.3	2.6	2.7	2.4	2.4	2.4
24	2.3	2.2	2.6	3.2	4.4	3.0	2.45	2.7	2.7	2.3	2.3	2.5
25	2.3	2.1	2.6	3.2	4.2	3.0	2.9	2.8	2.7	2.3	2.3	2.5
26	2.3	2.3	2.6	3.1	4.0	2.9	2.8	2.8	2.7	2.3	2.3	2.6
27	2.3	2.2	2.6	3.1	3.8	2.8	2.7	2.9	2.7	2.3	2.2	2.5
28	2.3	2.2	2.7	3.2	3.7	2.65	2.65	2.8	2.7	2.3	2.2	2.5
29	2.3	2.2	3.2	3.2	3.6	2.45	2.6	3.0	2.6	2.3	2.2	[a]1.6
30	2.2	.....	4.1	3.2	3.6	2.25	2.6	3.1	2.6	2.3	2.3	2.5
31	2.2	.....	4.3	.....	3.5	.....	2.5	3.1	.....	2.3	.....	2.5

[a] Turbine in power house above gage shut down.

NOTE.—No ice reported during 1912. The observer states that when the sawmill was in existence at Cedar Falls, considerable ice formed at the rapids and at the gage, but that since the new dam and power house have been built ice does not form at these points.

ZUMBRO RIVER AT ZUMBRO FALLS, MINN.

Location.—At the highway bridge at Zumbro Falls about 8 miles below the mouth of the South Branch.

Records available.—June 8, 1909, to December 31, 1912.

Drainage area.—1,120 square miles.

Gage.—Chain gage, attached to bridge; datum unchanged.

Channel.—Slightly shifting.

Discharge measurements.—Made from bridge.

Winter flow.—For a short time during and following an extremely cold period ice forms below the gage, causing backwater. The river is, however, fed by springs in the vicinity of the gage and the warmer water gradually wears away the ice. Daily gage heights are recorded during the winter, and from a close inspection of gage heights and temperature the necessary corrections are made to the discharge.

Maximum flow.—The high water of June, 1908, is marked by a spike in a telegraph pole near the railroad station at Zumbro Falls. This is at an elevation of 26.7

feet above the datum of the gage. The high water of April, 1888, reached a stage approximately 29.7 feet, as shown by a mark not so well defined as that of the 1908 flood.

Artificial control.—The slight artificial control at the small power plants above Zumbro Falls is not observable at the gage.

Discharge measurements of Zumbro River at Zumbro Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 21[a]	C. J. Emerson	7.56	1,170	May 28	S. B. Soulé	6.37	668
30	W. G. Hoyt	9.98	2,720	Aug. 15[b]	W. G. Hoyt	5.07	197
30	do	9.92	2,650				

[a] Measured from bridge; open water. [b] Wading at 200 feet above bridge.

Daily gage height, in feet, of Zumbro River at Zumbro Falls, Minn., for 1912.

[A. H. Sugg, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.3	5.2	5.2	9.4	6.1	5.85	5.4	5.05	5.2	4.98	5.0	5.1
2	5.3	5.2	5.2	.....	6.0	5.9	5.5	5.1	5.2	4.98	4.99	5.1
3	5.3	5.2	5.2	7.8	6.0	5.9	5.35	5.0	5.2	4.96	5.0	5.0
4	5.35	5.2	5.2	7.4	6.0	5.75	5.7	5.1	5.1	4.90	4.99	5.05
5	5.3	5.2	5.25	7.4	6.2	5.7	5.95	5.1	5.1	4.94	4.99	5.1
6	5.3	5.2	5.2	7.9	6.4	5.6	5.85	5.15	5.1	4.92	4.95	5.15
7	5.3	5.2	5.2	9.2	6.0	5.5	5.6	5.0	5.0	4.89	4.99	4.95
8	5.35	5.2	5.2	8.5	5.95	5.4	5.4	5.9	4.99	4.95	4.96	.....
9	5.35	5.2	5.2	7.6	5.8	5.4	5.4	5.6	4.99	4.89	4.99	.....
10	5.4	5.2	5.2	7.2	5.8	5.4	5.25	5.3	5.05	4.94	4.98	6.05
11	5.4	5.2	5.2	7.0	5.7	5.4	5.55	5.2	4.98	4.96	4.98	5.9
12	5.4	5.2	5.2	6.8	5.65	5.3	5.6	5.2	5.1	5.05	5.0	.....
13	5.4	5.2	5.15	6.7	5.6	5.4	5.8	5.1	5.0	5.2	5.15	5.4
14	5.4	5.2	5.3	6.9	5.55	5.55	5.75	5.15	5.05	5.2	5.35	5.2
15	5.4	5.2	5.2	8.4	5.6	5.65	5.6	5.15	5.0	5.2	5.4	5.05
16	5.4	5.25	5.25	7.9	5.6	5.6	5.55	5.05	5.0	5.15	5.25	5.0
17	5.4	5.25	5.4	7.2	5.6	5.55	5.5	5.15	5.0	5.1	5.2	5.0
18	5.4	5.3	6.9	6.8	5.55	5.4	5.35	5.05	5.05	5.1	5.15	4.99
19	5.4	5.3	9.8	6.6	6.5	5.3	5.3	5.6	5.1	5.1	5.2	5.0
20	5.4	5.3	9.1	6.4	13.7	5.35	5.3	5.6	5.05	5.05	5.1	4.96
21	5.4	5.3	7.6	6.5	10.6	5.25	5.5	5.45	5.1	5.05	5.1	4.75
22	5.35	5.3	6.9	9.1	8.2	5.2	5.5	5.4	5.0	5.05	5.1	4.75
23	5.3	5.3	6.7	9.0	7.8	5.2	5.6	5.3	5.0	5.05	5.1	4.86
24	5.3	5.35	6.8	7.6	7.7	5.25	5.45	5.2	5.0	5.0	5.05	4.95
25	5.25	5.35	7.0	7.2	7.0	5.2	5.35	5.15	5.0	5.0	5.0	5.0
26	5.25	5.25	6.8	6.8	6.6	5.2	5.3	5.1	4.98	5.0	5.0	4.96
27	5.25	5.2	8.0	6.6	6.6	5.2	5.3	5.1	4.95	5.05	5.0	4.92
28	5.25	5.3	11.3	6.45	6.35	5.15	5.2	5.1	4.95	5.0	5.05	4.91
29	5.2	5.3	13.0	6.3	6.1	5.1	5.15	5.1	4.92	5.0	5.0	4.95
30	5.2	.....	10.2	6.2	6.0	5.1	5.05	5.2	4.94	5.0	4.98	4.85
31	5.2	.....	9.3	.....	5.9	.....	5.1	5.2	.....	5.0	.....	4.99

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 1 to 31, and Dec. 4 to 15.

Daily discharge, in second feet, of Zumbro River at Zumbro Falls, Minn., for 1912.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	232	232	2,320	524	424	282	200	232	186	190	210
2	232	232	1,850	482	442	310	210	232	186	188	210
3	232	232	1,380	482	442	269	190	232	183	190	190
4	232	232	1,160	482	389	372	210	210	172	188	.....
5	232	244	1,160	566	372	462	210	210	179	188	.....
6	232	232	1,430	652	340	424	221	210	176	181	.....
7	232	232	2,180	482	310	340	190	190	170	188	.....
8	232	232	1,760	462	282	282	442	188	181	183	.....
9	232	232	1,260	406	282	282	340	188	170	188	.....
10	232	232	1,050	406	282	244	256	200	179	186	.....
11	232	232	944	372	282	325	232	186	183	186	.....
12	232	232	840	356	256	340	232	210	200	190	.....
13	232	221	790	340	282	406	210	190	232	221	.....
14	232	256	892	325	325	389	221	200	232	269	.....
15	232	232	1,700	340	356	340	221	190	232	282	.....
16	244	244	1,430	340	340	325	200	190	221	244	190
17	244	282	1,050	340	325	310	221	190	210	232	190
18	256	892	840	325	282	269	200	200	210	221	188
19	256	2,590	742	696	256	256	340	210	210	232	190
20	256	2,120	652	5,860	269	256	340	200	200	210	183
21	256	1,260	696	3,180	244	310	296	210	200	210	149
22	256	892	2,120	1,600	232	310	282	190	200	210	149
23	256	790	2,060	1,380	232	340	256	190	200	210	166
24	269	840	1,260	1,320	244	296	232	190	190	200	181
25	269	944	1,050	944	232	269	221	190	190	190	190
26	244	840	840	742	232	256	210	186	190	190	183
27	232	1,480	742	742	232	256	210	181	200	190	176
28	256	3,760	674	630	221	232	210	181	190	200	174
29	256	5,200	608	524	210	221	210	176	190	190	181
30	.....	2,880	566	482	210	200	232	179	190	186	164
31	.....	2,250	.....	442	.....	210	232	.....	190	.....	188

NOTE.—Daily discharge computed from a rating table well defined between 190 and 3,500 second-feet (gage heights 5.0 and 11.0 feet), and fairly well defined throughout the remainder of the range of stage covered by 1912 gage heights.

Discharge Apr. 21 interpolated. Discharge Jan. 1 to 31 estimated, because of ice, from discharge of adjacent drainage areas as 90 per cent of open-water flow for same gage heights. Mean discharge Dec. 4 to 15 estimated, because of ice, at 185 second-feet.

Monthly discharge of Zumbro River at Zumbro Falls, Minn., for 1912.

[Drainage area, 1,390 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	245	0.176	0.20	C.
February	269	232	242	.174	.19	B.
March	5,200	221	993	.714	.82	A.
April	2,320	566	1,200	.863	.96	A.
May	5,860	325	846	.609	.70	A.
June	442	210	294	.212	.24	A.
July	462	200	303	.218	.25	A.
August	442	190	241	.173	.20	A.
September	232	176	198	.142	.16	A.
October	232	170	195	.140	.16	A.
November	282	181	204	.147	.16	A.
December	.....	.....	183	.132	.15	B.
The year	5,860	.....	429	.309	4.19	

NOTE.—See footnotes to table of daily discharge.

SOUTH BRANCH OF ZUMBRO RIVER NEAR ZUMBRO FALLS, MINN.

Location.—At the Woodville bridge, 1¼ miles above the mouth of the river, in sec. 22, T. 109 N., R. 14 W., 6 miles below the mouth of the Middle Branch.

Records available.—June 16, 1911, to December 31, 1912.

Drainage area.—821 square miles.

Gage.—Chain gage, attached to bridge; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Made from highway bridge.

Winter flows.—The river freezes over in the vicinity of the gage following long cold periods. The rapids below the gage, however, remain partly open so that the backwater effect is small. Discharge measurements are made to aid in the winter estimates.

Artificial control.—The small power plants above the station do not control the flow to such an extent as to be noticeable at the gage.

Discharge measurements of South Branch of Zumbro River near Zumbro Falls, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan 26[a]	W. G. Hoyt	2.20	141	Mar 30	W. G. Hoyt	6.25	2,680
Mar 22[b]	C. J. Emerson	3.28	633	May 28	S. B. Soulé	2.95	495
30	W. G. Hoyt	6.36	2,930	Aug 15[c]	W. G. Hoyt	2.06	140

[a] Complete ice cover; average thickness, 0.90 foot; average distance water surface to top of ice, 0.00 foot.
[b] At bridge section; open water.
[c] Wading measurement below bridge, 5 feet.

Daily gage height, in feet, of South Branch of Zumbro River near Zumbro Falls, Minn., for 1912.

[W. M. Whipple, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.30	2.00	2.20	5.5	2.6	2.6	2.19	1.99	2.11	1.96	1.99	2.01
2	2.25	.....	2.20	4.9	2.55	2.6	2.40	2.09	2.06	1.96	1.99	2.06
3	2.25	.....	2.20	4.2	2.6	2.65	2.26	1.99	2.04	1.99	1.99	2.09
4	.....	.....	2.20	3.9	2.6	2.6	2.36	2.06	2.04	1.94	1.99	2.04
5	.....	2.10	2.15	3.9	2.9	2.5	2.6	2.01	2.06	1.94	1.96	2.01
6	.....	.....	2.10	4.3	2.8	2.45	2.50	2.00	2.01	1.99	1.94	2.04
7	.....	.....	2.15	4.8	2.6	2.41	2.38	2.09	2.01	2.01	1.96	2.04
8	.....	2.00	2.20	4.7	2.5	2.39	2.28	2.16	2.95	1.96	1.94	1.99
9	.....	.....	2.20	4.2	2.41	2.34	2.21	2.22	2.5	1.99	1.96	2.01
10	.....	.....	2.20	3.6	2.41	2.30	2.16	2.22	2.95	1.99	1.94	2.01
11	1.80	.....	2.15	3.4	2.32	2.31	2.38	2.04	2.5	1.96	1.94	2.02
12	.....	2.10	2.31	3.2	2.28	2.31	2.31	2.11	2.01	2.06	1.99	1.94
13	.....	.....	2.32	3.1	2.28	2.29	2.35	2.14	2.00	2.19	2.08	1.91
14	.....	.....	2.30	3.25	2.28	2.38	2.36	2.01	2.04	2.14	2.19	1.96
15	.....	2.15	3.0	4.5	2.35	2.44	2.29	2.09	2.01	2.09	2.14	1.99
16	2.05	.....	3.1	4.0	2.31	2.41	2.32	2.06	2.00	2.08	2.14	1.96
17	.....	2.00	2.20	3.6	2.29	2.39	2.30	2.12	2.04	2.09	2.09	1.99
18	.....	.....	3.8	3.25	2.29	2.34	2.24	2.09	2.02	2.06	2.04	1.96
19	2.15	2.5	4.8	3.0	2.6	2.29	2.21	2.18	2.01	2.01	2.05	1.99
20	.....	2.5	4.9	2.9	10.0	2.24	2.18	2.38	2.05	2.01	2.06	1.95
21	.....	3.4	3.8	3.5	6.2	2.19	2.39	2.28	2.04	2.04	2.01	1.82
22	2.15	2.25	3.4	5.2	4.6	2.19	2.36	2.21	2.00	2.01	2.01	1.91
23	.....	2.35	3.2	4.9	4.4	2.15	2.36	2.16	2.00	2.01	2.04	1.94
24	.....	2.30	3.0	3.7	4.1	2.15	2.32	2.11	2.04	2.01	2.01	1.92
25	2.10	2.35	3.05	3.4	3.5	2.16	2.16	2.06	2.04	1.98	1.99	1.96
26	2.20	2.30	3.0	3.1	3.2	2.11	2.21	2.04	2.01	1.99	1.99	1.91
27	.....	2.15	4.9	3.0	3.1	2.14	2.16	2.02	2.00	2.00	1.99	1.94
28	.....	2.20	7.3	2.8	3.0	2.16	2.19	2.04	2.01	1.99	2.01	1.89
29	2.25	2.20	8.8	2.7	2.85	2.14	2.14	2.01	1.96	2.01	1.96	1.84
30	.....	.....	6.2	2.65	2.75	2.14	2.01	2.11	1.92	1.99	2.00	1.86
31	.....	.....	5.4	.....	2.7	.....	2.14	2.06	.....	1.96	.....	1.91

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Feb. 21; probably no backwater at the gage from ice during December.

Daily discharge, in second-feet, of South Branch of Zumbro River near Zumbro Falls, Minn., for 1912.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	183	2,040	337	337	180	112	152	103	112	118
2	.....	183	1,580	317	337	258	145	135	103	112	135
3	.....	183	1,130	337	358	205	112	128	112	112	145
4	.....	183	955	337	337	243	135	128	96	112	128
5	.....	166	955	462	297	337	118	135	96	103	118
6	.....	148	1,190	420	278	297	115	118	112	96	128
7	.....	166	1,510	337	262	250	145	118	118	103	128
8	.....	183	1,440	297	254	213	169	484	103	96	112
9	.....	183	1,130	262	235	187	190	297	112	103	118
10	.....	183	790	262	220	169	190	484	112	96	118
11	.....	166	690	228	224	250	128	297	103	96	122
12	.....	224	595	213	224	224	152	118	135	112	96
13	.....	228	550	213	216	239	162	115	180	141	87
14	.....	220	618	213	250	243	118	128	162	180	103
15	.....	505	1,320	239	274	216	145	118	145	162	112
16	.....	550	1,010	224	262	228	135	115	141	162	103
17	.....	183	790	216	254	220	155	128	145	145	112
18	.....	900	618	216	235	198	145	122	135	128	103
19	.....	1,510	505	337	216	187	176	118	118	132	112
20	.....	1,580	462	7,110	198	176	250	132	118	135	100
21	.....	900	740	2,700	180	254	213	128	128	118	66
22	202	690	1,790	1,380	180	243	187	115	118	118	87
23	239	595	1,580	1,250	166	243	169	115	118	128	96
24	220	505	845	1,070	166	228	152	128	118	118	90
25	239	528	690	740	169	169	135	128	109	112	103
26	220	505	550	595	152	187	128	118	112	112	87
27	166	1,580	505	550	162	169	122	115	115	112	96
28	183	3,850	420	505	169	180	128	118	112	118	82
29	183	5,610	378	441	162	162	118	103	118	103	71
30	.....	2,700	358	399	162	118	152	90	112	115	75
31	.....	1,960	.....	378	.....	162	135	.....	103	.....	87

NOTE.—Daily discharge computed from a rating curve well defined between 62 and 3,520 second-feet (gage heights 1.8 and 7.0 feet). Above discharge 3,520 second-feet (gage height 7.0 feet) the rating curve is an extension and is subject to an error of about 10 per cent at discharge 7,110 second-feet (gage height 10.0 feet).

Discharge Jan. 1 to Feb. 21 estimated, because of ice, from climatologic records, discharge measurements, observer's notes, and discharge of adjacent drainage areas, as follows: Jan. 1 to 31, 165 second-feet, varying from about 200 to 140 second-feet; Feb. 1 to 21, 130 second-feet.

Monthly discharge of South Branch of Zumbro River near Zumbro Falls, Minn., for 1912.

[Drainage area, 821 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	165	0.201	0.23	C.
February	239	.....	151	.184	.20	C.
March	5,610	148	879	1.07	1.23	A.
April	2,040	358	924	1.13	1.26	A.
May	7,110	213	729	.888	1.02	A.
June	358	152	231	.281	.31	B.
July	337	118	214	.261	.30	B.
August	250	112	150	.183	.21	B.
September	484	90	158	.192	.21	B.
October	180	96	120	.146	.17	B.
November	180	96	120	.146	.16	B.
December	145	66	104	.127	.15	C.
The year	7,110	.....	329	.401	5.45	

NOTE.—See footnotes to table of daily discharge.

ROOT RIVER NEAR HOUSTON, MINN.

Location.—At highway bridge 1 mile east of Houston in sec. 34, T. 104 N., R. 6 W., 1 mile above the mouth of South Root River, ordinarily a relatively insignificant stream, but during heavy rains overflowing its banks badly and flooding considerable area.

Records available.—May 28, 1909, to December 31, 1912.

Drainage area.—1,560 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Shifting; scouring out during floods, and gradually filling in afterward; nearly permanent at low stages.

Discharge measurements.—Made from bridge.

Winter flow.—During the ice period of 1912 the readings were discontinued and the flow has been estimated from the flow of North Branch Root near Lanesboro, there being a well-defined open-water relation between these stations.

Artificial control.—No dam below the station; nearest dam above is at Rushford. As the flow is ample at all times for the power generated at that point, it is not held back during certain portions of the day, and thus the dam has no appreciable influence on the gage heights at Houston.

Accuracy.—The shifting channel renders it necessary to make more frequent measurements than at other stations, and the results based on them can probably not be considered better than fair or possibly good, except for low stages when the channel changes but little.

Discharge measurements of Root River near Houston, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 31	C. J. Emerson	8.88	5,930
Apr. 30	S. B. Soulé	2.24	650
Sept. 5	....do	1.32	383

Daily gage height, in feet, of Root River near Houston, Minn., for 1912.

[Olaf Larson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	8.9	2.2	2.5	1.5	1.6	1.5	1.4	1.4	1.4
2	.....	.....	.....	7.5	2.1	3.8	1.8	1.5	1.4	1.4	1.4	1.7
3	.....	.....	.....	5.9	2.1	3.0	1.9	1.5	1.4	1.3	1.4	1.5
4	.....	.....	.....	5.1	2.3	2.7	1.8	1.5	1.4	1.3	1.4	1.5
5	.....	.....	.....	5.0	2.6	2.5	1.6	1.4	1.4	1.3	1.4	1.5
6	.....	.....	.....	5.1	2.2	2.3	1.5	1.6	1.6	1.3	1.4	1.6
7	.....	.....	.....	5.7	2.1	2.2	1.6	3.0	1.4	1.3	1.4	1.3
8	.....	.....	.....	5.6	2.0	2.1	1.4	1.8	1.4	1.3	1.4	1.4
9	.....	.....	.....	4.5	1.9	2.0	1.8	1.6	1.3	1.3	1.4	2.8
10	.....	.....	.....	3.9	1.9	1.9	8.0	1.6	1.6	1.3	1.3	.....
11	.....	.....	.....	3.6	1.9	1.9	6.1	1.7	1.5	1.3	1.4	.....
12	.....	.....	.....	3.3	1.8	1.9	3.6	1.5	1.4	1.8	1.4	.....
13	.....	.....	.....	3.2	1.8	1.9	3.2	1.5	1.3	1.9	1.6	.....
14	.....	.....	.....	3.5	1.8	1.9	3.1	1.5	1.4	1.8	1.5	.....
15	.....	.....	.....	3.5	1.8	1.9	2.7	1.4	1.5	1.7	1.6	.....
16	.....	.....	.....	4.1	1.7	1.9	2.4	1.4	1.4	1.6	1.6	.....
17	.....	.....	.....	3.5	1.7	1.8	2.2	1.5	1.4	1.5	1.5	.....
18	.....	.....	.....	3.1	1.6	1.7	2.1	1.5	1.5	1.5	1.4	.....
19	.....	.....	.....	2.9	1.7	1.7	2.0	1.6	1.6	1.4	1.4	.....
20	.....	.....	.....	2.7	7.7	1.6	2.6	1.6	1.6	1.5	1.4	.....
21	.....	.....	.....	2.6	3.9	1.6	2.8	1.7	1.5	1.5	1.4	.....
22	.....	.....	.....	2.6	2.8	1.6	2.4	1.6	1.5	1.5	1.5	.....
23	.....	.....	.....	4.0	5.6	1.6	2.7	1.5	1.4	1.4	1.4	.....
24	.....	.....	.....	4.0	7.8	1.5	2.3	1.5	1.4	1.4	1.4	.....
25	.....	.....	.....	3.2	5.2	1.5	2.0	1.5	1.4	1.4	1.4	.....
26	.....	.....	2.6	2.8	3.9	1.4	1.9	1.4	1.4	1.4	1.4	.....
27	.....	.....	2.6	2.6	3.4	1.4	1.8	1.4	1.4	1.4	1.4	.....
28	.....	.....	7.3	2.5	3.1	1.4	1.8	1.3	1.4	1.4	1.2	.....
29	.....	.....	9.4	2.4	3.3	1.4	1.7	1.3	1.3	1.4	1.3	.....
30	.....	.....	9.8	2.3	2.7	1.6	1.6	1.6	1.3	1.4	1.3	.....
31	.....	.....	8.9	.....	2.5	.....	1.6	1.5	.....	1.4	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 25 and about Dec. 9 to 31.

Daily discharge, in second-feet, of Root River near Houston, Minn., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5,960	632	739	430	456	430	405	405	405
2	.....	4,270	598	1,280	509	430	405	405	405	482
3	.....	2,660	598	930	537	430	405	380	405	430
4	.....	2,050	667	813	509	430	405	380	405	430
5	.....	1,980	776	739	456	405	405	380	405	430
6	.....	2,050	632	667	430	456	456	380	405	456
7	.....	2,500	598	632	456	930	405	380	405	380
8	.....	2,420	566	598	405	509	405	380	405	405
9	.....	1,660	537	566	509	456	380	380	405	.....
10	.....	1,330	537	537	4,870	456	456	380	380	.....
11	.....	1,180	537	537	2,840	482	430	380	405	.....
12	.....	1,050	509	537	1,180	430	405	509	405	.....
13	.....	1,010	509	537	1,010	430	380	537	456	.....
14	.....	1,140	509	537	970	430	405	509	430	.....
15	.....	1,140	509	537	813	405	430	482	456	.....
16	.....	1,440	482	537	703	405	405	456	456	.....
17	.....	1,140	482	509	632	430	405	430	430	.....
18	.....	970	456	482	598	430	430	430	405	.....
19	.....	890	482	482	566	456	456	405	405	.....
20	.....	813	4,510	456	776	456	456	430	405	.....
21	.....	776	1,330	456	851	482	430	430	405	.....
22	.....	776	851	456	703	456	430	430	430	.....
23	.....	1,380	2,420	456	813	430	405	405	405	.....
24	.....	1,380	4,630	430	667	430	405	405	405	.....
25	.....	1,010	2,120	430	566	430	405	405	405	.....
26	776	851	1,330	405	537	405	405	405	405	.....
27	776	776	1,100	405	509	405	405	405	405	.....
28	4,040	739	970	405	509	380	405	405	356	.....
29	6,590	703	1,050	405	482	380	380	405	380	.....
30	7,090	667	813	456	456	456	380	405	380	.....
31	5,960	.....	739	.....	456	430	.....	405	.....	.....

NOTE.—Daily discharge computed from a well-defined rating curve.
Discharge Jan. 1 to Mar. 26 and Dec. 9 to 31 estimated, because of ice, from climatologic records and open-water relation between flow of North Branch of Root River near Lanesboro and Houston, as follows: Jan. 1 to 13, 485 second-feet; Feb. 1 to 29, 400 second-feet; Mar. 1 to 25, 540 second-feet; Dec. 9 to 31, 285 second-feet.

Monthly discharge of Root River near Houston, Minn., for 1912.

[Drainage area, 1,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	485	0.311	0.36	
February	.....	.....	400	.256	.28	
March	7,090	.....	1,250	.801	.92	
April	5,960	667	1,560	1.00	1.12	B.
May	4,630	456	1,050	.673	.78	B.
June	1,280	405	565	.362	.40	B.
July	4,870	405	831	.533	.61	B.
August	930	380	451	.289	.33	B.
September	456	380	413	.265	.30	B.
October	537	380	417	.267	.31	B.
November	456	356	408	.262	.29	B.
December	.....	.....	322	.206	.24	D.
The year	7,090	.....	680	.436	5.94	

NOTE.—See footnotes to tables of daily gage height and daily discharge.

NORTH BRANCH OF ROOT RIVER NEAR LANESBORO, MINN.

Location.—At the first highway bridge 1 mile above the junction of the North and South branches, in sec. 6, T. 103 N., R. 9 W., in Fillmore County, 2 miles north of Lanesboro and about 5 miles below a small creek that enters from the west.

Records available.—March 9, 1910, to December 31, 1912.

Drainage area.—647 square miles.

Gage.—Chain; datum unchanged.

Channel.—Probably permanent. As there is more than 10 feet fall between the station and the mouth of the South Branch backwater from that stream is improbable. One thousand feet back from the right bank there is an old channel through which the river formerly flowed. At a stage of 6 feet the flow begins through this old channel. At extreme flood stage the right bank is overflowed for a width of one-fourth mile.

Discharge measurements.—Made from the bridge. At extreme flood stages measurements can be made from the railroad bridge just above the junction with the South Branch.

Winter flow.—From December to March the river is frozen over and current-meter measurements are made to determine the winter discharge.

Discharge measurements of North Branch of Root River near Lanesboro, Minn., in 1912.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 24[a]	W. G. Hoyt	2.90	160	Sept. 5	S. B. Soulé	2.29	225
Feb. 16[b]	S. B. Soulé	2.98	154	5	do	2.26	216
Apr. 30	do	2.54	313				

[a] Complete ice cover; average thickness of ice, 1.12 feet; average distance water surface to top of ice, 0.00 foot.

[b] Complete ice cover; average thickness of ice, 1.10 feet; average distance water surface to top of ice, 0.13 foot.

Daily gage height, in feet, of North Branch of Root River near Lanesboro, Minn., for 1912.

[K. E. Hoium, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	2.9	.....	6.0	2.5	2.65	2.21	2.10	2.12	2.06	2.05	2.05
2	.....	.....	.....	4.8	2.42	2.95	2.29	2.06	2.08	2.08	2.05	2.10
3	.....	.....	.....	4.0	2.6	2.8	2.28	2.10	2.02	2.08	2.05	2.08
4	2.8	.....	2.5	3.8	2.55	2.65	2.34	2.12	2.06	2.05	2.05	2.05
5	.....	2.9	.....	3.9	2.5	2.6	2.25	2.16	2.38	2.04	2.05	2.15
6	.....	.....	.....	4.1	2.5	2.48	2.26	2.20	2.18	2.05	2.02	2.20
7	.....	.....	2.40	4.6	2.42	2.38	2.30	2.20	2.10	2.05	2.02	2.16
8	2.9	2.95	.....	4.2	2.39	2.28	2.20	2.18	2.10	2.05	2.00	2.12
9	.....	.....	.....	3.5	2.35	2.26	2.22	2.12	2.05	2.02	2.02	2.08
10	.....	.....	.....	3.15	2.35	2.25	4.0	2.10	2.05	2.02	2.02	2.05
11	2.9	.....	2.30	3.1	2.35	2.20	2.9	2.10	2.00	2.05	2.02	2.06
12	.....	3.15	.....	3.05	2.32	2.20	2.85	2.10	2.00	2.18	2.09	2.06
13	.....	.....	.....	3.0	2.32	2.25	2.7	2.06	2.12	2.5	2.18	2.05
14	.....	.....	2.40	3.05	2.29	2.30	2.75	2.00	2.14	2.30	2.14	2.05
15	2.9	3.1	.....	3.75	2.30	2.24	2.6	2.00	2.15	2.20	2.15	2.05
16	.....	.....	.....	3.5	2.29	2.20	2.45	2.08	2.08	2.16	2.15	2.06
17	.....	.....	.....	3.05	2.28	2.20	2.30	2.10	2.12	2.12	2.15	2.02
18	2.7	.....	2.30	2.9	2.28	2.18	2.34	2.18	2.22	2.12	2.19	1.98
19	.....	2.9	4.2	2.75	2.30	2.18	2.22	2.24	2.34	2.15	2.22	1.98
20	.....	.....	4.8	2.7	4.8	2.18	2.30	2.28	2.28	2.15	2.35	.....
21	.....	.....	3.2	2.7	2.65	2.18	2.61	2.32	2.14	2.19	2.28	.....
22	2.9	2.6	3.05	3.4	2.6	2.18	2.42	2.35	2.15	2.21	2.22	.....
23	.....	.....	3.1	4.4	7.3	2.18	2.42	2.28	2.06	2.10	2.15	.....
24	.....	.....	2.95	3.4	5.2	2.12	2.30	2.11	2.00	2.05	2.12	.....
25	2.85	.....	2.85	3.0	3.6	2.12	2.20	2.02	2.08	2.05	2.11	.....
26	.....	2.40	2.7	2.8	3.1	2.10	2.28	2.00	2.05	2.05	2.11	1.9
27	.....	.....	3.1	2.75	2.9	2.10	2.12	2.00	2.06	2.05	2.09	.....
28	.....	.....	5.2	2.65	2.85	2.10	2.12	2.00	2.08	2.05	2.05	.....
29	2.85	2.40	9.1	2.6	2.8	2.10	2.20	2.02	2.08	2.05	2.05	.....
30	.....	.....	7.4	2.6	2.6	2.10	2.20	2.18	2.02	2.05	2.00	.....
31	.....	.....	6.6	.....	2.5	.....	2.10	2.15	.....	2.05	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 25 and about Dec. 9 to 31.

