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

WATER-SUPPLY PAPER 305

SURFACE WATER SUPPLY OF THE UNITED STATES

1911

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

ROBERT FOLLANSBEE, A. H. HORTON
AND H. J. JACKSON

WASHINGTON
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SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER, 1911.

By ROBERT FOLLANSBEE, A. H. HORTON, and H. J. JACKSON.

AUTHORITY FOR INVESTIGATIONS.

This volume is Part V of a series of 12 reports presenting results of measurements of flow made on certain streams in the United States during the calendar year 1911. The reports are listed below:

Papers on surface water supply of the United States, 1911.

Part.[a]	No.	Title.	Part.[a]	No.	Title.
I	301	North Atlantic coast.	VI	306	Missouri River basin.
II	302	South Atlantic coast and eastern Gulf of Mexico.	VII	307	Lower Mississippi River basin.
			VIII	308	Western Gulf of Mexico.
III	303	Ohio River basin.	IX	309	Colorado River basin.
IV	304	St. Lawrence River basin.	X	310	Great Basin.
V	305	Upper Mississippi River and Hudson Bay basins.	XI	311	Pacific coast in California.
			XII	312	North Pacific coast.

[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.

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 year ending June 30—

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 various private and State organizations have cooperated. Acknowledgments for such cooperation are made on page 15, and also in connection with the description of each station affected by the cooperative work.

PUBLICATIONS.

Measurements of stream flow have been made at more than 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 1911 gaging stations were maintained by the Survey and the cooperating organizations at about 1,500 points in the United States, 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 surface water-supply papers from time to time. A complete list of the gaging stations maintained by the Survey to and including 1910 and a list of the papers relating to the water supply of the country has been published by the Survey as Water-Supply Paper 280. An index to the reports containing stream-flow measurements prior to 1904 has been published as Water-Supply Paper 119.

For each calendar year there has been prepared a report embodying the stream-flow data collected during that year, which has been published either as a part of the annual report of the Director, as a bulletin, or as a water-supply paper, as shown by 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, meaurements, 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.

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

Report.	Character of data.	Year.
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 201 to 214	Complete data, except descriptions	1906.
WS 241 to 252	Complete data	1907–8.
WS 261 to 272	do	1909.
WS 281 to 292	do	1910.
WS 301 to 312	do	1911.

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 Machias River at Whitneyville, Me., 1903 to 1911, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, and 301, which contain records for the New England streams from 1903 to 1911.

Numbers of water-supply papers containing results of stream measurements, 1899–1911.

	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] 72, 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	[j] 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

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[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.
[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.

Numbers of water-supply papers containing results of stream measurements, 1899–1911—Continued.

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

[a] New England rivers only.
[b] Hudson River to Delaware River, inclusive.
[c] Susquehanna River to Yadkin River inclusive.
[d] Tributaries of Mississippi from east.
[e] Below junction with Gila.
[f] Great Basin in California, excepting Truckee and Carson drainage basin.
[g] Rogue, Umpqua, and Siletz rivers only.

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 depth 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 (second-feet per square mile).	Run-off (depth 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 (second-feet).	Run-off (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 the 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 mile 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.
1½ 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 so far as available, 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

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MAP OF UNITED STATES, SHOWING MEAN ANNUAL RUN-OFF

Blue lines and figures indicate average annual run-off in depth in inches

Prepared by Henry Gannett
mainly from data of the
United States Geological Survey

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

MAP OF UNITED STATES, SHOWING MEAN ANNUAL PRECIPITATION

Blue lines and figures indicate average annual precipitation in depth in inches

Prepared by Henry Gannett
mainly from data of the
United States Geological Survey
and United States Weather Bureau

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 arbitrary 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, as follows:

First plot the discharge measurements for the current and earlier years on cross-section paper, with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage-height table for the complete range of stage given and the corresponding discharges for the days selected from the daily discharge table and plot the values on cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant, except for known backwater periods.

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 at "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 10, are based.

The field methods used in the collection of the data presented in this series of reports are described in the introductory sections of Water-Supply Papers 261 to 272, inclusive, "Surface water supply of the United States, 1909." Plates I and II show the average precip-

itation and run-off in the United States as determined from the measurements of stream flow made by the Geological Survey and records of rainfall collected by the Weather Bureau; Plate III shows typical gaging stations indicating the method of suspending the current meter; Plate IV shows current meters[1] 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.

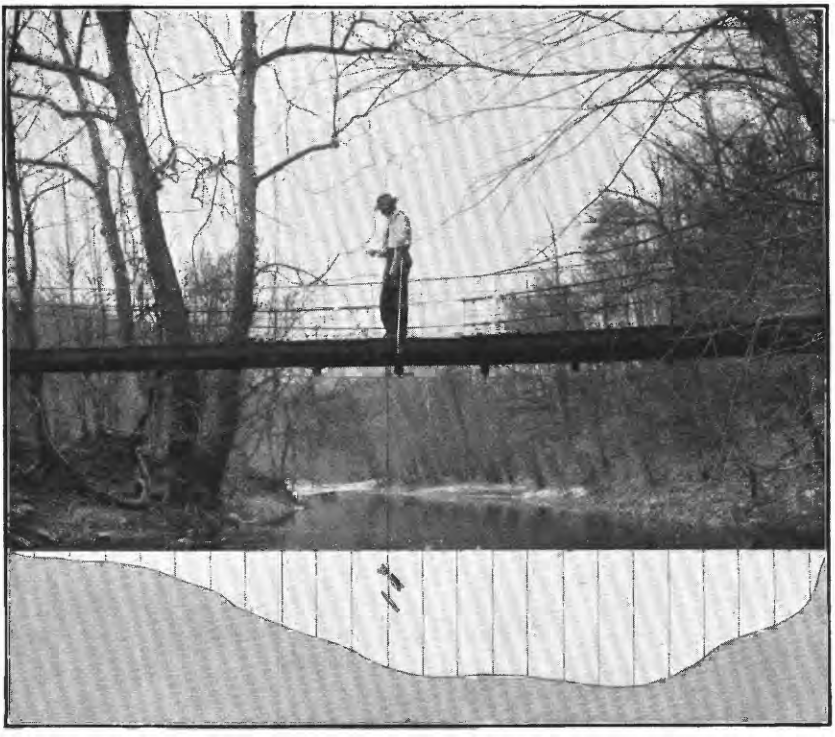
Errors of the second class are due, first, to errors in observation of stage; second, to errors in measurements of flow; and, third, to errors due to misinterpretation of stage and flow data.

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.

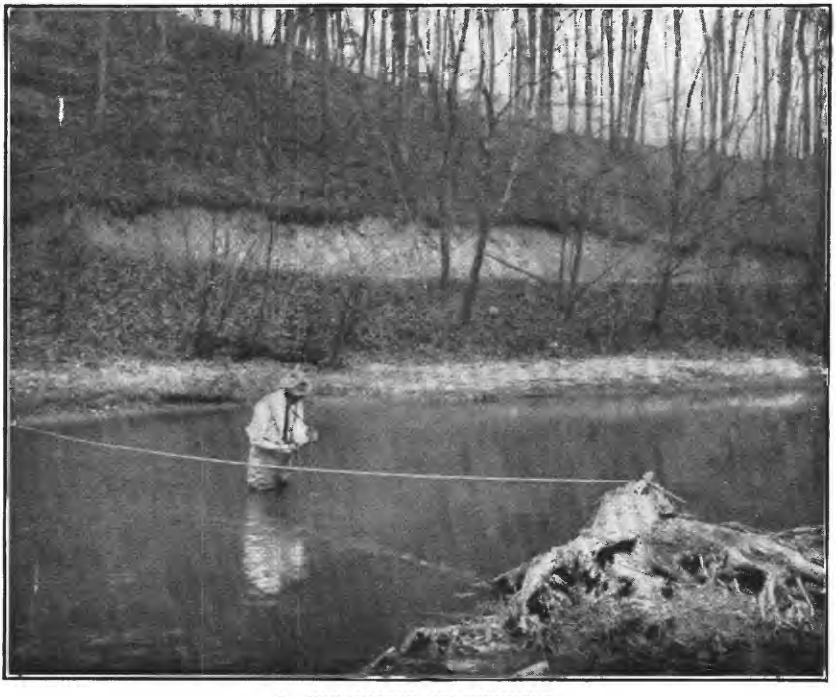
The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, the probable reliability of the observer, and knowledge of local conditions. In this column, A indicates that the 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 run-off 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.

[1] See Hoyt, J. C., and others, Use and care of current meter as practiced by the United States Geological Survey: Trans. Am. Soc. Civil Eng., vol. 66, 1910, p. 70.

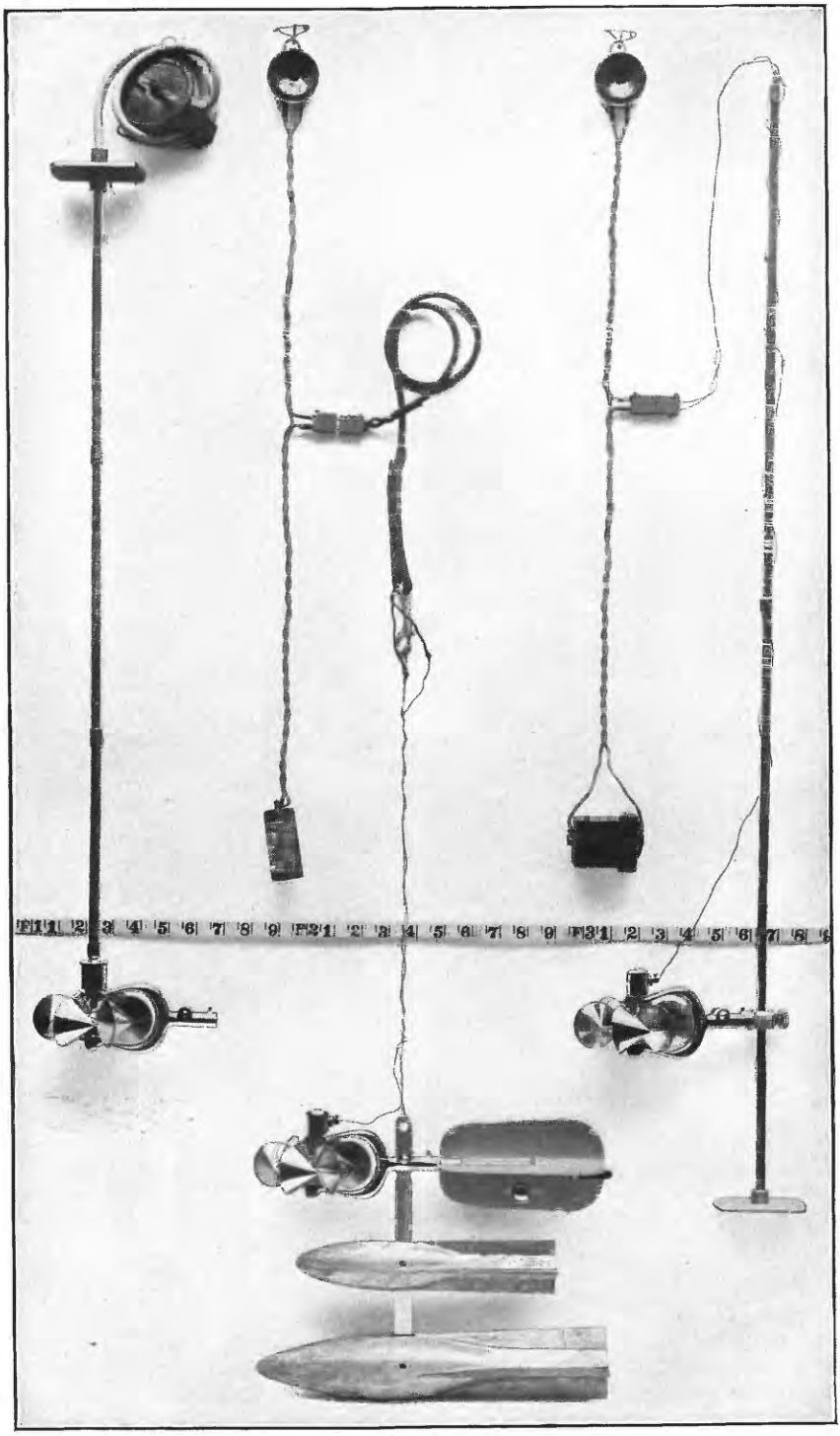


A. FOR BRIDGE MEASUREMENT.



B. FOR WADING MEASUREMENT.

TYPICAL GAGING STATIONS.



SMALL PRICE CURRENT METERS.

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 AND ACKNOWLEDGMENTS.

Assistance has been rendered or records furnished by the following, to whom special acknowledgments are due:

United States Engineer Corps, for records of flow from reservoirs in the Upper Mississippi Basin.

United States Reclamation Service, for maintenance of stations in the St. Mary Basin.

United States Weather Bureau, for records of gage heights at St. Paul, Mankato, Chippewa Falls, Cedar Rapids, and other points.

Minnesota & Ontario Power Co., and Canadian Department of Public Works, for cooperation in the maintenance of the station at International Falls.

St. Anthony Falls Water Power Co., for records of the Mississippi at Minneapolis.

Minneapolis General Electric Co., for records of flow of the St. Croix River near St. Croix Falls, Wis.

Kettle River Co., for cooperation in the maintenance of the Sandstone station.

Wisconsin Valley Improvement Co., for gage-height records at Rhinelander, Merrill, and Necedah.

Chippewa Valley Railway Light & Power Co., for gage-height records of Red Cedar River at Chippewa Falls, Wis.

Chippewa Lumber & Boom Co., for records of gage heights at Chippewa Falls, Wis.

Mr. F. Dearborn, for gage records at Stone City, Iowa.

Iowa State Geological Survey, G. F. Kay, director, for cooperation in the maintenance of gaging stations at Cedar Rapids, Fort Dodge, Keosauqua, and Iowa Falls.

East Side Levee and Sanitary District of East St. Louis, Ill., for records on Cahokia Creek.

Work in Minnesota during 1911 has been done with State cooperation under the terms of an act of the legislature in 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 said 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 cooperates in stream-gaging work in that State, the appropriation being under the control of the Internal Improvement Commission, Isham Randolph, chairman, and, when that commission expired, of the Rivers and Lakes Commission, Robert R. McCormick, chairman.

DIVISION OF WORK.

The field data for the Hudson Bay drainage basin, except in Montana, were collected under the direction of Robert Follansbee, district engineer, St. Paul, Minn., from January 1 to November 1, and by W. G. Hoyt, district engineer, St. Paul, Minn., after November 1, assisted by E. F. Chandler, S. B. Soulé, and C. R. Adams, and in Montana under the direction of W. A. Lamb, district engineer, Helena, Mont., assisted by E. F. Chandler, B. E. Jones, George Ebner, and Goric Monley.

The field data for the upper Mississippi drainage basin, except in Illinois, were collected under the direction of Robert Follansbee, district engineer, St. Paul, Minn., from January 1 to November 1, inclusive, and by W. G. Hoyt, district engineer, St. Paul, Minn., after November 1, assisted by S. B. Soulé, C. J. Emerson, and C. R. Adams, and in Illinois under the direction of A. H. Horton, district engineer, Newport, Ky., assisted by C. T. Bailey and P. S. Monk.

The ratings, special estimates, and studies of the completed data were made by Robert Follansbee, A. H. Horton, R. H. Bolster, W. A. Lamb, W. G. Hoyt, H. J. Jackson, and E. F. Chandler.

The completed data were prepared for publication under the direction of R. H. Bolster, hydraulic engineer, by Robert Follansbee, and H. J. Jackson.

The computations were made under the direction of Robert Follansbee, R. H. Bolster, and H. J. Jackson, by H. D. Padgett, A. H. Tuttle, H. J. Dean, G. K. Larrison, O. De Carre, A. McMillan, C. L. Batchelder, W. R. King, and M. I. Walters.

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

HUDSON BAY DRAINAGE AREA IN THE UNITED STATES.

ST. MARY RIVER BASIN.

ST. MARY RIVER NEAR BABB, MONT.

Location.—Near dam site 1 mile below the outlet of Lower St. Mary Lake and 1 mile above the mouth of Swiftcurrent Creek.

Records available.—April 9, 1902, to December 31, 1911. The records for this station were published in Water Supply Papers Nos. 85 and 100 as "St. Mary River dam site," and in Water Supply Paper No. 130 as "St. Mary River at St. Mary."

Drainage area.—177 square miles.

Gage.—Chain gage on the right bank of the stream; datum unchanged since establishment.

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.

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

Discharge measurements of St. Mary River near Babb, Mont., 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 14	W. A. Lamb	0.93	[a] 79
May 3	B. E. Jones	2.25	515
7	do	2.80	797
June 5	do	4.22	1,840
23	W. A. Lamb	4.52	2,140
July 17	do	3.03	990
Aug. 25	B. E. Jones	2.06	443
Oct. 12	do	1.82	332
Dec. 8	do	1.00	[b] 86

[a] Some ice at gage. Gage height taken with level; measurement made by wading.
[b] Measurement made from bridge at United States Reclamation Service camp.

Daily gage height, in feet, of St. Mary River near Babb, Mont., for 1911.

[Carl Giruin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.55	1.35	1.05	0.95	2.2	2.8	3.8	2.55	1.9	2.3	1 35	1.0
2	.65	1.35	1.05	.95	2.2	3.3	3.7	2.5	1.9	2.25	1.35	1.0
3	.85	1.25	1.05	1.05	2.2	3.4	3.4	2.5	1.9	2.25	1.3	1.0
4	.75	1.25	.95	1.05	2.3	4.0	3.5	2.4	2.2	2.2	1.3	1.0
5	.75	1.25	1.05	1.05	2.4	4.3	3.5	2.3	2.3	2.2	1.3	1.0
6	.75	1.15	1.05	1.05	2.5	4.4	3.5	2.3	2.5	2.15	1.3	1.0
7	.75	1.05	.95	1.05	2.8	4.3	3.5	2.35	2.5	2.1	1.3	1.0
8	.85	.95	.95	1.05	2.95	4.2	3.4	2.4	2.45	2.0	1.2	1.0
9	.95	.95	.95	1.05	3.0	4.2	3.3	2.4	2.4	1.95	1.2	1.0
10	1.05	.85	.95	1.05	3.1	4.2	3.2	2.4	2.4	1.85	1.1	.85
11	1.05	.85	.95	1.05	3.2	4.2	3.1	2.4	2.45	1.8	1.1	.85
12	1.15	.85	.95	1.05	3.1	4.3	3.1	2.35	2.45	1.8	1.0	.8
13	1.15	.75	.95	1.05	3.1	4.6	3.0	2.3	2.5	1.8	.9	.8
14	1.15	[a] .25	.95	1.05	3.1	4.7	3.0	2.3	2.5	1.75	.9	.8
15	1.15	.75	.85	1.05	3.2	4.8	3.0	2.3	2.5	1.75	.9	.75
16	1.05	.85	.85	1.05	3.6	4.9	3.0	2.25	2.5	1.7	1.0	.7
17	1.05	.95	.85	1.15	3.7	4.8	3.0	2.25	2.5	1.7	1.1	.65
18	1.05	.95	.85	1.15	3.7	4.8	3.0	2.2	2.5	1.7	1.2	.65
19	1.05	1.05	.85	1.15	3.7	4.8	3.0	2.2	2.5	1.65	1.2	.65
20	1.15	1.05	.85	1.15	3.6	4.7	3.0	2.2	2.45	1.6	1.2	.65
21	1.15	1.05	.85	1.25	3.6	4.4	2.95	2.2	2.45	1.6	1.25	.65
22	1.15	1.05	.85	1.25	3.5	4.6	2.9	2.15	2.4	1.55	1.2	.65
23	1.25	1.15	.85	1.35	3.3	4.6	2.8	2.15	2.45	1.5	1.2	.65
24	1.25	1.15	.95	1.45	3.3	4.7	2.8	2.1	2.5	1.5	1.2	.65
25	1.15	1.05	.95	1.45	3.2	4.6	2.8	2.1	2.55	1.5	1.2	.65
26	1.25	.95	.95	1.45	3.2	4.5	2.75	2.1	2.5	1.5	1.2	.65
27	1.25	.95	.95	1.65	3.2	4.3	2.7	2.1	2.5	1.5	1.1	.65
28	1.25	1.05	.95	1.85	3.1	4.1	2.65	2.15	2.45	1.5	1.1	.65
29	1.25	.....	.95	1.95	2.9	4.0	2.6	2.1	2.4	1.5	1.0	.65
30	1.35	.....	.95	1 95	2.8	4.0	2.6	2.0	2.35	1.45	1.0	.65
31	1.35	.....	.95	.....	2.7	.....	2.6	1.95	.....	1.35	.....	.65

[a] Feb. 14.—Extremely low stage due to water being held back by ice at outlet of St. Mary Lake at time of observation; mean gage height for day probably greater.

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 10 to Feb. 7 and Feb. 19 to Mar. 3.

Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	22	.....	.....	80	500	815	1,520	675	370	550	182	90
2	33	.....	.....	80	500	1,130	1,440	650	370	525	182	90
3	62	.....	.....	102	500	1,200	1,200	650	370	525	167	90
4	46	.....	80	102	550	1,680	1,280	600	500	500	167	90
5	46	.....	102	102	600	1,920	1,280	550	550	500	167	90
6	46	.....	102	102	650	2,010	1,280	550	650	475	167	90
7	46	.....	80	102	815	1,920	1,280	575	650	450	167	90
8	62	80	80	102	905	1,840	1,200	600	625	410	139	90
9	80	80	80	102	935	1,840	1,130	600	600	390	139	90
10	.....	62	80	102	995	1,840	1,060	600	600	350	113	62
11	.....	62	80	102	1,060	1,840	995	600	625	330	113	62
12	.....	62	80	102	995	1,920	895	575	625	330	90	53
13	.....	46	80	102	995	2,190	935	550	650	330	70	53
14	.....	4	80	102	995	2,280	935	550	650	312	70	53
15	.....	46	62	102	1,060	2,370	935	550	650	312	70	46
16	.....	62	62	102	1,360	2,460	935	525	650	295	90	39
17	.....	80	62	126	1,440	2,370	935	525	650	295	113	33
18	.....	80	62	126	1,440	2,370	935	500	650	295	139	33
19	.....	.....	62	126	1,440	2,370	935	500	650	278	139	33
20	.....	.....	62	126	1,360	2,280	935	500	625	262	139	33
21	.....	.....	62	153	1,360	2,010	905	500	625	262	153	33
22	.....	.....	62	153	1,280	2,190	875	475	600	246	139	33
23	.....	.....	62	182	1,130	2,190	815	475	625	229	139	33
24	.....	.....	80	213	1,130	2,280	815	450	650	229	139	33
25	.....	.....	80	213	1,060	2,190	815	450	675	229	139	33
26	.....	.....	80	213	1,060	2,100	785	450	650	229	139	33
27	.....	.....	80	278	1,060	1,920	755	450	650	229	113	33
28	.....	.....	80	350	995	1,760	728	475	625	229	113	33
29	.....	.....	80	390	875	1,680	700	450	600	229	90	33
30	.....	.....	80	390	815	1,680	700	410	575	213	90	33
31	.....	.....	80	.....	755	.....	700	390	.....	182	.....	33

NOTE.—Daily discharge computed from rating curve well defined between 70 and 2,190 second-feet (gage heights 0.9 and 4.6 feet), but poorly defined below 70 second-feet (gage height 0.9 foot). Discharge Jan. 10 to Feb. 7 and Feb. 19 to Mar. 3 estimated, because of ice, from climatologic records. Mean discharge Jan. 10 to Feb. 7 estimated 100 second-feet, varying from about 85 to 130 second-feet. Mean discharge Feb. 19 to Mar. 3 estimated 80 second-feet.

Monthly discharge of St. Mary River near Babb, Mont., for 1911.

[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	.....	22	85.3	0.482	0.56	5,240	D.
February	.....	*a* 4	77.3	.437	.46	4,290	D.
March	102	62	76.2	.431	.50	4,690	B.
April	390	80	154	.870	.97	9,160	A.
May	1,440	500	988	5.58	6.43	60,800	A.
June	2,460	815	1,950	11.0	12.27	116,000	A.
July	1,520	700	991	5.60	6.46	60,900	B.
August	675	390	529	2.99	3.45	32,500	A.
September	675	370	600	3.39	3.78	35,700	A.
October	550	182	330	1.87	2.16	20,300	A.
November	182	70	129	.729	.81	7,680	B.
December	90	33	54.0	.305	.35	3,320	C.
The year	2,460	*a* 4	498	2.81	38.20	361,000	

a Extremely low minimum due to water being held back by ice at outlet of St. Mary Lake Feb. 14.

NOTE.—See footnotes under table of daily discharge.

ST. MARY RIVER BELOW SWIFTCURRENT CREEK, AT BABB, MONT.

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, 1911. The records at this station for 1901 and 1902 were published in Water-Supply Paper 66 as for "St. Mary River at Main, Mont."

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.

Channel.—Liable 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.

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.

Discharge measurements of St. Mary River below Swiftcurrent Creek, at Babb, Mont., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 15	B. E. Jones	3.40	[a] 89
May 4	do	5.13	[b] 1,050
6	do	5.76	[b] 1,520
June 5	do	7.66	[c] 3,210
25	W. A. Lamb	7.60	[c] 3,240
July 19[d]	do	[e] 5.60	[f] 1,340
Aug. 25	B. E. Jones	[e] 4.67	[c] 542
Oct. 12	do	[e] 4.55	500
Dec. 8	do	[e] 3.81	[g] 138

[a] Ice, measurement made by wading.
[b] Measurement made from footbridge.
[c] Measurement made from cable.
[d] July 19, new chain gage installed at different datum from that of gage previously used.
[e] The last four gage heights above were read on the new gage.
[f] Measurement made from cable. New gage installed on opposite side of river. Old gage read 5.65.
[g] Measurement made by wading above gage.

Daily gage height, in feet, of St. Mary River below Swift current Creek, at Babb, Mont., for 1911.

[Carl Giruin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	4.1	3.5	3.5	4.9	6.4	6.7	5.4	4.6	5.0	4.2	3.85
2	4.1	4.1	3.4	3.5	4.9	6.8	6.6	5.4	4.6	4.95	4.2	3.8
3	4.3	4.0	3.4	3.5	5.0	7.2	6.5	5.45	4.6	4.9	4.15	3.8
4	4.3	4.0	3.3	3.5	5.2	7.6	6.6	5.3	5.3	4.85	4.1	3.8
5	4.3	3.9	3.4	3.5	5.4	7.8	6.6	5.3	5.45	4.8	4.1	3.8
6	4.3	3.8	3.5	3.5	5.8	7.4	6.7	5.2	5.4	4.75	4.1	3.8
7	4.3	3.7	3.5	3.5	5.9	7.5	6.7	5.2	5.35	4.7	3.9	3.8
8	4.2	3.6	3.4	3.5	5.9	7.4	6.6	5.25	5.3	4.7	3.85	3.8
9	4.0	3.5	3.4	3.5	6.0	7.4	6.4	5.3	5.3	4.6	3.8	3.8
10	3.8	3.4	3.4	3.5	5.9	7.4	6.2	5.3	5.3	4.6	3.8	3.75
11	3.8	3.4	3.4	3.5	5.8	7.6	5.9	5.25	5.3	4.6	3.8	3.75
12	3.7	3.4	3.3	3.6	5.8	7.7	5.8	5.2	5.3	4.55	3.8	3.7
13	3.7	3.4	3.3	3.6	5.9	7.9	5.7	5.1	5.35	4.55	3.8	3.7
14	3.6	3.3	3.3	3.5	5.9	8.0	5.6	5.1	5.35	4.5	3.9	3.7
15	3.6	3.3	3.3	3.5	6.7	8.0	5.6	5.0	5.35	4.5	4.0	3.65

Daily gage height, in feet, of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1911—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.5	3.4	3.3	3.6	6.8	7.8	5.6	5.0	5.3	4.5	4.1	3.65
17	3.5	3.4	3.3	3.6	6.8	7.8	5.7	5.0	5.3	4.5	4.1	3.6
18	3.5	3.5	3.3	3.6	6.7	7.8	5.7	4.95	5.35	4.45	4.1	3.6
19	3.5	3.5	3.4	3.7	6.6	7.8	5.6	4.95	5.35	4.4	4.1	3.6
20	3.5	3.5	3.4	3.8	6.6	7.7	5.65	4.9	5.3	4.4	4.1	3.6
21	3.5	3.4	3.4	4.0	6.4	7.4	5.6	4.9	5.3	4.4	4.1	3.6
22	3.6	3.4	3.4	4.1	6.4	7.4	5.6	4.85	5.25	4.35	4.1	3.6
23	3.6	3.4	3.4	4.2	6.1	7.4	5.5	4.8	5.3	4.35	4.0	3.6
24	3.7	3.4	3.5	4.4	6.1	7.5	5.5	4.75	5.35	4.35	4.0	3.6
25	3.6	3.4	3.5	4.6	6.0	7.6	5.4	4.7	5.4	4.35	4.0	3.6
26	3.7	3.4	3.5	4.7	5.9	7.3	5.4	4.7	5.35	4.35	4.0	3.6
27	3.8	3.5	3.5	4.8	5.8	7.2	5.35	4.65	5.3	4.35	4.0	3.8
28	3.9	3.5	3.5	4.9	5.7	7.0	5.3	4.65	5.25	4.3	4.0	4.0
29	3.9	.....	3.5	4.9	5.5	6.8	5.3	4.65	5.2	4.3	3.9	4.0
30	4.0	.....	3.5	4.9	5.6	7.0	5.3	4.6	5.1	4.25	3.85	4.0
31	4.1	.....	3.5	.....	5.6	.....	5.35	4.6	.....	4.2	.....	4.0

NOTE.—Relation of gage height to discharge affected by ice Jan. 1 to Mar. 3 and Dec. 26 to 31.

Daily discharge, in second-feet, of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	170	895	2,070	2,340	1,150	512	805	291	152
2	.....	170	895	2,430	2,250	1,150	512	765	291	135
3	.....	170	960	2,800	2,160	1,200	512	725	268	135
4	95	170	1,100	3,180	2,250	1,060	1,060	687	246	135
5	130	170	1,240	3,360	2,250	1,060	1,200	649	246	135
6	170	170	1,560	2,980	2,340	973	1,150	614	246	135
7	170	170	1,640	3,080	2,340	973	1,100	578	168	135
8	130	170	1,640	2,980	2,250	1,020	1,060	578	152	135
9	130	170	1,720	2,980	2,070	1,060	1,060	512	135	135
10	130	170	1,640	2,980	1,890	1,060	1,060	512	135	120
11	130	170	1,560	3,180	1,640	1,020	1,060	512	135	120
12	95	210	1,560	3,270	1,560	973	1,060	482	135	106
13	95	210	1,640	3,460	1,480	888	1,100	482	135	106
14	95	170	1,640	3,560	1,400	888	1,100	451	168	106
15	95	170	2,340	3,560	1,400	805	1,100	451	205	93
16	95	210	2,430	3,360	1,400	805	1,060	451	246	93
17	95	210	2,430	3,360	1,480	805	1,060	451	246	80
18	95	210	2,340	3,360	1,480	765	1,100	422	246	80
19	130	255	2,250	3,360	1,340	765	1,100	394	246	80
20	130	300	2,250	3,270	1,390	725	1,060	394	246	80
21	130	395	2,070	2,980	1,340	725	1,060	394	246	80
22	130	445	2,070	2,980	1,340	687	1,020	368	246	80
23	130	495	1,800	2,980	1,240	649	1,060	368	205	80
24	170	600	1,800	3,080	1,240	614	1,100	368	205	80
25	170	710	1,720	3,180	1,150	578	1,150	368	205	80
26	170	770	1,640	2,890	1,150	578	1,100	368	205	.....
27	170	830	1,560	2,800	1,100	545	1,060	368	205	.....
28	170	895	1,480	2,610	1,060	545	1,020	341	205	.....
29	170	895	1,320	2,430	1,060	545	973	341	168	.....
30	170	895	1,400	2,610	1,060	512	888	316	152	.....
31	170	.....	1,400	.....	1,100	512	.....	291	.....	.....

NOTE.—Daily discharge computed from two rating curves, one, applicable Mar. 4 to July 18, well defined between 130 and 3,270 second-feet; the other, applicable July 19 to Dec. 25, fairly well defined between 135 and 1,340 second-feet.

Discharge Mar. 1 to 3, and Dec. 26 to 31 estimated, because of ice, from climatologic records and records of discharge of adjacent drainage areas.

Mean discharge Mar. 1 to 3, estimated, 95 second-feet.

Mean discharge Dec. 26 to 31, estimated, 65 second-feet.

Monthly discharge of St. Mary River below Swiftcurrent Creek, at Babb, Mont., for 1911.

[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	.....	.....	155	0.520	0.60	9,530	D.
February	.....	.....	140	.470	.49	7,780	D.
March	170	95	130	.436	.50	7,990	B.
April	895	170	358	1.20	1.34	21,300	A.
May	2,430	895	1,680	5.64	6.50	103,000	A.
June	3,560	2,070	3,040	10.2	11.38	181,000	A.
July	2,340	1,060	1,600	5.37	6.19	98,400	B.
August	1,200	512	827	2.78	3.20	50,800	A.
September	1,200	512	1,020	3.42	3.82	60,700	A.
October	805	291	478	1.60	1.84	29,400	A.
November	291	135	208	.698	.77	12,400	A.
December	152	.....	99.5	.334	.39	6,120	C.
The year	3,560	.....	812	2.72	37.02	588,000	

NOTE.—Monthly mean discharge, January and February, estimated because of ice by comparison with record of discharge of St. Mary River above Swiftcurrent Creek near Babb, Mont. See footnotes to table of daily discharge.

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, and about a mile below the mouth of Boundary Creek.

Records available.—September 4, 1902, to December 31, 1911.

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 below the cable. There is 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 months.

Discharge measurements of St. Mary River near Cardston, Alberta, in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 5	B. E. Jones	2.87	1,240
5	....do	2.87	1,280
June 6	....do	5.26	3,260
7	....do	5.14	3,220
24	W. A. Lamb	5.47	3,610
July 18	....do	3.02	1,610
Aug. 26	B. E. Jones	1.75	698
Oct. 13	....do	1.64	610
Dec. 7	....do	*a* .33	223

a Gage height obtained with level; no ice at gage or below gage.

Daily gage height, in feet, of St. Mary River near Cardston, Alberta, for 1911.

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

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	2.55	2.8	0.5	2.4	4.3	4.2	2.5	3.0	2.35	1.05	.....
2	.....	.....	.....	.....	2.4	5.3	.....	2.5	3.0	2.3	1.0	.....
3	.....	.....	.....	.55	2.4	5.7	4.0	2.5	3.0	2.25	1.0	.....
4	.....	2.6	2.85	.5	2.7	5.8	3.9	2.4	3.0	2.2	.95	.....
5	1.45	.....	.....	.6	2.8	5.6	3.9	2.4	2.9	2.15	.9	.....
6	.....	2.65	2.95	.65	3.6	5.25	3.7	2.4	2.9	2.1	.9	.....
7	1.55	.....	.....	.5	3.5	5.2	3.6	2.4	2.9	1.9	.9	0.3
8	.....	2.7	2.95	.55	3.5	5.2	3.5	2.4	2.8	1.95	.85	.2
9	.....	.....	.....	.6	3.5	.....	3.5	2.4	2.8	1.9	.75	.3
10	.....	.....	2.65	.7	3.5	5.0	3.3	2.4	2.7	1.85	.75	.3
11	.....	2.8	.....	.....	3.5	5.5	3.2	2.4	2.7	1.75	.7	.35
12	.....	.....	2.7	.75	3.4	5.7	3.1	2.4	2.6	.....	.75	.35
13	.....	.....	.....	.75	3.6	5.8	3.0	2.5	2.6	1.65	.85	.3
14	.....	2.85	2.85	.75	3.7	5.8	3.0	2.5	2.7	1.65	.8	.2
15	2.3	.....	.....	.8	3.9	5.7	3.0	2.5	2.7	1.55	.85	.1
16	.....	2.9	3.25	.8	5.8	5.6	3.0	2.4	2.8	1.55	.85	.....
17	.....	.....	.....	.95	5.4	5.7	3.0	2.4	2.7	1.45	.8	.3
18	2.55	2.85	.....	1.0	5.1	5.7	3.0	2.4	2.6	1.4	.9	.3
19	.....	.....	3.2	1.25	5.0	5.6	3.0	2.3	2.7	1.4	1.0	.25
20	.....	2.8	.....	1.2	4.6	5.5	3.0	2.2	2.7	1.4	1.05	.25
21	2.45	.....	3.55	2.4	4.3	5.4	3.0	2.0	2.7	1.35	1.0	.2
22	.....	.....	4.0	2.2	4.3	5.2	2.9	2.0	2.8	1.35	.95	.2
23	2.3	2.9	4.05	2.3	.....	5.2	2.9	2.0	2.9	1.3	.95	.3
24	.....	.....	4.15	.....	4.8	5.4	2.7	2.0	2.8	1.3	.95	.3
25	.....	2.85	4.0	2.5	4.9	5.6	2.7	1.85	.....	1.25	.9	.3
26	2.35	.....	3.1	.....	4.9	5.4	2.6	1.8	.....	1.25	.....	.2
27	.....	2.7	3.2	2.6	3.6	5.5	2.6	1.75	2.6	1.25	.....	.15
28	2.4	2.8	3.15	2.5	3.4	4.8	2.6	1.9	2.6	1.15	.....	.....
29	.....	.....	3.0	2.5	3.2	4.8	2.6	2.0	2.5	1.1	.....	.....
30	2.45	.....	2.05	2.4	3.2	4.6	2.5	3.4	2.4	1.1	.....	2.0
31	.....	.....	2.2	.....	3.5	.....	2.5	3.4	.....	1.05	.....	2.2

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 1 to Mar. 31, Nov. 10 to 16, and Dec. 16 to 31. On Mar. 22 the observer reported "Ice going out." Gage heights Dec. 7 to 27 read from temporary iron rod gage driven in bed of stream, and then reduced to regular gage datum.