Daily discharge, in second-feet, of North Branch of Root River near Lanesboro, Minn., for 1912.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3,400	284	386	196	157	164	144	141	141
2	.....	2,040	250	541	226	144	150	150	141	157
3	.....	1,250	329	461	222	157	131	150	141	150
4	.....	1,080	306	386	246	164	144	141	141	141
5	.....	1,160	284	362	211	178	263	137	141	174
6	.....	1,340	284	306	215	192	185	141	131	192
7	.....	1,830	250	263	230	192	157	141	131	178
8	.....	1,430	238	222	192	185	157	141	125	164
9	.....	850	222	215	199	164	141	131	131	.....
10	.....	617	222	211	1,310	157	141	131	131	.....
11	.....	587	222	192	514	157	125	141	131	.....
12	.....	558	211	192	487	157	125	185	154	.....
13	.....	530	211	211	410	144	164	316	185	.....
14	.....	558	199	230	435	125	171	230	171	.....
15	.....	1,040	203	207	362	125	174	192	174	.....
16	.....	850	199	192	293	150	150	178	174	.....
17	.....	558	196	192	230	157	164	164	174	.....
18	.....	476	196	185	246	185	199	164	189	.....
19	.....	400	203	185	199	207	246	174	199	.....
20	.....	376	2,040	185	230	222	222	174	250	.....
21	.....	376	352	185	367	238	171	189	222	.....
22	.....	779	329	185	280	250	174	196	199	.....
23	.....	1,620	5,090	185	280	222	144	157	174	.....
24	.....	779	2,520	164	230	160	125	141	164	.....
25	.....	530	970	164	192	131	150	141	160	.....
26	376	425	629	157	222	125	141	141	160	.....
27	587	400	514	157	164	125	144	141	154	.....
28	2,480	352	487	157	164	125	150	141	141	.....
29	7,640	329	461	157	192	131	150	141	141	.....
30	5,200	329	362	157	192	185	131	141	125	.....
31	4,140	.....	316	.....	157	174	.....	141	.....	.....

NOTE.—Daily discharge computed from rating well-defined curves. Rating table applied indirectly May 23, 24, 25 and new table used subsequent to May 26. Discharge Jan. 1 to Mar. 25 and Dec. 9 to 31 estimated, because of ice, from climatologic records, discharge measurements, and gage heights, as follows: Jan. 1 to 30, 180 second-feet, varying from about 230 to 150 second-feet; Feb. 1 to 29, 150 second-feet, varying from about 150 to 180 second-feet; Mar. 1 to 25, 200 second-feet, varying from about 180 to 400 second-feet; Dec. 9 to 31, 120 second-feet.

Monthly discharge of North Branch of Root River near Lanesboro, Minn., for 1912.

[Drainage area, 647 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	180	0.278	0.32	C.
February	.....	.....	150	.232	.25	C.
March	7,640	.....	820	1.27	1.46	C.
April	3,400	329	895	1.38	1.54	A.
May	5,090	196	599	.926	1.07	B.
June	541	157	233	.360	.40	B.
July	1,310	157	293	.453	.52	B.
August	250	125	167	.258	.30	A.
September	263	125	162	.251	.28	B.
October	316	131	161	.249	.29	B.
November	250	125	160	.247	.28	B.
December	192	.....	131	.202	.23	C.
The year	7,640	.....	330	.510	6.94	

NOTE.—See footnotes to tables of daily gage height and daily discharge.

WISCONSIN RIVER NEAR RHINELANDER, WIS.

Location.—At the highway bridge about 400 feet below Forbes & Wixson's power plant, about 8 miles southwest of Rhinelander, Wis., in sec. 27, T. 36 N., R. 8 E., 8 miles below the mouth of Pelican River.

Records available.—December 1, 1905, to December 31, 1912.

Drainage area.—Not measured.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably permanent.

Discharge measurements.—Made from downstream side of bridge to which gage is attached.

Winter flow.—The winters are severe, but little if any ice forms at the gage.

Artificial control.—The natural flow of the stream is much modified by the operation of power plants and by storage above the station.

Accuracy.—The fluctuation of the load on the turbines may affect discharge measurements, but it is thought that the records give the flow at the section accurately. As the station was last visited in July, 1908, estimates of discharge are withheld until the discharge rating curve and the permanency of the gage datum are checked.

Cooperation.—Gage heights furnished by the Wisconsin Valley Improvement Co.

Daily gage height, in feet, of Wisconsin River near Rhinelander, Wis., for 1912.

[G. N. Kramer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.4	3.1	3.3	2.9	3.4	4.0	3.3	3.4	3.1	3.3	3.2	2.0
2	3.5	3.0	3.4	3.3	3.4	3.6	3.1	3.5	4.7	3.4	3.4	3.6
3	3.3	3.1	2.8	3.4	3.2	3.4	3.1	3.7	5.3	3.0	2.7	3.4
4	3.3	3.0	3.5	3.5	3.6	3.2	2.4	3.0	5.1	3.2	3.4	3.2
5	3.3	3.9	3.1	3.9	3.4	3.7	3.2	3.5	5.4	3.5	3.7	3.3
6	3.2	3.9	3.1	4.2	3.5	3.5	3.4	3.7	5.7	2.4	3.6	3.6
7	2.9	3.9	3.4	4.5	3.5	3.4	1.9	4.2	5.2	3.1	3.4	3.4
8	3.3	3.9	3.3	4.0	3.3	3.4	3.3	4.6	4.6	3.5	3.5	2.4
9	3.5	4.0	3.2	4.3	3.4	3.0	3.3	5.2	5.1	3.6	3.4	3.3
10	3.8	4.1	2.5	4.4	3.7	3.1	3.4	5.7	4.8	3.1	2.9	3.5
11	3.8	3.8	2.8	4.3	3.7	3.3	3.2	6.0	4.6	3.1	3.3	3.1
12	3.7	3.9	3.0	4.4	3.0	3.3	3.2	5.6	4.7	3.5	3.5	3.2
13	3.8	3.8	3.1	4.5	3.2	3.4	3.1	5.7	4.6	2.1	3.4	3.4
14	3.2	3.8	3.0	3.5	3.5	2.9	1.8	5.4	4.6	3.3	3.3	3.4
15	3.7	3.8	3.0	4.3	3.4	2.9	3.2	5.2	3.0	3.5	3.2	2.1
16	3.6	3.7	3.1	4.3	3.1	2.2	3.4	5.3	3.9	3.2	3.2	3.4
17	3.8	3.5	1.9	4.3	3.5	3.0	3.3	5.2	3.6	3.3	2.8	3.2
18	3.7	3.2	3.2	4.2	3.4	3.1	3.1	3.0	3.6	3.1	3.4	3.3
19	3.8	3.7	3.0	3.9	3.0	3.4	3.1	4.9	3.1	3.5	3.4	3.1
20	3.8	3.9	3.1	3.7	3.3	2.9	3.4	4.7	3.1	2.7	3.4	3.1
21	2.7	3.8	2.8	3.7	3.4	3.1	2.0	4.7	3.3	3.4	3.3	3.0
22	3.6	3.7	2.7	3.8	3.2	3.2	3.0	4.6	2.9	3.4	3.5	2.7
23	3.7	3.8	2.9	3.7	3.4	1.8	3.0	4.6	3.0	3.2	3.3	2.9
24	3.5	3.9	1.8	3.5	3.5	3.2	3.2	4.4	3.0	3.3	2.7	2.7
25	3.2	3.8	3.1	3.5	3.7	3.4	3.4	3.2	3.4	3.4	3.3	2.8
26	3.2	3.9	2.8	3.4	3.5	3.1	3.4	4.2	3.4	3.3	3.3	2.6
27	3.3	3.9	2.9	3.4	3.4	3.0	3.6	4.5	3.1	2.6	3.4	2.9
28	3.0	3.7	3.8	3.4	3.4	3.1	3.1	4.6	3.1	3.3	3.2	2.9
29	3.3	3.4	3.4	4.4	3.7	2.9	3.7	4.4	2.7	3.5	3.2	2.7
30	3.2	.....	2.7	4.3	3.8	2.0	3.4	4.4	3.3	3.2	3.0	2.6
31	3.2	.....	2.0	.....	3.7	.....	3.5	4.4	.....	3.4	.....	2.6

NOTE.—Ice along shore at gage Jan. 1 to Mar. 23 and Dec. 6 to 31.

WISCONSIN RIVER AT MERRILL, WIS.

Location.—At highway bridge at east end of Merrill, Wis., one-half mile below the mouth of Prairie River.

Records available.—November 17, 1902, to December 31, 1912.

Drainage area.—2,630 square miles.

Gage.—Standard gage attached to bridge; datum unchanged.

Channel.—Probably permanent; current swift.

Discharge measurements.—Made from bridge to which gage is attached.

Winter flow.—Winters are severe but the swift current prevents the river from freezing across at the gage. Relation between gage height and discharge is, however, affected by backwater at times, caused by ice at or below the gage.

Artificial control.—The flow is affected by operation of power plants above the station and by storage.

Accuracy.—During the logging season gage heights are affected by backwater caused by log jams. Except as the gage readings may be affected by conditions above noted, the records are reliable and accurate. As this station has not been visited since February, 1909, estimates of discharge are withheld until the discharge rating curve and the permanency of the gage datum are checked.

Cooperation.—Gage heights furnished by the Wisconsin Valley Improvement Co.

Daily gage height, in feet, of Wisconsin River at Merrill, Wis., for 1912.

[A. F. Luck, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	5.6	5.4	4.0	7.0	6.6	3.8	5.4	11.5	5.3	5.1	5.55
2	5.4	5.6	5.4	5.6	7.0	6.6	3.75	5.1	12.5	5.35	4.95	5.65
3	5.4	5.6	5.4	5.7	6.6	6.6	5.0	4.5	7.6	5.5	4.65	5.55
4	5.4	5.6	5.2	6.2	6.8	6.6	4.9	4.5	9.2	5.3	5.0	6.15
5	5.2	5.4	4.9	6.6	7.7	6.6	4.6	4.4	8.0	5.1	5.05	6.35
6	5.0	5.4	5.2	7.8	7.6	6.4	4.45	4.8	8.0	5.45	5.4	5.95
7	5.2	5.4	5.1	8.2	7.5	6.4	4.6	5.4	7.6	5.5	4.95	5.8
8	5.6	5.4	5.1	8.6	7.5	6.2	4.6	6.0	7.4	5.3	4.95	5.65
9	5.4	5.4	5.0	8.2	7.1	6.2	4.4	6.8	7.1	5.6	4.9	5.65
10	5.8	5.4	5.0	7.9	6.6	5.6	4.8	9.1	6.5	5.6	5.05	5.55
11	5.8	5.5	5.0	8.0	6.6	4.6	5.0	9.7	6.2	5.45	4.95	5.8
12	6.0	5.6	5.1	7.8	6.7	5.1	5.0	9.6	6.1	5.45	5.0	5.2
13	5.8	5.3	4.6	7.8	6.4	5.4	4.8	8.8	6.0	6.35	5.65	5.55
14	5.7	5.6	5.1	7.4	5.6	4.9	4.6	7.6	6.2	6.6	5.3	5.6
15	5.5	5.5	5.0	7.7	6.6	5.1	4.45	7.4	6.2	6.2	5.25	5.35
16	5.5	5.6	4.8	7.8	6.9	5.1	4.45	6.8	6.1	5.95	5.35	5.3
17	5.6	5.8	4.6	7.5	5.7	4.8	4.8	7.0	6.1	6.0	5.25	5.55
18	5.6	5.6	4.8	7.4	6.0	5.3	4.6	6.8	5.9	6.0	4.8	5.6
19	5.4	5.6	4.6	7.0	6.2	4.6	4.7	6.8	6.0	6.1	5.15	5.25
20	5.3	5.6	4.8	7.0	6.2	5.3	4.2	7.0	5.8	5.85	4.95	5.05
21	5.6	5.6	5.0	7.0	6.2	5.3	4.6	6.8	5.9	5.45	5.15	5.3
22	5.4	5.6	4.9	7.8	6.7	4.9	4.4	6.5	6.1	5.15	5.15	5.15
23	5.2	5.2	4.8	8.3	7.8	5.2	5.2	6.4	5.6	5.4	5.1	5.0
24	5.2	5.4	4.9	8.4	8.3	5.0	13.6	6.3	5.4	5.45	5.05	5.25
25	5.2	5.4	4.7	7.6	7.9	5.1	10.2	6.2	5.6	5.4	4.9	5.2
26	5.5	5.3	4.6	7.2	7.2	5.2	8.4	5.6	5.8	5.1	5.05	5.0
27	5.6	5.1	5.0	7.6	7.7	5.3	7.4	6.2	5.2	5.2	5.0	4.75
28	5.6	5.5	4.8	7.5	8.1	4.6	6.4	6.0	5.2	5.1	4.95	4.95
29	5.3	5.4	5.4	7.4	8.2	4.4	5.8	6.0	4.8	5.3	5.05	4.6
30	5.4	.....	5.0	7.2	7.8	5.2	5.6	6.4	5.4	5.05	5.1	4.8
31	5.4	.....	4.6	.....	7.6	.....	5.4	6.6	.....	5.0	.....	5.15

NOTE.—Observer made no report concerning ice. Relation of gage height to discharge probably not affected by ice during 1912.

WISCONSIN RIVER NEAR NECEDAH, WIS.

Location.—At the highway bridge about 3 miles east of Necedah, Wis., on the road from Necedah to Strongs Prairie, 5 miles above the mouth of Big Roche a Cri Creek.

Records available.—December 2, 1902, to December 31, 1912.

Drainage area.—About 5,800 square miles.

Gage.—Standard chain gage attached to bridge. As the gage has not been checked with level since February, 1909, the present datum may be slightly in error.

Discharge measurements.—Made from bridge to which gage is attached.

Channel.—Shifts during floods.

Winter flow.—Ice forms from 1 to 2 feet in thickness, lasts about three months, and modifies the relation between gage height and discharge.

Accuracy.—As the station was last visited in February, 1909, estimates of discharge are withheld from publication.

Cooperation.—Gage-height records are furnished by the Wisconsin Valley Improvement Co.

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1912.

[Michael Coughlin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	7.2	9.8	11.0	5.8	8.2	8.8	6.8	6.0	5.5
2	.....	.....	7.4	8.0	9.0	10.0	5.6	7.7	9.4	6.6	5.9	5.6
3	.....	7.6	.....	8.1	8.8	9.0	5.2	7.4	11.0	6.4	6.0	6.2
4	.....	.....	.....	8.4	8.4	8.7	5.4	7.1	13.6	6.2	5.8	6.4
5	.....	.....	.....	8.8	8.2	8.2	5.2	6.8	15.7	6.3	5.9	7.1
6	8.3	.....	.....	9.7	8.1	8.0	5.8	6.8	15.0	6.4	5.4	7.7
7	.....	.....	.....	10.1	8.9	7.7	4.9	6.7	13.6	6.1	6.0	7.9
8	.....	.....	.....	10.8	9.7	7.3	5.6	6.4	12.6	6.4	5.8	8.0
9	.....	.....	7.2	11.6	10.0	7.3	5.6	6.3	11.7	6.2	5.9	6.8
10	.....	7.5	.....	12.2	9.6	6.6	5.4	7.2	10.4	6.4	5.8	6.5
11	.....	.....	.....	11.8	8.9	7.0	5.4	8.7	9.4	6.2	5.6	6.8
12	.....	.....	.....	10.8	8.4	6.9	5.4	10.2	9.2	6.4	5.9	8.0
13	8.3	.....	.....	10.1	8.2	6.1	5.5	11.8	8.6	6.5	6.0	8.5
14	.....	.....	.....	9.9	8.6	6.4	6.0	12.8	8.3	6.4	5.9	8.7
15	.....	.....	.....	9.6	8.4	6.1	5.5	12.7	7.9	7.6	6.2	8.8
16	.....	.....	7.1	9.4	8.0	6.3	5.6	11.6	7.8	7.6	6.3	8.4
17	.....	7.6	.....	9.8	7.9	5.7	6.2	10.0	7.5	7.4	6.2	8.5
18	.....	.....	.....	9.8	8.2	6.4	6.1	9.3	7.6	7.3	6.0	8.6
19	.....	.....	.....	9.5	8.1	5.8	6.0	8.9	7.4	7.1	6.2	8.3
20	7.8	.....	.....	9.5	8.0	5.9	5.8	9.1	7.6	6.8	6.1	8.4
21	.....	.....	.....	8.6	8.3	6.0	5.8	9.2	7.5	6.4	5.9	8.5
22	.....	.....	.....	8.5	8.1	6.0	5.6	9.1	7.5	6.6	6.0	7.4
23	.....	.....	7.2	8.5	8.6	5.6	5.0	8.8	7.3	6.5	6.0	8.3
24	.....	7.4	.....	10.0	9.2	5.2	6.9	8.5	7.2	6.2	6.0	8.1
25	.....	.....	.....	11.1	9.7	5.9	10.1	8.0	7.1	6.3	6.3	7.9
26	.....	.....	.....	11.2	10.0	5.5	13.6	8.0	7.0	6.4	6.2	8.0
27	10.6	.....	.....	11.2	9.9	5.7	14.4	7.5	6.9	6.4	6.0	7.7
28	.....	.....	.....	9.7	9.5	5.6	14.6	7.3	6.8	6.2	5.9	7.5
29	.....	.....	.....	10.0	9.7	5.7	12.7	7.9	6.8	6.3	5.8	7.6
30	.....	.....	6.9	10.2	10.8	5.8	9.9	8.1	6.6	6.2	5.6	7.5
31	.....	.....	.....	.....	11.5	.....	8.7	8.4	.....	6.0	.....	7.8

NOTE.—Jan. 6 to Mar. 23, ice 1 to 2 feet thick. Mar. 30, river clear of ice. During December river completely frozen over, with ice of insufficient thickness to hold a person. Relation of gage height to discharge affected by ice about Jan. 1 to Mar. 29 and Dec. 2 to 31.

WAPSIPINICON RIVER AT STONE CITY, IOWA.

Location.—At the highway bridge at Stone City, Iowa, a short distance above the Chicago, Milwaukee & St. Paul Railway bridge, about 4 miles above the mouth of Buffalo Creek.

Records available.—August 19, 1903, to December 31, 1912.

Drainage area.—1,310 square miles.

Gage.—Chain, attached to bridge. On December 4, 1906, repairs to the bridge resulted in raising the gage box. Gage heights from that date to January 13, 1910, when the change was determined, have been corrected. Corrected gage heights for 1907, 1908, and 1909 were published in Water-Supply Paper 265.

Channel.—Slightly shifting, as indicated by discharge measurements in 1912.

Discharge measurements.—Made from upstream side of bridge.

Artificial control.—During the year there has been a power plant installed at Center City, about 20 miles above the station which may possibly cause some diurnal fluctuation at the gage.

Winter flow.—The relation between gage height and discharge is affected by heavy ice during December, January, February, and a portion of March. Ice forms from 1 to 2 feet in thickness.

Cooperation.—Gage heights furnished by Frank Dearborn, of Stone City, Iowa.

Discharge measurements of Wapsipinicon River at Stone City, Iowa, in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 4	J. B. Hill	3.72	514
Nov. 9	S. B. Soulé	2.95	198

Daily gage height, in feet, of Wapsipinicon River at Stone City, Iowa, for 1912.

[Frank Dearborn, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.2	.....	14.1	4.1	3.3	2.62	3.0	3.35	3.2	3.05	3.3
2	.....	.....	.....	14.9	4.1	3.35	2.78	2.88	3.35	3.25	3.0	3.1
3	3.7	.....	.....	13.4	3.9	3.35	2.70	2.75	3.2	3.1	3.05	3.1
4	.....	.....	.....	11.8	3.8	3.3	2.85	2.80	3.5	3.05	3.25	3.1
5	.....	.....	.....	10.9	3.6	3.2	2.82	2.72	3.4	3.0	3.05	2.72
6	.....	.....	a 4.8	10.0	3.7	3.3	2.88	2.85	3.4	2.88	3.0	2.94
7	.....	3.6	.....	9.2	3.6	3.15	2.58	2.80	3.5	2.96	3.0	3.2
8	.....	.....	.....	8.3	3.5	3.1	2.62	2.85	3.95	2.85	2.90	3.2
9	.....	.....	.....	7.5	3.45	3.45	2.82	2.87	3.0	3.3	3.0	3.15
10	.....	.....	.....	7.5	3.3	3.05	2.72	2.87	3.05	3.65	2.98	3.2
11	3.2	.....	.....	6.9	3.65	2.98	2.85	2.60	3.3	3.9	3.0	3.2
12	.....	.....	.....	6.5	4.0	2.95	2.85	2.62	3.15	3.75	2.96	3.15
13	.....	.....	a 4.2	6.4	3.8	3.1	2.78	2.84	2.95	4.15	3.3	3.1
14	.....	3.55	.....	8.3	3.6	3.2	2.63	2.42	3.1	3.95	3.5	3.1
15	.....	.....	.....	7.0	3.45	3.05	2.55	2.40	3.0	3.65	3.45	.....
16	.....	.....	.....	6.6	3.45	3.0	2.72	2.40	3.0	3.35	3.5	.....
17	3.1	.....	.....	6.4	3.45	2.93	2.72	2.42	2.85	3.45	3.35	.....
18	.....	.....	.....	5.8	3.5	2.92	2.68	2.50	3.0	3.3	3.15	3.1
19	.....	.....	.....	5.6	3.45	2.90	2.65	7.1	3.2	3.3	3.05	.....
20	.....	.....	a 3.9	5.1	3.65	2.87	2.65	6.7	3.35	3.25	3.1	.....
21	.....	3.5	.....	5.0	3.6	2.95	2.88	6.1	3.6	3.3	3.1	.....
22	.....	.....	.....	4.8	3.5	2.97	2.53	5.2	3.55	3.25	3.0	.....
23	.....	.....	6.2	4.7	3.4	2.97	2.45	4.5	3.45	3.1	3.0	.....
24	3.15	.....	a 8.7	4.9	3.35	2.92	2.90	4.3	3.4	3.2	3.0	.....
25	.....	.....	8.2	4.5	3.25	2.85	2.85	4.1	3.35	3.15	3.0	.....
26	.....	.....	8.2	4.1	3.35	2.90	2.72	3.9	3.25	3.0	2.98	3.1
27	.....	.....	8.2	4.1	3.35	2.90	2.75	3.7	3.15	3.1	2.95	.....
28	.....	4.4	8.5	3.8	4.2	2.90	2.75	3.75	3.25	2.98	2.98	.....
29	.....	.....	9.0	3.55	3.7	2.88	2.82	3.65	3.3	3.15	3.0	.....
30	.....	.....	13.9	3.9	3.4	2.70	2.80	3.4	3.2	3.0	3.9	.....
31	.....	.....	13.6	.....	3.4	.....	3.05	3.45	.....	3.1	.....	.....

a Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to about Mar. 30, and about Dec. 7 to 31.

Daily discharge, in second-feet, of Wapsipinicon River at Stone City, Iowa, for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9,300	710	335	119	220	355	295	238	335
2	10,400	710	355	159	185	355	315	220	255
3	8,320	610	355	138	151	295	255	238	255
4	6,340	560	335	177	164	420	238	315	255
5	5,430	465	295	169	143	375	220	238	143
6	4,640	510	335	185	177	375	185	220	202
7	4,000	465	275	110	164	420	208	220	.....
8	3,320	420	255	119	177	635	177	190	.....
9	2,730	398	398	169	182	220	335	220	.....
10	2,730	335	238	143	182	238	488	214	.....
11	2,320	488	214	177	114	335	610	220	.....
12	2,060	660	205	177	119	275	535	208	.....
13	2,000	560	255	159	174	205	738	335	.....
14	3,320	465	295	121	78	255	635	420	.....
15	2,380	398	238	103	74	220	488	398	.....
16	2,120	398	220	143	74	220	355	420	.....
17	2,000	398	199	143	78	177	398	355	.....
18	1,640	420	196	133	92	220	335	275	.....
19	1,540	398	190	126	2,450	295	335	238	.....
20	1,260	488	182	126	2,180	355	315	255	.....
21	1,200	465	205	185	1,820	465	335	255	.....
22	1,100	420	211	99	1,320	442	315	220	.....
23	1,040	375	211	83	930	398	255	220	.....
24	1,150	355	196	190	820	375	295	220	.....
25	930	315	177	177	710	355	275	220	.....
26	710	355	190	143	610	315	220	214	.....
27	710	355	190	151	510	275	255	205	.....
28	560	765	190	151	535	315	214	214	.....
29	442	510	185	169	488	335	275	220	.....
30	610	375	138	164	375	295	220	610	.....
31	.....	375	.....	238	398	.....	255	.....	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined. Daily discharge Jan. 1 to Mar. 30, and Dec. 7 to Dec. 31; estimated, because of ice, from climatologic records discharge of adjacent drainage areas and observer's reports, as follows: Jan. 1 to 31, 200 second-feet, varying from about 250 to 150 second-feet; Feb. 1 to 29, 150 second-feet; Mar 1 to 30, 990 second-feet, varying from about 200 to 8,000 second-feet; Dec. 7 to 31, 170 second-feet.

Monthly discharge of Wapsipinicon River at Stone City, Iowa, for 1912.

[Drainage area, 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	200	0.153	0.18	
February	.....	.....	150	.115	.12	
March	.....	.....	990	.756	.87	
April	10,400	442	2,880	2.20	2.46	B.
May	765	315	468	.357	.41	A.
June	398	138	242	.185	.21	A.
July	238	83	150	.115	.13	A.
August	2,450	74	506	.386	.44	B.
September	635	177	327	.250	.28	A.
October	738	177	335	.256	.30	A.
November	610	190	268	.205	.23	A.
December	.....	.....	184	.140	.16	
The year	10,400	.....	556	.424	5.79	

NOTE.—See footnote to table of daily discharge.

ROCK RIVER BELOW MOUTH OF PECATONICA RIVER, AT ROCKTON, ILL.

Location.—At highway bridge 1 mile below dam and three-fourths of a mile below mouth of Pecatonica River.

Records available.—June 28, 1903, to July 20, 1906; October 1, 1906, to March 31, 1909. (A discharge measurement was made May 13, 1903.)

Drainage area.—6,290 square miles.

Gage.—Standard chain gage attached to downstream side of first span from left end of bridge. Datum raised 1.0 foot October 1, 1906, so that gage readings since that date are 1.0 foot less than they would have been by the former datum.

Control.—Practically permanent.

Discharge measurements.—Made from upstream side of 5-span bridge.

Floods.—The highest recorded stage during the period when the gage was in operation was 13.23 feet, in 1904. No other flood records available.

Winter flow.—Discharge relation affected by ice.

Regulation.—Low-water flow modified by operation of dam and power plant.

Diversions.—Some water diverted for small power plants.

Accuracy.—Amount of change in datum on October 1, 1906, only approximately known; estimates since that date liable to some error, probably small. Data were published in Water-Supply Paper 305 as originally recomputed for the 1911 report of the River and Lakes Commission of the State of Illinois. Tables of monthly discharge in Water-Supply Paper 305 are erroneous. Corrected tables are published in this report and in report of Rivers and Lakes Commission for 1911.

Monthly discharge of Rock River, below mouth of Pecatonica River, at Rockton, Ill., for 1903–1909.

[Drainage area, 6,290 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1903.					
July	12,000	2,100	5,630	0.895	1.03
August	5,760	3,030	4,270	.679	.78
September	9,020	3,870	5,600	.890	.99
October	9,020	3,030	4,820	.766	.88
November	3,530	2,100	2,810	.447	.50
December	.....	.....	2,150	.342	.39
1904.					
January	.....	.....	1,560	.248	.29
February	.....	.....	1,630	.259	.28
March	27,100	.....	14,300	2.27	2.62
April	20,600	5,820	10,800	1.72	1.92
May	6,600	4,200	5,420	.862	.99
June	4,010	1,620	2,510	.399	.45
July	2,100	1,160	1,660	.264	.30
August	3,030	950	1,550	.246	.28
September	4,960	1,560	2,420	.385	.43
October	5,550	2,180	3,130	.498	.57
November	2,320	1,690	1,930	.307	.34
December	.....	.....	1,850	.294	.34
The year	27,100	.....	4,070	.647	8.81
1905.					
January	.....	.....	2,170	.345	.40
February	.....	.....	1,780	.283	.29
March	22,500	.....	12,700	2.02	2.33
April	19,300	4,770	10,100	1.61	1.80
May	12,300	3,530	6,770	1.08	1.24
June	7,540	4,960	6,490	1.03	1.15
July	5,150	2,550	3,970	.631	.73
August	3,360	2,030	2,620	.417	.48
September	4,310	1,820	2,720	.432	.48
October	5,150	1,320	2,490	.396	.46
November	3,110	2,100	2,550	.405	.45
December	5,760	1,820	2,800	.445	.51
The year	22,500	.....	4,780	.760	10.32

Monthly discharge of Rock River, below mouth of Pecatonica River, at Rockton, Ill., for 1903–1909—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1906.					
January	18,100	2,630	9,610	1.53	1.76
February	.....	.....	9,900	1.57	1.64
March	21,900	5,150	12,500	1.99	2.29
April	15,800	4,980	9,160	1.46	1.63
May	4,860	2,630	3,650	.580	.67
June	3,360	1,820	2,380	.378	.42
July 1–20	3,360	1,820	2,410	.383	.28
October	2,400	1,380	1,720	.273	.31
November	6,400	1,560	2,630	.418	.47
December	5,060	2,030	3,320	.528	.61
1907.					
January 1–28	.....	.....	6,940	1.10	1.14
February 18–28	.....	.....	6,510	1.03	.42
March	10,600	3,360	4,820	.766	.88
April	12,300	4,580	7,420	1.18	1.32
May	5,760	2,550	4,020	.639	.74
June	8,270	3,360	5,230	.831	.93
July	11,100	2,870	5,960	.948	1.09
August	5,550	2,870	3,980	.633	.73
September	9,900	1,760	4,490	.714	.80
October	9,400	2,710	4,460	.709	.82
November	3,360	2,030	2,600	.413	.46
1908.					
January	.....	.....	2,330	.370	.43
February	.....	.....	6,620	1.05	1.13
March	15,800	6,440	10,900	1.73	1.99
April	10,400	4,580	6,720	1.07	1.19
May	11,900	7,070	9,090	1.45	1.67
June	8,900	3,280	6,410	1.02	1.14
July	6,400	2,070	3,530	.561	.65
August	2,480	1,500	1,810	.288	.33
September	1,620	1,380	1,470	.234	.26
October	1,720	1,380	1,510	.240	.28
November	2,400	1,320	1,720	.273	.30
December	2,790	1,560	2,110	.335	.39
The year	15,800	.....	4,510	.717	9.76
1909.					
January	.....	.....	4,010	.638	.74
February	13,700	.....	7,510	1.19	1.24
March	12,200	5,450	8,590	1.37	1.58

IOWA RIVER NEAR IOWA FALLS, IOWA.

Location.—About 1 mile above Iowa Falls and 2 miles below the Northwestern Railway bridge.

Records available.—August 5, 1911, to December 31, 1912.

Gage.—Vertical staff fastened to a maple tree on the left bank of the river.

Channel.—Rock bottom—permanent.