Daily discharge, in second-feet, of St. Mary River near Cardston, Alberta, for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	177	952	2,380	2,470	1,190	1,440	992	398	310
2	181	952	3,320	2,390	1,190	1,440	963	390	295
3	185	952	3,710	2,310	1,190	1,440	929	390	280
4	177	1,140	3,810	2,230	1,100	1,440	901	371	265
5	193	1,200	3,610	2,230	1,100	1,370	873	351	250
6	203	1,790	3,260	2,070	1,100	1,370	846	351	235
7	177	1,710	3,280	1,990	1,100	1,370	741	351	217
8	185	1,710	3,280	1,930	1,100	1,290	766	344	202
9	193	1,710	3,190	1,930	1,100	1,290	741	308	217
10	213	1,710	3,100	1,770	1,100	1,230	711	280	217
11	219	1,710	3,580	1,700	1,100	1,230	663	240	226
12	225	1,640	3,790	1,640	1,100	1,160	639	210	226
13	225	1,790	3,890	1,580	1,150	1,160	615	200	217
14	225	1,870	3,890	1,580	1,150	1,220	615	210	202
15	237	2,040	3,800	1,580	1,150	1,220	570	240	190
16	237	3,810	3,700	1,580	1,070	1,290	570	280	190
17	283	3,410	3,810	1,580	1,070	1,220	539	347	190
18	300	3,120	3,810	1,580	1,070	1,160	517	387	180
19	398	3,030	3,720	1,580	1,010	1,210	517	426	180
20	377	2,650	3,620	1,580	952	1,210	517	446	170
21	952	2,380	3,530	1,580	830	1,210	496	438	170
22	842	2,380	3,340	1,500	830	1,280	496	418	170
23	896	2,610	3,340	1,500	830	1,350	487	418	160
24	953	2,840	3,540	1,350	830	1,280	487	418	160
25	1,010	2,930	3,750	1,350	746	1,230	467	398	160
26	1,040	2,930	3,550	1,270	721	1,180	467	383	150
27	1,070	1,790	3,670	1,270	696	1,140	467	370	150
28	1,010	1,640	3,000	1,270	772	1,140	438	355	140
29	1,010	1,490	3,000	1,270	825	1,080	418	340	120
30	952	1,490	2,830	1,190	1,740	1,020	418	325	110
31	.....	1,710	.....	1,190	1,740	.....	398	.....	100

NOTE.—Daily discharge determined by means of a discharge rating curve fairly well defined between 350 and 3,600 second-feet. The shifting-channel method was used, each discharge measurement made during the year being given full weight. Discharge interpolated for days on which gage was not read. Discharge Jan. 1 to Mar. 31, Nov. 10 to 16, and Dec. 16 to 31 estimated, because of ice, from climatologic records and discharge of St. Mary River below Swiftcurrent Creek, near Babb, Mont.

Monthly discharge of St. Mary River near Cardston, Alberta, for 1911.

[Drainage area, 452 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	.....	.....	a 170	0.376	0.43	10,500	D.
February	.....	.....	a 150	.332	.35	8,330	D.
March	.....	.....	a 145	.321	.37	8,920	D.
April	1,040	177	478	1.06	1.18	28,400	C.
May	3,810	952	2,040	4.51	5.20	125,000	A.
June	3,890	2,380	3,470	7.68	8.57	206,000	A.
July	2,470	1,190	1,680	3.72	4.29	103,000	A.
August	1,740	696	1,050	2.32	2.68	64,600	A.
September	1,440	1,020	1,260	2.79	3.11	75,000	A.
October	992	398	621	1.37	1.58	38,200	B.
November	446	a 200	346	.765	.85	20,600	B.
December	310	a 100	195	.431	.50	12,000	C.
The year	3,890	.....	968	2.14	29.11	701,000	

a Estimated.

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

RED RIVER BASIN.

OTTER TAIL RIVER NEAR FERGUS FALLS, MINN.

Location.—Threemile 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 Otter Tail Lake, through which the river flows.

Records available.—May 9, 1904, to December 31, 1911. A gaging station was maintained from May 1, 1899, to May 14, 1904, by the United States Engineer Corps at the outlet of Otter Tail 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 Otter Tail Lake furnish a 13-year record of flow of the river below Otter Tail Lake.

Drainage area.—1,310 square miles.

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

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.

Regulation.—Otter Tail Lake, about 22 square miles in area, forms a natural reservoir, regulating 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 Otter Tail 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, but 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.

The following discharge measurement was made by W. G. Hoyt and S. B. Soulé: December 16, 1911: Gage height, 3.44 feet; discharge, 119 second-feet. Complete ice cover; average thickness of ice 0.92 foot.

Daily gage height, in feet, of Otter Tail River near Fergus Falls, Minn., for 1911.

[O. Tommerdahl and H. G. Evensen, jr., observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	.....	2.75	2.75	2.45	2.35	2.4	2.5	2.6	.....
2	.....	4.0	.....	2.7	2.75	2.75	2.4	2.4	2.35	2.55	2.55	3.1
3	.....	.....	4.8	2.65	2.75	2.75	2.45	2.45	2.4	2.55	2.6	.....
4	.....	.....	.....	2.7	2.8	2.75	2.45	2.45	2.35	2.6	2.55	3.25
5	3.6	.....	.....	2.65	2.75	2.75	2.45	2.45	2.4	2.55	2.55	.....
6	.....	.....	.....	2.65	2.75	2.7	2.45	2.4	2.45	2.55	2.55	.....
7	.....	.....	.....	2.65	2.7	2.7	2.4	2.45	2.4	2.6	2.55	.....
8	.....	.....	.....	2.7	2.7	2.7	2.45	2.45	2.45	2.55	2.55	.....
9	.....	.....	4.7	2.75	2.75	2.7	2.45	2.5	2.4	2.6	2.5	3.3
10	.....	.....	.....	2.75	2.75	2.7	2.45	2.5	2.45	2.6	2.55	.....
11	.....	4.2	.....	2.85	2.75	2.65	2.4	2.55	2.45	2.6	2.6	3.35
12	.....	.....	.....	2.85	2.75	2.65	2.35	2.55	2.4	2.65	.....	.....
13	3.4	.....	.....	2.85	2.75	2.6	2.4	2.5	2.5	2.6	2.65	.....
14	.....	.....	.....	2.85	2.75	2.6	2.35	2.55	2.45	2.65	.....	.....
15	.....	.....	.....	2.8	2.75	2.6	2.35	2.5	2.5	2.6	.....	.....
16	.....	4.35	3.3	2.8	2.75	2.6	2.35	2.5	2.5	2.6	2.75	3.35
17	.....	.....	.....	2.85	2.8	2.55	2.35	2.5	2.45	2.65	.....	3.3
18	.....	.....	.....	2.85	2.8	2.55	2.35	2.45	2.5	2.6	.....	.....
19	.....	.....	.....	2.9	2.8	2.55	2.35	2.5	2.5	2.65	.....	.....
20	3.65	.....	.....	2.8	2.8	2.55	2.35	2.45	2.55	2.6	2.75	.....
21	.....	.....	.....	2.8	2.8	2.5	2.4	2.5	2.5	2.6	.....	.....
22	.....	.....	2.9	2.75	2.8	2.5	2.4	2.5	2.5	2.6	.....	.....
23	.....	4.6	.....	2.75	2.75	2.5	2.35	2.4	2.45	2.55	.....	3.35
24	.....	.....	.....	2.85	2.75	2.45	2.4	2.45	2.5	2.6	.....	.....
25	.....	.....	.....	2.8	2.75	2.45	2.35	2.4	2.45	2.55	2.8	3.4
26	3.7	.....	2.6	2.8	2.75	2.45	2.35	2.45	2.5	2.55	.....	.....
27	.....	.....	2.7	2.8	2.75	2.45	2.35	2.45	2.55	2.6	3.0	.....
28	.....	.....	2.7	2.8	2.75	2.5	2.35	2.35	2.5	2.55	.....	.....
29	.....	.....	2.75	2.85	2.75	2.5	2.35	2.4	2.55	2.6	.....	.....
30	.....	.....	2.8	2.8	2.75	2.45	2.35	2.35	2.5	2.55	.....	3.6
31	.....	.....	2.8	.....	2.75	.....	2.4	2.4	.....	2.55	.....	.....

NOTE.—Ice present from Jan. 1 to Mar. 25, average thickness of ice about 1.5 to 2 feet; and from Nov. 11 to Dec. 31, average thickness of ice about 0.5 to 1 foot.

Daily discharge, in second-feet, of Otter Tail River near Fergus Falls, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	218	218	218	124	98	111	138	168
2	.....	201	218	218	111	111	98	153	153
3	.....	184	218	218	124	124	111	153	168
4	.....	201	236	218	124	124	98	168	153
5	.....	184	218	218	124	124	111	153	153
6	.....	184	218	201	124	111	124	153	153
7	.....	184	201	201	111	124	111	168	153
8	.....	201	201	201	124	124	124	153	153
9	.....	218	218	201	124	138	111	168	138
10	.....	218	218	201	124	138	124	168	153
11	.....	255	218	184	111	153	124	168	.....
12	.....	255	218	184	98	153	111	184	.....
13	.....	255	218	168	111	138	138	168	.....
14	.....	255	218	168	98	153	124	184	.....
15	.....	236	218	168	98	138	138	168	.....
16	.....	236	218	168	98	138	138	168	.....
17	.....	255	236	153	98	138	124	184	.....
18	.....	255	236	153	98	124	138	168	.....
19	.....	274	236	153	98	138	138	184	.....
20	.....	236	236	153	98	124	153	168	.....
21	.....	236	236	138	111	138	138	168	.....
22	.....	218	236	138	111	138	138	168	.....
23	.....	218	218	138	98	111	124	153	.....
24	.....	255	218	124	111	124	138	168	.....
25	.....	236	218	124	98	111	124	153	.....
26	168	236	218	124	98	124	138	153	.....
27	201	236	218	124	98	124	153	168	.....
28	201	236	218	138	98	98	138	153	.....
29	218	255	218	138	98	111	153	168	.....
30	236	236	218	124	98	98	138	153	.....
31	236	.....	218	.....	111	111	.....	153	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Jan. 1 to Mar. 25 and Nov. 12 to Dec. 31 estimated, because of ice, from discharge measurement, gage observer's notes, and climatologic records. Mean discharge Jan. 1 to 31 estimated 80 second-feet. Mean discharge Feb. 1 to 28 estimated 85 second-feet. Mean discharge Mar. 1 to 25 estimated 105 second-feet. Mean discharge Nov. 12 to 30 estimated 115 second-feet, varying from about 100 to 150 second-feet. Mean discharge Dec. 1 to 31 estimated 110 second-feet, varying from about 80 to 130 second-feet. Discharge Apr. 1 interpolated.

Monthly discharge of Otter Tail River near Fergus Falls, Minn., for 1911.

[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	B.
February	.....	.....	85	.065	.07	4,720	B.
March	.....	.....	125	.095	.11	7,690	C.
April	274	184	229	.175	.20	13,600	A.
May	236	201	221	.169	.19	13,600	A.
June	218	124	169	.129	.14	10,100	A.
July	124	98	108	.082	.09	6,640	A.
August	153	98	126	.096	.11	7,750	A.
September	153	98	128	.098	.11	7,620	A.
October	184	138	164	.125	.14	10,100	A.
November	168	.....	128	.098	.11	7,620	B.
December	.....	.....	110	.084	.10	6,760	B.
The year	274	.....	140	.107	1.44	101,000	

NOTE.—See footnotes to table of daily discharge.

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, 1911.

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.

Regulation.—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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 24	E. F. Chandler	6.70	143
Aug. 21	.....do	6.73	161

NOTE.—Measurements made from Front Street Bridge.

Daily gage height, in feet, of Red River at Fargo, N. Dak., for 1911.

[Mrs. H. R. Grasse, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	6.2	7.7	7.4	7.2	6.6	6.6	6.6	7.0	.....
2	.....	7.7	7.4	7.3	6.6	6.6	6.6	6.9	.....
3	.....	7.7	7.4	7.5	6.6	6.6	6.6	6.8	.....
4	.....	7.8	7.5	8.0	6.5	6.5	6.5	6.7	.....
5	.....	7.8	7.5	8.0	6.4	6.7	6.5	6.7	6.6
6	.....	7.5	7.4	8.0	6.5	6.8	6.5	7.5	6.6
7	6.4	7.5	7.4	7.9	6.5	7.0	6.5	7.6	7.1
8	6.5	7.5	7.3	7.8	6.5	7.1	6.7	7.7	7.2
9	6.5	7.5	7.3	7.7	6.5	7.0	6.8	7.2	7.2
10	6.6	8.0	7.4	7.7	6.5	7.1	6.7	7.3	.....
11	6.7	8.7	7.4	7.2	6.3	7.1	6.5	7.3	.....
12	6.8	8.3	7.5	7.3	6.3	7.1	6.7	7.2	.....
13	6.9	8.2	7.5	7.3	6.3	7.1	6.7	7.1	.....
14	7.0	8.0	7.4	7.3	6.3	7.1	6.8	7.1	.....
15	7.2	8.0	7.5	7.3	6.2	7.0	6.9	7.2	.....
16	7.2	8.0	7.5	7.2	6.2	6.9	6.8	7.2	.....
17	7.7	8.0	7.5	7.1	6.3	6.9	6.9	7.2	.....
18	7.8	7.8	7.5	7.0	6.3	6.9	7.1	7.2	.....
19	7.9	7.8	7.5	6.9	6.2	6.8	6.9	7.3	.....
20	8.0	7.6	7.5	6.8	6.2	6.7	6.9	7.3	.....
21	8.1	7.7	7.5	6.8	6.2	6.6	6.9	7.3	.....
22	8.1	7.8	7.4	6.8	6.2	6.7	6.7	7.3	.....
23	8.0	7.6	7.4	6.5	6.2	6.7	6.8	7.3	.....
24	8.1	7.6	7.4	6.5	6.3	6.7	6.9	7.3	.....
25	8.1	7.6	7.2	6.5	6.3	6.7	6.9	7.3	.....
26	8.2	7.6	7.2	6.6	6.3	6.6	6.9	7.3	.....
27	8.5	7.5	7.2	6.5	6.5	6.6	6.9	7.3	.....
28	7.9	7.4	7.2	6.5	6.4	6.7	6.9	7.3	.....
29	7.5	7.4	7.2	6.6	6.5	6.7	7.0	.....	.....
30	7.5	7.4	7.2	6.6	6.6	6.7	7.0	.....	.....
31	7.5	.....	7.2	.....	6.6	6.6	.....	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 16 and Nov. 9 to Dec. 31.

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	356	286	242	131	131	131	201
2	.....	356	286	264	131	131	131	182
3	.....	356	286	309	131	131	131	164
4	.....	380	309	428	116	116	116	147
5	.....	380	309	428	102	147	116	147
6	.....	309	286	428	116	164	116	309
7	.....	309	286	404	116	201	116	332
8	.....	309	264	380	116	221	147	356
9	.....	309	264	356	116	201	164	242
10	.....	428	286	356	116	221	147	264
11	.....	608	286	242	90	221	116	264
12	.....	504	309	264	90	221	147	242
13	.....	474	309	264	90	221	147	221
14	.....	428	286	264	90	221	164	221
15	.....	428	309	264	79	201	182	242
16	.....	428	309	242	79	182	164	242
17	356	428	309	221	90	182	182	242
18	380	380	309	201	90	182	221	242
19	404	380	309	182	79	164	182	264
20	428	332	309	164	79	147	182	264
21	453	356	309	164	79	131	182	264
22	453	380	286	164	79	147	147	264
23	428	332	286	116	79	147	164	264
24	453	332	286	116	90	147	182	264
25	453	332	242	116	90	147	182	264
26	478	332	242	131	90	131	182	264
27	556	309	242	116	116	131	182	264
28	404	286	242	116	102	147	182	264
29	309	286	242	131	116	147	201	a250
30	309	286	242	131	131	147	201	a230
31	309	.....	242	.....	131	131	.....	a210

a Daily discharge estimated.

NOTE.—Discharge Mar. 1 to 16 estimated, because of ice, from observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Mar. 1 to 16 estimated 90 second-feet, varying from about 60 to 130 second-feet.

Monthly discharge of Red River at Fargo, N. Dak., for 1911.

[Drainage area, 6,020 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.	
March	556	60	246	0.041	0.05	15,100	C.
April	608	286	370	.062	.07	22,000	B.
May	309	242	283	.047	.05	17,400	B.
June	428	116	240	.040	.04	14,300	B.
July	131	79	102	.017	.02	6,270	B.
August	221	116	166	.028	.03	10,200	B.
September	221	116	160	.027	.03	9,520	B.
October	356	147	245	.041	.05	15,100	C.
The period						110,000	

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

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, 1911. 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.

Regulation.—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 reservoirs 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.

Discharge measurements of Red River at Grand Forks, N. Dak., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 14	Chandler and Monley	[a]4.10	198
18	Goric Monley	[b]4.11	177
25	....do	[c]4.33	235
May 13	Chandler and Monley	7.13	1,740
July 18	E. F. Chandler	3.81	542

[a] Measurement Feb. 14 affected by ice. Mean lower surface of ice=2.60 feet on gage.
[b] Measurement Feb. 18 affected by ice. Mean lower surface of ice=2.48 feet on gage.
[c] Measurement Feb. 25 affected by ice. Mean lower surface of ice=2.88 feet on gage.

NOTE.—All measurements made at Great Northern Railway bridge.

Daily gage height, in feet, of Red River at Grand Forks, N. Dak., for 1911.

[J. F. Hayes, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	9.25	6.75	5.95	5.58	2.70	3.10	3.00	3.6	.....
2	.....	.....	.....	9.42	6.52	6.00	5.15	2.72	3.20	2.95	3.6	3.3
3	.....	.....	.....	8.80	6.50	6.25	5.10	2.80	3.25	2.70	3.4	.....
4	.....	3.65	4.5	8.60	6.39	6.42	5.00	2.90	3.05	2.70	3.4	.....
5	.....	.....	.....	8.40	6.32	6.82	4.95	3.20	3.00	2.60	.....	.....
6	.....	.....	.....	8.20	6.15	6.55	4.80	3.20	2.92	2.55	.....	.....
7	.....	.....	.....	7.75	6.00	6.40	4.60	3.22	3.05	2.30	.....	.....
8	.....	.....	.....	7.60	5.92	6.55	4.72	3.30	3.15	2.90	.....	.....
9	4.1	.....	.....	7.58	5.90	6.80	4.62	3.40	3.00	3.00	.....	3.4
10	.....	.....	.....	7.75	6.05	7.85	4.58	3.30	2.95	3.05	.....	.....
11	.....	3.8	4.8	7.95	6.10	10.10	4.62	3.25	2.95	3.10	3.5	.....
12	.....	.....	.....	8.20	6.18	10.65	4.50	3.18	3.10	3.05	.....	.....
13	.....	.....	.....	8.40	6.76	10.55	4.20	3.20	3.00	2.60	.....	.....
14	3.7	4.1	.....	8.90	7.05	9.85	4.00	3.30	3.00	3.30	.....	.....
15	.....	.....	.....	9.18	6.80	8.95	3.90	3.42	3.05	3.30	.....	.....
16	.....	.....	.....	9.02	6.58	8.32	3.70	3.40	3.00	3.20	.....	3.5
17	.....	.....	.....	8.85	6.75	7.92	3.65	3.45	3.25	3.45	.....	.....
18	.....	4.0	6.0	8.65	8.15	7.45	3.55	3.28	3.40	3.72	3.3	.....
19	.....	.....	.....	8.45	8.50	7.35	3.42	3.00	3.38	4.00	.....	.....
20	.....	.....	.....	8.10	7.74	7.08	3.38	2.90	3.05	3.90	.....	.....
21	3.7	.....	.....	7.50	7.66	7.08	3.22	2.82	3.00	3.90	.....	.....
22	.....	.....	.....	7.11	7.68	6.75	3.02	2.80	2.92	4.00	.....	.....
23	.....	.....	.....	7.00	7.35	6.20	2.92	2.82	3.15	4.05	.....	3.8
24	.....	.....	.....	6.95	7.00	6.14	2.80	2.82	3.00	4.18	.....	.....
25	.....	4.35	8.65	6.90	6.75	6.10	2.78	2.78	3.02	4.22	3.0	.....
26	.....	.....	.....	6.88	6.50	5.82	2.80	2.92	3.12	4.15	.....	.....
27	.....	.....	.....	6.88	6.20	5.60	2.80	2.90	3.18	4.10	.....	.....
28	3.9	.....	.....	6.71	5.80	5.55	2.70	2.82	2.80	4.00	.....	.....
29	.....	.....	.....	7.02	5.72	5.60	2.71	2.95	2.90	4.05	.....	.....
30	.....	.....	.....	6.98	5.80	5.55	2.62	3.10	2.95	3.95	.....	3.5
31	.....	.....	9.45	.....	5.90	.....	2.62	3.08	.....	3.90	.....	.....

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Apr. 9 and Oct. 29 to Dec. 31.

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1,550	1,210	1,060	331	397	380
2	.....	1,440	1,220	914	334	415	372
3	.....	1,440	1,330	897	347	424	331
4	.....	1,390	1,400	865	363	388	331
5	.....	1,360	1,580	850	415	380	315
6	.....	1,290	1,460	803	415	366	308
7	.....	1,220	1,390	744	419	388	271
8	.....	1,190	1,460	779	434	406	363
9	.....	1,190	1,570	750	454	380	380
10	2,020	1,240	2,060	738	434	372	388
11	2,110	1,260	3,200	750	424	372	397
12	2,230	1,300	3,500	715	411	397	388
13	2,330	1,550	3,440	634	415	380	315
14	2,580	1,680	3,070	585	434	380	434
15	2,720	1,570	2,600	562	458	388	434
16	2,640	1,470	2,290	518	454	380	415
17	2,560	1,550	2,100	507	464	424	464
18	2,460	2,210	1,870	486	430	454	522
19	2,360	2,380	1,820	458	380	450	585
20	2,180	2,010	1,700	450	363	388	562
21	1,900	1,970	1,700	419	350	380	562
22	1,710	1,980	1,550	383	347	366	585
23	1,660	1,820	1,310	366	350	406	597
24	1,640	1,660	1,280	347	350	380	629
25	1,610	1,550	1,260	344	344	383	639
26	1,600	1,440	1,150	347	366	401	622
27	1,600	1,310	1,070	347	363	411	609
28	1,530	1,150	1,050	331	350	347	585
29	1,670	1,120	1,070	333	372	363	550
30	1,650	1,150	1,050	318	397	372	525
31	.....	1,190	.....	318	394	.....	500

NOTE.—Daily discharge computed from a rating curve well defined between 475 and 10,000 second-feet. Discharge Jan. 1 to Apr. 9 and Oct. 29 to Dec. 31 estimated, because of ice, from discharge measurements, weekly gage heights, gage observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Apr. 1 to 9, estimated, 1,500 second-feet.

Monthly discharge of Red River at Grand Forks, N. Dak., for 1911.

[Drainage area, 25,000 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	.....	.....	[a] 210	0.0084	0.01	12,900	C.
February	.....	.....	[a] 185	.0074	.008	10,300	B.
March	.....	.....	[a] 760	.030	.03	46,700	C.
April	2,720	.....	1,880	.075	.08	112,000	B.
May	2,380	1,120	1,500	.060	.07	92,200	A.
June	3,500	1,050	1,760	.070	.08	105,000	A.
July	1,060	318	578	.023	.03	35,500	A.
August	464	331	392	.016	.02	24,100	B.
September	454	347	391	.016	.02	23,300	B.
October	639	271	463	.018	.02	28,500	B.
November	.....	.....	[a] 370	.015	.02	22,000	C.
December	.....	.....	[a] 340	.014	.02	20,900	D.
The year	3,500	.....	736	.029	.41	533,000	

[a] Estimated. See footnotes to table of daily discharge.

PELICAN RIVER NEAR FERGUS FALLS, MINN.

Location.—At the private highway bridge 6 miles northwest of Fergus Falls, in section 18 of that township, about 5 miles above junction with Otter Tail River.

Records available.—June 19, 1909, to December 31, 1911.

Drainage area.—433 square miles.

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

Channel.—Practically permanent.

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

Winter flow.—Ice is present from the middle of November to the 1st of April, and during that time discharge measurements are made to determine the winter flow.

Regulation.—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 Otter Tail River does not extend to the station, as the range in stage of that stream is small.

The following discharge measurement was made by Hoyt (W. G.) and Soulé, under complete ice cover, December 16, 1911:

Gage height, 5.45 feet; discharge, 6.6 second-feet. Average thickness of ice, 2 feet. Average distance water surface to top of ice, 0.9 foot.

Daily gage height, in feet, of Pelican River near Fergus Falls, Minn., for 1911.

[Henry W. Luther, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.6	.....	5.95	5.68	5.62	5.75	5.44	5.50	5.55	5.95	5.8
2	.....	.....	.....	5.91	5.71	5.74	5.56	5.50	5.40	5.85	5.82	.....
3	5.5	.....	.....	5.95	5.85	5.78	5.72	5.44	5.39	5.90	5.80	.....
4	.....	5.5	6.6	5.80	5.95	5.91	5.49	5.70	5.50	5.68	5.62	.....
5	.....	.....	.....	5.95	5.90	5.80	5.60	5.70	5.40	5.50	5.50	6.2
6	.....	.....	.....	5.88	5.86	5.80	5.45	5.46	5.60	5.70	5.85	.....
7	.....	5.3	7.0	5.80	5.65	5.84	5.55	5.82	5.48	5.71	5.90	.....
8	.....	.....	.....	5.90	5.86	5.75	5.41	5.80	5.48	5.50	5.80	6.0
9	.....	.....	.....	5.60	5.62	6.06	5.44	5.58	5.48	5.70	5.85	.....
10	.....	5.4	6.6	5.70	5.82	5.70	5.38	5.44	5.40	5.70	5.88	.....
11	5.4	.....	.....	5.88	5.82	5.58	5.34	5.48	5.71	5.80	.....	.....
12	.....	.....	.....	5.75	5.92	5.98	5.41	5.65	5.85	5.80	.....	6.1
13	.....	.....	.....	5.68	5.80	5.52	5.31	5.50	5.78	5.80	.....	.....
14	.....	5.2	6.4	5.50	5.49	5.91	5.44	5.42	5.80	5.80	6.4	.....
15	.....	.....	.....	5.50	5.90	5.81	5.31	5.55	5.68	5.50	.....	5.8
16	.....	.....	.....	5.60	5.81	5.62	5.40	5.40	5.85	5.70	.....	5.45
17	.....	.....	.....	5.80	5.92	5.86	5.60	5.71	5.42	5.70	6.20	.....
18	5.2	5.0	6.3	5.90	5.75	5.82	5.66	5.54	5.65	5.90	.....	.....
19	.....	.....	.....	5.85	5.61	5.60	5.52	5.44	5.62	5.50	.....	6.7
20	.....	.....	.....	5.78	5.75	5.75	5.39	5.49	5.68	5.50	.....	.....
21	6.5	5.05	6.0	5.82	5.50	5.50	5.38	5.40	5.70	5.85	6.00	.....
22	.....	.....	.....	5.90	5.60	5.74	5.46	5.70	5.65	5.66	.....	6.8
23	.....	.....	.....	5.50	5.61	5.51	5.40	5.78	5.52	5.98	.....	.....
24	.....	4.9	6.8	5.60	5.52	5.75	5.50	5.65	5.58	6.00	5.70	.....
25	5.5	.....	.....	5.55	5.65	5.60	5.40	5.55	5.56	5.88	.....	.....
26	.....	.....	.....	5.68	5.52	5.50	5.50	5.40	5.59	5.85	.....	.....
27	.....	.....	6.6	5.80	5.60	5.72	5.68	5.41	5.48	5.85	.....	5.9
28	5.3	6.1	.....	5.70	5.68	5.85	5.62	5.50	5.50	5.78	5.60	.....
29	.....	.....	6.10	5.80	5.55	5.50	5.68	5.40	5.60	5.50	.....	6.4
30	.....	.....	6.10	5.69	5.62	5.58	5.42	5.50	5.50	5.82	.....	.....
31	.....	.....	5.85	.....	5.72	.....	5.45	5.40	.....	5.80	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 31 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Pelican River near Fergus Falls, Minn., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	64	28	21	36	6	10	14	64
2	58	31	35	15	10	4	49	45
3	64	49	40	32	6	4	56	42
4	42	64	58	9	30	10	28	21
5	64	56	42	19	30	4	10	10
6	53	50	42	7	8	19	30	49
7	42	24	48	14	45	9	31	56
8	56	50	36	5	42	9	10	42
9	19	21	84	6	17	9	30	49
10	30	45	30	3	6	4	30	53
11	53	45	17	2	9	31	42	.....
12	36	59	70	5	24	49	42	.....
13	28	42	12	1	10	40	42	.....
14	10	9	58	6	5	42	42	.....
15	10	56	43	1	14	28	10	.....
16	19	43	21	4	4	49	30	.....
17	42	59	50	19	31	5	30	.....
18	56	36	45	26	14	24	56	.....
19	49	20	19	12	6	21	10	.....
20	40	36	36	4	9	28	10	.....
21	45	10	10	3	4	30	49	.....
22	56	19	35	8	30	24	26	.....
23	10	20	11	4	40	12	70	.....
24	19	12	36	10	24	17	73	.....
25	14	24	19	4	14	15	53	.....
26	28	12	10	10	4	18	49	.....
27	42	19	32	28	5	9	49	.....
28	30	28	49	21	10	10	40	.....
29	42	14	10	28	4	19	10	.....
30	29	21	17	5	10	10	45	.....
31	.....	32	.....	7	4	.....	42	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Operations of flour mill at Elizabeth, a few miles above, have a decided influence on the flow, especially in winter and during periods of low water. Discharge Jan. 1 to Mar. 31 and Nov. 11 to Dec. 31 estimated, because of ice, from discharge measurements, gage observer's reports, climatologic records, and discharge of adjacent drainage areas. Mean discharge, Nov. 11 to 30, estimated 12 second-feet.

Monthly discharge of Pelican River near Fergus Falls, Minn., for 1911.

[Drainage area. 433 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	[a] 2.0	0.0046	0.005	
February	.....	.....	[a] 2.0	.0046	.005	
March	.....	.....	[a] 10.0	.023	.03	D.
April	64	10	38.3	.088	.09	C.
May	64	9	33.4	.077	.09	B.
June	84	10	34.5	.080	.09	B.
July	36	1	11.4	.026	.03	C.
August	45	4	15.3	.035	.04	C.
September	49	4	18.8	.043	.05	C.
October	73	10	35.7	.082	.09	B.
November	64	.....	22.4	.052	.06	D.
December	.....	.....	[b] 10.0	.023	.03	D.
The year	84	.....	19.5	.045	.61	

[a] Estimated from 1 discharge measurement, semiweekly gage heights, and climatologic records.
[b] Estimated from discharge of Otter Tail River near Fergus Falls, Minn.

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, 1911.

Drainage area.—805 square miles.

Gage.—Vertical staff; datum unchanged since establishment.

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

Discharge measurements.—From the bridge, except during extreme low water, when measurements 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 9,200 second-feet.

Regulation.—There is a dam across the river at Heiberg, but the highest backwater effect is at a point more than a mile below Twin Valley.

Accuracy.—The estimate for the flood discharge above 14 feet made by Kutter's formula in connection with the known area of the cross section and may be somewhat in error, but it is believed this error will not exceed 10 per cent. The remaining estimates are based on a well-defined discharge rating curve and should be reliable.

Discharge measurements of Wild Rice River at Twin Valley, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 19	E. F. Chandler [a]	4.75	51.5
19	....do	4.75	54.3
Dec. 19	Goric Monley	5.18	[b] 37.7

[a] June 19, measurement made at wading section.
[b] Dec. 19, measurement made under complete ice cover. Thickness of ice below water surface 0.91 foot.

Daily gage height, in feet, of Wild Rice River at Twin Valley, Minn., for 1911.

[Axel Johnson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	5.3	6.2	5.1	5.7	4.6	4.5	4.6	4.9	.....
2	.....	.....	.....	4.9	6.2	5.1	6.0	4.6	4.5	4.6	4.8	5.0
3	.....	.....	.....	5.1	6.0	5.1	6.0	4.6	4.45	4.6	4.8	.....
4	.....	.....	.....	5.1	6.0	5.1	6.15	4.6	4.45	4.6	4.7	.....
5	.....	.....	.....	5.5	5.9	5.1	6.3	4.6	4.45	4.6	4.6	.....
6	.....	.....	.....	5.5	5.8	5.0	6.15	4.6	4.45	4.6	4.6	.....
7	.....	.....	.....	4.5	5.8	4.95	5.95	4.55	4.5	4.6	4.6	.....
8	.....	.....	.....	5.15	5.7	4.8	5.8	4.5	4.6	4.65	4.7	.....
9	.....	.....	.....	5.15	5.35	4.8	5.65	4.5	4.6	4.65	4.7	5.0
10	.....	.....	.....	5.15	5.3	4.9	5.5	4.5	4.6	4.65	4.7	.....
11	.....	.....	.....	5.3	5.2	4.9	5.8	4.5	4.6	5.15	4.6	.....
12	.....	.....	.....	5.8	5.2	4.9	5.6	4.5	4.55	5.42	4.6	.....
13	.....	5.9	.....	5.9	5.35	4.9	5.35	4.5	4.55	5.52	4.6	.....
14	5.5	.....	6.1	5.78	5.2	4.8	5.15	4.5	4.5	5.5	.....	.....
15	.....	.....	.....	5.55	5.3	4.8	4.9	4.5	4.5	5.55	.....	.....
16	.....	.....	.....	5.8	5.4	4.8	4.7	4.55	4.5	5.5	.....	5.05
17	.....	.....	.....	5.7	6.3	4.8	4.6	4.55	4.5	5.6	.....	.....
18	.....	.....	.....	5.55	6.35	4.75	4.6	5.0	4.5	5.7	5.0	.....
19	.....	.....	.....	5.4	6.05	4.75	4.6	4.85	4.5	5.78	.....	5.18
20	.....	.....	.....	5.75	5.8	4.7	4.6	4.85	4.55	5.7	.....	.....
21	.....	.....	.....	6.45	5.7	4.7	4.6	4.7	4.55	5.65	.....	.....
22	.....	.....	.....	6.6	5.5	5.1	4.6	4.7	4.55	5.6	.....	.....
23	.....	.....	.....	6.65	5.35	5.28	4.65	4.7	4.5	5.55	.....	.....
24	.....	.....	.....	6.52	5.25	5.48	4.6	4.7	4.5	5.55	.....	5.05
25	.....	.....	.....	6.58	5.2	5.6	4.6	4.6	4.5	5.5	5.0	.....
26	.....	.....	.....	6.2	5.1	5.5	4.65	4.5	4.5	5.5	.....	.....
27	.....	5.1	.....	6.0	5.1	4.9	4.65	4.5	4.5	5.35	.....	.....
28	5.7	.....	.....	6.0	5.1	5.6	4.5	4.5	4.6	5.3	.....	.....
29	.....	.....	5.7	6.05	5.05	5.7	4.5	4.5	4.6	5.2	.....	.....
30	.....	.....	.....	6.2	5.0	5.5	4.55	4.5	4.6	5.1	.....	.....
31	.....	.....	.....	.....	5.0	.....	4.55	4.5	.....	5.0	.....	5.0

NOTE.—Ice present Jan. 1 to Mar. 31 (average thickness of ice, about 1.5 feet), and about Nov. 12 to Dec. 31 (average thickness, about 0.8 foot).