Discharge measurements.—Made at low water by wading in the vicinity of the gage—at other stages made from bridge.

Winter flow.—Relation of gage height to discharge is affected by ice.

Artificial control.—There is a dam 7 miles above the gage at Alden, which is used occasionally. It is thought that the flow at the gage is the natural flow of the stream.

Accuracy.—Sufficient discharge data have not been obtained to permit estimates of flow.

Discharge measurements of Iowa River near Iowa Falls, Iowa, in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Nov. 7	Lees and Soulé	0.61	28.1
7	....do	.61	30.2

NOTE.—Measurements made by wading.

Daily gage height, in feet, of Iowa River near Iowa Falls, Iowa, for 1912.

[Albert Kulas, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.90	0.76	1.01	4.6	1.22	1.50	0.82	0.65	0.64	0.56	0.85	0.85
2	.88	.68	1.01	4.0	1.16	1.42	.92	.64	.80	.72	.86	.85
3	.80	.74	1.10	3.4	1.14	1.28	.88	.61	.79	.60	.85	.74
4	.85	.60	1.18	2.75	1.10	1.20	.85	.60	.74	.60	.92	.88
5	.70	.60	1.20	2.4	1.10	1.12	.85	.60	.69	.62	.82	.98
6	.72	.75	1.20	2.2	1.10	1.10	.78	.60	.69	.62	.72	1.00
7	.70	.84	1.15	2.0	1.09	1.06	.76	.60	.65	.62	.68	1.00
8	.71	.80	1.15	1.85	1.09	1.00	.79	.66	.68	.72	.90	.94
9	.79	.74	1.15	1.65	1.08	.96	.78	.65	.68	.65	.76	.95
10	.78	.65	1.14	1.50	1.08	.90	.79	.66	.79	.71	.78	.80
11	.69	.70	1.10	1.42	1.35	.89	.79	.71	.66	.78	.72	.82
12	.69	.65	1.15	1.36	2.1	.86	.90	.90	.58	.72	.79	.80
13	.62	.68	1.11	1.30	1.65	1.12	.88	.86	.71	1.05	.81	.85
14	.61	.76	1.20	1.90	1.49	1.22	.88	.88	.72	1.00	.82	.85
15	.65	.71	.91	2.15	1.40	1.48	.78	.80	.61	1.00	.84	.86
16	.62	.70	1.15	1.85	1.30	1.24	.74	.78	.76	.94	.82	.90
17	.61	.76	1.12	1.65	1.25	1.18	.70	.75	.70	.89	.85	.88
18	.70	.80	1.22	1.49	1.19	1.10	.70	.75	.58	.84	.72	.89
19	.74	.78	1.84	1.35	1.12	1.02	.80	.79	.78	.80	.66	.90
20	.70	.78	1.95	1.30	1.10	.99	1.01	.82	.72	.81	.82	.90
21	.75	.84	1.74	1.38	1.06	.92	1.12	.82	.64	.90	.81	.92
22	.68	.75	1.70	1.65	1.01	.90	1.10	.82	.69	1.05	.84	.94
23	.68	.85	1.61	1.69	1.00	.89	1.01	.79	.74	1.00	.88	.91
24	.80	1.02	1.55	1.66	.94	.86	.94	.78	.69	.98	.75	.92
25	.78	1.01	2.55	1.55	.90	.82	.85	.75	.62	.98	.82	.90
26	.80	.99	3.0	1.39	.95	.80	.85	.71	.62	.94	.69	.90
27	.75	.91	3.9	1.28	1.70	.78	.75	.72	.68	.90	.56	.92
28	.70	.90	4.3	1.32	2.2	.78	.72	.69	.72	.90	.72	.95
29	.61	.91	a10.0	1.30	2.1	.75	.70	.68	.58	.88	.90	.92
30	.64	.....	a10.5	1.30	1.74	.75	.70	.66	.74	.88	.78	.95
31	.70	.....	5.2	.....	1.50	.....	.66	.65	.....	.85	.....	.99

NOTE.—Relation of gage height to discharge probably affected by ice Jan. 1 to Mar. 28, and Dec. 8 to Dec. 31. Gage observer reported that ice broke at 1.30 p. m. Mar. 28, forming a gorge one-half mile below the gage, backing up the ice and water so as to make it impossible to reach the gage until Mar. 30. Gage height Mar. 29 and 30 estimated by observer.

CEDAR RIVER NEAR AUSTIN, MINN.

Location.—Just below the dam of the Red Cedar Mill, 2 miles below Austin in sec. 15, T. 102 N., R. 18 W.

Records available.—May 29, 1909, to December 31, 1912.

Drainage area.—425 square miles.

Gage.—May 29, 1909, to May 1, 1912, staff gage located in the tail race. May 2, 1912, to December 31, 1912, chain gage located on bridge a short distance below the power house.

Winter flow.—The relation between stage and discharge is somewhat affected by ice. The discharge during the period of ice is estimated from discharge measurements.

Artificial control.—Immediately above the station is the water power plant known as Red Cedar Mill. During the low-water season the water is drawn down below the crest of the dam by the end of the 10 or 12 hour run, and after the turbine is closed the water is held back for several hours before it has risen sufficiently to flow over the crest. Consequently, the stage of the river changes considerably during each 24 hours. In order to get a mean gage height, the gage is read five times daily as follows: Before the turbine is started in the morning, one hour after starting, at noon, just before shutting down at night, and one-half hour later. It is believed that the monthly mean discharge represents very nearly the natural flow.

Accuracy.—Owing to the slightly shifting channel and fluctuations caused by power house, records are only fair.

Discharge measurements on Cedar River near Austin, Minn., in 1912.

[Referred to staff gage.]

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5[a]	W. G. Hoyt	5.01	107	Mar. 29	C. J. Emerson	10.96	3,000
Feb. 17[a]	S. B. Soulé	4.87	131	30	do	12.32	4,060
17	do	4.86	131	May 1[b]	S. B. Soulé	5.06	182

[a] Made from bridge and ice. Partial ice cover. Open at gage.
[b] First measurement after installation of chain gage.

[Referred to chain gage.]

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 1[a]	S. B. Soulé	3.03	182
Sept. 6[b]	do	2.11	7.8
6[b]	do	2.11	7.1

[a] First measurement after installation of chain gage.
[b] About 200 feet above gage by wading. Flow being held back by dam.

Daily gage height, in feet, at staff gage on Cedar River near Austin, Minn., for 1912.

[J. C. King, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	Day.	Jan.	Feb.	Mar.	Apr.	May.
1	4.15	3.60	3.75	8.4	4.95	16	4.95	3.70	4.25	6.3	.....
2	4.55	4.75	4.45	7.5	.....	17	4.85	4.55	3.65	5.7	.....
3	4.5	4.5	3.60	6.6	.....	18	4.65	3.80	4.5	5.5	.....
4	4.45	3.70	4.40	6.1	.....	19	4.5	4.30	5.15	5.25	.....
5	3.75	4.65	4.35	6.1	.....	20	4.65	4.45	5.55	5.0	.....
6	4.85	4.6	4.30	6.6	.....	21	3.65	4.15	5.55	6.0	.....
7	4.10	3.65	3.55	7.5	.....	22	4.25	4.40	5.2	8.8	.....
8	4.6	4.6	4.35	6.5	.....	23	4.6	4.30	5.1	7.4	.....
9	4.7	4.5	4.35	5.7	.....	24	4.6	4.35	4.95	5.9	.....
10	4.5	4.35	3.65	5.5	.....	25	4.45	3.75	5.0	5.4	.....
11	4.6	3.75	4.30	5.4	.....	26	4.35	4.35	5.05	5.3	.....
12	4.45	4.55	4.35	5.3	.....	27	4.35	4.40	7.8	5.3	.....
13	4.85	4.5	4.30	5.4	.....	28	3.70	3.65	12.6	4.95	.....
14	4.10	3.80	3.60	7.4	.....	29	4.35	4.40	11.9	5.1	.....
15	4.8	4.55	4.30	7.6	.....	30	4.5	.....	9.3	5.05	.....
						31	4.55	.....	8.8	.....	.....

NOTE.—Jan. 6, observer reported backwater from ice.

Daily discharge, in second-feet, of Cedar River near Austin, Minn., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	63	9	11	1,660	16	144	16	44	645
2	132	76	64	1,200	17	111	77	7.5	408
3	111	52	6	770	18	76	13	70	332
4	102	12	58	565	19	52	48	210	242
5	26	70	53	565	20	70	64	351	166
6	35	63	48	770	21	11	35	351	525
7	44	12	5	1,200	22	31	58	225	1,880
8	111	70	53	727	23	58	48	194	1,150
9	122	58	53	408	24	52	53	154	486
10	84	44	7.5	332	25	40	11	166	295
11	92	16	48	295	26	34	53	180	259
12	70	70	53	259	27	34	58	1,350	259
13	132	63	48	295	28	10	7.5	4,180	154
14	34	18	6	1,150	29	34	58	3,720	194
15	111	76	48	1,250	30	48	.....	2,150	180
					31	52	.....	1,880	.....

NOTE.—Daily discharge computed from a rating table well defined between 84 and 4,440 second-feet (gage heights 4.6 and 13.0 feet). Rating table applied indirectly Jan. 1 to Feb. 16. Jan. 6, discharge interpolated because of backwater from ice.

Daily gage height at chain gage, in feet, of Cedar River near Austin, Minn., for 1912.

[J. C. King, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.7	2.44	2.53	.....	2.11	2.45	2.43
2	2.8	2.7	2.62	2.70	.....	2.47	2.46	2.36
3	2.75	2.6	2.18	2.42	.....	2.47	2.33	2.36
4	2.8	2.6	2.69	2.81	.....	2.48	2.40	2.42
5	2.75	2.65	2.22	2.61	.....	2.49	2.42	2.42
6	2.85	2.65	2.51	2.39	2.11	2.33	2.48	2.34
7	2.8	2.65	2.53	2.47	2.20	2.37	2.43	2.34
8	2.8	2.6	2.41	2.22	2.39	2.42	2.46	2.30
9	2.75	2.5	2.08	2.47	2.73	2.44	2.44	2.47
10	2.65	2.15	6.9	2.71	2.22	2.42	2.31	2.42
11	2.65	2.6	5.6	2.56	2.67	2.52	2.38	2.23
12	2.5	2.6	4.65	2.63	2.69	2.60	2.52	2.27
13	2.65	2.6	4.65	2.44	2.58	2.43	2.66	2.24
14	2.65	2.6	4.10	2.67	2.52	2.69	2.65	2.21
15	2.65	2.65	3.90	2.59	2.50	2.59	2.66	2.08
16	2.65	2.55	3.65	2.23	2.47	2.53	2.64	2.35
17	2.55	2.7	3.40	2.76	2.48	2.51	2.48	2.47
18	2.6	2.65	3.25	2.61	2.57	2.51	2.58	2.44
19	2.45	2.6	3.15	2.74	2.54	2.46	2.56	2.41
20	2.6	2.6	3.30	2.64	2.48	2.32	2.56	2.27
21	2.6	2.6	3.50	2.68	2.54	2.55	2.57	2.20
22	2.6	2.6	3.50	2.65	2.36	2.56	2.48	2.00
23	4.5	2.4	3.30	2.60	2.36	2.49	2.50	2.39
24	4.6	2.5	3.15	2.19	2.41	2.45	2.33	2.26
25	3.65	2.7	3.00	2.86	2.23	2.49	2.53	2.11
26	3.25	2.0	2.97	2.34	1.95	2.44	2.52	2.35
27	3.25	2.8	2.62	.....	2.62	2.36	2.54	2.30
28	3.15	2.1	2.87	.....	1.99	2.42	2.37	2.22
29	2.95	2.4	2.49	.....	2.04	2.44	2.52	1.97
30	2.75	2.55	2.92	.....	2.10	2.42	2.58	2.25
31	2.75	.....	2.64	.....	.....	2.47	.....	2.37

NOTE.—No record obtained Aug. 27 to Sept. 5 because chain gage was removed in making repairs to bridge. Dec. 9 and 10, increase in gage height probably due to ice.

Daily discharge, in second-feet, of Cedar River near Austin, Minn., for 1912.

[From chain gage record.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[a]154	100	46	62	18	7.5	48	45
2	125	100	81	100	16	51	50	34
3	112	76	13	43	14	51	30	34
4	125	76	98	128	12	53	40	43
5	112	88	17	78	10	54	43	43
6	138	88	58	38	7.5	30	53	31
7	125	88	62	51	15	36	45	31
8	125	76	42	17	38	43	50	25
9	112	56	6.3	51	108	46	46	23
10	88	11	1,800	102	17	43	26	21
11	88	76	1,070	68	93	60	37	18
12	56	76	670	83	98	76	60	22
13	88	76	670	46	72	45	90	19
14	88	76	490	93	60	98	88	16
15	88	88	428	74	56	74	90	6.3
16	88	66	353	18	51	62	86	32
17	66	100	282	115	53	58	53	51
18	76	88	241	78	70	58	72	46
19	48	76	215	110	64	50	68	42
20	76	76	254	86	53	28	68	22
21	76	76	310	95	64	66	70	15
22	76	76	310	88	34	68	53	4.5
23	618	40	254	76	34	54	56	38
24	652	56	215	14	42	48	30	21
25	353	100	176	140	18	54	62	7.5
26	241	4.5	168	31	4.0	46	60	32
27	241	125	81	29	81	34	64	25
28	215	6.7	142	27	4.4	43	36	17
29	163	40	54	24	5.4	46	60	4.2
30	112	66	155	22	6.7	43	72	20
31	112	.....	86	20	.....	51	.....	36

[a] From staff gage record.

NOTE.—Daily discharge Aug. 27 to Sept. 5 and Dec. 9 and 10 interpolated. Daily discharge computed from a rating curve fairly well defined between 6.7 and 1,020 second-feet (gage heights 2.1 and 5.5 feet). Four discharge measurements made during 1913 (before the preparation of this report) were used to determine this rating curve.

Monthly discharge of Cedar River near Austin, Minn., for 1912.[a]

[Drainage area, 425 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	144	10	68.6	0.161	0.19	C.
February	77	7.5	45.1	.106	.11	C.
March	4,180	5	509	1.20	1.38	B.
April	1,880	154	621	1.46	1.63	B.
May	652	48	156	.367	.42	B.
June	125	4.5	71.6	.168	.19	B.
July	1,800	6.3	285	.671	.77	C.
August	140	14	64.7	.152	.18	C.
September	108	4.0	40.6	.096	.11	C.
October	98	7.5	50.9	.120	.14	B.
November	90	26	56.9	.134	.15	B.
December	51	4.2	26.6	.063	.07	C.
The year	4,180	4.2	[a]167	.393	5.34	

[a] January, February, March, and April from staff gage records; remainder from chain gage records.

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

Location.—In the central part of Cedar Rapids, below the dam and between the electric railroad bridge and the Seventh Avenue combination railroad and foot bridge.

Records available.—October 26, 1902, to December 31, 1912.

Drainage area.—6,320 square miles.

Gage.—An inclined staff gage reading from 0 to 15 feet, fastened to posts driven in the right bank of the river in the rear of the Iowa Windmill & Pump Co.'s plant.

Channel.—Rock and gravel; clean of vegetation and nearly permanent.

Discharge measurements.—Made from the upstream side of the First Avenue bridge.

Artificial control.—A dam and power plant above the station may modify the flow to some extent during low stage of the river.

Winter flow.—The gage is located where the current is swift and ice seldom forms across the river for the entire width. The relation therefore between the gage and the discharge is affected only slightly by ice.

Discharge measurements of Cedar River at Cedar Rapids, Iowa, in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 21	J. B. Hill	4.25	3,910
Nov. 8	S. B. Soulé	3.01	910

Daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.4	3.8	17.2	4.4	3.7	3.0	3.1	3.2	3.1	3.1	3.0
2	3.6	.....	3.9	16.3	4.3	3.8	3.1	3.2	3.3	3.2	3.0	2.9
3	.....	.....	3.9	12.9	4.3	3.6	3.0	3.2	3.2	3.1	3.1	3.1
4	.....	3.5	4.0	10.7	4.1	3.7	3.1	3.1	3.3	3.2	3.0	2.8
5	3.7	.....	3.8	8.9	4.1	3.6	3.0	3.1	3.3	3.1	3.0	2.9
6	.....	.....	3.8	7.5	4.0	3.7	3.1	3.0	3.4	3.2	2.9	2.7
7	3.6	3.4	3.7	6.7	4.2	3.5	3.0	3.1	3.2	3.1	3.2	2.8
8	.....	.....	3.9	6.1	4.0	3.6	3.1	3.0	3.3	3.2	3.0	2.8
9	3.8	.....	3.8	5.8	4.1	3.4	3.0	3.1	3.2	3.2	3.1	2.9
10	.....	3.5	3.8	5.7	3.9	3.5	3.0	3.1	3.3	3.5	2.9	3.0
11	.....	.....	3.7	5.6	4.0	3.4	2.9	3.3	3.2	3.4	3.0	3.1
12	3.8	.....	3.8	5.3	4.0	3.4	3.1	3.1	3.2	3.4	2.9	3.0
13	.....	3.3	3.7	5.3	4.0	3.2	3.0	3.2	3.1	3.3	3.1	3.1
14	.....	.....	3.9	5.1	3.9	3.3	3.2	3.0	3.2	3.3	3.2	3.2
15	3.7	3.6	3.8	5.1	4.1	3.5	3.2	3.1	3.2	3.2	3.4	2.8
16	.....	.....	4.0	5.0	4.0	3.5	3.5	3.0	3.3	3.3	3.2	2.7
17	.....	3.6	4.0	5.3	4.1	3.3	3.7	3.2	3.2	3.1	3.2	2.8
18	3.6	.....	4.4	5.9	4.1	3.4	3.6	3.1	3.4	3.2	3.0	2.8
19	.....	3.9	5.1	5.5	4.2	3.3	3.4	3.8	3.3	3.1	3.1	2.9
20	3.9	.....	5.5	5.2	4.2	3.4	3.5	4.2	3.3	3.2	3.0	2.8
21	.....	3.7	5.7	5.0	4.1	3.3	3.5	3.9	3.2	3.1	3.1	2.9
22	3.8	.....	6.7	4.6	3.8	3.4	3.7	3.6	3.3	3.1	2.9	2.8
23	.....	.....	6.3	4.7	3.8	3.2	3.6	3.6	3.2	3.0	3.0	2.9
24	.....	4.6	6.5	4.5	3.7	3.3	3.6	3.5	3.3	3.1	2.9	2.7
25	3.7	4.9	6.1	5.0	4.0	3.2	3.5	3.5	3.2	3.1	2.9	2.8
26	.....	4.6	5.9	5.2	3.9	3.2	3.6	3.4	3.2	3.2	2.8	2.7
27	3.7	4.5	6.5	5.1	4.3	3.1	3.5	3.5	3.1	3.1	2.9	2.9
28	.....	4.0	8.3	4.8	4.0	3.2	3.5	3.3	3.2	3.2	2.9	2.8
29	.....	3.9	9.5	4.6	3.9	3.0	3.3	3.3	3.2	3.1	3.0	3.0
30	3.6	.....	11.1	4.5	3.8	3.1	3.4	3.3	3.2	3.1	2.9	2.9
31	.....	.....	15.7	.....	3.9	.....	3.2	3.4	.....	3.0	.....	3.1

NOTE.—Ice was reported at the gage Jan. 1 to Feb. 23, but the effect on the relation of gage height to discharge was probably small.

Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	a 1,850	1,630	2,590	54,100	4,430	2,320	950	1,100	1,260	1,100	1,100	950
2	2,070	a 1,700	2,870	50,600	4,110	2,590	1,100	1,260	1,440	1,260	950	810
3	a 2,150	a 1,770	2,870	37,200	4,110	2,070	950	1,260	1,260	1,100	1,100	1,100
4	a 2,230	1,840	3,170	28,500	3,480	2,320	1,100	1,100	1,440	1,260	950	690
5	2,320	a 1,770	2,590	21,400	3,480	2,070	950	1,100	1,440	1,100	950	810
6	a 2,200	a 1,700	2,590	15,800	3,170	2,320	1,100	950	1,630	1,260	810	580
7	2,070	1,630	2,320	12,700	3,790	1,840	950	1,100	1,260	1,100	1,260	690
8	a 2,330	a 1,700	2,870	10,400	3,170	2,070	1,100	950	1,440	1,260	950	690
9	2,590	a 1,770	2,590	9,340	3,480	1,630	950	1,100	1,260	1,260	1,100	810
10	a 2,590	1,840	2,590	8,970	2,870	1,840	950	1,100	1,440	1,840	810	950
11	a 2,590	a 1,710	2,320	8,610	3,170	1,630	810	1,440	1,260	1,630	950	1,100
12	2,590	a 1,580	2,590	7,530	3,170	1,630	1,100	1,100	1,260	1,630	810	950
13	a 2,500	1,440	2,320	7,530	3,170	1,260	950	1,260	1,100	1,440	1,100	1,100
14	a 2,410	a 1,570	2,870	6,820	2,870	1,440	1,260	950	1,260	1,440	1,260	1,260
15	2,320	2,070	2,590	6,820	3,480	1,840	1,260	1,100	1,260	1,260	1,630	690
16	a 2,230	a 2,070	3,170	6,470	3,170	1,840	1,840	950	1,440	1,440	1,260	580
17	a 2,150	2,070	3,170	7,530	3,480	1,440	2,320	1,260	1,260	1,100	1,260	690
18	2,070	a 2,470	4,430	9,710	3,480	1,630	2,070	1,100	1,630	1,260	950	690
19	a 2,470	2,870	6,820	8,250	3,790	1,440	1,630	2,590	1,440	1,100	1,100	810
20	2,870	a 2,600	8,250	7,170	3,790	1,630	1,840	3,790	1,440	1,260	950	690
21	a 2,730	2,320	8,970	6,470	3,480	1,440	1,840	2,870	1,260	1,100	1,100	810
22	2,590	a 3,240	12,700	5,090	2,590	1,630	2,320	2,070	1,440	1,100	810	690
23	a 2,500	a 4,160	11,200	5,430	2,590	1,260	2,070	2,070	1,260	950	950	810
24	a 2,410	5,090	12,000	4,760	2,320	1,440	2,070	1,840	1,440	1,100	810	580
25	2,320	6,120	10,400	6,470	3,170	1,260	1,840	1,840	1,260	1,100	810	690
26	a 2,320	5,090	9,710	7,170	2,870	1,260	2,070	1,630	1,260	1,260	690	580
27	2,320	4,760	12,000	6,820	4,110	1,100	1,840	1,840	1,100	1,100	810	810
28	a 2,230	3,170	19,000	5,770	3,170	1,260	1,840	1,440	1,260	1,260	810	690
29	a 2,150	2,870	23,700	5,090	2,870	950	1,440	1,440	1,260	1,100	950	950
30	2,070	.....	30,000	4,760	2,590	1,100	1,630	1,440	1,260	1,100	810	810
31	a 1,850	.....	48,200	.....	2,870	.....	1,260	1,630	.....	950	.....	1,100

a Daily discharge interpolated.

NOTE.—Daily discharge computed from a rating curve well defined between 600 and 36,000 second-feet. Open-channel rating table applied throughout entire year. Values in January and February should be used with caution. See footnote to table of daily gage height.

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for 1912.

[Drainage area, 6,320 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	2,870	1,850	2,330	0.369	0.43	(a)
February	6,120	1,440	2,570	.407	.44	(a)
March	48,200	2,320	8,500	1.34	1.54	B.
April	54,100	4,760	12,800	2.03	2.26	B.
May	4,430	2,320	3,300	.522	.60	A.
June	2,590	950	1,650	.261	.29	A.
July	2,320	810	1,460	.231	.27	A.
August	3,790	950	1,510	.239	.28	A.
September	1,630	1,100	1,330	.210	.23	A.
October	1,840	950	1,230	.195	.22	A.
November	1,630	690	993	.157	.18	A.
December	1,260	580	812	.128	.15	B.
The year	54,100	580	3,200	.506	6.89	

a Error due to possible effect of ice during January and February not known. Use discharge values with due caution.

DES MOINES RIVER AT JACKSON, MINN.

Location.—At highway bridge one-half mile below the dam at Jackson, 100 yards above the nearest tributary, a small stream entering from the west.

Records available.—May 31, 1909, to December 5, 1912.

Drainage area.—1,160 square miles.

Gage.—Vertical staff; datum unchanged.

Channel.—Shifting during periods of high water; probably permanent during low water.

Discharge measurements.—Made from the bridge and by wading.

Winter flow.—Observations are discontinued from December to March because of ice.

Artificial control.—At the dam one-half mile above the station there is a power plant that develops 35 horsepower under a head of 6½ feet. The plant is operated only six hours a day on the average, but the morning and evening gage heights thus far obtained do not show any appreciable change in the stage of the river in the low-water season, owing to water being held back after the turbines have been shut down.

Discharge measurements of Des Moines River at Jackson, Minn., in 1912.

[S. B. Soulé, hydrographer.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 2	4.26	211	Sept. 7[a]	2.86	4.6
2	4.24	200	7[a]	2.86	5.4
Sept. 7[a]	2.86	5.1			

[a] Measurement made by wading at section about 200 feet below gage.

NOTE.—Zero flow determined to be at gage height 1.8 feet, Sept. 7, 1912.

Daily gage height, in feet, of Des Moines River at Jackson, Minn., for 1912.

[Albert Strobel, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.0	4.3	3.5	2.80	2.72	2.90	2.80	2.78	3.0
2	5.1	4.2	3.4	2.79	2.72	2.95	2.80	2.95	2.98
3	5.5	4.2	3.3	2.88	2.72	2.95	2.78	2.95	2.89
4	5.0	4.15	3.4	3.0	2.72	2.94	2.75	2.90	2.81
5	4.7	4.15	3.35	3.0	2.75	2.90	2.76	2.91	2.80
6	4.7	4.2	3.3	2.92	2.76	2.88	2.76	2.91	.....
7	4.6	4.2	3.25	2.95	2.82	2.85	2.75	2.91	.....
8	4.6	4.1	3.2	3.0	4.1	2.85	2.75	2.89	.....
9	4.5	4.05	3.15	2.91	3.3	2.85	2.91	2.88	.....
10	4.5	4.0	3.0	2.98	3.1	2.85	3.25	2.89	.....
11	4.45	4.05	3.2	3.0	3.0	2.85	3.1	2.90	.....
12	4.4	3.95	3.1	2.95	3.0	2.85	3.05	2.95	.....
13	4.5	3.9	3.1	2.86	2.96	2.85	3.0	2.98	.....
14	4.7	3.9	3.1	2.82	2.92	2.85	2.98	3.0	.....
15	4.7	3.9	3.15	2.78	2.91	2.82	2.94	2.96	.....
16	4.6	3.85	3.15	2.78	2.89	2.80	3.0	2.95	.....
17	4.5	3.8	3.05	2.78	2.90	2.81	3.3	2.95	.....
18	4.4	3.8	3.1	2.78	2.90	2.85	3.10	2.92	.....
19	4.4	3.8	3.05	2.88	3.6	2.85	2.99	2.96	.....
20	4.3	3.75	3.0	2.96	3.2	2.85	2.92	2.96	.....
21	5.0	3.75	3.0	2.90	3.15	2.84	2.89	2.90	.....
22	5.0	3.7	3.0	2.84	3.0	2.85	2.85	2.90	.....
23	4.8	3.7	3.0	2.82	2.98	2.82	2.85	2.90	.....
24	4.6	3.6	3.0	2.78	2.92	2.79	2.82	2.96	.....
25	4.5	3.65	2.88	2.75	2.90	2.81	2.80	2.88	.....
26	4.6	3.6	2.98	2.74	2.88	2.81	2.81	3.0	.....
27	4.5	3.5	2.96	2.72	2.84	2.82	2.80	3.1	.....
28	4.45	3.65	2.85	2.72	2.81	2.82	2.80	3.0	.....
29	4.4	3.55	2.82	2.72	2.80	2.86	2.80	2.98	.....
30	4.3	3.5	2.80	2.75	2.88	2.86	2.79	2.98	.....
31	.....	3.5	.....	2.75	2.89	.....	2.78	.....	.....

Daily discharge, in second-feet, of Des Moines River at Jackson, Minn., for 1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	362	214	80	5	4.2	9	5	4.8	18
2	385	195	66	4.9	4.2	14	5	14	16
3	479	195	54	8.2	4.2	14	4.8	14	8.6
4	362	186	66	18	4.2	13	4.5	9.0	5.4
5	296	186	60	18	4.5	9	4.6	9.9	5.0
6	296	195	54	11	4.6	8.2	4.6	9.9	.....
7	275	195	48	14	5.8	7	4.5	9.9	.....
8	275	176	42	18	176	7	4.5	8.6	.....
9	254	167	36	9.9	54	7	9.9	8.2	.....
10	254	158	18	16	30	7	48	8.6	.....
11	244	167	42	18	18	7	30	9.0	.....
12	234	149	30	14	18	7	24	14	.....
13	254	140	30	7.4	14	7	18	16	.....
14	296	140	30	5.8	11	7	16	18	.....
15	296	140	36	4.8	9.9	5.8	13	14	.....
16	275	132	36	4.8	8.6	5	18	14	.....
17	254	123	24	4.8	9	5.4	54	14	.....
18	234	123	30	4.8	9	7	30	11	.....
19	234	123	24	8.2	94	7	17	14	.....
20	214	116	18	14	42	7	11	14	.....
21	362	116	18	9	36	6.6	8.6	9.0	.....
22	362	108	18	6.6	18	7	7.0	9.0	.....
23	317	108	18	5.8	16	5.8	7.0	9.0	.....
24	275	94	18	4.8	11	4.9	5.8	14	.....
25	254	101	8.2	4.5	9	5.4	5.0	8.2	.....
26	275	94	16	4.4	8.2	5.4	5.4	18	.....
27	254	80	14	4.2	6.6	5.8	5.0	30	.....
28	244	101	7	4.2	5.4	5.8	5.0	18	.....
29	234	87	5.8	4.2	5	7.4	5.0	16	.....
30	214	80	5	4.5	8.2	7.4	4.9	16	.....
31	.....	80	.....	4.5	8.6	.....	4.8	.....	.....

NOTE.—Daily discharge computed from a fairly well defined rating curve.

Monthly discharge of Des Moines River at Jackson, Minn., for 1912.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
April	479	214	285	0.246	0.27	B.
May	214	80	138	.119	.14	B.
June	80	5	31.7	.027	.03	B.
July	18	4.2	8.59	.0074	.009	C.
August	176	4.2	21.2	.018	.02	C.
September	14	4.9	7.40	.0064	.007	C.
October	54	4.5	12.6	.011	.01	C.
November	30	4.8	12.7	.011	.01	C.

DES MOINES RIVER NEAR FORT DODGE, IOWA.

Location.—At the upper highway bridge 1 mile upstream from Fort Dodge and just above the Illinois Central Railroad bridge, about 1 mile above the old Swede Town bridge at which the station was maintained during 1905–1906. The original bridge has been torn down and the new structure about 15 feet higher, which has been put in its place, was found to be unsuited for a gaging station.

Records available.—April 23, 1905, to July 19, 1906; August 4, 1911, to December 31, 1912.

Drainage area.—Not measured.

Gage.—Chain, fastened to the outside handrail, downstream side of right span; datum unchanged.

Channel.—Bed composed of sand and gravel; considered practically permanent. One channel at all stages broken only by the bridge pier.

Winter flow.—Ice may affect the relation of gage height to discharge during December, January, and February.