Daily discharge, in second-feet, of Wild Rice River at Twin Valley, Minn., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	148	343	110	228	32	23	32	75
2	75	343	110	295	32	23	32	59
3	110	295	110	295	32	20	32	59
4	110	295	110	331	32	20	32	44
5	188	272	110	367	32	20	32	32
6	188	250	92	331	32	20	32	32
7	23	250	84	284	28	23	32	32
8	120	228	59	250	23	32	38	44
9	120	158	59	218	23	32	38	44
10	120	148	75	188	23	32	38	44
11	148	129	75	250	23	32	120	32
12	250	129	75	208	23	28	172	.....
13	272	158	75	158	23	28	192	.....
14	246	129	59	120	23	23	188	.....
15	198	148	59	75	23	23	198	.....
16	250	168	59	44	28	23	188	.....
17	228	367	59	32	28	23	208	.....
18	198	380	52	32	92	23	228	.....
19	168	307	52	32	67	23	246	.....
20	239	250	44	32	67	28	228	.....
21	406	228	44	32	44	28	218	.....
22	445	188	110	32	44	28	208	.....
23	459	158	144	38	44	23	198	.....
24	424	138	184	32	44	23	198	.....
25	440	129	208	32	32	23	188	.....
26	343	110	188	38	23	23	188	.....
27	295	110	75	38	23	23	158	.....
28	295	110	208	23	23	32	148	.....
29	307	101	228	23	23	32	129	.....
30	343	92	188	28	23	32	110	.....
31	.....	92	.....	28	23	.....	92	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between 23 and 3,400 second-feet. Discharge Nov. 12 to Dec. 31 estimated because of ice from 1 discharge measurement, observer's weekly reports, and climatologic records. Mean discharge Nov. 12 to 30 estimated 25 second-feet. Mean discharge Dec. 1 to 31 estimated 35 second-feet.

Monthly discharge of Wild Rice River at Twin Valley, Minn., for 1911.

[Drainage area, 805 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	22	0.027	0.03	(a)
February	.....	.....	18	.022	.02	(a)
March	.....	.....	70	.087	.10	(a)
April	459	23	239	.297	.33	B.
May	380	92	200	.248	.29	B.
June	228	44	104	.129	.14	B.
July	367	23	133	.165	.19	B.
August	92	23	33.3	.041	.05	C.
September	32	20	25.5	.032	.04	C.
October	246	32	134	.166	.19	B.
November	75	.....	32.4	.040	.04	C.
December	.....	.....	35	.044	.05	D.
The year	459	.....	87.5	.109	1.47	

a Estimates of discharge for January, February, and March are very rough and are based on one discharge measurement made in December, 1910, fortnightly gage heights and gage observer's notes.

NOTE.—See footnotes to table of 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 Geological Survey bench-mark post which is set in the bank directly behind the gage and about 8 rods distant.

That the lake level is still being lowered is shown by the following gage heights, those at the close of the season being the lowest ever recorded.

Gage height of Devils Lake, N. Dak., in 1911.

	Feet.		Feet.
July 13	8.50	Aug. 14	8.72
Aug. 4	8.50	Sept. 30	8.46
Aug. 10	8.70		

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, 1911.

Drainage area.—3,430 square miles.

Gage.—Vertical and inclined staff; datum unchanged since establishment. The gage is read morning and evening and the mean of the two readings is recorded as the mean for the day.

Channel.—Somewhat shifting. The control is also changed temporarily by log jams forming below.

Discharge measurements.—From a car and cable located near 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 discharge.

Regulation.—A short distance above is the dam used by the Hansen & Barzen Milling Co. and the city lighting plant. The fluctuating loads on the turbines cause fluctuations in the river stage below the dam. This fluctuation is reduced by the operation of the lighting plant at night, and by the mill, chiefly during the daytime.

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.

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[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.

Discharge measurements of Red Lake River at Thief River Falls, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 5	E. F. Chandler	5.10	[a] 197
June 27	.....do	3.86	220
28	.....do	4.00	215
July 20	.....do	2.92	17.7
Sept. 14	.....do	3.60	125
Dec. 21	Goric Monley	3.12	[b] 28.6

[a] May 5, log jam 1 mile below.
[b] Dec. 21, measurement under complete ice cover. Average thickness of ice 0.72 foot.

Daily gage height, in feet, of Red Lake River at Thief River Falls, Minn., for 1911.

[Chas. P. Quist, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	5.40	6.10	5.15	4.07	3.10	3.00	2.55	2.60	.....
2	.....	.....	.....	5.15	5.45	5.32	3.00	2.50	2.95	2.60	3.15	.....
3	.....	4.4	4.65	5.45	5.40	5.45	3.85	2.90	2.95	3.40	2.50	.....
4	.....	.....	.....	5.42	5.50	5.82	3.80	2.80	3.20	2.70	3.05	.....
5	.....	.....	.....	5.45	5.10	6.05	3.97	3.05	2.90	3.55	2.50	2.5
6	.....	.....	.....	5.38	5.10	5.70	3.82	3.60	3.15	3.30	2.95	.....
7	.....	4.2	4.7	5.40	4.70	5.35	3.90	2.85	2.95	2.75	2.65	.....
8	.....	.....	.....	5.35	4.75	7.50	4.00	3.40	3.25	2.70	3.50	3.0
9	.....	.....	.....	5.15	5.12	9.25	3.15	2.85	3.10	2.50	2.90	.....
10	.....	4.4	4.6	5.45	5.42	7.95	3.70	3.30	2.45	3.60	3.50	.....
11	.....	.....	.....	6.25	5.55	6.10	3.05	3.15	2.60	2.55	2.50	.....
12	.....	.....	.....	6.30	5.70	5.50	3.00	3.20	2.70	2.65	2.30	2.5
13	4.4	.....	.....	6.35	5.65	5.20	2.35	2.20	3.00	3.60	2.95	.....
14	.....	4.6	5.2	5.50	4.72	5.00	2.35	3.20	3.65	2.55	2.30	.....
15	.....	.....	.....	5.25	5.45	4.70	2.35	3.10	2.80	2.50	2.35	3.0
15	.....	.....	.....	6.00	5.58	4.75	2.20	3.10	3.20	2.70	2.60	.....
17	4.1	4.6	5.6	4.85	5.80	4.70	2.00	3.40	2.30	3.55	2.40	.....
18	.....	.....	.....	4.95	5.80	4.50	2.85	3.20	2.60	2.50	2.25	.....
19	.....	.....	.....	5.10	5.40	4.50	2.40	2.95	3.25	3.60	2.25	3.2
20	4.2	.....	.....	4.75	5.45	4.30	2.95	2.40	2.85	2.75	2.85	.....
21	4.2	4.7	5.7	5.62	4.70	4.15	3.20	3.25	2.90	3.25	2.45	3.2
22	.....	.....	.....	5.78	5.30	4.00	2.60	3.30	2.70	2.55	2.95	2.6
23	.....	.....	.....	4.90	5.35	4.00	2.45	3.25	2.75	2.65	2.80	.....
24	.....	4.6	5.8	5.40	5.30	3.90	3.20	2.25	2.45	2.65	2.55	.....
25	.....	.....	.....	5.40	5.35	2.80	3.15	2.90	3.35	2.60	2.90	.....
26	.....	.....	.....	5.75	5.50	4.10	2.70	2.25	2.75	2.85	2.55	2.8
27	4.0	.....	.....	5.85	5.50	3.95	2.65	1.75	2.60	2.75	2.95	.....
28	.....	5.0	5.7	5.95	4.95	3.75	2.70	3.05	2.60	3.55	2.70	4.0
29	.....	.....	.....	6.20	5.65	4.00	2.70	3.15	3.25	2.60	2.70	3.8
30	.....	.....	.....	5.68	5.20	4.15	3.30	3.00	3.45	2.70	2.50	3.8
31	4.4	.....	5.65	.....	5.20	.....	3.05	2.90	.....	2.50	.....	.....

NOTE.—Prior to June 8 the gage heights were greatly affected by log jams. During the latter half of the year the intermittent operation of the power plant above the station seriously affected the discharge of the river. Ice present Jan. 1 to Mar. 31 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for 1911.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	350	254	30	20	3.5	4
2	320	20	3	16	4	42
3	450	192	13	16	79	3
4	325	179	8	43	5.5	25
5	340	226	25	13	114	3
6	400	184	129	36	59	16
7	500	206	10	16	6.8	4.8
8	2,070	234	77	51	5.5	102
9	3,820	36	10	30	3	13
10	2,480	153	59	2.5	127	102

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for 1911—Continued.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	1,070	25	36	4	3.5	.....
12	770	20	43	5.5	4.8	.....
13	644	1.8	1	20	127	.....
14	565	1.8	43	141	3.5	.....
15	456	1.8	30	8	3	.....
16	474	1	30	43	5.5	.....
17	456	0	77	1.5	114	.....
18	389	10	43	4	3	.....
19	389	2	16	51	127	.....
20	324	16	2	10	6.8	.....
21	278	43	51	13	51	.....
22	234	4	59	5.5	3.5	.....
23	234	2.5	51	6.8	4.8	.....
24	206	43	1.2	2.5	4.8	.....
25	8	36	13	68	4	.....
26	263	5.5	1.2	6.8	10	.....
27	220	4.8	0	4	6.8	.....
28	166	5.5	25	4	114	.....
29	234	5.5	36	51	4	.....
30	278	59	20	87	5.5	.....
31	.....	25	13	.....	3	.....

NOTE.—Owing to backwater from log jams no daily discharge has been computed prior to June 1. June 1 to 7 the discharge has been estimated from a comparison of the Crookston and Red Lake Falls stations. Subsequent to June 7, daily discharge computed from a fairly well defined rating curve. Discharge Jan. 1 to Mar. 31 and Nov. 11 to Dec. 31 estimated, because of ice, from discharge measurements, gage observer's notes, climatologic records, and discharge of adjacent drainage areas.

Mean discharge Nov. 11 to 30 estimated 5 second-feet, varying from about 1 to 14 second-feet.

Mean discharge Dec. 1 to 31 estimated 9 second-feet, varying from about 3 to 30 second-feet.

Monthly discharge of Red Lake River at Thief River Falls, Minn., for 1911.

[Drainage area, 3,430 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	.....	.....	[a] 125	0.036	0.04	7,690	D.
February	.....	.....	[a] 95	.028	.03	5,280	D.
March	.....	.....	[a] 150	.044	.05	9,220	D.
April	.....	.....	[a] 375	.109	.12	22,300	C.
May	.....	.....	[a] 290	.085	.10	17,800	C.
June	3,820	8	624	.182	.20	37,100	C.
July	254	0	64.4	.019	.02	3,960	B.
August	129	0	30.8	.0090	.01	1,890	B.
September	141	1.5	26.0	.0076	.008	1,550	B.
October	127	3	32.8	.0096	.011	2,020	C.
November	102	.....	13.8	.0040	.005	821	C.
December	.....	.....	9	.0026	.003	553	D.
The year	3,820	0	152	.044	.597	110,000	

[a] Monthly mean discharge January, February, March, April, and May estimated by comparison with records at Red Lake River at Crookston, and Clearwater River at Red Lake Falls.

NOTE.—See footnotes to table of daily discharge.

RED LAKE RIVER AT CROOKSTON, MINN.

Location.—At new highway bridge in Crookston, less than a quarter of a mile below the dam and powerhouse of the Crookston Waterworks, Power & Light Co.; no tributaries within several miles.

Records available.—May 19, 1901, to December 31, 1911.

Drainage area.—5,320 square miles.

Gage.—Until July 1, 1909, the gage was located at the old "Sampson's Addition" bridge, but on that date a chain gage was installed on the new bridge 20 rods below, and set to read the same as the original gage, the datum of which has remained constant since the establishment of the station. In September, 1911, an automatic gage was substituted for the chain gage. A vertical staff nearby reads to the same datum.

Channel.—Slightly changing from year to year.

Discharge measurements.—Made from new bridge.

Winter flow.—At the original section the channel was wholly or partly open throughout the winter, owing to the presence of the dam; at the present section the river freezes entirely across from December to March, and discharge measurements are made through the ice to determine the approximate winter flow.

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., 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 1[a]	Geo. Ebner	3.46	56.8
1[a]	do	4.09	142
Apr. 30	E. F. Chandler	3.73	466
May 6	do	3.59	387
July 19	do	2.46	92.1
Sept. 15[b]	do	2.13	21.9
Nov. 6[b]	do	2.10	14.5
Dec. 18[c]	Goric Monley	2.07	22.5

[a] Mar. 1, measurements made through ice short distance above gage.
[b] Sept. 15 and Nov. 6, measurements made by wading above gage.
[c] Dec. 18, slight ice effect.

Daily gage height, in feet, of Red Lake River at Crookston, Minn., for 1911.

[J. E. Carroll, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8	3.8	3.8	4.25	3.98	3.75	3.3	2.85	2.40	2.79	2.25	2.57
2	3.8	3.85	3.75	4.30	3.95	3.68	3.05	2.50	2.48	.....	2.30	2.51
3	4.0	3.8	3.8	4.00	3.88	4.25	3.05	2.70	3.25	2.44	2.31	2.94
4	3.95	3.8	3.8	2.90	3.90	3.90	3.10	2.72	2.40	2.49	2.31	2.41
5	4.0	3.85	4.0	4.00	3.78	3.95	2.65	2.77	2.40	2.51	2.75	2.44
6	4.1	3.85	4.0	4.00	3.62	4.11	2.40	2.90	2.40	2.35	2.28	2.46
7	4.0	3.85	4.1	4.00	3.60	4.10	2.30	2.50	2.25	2.38	2.42	2.56
8	4.0	.....	4.3	3.90	3.70	4.15	2.70	2.80	2.30	2.86	2.39	2.56
9	4.0	3.85	3.8	4.00	3.23	6.80	3.05	2.82	2.30	2.16	2.41	2.42
10	4.1	3.9	4.1	4.00	3.45	8.15	3.08	2.52	3.02	2.58	2.47	2.92
11	4.0	3.9	4.75	4.50	3.40	8.10	2.90	2.70	2.28	2.46	2.59	2.44
12	4.0	3.85	4.7	4.50	3.55	7.55	2.60	2.45	2.60	2.48	2.40	2.48
13	4.1	3.8	4.7	4.40	3.70	6.84	2.90	2.40	2.43	2.42	2.42	2.54
14	4.15	3.8	4.75	4.40	3.20	5.60	2.80	2.60	2.52	2.48	2.44	2.54
15	4.0	3.8	4.7	4.50	4.05	5.28	2.60	2.75	2.32	2.72	2.44	2.58
16	3.55	3.75	4.7	4.55	4.18	4.63	2.60	2.72	2.35	2.32	2.43	2.50
17	3.5	3.8	4.8	4.50	3.45	4.85	2.40	2.65	2.25	2.44	2.46	2.86
18	3.6	3.8	5.4	4.50	3.55	4.60	2.60	2.43	2.30	2.49	2.49	2.45
19	3.75	3.8	4.75	4.45	3.60	4.70	2.60	2.42	2.48	2.58	2.32	2.47
20	3.7	3.75	4.75	4.20	3.90	3.85	2.60	2.55	2.40	2.55	2.51	2.58
21	3.65	3.65	4.7	4.18	3.80	3.90	2.60	2.50	2.40	2.50	2.42	2.64
22	.....	3.6	4.65	4.05	3.88	4.00	2.62	2.42	2.45	2.73	2.32	2.60
23	3.85	3.7	4.65	4.40	3.97	3.35	2.65	2.35	2.28	2.40	2.29	2.47
24	4.05	3.7	4.7	3.95	3.70	3.70	2.68	2.42	2.60	2.58	2.37	2.75
25	4.0	3.85	4.8	3.90	3.52	2.80	2.62	2.55	2.25	2.53	2.43	2.62
26	3.85	3.8	4.75	3.78	3.60	3.72	2.45	2.45	2.48	2.51	2.86	2.82
27	3.9	4.0	4.75	3.90	3.85	3.15	2.42	2.42	2.29	2.51	2.18	2.75
28	3.8	4.5	5.1	4.50	3.70	3.15	2.42	2.40	2.36	2.56	2.47	2.67
29	3.8	.....	5.0	4.05	3.60	3.30	2.45	2.40	2.35	2.74	2.57	2.72
30	3.85	.....	4.7	3.80	3.75	3.05	2.45	2.45	2.35	2.45	2.54	2.63
31	3.85	.....	4.3	.....	3.70	.....	2.95	2.40	.....	2.40	.....	2.97

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Mar. 23 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	685	561	465	304	178	72	162	44
2	.....	710	548	437	231	93	89	120	52
3	.....	570	519	685	231	140	289	80	54
4	.....	527	527	527	245	145	72	91	54
5	.....	570	477	548	128	158	72	95	152
6	.....	570	414	646	72	191	72	62	49
7	.....	570	406	615	52	93	44	68	76
8	.....	527	445	638	140	165	52	181	70
9	.....	570	283	2,320	231	170	52	29	74
10	.....	570	353	3,380	239	98	223	111	87
11	.....	815	336	3,340	191	140	49	85	.....
12	.....	815	388	2,900	116	82	116	89	.....
13	.....	760	445	2,350	191	72	78	76	.....
14	.....	760	274	1,460	165	116	98	89	.....
15	.....	815	592	1,270	116	152	56	145	.....
16	.....	842	651	886	116	145	62	56	.....
17	.....	815	353	1,010	72	128	44	80	.....
18	.....	815	388	870	116	78	52	91	.....
19	.....	788	406	925	116	76	89	111	.....
20	.....	660	527	506	116	104	72	104	.....
21	.....	651	485	527	116	93	72	93	.....
22	.....	592	519	570	121	76	82	148	.....
23	.....	760	557	320	128	62	49	72	.....
24	925	548	445	445	135	76	116	111	.....
25	980	527	377	165	121	104	44	100	.....
26	952	477	406	453	82	82	89	95	.....
27	952	527	506	260	76	76	50	95	.....
28	1,160	815	445	260	76	72	64	107	.....
29	1,100	592	406	304	82	72	62	150	.....
30	925	485	465	231	82	82	62	82	.....
31	710	.....	445	.....	204	72	.....	72	.....

NOTE.—Daily discharge computed from a rating curve well defined between discharges 10 and 570 second-feet (gage heights 2 and 4 feet), and fairly well defined above discharge 570 second-feet. Discharge Jan. 1 to Mar. 23 and Nov. 11 to Dec. 31 estimated, because of ice, from discharge measurements, gage heights, and climatologic records. Mean discharge Jan. 1 to 31 estimated 150 second-feet, varying from about 70 to 190 second-feet. Mean discharge Feb. 1 to 28 estimated 120 second-feet, varying from about 60 to 270 second-feet. Mean discharge Mar. 1 to 23 estimated 250 second-feet, varying from about 90 to 850 second-feet. Mean discharge Nov. 11 to 30 estimated 60 second-feet, varying from about 30 to 180 second-feet. Mean discharge Dec. 1 to 31 estimated 80 second-feet, varying from about 40 to 190 second-feet. Discharge Oct. 2, interpolated.

Monthly discharge of Red Lake River at Crookston, Minn., for 1911.

[Drainage area, 5,320 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	.....	.....	150	0.028	0.03	9,220	D.
February	.....	.....	120	.023	.02	6,660	D.
March	1,160	.....	434	.082	.09	26,700	C.
April	842	477	658	.124	.14	39,200	B.
May	651	274	450	.085	.10	27,700	B.
June	3,380	165	977	.184	.21	58,100	B.
July	304	52	142	.027	.03	8,730	B.
August	191	62	109	.020	.02	6,700	B.
September	289	44	81.4	.015	.02	4,840	B.
October	162	29	98.4	.018	.02	6,050	B.
November	.....	.....	63.7	.012	.01	3,790	C.
December	.....	.....	80	.015	.02	4,920	D.
The year	3,380	.....	280	.053	.71	203,000	

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, 1911.

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 (before the publication of this report) 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.

Regulation.—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.

The following discharge measurement was made by E. F. Chandler:

June 29, 1911: Gage height, 3.82 feet; discharge, 3.0 second-feet; velocity observations made with floats.

Daily gage height, in feet, of Thief River near Thief River Falls, Minn., for 1911.

[H. J. Maland, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.20	5.08	3.61	3.57	3.25	3.2	3.4		
2		4.19	4.44	3.65	3.56	3.2	3.2	3.4		
3		4.32	4.11	3.75	3.48	3.2	3.2	3.42		
4		4.34	4.05	3.94	3.85	3.2	3.25	3.46		
5		4.30	4.00	4.04	4.10	3.2	3.2	3.48	3.4	
6		4.18	3.90	3.83	3.85	3.2	3.2	3.55		
7		4.20	3.89	3.73	3.83	3.2	3.2	3.55		
8		4.25	4.11	4.35	3.73	3.2	3.2	3.55		
9		4.22	3.87	4.20	3.66	3.2	3.2	3.48		
10		4.38	3.87	4.42	3.57	3.2	3.2	3.45		
11		4.53	4.04	4.24	3.48	3.2	3.2	3.45		
12		4.53	4.05	4.05	3.42	3.2	3.2	3.45		
13		5.08	4.01	3.87	3.40	3.2	3.25	3.45		
14		4.57	3.91	3.79	3.38	3.42	3.2	3.45		3.2
15		4.86	3.85	3.75	3.38	3.4	3.2	3.45		

Daily gage height, in feet, of Thief River near Thief River Falls, Minn., for 1911— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	4.15	4.90	3.81	3.75	3.38	3.38	3.2	3.45	.....	.....
17	4.15	4.75	3.76	4.21	3.35	3.35	3.2	3.45	.....	.....
18	4.0	4.64	3.74	4.55	3.32	3.35	3.2	3.45	.....	.....
19	3.85	4.55	3.73	4.60	3.30	3.32	3.6	3.42	.....	.....
20	4.0	4.50	3.69	4.42	3.25	3.30	3.57	3.42	.....	3.2
21	4.25	4.41	3.61	4.31	3.25	3.30	3.48	3.42	.....	.....
22	4.55	4.60	3.59	4.22	3.25	3.2	3.45	3.42	.....	.....
23	4.55	4.76	3.57	4.19	3.35	3.2	3.42	3.42	.....	.....
24	4.5	5.04	3.66	4.15	3.3	3.2	3.42	3.42	.....	.....
25	4.87	5.26	3.55	4.15	3.25	3.2	3.42	3.4	.....	.....
26	5.05	5.32	3.63	4.12	3.25	3.2	3.42	3.4	.....	.....
27	4.50	5.32	3.56	4.02	3.25	3.35	3.4	3.4	3.2	
28	4.6	5.20	3.56	3.87	3.25	3.32	3.4	3.4	.....	.....
29	4.3	5.14	3.42	3.69	3.25	3.3	3.42	3.4	.....	.....
30	4.22	5.20	3.48	3.65	3.25	3.3	3.42	3.4	.....	.....
31	4.14	.....	3.6	.....	3.25	.....	.....	3.42	.....	.....

NOTE.—Gage heights July 25 to Aug. 13, Aug. 22 to 26, Sept. 1 to 19, and Nov. 27 to Dec. 31, 1911, estimated because water surface was below gage. Where 3.40 is recorded, the observer reported "3.40 or below." The observer reported no flow past the gage Jan. 1 to Mar. 15, July 25 to Aug. 13, Aug. 22 to 26, and about Nov. 10 to Dec. 31, 1911.

Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	12	82	2.1	1.8	0.2	0.0	0.9	0.9
2	.....	12	24	2.4	1.8	.0	.0	.9	.8
3	.....	18	8.0	3.1	1.3	.0	.0	1.0	.7
4	.....	19	6.5	4.8	4.0	.0	.2	1.2	.6
5	.....	17	5.5	6.3	7.5	.0	.0	1.3	.6
6	.....	11	4.4	3.8	4.0	.0	.0	1.7	.6
7	.....	12	4.3	2.9	3.8	.0	.0	1.7	.5
8	.....	14	8.0	20	2.9	.0	.0	1.7	.4
9	.....	13	4.1	12	2.4	.0	.0	1.3	.3
10	.....	21	4.1	23	1.8	.0	.0	1.2	.....
11	.....	30	6.3	14	1.3	.0	.0	1.2	.....
12	.....	30	6.5	6.5	1.0	.0	.0	1.2	.....
13	.....	82	5.7	4.1	.9	.0	.2	1.2	.....
14	.....	33	4.5	3.4	.8	1.0	.0	1.2	.....
15	.....	57	4.0	3.1	.8	.9	.0	1.2	.....
16	.....	61	3.6	3.1	.8	.8	.0	1.2	.....
17	.....	47	3.2	12	.6	.6	.0	1.2	.....
18	5.5	38	3.0	32	.5	.6	.0	1.2	.....
19	4.0	32	2.9	35	.4	.5	2.0	1.0	.....
20	5.5	28	2.6	23	.2	.4	1.8	1.0	.....
21	14	23	2.1	18	.2	.4	1.3	1.0	.....
22	32	35	1.9	13	.2	.0	1.2	1.0	.....
23	32	48	1.8	12	.6	.0	1.0	1.0	.....
24	28	77	2.4	9.8	.4	.0	1.0	1.0	.....
25	58	105	1.7	9.8	.2	.0	1.0	.9	.....
26	78	114	2.2	8.4	.2	.0	1.0	.9	.....
27	28	114	1.8	5.9	.2	.6	.9	.9	.....
28	35	97	1.8	4.1	.2	.5	.9	.9	.....
29	17	89	1.0	2.6	.2	.4	1.0	.9	.....
30	13	97	1.3	2.4	.2	.4	1.0	.9	.....
31	9.3	.....	2.0	.....	.2	.2	.....	1.0	.....

NOTE.—Discharge Jan. 1 to Mar. 17 and Nov. 1 to Dec. 31 estimated, because of ice, from observer's notes and climatologic records. No flow from Jan. 1 to Mar. 12. Discharge Mar. 13 to 17 estimated 4 second-feet varying from about 1 to 9 second-feet. Nov. 10 to Dec. 31 no flow. Where no flow is noted the discharge is estimated to have been less than 0.1 second-feet.

Monthly discharge of Thief River near Thief River Falls, Minn., for 1911.

[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.		
January			0	0.000	0.00	
February			0	.000	.00	
March	78		12.2	.012	.01	C.
April	114	11	46.2	.046	.05	B.
May	82	1.0	6.88	.0068	.008	C.
June	35	2.1	10.1	.010	.01	B.
July	7.5	.2	1.34	.0013	.001	C.
August	1.0	.0	.24	.00024	.0003	D.
September	2.0	.0	.48	.00048	.0005	D.
October	1.7	.9	1.13	.0011	.001	C.
November	.9		.18	.00018	.0002	D.
December			0	.000	.00	
The year	114	0	6.53	.0065	.08	

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, 1911.

Drainage area.—1,310 square miles.

Gage.—Vertical staff, about half a mile farther down stream than the original gage. It 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. Readings to October 31, 1911, have been taken from the original gage and estimates of discharge based thereon. Simultaneous records were maintained from September 12 to October 31.

Channel.—Practically permanent.

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

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

Accuracy.—As conditions at this station are good, the records should be reliable. It is possible that backwater from the Healy dam on Red Lake River may slightly affect the relation of gage height to discharge at this new location if flashboards of usual height be put in place at the Healy dam.

Discharge measurements of Clearwater River at Red Lake Falls, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
July 20[a]	E. F. Chandler	5.60	26.1
Sept. 13[a]	....do	[b] 2.23	80
Dec. 20[c]	Goric Monley	2.11	65

[a] Measurement made by wading.
[b] Old gage read 5.83.
[c] Measurement made under complete ice cover. Average thickness of ice 1.35 feet.

NOTE.—The measurements of Sept. 13 and Dec. 20 refer to the new gage.

Daily gage height, in feet, of Clearwater River at Red Lake Falls, Minn., for 1911.

Old gage.

[James Benoit, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		7.05			6.05	6.00	5.54	5.90	5.88	5.84
2					6.00	6.02	5.54	6.02	5.82	5.80
3					6.05	6.10	5.40	5.95	5.80	5.84
4	7.0				5.92	6.50	5.00	5.90	5.80	5.86
5				7.9	5.88	6.52	5.30	5.90	5.80	5.80
6					5.80	6.38	5.38	5.95	5.78	5.80
7		7.02			5.81	6.32	5.40	6.15	5.75	5.84
8			7.22		5.82	6.85	5.50	6.12	5.70	5.89
9				7.88	5.74	7.80	5.56	6.00	5.70	5.84
10				7.81	5.60	7.75	5.62	5.82	5.75	5.80
11	7.1			7.78	6.92	7.55	5.60	5.75	5.75	5.91
12				7.56	6.88	7.35	5.45	5.80	5.88	5.81
13				7.45	6.68	7.16	5.45	5.78	5.98	5.80
14				7.24	6.55	6.95	5.48	5.78	5.94	5.81
15		7.05	7.3	6.89	6.40	6.81	5.50	5.80	5.82	5.82
16				6.85	6.25	6.65	5.52	5.82	5.80	5.89
17				6.92	6.29	6.51	5.55	5.85	5.80	5.94
18	7.12			6.76	6.30	6.42	5.60	5.90	5.85	5.90
19				6.55	6.26	6.30	5.60	5.95	5.82	5.91
20				6.42	6.20	6.22	5.52	6.00	5.78	5.91
21		7.15		6.38	6.28	6.10	5.60	6.10	5.72	5.89
22			7.6	6.31	6.29	6.05	5.60	6.20	5.70	5.80
23				6.30	6.20	5.96	5.65	6.20	5.70	5.65
24				6.31	6.22	5.97	5.70	6.20	5.75	5.62
25	7.1			6.32	6.15	5.88	5.65	6.30	5.80	5.64
26				6.29	6.12	5.92	5.50	6.35	5.85	5.66
27				6.20	6.08	5.98	5.60	6.30	5.92	5.70
28		7.1		6.12	6.00	6.00	5.72	6.40	6.00	5.74
29				6.10	6.01	5.79	5.80	6.25	5.95	5.79
30				6.12	6.12	5.55	5.85	6.15	5.85	5.88
31					6.08		5.90	6.05		5.82

NOTE.—Ice present Jan. 1 to Apr. 8. Average thickness of ice 2 to 2.5 feet.
July 4, gage height apparently in error.

New gage.

[Leo Steinert, observer.]

Day.	Sept.	Oct.	Nov.	Day.	Sept.	Oct.	Nov.	Day.	Sept.	Oct.	Nov.
1		2.1	2.05	11		2.2	2.42	21	2.15	2.2	
2		2.2	2.3	12	2.1	2.2		22	2.2	2.4	
3		2.25	2.65	13	2.18	2.2		23	2.2	2.05	
4		2.25	2.2	14	2.15	2.22		24	2.2	2.2	
5		2.25	2.15	15	2.05	2.3		25	2.2	2.25	
6		2.25	2.22	16	2.15	2.3		26	2.2	2.2	
7		2.3	2.22	17	2.2	2.3		27	2.2	2.3	
8		2.2	2.25	18	2.05	2.38		28	2.2	2.3	
9		2.25	2.3	19	2.2	2.05		29	2.2	2.25	
10		2.25	2.3	20	2.2	2.2		30	2.2	2.3	
								31		2.3	

NOTE.—Relation of gage height to discharge affected by ice about Nov. 10 to Dec. 31, 1911.

Daily discharge, in second-feet, of Clearwater River at Red Lake Falls, Minn., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1....	60	68	63	30	53	51	48	16....	234	95	178	30	46	44	52
2....	70	63	65	30	65	46	44	17....	257	101	146	30	48	44	57
3....	80	68	74	27	58	44	48	18....	207	103	126	32	53	48	53
4....	100	55	144	20	53	44	49	19....	155	97	103	32	58	46	54
5....	125	51	148	26	53	44	44	20....	126	87	90	30	63	43	54
6....	175	44	118	27	58	43	44	21....	118	100	74	32	74	38	52
7....	250	45	107	27	80	40	48	22....	105	101	68	32	87	37	44
8....	400	46	234	29	77	37	52	23....	103	87	59	34	87	37	34
9....	767	40	715	31	63	37	48	24....	105	90	60	37	87	40	33
10....	722	32	685	33	46	40	44	25....	107	80	51	34	103	44	34
11....	703	257	565	32	40	40	54	26....	101	77	55	29	112	48	35
12....	571	244	448	28	44	51	45	27....	87	72	61	32	103	55	37
13....	505	185	352	28	43	61	44	28....	77	63	63	38	122	63	40
14....	390	155	268	29	43	57	45	29....	74	64	43	44	95	58	43
15....	247	122	221	29	44	46	46	30....	77	77	30	48	80	48	51
								31....	.....	72	.....	53	68	.....	46

NOTE.—Daily discharge computed from a well-defined rating curve and gage heights read from original gage. Discharge estimated from Apr. 1 to 8 because of ice. Discharge estimated July 4 because of apparent error in gage height.

Monthly discharge of Clearwater River at Red Lake Falls, Minn., for 1911.

[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	.....	.....	[a] 45.0	0.034	0.04	2,770	C.
February	.....	.....	[a] 45.0	.034	.04	2,500	D.
March	.....	.....	[a] 55.0	.042	.05	3,380	D.
April	767	60	237	.181	.20	14,100	B.
May	257	32	91.6	.070	.08	5,630	A.
June	715	30	180	.137	.15	10,700	A.
July	53	[b] 20	32.0	.024	.03	1,970	B.
August	122	40	67.9	.052	.06	4,180	C.
September	63	37	45.8	.035	.04	2,730	C.
October	57	33	45.9	.035	.04	2,820	C.
The period	.....	.....	.....	.....	.....	50,800	

[a] Estimated from one discharge measurement, semiweekly gage heights to the water surface, and climatologic records.
[b] Estimated.

NOTE.—See footnotes to table of daily discharge.

SOUTH BRANCH OF TWO RIVERS AT HALLOCK, MINN.

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

Records available.—April 29 to November 15, 1911.

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.

Accuracy.—Low because of doubt as to accuracy of daily gage heights in addition to discharge rating curve only fairly well defined.

Discharge measurements of South Branch of Two Rivers at Hallock, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Apr. 29	E. F. Chandler	2.21	30.0
June 15	do	7.72	540
26	do	4.32	178
Oct. 23	Goric Monley	1.80	9.2

Daily gage height, in feet, of South Branch of Two Rivers at Hallock, Minn., for 1911.

[John A. Ross, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.10	2.40	3.0	1.6	1.8	2.0	2.0
2	.....	2.00	2.50	3.0	1.6	1.8	2.0	2.0
3	.....	1.90	2.60	2.9	1.6	1.8	2.0	2.0
4	.....	1.90	4.10	2.8	1.6	1.8	2.6	2.0
5	.....	1.90	4.60	2.6	1.6	1.8	2.6	1.9
6	.....	1.90	4.50	2.6	1.8	1.7	3.0	1.9
7	.....	1.90	4.50	2.4	1.8	1.7	3.0	1.9
8	.....	1.90	5.50	2.4	1.8	1.6	3.0	1.9
9	.....	1.80	7.30	2.4	1.6	1.6	2.9	1.9
10	.....	1.90	8.30	2.4	1.6	1.6	2.9	1.9
11	.....	2.50	8.60	2.4	1.6	1.6	2.6	.....
12	.....	2.65	8.60	2.2	1.6	1.6	2.6	.....
13	.....	2.85	8.60	2.2	1.6	1.6	2.9	.....
14	.....	3.10	8.10	2.2	1.6	1.6	3.0	.....
15	.....	3.30	7.70	2.1	1.6	1.6	3.0	.....
16	.....	3.38	7.00	2.1	1.6	1.6	2.9	.....
17	.....	3.30	7.40	2.1	1.6	1.6	2.9	.....
18	.....	3.35	7.40	2.0	1.6	1.9	2.6	.....
19	.....	3.20	7.00	2.0	1.6	2.0	2.6	.....
20	.....	3.40	6.60	2.0	1.6	2.0	2.3	.....
21	.....	3.50	6.30	2.0	1.6	1.9	2.0	.....
22	.....	2.90	6.00	1.9	1.8	1.9	2.0	.....
23	.....	2.60	5.60	1.8	1.8	1.7	2.0	.....
24	.....	2.70	5.00	1.8	1.9	1.7	2.0	.....
25	.....	2.60	4.70	1.8	2.0	1.7	2.0	.....
26	.....	2.50	4.50	1.6	2.0	1.7	2.0	.....
27	.....	2.30	4.00	1.6	1.8	1.7	2.0	.....
28	.....	2.20	3.50	1.6	1.8	2.0	2.0	.....
29	2.2	2.20	3.20	1.6	1.8	2.0	2.0	.....
30	2.15	2.30	3.00	1.6	1.8	2.0	2.0	.....
31	.....	2.30	.....	1.6	1.8	.....	2.0	.....