Accuracy.—The relation between gage height and discharge may at times be affected by backwater from Lizard Creek. Sufficient discharge measurements have not been made to develop the discharge rating curve above 1,500 second-feet; therefore estimates of discharge above that point are not published.

Discharge measurements of Des Moines River near Fort Dodge, Iowa, in 1912.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 27	J. B. Hill	2.62	1,020
Nov. 6[a]	S. B. Soulé	1.32	102
6[a]	....do	1.19	71.5

[a] Measurement made by wading.

Daily gage height, in feet, of Des Moines River near Fort Dodge, Iowa, for 1912.

[Ole C. Hanson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	.....	7.0	2.6	2.6	1.20	1.20	1.30	1.30	1.30
2	.....	.....	.....	6.4	2.55	2.6	1.30	1.25	1.30	1.30	1.40
3	.....	.....	.....	5.8	2.5	2.45	1.32	1.20	1.25	1.22	1.42
4	.....	.....	.....	5.0	2.5	2.4	1.35	1.15	1.20	1.30	1.40
5	.....	.....	.....	4.3	3.9	2.15	1.40	1.02	1.08	1.20	1.30
6	.....	.....	.....	3.4	4.0	2.1	1.42	1.10	1.30	1.30	1.22
7	1.60	.....	.....	3.6	3.7	2.1	1.38	1.10	1.30	1.15	1.22
8	1.60	.....	.....	3.4	3.3	2.0	1.35	1.30	1.25	1.25	1.20
9	1.58	.....	.....	3.4	3.0	1.90	1.30	1.25	1.20	1.20	1.20
10	1.58	.....	.....	3.0	2.8	1.75	1.20	1.10	1.28	1.20	1.22
11	1.55	.....	.....	2.9	3.1	1.80	1.35	1.18	1.35	1.15	1.22
12	1.52	.....	.....	2.75	2.95	1.75	1.40	1.30	1.30	1.50	1.25
13	1.50	.....	.....	2.5	2.8	1.75	1.45	1.42	1.30	1.35	1.30
14	1.50	.....	.....	2.4	2.7	1.90	1.40	1.40	1.25	1.40	1.35
15	1.50	.....	.....	2.35	2.2	2.3	1.35	1.30	1.25	1.30	1.40
16	1.50	.....	.....	2.3	2.2	2.25	1.30	1.42	1.32	1.40	1.42
17	1.50	.....	.....	2.3	2.2	2.2	1.30	1.40	1.30	1.32	1.45
18	1.50	.....	.....	2.35	2.15	1.80	1.25	1.40	1.30	1.40	1.42
19	1.50	.....	.....	2.3	2.1	1.80	1.20	1.60	1.32	1.40	1.40
20	1.50	.....	.....	2.3	2.25	1.68	1.40	1.85	1.20	1.42	1.40
21	.....	.....	.....	2.4	2.0	1.70	1.62	2.0	1.30	1.30	1.40
22	.....	.....	.....	2.45	1.95	1.68	1.65	1.95	1.32	1.42	1.42
23	.....	.....	.....	2.7	1.90	1.65	1.62	1.90	1.30	1.30	1.40
24	.....	.....	.....	2.85	1.90	1.55	1.60	1.85	1.32	1.40	.....
25	.....	.....	.....	2.8	1.85	1.50	1.60	1.62	1.25	1.28	.....
26	.....	.....	.....	2.7	1.80	1.48	1.55	1.70	1.30	1.30	.....
27	.....	.....	.....	2.6	4.5	1.45	1.50	1.60	1.32	1.25	.....
28	.....	.....	6.9	2.6	4.0	1.40	1.45	1.45	1.30	1.38	.....
29	.....	.....	8.9	2.6	3.7	1.35	1.40	1.40	1.35	1.40	.....
30	.....	.....	8.5	2.6	3.4	1.32	1.28	1.32	1.20	1.40	.....
31	.....	.....	7.4	.....	3.0	.....	1.32	1.20	.....	1.38	.....

NOTE.—Relation of gage height to discharge affected by ice an unknown amount Jan. 7 to 20; no estimates of discharge made.

Daily discharge, in second-feet, of Des Moines River near Fort Dodge, Iowa, for 1911–12.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1911.					1911.				
1	.....	51	170	244	16	85	78	270	194
2	.....	65	170	330	17	51	85	300	170
3	.....	51	194	300	18	65	85	300	170
4	29	65	170	270	19	92	81	270	.....
5	39	51	151	244	20	85	81	270	.....
6	39	78	151	218	21	92	92	270	.....
7	49	92	170	228	22	98	81	244	.....
8	51	81	151	218	23	81	81	270	.....
9	45	81	132	218	24	78	81	270	.....
10	54	218	151	194	25	78	92	270	.....
11	58	132	151	218	26	81	92	260	.....
12	65	92	218	194	27	73	81	270	.....
13	58	435	244	218	28	81	81	270	.....
14	65	132	270	218	29	65	85	270	.....
15	65	102	300	218	30	85	92	244	.....
					31	81	.....	244	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1912.								
1	.....	1,000	1,000	81	81	102	102	102
2	.....	945	1,000	102	92	102	102	132
3	.....	890	840	108	81	92	85	140
4	.....	890	790	117	73	81	102	132
5	.....	.....	580	132	54	62	81	102
6	.....	.....	540	140	65	102	102	85
7	.....	.....	540	126	65	102	73	85
8	.....	.....	470	117	102	92	92	81
9	.....	1,460	400	102	92	81	81	81
10	1,460	1,220	300	81	65	98	81	85
11	1,340	1,580	330	117	78	117	73	85
12	1,160	1,400	300	132	102	102	170	92
13	890	1,220	300	151	140	102	117	102
14	790	1,110	400	132	132	92	132	117
15	745	620	700	117	102	92	102	132
16	700	620	660	102	140	108	132	140
17	700	620	620	102	132	102	108	151
18	745	580	330	92	132	102	132	140
19	700	540	330	81	218	108	132	132
20	700	660	260	132	365	81	140	132
21	790	470	270	228	470	102	102	132
22	840	435	260	244	435	108	140	140
23	1,110	400	244	228	435	102	102	132
24	1,280	400	194	218	365	108	132	.....
25	1,220	365	170	218	228	92	98	.....
26	1,110	330	162	194	270	102	102	.....
27	1,000	.....	151	170	218	108	92	.....
28	1,000	.....	132	151	151	102	126	.....
29	1,000	.....	117	132	132	117	132	.....
30	1,000	.....	108	98	108	81	132	.....
31	.....	1,460	.....	108	81	.....	126	.....

NOTE.—Discharge Nov. 19 to Dec. 31, 1911, estimated, because of ice, from climatologic records and discharge of adjacent drainage areas, as follows: Nov. 19–30, 120 second-feet; Dec. 1–31, 150 second-feet. These estimates of discharge are based on insufficient data and therefore should be used with caution.

Monthly discharge of Des Moines River near Fort Dodge, Iowa, for 1911–12.

Month.	Discharge in second-feet.			Accuracy.
	Maximum.	Minimum.	Mean.	
1911.				
August 4–31	98	29	67.4	B.
September	435	51	99.8	B.
October	300	132	229	B.
November	330	.....	183	C.
December	.....	.....	150	D.
1912.				
March [a]	.....	.....	.....	
April [a]	.....	.....	.....	
May [a]	.....	.....	.....	
June	1,000	108	417	B.
July	244	81	137	B.
August	470	54	168	B.
September	117	62	98.1	B.
October	170	73	110	B.
November 1–23	151	81	115	B.

[a] See "Accuracy" in station description.

DES MOINES RIVER AT KEOSAUQUA, IOWA.

Location.—At county bridge, one-fourth mile above old dam site and Government locks.

Records available.—May 30, 1903, to July 16, 1906; April 5 to December 31, 1910 (United States Engineer Corps); August 3, 1911, to December 23, 1912.

Drainage area.—14,300 square miles.

Gage.—Chain gage attached to upstream side of bridge (gage originally attached to downstream side of bridge; changed because of repairs to bridge at unknown date); same gage used throughout period of records. Datum unchanged. A chain length of approximately 36.80 feet maintained May 30, 1903, to November 12, 1912. On November 12, 1912, the chain length was changed to 37.80 feet and the zero of the gage scale moved 1 foot farther from the pulley, the net result being no change in datum. See "Accuracy."

Bench marks.—The following descriptions and elevations of bench marks supersede those published in Water Supply Paper 171. Elevations are referred to gage datum with chain length 37.80 feet.

Bench mark No. 1.—Chiseled cross in the bridge seat stone at northeast corner of right abutment of the county bridge; elevation, 30.31 feet.

Bench mark No. 2.—Spike driven horizontally in the south side near base of oak tree on north side of the road about 100 feet from the bridge; elevation, 32.63 feet.

Bench mark No. 3.—Apparently destroyed.

Channel.—Composed of sand and gravel on the left and rock on the right. Sand shifts at flood stages.

Discharge measurements.—Made from the downstream side of the bridge.

Winter flow.—During 1912 no gage readings were taken when the channel was frozen.

Accuracy.—Wye levels run August 3, 1911, November 12, 1912, and July 11, 1913[1] (before the preparation of this report), show a discrepancy between bench marks and gage datum varying from −0.22 to +0.26 foot. Using average values from these levels (which check among themselves), and taking the elevation of bench

[1] July 11, 1913, by engineers of the Mississippi Power Co., Keokuk, Iowa.

mark No. 1 as 30.11 feet, as published in Water Supply Paper 171, the elevation of the zero of the gage has been found to be −0.20 foot, whereas using bench mark No. 2 with elevation 32.88 feet, as published in Water Supply Paper 171, the elevation of the zero of the gage has been found to be +0.25 foot. Bench mark No. 3 has apparently been destroyed and bench mark No. 4 is simply a reference point, being subject to the same changes of elevation as the gage. Since the apparent error in the elevation of the gage practically balances between bench marks Nos. 1 and 2, and there is no definite change in gage on record (except the one from downstream to upstream side of bridge), the daily gage heights and discharge measurements have been referred to the original chain length (36.80 feet), no change has been made in gage datum, and bench mark elevations have been adjusted to correspond. These records should, therefore, be used with caution. However, in view of the fact that five discharge measurements have been made during 1910–1912, the records should be reliable, even though changes have occurred to alter the original relation between gage height and discharge which are subject to more than one interpretation.

Discharge measurements of Des Moines River at Keosauqua, Iowa, in 1910–1912.

Date.	Hydrographer.	Gage height.[a]	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
1910.		*Feet.*	*Sec.-ft.*	1912.		*Feet.*	*Sec.-ft.*
Aug. 4	A. D. Llewellyn[b]	0.5	719	Apr. 20	J. B. Hill	3.38	7,080
1911.				Nov. 11	S. B. Soulé	.90	1,340
Aug. 3	Follansbee and Kay	.10	266	13	do	.93	1,370

[a] Chain length 36.80 feet. See "Gage" paragraph in station description.
[b] Corps of Engineers, U. S. Army.

Daily gage height, in feet, of Des Moines River at Keosauqua, Iowa, for 1912.

[Oscar McCrary, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.9	2.8	2.9	1.05	0.75	0.7	0.6	1.2	0.75
2	14.5	4.4	2.8	1.1	.8	.75	.6	1.05	.8
3	16.0	4.3	2.4	.9	.7	.65	.6	1.05	.85
4	16.6	4.4	2.4	1.0	.75	1.3	.65	1.0	.9
5	15.9	4.5	2.4	.9	.65	1.9	.65	1.0	.9
6	14.5	3.9	2.5	1.0	.7	2.7	.....	1.0	.9
7	12.0	3.3	2.3	.9	.55	1.9	.....	1.0	.85
8	8.7	2.7	2.2	.95	.65	1.5	.....	.95	.8
9	6.8	2.9	1.9	.8	.55	1.1	.....	1.0	.7
10	5.6	2.8	1.95	1.1	.7	1.15	.....	.8	.7
11	5.1	4.5	1.7	.9	.6	1.0	.....	.9	.7
12	4.6	.....	1.65	.9	.6	.95	.....	.95	.7
13	4.6	.....	1.5	1.1	.6	.8	2.9	.9	.....
14	5.7	.....	1.9	2.3	.65	1.2	3.3	.95	.....
15	5.1	.....	1.65	2.6	.6	1.4	3.1	1.25	.....
16	5.1	.....	2.5	1.85	.65	1.4	2.8	1.3	.....
17	4.9	.....	3.1	1.2	.55	1.2	2.6	1.25	.....
18	4.2	.....	2.5	1.1	.65	1.2	2.35	1.2	.....
19	3.9	3.1	2.0	.9	.55	1.0	2.0	1.05	.....
20	3.2	2.8	2.0	.95	.55	1.05	2.0	1.05	.....
21	3.5	2.5	1.85	.8	1.2	.9	1.8	1.05	.....
22	3.4	2.2	1.85	.85	1.4	1.0	1.75	1.0	.....
23	4.0	2.1	1.6	.7	1.05	.9	1.75	1.0	.....
24	4.2	1.9	1.6	.9	1.15	.95	1.6	.95	.....
25	3.7	1.9	1.35	.9	.95	.8	1.5	.9	.....
26	3.0	1.6	1.4	1.1	1.0	.85	1.45	.95	.....
27	3.0	1.6	1.2	1.0	.85	.7	1.4	.9	.....
28	2.8	1.5	1.25	1.0	.9	.8	1.5	.85	.....
29	2.7	1.5	1.1	.85	.8	.65	1.45	.8	.....
30	2.8	1.7	1.2	.9	.9	.75	1.4	.75	.....
31	.....	2.4	.....	.85	.75	.....	1.35	.....	.....

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for 1910–1912.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.									
1	.....	2,280	2,280	1,640	795	730	1,640	730	610
2	.....	3,700	2,180	1,640	730	730	1,470	730	670
3	.....	3,820	1,990	1,810	730	730	1,470	730	730
4	.....	3,010	1,990	1,720	730	730	1,310	730	730
5	5,770	2,480	1,810	1,640	730	730	1,230	730	730
6	11,800	2,380	1,640	1,640	730	795	1,000	610	610
7	9,430	2,380	1,560	1,470	730	795	1,000	610	490
8	6,460	2,680	1,470	1,310	730	860	1,000	610	490
9	5,230	3,340	1,470	1,310	670	730	1,000	610	490
10	4,580	3,010	1,560	1,310	610	670	930	610	490
11	4,320	2,580	1,720	1,150	610	610	860	610	490
12	3,940	2,580	2,080	1,150	610	610	795	610	490
13	3,940	2,380	2,790	1,000	610	795	795	610	490
14	3,700	2,280	4,190	1,000	610	1,080	730	610	490
15	3,700	2,080	4,840	1,150	550	1,000	730	610	490
16	3,460	1,990	4,320	1,150	550	860	730	610	490
17	3,340	1,990	3,580	860	610	730	730	610	490
18	3,230	2,080	3,230	860	930	730	670	610	490
19	3,120	2,180	3,010	860	860	730	610	610	490
20	3,010	2,180	2,680	860	730	610	670	610	490
21	2,790	2,180	2,380	860	6,600	670	730	610	490
22	2,790	2,790	2,080	860	1,900	1,000	730	610	490
23	2,790	3,010	1,990	860	1,390	1,000	730	610	490
24	2,790	2,680	1,900	730	1,150	1,000	670	610	490
25	2,790	2,480	1,810	730	1,000	1,390	610	610	490
26	2,580	2,480	1,810	730	930	1,900	670	610	490
27	2,580	2,580	1,900	730	730	1,560	730	610	490
28	2,580	2,580	1,900	730	730	1,470	730	610	490
29	2,380	2,790	1,810	4,580	730	1,470	730	610	490
30	2,380	2,580	1,640	1,640	730	1,640	730	610	490
31	.....	2,480	.....	930	730	.....	730	.....	375

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1911.						1911.					
1	.....	160	8,850	860	730	16	265	860	1,310	730	930
2	.....	160	11,500	860	670	17	265	730	1,310	860	930
3	265	160	6,880	860	610	18	265	860	1,470	1,000	1,000
4	375	160	6,320	795	730	19	265	1,470	1,470	930	1,080
5	265	160	4,450	730	1,000	20	265	1,150	1,310	795	1,150
6	265	160	3,010	795	860	21	212	1,150	1,230	860	1,000
7	320	730	2,180	795	730	22	212	1,000	1,150	930	1,080
8	265	320	1,810	888	730	23	265	860	1,000	1,150	1,000
9	265	320	1,640	1,150	730	24	212	1,000	1,000	860	.....
10	265	1,180	1,470	1,810	3,940	25	212	1,720	1,000	1,150	.....
11	265	1,000	1,310	1,810	2,380	26	181	1,150	1,150	860	.....
12	265	2,180	1,310	2,380	1,310	27	181	860	1,000	730	.....
13	320	1,640	1,310	1,310	1,150	28	160	3,230	1,000	670	.....
14	320	1,470	1,310	730	1,080	29	160	12,600	930	730	.....
15	375	1,150	1,310	795	1,000	30	160	7,160	860	730	.....
						31	160	.....	860	.....	.....

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for 1910–1912—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1912.									
1	39,600	5,500	5,770	1,560	1,080	1,000	860	1,810	1,080
2	46,000	10,000	5,500	1,640	1,150	1,080	860	1,560	1,150
3	52,200	9,720	4,450	1,310	1,000	930	860	1,560	1,230
4	54,700	10,000	4,450	1,470	1,080	1,990	930	1,470	1,310
5	51,800	10,300	4,450	1,310	930	3,230	930	1,470	1,310
6	46,000	8,560	4,710	1,470	1,000	5,230	.....	1,470	1,310
7	36,100	6,880	4,190	1,310	795	3,230	.....	1,470	1,230
8	23,800	5,230	3,940	1,390	930	2,380	.....	1,390	1,150
9	17,200	5,770	3,230	1,150	795	1,640	.....	1,470	.....
10	13,500	5,500	3,340	1,640	1,000	1,720	.....	1,150	.....
11	12,000	10,300	2,790	1,310	860	1,470	.....	1,310	.....
12	10,600	9,800	2,680	1,310	860	1,390	.....	1,390	.....
13	10,600	9,300	2,380	1,640	860	1,150	5,770	1,310	.....
14	13,800	8,800	3,230	4,190	930	1,810	6,880	1,390	.....
15	12,000	8,300	2,680	4,970	860	2,180	6,320	1,900	.....
16	12,000	7,800	4,710	3,120	930	2,180	5,500	1,990	.....
17	11,500	7,320	6,320	1,810	795	1,810	4,970	1,900	.....
18	9,430	6,820	4,710	1,640	930	1,810	4,320	1,810	.....
19	8,560	6,320	3,460	1,310	795	1,470	3,460	1,560	.....
20	6,600	5,500	3,460	1,390	795	1,560	3,460	1,560	.....
21	7,440	4,710	3,120	1,150	1,810	1,310	3,010	1,560	.....
22	7,160	3,940	3,120	1,230	2,180	1,470	2,900	1,470	.....
23	8,850	3,700	2,580	1,000	1,560	1,310	2,900	1,470	.....
24	9,430	3,230	2,580	1,310	1,720	1,390	2,580	1,390	.....
25	8,000	3,230	2,080	1,310	1,390	1,150	2,380	1,310	.....
26	6,040	2,580	2,180	1,640	1,470	1,230	2,280	1,390	.....
27	6,040	2,580	1,810	1,470	1,230	1,000	2,180	1,310	.....
28	5,500	2,380	1,900	1,470	1,310	1,150	2,380	1,230	.....
29	5,230	2,380	1,640	1,230	1,150	930	2,280	1,150	.....
30	5,500	2,790	1,810	1,310	1,310	1,080	2,180	1,080	.....
31	.....	4,450	.....	1,230	1,080	.....	2,080	.....	.....

NOTE.—The open-channel rating curve has been applied throughout. Relation of gage height to discharge probably affected (an unknown amount) by ice during December, 1910, November and December, 1911, and December, 1912. Estimates of discharge for these months should be used with caution. See "Accuracy" in station description.

Monthly discharge of Des Moines River at Keosauqua, Iowa, for 1910–1912.

[Drainage area, 14,300 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1910.						
April 5–30	11,800	2,380	4,060	0.284	0.27	B.
May	3,820	1,990	2,580	.180	.21	B.
June	4,840	1,470	2,320	.162	.18	B.
July	4,580	730	1,260	.088	.10	B.
August	6,600	550	983	.069	.08	B.
September	1,900	610	945	.066	.07	B.
October	1,640	610	876	.061	.07	B.
November	730	610	630	.044	.05	C.
December	730	375	523	.037	.04	D.
1911.						
August 3–31	375	160	251	.018	.02	C.
September	12,600	160	1,560	.109	.12	B.
October	11,500	860	2,350	.164	.19	B.
November	2,380	670	985	.069	.08	C.
1912.						
April	54,700	5,230	18,600	1.30	1.45	B.
May	.....	2,380	6,250	.437	.50	B.
June	6,320	1,640	3,440	.241	.27	B.
July	4,970	1,000	1,650	.115	.13	B.
August	2,180	795	1,120	.078	.09	B.
September	5,230	930	1,710	.120	.13	B.
October	6,880	860	2,600	.182	.21	B.
November	1,990	1,080	1,480	.103	.11	B.

NOTE.—See footnote to table of daily discharge.

SANGAMON RIVER NEAR MONTICELLO, ILL.

Location.—At Illinois Central Railroad bridge about one-half mile west of Monticello, Ill.

Records available.—February 4, 1908, to October 1, 1912; October 31 to December 31, 1912, when station was finally discontinued.

Drainage area.—550 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Section is at a pool; measurements prior to 1912 indicated that control was permanent; measurement of July 30, 1912, indicates slight shift.

Discharge measurements.—Made from downstream side of bridge and wooden trestle approach.

Floods.—The flood of May, 1908, reached a height of 15.2 feet on the gage.

Winter flow.—Ice usually affects the relation between gage height and discharge during portions of December, January, and February.

The following discharge measurement was made by P. S. Monk:

July 30, 1912: Gage height, 2.94 feet; discharge, 81.0 second-feet.

Daily gage height, in feet, of Sangamon River near Monticello, Ill., for 1912.

[Martin Doyle, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	a 6.3	a 4.4	a 10.2	10.4	11.2	4.5	2.53	2.90	.....	1.90	2.28	.....
2	a 5.4	.....	a 9.5	10.0	11.5	.....	3.15	2.71	2.20	.....	2.25	2.95
3	a 4.8	a 4.0	.....	9.5	10.4	5.3	4.9	2.60	2.20	.....	.....	2.90
4	a 5.4	.....	6.5	9.0	9.9	4.8	.....	.....	2.19	.....	3.10	3.0
5	a 5.1	3.7	a 5.8	8.1	.....	4.4	4.9	2.49	2.00	.....	2.88	3.0
6	a 5.3	a 3.6	a 5.3	7.8	9.8	4.2	4.5	2.42	2.00	.....	3.15	2.94
7	a 5.15	a 3.55	a 4.9	.....	9.2	4.0	.....	2.40	2.11	.....	3.15	2.90
8	a 5.0	a 3.4	a 4.6	8.0	8.5	4.0	3.5	2.39	2.05	.....	5.3	.....
9	a 4.8	a 3.4	a 4.7	8.0	7.8	.....	4.6	2.49	2.00	.....	5.8	2.62
10	a 4.6	a 3.35	.....	7.1	7.1	3.5	4.0	2.50	2.00	.....	.....	2.50
11	a 4.4	.....	4.0	6.4	6.7	3.4	6.8	.....	2.00	.....	4.5	2.46
12	a 4.2	3.25	a 3.9	5.9	.....	3.2	8.3	2.78	1.95	.....	4.2	2.42
13	a 4.1	a 3.2	3.8	5.6	9.8	3.2	8.9	2.85	1.95	.....	4.0	2.68
14	4.0	a 3.2	3.9	.....	9.6	3.2	.....	2.88	1.99	.....	4.0	2.68
15	a 4.0	a 3.15	9.8	9.0	9.6	3.15	7.1	2.59	.....	.....	5.7	.....
16	a 4.0	a 3.2	10.0	7.1	9.0	.....	6.2	2.50	1.98	.....	5.5	2.61
17	a 4.0	3.45	.....	7.6	8.2	3.95	5.0	2.52	2.01	.....	.....	2.82
18	a 5.3	.....	12.2	8.9	7.5	3.75	4.4	.....	2.10	.....	4.4	2.75
19	a 8.5	8.3	13.2	10.0	.....	3.55	3.95	3.1	2.05	.....	.....	2.60
20	a 8.0	8.4	13.9	10.3	6.2	3.35	3.6	4.0	2.00	.....	3.85	2.38
21	.....	.....	12.8	.....	5.8	3.65	.....	2.90	2.08	.....	3.8	2.31
22	6.0	a 7.1	11.3	9.3	5.5	3.4	6.1	5.2	.....	.....	3.6	.....
23	5.9	a 5.3	10.8	.....	5.2	.....	4.0	3.85	2.00	.....	3.5	2.70
24	8.1	a 4.4	.....	8.9	5.0	3.0	3.8	3.5	2.00	.....	.....	2.69
25	8.3	.....	10.7	8.0	4.7	2.88	3.45	.....	1.99	.....	3.3	.....
26	8.0	8.6	10.3	7.2	.....	2.79	3.2	2.82	1.95	.....	3.2	2.62
27	7.4	10.8	10.0	7.0	4.4	2.73	2.96	2.65	1.95	.....	3.1	2.42
28	5.8	10.4	10.3	.....	4.6	2.70	.....	2.56	1.94	.....	3.0	2.38
29	a 5.2	a 10.3	11.7	10.5	4.7	2.60	3.25	2.42	.....	.....	2.96	.....
30	a 4.8	.....	11.6	11.9	4.6	.....	2.89	2.38	1.90	.....	2.85	2.42
31	a 4.6	.....	.....	.....	4.9	.....	.....	2.30	.....	2.05	.....	2.50

a Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 4 to Feb. 25, and possibly also to some extent during the first part of March. Observer reported ice from 6 to 9 inches in thickness during January, and about 7 inches during the greater part of February. From Feb. 29 to Mar. 11 the river was reported partly frozen, with ice about half an inch in thickness. Gage was not read on Sunday.

Daily discharge, in second-feet, of Sangamon River near Monticello, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	540	.....	2,120	2,320	3,240	244	48	76	a 31	15	33	a 76
2	382	.....	1,520	1,920	3,600	a 305	98	61	28	.....	31	80
3	286	.....	1,050	1,520	2,320	366	302	53	28	.....	a 62	76
4	.....	.....	576	1,260	1,830	286	a 302	a 49	28	.....	93	84
5	.....	.....	450	950	a1,780	230	302	45	19	.....	74	84
6	.....	.....	366	864	1,740	204	244	41	19	.....	98	79
7	.....	.....	302	a 892	1,350	180	a 187	40	24	.....	98	76
8	.....	.....	258	920	1,080	180	130	39	21	.....	366	a 65
9	.....	.....	272	920	864	a 155	258	45	19	.....	450	54
10	.....	.....	226	698	698	130	180	46	19	.....	a 347	46
11	.....	.....	180	558	616	120	636	a 56	19	.....	244	44
12	.....	.....	170	468	a1,180	102	1,010	66	17	.....	204	41
13	.....	.....	160	414	1,740	102	1,220	72	17	.....	180	59
14	.....	.....	170	a 837	1,590	102	a 959	74	19	.....	180	59
15	.....	.....	1,740	1,260	1,590	98	698	52	a 18	.....	432	a 56
16	.....	.....	1,920	698	1,260	a 136	522	46	18	.....	398	54
17	.....	.....	a3,220	814	980	175	318	47	19	.....	a 314	70
18	.....	.....	4,530	1,220	790	155	230	a 70	23	.....	230	64
19	.....	.....	6,080	1,920	a 656	135	175	93	21	.....	a 198	53
20	.....	.....	7,200	2,220	522	116	140	180	19	.....	165	39
21	.....	.....	5,440	a1,810	450	145	a 322	76	22	.....	160	35
22	.....	.....	3,360	1,400	398	120	504	350	a 20	.....	140	a 48
23	.....	.....	2,760	a1,310	350	a 102	180	165	19	.....	130	60
24	.....	.....	a2,700	1,220	318	84	160	130	19	.....	a 120	59
25	.....	.....	2,650	920	272	74	125	a 100	19	.....	111	a 56
26	.....	1,110	2,220	720	a 251	67	102	70	17	.....	102	54
27	.....	2,760	1,920	676	230	62	81	56	17	.....	93	41
28	.....	2,320	2,220	a1,550	258	60	a 94	50	17	.....	84	39
29	.....	2,220	3,860	2,430	272	53	106	41	a 16	.....	81	a 40
30	.....	.....	3,730	4,120	258	a 50	75	39	15	.....	72	41
31	.....	.....	a3,020	.....	302	.....	a 76	34	.....	21	.....	46

a Interpolated.

NOTE.—See footnotes to table of daily gage heights. Daily discharge computed from a rating curve well defined between 46 and 1,830 second-feet (gage heights 2.5 and 9.9 feet), and fairly well defined between 1,920 and 7,360 second-feet (gage heights 10.0 and 14.0 feet). Discharge Jan. 4 to Feb. 25 estimated because of ice, from gage heights, observer's notes, climatologic records and discharge of adjacent drainage areas, as follows: Jan 4–31, 300 second-feet; Feb. 1–25, 200 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Monthly discharge of Sangamon River near Monticello, Ill., for 1912.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	310	0.564	0.65	D.
February	2,760	.....	462	.840	.91	D.
March	7,200	160	2,140	3.89	4.48	C.
April	4,120	414	1,290	2.35	2.62	A.
May	3,600	230	1,060	1.93	2.22	A.
June	366	50	145	.264	.29	A.
July	1,220	48	316	.575	.66	A.
August	350	34	76.2	.139	.16	B.
September	31	15	20.2	.037	.04	C.
October	.....	.....	.....	.....	.....	.....
November	450	31	176	.320	.36	B.
December	84	35	57.4	.104	.12	B.

NOTE.—See footnote to table of daily discharge.

SANGAMON RIVER AT RIVERTON, ILL.

Location.—At Wabash Railroad bridge about one-fourth mile west of depot at Riverton, Ill., about 2½ miles below the mouth of South Fork.

Records available.—February 13, 1908, to December 31, 1912. Station discontinued December 31, 1912.

Drainage area.—2,560 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Slightly shifting; section is at a pool; measurements to date indicate that the point of control is not changing.

Discharge measurements.—Made from downstream side of three-span bridge.

Floods.—The high water of 1883 reached a height of approximately 32 feet on the present gage. The high water of 1875 is said to have been one-half foot lower than this. The high water of October, 1911, reached a height of 27.1 feet.

Winter flow.—Ice may affect the relation between gage height and discharge during short periods of extremely cold weather.

The following discharge measurement was made by P. S. Monk:
July 30, 1912: Gage height, 9.82 feet; discharge, 560 second-feet.

Daily gage height, in feet, of Sangamon River at Riverton, Ill., for 1912.