Daily discharge, in second-feet, of South Branch of Two Rivers at Hallock, Minn., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	24	39	76	8	13	20	20
2	.....	20	45	76	8	13	20	20
3	.....	16	51	69	8	13	20	20
4	.....	16	161	63	8	13	51	20
5	.....	16	206	51	8	13	51	16
6	.....	16	197	51	13	10	76	16
7	.....	16	197	39	13	10	76	16
8	.....	16	295	39	13	8	76	16
9	.....	13	491	39	8	8	69	16
10	.....	16	601	39	8	8	69	16

Daily discharge, in second-feet, of South Branch of Two Rivers at Hallock, Minn., for 1911— Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	45	634	39	8	8	51	.....
12	.....	54	634	29	8	8	51	.....
13	.....	66	634	29	8	8	69	.....
14	.....	83	579	29	8	8	76	.....
15	.....	97	535	24	8	8	76	.....
16	.....	103	458	24	8	8	69	.....
17	.....	97	502	24	8	8	69	.....
18	.....	100	502	20	8	16	51	.....
19	.....	90	458	20	8	20	51	.....
20	.....	104	414	20	8	20	34	.....
21	.....	112	381	20	8	16	20	.....
22	.....	69	348	16	13	16	20	.....
23	.....	51	305	13	13	10	20	.....
24	.....	57	245	13	16	10	20	.....
25	.....	51	215	13	20	10	20	.....
26	.....	45	197	8	20	10	20	.....
27	.....	34	152	8	13	10	20	.....
28	.....	29	112	8	13	20	20	.....
29	29	29	90	8	13	20	20	.....
30	26	34	76	8	13	20	20	.....
31	.....	34	.....	8	13	.....	20	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between 6 and 568 second-feet (gage heights 1.5 and 8.0 feet). Discharge Nov. 11 to Dec. 31 estimated by Prof. E. F. Chandler from climatologic records, discharge of adjacent drainage areas, one discharge measurement (made Mar. 12, 1912, before the preparation of this report) and the fact that the observer kept watch of the stream in order to report any marked variation in discharge. It should be noted that these estimates are based on less data than estimates at most of the stations in this report and that they simply represent the best values available for publication. Mean discharge Nov. 11 to 30 estimated 10 second-feet. Mean discharge Dec. 1 to 31 estimated 8 second-feet.

Monthly discharge of South Branch of Two Rivers at Hallock, Minn., for 1911.

[Drainage area, 776 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
May	112	13	50.1	0.065	0.07	B.
June	634	39	325	.419	.47	B.
July	76	8	29.8	.038	.04	D.
August	20	8	10.6	.014	.02	D.
September	20	8	12.1	.016	.02	D.
October	76	20	43.4	.056	.06	D.
November	20	.....	12.5	.016	.02	D.
December	.....	.....	8.0	.010	.01	

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, 1911.

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 below the Great Northern dam.

Regulation.—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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 30	E. F. Chandler	2.79	148
July 31	....do	1.77	15.7
Oct. 1	Gorie Monley	1.70	9.4

NOTE.—Measurements of July 31 and Oct. 1 were 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 1911.

[W. Young and E. Young, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	4.3	3.2	2.7	.....	.....	1.7	1.4
2	.....	4.0	3.3	2.7	.....	.....	1.7	1.4
3	.....	4.0	3.4	2.8	.....	.....	1.7	1.5
4	.....	4.0	3.0	2.8	.....	1.9	1.7	1.7
5	.....	3.9	3.0	2.7	.....	1.9	1.8	1.9
6	.....	3.7	3.1	2.7	.....	1.9	1.7	1.9
7	.....	3.7	3.2	2.7	.....	2.0	1.7	1.9
8	.....	3.6	3.3	2.8	.....	2.0	1.8	1.8
9	.....	3.5	3.4	2.9	.....	2.0	1.7	1.8
10	.....	3.2	3.3	3.0	.....	1.9	1.6	1.9
11	.....	3.1	3.3	3.0	.....	1.9	1.5	1.9
12	.....	3.0	3.0	2.8	.....	2.0	1.5	1.9
13	.....	3.4	3.0	2.9	.....	2.0	1.4	1.9
14	.....	3.8	3.0	3.0	.....	1.9	1.4	1.9
15	.....	3.6	3.1	3.1	.....	1.9	1.3	1.9
16	.....	3.3	3.4	2.9	.....	1.9	1.3	1.9
17	.....	4.0	4.6	3.0	.....	1.9	1.4	1.9
18	.....	4.3	4.8	2.8	.....	1.9	1.3	1.9
19	.....	3.8	4.5	2.8	.....	1.9	1.3	1.9
20	.....	3.5	3.8	2.8	.....	1.9	1.4	2.0
21	.....	3.2	3.1	2.7	.....	1.9	1.3	2.0
22	.....	3.2	3.3	2.9	.....	2.0	1.3	1.9
23	8.4	3.2	3.0	3.0	.....	1.9	1.3	1.9
24	8.9	3.0	2.9	3.0	.....	1.9	1.3	1.9
25	8.6	3.6	2.7	2.9	.....	1.8	1.4	1.8
26	8.2	3.8	3.0	2.8	.....	1.8	1.4	1.8
27	5.8	3.2	3.1	2.7	.....	1.8	1.5	1.7
28	5.0	3.6	3.0	2.7	.....	1.8	1.5	1.7
29	.....	4.0	2.9	2.7	.....	1.8	1.7	1.7
30	.....	4.3	2.9	2.6	.....	1.8	.....	1.6
31	4.8	.....	2.8	.....	.....	1.7	.....	1.7

NOTE.—The new observer, Elsie Young, began reading the gage on May 21. From July 1 to Aug. 3 the river was below the top of the cofferdam around the railway bridge pier, to which the old gage is attached, and the gage heights reported by observer represented the level of the water in a pool inside the cofferdam and not the height of the river proper and are therefore not published. The observer notes that from Aug. 4 on she read the gage at the highway bridge. Relation of gage height to discharge probably affected by ice Mar. 23 to 30. River reported "frozen" Mar. 29 and 30.

Daily discharge, in second-feet, of Pembina River at Neche, N. Dak., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	420	215	133	110	15	11	2
2	.....	363	233	133	110	15	11	2
3	.....	363	251	149	100	20	11	4
4	.....	363	181	149	100	25	11	11
5	.....	344	181	133	90	25	17	25
6	.....	306	198	133	90	25	11	25
7	.....	306	215	133	80	35	11	25
8	.....	287	283	149	70	35	17	17
9	.....	269	251	165	70	35	11	17
10	.....	215	233	181	60	25	7	25
11	.....	198	233	181	60	25	4	25
12	.....	181	181	149	50	35	4	25
13	.....	251	181	165	50	35	2	25
14	.....	325	161	165	40	25	2	25
15	.....	287	198	198	40	25	1	25
16	.....	233	251	165	40	25	1	25
17	.....	363	480	181	35	25	2	25
18	.....	420	520	149	35	25	1	25
19	.....	325	460	149	35	25	1	25
20	.....	269	325	149	30	25	2	35
21	.....	215	198	133	30	25	1	35
22	.....	215	233	165	25	35	1	25
23	800	215	181	181	25	25	1	25
24	900	181	165	181	25	25	1	25
25	900	287	133	165	20	17	2	17
26	800	325	181	149	20	17	2	17
27	500	215	198	133	20	17	4	11
28	450	287	181	133	20	17	4	11
29	450	363	165	133	15	17	11	11
30	450	420	165	118	15	17	7	7
31	520	.....	149	.....	15	11	.....	11

NOTE.—Daily discharge determined by means of a discharge rating curve that is based on three discharge measurements made during 1911 and the form of the 1910 curve and is poorly defined. Daily discharge, Mar. 23 to 30, estimated because of ice. Daily discharge, July 1 to Aug. 3, estimated because of error in reported gage heights. See footnote to table of daily gage height. Daily discharge Sept. 30 interpolated.

Monthly discharge of Pembina River at Neche, N. Dak., for 1911.

[Drainage area, 2,940 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.	
March 23–31	[a] 900	[a] 450	[a] 641	0.218	0.07	11,400	D.
April	420	181	294	.100	.11	17,500	C.
May	520	133	231	.079	.09	14,200	B.
June	198	118	154	.052	.06	9,160	B.
July	[a] 110	[a] 15	[a] 49.2	.017	.02	3,030	D.
August	35	11	24.1	.0082	.009	1,480	C.
September	17	1	5.7	.0019	.002	339	D.
October	35	2	19.6	.0067	.008	1,210	D.
The period	.....	.....	.....	.....	.....	58,300	

[a] Estimated.

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

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.—Gage heights and discharge measurements from May 6 to November 15, 1911.

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.

Regulation.—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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 6	E. F. Chandler	2.18	4.9
June 27	do	2.49	9.7
Sept 13[a]	do	1.98	0.44

[a] Float measurement.

Daily gage height, in feet, of West Branch of Roseau River near Malung, Minn., for 1911.

[August Hedin, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.4	2.4	2.15	2.1	2.1	2.1	16	2.45	4.65	2.2	2.25	2.0	2.15	.....
2	.....	2.35	2.4	2.15	2.1	2.1	2.1	17	2.4	4.5	2.2	2.2	2.0	2.1	.....
3	.....	2.55	2.4	2.15	2.05	2.2	2.1	18	2.35	4.1	2.2	2.15	2.0	2.1	.....
4	.....	2.7	2.35	2.15	2.05	2.2	2.1	19	2.3	3.65	2.2	2.1	2.0	2.1	.....
5	.....	3.1	2.3	2.2	2.0	2.2	2.1	20	2.3	3.45	2.2	2.1	2.05	2.1	.....
6	2.2	3.0	2.3	2.25	2.0	2.2	2.1	21	2.3	3.15	2.2	2.2	2.05	2.1	.....
7	2.2	2.8	2.3	2.25	2.0	2.2	2.1	23	2.25	2.95	2.15	2.2	2.1	2.15	.....
8	2.15	3.1	2.45	2.2	2.0	2.2	2.05	23	2.25	2.7	2.15	2.15	2.1	2.15	.....
9	2.15	3.4	2.4	2.15	2.0	2.2	2.05	24	2.2	2.65	2.15	2.1	2.1	2.15	.....
10	2.2	4.6	2.4	2.15	2.0	2.15	2.05	25	2.2	2.5	2.15	2.1	2.1	2.15	.....
11	2.2	6.85	2.35	2.1	2.0	2.15	2.05	26	2.3	2.5	2.15	2.05	2.1	2.1	.....
12	2.3	8.15	2.35	2.05	2.0	2.1	2.2	27	2.3	2.45	2.1	2.1	2.1	2.1	.....
13	2.3	7.9	2.3	2.05	2.0	2.15	2.2	28	2.35	2.45	2.1	2.15	2.1	2.1	.....
14	2.35	6.6	2.3	2.45	2.0	2.2	.....	29	2.3	2.45	2.1	2.1	2.1	2.1	.....
15	2.45	5.3	2.25	2.35	2.0	2.2	.....	30	2.4	2.4	2.1	2.1	2.1	2.1	.....
								31	2.4	.....	2.1	2.1	.....	2.1	.....

Daily discharge, in second-feet, of West Branch of Roseau River near Malung, Minn., for 1911.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1....	.....	7.6	7.6	3.0	2.2	2.2	2.2	16....	8.7	126	3.8	4.7	.8	3.0	.....
2....	.....	6.6	7.6	3.0	2.2	2.2	2.2	17....	7.6	115	3.8	3.8	.8	2.2	.....
3....	.....	11	7.6	3.0	1.5	3.8	2.2	18....	6.6	87	3.8	3.0	.8	2.2	.....
4....	.....	15	6.6	3.0	1.5	3.8	2.2	19....	5.6	58	3.8	2.2	.8	2.2	.....
5....	.....	29	5.6	3.8	.8	3.8	2.2	20....	5.6	46	3.8	2.2	1.5	2.2	.....
6....	3.8	25	5.6	4.7	.8	3.8	2.2	21....	5.6	31	3.8	3.8	1.5	2.2	.....
7....	3.8	18	5.6	4.7	.8	3.8	2.2	22....	4.7	23	3.0	3.8	2.2	3.0	.....
8....	3.0	29	8.7	3.8	.8	3.8	1.5	23....	4.7	15	3.0	3.0	2.2	3.0	.....
9....	3.0	43	7.6	3.0	.8	3.8	1.5	24....	3.8	14	3.0	2.2	2.2	3.0	.....
10....	3.8	122	7.6	3.0	.8	3.0	1.5	25....	3.8	9.8	3.0	2.2	2.2	3.0	.....
11....	3.8	342	6.6	2.2	.8	3.0	1.5	26....	5.6	9.8	3.0	1.5	2.2	2.2	.....
12....	5.6	507	6.6	1.5	.8	2.2	3.8	27....	5.6	8.7	2.2	2.2	2.2	2.2	.....
13....	5.6	473	5.6	1.5	.8	3.0	.....	28....	6.6	8.7	2.2	3.0	2.2	2.2	.....
14....	6.6	314	5.6	8.7	.8	3.8	.....	29....	5.6	8.7	2.2	2.2	2.2	2.2	.....
15....	8.7	182	4.7	6.6	.8	3.8	.....	30....	7.6	7.6	2.2	2.2	2.2	2.2	.....
								31....	7.6	.....	2.2	2.2	.....	2.2	.....

NOTE.—Discharge Nov. 13 to Dec. 31 estimated by E. F. Chandler from climatologic records, discharge of adjacent drainage areas, and the fact that the observer kept watch of the stream in order to report any marked variation in discharge. It should be noted that these estimates are based on less data than estimates at most of the stations in this report and that they simply represent the best values available for publication. Mean discharge Nov. 13 to 30 estimated 2 second-feet. Mean discharge Dec. 1 to 31 estimated 1.5 second-feet.

Monthly discharge of West Branch of Roseau River near Malung, Minn., for 1911.

[Drainage area, 265 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
May 6-31	8.7	3.0	5.50	0.021	0.02	C.
June	507	6.6	89.8	.339	.38	B.
July	8.7	2.2	4.77	.018	.02	C.
August	8.7	1.5	3.22	.012	.01	C.
September	2.2	.8	1.41	.0053	.006	D.
October	3.8	2.2	2.87	.011	.01	D.
November	3.8	.....	2.04	.0077	.009	
December	.....	.....	1.5	.0057	.007	

NOTE.—See footnotes 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, 1911.

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 measurement 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.

Regulation.—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 6.0 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 in 1911 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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Aug. 3	E. F. Chandler	4.49	18.3
17	do	4.54	21.8

NOTE.—Measurements made by wading below the "Soo" Railway's dam.

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1911.

[Ephraim Cox, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.40	7.55	5.3	4.8	4.45	4.2	3.7	4.4	.....
2	.....	4.5	7.5	5.4	4.8	4.45	4.15	3.7	4.4	.....
3	.....	4.5	7.45	5.45	4.75	4.5	4.15	3.7	4.45	.....
4	.....	4.55	7.4	5.5	4.75	4.5	4.15	3.75	4.45	.....
5	.....	4.55	7.35	5.45	4.75	4.55	4.2	3.75	4.45	.....
6	.....	4.6	7.3	5.45	4.75	4.55	4.2	3.75	4.45	.....
7	.....	4.6	7.2	5.4	4.7	4.55	4.2	3.75	4.45	.....
8	.....	4.55	7.15	5.4	4.7	4.55	4.25	3.75	4.5	.....
9	.....	4.65	7.1	5.35	4.7	4.55	4.25	3.75	4.5	.....
10	.....	4.8	7.0	5.35	4.65	4.5	4.2	3.85	4.5	.....
11	.....	5.2	6.95	5.3	4.65	4.5	4.2	3.9	.....	.....
12	.....	5.5	6.85	5.3	4.65	4.5	4.15	3.95	.....	.....
13	.....	5.65	6.75	5.25	4.65	4.5	4.15	3.95	.....	.....
14	.....	5.75	6.7	5.25	4.6	4.5	4.0	4.0	.....	.....
15	.....	5.85	6.65	5.2	4.6	4.45	4.0	4.05	.....	4.1

Daily gage height, in feet, of Mouse River at Minot, N. Dak., for 1911—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	5.95	6.55	5.2	4.6	4.45	4.0	4.05	.....	.....
17	.....	6.2	6.45	5.15	4.6	4.45	4.0	4.1	.....	.....
18	.....	6.35	6.3	5.15	4.6	4.45	4.0	4.1	.....	.....
19	4.1	6.5	6.2	5.1	4.6	4.4	3.95	4.1	.....	.....
20	4.1	6.6	6.1	5.1	4.55	4.45	3.95	4.15	.....	.....
21	4.15	6.75	5.95	5.0	4.55	4.45	3.95	4.15	.....	.....
22	4.2	6.85	5.8	5.0	4.55	4.5	3.8	4.15	.....	.....
23	4.2	6.95	5.75	4.9	4.55	4.5	3.8	4.15	.....	.....
24	4.25	7.15	5.6	4.9	4.55	4.5	3.8	4.15	.....	.....
25	4.3	7.3	5.55	4.85	4.55	4.45	3.8	4.2	.....	.....
26	4.35	7.35	5.5	4.85	4.5	4.45	3.75	4.2	.....	.....
27	4.35	7.45	5.45	4.8	4.5	4.4	3.75	4.2	.....	.....
28	4.4	7.55	5.3	4.8	4.5	4.4	3.75	4.3	.....	.....
29	4.4	7.65	5.25	4.8	4.45	4.25	3.7	4.3	.....	.....
30	4.45	7.6	5.25	4.75	4.45	4.25	3.7	4.35	4.2	.....
31	4.45	.....	5.2	.....	4.45	4.2	.....	4.35	.....	4.1

NOTE.—Gage heights July 1 to Nov. 10 above are corrected values, but may be from 0.1 to 0.3 foot in error as result of mistake made by gage observer.

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	14	722	168	64	14	3.6	0.7	10
2	.....	18	712	191	64	14	3.1	.7	10
3	.....	18	702	202	55	18	3.1	.7	14
4	.....	24	691	214	55	18	3.1	.8	14
5	.....	24	680	202	55	24	3.6	.8	14
6	.....	30	670	202	55	24	3.6	.8	14
7	.....	30	648	191	46	24	3.6	.8	14
8	.....	24	636	191	46	24	4.4	.8	18
9	.....	38	625	180	46	24	4.4	.8	18
10	.....	64	601	180	38	18	3.6	1.2	18
11	.....	146	589	168	38	18	3.6	1.4	.....
12	.....	214	564	168	38	18	3.1	1.6	.....
13	.....	250	539	157	38	18	3.1	1.6	.....
14	.....	274	526	157	30	18	1.9	1.9	.....
15	.....	300	512	146	30	14	1.9	2.2	.....
16	.....	325	486	146	30	14	1.9	2.2	.....
17	.....	391	458	135	30	14	1.9	2.6	.....
18	.....	432	418	135	30	14	1.9	2.6	.....
19	2.6	472	391	124	30	10	1.6	2.6	.....
20	2.6	499	364	124	24	14	1.6	3.1	.....
21	3.1	539	325	103	24	14	1.6	3.1	.....
22	3.6	564	287	103	24	18	1	3.1	.....
23	3.6	589	274	83	24	18	1	3.1	.....
24	4.4	636	238	83	24	18	1	3.1	.....
25	5.3	670	226	74	24	14	1	3.6	.....
26	7.6	680	214	74	18	14	.8	3.6	.....
27	7.6	702	202	64	18	10	.8	3.6	.....
28	10	722	168	64	18	10	.8	5.3	.....
29	10	744	157	64	14	4.4	.7	5.3	.....
30	14	733	157	55	14	4.4	.7	7.6	.....
31	14	.....	146	.....	14	3.6	.....	7.6	.....