[J. H. Steele, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	15.3	12.1	21.4	23.0	24.5	12.4	9.8	9.8	8.5	7.6	7.8	8.3
2	14.5	11.9	19.7	23.1	23.8	12.3	9.7	9.8	8.3	7.5	8.1	8.2
3	14.1	11.6	19.3	23.2	23.2	12.2	10.3	9.5	8.2	7.5	8.2	8.2
4	13.4	11.3	19.7	23.0	22.9	12.6	10.2	9.0	8.1	7.5	8.2	8.2
5	13.2	10.8	19.0	22.6	22.8	12.5	10.5	8.7	8.0	7.5	8.3	8.2
6	12.8	10.5	17.5	22.2	22.8	12.0	10.5	8.6	8.0	7.45	8.6	8.3
7	12.6	10.4	15.2	21.8	22.5	11.6	11.8	8.5	8.1	7.5	9.0	8.2
8	12.5	10.3	13.6	21.2	21.8	11.1	12.4	8.4	8.0	7.45	9.6	8.2
9	12.4	10.1	12.4	20.5	21.1	11.0	11.6	.....	7.9	7.4	9.5	8.2
10	12.3	10.1	11.9	19.6	20.4	10.6	11.0	8.5	7.9	7.5	9.2	8.0
11	12.2	9.9	11.8	18.5	19.7	10.4	10.8	8.4	7.9	7.5	9.2	8.0
12	12.0	9.8	11.5	17.6	20.5	10.2	11.1	8.4	7.8	7.5	9.6	7.8
13	11.8	9.8	11.3	17.0	21.0	10.1	11.1	8.3	7.7	7.5	10.2	7.8
14	11.6	9.7	12.2	16.7	21.0	10.0	11.2	9.4	7.7	7.5	9.7	8.0
15	11.4	9.6	17.8	16.4	20.3	10.0	11.4	10.5	7.7	7.4	9.6	8.0
16	11.4	9.7	21.1	15.7	19.6	13.1	11.7	10.0	7.7	7.4	9.4	8.0
17	11.3	9.9	22.8	15.4	19.1	15.9	11.8	9.6	7.6	7.4	9.2	8.1
18	12.0	10.4	23.5	19.0	18.6	14.6	11.5	9.8	7.8	7.4	9.4	.....
19	16.1	11.6	23.5	21.2	18.0	14.0	10.8	9.7	7.7	.....	9.6	8.1
20	17.3	12.9	23.4	21.3	17.2	13.2	10.1	9.2	7.7	.....	9.5	8.1
21	17.5	13.1	24.2	20.9	16.1	12.6	9.7	9.3	7.8	.....	9.2	7.9
22	17.1	13.6	24.1	19.8	15.0	12.4	9.5	10.9	7.9	.....	9.0	7.9
23	17.0	12.7	25.2	19.7	14.2	12.3	9.2	9.8	7.8	.....	8.9	7.8
24	17.6	12.6	25.2	20.1	13.5	11.7	9.1	9.2	7.8	.....	8.8	7.8
25	17.6	13.4	24.9	19.4	13.1	11.1	9.4	9.5	7.8	.....	8.7	7.9
26	16.7	17.2	24.2	18.8	12.6	10.7	9.2	9.3	7.8	.....	8.6	7.9
27	15.6	19.4	23.4	19.1	12.6	10.4	9.0	8.9	7.7	.....	8.6	7.9
28	15.0	21.7	22.9	20.0	12.5	10.6	8.8	9.3	7.7	.....	8.5	7.8
29	14.3	21.8	22.8	21.4	13.1	10.1	9.0	8.9	7.6	.....	8.4	7.9
30	13.7	.....	23.9	23.7	13.0	9.9	10.0	8.9	7.6	.....	8.4	8.0
31	12.9	.....	23.2	.....	12.6	.....	9.7	8.9	.....	.....	.....	8.0

NOTE.—Jan. 8 to 31, Feb. 2, 3, and 4 to 20, observer reported: "No ice at gage." Relation of gage height to discharge probably not affected by ice during 1912.

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,820	1,310	7,720	10,300	13,300	1,420	542	542	254	148	168	227
2	2,380	1,240	5,700	10,500	11,900	1,390	513	542	227	138	202	214
3	2,160	1,130	5,330	10,700	10,700	1,350	696	460	214	138	214	214
4	1,830	1,020	5,700	10,300	10,200	1,500	665	344	202	138	214	214
5	1,750	856	5,070	9,620	9,980	1,460	760	287	190	138	227	214
6	1,580	760	4,070	8,940	9,980	1,280	760	270	190	133	270	227
7	1,500	728	2,760	8,300	9,440	1,130	1,200	254	202	138	344	214
8	1,460	696	1,920	7,450	8,300	955	1,420	240	190	133	486	214
9	1,420	634	1,420	6,560	7,320	920	1,130	[a] 247	179	128	460	214
10	1,390	634	1,240	5,610	6,450	792	920	254	179	138	388	190
11	1,350	572	1,200	4,690	5,700	728	856	240	179	138	388	190
12	1,280	542	1,100	4,130	6,560	665	955	240	168	138	486	168
13	1,200	542	1,020	3,780	7,180	634	955	227	158	138	665	168
14	1,130	513	1,350	3,610	7,180	603	990	435	158	138	513	190
15	1,060	486	4,250	3,430	6,340	603	1,060	760	158	128	486	190
16	1,060	513	7,320	3,040	5,610	1,710	1,170	603	158	128	435	190
17	1,020	572	9,980	2,870	5,160	3,140	1,200	486	148	128	388	202
18	1,280	728	11,300	5,070	4,760	2,430	1,100	542	168	128	435	[a] 202
19	3,260	1,130	11,300	7,450	4,370	2,100	856	513	158	.....	486	202
20	3,950	1,620	11,100	7,580	3,900	1,750	634	388	158	.....	460	202
21	4,070	1,710	12,700	7,060	3,260	1,500	513	411	168	.....	388	179
22	3,840	1,920	12,500	5,800	2,650	1,420	460	888	179	.....	344	179
23	3,780	1,540	14,900	5,700	2,210	1,390	388	542	168	.....	324	168
24	4,130	1,500	14,900	6,120	1,870	1,170	366	388	168	.....	305	168
25	4,130	1,830	14,200	5,420	1,710	955	435	460	168	.....	287	179
26	3,610	3,900	12,700	4,910	1,500	824	388	411	168	.....	270	179
27	2,980	5,420	11,100	5,160	1,500	728	344	324	158	.....	270	179
28	2,650	8,160	10,200	6,010	1,460	792	305	411	158	.....	254	168
29	2,260	8,300	9,980	7,720	1,710	634	344	324	148	.....	240	179
30	1,960	.....	12,100	11,700	1,660	572	603	324	148	.....	240	190
31	1,620	.....	10,700	.....	1,500	.....	513	324	.....	.....	.....	190

[a] Interpolated.

NOTE.—Daily discharge computed from a rating curve well defined between 138 and 4,370 second-feet (gage heights 7.5 and 18.0 feet). Discharge Oct. 19 to 31 estimated, because gage was not read, from precipitation records at 220 second-feet, varying from about 150 to 400 second-feet.

Monthly discharge of Sangamon River at Riverton, Ill., for 1912.

[Drainage area, 2,560 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	4,130	1,020	2,260	0.883	1.02	C.
February	8,300	486	1,740	.680	.73	C.
March	14,900	1,020	7,640	2.98	3.44	B.
April	11,700	2,870	6,650	2.60	2.90	B.
May	13,300	1,460	5,660	2.21	2.55	A.
June	3,140	572	1,220	.477	.53	A.
July	1,420	305	743	.290	.33	A.
August	888	227	409	.160	.18	A.
September	254	148	176	.069	.08	B.
October	.....	.....	171	.067	.08	C.
November	665	168	355	.139	.16	A.
December	227	168	194	.076	.09	B.
The year	14,900	.....	2,270	.887	12.09	

NOTE.—See footnotes to table of daily discharge.

SANGAMON RIVER NEAR OAKFORD, ILL.

Location.—At highway bridge 3 miles northeast of Oakford, Ill., near the northwest corner of T. 19 N., R. 7 W., 2½ miles above the Chicago, Peoria & St. Louis Railway bridge and 1¼ miles above the mouth of Crane Creek.

Records available.—October 26, 1909, to June 30, 1911; December 10, 1911, to March 31, 1912. Station discontinued March 31, 1912.

Drainage area.—5,000 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged. The sea-level elevation of the zero of the gage is 468.80 feet.

Channel.—Shifting; the river for some distance above and below the station has been dredged and straightened, thus increasing the slope considerably and disturbing the regimen of the river. Conditions along the improved section are probably reverting to their former natural state. Measurements to date, however, indicate little if any change in the relation between gage height and discharge.

Discharge measurements.—Made from downstream side of bridge and wooden trestle approaches.

Floods.—The floods of February and March, 1907, May, 1908, and October, 1911, reached a height of about 21 feet by the present gage.

Winter flow.—Ice may affect the relation between gage height and discharge during portions of December, January, and February.

Accuracy.—Backwater caused by ice jams or drift lodging at the railroad bridge 2½ miles below the gaging station may at times affect the relation between gage height and discharge.

The following discharge measurement was made by P. S. Monk:

July 31, 1912: Gage height, 3.58 feet; discharge, 959 second-feet.

Daily gage height, in feet, of Sangamon River near Oakford, Ill., for 1912.

[E. J. Bonnett, observer.]

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	9.9		13.7	16	6.8	4.4	12.5
2	8.7		13.6	17	7.0	4.3	14.2
3	8.2		12.8	18	7.3	4.8	16.2
4	7.6		11.6	19	7.8	5.9	17.0
5	7.6		11.1	20	8.5	6.6	17.6
6	7.7		10.5	21	10.0	6.0	17.6
7	7.8		9.3	22	10.4	6.3	17.3
8	7.9		8.1	23	10.5	6.0	17.6
9	8.0		7.2	24	10.9	6.3	18.0
10	7.9		6.4	25	11.4	7.6	18.1
11	7.8		6.0	26		11.2	18.0
12	7.8		5.8	27		12.2	17.7
13	7.5		5.8	28		13.0	17.2
14	7.2	5.0	7.8	29		13.6	17.0
15	7.0	4.5	10.6	30			17.0
				31			17.1

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 5 to Feb. 22. Observer reported as follows: Jan. 10, partly frozen; Jan. 11 to 16, frozen; Jan. 18 to 20, water on both sides; Jan. 21, ice breaking up; Jan. 22 to 23, water on both sides; Jan. 24 to 25, holes in ice; Jan. 26 to Feb. 7, frozen over; Feb. 8, water on sides; Feb. 9 to 13, ice; Feb. 14, holes in ice; Feb. 15 to 17, ice floating; Feb. 25, some slush ice; Feb. 27, ice floating; Feb. 28 to 29, slush ice.

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Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	5,680		10,200	16	2,920	1,340	8,600
2	4,490		10,100	17	3,070	1,290	11,100
3	4,040		8,980	18	3,300	1,560	15,300
4	3,540		7,520	19	3,700	2,250	17,300
5	3,540		6,960	20	4,310	2,770	18,800
6	3,620		6,300	21	5,780	2,320	18,800
7	3,700		5,060	22	6,200	2,540	18,100
8	3,780		3,950	23	6,300	2,320	18,800
9	3,860		3,220	24	6,740	2,540	19,800
10	3,780		2,620	25	7,290	3,540	20,100
11	3,700		2,320	26		7,070	19,800
12	3,700		2,180	27		8,240	19,100
13	3,460		2,180	28		9,240	17,800
14	3,220	1,670	3,700	29		10,100	17,300
15	3,070	1,390	6,410	30			17,300
				31			17,600

NOTE.—Daily discharge computed from a rating curve well defined between 380 and 8,000 second-feet (gage heights 2.0 and 12.0 feet). Above 14,800 second-feet (gage height 16.0 feet) the rating curve is a tangent and is based on one discharge measurement at gage height 16.6 feet. Figures for daily discharge published above are for unobstructed channel and are probably in error an unknown amount from Jan. 5 to Feb. 22 because of ice. See notes to table of daily gage height.

SOUTH FORK OF SANGAMON RIVER NEAR TAYLORVILLE, ILL.

Location.—At the Wabash Railroad bridge about 3½ miles southwest of Taylorville, about one-fourth mile upstream from the highway bridge known as the "Half Acre Bridge."

Records available.—February 11, 1908, to September 30, 1912; November 1 to December 31, 1912, when station was finally discontinued.

Drainage area.—427 square miles.

Gage.—Standard chain gage attached to bridge. On September 2, 1909, the gage datum was lowered 2 feet. The gage heights to August 10, 1909, refer to the old datum; those from August 11 to September 1, 1909, are of no value because of backwater from a construction dam built and used during that period. Gage heights from September 2, 1909, to date, refer to the new datum.

Channel.—In August, 1909, a drainage ditch was dug along the river in this vicinity, straightening the course of the stream, but coinciding with the original channel at the gaging station. The cross section of the channel was not changed at the measuring section, but the relation between gage height and discharge was considerably changed due to the change in slope. The channel shifts to some extent, but measurements to date indicate that the point of control is probably permanent.

Discharge measurements.—Made from downstream side of the bridge.

Floods.—Maximum gage height since establishment of gage, 15.9 feet, occurred in September, 1911. No authentic record of floods prior to the establishment of the station is available.

Winter flow.—Ice may affect the relation between gage height and discharge during parts of December, January, and February.

Accuracy.—During the summer of 1912 the bridge to which the gage is attached was being rebuilt. On August 2 the gaging section was full of false work with drift lodged against it, but the effect of the backwater was not determined. The construction work was not finished on December 31. Because of the probable backwater, the possibility of constant error in the gage heights, and the fact that the unverified 1911 rating table was used throughout, the records at this station from July 1 to December 31 should be used with caution.

No discharge measurements were made at this station during 1912.

Daily gage height, in feet, of South Fork of Sangamon River near Taylorville, Ill., for 1912.

[Joseph Ethridge, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.1	4.8	10.6	11.0	12.0	4.6	3.2	5.0	2.25	.....	2.55	2.75
2	5.5	4.4	10.3	10.6	11.1	5.0	5.8	4.8	2.25	.....	2.60	2.60
3	5.2	4.2	9.7	10.2	10.3	4.4	5.0	3.0	2.15	.....	2.85	2.65
4	5.5	4.1	8.0	10.6	9.6	4.2	4.2	2.65	2.05	.....	3.00	2.70
5	5.0	.....	6.6	10.1	9.6	4.0	4.0	2.45	2.0	.....	2.80	2.75
6	4.7	.....	5.6	10.0	9.6	3.9	4.0	2.35	.....	.....	3.5	2.55
7	4.4	.....	4.6	10.0	10.0	3.7	3.8	2.25	.....	.....	4.0	2.75
8	4.5	.....	5.2	9.4	9.6	3.6	3.8	2.35	.....	.....	3.8	2.65
9	4.5	.....	4.8	9.2	9.8	3.4	3.6	2.40	.....	.....	3.5	2.65
10	4.6	.....	4.3	8.6	8.6	3.4	5.1	2.50	1.95	.....	3.5	2.55
11	4.5	3.4	4.4	7.6	6.9	3.3	5.2	2.65	1.9	.....	3.2	2.60
12	4.4	.....	4.6	7.0	8.6	3.2	4.8	2.7	1.9	.....	3.2	2.55
13	4.2	.....	4.5	7.4	9.8	3.2	4.6	2.45	1.85	.....	3.2	2.55
14	4.2	.....	5.0	7.4	9.8	3.2	4.4	2.5	1.85	.....	3.0	2.55
15	.....	.....	9.2	7.6	9.4	3.4	4.4	2.65	1.85	.....	3.1	2.55
16	.....	.....	11.0	7.6	8.6	4.4	4.4	6.8	1.85	.....	3.05	2.55
17	.....	.....	12.7	7.0	7.9	6.2	4.0	6.8	1.9	.....	2.95	2.75
18	7.7	5.1	12.2	6.6	7.2	7.2	3.1	4.6	2.1	.....	2.85	2.75
19	9.2	6.7	12.1	10.0	6.4	6.8	3.0	3.6	2.3	.....	2.75	2.75
20	9.8	7.6	11.2	10.0	6.0	6.2	2.75	3.0	2.3	.....	2.80	2.75
21	10.0	6.0	11.0	9.8	5.8	5.4	2.75	2.9	2.25	.....	2.75	2.75
22	10.2	5.8	12.2	9.2	5.4	4.6	2.65	5.0	2.25	.....	2.70	2.75
23	10.0	4.6	12.4	8.2	5.2	4.4	2.55	4.2	2.1	.....	2.70	2.70
24	9.7	5.6	11.5	7.6	5.0	4.0	2.45	3.8	2.1	.....	2.80	2.65
25	8.7	8.0	10.7	6.9	4.8	3.6	2.35	3.4	2.05	.....	2.70	2.60
26	8.2	9.4	10.7	7.0	4.6	3.5	2.30	3.2	2.0	.....	2.65	2.60
27	7.3	11.6	9.8	8.2	4.6	3.4	2.25	3.0	1.9	.....	2.65	2.60
28	6.5	12.2	10.0	9.6	5.0	3.3	2.15	2.95	1.8	.....	2.65	2.60
29	5.9	11.1	10.5	10.0	5.4	3.4	3.8	2.95	1.75	.....	2.75	2.65
30	5.4	.....	11.7	10.9	5.2	3.4	6.3	2.55	1.8	.....	2.65	2.65
31	5.0	.....	11.8	.....	5.0	.....	6.9	2.35	.....	.....	.....	.....

NOTE.—Gage heights about July 1 to Dec. 31 affected by backwater from false work and drift obstructing channel, an unknown amount, probably a few tenths for a maximum, with the minimum effect at low water. River reported almost free from drift on Sept. 13, 17, and 22. Gage weight lost on Sept. 6 and replaced Sept. 10. Gage heights Sept. 10 to Dec. 31 subject to unknown constant error due to probable error in chain length caused by replacing weight. See "Accuracy" in station description. Gage heights Jan. 3 to 6, 8 to 13, 15 to 31, Feb. 1, 2, 3, 5 to 10, and 12 to 19, read to top of ice. Relation of gage height to discharge affected by ice about Jan. 3 to Feb. 20. Observer reported ice about 7 inches in thickness during January and from 6 to 11 inches during February. On Jan. 21 observer reported large ice gorge at gaging section.

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	252	.....	1,500	1,700	2,200	133	58	161	22	.....	32	40
2	201	.....	1,340	1,500	1,740	161	225	147	22	.....	34	34
3	.....	.....	1,050	1,300	1,340	121	161	50	20	.....	44	36
4	.....	.....	455	1,500	999	109	109	36	16	.....	50	38
5	.....	.....	297	1,240	999	97	97	28	15	.....	42	40
6	.....	.....	209	1,200	999	92	97	26	a 15	.....	72	32
7	.....	.....	133	1,200	1,200	82	87	22	a 15	.....	97	40
8	.....	.....	177	901	999	77	87	26	a 14	.....	87	36
9	.....	.....	147	805	1,100	67	77	27	a 14	.....	72	36
10	.....	.....	115	578	578	67	169	30	14	.....	72	32
11	.....	.....	121	397	324	62	177	36	13	.....	58	34
12	.....	.....	133	333	578	58	147	38	13	.....	58	32
13	.....	.....	127	374	1,100	58	133	28	12	.....	58	32
14	.....	.....	161	374	1,100	58	121	30	12	.....	50	32
15	.....	.....	805	397	901	67	121	36	12	.....	54	32

a Interpolated.

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	.....	1,700	397	578	121	121	315	12	.....	52	32
17	.....	.....	2,540	333	439	261	97	315	13	.....	48	40
18	.....	.....	2,300	297	353	353	54	133	18	.....	44	40
19	.....	.....	2,240	1,200	279	315	50	77	24	.....	40	40
20	.....	.....	1,800	1,200	243	261	40	50	24	.....	42	40
21	.....	243	1,700	1,100	225	193	40	46	22	.....	40	40
22	.....	225	2,300	805	193	133	36	161	22	.....	38	40
23	.....	133	2,400	490	177	121	32	109	18	.....	38	38
24	.....	209	1,940	397	161	97	28	87	18	.....	42	36
25	.....	455	1,540	324	147	77	26	67	16	.....	38	34
26	.....	901	1,540	333	133	72	24	58	15	.....	36	34
27	.....	2,000	1,100	490	133	67	22	50	13	.....	36	34
28	.....	2,300	1,200	999	161	62	20	48	11	.....	36	34
29	.....	1,740	1,440	1,200	193	67	87	48	10	.....	40	36
30	.....	.....	2,040	1,640	177	67	270	32	11	.....	36	36
31	.....	.....	2,100	.....	161	.....	324	26	.....	.....	.....	a36

a Estimated.

NOTE.—Daily discharge computed from a rating curve well defined between 58 and 1,440 second-feet (gage heights, 3.2 and 10.5 feet), but which was not verified during 1912 by discharge measurements. Discharge Jan. 3 to Feb. 20 estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 3 to 31, 200 second-feet; Feb. 1 to 20, 80 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Monthly discharge of South Fork of Sangamon River near Taylorville, Ill., for 1912.

[Drainage area, 427 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	202	0.473	0.55	D.
February	2,300	.....	338	.792	.85	D.
March	2,540	115	1,180	2.76	3.18	B.
April	1,700	297	833	1.95	2.18	B.
May	2,200	133	642	1.50	1.73	B.
June	353	58	119	.279	.31	C.
July	324	20	101	.237	.27	D.
August	315	22	75.6	.177	.20	D.
September	24	10	15.9	.037	.04	D.
October	.....	.....	.....	.....	.....	.....
November	97	32	49.5	.116	.13	D.
December	40	32	36.0	.084	.10	D.

NOTE.—See footnotes to tables of daily gage height and daily discharge.

SALT CREEK NEAR KENNEY, ILL.

Location.—At highway bridge about 3 miles west of Kenney, Ill., near the west boundary of T. 19 N., R. 1 E., about three-fourths mile below the Vandalia Railroad bridge.

Records available.—February 14, 1908, to October 2, 1912; October 30 to December 31, 1912, when station was finally discontinued.

Drainage area.—459 square miles.

Gage.—Standard chain gage attached to the bridge; datum unchanged.

Channel.—Section is at a pool; discharge measurements to date indicate that the point of control is practically permanent.

Discharge measurements.—Made from downstream side of bridge.

Floods.—The flood of 1882 is said to have been 1½ feet higher than that of 1908, or to have reached a height of about 16 feet by the present gage.

Winter flow.—Ice sometimes affects the relation between gage height and discharge during portions of December, January, and February.

Discharge measurements of Salt Creek near Kenney, Ill., in 1912.

[Hydrographer, P. S. Monk.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 29	2.30	106
29	[a] 2.27	103

[a] Measurement made by wading at about 10 feet below regular section.

Daily gage height, in feet, of Salt Creek near Kenney, Ill., for 1912.

[Chris McDermott, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	[a] 2.8	6.0	6.0	10.8	2.7	1.7	1.8	1.4	1.1	2.2	2.0
2	3.2	2.0	4.6	6.5	8.0	2.75	2.4	1.8	1.4	1.2	2.45	2.1
3	3.45	.....	3.8	5.9	7.0	2.65	1.8	1.65	1.4	.....	2.25	2.1
4	4.0	.....	3.25	4.8	6.0	2.6	4.9	1.65	1.3	.....	2.25	2.1
5	[a] 3.5	.....	3.0	4.7	8.2	2.5	4.4	1.6	1.5	.....	2.0	2.1
6	[a] 3.1	.....	2.7	4.5	7.3	2.5	3.5	1.55	1.3	.....	2.65	2.05
7	[a] 3.15	.....	2.65	6.1	6.2	2.4	3.0	1.55	1.3	.....	3.9	2.05
8	[a] 3.05	1.5	2.6	6.1	5.3	2.2	2.7	1.5	1.3	.....	3.7	2.0
9	[a] 3.0	.....	2.5	5.0	4.4	2.2	2.6	1.6	1.2	.....	3.4	1.9
10	[a] 2.95	.....	2.75	4.5	4.4	2.2	2.75	1.8	1.2	.....	3.0	1.7
11	[a] 2.85	.....	2.35	4.0	4.4	2.1	2.7	1.85	1.2	.....	2.8	2.0
12	2.15	.....	2.3	3.8	5.3	2.05	4.4	1.7	1.2	.....	2.6	1.8
13	.....	.....	2.3	4.1	6.7	2.0	4.0	1.6	1.1	.....	4.6	1.9
14	.....	.....	2.5	4.1	6.2	2.0	3.9	1.8	1.3	.....	4.7	1.9
15	.....	.....	5.8	4.0	5.6	2.0	2.8	1.75	1.2	.....	4.2	1.85
16	.....	[a] 2.35	5.9	4.0	5.1	2.0	2.5	1.65	1.2	.....	3.6	1.9
17	.....	[a] 2.35	8.5	7.3	4.7	2.1	2.15	1.6	1.2	.....	3.4	1.9
18	[a] 6.2	[a] 4.6	10.2	8.2	4.4	2.1	2.15	1.75	1.3	.....	3.1	1.9
19	[a] 5.5	[a] 5.0	13.0	9.0	4.0	2.1	2.05	1.8	1.2	.....	2.9	1.85
20	4.2	5.6	10.8	7.2	3.8	2.05	1.95	1.7	1.3	.....	2.8	1.85
21	.....	[a] 5.2	8.8	6.1	3.5	2.8	1.9	1.6	1.3	.....	2.7	1.8
22	.....	[a] 5.0	6.0	6.7	3.4	3.0	2.7	1.9	1.2	.....	2.6	1.8
23	.....	[a] 4.0	8.0	6.1	3.2	2.2	3.0	1.8	1.3	.....	2.5	1.9
24	.....	[a] 2.7	8.0	5.5	3.1	2.0	2.5	1.8	1.3	.....	2.4	1.9
25	.....	3.3	6.9	4.8	3.0	1.9	2.1	1.8	1.3	.....	2.4	1.9
26	4.2	7.7	6.5	5.0	2.8	1.85	2.0	1.7	1.1	.....	2.3	1.9
27	[a] 4.2	7.3	6.7	4.8	2.7	1.8	1.9	1.55	1.2	.....	2.25	1.9
28	[a] 3.4	7.7	7.4	5.9	2.85	1.75	1.8	1.5	1.1	.....	2.2	1.9
29	2.8	7.7	10.1	9.3	3.5	1.75	2.3	1.5	1.3	.....	2.0	1.8
30	[a] 3.0	.....	11.0	9.6	3.1	1.7	2.0	1.4	1.2	1.3	2.0	1.8
31	[a] 3.1	.....	9.4	.....	2.85	.....	2.0	1.4	.....	1.4	.....	1.75

[a] Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 3 to Feb. 23. Observer reported ice 6 to 9 inches in thickness from Jan. 12 to Feb. 15.

Daily discharge, in second-feet, of Salt Creek near Kenney, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	386	.....	1,100	1,100	3,410	170	40	49	19	6	95	70
2	266	.....	645	1,290	1,950	179	122	49	19	10	130	82
3	.....	.....	412	1,070	1,490	162	49	36	19	.....	102	82
4	.....	.....	277	707	1,100	153	738	36	14	.....	102	82
5	.....	.....	225	676	2,050	137	584	32	25	.....	70	82
6	.....	.....	170	614	1,620	137	335	28	14	.....	162	76
7	.....	.....	162	1,140	1,170	122	225	28	14	.....	439	76
8	.....	.....	153	1,140	867	95	170	25	14	.....	386	70
9	.....	.....	137	770	584	95	153	32	10	.....	311	59
10	.....	.....	179	614	584	95	179	49	10	.....	225	40
11	.....	.....	115	467	584	82	170	54	10	.....	188	70
12	.....	.....	108	412	867	76	584	40	10	.....	153	49
13	.....	.....	108	495	1,370	70	467	32	6	.....	645	59
14	.....	.....	137	495	1,170	70	439	49	14	.....	676	59
15	.....	.....	1,030	467	966	70	188	44	10	.....	524	54
16	.....	.....	1,070	467	802	70	137	36	10	.....	360	59
17	.....	.....	2,190	1,620	676	82	88	32	10	.....	311	59
18	.....	.....	3,070	2,050	584	82	88	44	14	.....	245	59
19	.....	.....	4,680	2,430	467	82	76	49	10	.....	206	54
20	.....	.....	3,410	1,580	412	76	64	40	14	.....	188	54
21	.....	.....	2,330	1,140	335	188	59	32	14	.....	170	49
22	.....	.....	1,100	1,370	311	225	170	59	10	.....	153	49
23	.....	.....	1,950	1,140	266	95	225	49	14	.....	137	59
24	.....	170	1,950	933	245	70	137	49	14	.....	122	59
25	.....	288	1,450	707	225	59	82	49	14	.....	122	59
26	.....	1,810	1,290	770	188	54	70	40	6	.....	108	59
27	.....	1,620	1,370	707	170	49	59	28	10	.....	102	59
28	.....	1,810	1,670	1,070	197	44	49	25	6	.....	95	59
29	.....	1,810	3,020	2,580	335	44	108	25	14	.....	70	49
30	.....	.....	3,520	2,740	245	40	70	19	10	14	70	49
31	.....	.....	2,630	.....	197	.....	70	19	.....	19	.....	44

NOTE.—Daily discharge computed from a rating curve well defined between 10 and 467 second-feet (gage heights 1.2 and 4.0 feet). Above gage height 4.0 feet the rating curve depends upon one discharge measurement made in 1908 at gage height 10.5 feet. The two discharge measurements made in 1912 verified the 1911 rating curve, indicating no change in the relation of gage height to discharge. Discharge Jan. 3 to Feb. 23 estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 3 to 31, 230 second-feet; Feb. 1 to 23, 130 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Monthly discharge of Salt Creek near Kenney, Ill., for 1912.

[Drainage area, 459 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area)	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	236	0.514	0.59	D.
February	1,810	.....	362	.789	.85	D.
March	4,680	108	1,340	2.92	3.37	B.
April	2,740	412	1,090	2.37	2.64	A.
May	3,410	170	821	1.79	2.06	A.
June	225	40	99.1	.216	.24	A.
July	738	40	193	.420	.48	A.
August	59	19	38.0	.083	.10	C.
September	25	6	12.6	.028	.03	C.
October	.....	.....	.....	.....	.....	.....
November	676	70	222	.484	.54	A.
December	82	40	60.9	.133	.15	B.

NOTE.—See footnote to table of daily discharge.

CAHOKIA CREEK NEAR POAG, ILL.

Location.—At the Wabash Railroad bridge, about three-fourths mile northeast of the Wabash Railroad station at Poag, Ill.

Records available.—December 13, 1909, to April 6, 1912. Station discontinued April 7, 1912.

Drainage area.—259 square miles.

Gage.—Standard chain gage fastened to bridge; datum unchanged.

Channel.—Practically permanent.

Discharge measurements.—Made from downstream side of bridge.

Floods.—Maximum gage height since establishment of gage, 19.0 feet, occurred in October, 1911. See notes under "Accuracy." No available record of floods prior to installation of gage.

Winter flow.—Ice may affect the relation between gage height and discharge during short periods in December, January, and February.

Accuracy.—The high water of October, 1911, was due to cutting off the flood channel to the east of the main channel by a levee built by the East Side Levee and Sanitary District. On April 7, 1912, Cahokia Creek was diverted west from a point near Poag into the Mississippi River just below the mouth of the Missouri instead of flowing into the river near Eads bridge, East St. Louis, Ill.

Remarks.—The data collected are being used by the East Side Levee and Sanitary District of East St. Louis, Ill., in its study for flood control and prevention at that place.

No discharge measurements were made at this station during 1912.

Daily gage height, in feet, of Cahokia Creek near Poag, Ill., for 1912.

[S. T. Sanders, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	5.8		10.0	11.4	16			14.2	
2	5.2	3.1	7.8	12.0	17			16.0	
3	4.6		6.1	14.1	18	2.8	4.0	16.3	
4	4.2		5.0	10.0	19		6.3	14.0	
5	3.6		4.3	8.2	20		6.8	12.2	
6	3.4		6.0	[a]12.8	21	6.5	6.0	13.4	
7	3.4		7.2		22	6.3	5.2	14.0	
8	3.3	2.8	7.0		23	5.0	4.8	10.2	
9	3.3		6.3		24	5.4	4.2	7.9	
10	3.2		6.0		25	5.8	5.0	6.4	
11	3.2		6.8		26	[b]6.0	14.4	8.4	
12	[b]3.2		7.3		27	5.8	14.0	12.0	
13	3.2		8.0		28	5.5	16.6	14.2	
14	3.2		8.6		29		12.0	15.3	
15		3.3	12.1		30			16.8	
					31			14.0	

[a] Gage heights worthless after Apr. 6. See "Accuracy" in station description.
[b] Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 6 to Feb. 17. Observer reported ice about 5 inches thick from Jan. 18 to Feb. 8.

Daily discharge, in second-feet, of Cahokia Creek near Poag, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	Day.	Jan.	Feb.	Mar.	Apr.
1	155		641	887	16			1,490	
2	123		335	1,000	17			2,630	
3	93		173	1,470	18		67	3,000	
4	75		113	641	19		188	1,440	
5	53		79	383	20		230	1,040	
6			167	1,170	21		167	1,300	
7			269		22		123	1,440	
8			249		23		103	675	
9			188		24		75	347	
10			167		25		113	196	
11			230		26		1,550	407	
12			279		27		1,440	1,000	
13			359		28		3,380	1,490	
14			433		29		1,000	1,930	
15			1,020		30			3,630	
					31			1,440	

NOTE.—Daily discharge computed from a rating curve well defined between 35 and 1,350 second-feet (gage heights 3.0 and 13.6 feet). Above 1,350 second-feet the rating curve is based on one discharge measurement at gage height 16.25 feet.

Discharge Jan. 6 to Feb. 17 estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 6–31, 40 second-feet; Feb. 1–17, 25 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data, and therefore should be used with caution.

Monthly discharge of Cahokia Creek near Poag, Ill., for 1912.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January			49.6	0.192	0.22	D.
February	3,380		306	1.18	1.27	D.
March	3,630	79	908	3.51	4.05	C.

NOTE.—See footnote to table of daily discharge.

KASKASKIA RIVER NEAR ARCOLA, ILL.

Location.—At highway bridge known as the "Bagdad Bridge," about 4 miles west of Arcola, Ill., in the northwest part of T. 14 N., R. 7 E.

Records available.—April 11, 1908, to September 30, 1912; November 1 to December 31, 1912, when station was finally discontinued.

Drainage area.—390 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably permanent. Discharge measurements to date indicate that the point of control is permanent.

Discharge measurements.—Made from downstream side of bridge or by wading.

Floods.—The flood of May, 1908, reached a height of 17.3 feet on the gage.

Winter flow.—Ice sometimes affects the relation between gage height and discharge during portions of December, January, and February.

The following discharge measurement was made by wading at a section about 50 feet below the bridge by P. S. Monk:

July 27, 1912: Gage height, 2.13 feet; discharge, 17.0 second-feet.

Daily gage height, in feet, of Kaskaskia River near Arcola, Ill., for 1912.

[L. L. Pfeifer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	.....	11.3	9.4	9.6	6.6	4.1	2.0	3.0	.....	0.6	1.2
2	5.4	.....	9.9	9.3	9.6	6.4	4.2	1.9	2.8	.....	.6	1.2
3	5.3	.....	8.4	9.3	9.6	6.2	4.5	1.9	2.8	.....	.8	1.1
4	5.3	5.3	7.2	9.2	9.4	6.0	5.1	1.8	2.7	.....	.8	1.1
5	5.3	.....	6.9	9.1	9.2	5.8	5.9	1.8	2.6	.....	1.0	1.0
6	5.3	.....	6.0	9.0	9.0	5.6	5.7	1.7	2.4	.....	1.2	1.0
7	5.3	.....	5.7	8.9	9.0	5.4	5.5	1.7	2.1	.....	1.4	1.0
8	5.3	.....	5.4	8.9	8.9	5.1	4.7	1.6	2.0	.....	1.4	1.1
9	5.3	.....	5.0	8.7	8.7	5.0	4.3	1.8	1.9	.....	1.3	1.1
10	5.3	.....	4.6	8.7	8.6	4.7	4.0	2.0	1.9	.....	1.2	1.1
11	5.3	5.3	4.9	8.6	8.4	4.7	3.9	2.1	1.8	.....	1.2	1.0
12	5.3	.....	5.0	8.6	8.2	4.6	3.8	2.0	1.7	.....	1.4	0.9
13	5.3	.....	5.1	8.6	8.4	4.1	3.6	2.4	1.6	.....	1.6	.9
14	5.3	.....	5.1	8.4	8.4	4.0	3.9	2.6	1.5	.....	1.6	.9
15	.....	.....	6.2	8.4	9.0	4.0	4.0	2.4	1.4	.....	1.5	.9
16	.....	.....	6.3	8.3	9.1	5.3	4.6	2.3	1.3	.....	1.5	.9
17	8.0	8.0	6.8	8.1	9.1	6.8	4.8	2.2	1.2	.....	1.4	.9
18	8.0	.....	7.7	8.0	9.0	6.9	.....	2.0	1.2	.....	1.4	.8
19	7.8	.....	7.9	7.9	8.9	7.1	.....	2.4	1.1	.....	1.3	.8
20	7.8	.....	8.1	7.9	8.7	6.7	.....	2.4	1.0	.....	1.3	.8
21	7.7	.....	8.4	9.0	8.6	6.4	.....	2.3	1.0	.....	1.3	.8
22	7.5	.....	8.7	9.1	8.4	5.9	.....	2.4	1.0	.....	1.3	.8
23	7.5	.....	8.9	9.0	8.1	5.6	3.0	5.6	0.9	.....	1.2	.8
24	.....	.....	9.1	8.8	7.8	5.4	2.7	5.6	.9	.....	1.4	.8
25	.....	7.4	9.3	8.6	7.7	5.1	2.7	5.1	.8	.....	1.4	.7
26	.....	7.4	9.8	8.5	7.6	4.8	2.6	5.0	.8	.....	1.3	.7
27	.....	7.7	10.1	8.4	7.4	4.6	2.1	4.8	.7	.....	1.3	.7
28	.....	8.1	10.4	7.9	7.2	4.5	2.2	4.4	.7	.....	1.3	.7
29	.....	8.1	10.7	8.9	7.2	4.2	2.2	3.8	.7	.....	1.2	.7
30	.....	.....	10.9	9.7	7.0	4.0	2.0	3.6	.6	.....	1.2	.7
31	.....	.....	11.2	.....	6.8	.....	2.0	3.1	.....	.....	.....	.7

NOTE.—Relation of gage height to discharge affected by ice about Jan. 4 to Feb. 28. Observer reported ice 2 to 8 inches thick during January and 5 to 8 inches during February.

Daily discharge, in second-feet, of Kaskaskia River near Arcola, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	254	.....	1,710	1,070	1,130	401	138	15	58	.....	0.1	2
2	254	.....	1,230	1,030	1,130	372	146	12	48	.....	.1	2
3	244	.....	767	1,030	1,130	345	170	12	48	.....	.5	1.5
4	.....	.....	500	1,000	1,070	320	224	10	43	.....	.5	1.5
5	.....	.....	448	971	1,000	298	309	10	38	.....	1.0	1.0
6	.....	.....	320	940	940	276	287	8	29	.....	2.0	1.0
7	.....	.....	287	909	940	254	265	8	18	.....	4	1.0
8	.....	.....	254	909	909	224	187	6	15	.....	4	1.5
9	.....	.....	214	850	850	214	154	10	12	.....	3	1.5
10	.....	.....	178	850	822	187	130	15	12	.....	2	1.5
11	.....	.....	205	822	767	187	122	18	10	.....	2	1.0
12	.....	.....	214	822	714	178	114	15	8	.....	4	.7
13	.....	.....	224	822	767	138	98	29	6	.....	6	.7
14	.....	.....	224	767	767	130	122	38	5	.....	6	.7
15	.....	.....	345	767	940	130	130	29	4	.....	5	.7
16	.....	.....	358	740	971	244	178	25	3	.....	5	.7
17	.....	.....	432	689	971	432	196	21	2	.....	4	.7
18	.....	.....	598	665	940	448	173	15	2	.....	4	.5
19	.....	.....	642	642	909	482	150	29	1.5	.....	3	.5
20	.....	.....	689	642	850	416	127	29	1.0	.....	3	.5

Daily discharge, in second-feet, of Kaskaskia River near Arcola, Ill., for 1912—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	.....	.....	767	940	822	372	104	25	1.0	.....	3	0.5
22	.....	.....	850	971	767	309	81	29	1.0	.....	3	.5
23	.....	.....	909	940	689	276	58	276	.7	.....	2	.5
24	.....	.....	971	879	620	254	43	276	.7	.....	4	.5
25	.....	.....	1,030	822	598	224	43	224	.5	.....	4	.3
26	.....	.....	1,190	794	577	196	38	214	.5	.....	3	.3
27	.....	.....	1,290	767	537	178	18	196	.3	.....	3	.3
28	.....	.....	1,390	642	500	170	21	162	.3	.....	3	.3
29	.....	689	1,500	909	500	146	21	114	.3	.....	2	.3
30	.....	.....	1,560	1,160	465	130	15	98	.1	.....	2	.3
31	.....	.....	1,670	.....	432	.....	15	64	.....	.....	.....	.3

NOTE.—Daily discharge computed from a rating curve well defined between 15 and 665 second-feet (gage heights 2.0 and 8.0 feet), and fairly well defined between 689 and 1,710 second-feet (gage heights 8.1 and 11.3 feet). Discharge Jan. 4 to Feb. 28 estimated, because of ice, from gage heights observer's notes, climatologic records and discharge of adjacent drainage areas, as follows: Jan. 4 to 31, 190 second-feet; Feb. 1 to 28, 200 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Discharge July 18 to 22 interpolated.

Monthly discharge of Kaskaskia River near Arcola, Ill., for 1912.

[Drainage area, 390 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	196	0.503	0.58	D.
February	.....	.....	217	.556	.60	D.
March	1,710	178	741	1.90	2.19	C.
April	1,160	642	859	2.20	2.46	A.
May	1,130	432	807	2.07	2.39	A.
June	482	130	264	.677	.76	C.
July	309	15	125	.321	.37	C.
August	276	6	65.5	.168	.19	C.
September	58	.1	12.3	.032	.04	D.
October	.....	.....	.....	.....	.....	.....
November	6	.1	2.94	.0075	.008	D.
December	2	.3	.82	.0021	.002	D.

NOTE.—See footnote to table of daily discharge.

KASKASKIA RIVER AT SHELBYVILLE, ILL.

Location.—At highway bridge in the eastern edge of Shelbyville, Ill., just above the Chicago & Eastern Illinois and Big Four railroad bridges.

Records available.—February 25, 1908, to September 30, 1912: November 1, to December 31, 1912, when station was finally discontinued.

Drainage area.—1,030 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Somewhat shifting; section at a pool; point of control unchanged.

Discharge measurements.—Made from downstream side of bridge.

Floods.—Maximum gage height since establishment of gage is 25.8 feet which occurred in May, 1908. No available records of floods prior to installation of gage.

Winter flow.—Ice may affect the relation between gage height and discharge during parts of December, January, and February.

Accuracy.—During high water the relation of gage height to discharge is liable to be affected by backwater caused by drift lodging at the two railroad bridges below the gaging station.

Discharge measurements of Kaskaskia River at Shelbyville, Ill., in 1912.

[Hydrographer, P. S. Monk.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 24	6.18	226
Aug. 23	7.58	653

Daily gage height, in feet, of Kaskaskia River at Shelbyville, Ill., for 1912.

[Homer Pound, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.8	8.1	17.6	16.8	17.3	7.3	6.3	5.7	5.7	.....	5.2	5.3
2	8.7	7.7	17.5	16.5	16.4	7.2	6.2	5.6	6.0	.....	5.3	5.3
3	8.7	7.5	16.1	16.9	15.9	7.0	6.4	5.6	6.2	.....	5.3	5.4
4	8.6	7.4	14.5	16.5	15.2	6.9	6.3	5.5	6.8	.....	5.3	5.4
5	8.6	7.4	12.6	18.5	14.9	6.8	6.3	5.5	6.5	.....	5.5	5.4
6	8.6	7.3	10.5	14.5	13.0	6.7	6.4	5.5	6.1	.....	5.6	5.4
7	8.6	7.2	9.6	13.3	12.1	6.6	6.5	5.4	5.9	.....	5.7	5.4
8	8.7	7.1	8.7	12.1	11.2	6.5	6.4	5.4	5.6	.....	5.8	5.4
9	8.8	7.0	8.8	11.5	10.9	6.4	6.3	5.4	5.5	.....	5.7	5.4
10	8.6	6.9	8.9	11.1	10.4	6.3	8.5	5.5	5.4	.....	5.7	5.4
11	8.4	6.9	8.2	10.9	10.1	6.3	7.3	5.6	5.4	.....	5.6	5.4
12	8.2	6.8	7.8	10.8	9.9	6.2	6.9	5.9	.....	.....	5.6	5.4
13	8.0	6.8	7.4	10.7	9.8	6.2	6.7	6.1	.....	.....	5.6	5.4
14	8.0	6.7	10.2	10.7	9.7	6.1	8.9	6.6	5.3	.....	5.6	5.4
15	.....	6.7	14.8	10.5	9.8	6.1	8.2	6.7	5.3	.....	5.5	5.4
16	.....	6.9	16.2	10.4	9.9	7.3	7.4	6.4	5.3	.....	5.5	5.4
17	.....	7.1	17.9	10.3	9.7	7.7	7.3	6.2	5.3	.....	5.5	5.3
18	.....	7.4	18.3	10.2	9.4	7.4	7.2	6.5	5.3	.....	5.5	5.3
19	.....	8.4	18.9	10.7	9.0	7.6	7.1	7.2	5.3	.....	5.5	5.3
20	.....	9.4	19.0	11.2	8.8	7.9	7.0	8.0	5.3	.....	5.4	5.2
21	12.3	9.2	19.4	11.8	8.4	8.0	6.6	9.9	5.3	.....	5.4	5.2
22	11.2	9.0	19.3	11.5	8.0	7.6	6.3	8.4	5.3	.....	5.4	5.2
23	10.9	8.9	18.7	11.1	7.9	7.2	6.2	7.9	5.3	.....	5.4	5.2
24	10.5	9.2	17.6	10.9	7.6	7.0	6.1	7.2	5.3	.....	5.4	5.2
25	10.2	12.3	16.6	10.1	7.4	6.8	6.0	6.7	5.3	.....	5.4	5.3
26	9.9	16.7	16.1	10.8	7.2	6.6	6.8	7.6	5.3	.....	5.4	5.3
27	9.8	17.3	15.6	11.9	7.2	7.7	6.5	6.8	5.3	.....	5.4	5.3
28	9.7	18.9	14.1	13.5	7.4	6.6	5.4	6.1	5.3	.....	5.4	5.3
29	9.2	18.8	17.1	15.3	7.3	6.5	5.3	6.0	5.2	.....	5.4	5.3
30	8.9	.....	17.1	17.0	7.5	6.4	5.8	5.9	5.2	.....	5.4	5.3
31	8.5	.....	16.9	.....	7.4	.....	5.8	5.8	.....	.....	.....	5.3

NOTE.—Relation of gage height to discharge affected by ice about Jan. 5 to Feb. 21; gage heights, Jan. 6 to 13, Jan. 21 to Feb. 18 and Dec. 12 to 15 were read to top of ice. Observer reported ice about 8 inches thick on Jan. 14.

Daily discharge, in second-feet, of Kaskaskia River at Shelbyville, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,110	.....	5,680	5,220	5,500	562	257	122	122	.....	51	63
2	1,070	.....	5,620	5,040	4,990	528	231	105	182	.....	63	63
3	1,070	.....	4,820	5,270	4,700	462	284	105	231	.....	63	76
4	1,030	.....	3,920	5,040	4,310	430	257	90	399	.....	63	76
5	.....	.....	2,900	6,200	4,140	399	257	90	312	.....	90	76
6	.....	.....	1,860	3,920	3,100	369	284	90	206	.....	105	76
7	.....	.....	1,450	3,260	2,650	340	312	76	160	.....	122	76
8	.....	.....	1,070	2,650	2,200	312	284	76	105	.....	140	76
9	.....	.....	1,110	2,350	2,050	284	257	76	90	.....	122	76
10	.....	.....	1,150	2,150	1,810	257	994	90	76	.....	122	76
11	.....	.....	882	2,050	1,680	257	562	105	76	.....	105	76
12	.....	.....	738	2,000	1,580	231	430	160	72	.....	105	76
13	.....	.....	596	1,960	1,540	231	369	206	67	.....	105	76
14	.....	.....	1,720	1,960	1,490	206	1,150	340	63	.....	105	76
15	.....	.....	4,090	1,860	1,540	206	882	369	63	.....	90	76

Daily discharge, in second-feet, of Kaskaskia River at Shelbyville, Ill., for 1912—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	.....	4,870	1,810	1,580	562	596	284	63	.....	90	76
17	.....	.....	5,850	1,770	1,490	702	562	231	63	.....	90	63
18	.....	.....	6,090	1,720	1,360	596	528	312	63	.....	90	63
19	.....	.....	6,440	1,960	1,190	666	495	528	63	.....	90	63
20	.....	.....	6,500	2,200	1,110	774	462	810	63	.....	76	51
21	.....	.....	6,740	2,500	956	810	340	1,580	63	.....	76	51
22	.....	1,190	6,680	2,350	810	666	257	956	63	.....	76	51
23	.....	1,150	6,320	2,150	774	528	231	774	63	.....	76	51
24	.....	1,270	5,680	2,050	666	462	206	528	63	.....	76	51
25	.....	2,750	5,100	1,680	596	399	182	369	63	.....	76	63
26	.....	5,160	4,820	2,000	528	340	399	666	63	.....	76	63
27	.....	5,500	4,540	2,550	528	702	312	399	63	.....	76	63
28	.....	6,440	3,700	3,380	596	340	76	206	63	.....	76	63
29	.....	6,380	5,390	4,370	562	312	63	182	51	.....	76	63
30	.....	.....	5,390	5,330	630	284	140	160	51	.....	76	63
31	.....	.....	5,270	.....	596	.....	140	140	.....	.....	.....	63

NOTE.—Daily discharge computed from a rating curve poorly defined below 182 second-feet (gage height, 6.0 feet) and well defined between 206 and 7,100 second-feet (gage heights, 6.1 and 20.0 feet). This rating curve differs from that used for 1911 below 528 second-feet (gage height, 7.2 feet), as a result of the two discharge measurements made during 1912. Discharge Jan. 5 to Feb. 21 estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 5 to 31, 820 second-feet; Feb. 1 to 21, 300 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution. No reduction made because of possible effect of ice in December.

Monthly discharge of Kaskaskia River at Shelbyville, Ill., for 1912.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	852	0.827	0.95	D.
February	6,440	.....	1,250	1.21	1.30	D.
March	6,740	596	4,100	3.98	4.59	B.
April	6,200	1,680	2,960	2.87	3.20	A.
May	5,500	528	1,850	1.80	2.08	A.
June	810	206	441	.428	.48	A.
July	1,150	63	381	.370	.43	A.
August	1,580	76	330	.320	.37	B.
September	399	51	105	.102	.11	C.
October	.....	.....	.....	.....	.....	.....
November	140	51	88.2	.086	.10	C.
December	76	51	66.9	.065	.07	D.

NOTE.—See footnote to table of daily discharge.

KASKASKIA RIVER AT VANDALIA, ILL.

Location.—At highway bridge at the east end of Main Street, Vandalia, Ill.

Records available.—February 26, 1908, to October 4, 1912; November 1 to December 31, 1912, when station was finally discontinued.

Drainage area.—1,980 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Somewhat shifting; section is at a pool; point of control is apparently permanent.

Discharge measurements.—Made from downstream side of bridge.

Floods.—The flood of May, 1908, reached a height of 21.2 feet on the gage; flood of 1882 was about 22 and that of 1875 about 22.8.

Winter flow.—Ice may affect the relation between gage heights and discharge during portions of December, January, and February.

Remarks.—The river is leveed along the left bank for some miles above and below the station. It is said that the levees, by confining the floods, cause unnatural flood heights along the right bank, and lawsuits to recover damages have resulted. During extreme floods the levees sometimes give way and so reduce the flood height; this occurred during the floods of May, 1908, and October, 1911, flood water for several days passing around the gaging station. Former statements that all the flood water eventually passed the gaging station are in error.

Discharge measurements of Kaskaskia River at Vandalia, Ill., in 1912.

[Hydrographer, P. S. Monk.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft*
Aug. 3	3.08	276
21	8.84	2,110

Daily gage height, in feet, of Kaskaskia River at Vandalia, Ill., for 1912.

[W. F. Radcliff, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.2	5.9	18.3	19.2	15.9	10.4	3.2	5.3	4.0	1.10	1.5	1.0
2	9.9	5.7	17.8	18.4	15.2	10.5	5.0	3.9	4.9	.90	1.7	1.15
3	10.2	5.5	15.8	17.8	14.9	9.5	8.0	3.15	4.5	.85	1.7	1.55
4	10.0	5.4	14.6	17.6	14.8	8.2	9.0	3.1	3.8	.75	1.7	1.75
5	9.4	5.0	12.4	17.3	14.5	7.0	7.0	2.95	3.8	.....	1.55	2.0
6	8.6	4.6	10.0	17.0	14.5	6.2	5.1	2.75	3.6	.....	1.5	2.45
7	7.9	4.5	8.5	16.1	14.4	5.0	4.4	2.45	3.6	.....	1.4	2.1
8	7.4	4.4	8.2	15.2	12.8	4.2	5.0	2.4	3.5	.....	1.8	2.0
9	7.2	4.3	7.0	13.0	11.4	4.4	4.7	2.4	3.45	.....	1.75	1.85
10	7.0	4.2	6.6	11.7	10.0	4.1	4.5	2.4	3.4	.....	1.6	1.8
11	6.8	4.0	6.1	10.0	9.2	3.9	4.8	2.8	3.4	.....	1.5	1.7
12	6.2	4.0	6.5	9.3	8.6	3.7	6.3	4.4	3.4	.....	1.4	1.65
13	5.8	3.9	8.7	8.7	8.4	3.6	5.6	5.5	3.1	.....	1.25	1.6
14	5.4	3.8	13.6	8.5	8.4	3.6	11.1	5.2	3.05	.....	1.2	1.45
15	5.0	4.2	15.8	8.3	8.2	3.45	12.6	4.4	3.3	.....	1.15	1.3
16	5.2	4.4	17.1	8.3	8.2	3.7	8.4	4.2	2.95	.....	1.1	1.3
17	5.2	4.5	18.5	11.6	8.2	4.5	7.0	4.2	2.6	.....	1.35	1.2
18	5.1	4.8	19.2	13.4	8.2	5.4	6.2	3.9	2.5	.....	2.0	1.2
19	5.1	7.2	19.6	14.1	8.2	6.6	5.6	3.8	2.4	.....	2.75	1.15
20	4.9	7.0	19.8	13.4	8.2	7.2	4.6	3.6	2.35	.....	3.05	1.0
21	5.0	6.8	19.6	12.4	8.1	6.8	4.0	3.4	2.3	.....	2.65	1.0
22	6.0	6.7	19.8	12.0	7.8	6.0	3.6	3.4	2.3	.....	1.8	1.25
23	9.1	7.0	19.8	11.9	7.6	5.4	3.45	3.3	2.2	.....	1.45	1.1
24	10.5	9.0	19.0	10.7	7.2	5.0	3.45	3.2	2.1	.....	1.3	1.1
25	12.2	11.0	18.0	9.8	6.7	4.8	3.3	3.5	1.85	.....	1.25	1.1
26	11.5	15.2	18.3	13.6	6.2	4.4	3.25	5.3	1.75	.....	1.15	1.15
27	9.0	18.5	18.6	16.8	6.7	3.45	5.0	6.5	1.7	.....	1.1	1.25
28	7.0	19.2	19.0	18.2	7.8	4.0	6.5	6.2	1.55	.....	1.1	1.3
29	6.6	19.6	19.8	18.7	8.8	4.2	9.0	5.3	1.4	.....	1.05	1.4
30	6.2	.....	20.1	17.2	9.9	3.35	6.6	4.2	1.15	.....	1.0	1.45
31	5.9	.....	19.6	.....	9.9	.....	5.8	4.1	.....	.....	.....	1.5

NOTE.—Relation of gage height to discharge affected by ice about Jan. 2 to 25 and Feb. 3 to 23. Observer reported ice 5 inches thick on Jan. 15 with river entirely frozen over and ice gorged at the railroad bridge above the gaging station on Feb. 4.

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,800	1,010	6,340	6,780	5,190	2,710	297	824	470	67	90	62
2	.....	945	6,100	6,390	4,860	2,750	738	446	610	58	105	70
3	.....	.....	5,140	6,100	4,710	2,330	1,720	288	600	56	105	94
4	.....	.....	4,580	6,010	4,670	1,800	2,120	279	422	52	105	109
5	.....	.....	3,580	5,860	4,530	1,360	1,360	254	422	.....	94	130
6	.....	.....	2,540	5,720	4,530	1,100	766	222	377	.....	90	178
7	.....	.....	1,920	5,290	4,480	738	573	178	377	.....	83	139
8	.....	.....	1,800	4,860	3,750	520	738	172	356	.....	113	130
9	.....	.....	1,360	3,840	3,140	573	654	172	346	.....	109	117
10	.....	.....	1,230	3,270	2,540	495	600	172	336	.....	97	113
11	.....	.....	1,070	2,540	2,200	446	682	229	336	.....	90	105
12	.....	.....	1,200	2,250	1,960	399	1,130	573	336	.....	83	101
13	.....	.....	2,000	2,000	1,880	377	914	884	279	.....	74	97
14	.....	.....	4,120	1,920	1,880	377	3,000	795	270	.....	72	86
15	.....	.....	5,140	1,840	1,800	346	3,660	573	316	.....	70	77
16	.....	.....	5,770	1,840	1,800	399	1,880	520	254	.....	67	77
17	.....	.....	6,440	3,220	1,800	600	1,360	520	199	.....	80	72
18	.....	.....	6,780	4,020	1,800	854	1,100	446	185	.....	130	72
19	.....	.....	6,970	4,350	1,800	1,230	914	422	172	.....	222	70
20	.....	.....	7,060	4,020	1,800	1,430	627	377	166	.....	270	62
21	.....	.....	6,970	3,580	1,760	1,290	470	336	160	.....	206	62
22	.....	.....	7,060	3,400	1,650	1,040	377	336	160	.....	113	74
23	.....	.....	7,060	3,360	1,580	854	346	316	149	.....	86	67
24	.....	2,120	6,680	2,830	1,430	738	346	297	139	.....	77	67
25	.....	2,960	6,200	2,460	1,260	682	316	356	117	.....	74	67
26	3,180	4,860	6,340	4,120	1,100	573	306	824	109	.....	70	70
27	2,120	6,440	6,490	5,620	1,260	346	738	1,200	105	.....	67	74
28	1,360	6,780	6,680	6,300	1,650	470	1,200	1,100	94	.....	67	77
29	1,230	6,970	7,060	6,540	2,040	520	2,120	824	83	.....	64	83
30	1,100	.....	7,210	5,820	2,500	326	1,230	520	70	.....	62	86
31	1,010	.....	6,970	.....	2,500	.....	976	495	.....	.....	.....	90

NOTE.—Daily discharge computed from a rating curve well defined between 262 and 2,540 second-feet (gage heights 3 and 10 feet). This curve differs from that used 1908–1911; change in the relation of gage height to discharge probably occurred about Oct. 3, 1911. Discharge Oct. 3 to Dec. 31, 1911, published in Water-Supply Paper 305, has not been revised by new curve. Discharge Jan. 2 to 25, and Feb. 3 to 23, estimated, because of ice, from gage heights, observer's notes, climatologic records and discharge of adjacent drainage areas, as follows: Jan. 2 to 25, 850 second-feet; Feb. 3 to 23, 450 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Monthly discharge of Kaskaskia River at Vandalia, Ill., for 1912.

[Drainage area, 1,980 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	1,040	0.525	0.61	D.
February	6,970	.....	1,430	.722	.78	D.
March	7,210	1,070	5,030	2.54	2.93	B.
April	6,780	1,840	4,200	2.12	2.36	A.
May	5,190	1,100	2,580	1.30	1.50	A.
June	2,750	326	922	.466	.52	A.
July	3,660	297	1,070	.540	.62	B.
August	1,200	172	482	.243	.28	A.
September	610	70	267	.135	.15	B.
October	.....	.....	.....	.....	.....	.....
November	270	62	101	.051	.06	C.
December	178	62	89.6	.045	.05	D.

NOTE.—See footnote to table of daily discharge.

KASKASKIA RIVER AT CARLYLE, ILL.

Location.—At the Baltimore & Ohio Southwestern Railroad bridge about one-fourth mile east of the railroad station at Carlyle, Ill.

Records available.—March 2, 1908, to September 30, 1912; November 1 to December 31, 1912, when station was finally discontinued.

Drainage area.—2,680 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably shifting. Measurements during 1912 indicate a change in the point of control. Main channel is broken by three bridge piers and flood channel by four additional piers.

Discharge measurements.—Made from downstream side of deck bridge.

Floods.—The flood of 1882, which is the highest known, is said to have attained a height 1½ feet above the flood of 1908, or about 32.5 feet on the present gage.

Winter flow.—Ice may effect the relation between gage height and discharge during portions of December, January, and February.

Artificial control.—A dam 3½ feet high, about 700 feet above the section, is used to store water for the city of Carlyle. The average amount pumped is about 3,500,000 gallons every 30 days, and during June, July, and August, about 4,500,000 gallons every 30 days. The outfalls of one section of the city sewage system and some private sewers are above the section, so that the diversion is negligible.

Accuracy.—See footnotes to table of daily discharge.

Remarks.—The stream never goes dry and during low water the water is hard, which indicates that the flow is kept up by springs.

Discharge measurements of Kaskaskia River at Carlyle, Ill., in 1912.

[Hydrographer, P. S. Monk.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Aug. 19	12.76	1,990
19	12.84	2,020

Daily gage height, in feet, of Kaskaskia River at Carlyle, Ill., for 1912.

[G. J. Klier, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	14.2	12.3	22.8	25.7	23.8	15.6	9.6	12.2	8.1	.....	5.6	5.4
2	14.2	11.6	22.9	24.9	24.1	11.0	10.1	10.0	7.9	.....	5.9	5.4
3	13.5	11.1	23.1	24.4	23.8	13.2	10.7	8.4	7.5	.....	6.1	5.4
4	12.1	10.9	23.2	24.2	23.5	12.6	12.5	7.8	6.9	.....	6.7	5.3
5	[a] 11.5	10.5	23.2	24.0	23.1	11.1	13.4	7.3	8.8	.....	6.5	5.3
6	[a] 10.8	9.7	23.0	23.5	22.8	10.1	13.6	7.0	9.1	.....	6.0	5.3
7	[a] 10.7	9.5	22.6	23.0	22.2	9.5	13.3	6.9	8.5	.....	6.2	5.5
8	[a] 10.5	9.4	22.1	22.7	22.0	9.2	11.3	6.8	7.6	.....	6.6	5.5
9	[a] 10.4	9.1	21.2	22.5	21.8	8.9	9.9	6.9	7.2	.....	6.6	5.4
10	.....	8.9	19.3	22.2	21.6	8.7	8.7	6.9	7.8	.....	6.5	5.4
11	.....	8.8	16.2	22.0	21.2	8.4	8.3	7.5	6.6	.....	6.2	5.4
12	10.9	8.7	14.7	21.9	20.9	8.2	8.1	7.4	6.5	.....	6.1	5.4
13	.....	8.5	13.3	21.2	20.2	8.1	8.0	7.7	6.4	.....	6.8	5.3
14	.....	8.4	15.1	20.4	19.4	7.9	13.0	8.4	6.3	.....	6.5	5.3
15	.....	8.3	19.2	19.9	18.0	9.3	15.6	10.7	6.1	.....	6.3	5.3

[a] Gage height to top of ice.

Daily gage height, in feet, of Kaskaskia River at Carlyle, Ill., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	9.7	8.3	20.4	18.9	14.8	11.2	18.1	10.5	6.3	.....	6.3	5.3
17	.....	8.4	21.2	18.1	14.1	12.0	19.3	9.9	6.5	.....	6.2	5.5
18	.....	8.5	22.9	17.4	13.5	13.2	19.6	11.5	6.6	.....	6.2	5.5
19	13.2	9.9	22.7	18.2	13.4	12.3	18.4	12.7	6.5	.....	6.1	5.4
20	[a] 17.8	11.5	23.4	18.6	12.9	11.1	14.5	10.8	6.2	.....	6.1	5.4
21	[a] 18.8	11.8	23.9	19.1	12.7	10.8	12.9	9.7	6.2	.....	6.0	5.4
22	19.1	11.7	24.6	19.4	12.1	10.4	10.7	12.4	6.1	.....	5.9	5.4
23	19.3	11.4	24.7	19.6	11.8	10.3	10.1	12.8	6.1	.....	5.8	5.3
24	19.3	11.8	24.5	19.7	11.7	10.2	8.9	13.5	6.0	.....	5.7	5.3
25	18.8	14.6	24.4	19.8	10.9	9.6	8.5	10.9	6.0	.....	5.7	5.3
26	17.6	18.9	24.4	20.3	10.5	9.2	8.2	9.9	6.0	.....	5.6	5.3
27	16.6	20.0	24.5	21.2	11.2	8.9	7.9	9.2	5.9	.....	5.6	5.3
28	15.5	20.7	24.9	22.0	13.5	8.6	7.5	9.1	5.9	.....	5.5	5.3
29	14.4	21.9	25.2	22.5	16.7	8.5	7.7	9.2	5.8	.....	5.5	5.3
30	13.9	.....	25.6	23.2	18.2	8.4	10.2	8.7	5.8	.....	5.5	5.3
31	13.0	.....	25.9	.....	18.6	.....	11.9	8.4	.....	.....	.....	5.3

[a] Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 5 to 25 and Feb. 3 to 17. Observer reported ice 9 to 11 inches in thickness from Jan. 12 to 19.

Daily discharge, in second-feet, of Kaskaskia River at Carlyle, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,360	1,790	7,790	12,200	9,310	2,780	1,010	1,760	597	.....	73	50
2	2,360	1,580	7,940	11,000	9,760	1,410	1,150	1,120	544	.....	115	50
3	2,150	.....	8,240	10,200	9,310	2,000	1,320	678	440	.....	145	50
4	1,730	.....	8,390	9,910	8,850	1,880	1,850	518	290	.....	248	40
5	.....	.....	8,390	9,610	8,240	1,440	2,120	388	786	.....	210	40
6	.....	.....	8,090	8,850	7,790	1,150	2,180	312	868	.....	130	40
7	.....	.....	7,480	8,090	6,870	980	2,090	290	705	.....	160	61
8	.....	.....	6,720	7,630	6,570	896	1,500	268	466	.....	228	61
9	.....	.....	5,400	7,330	6,270	813	1,090	290	362	.....	228	50
10	.....	.....	4,050	6,870	5,960	759	759	290	518	.....	210	50
11	.....	.....	2,960	6,570	5,400	678	651	440	228	.....	160	50
12	.....	.....	2,510	6,420	5,120	624	597	414	210	.....	145	50
13	.....	.....	2,090	5,400	4,560	597	570	492	192	.....	268	40
14	.....	.....	2,630	4,700	4,100	544	2,000	678	176	.....	210	40
15	.....	.....	4,000	4,360	3,530	924	2,780	1,320	145	.....	176	40
16	.....	.....	4,700	3,850	2,540	1,470	3,560	1,260	176	.....	176	40
17	.....	.....	5,400	3,560	2,330	1,700	4,050	1,090	210	.....	160	61
18	.....	705	7,940	3,340	2,150	2,060	4,200	1,560	228	.....	160	61
19	.....	1,090	7,630	3,590	2,120	1,790	3,660	1,910	210	.....	145	50
20	.....	1,560	8,700	3,720	1,970	1,440	2,450	1,350	160	.....	145	50
21	.....	1,640	9,460	3,950	1,910	1,350	1,970	1,040	160	.....	130	50
22	.....	1,610	10,500	4,100	1,730	1,240	1,320	1,820	145	.....	115	50
23	.....	1,530	10,700	4,200	1,640	1,210	1,150	1,940	145	.....	100	40
24	.....	1,640	10,400	4,250	1,610	1,180	813	2,150	130	.....	86	40
25	.....	2,480	10,200	4,300	1,380	1,010	705	1,380	130	.....	86	40
26	3,400	3,850	10,200	4,630	1,260	896	624	1,090	130	.....	73	40
27	3,080	4,420	10,400	5,400	1,470	813	544	896	115	.....	73	40
28	2,750	4,940	11,000	6,570	2,150	732	440	868	115	.....	61	40
29	2,420	6,420	11,400	7,330	3,110	705	492	896	100	.....	61	40
30	2,270	.....	12,000	8,390	3,590	678	1,180	759	100	.....	61	40
31	2,000	.....	12,500	.....	3,720	.....	1,670	678	.....	.....	.....	40

NOTE.—Daily discharge computed from a rating curve not well defined. The curve differs from the 1911 curve below 5,660 second-feet (gage height 21.4 feet) as a result of the two discharge measurements made Aug. 19, 1912; the change in relation of gage height to discharge probably occurred about Oct. 7, 1911, but the discharge values from Oct. 7 to Dec. 31, 1911, as published in Water-Supply Paper 305, p. 174, have not been revised by the new curve, the maximum error being about 10 per cent. Discharge Jan. 5 to 25 and Feb. 3 to 17 estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 5 to 25, 1,150 second-feet; Feb. 3 to 17, 750 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Monthly discharge of Kaskaskia River at Carlyle, Ill., for 1912.

[Drainage area, 2,680 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January			1,570	0.586	0.68	D.
February	6,420		1,600	.597	.64	D.
March	12,500	2,090	7,740	2.89	3.33	B.
April	12,200	3,340	6,340	2.37	2.64	A.
May	9,760	1,260	4,400	1.64	1.89	A.
June	2,780	544	1,190	.444	.50	B.
July	4,200	440	1,630	.608	.70	B.
August	2,150	268	966	.360	.42	A.
September	868	100	293	.109	.12	C.
October						
November	268	61	145	.054	.06	C.
December	61	40	46.3	.017	.02	D.

NOTE.—See footnote to table of daily discharge.

KASKASKIA RIVER AT NEW ATHENS, ILL.

Location.—At the Illinois Central Railroad bridge about 600 feet north of the railroad station at New Athens, Ill., about 1 mile below the mouth of Silver Creek and 3 miles above the mouth of Lively Creek.

Records available.—January 23, 1907, to September 30, 1912; October 30 to December 31, 1912, when station was finally discontinued. A record of river heights from January 23, 1907, to October 28, 1909, was kept by Mr. C. J. von Roth Roffy, the present observer, for the New Athens Journal. The river height was taken on Wednesday and Thursday mornings of each week, the river height for Thursday being published Friday with the change in 24 hours as obtained from the river height of Wednesday. This record was kept for the information of farmers living on the west side of the river who were cut off from reaching town when the river reached a height of 30 feet. The record is authentic. The gage heights have been reduced to the present datum, the maximum error probably not being over 0.4 foot, decreasing as the stage increases. The present gage was installed November 1, 1909.

Drainage area.—5,220 square miles.

Gage.—Standard chain gage attached to the bridge; datum unchanged.

Channel.—Probably permanent. Measurements to date indicate that point of control is permanent.

Discharge measurements.—Made from downstream lower chord of bridge and from wooden trestle approaches.

Floods.—The flood of the fall of 1898 reached a height of about 34.5 feet, referred to the present gage datum.

Winter flow.—The relation between gage height and discharge may be slightly affected by ice during portions of December, January, and February.

Accuracy.—The records at this station should be used with caution because the discharge rating curve above 12,000 second-feet is an extension and it seems probable that backwater from Mississippi River affects the relation of gage height to discharge when the Mississippi is in flood.

The following discharge measurement was made by P. S. Monk:

August 7, 1912: Gage height, 4.92 feet; discharge, 585 second-feet.

Daily gage height, in feet, of Kaskaskia River at New Athens, Ill., for 1912.

[C. J. von Roth Roffy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.6	11.0	21.6	27.6	24.0	16.0	6.2	8.5	5.8	.....	3.4	3.1
2	12.2	10.2	22.4	27.9	24.2	13.9	6.0	9.6	5.3	.....	5.1	3.0
3	11.8	9.8	23.0	28.2	24.4	10.8	5.8	9.0	4.9	.....	4.9	3.0
4	10.7	9.3	23.0	28.0	24.6	9.6	5.7	7.2	4.6	.....	4.4	3.0
5	9.4	8.8	23.0	27.4	24.4	11.1	7.4	6.0	4.4	.....	4.0	3.0
6	8.8	8.2	22.8	26.5	24.1	11.0	9.2	5.3	4.2	.....	4.0	3.0
7	9.7	7.6	22.4	25.7	23.4	11.0	14.2	4.9	5.0	.....	4.0	3.0
8	9.5	7.2	21.8	24.8	22.8	10.3	14.8	4.7	5.4	.....	4.5	3.0
9	9.0	6.8	21.4	23.8	22.2	8.6	12.1	4.5	4.7	.....	4.4	3.0
10	8.7	6.6	21.0	23.2	21.6	7.4	9.9	4.4	4.4	.....	4.6	3.0
11	8.4	6.8	20.8	22.4	21.8	6.8	9.8	4.4	4.2	.....	4.4	3.0
12	8.2	6.2	20.6	22.0	21.6	6.4	10.6	4.5	4.0	.....	4.2	3.0
13	8.2	6.0	20.0	21.6	21.5	6.0	9.8	6.6	3.9	.....	4.0	3.0
14	8.3	5.9	18.6	21.6	21.2	5.8	9.4	9.5	3.8	.....	3.9	3.0
15	8.2	5.8	18.8	21.5	20.7	5.7	15.4	8.5	3.7	.....	4.4	3.0
16	8.0	5.8	20.0	21.0	20.2	9.3	17.0	9.6	3.6	.....	4.7	3.0
17	7.7	5.8	21.5	21.0	19.0	18.0	17.5	10.0	3.6	.....	4.6	3.0
18	8.6	5.8	22.4	21.1	16.0	20.5	17.3	8.2	4.0	.....	4.4	3.0
19	13.9	6.4	23.2	20.8	12.2	21.2	17.2	7.6	4.0	.....	4.0	3.0
20	16.0	6.2	23.6	20.4	11.0	21.4	17.4	8.6	3.8	.....	3.8	3.0
21	16.8	8.8	23.8	20.1	10.6	21.0	16.8	9.0	3.9	.....	3.7	3.0
22	17.6	9.4	24.1	20.0	10.4	20.0	17.5	8.0	3.9	.....	3.6	3.0
23	18.2	10.2	24.4	19.4	9.8	17.0	16.8	7.2	3.8	.....	3.4	3.0
24	18.4	10.0	24.6	18.8	9.2	11.4	11.8	9.8	3.8	.....	3.3	3.0
25	18.2	9.8	25.0	18.2	8.8	8.8	8.6	9.9	3.7	.....	3.2	3.0
26	17.9	15.7	25.4	20.2	10.0	8.0	7.4	8.8	3.6	.....	3.2	2.9
27	17.5	19.0	25.5	22.6	9.2	7.4	6.4	9.4	3.4	.....	3.2	2.9
28	16.7	20.2	25.4	23.4	9.8	7.0	5.9	9.1	3.4	.....	3.1	2.9
29	15.3	21.0	25.8	23.8	12.8	7.2	5.6	7.8	3.3	.....	3.1	2.9
30	13.6	.....	26.7	24.0	15.7	6.6	5.4	7.3	3.2	2.8	3.1	2.9
31	12.2	.....	27.3	.....	16.0	.....	6.0	6.4	.....	2.8	.....	2.8

NOTE.—Relation of gage height to discharge affected by ice about Jan. 6 to 27, and possibly also to some extent during February and December.

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,190	3,300	14,400	35,100	22,700	6,460	938	1,950	802	.....	280	236
2	3,960	2,860	17,200	36,200	23,400	4,970	870	2,530	656	.....	606	222
3	3,740	2,640	19,200	37,200	24,100	3,190	802	2,200	560	.....	560	222
4	3,140	2,360	19,200	36,500	24,800	2,530	770	1,340	494	.....	454	222
5	2,420	2,100	19,200	34,400	24,100	3,360	1,420	870	454	.....	378	222
6	.....	1,800	18,600	31,300	23,000	3,300	2,310	656	414	.....	378	222
7	.....	1,510	17,200	28,600	20,600	3,300	5,160	560	582	.....	378	222
8	.....	1,340	15,100	25,500	18,600	2,920	5,580	516	682	.....	474	222
9	.....	1,170	13,700	22,000	16,500	2,000	3,900	474	516	.....	454	222
10	.....	1,090	12,400	19,900	14,400	1,420	2,700	454	454	.....	494	222
11	.....	1,170	11,800	17,200	15,100	1,170	2,640	454	414	.....	454	222
12	.....	938	11,400	15,800	14,400	1,010	3,080	474	378	.....	414	222
13	.....	870	10,300	14,400	14,100	870	2,640	1,090	360	.....	378	222
14	.....	836	8,710	14,400	13,000	802	2,420	2,480	344	.....	360	222
15	.....	802	8,910	14,100	11,600	770	6,000	1,950	328	.....	454	222
16	.....	802	10,300	12,400	10,600	2,360	7,260	2,530	312	.....	516	222
17	.....	802	14,100	12,400	9,120	8,130	7,680	2,750	312	.....	494	222
18	.....	802	17,200	12,700	6,460	11,100	7,520	1,800	378	.....	454	222
19	.....	1,010	19,900	11,800	3,960	13,000	7,430	1,510	378	.....	378	222
20	.....	938	21,300	11,000	3,300	13,700	7,600	2,000	344	.....	344	222

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for 1912—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	.....	2,100	22,000	10,500	3,080	12,400	7,100	2,200	360	.....	328	222
22	.....	2,420	23,000	10,300	2,970	10,300	7,680	1,700	360	.....	312	222
23	.....	2,860	24,100	9,580	2,640	7,260	7,100	1,340	344	.....	280	222
24	.....	2,750	24,800	8,910	2,310	3,520	3,740	2,640	344	.....	264	222
25	.....	2,640	26,200	8,310	2,100	2,100	2,000	2,700	328	.....	250	222
26	.....	6,220	27,500	10,600	2,750	1,700	1,420	2,100	312	.....	250	210
27	.....	9,120	27,900	17,900	2,310	1,420	1,010	2,420	280	.....	250	210
28	7,020	10,600	27,500	20,600	2,640	1,250	836	2,260	280	.....	236	210
29	5,930	12,400	28,900	22,000	4,310	1,340	738	1,610	264	.....	236	210
30	4,790	.....	32,000	22,700	6,220	1,090	682	1,380	250	198	236	210
31	3,960	.....	34,100	.....	6,460	.....	870	1,010	.....	198	.....	198

NOTE.—Daily discharge computed from a rating curve well defined between 378 and 12,400 second-feet (gage heights 4.0 and 21.0 feet). See "Accuracy" in station description.

Mean discharge Jan. 6 to 27, estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas, at 2,300 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data, and therefore should be used with caution. No correction applied for possible effect of ice during February and December.

Monthly discharge of Kaskaskia River at New Athens, Ill., for 1912.

[Drainage area, 5,220 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	2,900	0.556	0.64	D.
February	12,400	802	2,770	.531	.57	D.
March	34,100	8,710	19,300	3.70	4.27	C.
April	37,200	8,310	19,500	3.74	4.17	C.
May	24,800	2,100	11,300	2.16	2.49	B.
June	13,700	770	4,290	.822	.92	B.
July	7,680	682	3,610	.692	.80	A.
August	2,750	454	1,610	.308	.36	A.
September	802	250	409	.078	.09	C.
October	.....	.....	.....	.....	.....	.....
November	606	236	378	.072	.08	C.
December	236	198	220	.042	.05	D.

NOTE.—See footnote to table of daily discharge.

SHOAL CREEK NEAR BREESE, ILL.

Location.—At the Baltimore & Ohio Southwestern Railroad bridge about 1½ miles east of Breese, Ill., and about 3 miles above the mouth of Beaver Creek.

Records available.—November 5, 1909, to September 30, 1912; October 30 to December 31, 1912, when station was finally discontinued.

Drainage area.—760 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Practically permanent; rough, as rock has been placed in bed of stream under bridge to prevent scour.

Discharge measurements.—Made from upstream side of bridge and also from downstream side of wooden trestle over overflow channel during floods. There is a good wading section just above the bridge.

Floods.—The maximum gage height since establishment of the gage—19.6 feet—occurred in October, 1911. No available records of floods prior to installation of gage.

Winter flow.—The relation between gage height and discharge may be slightly affected by ice during short periods in December, January, and February.

Regulation.—The intake of the Breese municipal pumping system is about one-fourth mile above the section, but the quantity of water diverted is negligible.

Remarks.—The stream is fed by springs and has never been known to go dry at this point.

The following discharge measurement made was by wading at a section about 20 feet above the bridge by P. S. Monk:

August 19, 1912: Gage height, 1.48 feet; discharge, 63.0 second-feet.

Daily gage height, in feet, of Shoal Creek near Breese, Ill., for 1912.

[John Nordman, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.7	2.1	18.1	18.4	18.6	3.4	1.35	0.95	1.2	.....	1.5	1.2
2	3.1	1.9	17.9	18.6	18.4	3.3	1.45	.95	1.2	.....	1.3	1.2
3	2.6	1.8	15.7	17.4	17.6	3.2	1.8	1.05	1.1	.....	1.3	1.25
4	2.4	1.75	8.0	14.2	13.2	2.8	1.95	1.05	1.1	.....	1.3	1.3
5	2.3	1.7	5.5	13.4	9.0	2.6	2.5	1.1	1.05	.....	1.3	1.25
6	2.2	1.7	4.0	9.4	5.0	2.2	1.8	1.1	1.05	.....	1.75	1.2
7	1.9	1.65	3.6	6.8	4.4	1.85	1.5	1.05	1.05	.....	1.8	1.2
8	1.7	1.65	3.5	6.8	3.4	1.65	1.55	1.05	1.0	.....	1.8	1.2
9	1.7	1.65	3.4	6.8	3.2	1.45	1.35	1.2	1.0	.....	1.75	1.2
10	1.65	1.65	3.5	6.8	3.2	1.45	2.4	1.15	1.0	.....	1.4	1.2
11	1.65	1.65	3.8	6.4	5.0	1.4	6.2	1.15	1.15	.....	1.35	1.2
12	1.6	1.6	.....	6.3	9.0	1.35	2.1	1.15	1.2	.....	1.2	1.15
13	1.6	1.6	.....	6.0	8.4	1.35	1.95	1.3	1.15	.....	1.2	1.15
14	1.6	1.6	.....	8.6	5.2	1.3	7.2	1.45	1.1	.....	1.4	1.2
15	1.6	1.6	.....	13.0	3.6	4.8	6.5	1.65	1.1	.....	1.95	1.15
16	1.6	1.7	.....	11.4	3.0	1.95	2.0	1.85	1.1	.....	1.8	1.2
17	1.6	1.75	.....	12.2	2.6	9.0	7.0	1.65	1.1	.....	1.6	1.15
18	5.4	2.1	.....	13.7	2.6	10.4	10.4	2.6	1.15	.....	1.4	1.2
19	9.4	3.7	.....	15.4	2.4	4.4	7.4	1.6	1.15	.....	1.35	1.2
20	12.5	6.4	.....	15.6	2.2	3.4	3.6	1.4	1.1	.....	1.2	1.2
21	11.2	6.1	.....	11.4	2.1	3.2	2.0	1.35	1.1	.....	1.2	1.2
22	6.2	4.4	18.4	7.0	2.0	2.8	2.0	3.1	1.1	.....	1.2	1.2
23	5.1	2.3	17.6	8.0	1.8	2.4	1.75	1.6	1.1	.....	1.2	1.2
24	5.0	2.2	17.2	7.8	5.0	1.95	1.6	1.3	1.1	.....	1.2	1.2
25	5.7	4.8	16.6	7.6	3.6	1.55	1.55	1.35	1.1	.....	1.2	1.2
26	5.6	13.1	12.6	15.2	3.0	1.35	1.35	1.4	1.1	.....	1.3	1.2
27	4.6	15.2	14.6	16.2	2.4	1.35	1.25	3.2	1.05	.....	1.3	1.2
28	4.2	16.0	15.2	17.0	6.5	1.65	1.25	1.55	1.05	.....	1.25	1.2
29	3.1	17.2	16.9	18.0	6.4	1.5	1.05	1.4	1.05	.....	1.2	1.2
30	2.7	.....	18.0	18.6	8.8	1.45	1.05	1.4	1.05	0.9	1.2	1.2
31	2.5	.....	18.8	.....	4.4	.....	1.0	1.3	.....	.9	.....	1.2

NOTE.—Relation of gage height to discharge affected by ice about Jan. 8 to 21, and Feb. 4 to 22. Gage not read Mar. 12 to 21 because of displacement resulting from reconstruction of railroad bridge.

Daily discharge, in second-feet, of Shoal Creek near Breese, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	696	132	4,930	5,320	5,580	299	52	26	41	.....	65	41
2	251	114	4,670	5,580	5,320	283	60	26	41	.....	48	41
3	183	106	2,770	4,050	4,290	267	92	32	35	.....	48	44
4	161	.....	1,110	2,380	2,160	206	107	32	35	.....	48	48
5	151	.....	660	2,210	1,300	180	168	35	32	.....	48	44
6	141	.....	400	1,380	570	133	92	35	32	.....	88	41
7	114	.....	332	894	468	97	65	32	32	.....	92	41
8	.....	.....	315	894	299	78	70	32	29	.....	92	41
9	.....	.....	299	894	267	60	52	41	29	.....	88	41
10	.....	.....	315	894	267	60	156	38	29	.....	56	41
11	.....	.....	366	822	570	56	786	38	38	.....	52	41
12	.....	.....	.....	804	1,300	52	122	38	41	.....	41	38
13	.....	.....	.....	750	1,190	52	107	48	38	.....	41	38
14	.....	.....	.....	1,220	606	48	966	60	35	.....	56	41
15	.....	.....	.....	2,120	332	536	840	78	35	.....	107	38

Daily discharge, in second-feet, of Shoal Creek near Breese, Ill., for 1912—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	.....	.....	1,780	235	107	112	97	35	.....	92	41
17	.....	.....	.....	1,940	180	1,300	930	78	35	.....	74	38
18	.....	.....	.....	2,270	180	1,580	1,580	180	38	.....	56	41
19	.....	.....	.....	2,680	156	468	1,000	74	38	.....	52	41
20	.....	.....	.....	2,740	133	299	332	56	35	.....	41	41
21	.....	.....	.....	1,780	122	267	112	52	35	.....	41	41
22	786	.....	5,320	930	112	206	112	251	35	.....	41	41
23	588	151	4,290	1,110	92	156	88	74	35	.....	41	41
24	570	141	3,810	1,070	570	107	74	48	35	.....	41	41
25	696	536	3,160	1,040	332	70	70	52	35	.....	41	41
26	678	2,140	2,030	2,620	235	52	52	56	35	.....	48	41
27	502	2,620	2,470	2,960	156	52	44	267	32	.....	48	41
28	434	2,880	2,620	3,570	840	78	44	70	32	.....	44	41
29	251	3,810	3,450	4,800	822	65	32	56	32	.....	41	41
30	196	.....	4,800	5,580	1,260	60	32	56	32	23	41	41
31	172	.....	5,840	.....	468	.....	29	48	.....	23	.....	41

NOTE.—Daily discharge computed from a rating curve well defined between 66 and 570 second-feet (gage heights 1.3 and 5.0 feet), and fairly well defined throughout the remainder of the range of discharge covered by the 1912 gage heights. Two rating curves were used for 1912, the change, made Mar. 1, being based on the discharge measurements made Aug. 19, 1912.

Discharge Jan. 8 to 21 and Feb. 4 to 22 estimated because of ice, from gage heights, climatologic records and discharge of adjacent drainage areas, as follows: Jan. 8 to 21, 250 second-feet, Feb. 4 to 22, 130 second-feet.

Discharge Mar. 12 to 21 estimated because of missing gage heights resulting from reconstruction of bridge, from climatologic records and discharge of adjacent drainage areas, at 2,900 second-feet.

These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice and based on insufficient data, and therefore should be used with caution.

Monthly discharge of Shoal Creek near Breese, Ill., for 1912.

[Drainage area, 760 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	325	0.428	0.49	D.
February	3,810	.....	521	.686	.74	D.
March	.....	.....	2,680	3.53	4.07	C.
April	5,580	750	2,240	2.95	3.29	B.
May	5,580	92	981	1.29	1.49	B.
June	1,580	48	242	.318	.35	A.
July	1,580	29	270	.355	.41	A.
August	267	26	67.9	.089	.10	B.
September	41	29	34.7	.046	.05	C.
October	.....	.....	.....	.....	.....	.....
November	107	41	57.1	.075	.08	C.
December	48	38	41.0	.054	.06	C.

NOTE.—See footnote to table of daily discharge.

SILVER CREEK NEAR LEBANON, ILL.

Location.—At highway bridge at Wrights Crossing, about 2 miles west of Lebanon, Ill., between the Baltimore & Ohio Southwestern and the East St. Louis & Suburban Railroad bridges across Silver Creek.

Records available.—March 3, 1908, to September 30, 1912; November 3 to December 31, 1912, when station was finally discontinued.

Drainage area.—335 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably permanent.

Discharge measurements.—Made from downstream side of bridge and small approach spans, and also at high stages from downstream side of 3 steel viaducts on road west of bridge.

Floods.—The maximum stage since establishment of gage—15.9 feet—occurred in May, 1908. No available records of floods prior to the establishment of the station.

Winter flow.—Ice may affect the relation of gage height to discharge during parts of December, January, and February.

Accuracy.—From March 3, 1908, to May 10, 1909, the gage was so situated that 2 feet was the lowest obtainable reading, and the gage reader noted that the stream was dry whenever the water surface was below 2 feet. On inquiry he stated that the stream was dry for only one week during 1908; therefore, where the gage heights have been marked "Dry" during this period this note was inserted "Dry under gage, can not obtain gage height of water surface." The position of the gage was changed on May 10, 1909, so as to obviate this difficulty.

The following discharge measurement was made by P. S. Monk:

August 5, 1912: Width, 25 feet; area, 65.5 square feet; mean velocity, 0.06 foot per second; gage height, 1.85 feet; discharge, 4.2 second-feet. This measurement is not considered accurate because of the low velocity.

Daily gage height, in feet, of Silver Creek near Lebanon, Ill., for 1912.

[E. C. Turner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.4	2.9	12.8	12.6	13.5	3.0	2.3	1.9	1.9	.....	.....	1.8
2	5.1	2.9	12.2	11.9	12.6	3.3	2.3	1.9	1.8	.....	.....	1.9
3	4.4	2.8	10.5	11.6	11.9	4.0	2.3	1.9	1.7	.....	1.9	1.9
4	3.8	2.8	7.1	11.8	7.5	3.1	2.4	1.75	1.6	.....	1.9	2.0
5	3.2	2.8	6.0	11.8	.....	2.7	2.5	1.85	1.5	.....	2.3	2.0
6	2.7	2.7	5.6	8.7	3.8	7.4	2.3	1.8	1.5	.....	5.4	2.0
7	2.5	2.7	4.6	9.2	3.4	9.8	8.6	1.8	1.5	.....	5.1	2.0
8	2.4	2.7	4.2	9.0	3.3	5.7	4.3	1.8	1.5	.....	4.4	2.0
9	2.3	2.7	4.3	6.1	3.1	3.6	2.9	1.8	1.5	.....	3.7	1.9
10	2.3	2.7	4.6	4.2	3.0	2.6	7.7	1.9	1.4	.....	3.1	1.9
11	2.3	2.7	5.0	3.8	5.1	2.4	4.3	1.8	1.4	.....	2.7	1.9
12	2.3	2.7	5.1	3.6	9.8	2.3	3.0	1.8	1.4	.....	2.3	1.8
13	2.3	2.7	5.8	3.4	7.5	2.2	5.0	4.9	1.3	.....	2.1	1.8
14	2.3	2.7	8.6	8.7	4.6	2.2	7.8	3.2	1.3	.....	2.1	1.7
15	2.3	2.7	11.4	7.1	3.6	9.2	10.1	9.9	1.9	.....	2.0	1.7
16	2.3	3.0	11.6	5.3	3.3	10.8	10.9	7.9	2.4	.....	2.0	1.8
17	8.5	3.5	11.6	5.7	3.1	12.5	12.2	3.7	2.1	.....	2.0	1.8
18	10.6	4.1	11.6	10.4	3.0	12.7	12.0	5.1	2.9	.....	2.0	2.0
19	10.6	5.2	11.4	11.0	2.9	12.6	12.0	4.0	2.2	.....	1.95	2.0
20	10.8	6.7	13.6	11.7	2.6	12.1	12.4	2.7	1.9	.....	1.95	1.95
21	10.9	6.3	12.5	.....	2.5	9.2	9.4	2.3	2.9	.....	1.9	1.95
22	8.2	5.2	12.4	5.4	2.5	5.1	6.3	5.0	3.3	.....	1.9	1.9
23	8.1	3.9	12.4	7.5	2.6	3.8	5.3	4.2	3.4	.....	1.9	1.9
24	7.9	3.8	12.1	5.7	2.6	3.1	3.3	3.8	2.9	.....	1.9	1.9
25	7.2	8.0	9.1	3.9	3.9	2.8	2.6	3.7	2.3	.....	1.9	1.85
26	7.2	11.2	7.0	11.5	5.4	2.7	2.4	7.1	1.9	.....	1.9	1.85
27	6.1	12.5	10.9	13.8	2.6	2.6	2.2	8.6	1.8	.....	1.85	1.85
28	5.4	13.9	11.9	.....	6.4	3.6	2.2	4.0	1.7	.....	1.85	1.85
29	4.6	13.7	13.7	13.2	10.0	2.5	2.1	2.5	1.6	.....	1.85	1.85
30	4.2	.....	14.6	13.1	.....	2.3	1.9	2.2	1.6	.....	1.8	1.9
31	2.9	.....	.....	.....	4.0	.....	1.95	2.0	.....	.....	.....	1.9

NOTE.—Jan. 2 to Feb. 16, gage heights read to top of ice. Feb. 17, gage height to water surface; water on top of ice. Relation of gage height to discharge affected by ice about Jan. 7 to Feb. 22.

Daily discharge, in second-feet, of Silver Creek near Lebanon, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	271	.....	1,980	1,780	2,680	41	17	8	8	.....	15	7
2	164	.....	1,400	1,190	1,780	54	17	8	7	.....	10	8
3	116	.....	750	1,050	1,190	92	17	8	6	.....	8	8
4	80	.....	335	1,140	375	45	20	6.5	5	.....	8	10
5	49	.....	235	1,140	228	29	23	7.5	4	.....	17	10
6	29	.....	203	504	80	365	17	7	4	.....	187	10
7	.....	.....	129	564	59	639	492	7	4	.....	164	10
8	.....	.....	104	540	54	211	110	7	4	.....	116	10
9	.....	.....	110	244	45	69	37	7	4	.....	74	8
10	.....	.....	129	104	41	26	395	8	3	.....	45	8
11	.....	.....	157	80	164	20	110	7	3	.....	29	8
12	.....	.....	164	69	639	17	41	7	3	.....	17	7
13	.....	.....	219	59	375	14	157	150	2.5	.....	12	7
14	.....	.....	492	504	129	14	405	49	2.5	.....	12	6
15	.....	.....	975	335	69	564	679	652	8	.....	10	6
16	.....	.....	1,050	179	54	814	836	415	20	.....	10	7
17	.....	.....	1,050	211	45	1,680	1,400	74	12	.....	10	7
18	.....	.....	1,050	730	41	1,880	1,240	164	37	.....	10	10
19	.....	.....	975	860	37	1,780	1,240	92	14	.....	9	10
20	.....	.....	2,780	1,090	26	1,320	1,580	29	8	.....	9	9
21	.....	.....	1,680	638	23	564	588	17	37	.....	8	9
22	.....	.....	1,580	187	23	164	262	157	54	.....	8	8
23	.....	86	1,580	375	26	80	179	104	59	.....	8	8
24	.....	80	1,320	211	26	45	54	80	37	.....	8	8
25	.....	425	552	86	86	33	26	74	17	.....	8	7.5
26	.....	915	325	1,010	187	29	20	335	8	.....	8	7.5
27	.....	1,680	836	2,980	26	26	14	492	7	.....	7.5	7.5
28	.....	3,080	1,190	2,680	271	69	14	92	6	.....	7.5	7.5
29	.....	2,880	2,880	2,380	665	23	12	23	5	.....	7.5	7.5
30	.....	.....	3,820	2,280	378	17	8	14	5	.....	7	8
31	.....	.....	2,800	.....	92	.....	9	10	.....	.....	.....	8

NOTE.—Daily discharge computed from a discharge rating curve well defined between 29 and 307 second-feet (gage heights 2.7 and 6.8 feet) and fairly well defined between 316 and 2,180 second-feet (gage heights 6.9 and 13.0 feet). Discharge Jan. 7 to Feb. 22 estimated, because of ice, from gage heights, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 7 to 31, 130 second-feet; Feb. 1 to 22, 40 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data, and therefore should be used with caution. Discharge Nov. 1 and 2 estimated. Discharge Apr. 21, 28, May 5 and 30, interpolated.

Monthly discharge of Silver Creek near Lebanon, Ill., for 1912.

[Drainage area, 335 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	128	0.382	0.44	D.
February	3,080	.....	346	1.03	1.11	D.
March	3,820	104	1,060	3.16	3.64	C.
April	2,980	59	840	2.51	2.80	B.
May	2,680	23	320	.955	1.10	B.
June	1,880	14	357	1.07	1.19	C.
July	1,580	8	323	.964	1.11	C.
August	652	6.5	100	.299	.34	C.
September	59	2.5	13.1	.039	.04	D.
October	.....	.....	.....	.....	.....	.....
November	187	7	28.3	.084	.09	D.
December	10	6	8.15	.024	.03	D.

NOTE.—See footnote to table of daily discharge.

BIG MUDDY RIVER NEAR CAMBON, ILL.

Location.—At the Chicago, Burlington & Quincy Railroad bridge about 1 mile north of Cambon station and 1½ miles east of Plumfield, Ill., in sec. 17, T. 7 S., R. 2 E., about one-fourth mile below the mouth of the Middle Fork.

Records available.—June 16, 1908, to September 30, 1912; November 1 to December 31, 1912, when station was finally discontinued.

Drainage area.—735 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably permanent except at low stages.

Discharge measurements.—Made from downstream side of bridge and wooden approach trestles.

Floods.—Maximum gage heights since establishment of the gage—25.3 feet—occurred in May, 1911. No available records of floods prior to establishment of station.

Winter flow.—Ice may affect the relation between gage height and discharge during portions of December, January, and February.

The following discharge measurement was made by wading at a section about 100 feet below the bridge by P. S. Monk:

August 10, 1912: Gage height, 2.43 feet; discharge, 14.6 second-feet.

Daily gage height, in feet, of Big Muddy River near Cambon, Ill., for 1912.

[Joel Prine, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.0	6.2	20.3	19.2	21.2	10.7	4.5	6.0	6.0	.....	3.8	2.1
2	11.4	5.8	20.5	19.0	20.1	8.4	3.8	5.0	5.0	.....	4.2	2.3
3	9.8	5.6	19.2	18.4	18.4	6.2	3.6	4.3	4.3	.....	6.1	2.3
4	6.6	4.0	17.3	17.9	16.8	5.8	7.6	4.0	4.0	.....	7.6	2.3
5	6.0	3.7	15.5	17.5	12.9	4.1	10.6	3.3	3.3	.....	8.0	2.2
6	5.4	3.6	12.7	16.7	10.0	3.7	9.4	3.1	3.1	.....	6.9	2.2
7	4.8	3.4	9.8	16.5	6.9	3.4	9.4	2.8	2.8	.....	4.7	2.1
8	4.6	3.3	10.6	15.7	4.5	3.1	9.0	2.6	2.4	.....	6.4	2.1
9	4.4	3.3	12.6	13.0	3.7	2.9	7.8	2.5	2.5	.....	8.8	2.1
10	3.5	3.2	13.7	9.5	3.4	2.7	5.7	2.4	2.4	.....	8.3	2.2
11	3.4	3.2	14.7	6.6	5.1	2.5	6.3	3.0	3.0	.....	6.8	2.3
12	3.3	3.1	15.1	5.1	10.5	2.4	8.1	4.2	4.2	.....	4.9	2.3
13	3.1	3.1	15.6	4.4	11.9	2.3	10.4	5.5	5.0	.....	4.1	2.2
14	3.0	3.0	16.1	4.3	12.9	2.3	11.3	7.1	7.1	.....	4.1	2.1
15	3.0	3.0	17.6	5.7	13.4	2.3	9.8	7.4	7.4	.....	4.1	2.1
16	3.0	3.0	17.8	5.7	12.6	2.3	6.5	6.5	6.0	.....	3.5	2.2
17	6.0	3.1	19.0	4.9	10.4	8.6	4.4	4.4	5.3	.....	3.2	2.2
18	8.0	3.3	19.2	4.6	9.4	14.0	3.8	3.8	5.0	.....	3.0	2.3
19	11.0	3.7	19.0	5.8	7.3	15.2	3.1	3.1	4.8	.....	2.9	2.3
20	14.0	4.5	18.4	5.9	5.8	16.5	2.9	2.9	4.7	.....	2.8	2.2
21	14.4	6.2	15.9	4.6	4.7	17.8	2.8	2.8	4.6	.....	2.7	2.1
22	14.7	6.7	17.5	6.3	4.0	19.0	2.7	2.7	3.8	.....	2.6	2.1
23	15.7	6.2	17.4	8.5	3.6	19.2	2.6	2.6	3.6	.....	2.5	2.1
24	16.7	6.0	17.4	8.2	3.4	18.7	4.3	4.3	2.9	.....	2.4	2.2
25	16.4	9.8	17.5	6.0	3.1	17.2	4.5	3.9	2.7	.....	2.3	2.3
26	15.9	14.8	17.6	12.8	2.9	14.9	3.9	3.1	5.0	.....	2.3	2.3
27	15.4	17.0	17.6	17.2	2.8	10.3	3.1	3.0	7.4	.....	2.3	2.2
28	14.6	19.0	17.5	21.2	3.2	7.5	2.9	2.9	9.2	.....	2.2	2.2
29	14.0	19.9	17.6	22.0	4.6	5.7	2.6	2.3	11.3	.....	2.2	2.3
30	13.7	.....	17.9	22.5	8.7	4.9	2.2	2.2	12.0	.....	2.1	2.3
31	13.5	.....	.....	.....	10.4	.....	7.2	7.2	.....	.....	.....	2.2

NOTE.—Relation of gage height to discharge affected by ice about Jan. 7 to 31 and Feb. 5 to 18.

Daily discharge, in second-feet, of Big Muddy River near Cambon, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,070	274	5,850	4,900	6,710	1,000	111	250	250	.....	69	4
2	1,160	228	6,030	4,740	5,670	574	69	148	148	.....	92	9
3	824	206	4,900	4,260	4,260	274	59	98	98	.....	262	9
4	324	84	3,490	3,910	3,180	228	454	80	80	.....	454	9
5	250	.....	2,500	3,630	1,530	86	982	45	45	.....	510	6
6	186	.....	1,470	3,120	860	64	752	37	37	.....	363	6
7	.....	.....	824	3,000	363	49	752	26	26	.....	125	4
8	.....	.....	982	2,600	111	37	680	20	13	.....	298	4
9	.....	.....	1,440	1,560	64	30	482	16	16	.....	644	4
10	.....	.....	1,780	770	49	23	217	13	13	.....	558	6
11	.....	.....	2,160	324	157	16	286	33	33	.....	350	9
12	.....	.....	2,320	157	960	13	526	92	92	.....	140	9
13	.....	.....	2,550	104	1,270	9	940	196	148	.....	86	6
14	.....	.....	2,800	99	1,530	9	1,140	389	389	.....	86	6
15	.....	.....	3,700	217	1,680	9	824	428	428	.....	86	6
16	.....	.....	3,840	217	1,440	9	311	311	250	.....	54	6
17	.....	.....	4,740	140	940	608	104	104	176	.....	41	6
18	.....	.....	4,900	117	752	1,880	69	69	148	.....	33	9
19	.....	71	4,740	228	415	2,360	37	37	132	.....	30	9
20	.....	110	4,260	239	228	3,000	30	30	125	.....	26	6
21	.....	274	2,700	117	125	3,840	26	26	118	.....	23	4
22	.....	337	3,630	286	80	4,740	23	23	69	.....	20	4
23	.....	274	3,560	590	59	4,900	20	20	59	.....	16	4
24	.....	250	3,560	542	49	4,450	98	98	30	.....	13	6
25	.....	824	3,630	250	37	3,420	111	74	23	.....	9	9
26	.....	2,200	3,700	1,500	30	2,240	74	37	148	.....	9	9
27	.....	3,300	3,700	3,420	26	920	37	33	428	.....	9	6
28	.....	4,740	3,630	6,710	41	441	30	30	716	.....	6	6
29	.....	5,490	3,700	7,530	118	217	20	9	1,140	.....	6	9
30	.....	.....	3,910	8,060	626	140	6	6	1,290	.....	4	9
31	.....	.....	4,400	.....	940	.....	402	402	.....	.....	.....	6

NOTE.—Daily discharge computed from a fairly well defined rating curve. Below 132 second-feet (gage height 4.8 feet) the rating curve differs from that used during 1911, the change being based on the discharge measurement made Aug. 10, 1912. Discharge Jan. 7 to 31 and Feb. 5 to 18 estimated, because of ice, from gage heights, climatologic records, and discharge of adjacent drainage areas, as follows: Jan. 7 to 31, 550 second-feet; Feb. 5 to 18, 20 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Discharge Mar. 31 interpolated.

Monthly discharge of Big Muddy River near Cambon, Ill., for 1912.

[Drainage area, 735 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	567	0.771	0.89	D.
February	5,490	.....	653	.888	.96	D.
March	6,030	824	3,400	4.63	5.34	B.
April	8,060	99	2,110	2.87	3.20	B.
May	6,710	26	1,110	1.51	1.74	B.
June	4,900	9	1,190	1.62	1.81	B.
July	1,140	6	312	.424	.49	B.
August	428	6	103	.140	.16	B.
September	1,290	13	222	.302	.34	B.
October	.....	.....	.....	.....	.....	.....
November	644	4	147	.200	.22	C.
December	9	4	6.5	.0088	.01	D.

NOTE.—See footnote to table of daily discharge.

BEAUCOUP CREEK NEAR PINCKNEYVILLE, ILL.

Location.—At Illinois Central Railroad bridge about 1½ miles east of Pinckneyville, Ill., about 10 miles above the mouth of Galum Creek.

Records available.—June 17, 1908, to September 30, 1912; November 30 to December 31, 1912, when station was finally discontinued. The gage readings for 1908 were taken whenever the observer happened to be in the vicinity of the gage. Except for a few days, fairly accturae results will probably be obtained if the missing gage heights are interpolated.

Drainage area.—227 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Practically permanent except at low stages.

Discharge measurements.—Made from downstream side of wooden trestle; low-water measurements made at wading section about 250 yards upstream.

Floods.—The flood of 1902 reached a height of about 27.5 feet, referred to the present gage.

Winter flow.—Ice sometimes affects the relation between gage height and discharge during parts of December, January, and February.

Remarks.—The creek goes dry at times, the water then standing in pools near the gage.

The following discharge measurement was made at wading section above bridge by P. S. Monk:

August 8, 1912: Gage height, 2.12 feet; discharge, 2.3 second-feet.

Daily gage height, in feet, of Beaucoup Creek near Pinckneyville, Ill., for 1912.

[R. C. Huggins, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.5	2.84	7.5	5.5	4.5	2.65	2.24	3.25	2.36	.....	2.40	1.95
2	4.2	2.66	7.4	12.0	3.8	.....	2.22	2.00	2.20	.....	6.4	1.98
3	3.6	.....	.....	15.0	3.35	2.45	4.8	.....	2.05	.....	3.6	1.96
4	3.1	2.98	5.2	12.0	3.05	2.90	4.4	2.29	2.00	.....	2.87	1.98
5	2.90	.....	4.1	.....	2.86	2.56	2.52	2.20	1.95	.....	2.62	2.00
6	2.80	.....	3.65	4.5	2.74	2.41	11.0	2.17	1.90	.....	3.4	1.97
7	2.70	.....	4.0	3.95	2.61	2.27	10.2	2.04	1.90	.....	3.4	.....
8	2.70	.....	4.9	3.5	2.54	2.25	4.9	2.05	1.90	.....	4.2	1.90
9	2.38	.....	5.1	3.25	2.46	2.21	3.45	2.12	1.90	.....	3.2	1.89
10	2.34	.....	7.6	2.97	2.45	2.14	2.74	.....	1.85	.....	3.0	.....
11	[a] 2.34	.....	.....	2.96	3.35	2.13	3.95	2.13	1.62	.....	2.45	1.90
12	[a] 2.34	.....	7.8	2.84	14.8	2.12	3.25	3.0	1.60	.....	2.40	1.90
13	.....	.....	8.9	4.3	11.3	2.07	3.35	4.9	.....	.....	2.31	1.89
14	2.29	2.43	11.8	5.4	4.8	2.05	3.05	2.25	.....	.....	2.28	1.87
15	.....	.....	16.3	3.75	3.75	2.15	2.36	3.1	.....	.....	3.3	1.87
16	.....	.....	17.3	3.35	2.41	3.1	2.32	3.1	1.80	.....	2.70	1.84
17	.....	2.43	17.8	2.97	3.7	9.2	2.24	2.10	1.84	.....	2.34	.....
18	.....	2.58	17.1	3.35	3.75	13.3	2.15	2.14	1.82	.....	2.28	.....
19	13.2	2.88	15.4	3.85	.....	8.2	3.35	2.30	.....	.....	2.30	1.89
20	15.0	3.2	11.0	3.3	2.77	5.1	2.74	2.20	.....	.....	2.28	1.90
21	12.5	.....	9.8	2.96	2.58	4.5	.....	4.3	1.98	.....	2.20	1.90
22	7.2	3.5	13.0	2.94	2.51	3.5	11.0	3.2	1.95	.....	2.15	.....
23	7.6	3.65	7.7	2.78	2.37	2.45	5.1	2.89	2.00	.....	2.18	.....
24	9.5	.....	9.0	2.71	2.36	2.56	3.55	2.59	2.00	.....	2.16	1.90
25	9.1	5.5	11.0	2.61	5.4	2.55	2.23	.....	2.01	.....	2.15	1.90
26	7.0	16.1	12.0	13.8	.....	2.38	2.44	2.60	.....	.....	2.10	.....
27	5.6	20.1	7.8	19.0	2.27	2.27	2.24	5.2	.....	.....	2.05	1.89
28	5.4	19.8	6.8	18.2	4.6	.....	2.22	3.6	1.90	.....	1.98	1.90
29	5.3	17.4	15.0	10.2	7.4	2.64	8.2	2.65	1.98	.....	1.95	1.95
30	4.8	.....	17.5	6.3	5.3	2.32	3.05	2.60	2.00	.....	1.90	.....
31	3.85	.....	.....	.....	3.2	.....	3.0	2.56	.....	.....	.....	1.90

[a] Gage height to top of ice.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 5 to 18 and Feb. 3 to 16. Observer reported ice about 4 inches thick from Jan. 14 to Feb. 14.

Daily discharge, in second-feet, of Beaucoup Creek near Pinckneyville, Ill., for 1912.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	272	25	363	187	112	17	4.8	42	7.2	.....	8	1.8
2	92	17	353	900	70	a 13	4.4	2.1	4.0	.....	263	2.0
3	60	.....	a 258	1,320	48	9.5	133	a 4.0	2.4	.....	60	1.9
4	35	.....	163	900	33	27	105	5.8	2.1	.....	24	2.0
5	.....	.....	86	a 506	25	13	12	4.0	1.8	.....	16	2.1
6	.....	.....	62	112	21	8.3	770	3.6	1.5	.....	50	1.9
7	.....	.....	80	78	15	5.4	666	2.4	1.5	.....	50	a 1.7
8	.....	.....	140	55	13	5.0	140	2.4	1.5	.....	92	1.5
9	.....	.....	155	42	10	4.2	52	3.0	1.5	.....	40	1.4
10	.....	.....	373	30	9.5	3.3	21	a 3.1	1.2	.....	31	a 1.4
11	.....	.....	a 383	29	48	3.2	78	3.2	.6	.....	9.5	1.5
12	.....	.....	393	25	1,290	3.0	42	31	.6	.....	8	1.5
13	.....	.....	512	98	809	2.6	48	140	a .7	.....	6.2	1.4
14	.....	.....	874	179	133	2.4	33	5	a .8	.....	5.6	1.4
15	.....	.....	1,500	68	68	3.4	7.2	35	a .9	.....	45	1.4
16	.....	.....	1,640	48	8.3	35	6.4	35	1.0	.....	19	1.2
17	.....	9	1,710	30	65	545	4.8	2.8	1.2	.....	6.8	a 1.3
18	.....	14	1,610	48	68	1,080	3.4	3.3	1.1	.....	5.6	a 1.3
19	1,070	26	1,380	72	a 45	435	48	6	a 1.4	.....	6	1.4
20	1,320	40	770	45	22	155	21	4	a 1.7	.....	5.6	1.5
21	970	a 48	616	29	14	112	a 396	98	2.0	.....	4	1.5
22	335	55	1,040	29	11	55	770	40	1.8	.....	3.4	a 1.5
23	373	62	383	22	7.4	9.5	155	27	2.1	.....	3.8	a 1.5
24	580	a 124	523	19	7.2	13	58	15	2.1	.....	3.5	1.5
25	534	187	770	15	179	13	4.6	a 15	2.2	.....	3.4	1.5
26	317	1,470	900	1,150	a 92	7.6	9.2	15	a 2.0	.....	2.8	a 1.4
27	195	2,030	393	1,880	5.4	5.4	4.8	163	a 1.8	.....	2.4	1.4
28	179	1,990	299	1,770	119	a 11	4.4	60	1.5	.....	2.0	1.5
29	171	1,660	1,320	666	353	17	435	17	2.0	.....	1.8	1.8
30	133	.....	1,670	254	171	6.4	33	15	2.1	.....	1.5	a 1.6
31	72	.....	a 928	.....	40	.....	31	13	.....	.....	.....	1.5

a Discharge interpolated.

NOTE.—Daily discharge computed from a rating curve fairly well defined between 2 and 900 second-feet (gage heights, 2.0 and 12.0 feet). Below 40 second-feet (gage height 3.2 feet) differs from that used 1908–1911, the revision being based on the discharge measurement made Aug. 8, 1912. Discharge Jan. 5 to 18 and Feb. 3 to 16 estimated, because of ice, from gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas: Jan. 5 to 18, 5 second-feet; Feb. 3 to 16, 8 second-feet. These estimates of discharge for periods when the relation of gage height to discharge is believed to have been affected by ice are based on insufficient data and therefore should be used with caution.

Monthly discharge of Beaucoup Creek near Pinckneyville, Ill., for 1912.

[Drainage area, 227 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	219	0.965	1.11	D.
February	2,030	.....	271	1.19	1.28	D.
March	1,710	62	698	3.07	3.54	C.
April	1,880	15	354	1.56	1.74	B.
May	1,290	5.4	126	.555	.64	B.
June	1,080	2.4	87.3	.385	.43	C.
July	770	3.4	132	.581	.67	B.
August	163	2.1	26.3	.116	.13	B.
September	7.2	.6	1.81	.0080	.01	D.
October	.....	.....	.....	.....	.....	
November	263	1.5	26.0	.115	.13	C.
December	2.1	1.2	1.56	.0069	.01	D.

NOTE.—See footnote to table of daily discharge.

MISCELLANEOUS MEASUREMENTS.

Miscellaneous measurements in Hudson Bay and upper Mississippi drainage basins in 1912.

St. Mary River (Mont.) drainage basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Mar. 19	Swiftcurrent Creek	St. Mary River	McDermott Lake, Mont	.....	10.8
June 7	Kennedy Creek	do	Babb, Mont	.....	179
Aug. 16	do	do	do	.....	55

Red River (Minn.) drainage basin.

May 6[a]	Bois de Sioux River.	Red River	Breckenridge, Minn., about 300 feet above junction with Ottertail River.	.....	48
6[a]	Ottertail River	do	Breckenridge, Minn., about 300 feet above junction with Bois de Sioux River.	.....	590

Upper Mississippi River drainage basin.

Feb. 12	Mississippi River	Gulf of Mexico	Washington Avenue Bridge, Minneapolis, Minn.	.....	2,380
Sept. 4	do	do	Winona, Minn	5.48	27,800
July 18	Blue Earth River	Minnesota River	Rapidan Mills, Minn	1.59	262

[a] Measurement made by S. B. Soulé.

SUMMARY OF MEAN DISCHARGE PER SQUARE MILE.

The following summary of discharge per square mile is given to allow ready comparison of relative rates of run-off from different areas in the Hudson Bay and upper Mississippi drainage basins. It shows in a general way the seasonal distribution of run-off and the effect of snow, ground, surface, and storage—both artificial and natural. It will be noted that "second-feet per square mile" and "run-off (depth in inches)" have been omitted in this report for certain stations for which such values have heretofore been published, in general, because they were deemed misleading in that they did not represent the rate of run-off for the entire drainage area above the gaging station or that the drainage area was not uniformly productive of run-off and therefore not at all comparable with other areas. The special reasons for not publishing these data are given in each case with the data published for the station.

With regard to the values that are published, the most noteworthy fact is the almost entire lack of uniformity or agreement between any two streams, which indicates that the discharge of each stream is a law unto itself and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible.

Summary of discharge, in second-feet per square mile, in Hudson Bay and upper Mississippi River drainage basins for 1912.

Station.	Drainage area.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	Sq. mi.													
St. Mary River near Babb, Mont.	177	0.37	0.34	0.28	0.89	5.53	7.68	5.20	3.16	1.81	1.14	1.23	0.71	2.37
St. Mary River below Swiftcurrent Creek, at Babb, Mont.	298	.33	.34	.26	1.26	5.34	6.68	4.90	2.60	1.55	1.14	1.18	.66	2.19
St. Mary River near Cardston, Alberta	452	.29	.26	.24	1.20	4.49	5.20	3.50	1.96	1.16	.94	.96	.55	1.73
Swiftcurrent Creek at McDermott Lake, Mont.	31.4							7.32	4.01	2.79	2.20			
Swiftcurrent Creek at Sherburne Lake, Mont.	64							5.84	2.74	1.88	1.46	1.44	.97	
Ottertail River near Fergus Falls, Minn.	1,310	.06	.05	.05	.14	.22	.25	.21	.16	.16	.15	.15	.12	.14
Vermilion River below Lake Vermilion, near Tower, Minn.	507	.25	.23	.19	.23	.97	.90	.41	.21	.22	.22	.20	.20	.35
Little Fork River at Little Fork, Minn.	1,720	.05	.04	.04	.66	1.32	.34	.18	.08	.43	.31	.18	.09	.31
Crow Wing River at Nimrod, Minn.	1,010					.46	.33	.24	.32	.40	.40	.32		
Crow Wing River at Pillager, Minn.	3,230	.11	.10	.12	.42	.82	.32	.20	.23	.23	.22	.17	.14	.26
Long Prairie River near Motley, Minn.	975	.11	.10	.12	.31	.87	.35	.18	.27	.22	.17	.13	.10	.24
Sauk River near St. Cloud, Minn.	816	.07	.04	.10	.33	1.32	.28	.11	.23	.19	.20	.11	.10	.26
Elk River near Big Lake, Minn.	615	.10	.08	.15	.92	2.15	.47	.24	.27	.33	.24	.19	.15	.44
Crow River at Rockford, Minn.	2,520	.02	.03	.15	.37	.82	.25	.16	.36	.24	.11	.07	.06	.22
South Fork Crow River near Rockford, Minn.	1,160	.02	.01	.10										
Minnesota River near Odessa, Minn.	1,560	(a)	(a)	.01	.09	.06	.02	.04	.03	.02	.02	.02	.02	.03
Minnesota River near Montevideo, Minn.	6,300	(a)	(a)	.01	.10	.29	.07	.04	.02	.02	.02	.02	.02	.05
Minnesota River near Mankato, Minn.	14,600	.02	.02	.10	.29	.29	.10	.06	.04	.03	.02	.02	.02	.08
Whetstone River near Big Stone, S. Dak.	441				.23	.16	.04	.05	.01	.01	.01	.01		
Lac qui Parle River at Lac qui Parle, Minn.	838	(a)	(a)	.01	.10	.45	.09	.02	.02	.01	.01	.01	.01	.06
Chippewa River near Watson, Minn.	1,940	(a)	(a)	.01	.15	.45	.08	.03	.03	.02	.03	.03	.02	.07
Redwood River near Redwood Falls, Minn.	703	(a)	(a)	.01	.08	.14	.03	.02	.01	.01	.03	.03	.01	.03
Cottonwood River near New Ulm, Minn.	864	.02	.02	.10	.27	.14	.06	.04	.03	.02	.02	.02	.02	.06
St. Croix River near St. Croix Falls, Wis.	5,930	.25	.24	.26	1.16	1.65	.60	.30	.29	.35	.31	.26	.25	.49
Kettle River near Sandstone, Minn.	825	.16	.11	.12	1.81	3.08	.74	.21	.18	.19	.14	.10	.10	.58
Snake River at Mora, Minn.	422	.07	.08	.10	1.79	2.82	.47	.12	.12	.13	.09	.08	.08	.50
Zumbro River at Zumbro Falls, Minn.	1,390	.18	.17	.71	.86	.61	.21	.22	.17	.14	.14	.15	.13	.31
South Branch of Zumbro River near Zumbro Falls, Minn.	821	.20	.18	1.07	1.13	.89	.28	.26	.18	.19	.15	.15	.13	.40
Root River near Houston, Minn.	1,560	.31	.26	.80	1.00	.67	.36	.53	.29	.26	.27	.26	.21	.44
North Branch of Root River near Lanesboro, Minn.	647	.28	.23	1.27	1.38	.93	.36	.45	.26	.25	.25	.25	.20	.51
Wapsipinicon River at Stone City, Iowa.	1,310	.15	.12	.76	2.20	.36	.18	.12	.39	.25	.26	.20	.14	.42
Cedar River near Austin, Minn.	425	.16	.11	1.20	1.46	.37	.17	.67	.15	.10	.12	.13	.06	.39
Cedar River at Cedar Rapids, Iowa.	6,320	.37	.41	1.34	2.03	.52	.26	.23	.24	.21	.20	.16	.13	.51
Des Moines River at Jackson, Minn.	1,160				.25	.12	.03	.01	.02	.01	.01	.01		
Des Moines River at Keosauqua, Iowa.	14,300				1.30	.44	.24	.12	.08	.12	.18	.10		
Sangamon River near Monticello, Ill.	550	.56	.84	3.89	2.35	1.93	.26	.58	.14	.04		.32	.10	
Sangamon River at Riverton, Ill.	2,560	.88	.68	2.98	2.60	2.21	.48	.29	.16	.07	.07	.14	.08	.89
South Fork of Sangamon River near Taylorville, Ill.	427	.47	.79	2.76	1.95	1.50	.28	.24	.18	.04		.12	.08	
Salt Creek near Kenney, Ill.	459	.51	.79	2.92	2.37	1.79	.22	.42	.08	.03		.48	.13	
Cahokia Creek near Poag, Ill.	259	.19	1.18	3.51										

a Discharge per square mile less than 0.005 second-feet.

Summary of discharge, in second-feet per square mile, in Hudson Bay and upper Mississippi River drainage basins for 1912—Continued.

Station.	Drainage area.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	Sq. mi.													
Kaskaskia River near Arcola, Ill.	390	0.50	0.56	1.90	2.20	2.07	0.68	0.32	0.17	0.03	.....	0.01	(a)	.....
Kaskaskia River at Shelbyville, Ill.	1,030	.83	1.21	3.98	2.87	1.80	.43	.37	.32	.10	.....	.09	0.06	.....
Kaskaskia River at Vandalia, Ill.	1,980	.52	.72	2.54	2.12	1.30	.47	.54	.24	.14	.....	.05	.04	.....
Kaskaskia River at Carlyle, Ill.	2,680	.59	.60	2.89	2.37	1.64	.44	.61	.36	.11	.....	.05	.02	.....
Kaskaskia River at New Athens, Ill.	5,220	.56	.53	3.70	3.74	2.16	.82	.69	.31	.08	.....	.07	.04	.....
Shoal Creek near Breese, Ill.	760	.43	.69	3.53	2.95	1.29	.32	.36	.09	.05	.....	.08	.05	.....
Silver Creek near Lebanon, Ill.	335	.38	1.03	3.16	2.51	.96	1.07	.96	.30	.04	.....	.08	.02	.....
Big Muddy River near Cambon, Ill.	735	.77	.89	4.63	2.87	1.51	1.62	.42	.14	.30	.....	.20	.01	.....
Beaucoup Creek near Pinckneyville, Ill.	227	.96	1.19	3.07	1.56	.56	.38	.58	.12	.01	.....	.12	.01	.....

(a) Discharge per square mile less than 0.005 second-feet.

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