NOTE.—Daily discharge determined by means of discharge rating curve that was made by considering the Soo Dam as a broad-crested weir, with corrections for velocity of approach, for the slope of the upstream face, for the submergence or partial submergence of the weir when the reading at the gage is greater than 6 feet, and for the backwater function or slope of the water surface between the weir and the gage, suitable coefficients for use in the computations having been secured by successive approximations until the table fits closely the discharge measurements made during 1911. Discharge Nov. 10 to Dec. 31 estimated, because of ice, from observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Nov. 10 to 30 estimated 8 second-feet, varying from about 3 to 16 second-feet. Mean discharge Dec. 1 to 31 estimated 2 second-feet.

Monthly discharge of Mouse River at Minot, N. Dak., for 1911.

[Drainage area, 8,400 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.	
March 19–31	14	2.6	6.80	0.00081	0.0004	175	D.
April	744	14	339	.040	.04	20,200	B.
May	722	146	449	.053	.06	27,600	B.
June	214	55	138	.016	.02	8,210	C.
July	64	14	34.1	.0041	.005	2,100	D.
August	24	3.6	15.6	.0019	.002	959	D.
September	4.4	.7	2.27	.00027	.0003	135	D.
October	7.6	.7	2.55	.00030	.0003	157	D.
November	18	.....	10.1	.0012	.001	601	D.
December	.....	.....	2	.00024	.0003	123	D.
The period	.....	.....	.....	.....	.....	60,300	

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

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 1911, daily observations being made during the entire open season, except the first two weeks. 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.

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.

[1] For complete description of this station and records of evaporation, rainfall, and temperature for 1905, 1908, see Water-Supply Paper U. S. Geol. Survey No. 245, 1910, pp. 64–67.

Observations were made usually about a half 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 1911 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 1911.

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

Date.	Evaporation.	Rainfall.	Mean temperature.	
			Water.	Air.
	Inches.	*Inches.*	°*F.*	°*F.*
Apr. 22–30	1.80	0.00	51	54
May 1–10	1.60	.64	54	52
May 11–20	.94	1.90	59	61
May 21–31	1.17	.63	62	59
June 1–10	.53	3.83	72	69
June 11–20	1.69	.44	73	67
June 21–30	2.11	.51	73	70
July 1–10	2.01	1.02	76	71
July 11–20	2.05	.26	68	60
July 21–31	2.07	.78	67	64
Aug. 1–10	1.13	1.66	66	65
Aug. 11–20	1.50	.47	72	68
Aug. 21–31	1.36	1.25	60	58
Sept. 1–10	1.03	.56	59	57
Sept. 11–20	.75	.41	56	58
Sept. 21–30	.54	.10	50	48
Oct. 1–10	.46	.83	50	51
Oct. 11–21	.53	.03	53	49
Oct. 21–31	.30	.08	38	28
Total for period	23.57	15.40		

RAINY RIVER BASIN.

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, 1911, from Geological Survey records, and August 14 to December 31, 1911, from an independent interpretation of power-house records by the Canadian Department of Public Works.

Drainage area.—14,600 square miles.[1]

Gage.—Vertical staff. Prior to April 20, 1911, the gage heights were furnished through the courtesy of the Minnesota & Ontario Power Co. They were referred to a gage located just below the dam, first on the American side but later on the Canadian side. On April 20, 1911, a gage was installed by the United States Geological Survey at the American steamboat dock below the falls. The zero of the latter gage is 460.99 feet above that of the power company's gage, when the slope[2] of the river between the two points is considered. The gage heights given herein are referred to the Geological Survey gage.

[1] Revised since previous report. [2] Slope determined at gage height 2.65 feet.

Channel.—Practically permanent.

Discharge measurements.—Discharge measurements for the purpose of rating the section have been made by the Geological Survey since 1909, 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. Additional measurements referred to the same gage have been made by Canadian Government engineers and furnished through their courtesy.

Winter flow.—Although the dam prevents ice forming at the power company's gage, which is used during the winter months, ice forms on the rapids several miles below, causing serious backwater at the gage. Since 1909 and 1910 the monthly estimates during the frozen period have been based indirectly on records of flow through the turbines, as kept by the power company, and upon a few discharge measurements. Previous to 1910 the winter estimates can be considered only very approximate.

Regulation.—The low-water flow at the station is controlled by the operation of the power plants at the dam, as shown by the drop in gage heights on Sundays during portions of 1910 and 1911. The flow during the summer and fall months of 1911 does not represent the natural run-off from the drainage basin, as during that period the water level above the dam rose 5 feet. As the dam backs up the water in Rainy Lake, this rise represents a large increase in storage.

Accuracy.—Although the channel is practically permanent, the conditions for measuring the flow are not of the best, and therefore the results of the measurements are somewhat erratic. See "Winter flow."

Discharge measurements of Rainy River at International Falls, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 20	Canadian Government engineers	1.93	5,880
June 7	R. Follansbee and S. B. Soulé	2.68	6,720
July 13	S. B. Soulé	.53	[a] 4,750
14	do	.70	4,010
Aug. 12	Canadian Government engineers	2.73	6,510
Sept. 19	do	2.02	5,910
Dec. 5	do	[b] 3.14	5,890

[a] Rejected; affected by motion of boat due to waves. [b] Backwater from ice.

Daily gage height, in feet, of Rainy River at International Falls, Minn., for 1911.

[George St. Lawrence, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	1.27	1.17	.....	−0.31	2.30	0.64	2.55	2.71	1.6	1.58	3.30
2	0.47	1.27	1.22	.....	.55	2.24	a −.50	2.54	2.70	.95	1.60	3.25
3	1.57	1.47	1.37	.....	.68	2.24	a −1.00	2.70	2.70	1.70	1.50	2.80
4	1.87	1.57	1.87	.....	.62	a.85	a −1.00	2.65	2.36	1.85	1.25	2.66
5	1.77	(a)	(a)	.....	.64	.85	.35	2.45	2.46	1.85	0.68	3.14
6	1.77	.47	1.07	.....	.64	2.60	.78	1.35	2.64	1.9	1.00	3.08
7	2.57	1.47	.....	.....	a−.01	2.68	.70	2.35	2.54	1.75	1.35	2.94
8	(a)	1.67	.....	.....	a−.13	2.66	.75	2.60	2.60	1.32	1.32	2.96
9	.67	1.67	.....	.....	.72	2.62	a.55	2.64	2.50	1.08	1.40	3.09
10	1.87	1.67	.....	.....	.94	3.20	.60	2.74	2.36	1.38	1.68	2.45
11	2.07	1.57	.....	.....	1.66	a 1.20	.90	2.85	2.40	1.84	1.25	2.12
12	2.37	(a)	.....	.....	1.60	2.65	.65	2.84	2.40	1.89	2.16	2.60
13	.....	.47	.....	.....	.95	3.90	.70	a.62	2.36	1.88	2.69	2.65
14	2.17	.....	.....	.....	a−.27	4.04	.74	2.55	2.36	1.69	3.01	2.65
15	(a)	.....	.....	.....	.76	4.12	.90	2.85	2.40	.95	3.20	2.58

[a] Power plant closed.

Daily gage height, in feet, of Rainy River at International Falls, Minn., for 1911—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.85	.....	.....	.....	1.22	3.98	a.30	2.74	2.09	1.00	3.18	2.48
17	1.37	.....	.....	.....	2.11	3.15	.61	2.74	a1.35	1.58	3.22	1.98
18	1.87	.....	.....	1.26	1.51	a1.00	.64	2.94	a1.21	1.78	3.25	1.52
19	1.37	.....	.....	1.01	1.98	1.24	.53	2.80	2.00	1.89	1.60	2.42
20	1.27	.....	.....	1.08	1.92	2.66	— .04	a1.95	2.15	2.04	2.31	2.56
21	1.27	.....	.....	.95	a—.25	2.90	— .08	2.40	2.00	1.75	3.25	2.50
22	(a)	.....	.....	.94	1.06	2.84	— .08	2.74	1.72	1.19	3.35	2.48
23	.47	.....	.....	.30	2.06	2.38	(a)	2.74	2.01	1.00	3.35	2.41
24	1.07	.....	.....	.52	2.16	1.80	(a)	2.92	a1.25	1.05	3.50	.95
25	.87	1.17	.....	.58	2.17	a1.80	.72	2.72	a.61	1.75	3.68	.10
26	.97	(a)	.....	.40	1.85	1.61	2.11	2.88	1.70	1.84	3.08	1.85
27	1.07	.37	.....	.30	2.13	1.70	2.31	a1.92	1.70	1.92	2.10	3.38
28	1.37	1.07	.....	.16	a—.01	1.65	2.52	2.40	1.82	1.84	3.08	3.65
29	(a)	.....	.....	.04	.78	1.49	2.68	2.55	1.90	1.48	3.22	3.70
30	.37	.....	.....	— .29	2.10	.75	a.31	2.71	1.92	.90	3.28	3.48
31	1.17	.....	.....	.....	2.26	.....	1.41	2.70	.....	1.40	.....	2.55

a Power plant closed.

NOTE.—There was backwater from ice gorging in rapids below the station Mar. 1 to 31 and Dec. 1 to 31, 1907; Jan. 1 to Feb. 28, and Dec. 1 to 31, 1908; Jan. 1 to Mar. 31, and Nov. 27 to Dec. 31, 1909; Jan. 1 to Apr. 10, and Dec. 1 to 31, 1910; Jan. 1 to Mar. 31, and Nov. 13 to Dec. 31, 1911.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1907–1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.								
1	5,840	6,270	10,500	11,700	13,200	17,200	17,800	16,400
2	5,270	6,490	10,300	11,900	13,200	17,200	17,800	16,400
3	5,270	6,720	10,100	12,200	13,200	17,200	17,800	16,300
4	5,130	7,020	9,820	12,300	13,200	17,200	17,700	16,200
5	4,990	7,170	9,660	12,400	13,300	17,200	17,700	16,200
6	4,990	7,320	9,500	12,500	13,300	17,200	17,800	16,200
7	5,130	7,240	9,580	12,600	13,300	17,200	17,800	16,100
8	5,270	7,160	9,660	12,700	13,500	17,200	17,800	16,100
9	5,130	7,320	9,580	12,700	13,500	17,300	17,700	16,100
10	5,130	7,160	9,500	12,800	13,500	17,300	17,800	16,000
11	5,270	7,320	9,500	12,800	14,700	17,300	17,700	15,900
12	5,130	7,320	9,660	12,900	15,900	17,200	17,700	15,700
13	5,130	7,320	9,740	12,900	16,100	17,300	17,700	15,600
14	5,130	7,160	9,820	13,000	16,100	17,300	17,700	15,400
15	4,990	7,550	9,870	13,000	16,100	17,300	17,500	15,400
16	4,860	7,940	9,820	13,000	15,900	17,300	17,300	15,400
17	4,860	8,710	9,980	13,100	15,600	17,300	17,300	15,300
18	5,130	9,180	9,980	13,200	15,600	17,300	17,300	15,200
19	5,270	9,660	10,100	13,300	16,100	17,300	17,300	15,100
20	5,270	9,820	10,100	13,400	16,100	17,700	17,200	15,100
21	5,340	9,820	10,200	13,500	16,200	17,700	17,000	14,900
22	5,410	9,660	10,400	13,600	16,200	17,900	16,800	14,800
23	5,900	9,660	10,600	13,700	16,200	18,100	16,700	14,600
24	6,400	9,820	10,800	13,700	16,200	18,100	16,500	14,600
25	6,860	9,820	10,900	13,600	16,300	18,100	16,500	14,600
26	6,860	9,980	11,000	13,600	16,400	18,100	16,500	14,500
27	7,020	10,100	11,100	13,500	16,500	18,100	16,400	14,500
28	6,560	10,800	11,200	13,500	16,500	18,100	16,400	14,400
29	6,560	10,800	11,300	13,400	16,600	18,000	16,500	14,400
30	6,420	10,600	11,500	13,300	16,700	18,000	16,500	14,400
31	.....	10,600	.....	13,300	17,200	.....	16,500	.....
1908.								
1	.....	.....	.....	13,200	14,500	12,800	10,900	8,630
2	.....	.....	.....	13,200	14,500	12,600	10,800	8,560
3	.....	.....	12,400	13,200	14,400	12,500	10,800	8,400
4	.....	.....	.....	13,200	14,300	12,400	10,700	8,240
5	.....	.....	.....	13,200	14,200	12,300	10,600	8,240
6	.....	.....	.....	13,200	14,100	12,200	10,500	8,090
7	4,580	.....	.....	13,400	14,100	12,100	10,400	7,940
8	.....	.....	.....	13,500	14,000	12,100	10,300	7,860
9	.....	.....	14,600	13,400	14,000	12,000	10,200	7,780
10	.....	.....	.....	13,400	14,000	12,000	10,100	7,780

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1907–1911—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
11	.....	.....	.....	13,300	14,000	11,900	10,000	7,620
12	.....	.....	.....	13,400	14,000	11,800	9,930	7,620
13	.....	.....	15,300	13,500	14,000	11,700	9,840	7,620
14	.....	.....	.....	13,500	14,000	11,600	9,750	7,620
15	.....	11,400	.....	13,600	14,000	11,500	9,660	7,470
16	.....	.....	.....	13,700	14,000	11,400	9,660	7,320
17	.....	.....	.....	14,200	14,000	11,400	9,500	7,320
18	7,470	.....	12,500	14,700	14,000	11,400	9,420	7,320
19	.....	.....	.....	15,100	13,900	11,400	9,340	7,320
20	.....	.....	.....	15,400	13,800	11,200	9,260	7,320
21	.....	.....	.....	15,300	13,700	11,100	9,180	7,160
22	.....	.....	.....	15,200	13,500	11,100	9,120	7,090
23	.....	.....	.....	15,100	13,200	11,000	9,070	7,020
24	.....	.....	.....	15,000	12,900	11,000	9,020	7,020
25	.....	.....	.....	14,900	12,700	11,000	9,020	6,860
26	.....	.....	13,000	14,800	12,500	10,900	9,020	6,860
27	.....	14,000	.....	14,700	12,500	10,900	8,940	6,860
28	.....	.....	.....	14,600	12,600	10,900	8,860	6,860
29	.....	.....	.....	14,600	12,700	10,900	8,860	6,790
30	12,900	.....	.....	14,600	12,800	10,900	8,710	6,720
31	.....	.....	.....	14,500	12,900	.....	8,710	.....
1909.								
1	5,550	2,380	976	10,900	9,340	8,710	8,710	8,860
2	5,270	2,500	1,900	10,900	9,340	8,240	8,560	8,510
3	5,130	2,530	3,140	11,100	9,500	8,710	8,560	8,130
4	5,060	2,560	4,720	11,000	10,100	9,340	8,560	7,750
5	4,990	2,590	5,270	10,900	9,820	9,420	8,560	7,370
6	4,450	2,630	5,690	11,100	9,980	9,500	9,820	6,990
7	4,380	3,010	4,580	10,900	10,100	8,400	9,820	6,610
8	4,320	3,390	4,860	11,100	10,200	7,940	9,820	6,230
9	4,180	3,780	5,980	11,100	10,300	9,020	9,820	5,750
10	4,050	3,920	6,120	11,000	10,800	9,500	9,900	5,480
11	3,920	3,920	6,420	10,800	11,100	10,100	9,980	5,100
12	3,780	3,920	6,120	10,800	11,100	10,200	10,100	4,720
13	2,380	4,860	6,490	9,820	12,900	10,300	10,300	3,920
14	2,260	7,160	6,860	9,980	13,700	10,100	10,100	3,990
15	2,260	7,500	7,020	9,820	13,600	10,100	9,050	4,050
16	2,260	7,500	7,160	10,300	13,500	10,100	8,530	4,140
17	2,140	7,300	7,020	10,300	13,000	10,100	8,020	4,230
18	1,780	7,000	7,160	10,800	12,400	10,100	7,520	4,320
19	1,430	6,860	7,160	11,300	12,100	9,330	7,020	4,320
20	1,430	5,980	7,160	11,300	11,900	8,560	7,160	4,450
21	431	4,990	7,160	11,300	12,400	8,560	7,620	4,600
22	1,200	4,180	8,400	11,300	12,000	8,710	8,240	4,720
23	1,320	3,520	8,560	10,900	11,700	8,710	8,560	5,130
24	1,550	3,010	9,020	10,500	10,800	8,860	9,180	4,320
25	1,660	2,500	9,340	10,300	10,000	8,860	9,340	3,520
26	1,780	1,900	9,500	10,100	7,320	8,860	9,820	3,920
27	1,900	1,550	9,980	9,020	7,470	8,860	9,980	5,190
28	1,780	1,200	10,300	9,660	7,680	8,860	9,660	5,190
29	1,900	865	10,600	9,820	7,880	8,860	9,660	5,190
30	2,140	646	10,900	9,500	8,090	8,710	9,340	5,190
31	.....	755	.....	9,500	7,940	.....	9,180	.....
1910.								
1	6,000	11,700	8,660	9,620	4,010	5,370	4,950	6,660
2	6,500	11,900	10,300	9,780	6,080	5,090	2,500	3,460
3	7,000	11,900	8,660	9,780	6,080	5,090	4,810	6,520
4	7,500	11,700	8,660	9,680	6,370	5,090	4,810	6,820
5	8,000	11,700	8,660	8,040	6,150	5,090	4,810	6,820
6	8,500	11,700	9,140	8,980	6,150	5,090	4,810	2,500
7	9,000	11,700	10,900	8,660	4,140	5,090	5,910	3,420
8	9,500	11,700	10,300	7,270	5,370	5,090	5,510	6,600
9	10,000	11,700	11,900	7,040	6,230	5,090	5,510	6,600
10	10,500	12,000	11,500	6,370	5,510	5,090	2,420	6,620
11	10,600	12,200	11,900	7,120	4,810	5,090	5,790	6,600
12	10,600	12,500	11,900	6,670	5,230	5,090	5,790	6,740
13	10,400	12,500	11,100	6,970	5,370	5,230	6,010	2,000
14	10,400	9,620	11,900	6,820	4,410	4,950	6,230	5,510
15	10,600	9,620	11,400	6,670	4,410	4,950	6,370	6,600

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1907–1911—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.								
16	10,600	9,780	11,500	6,370	4,410	4,950	2,340	6,740
17	10,700	9,780	11,400	6,370	5,090	4,950	3,480	6,970
18	11,700	10,400	8,590	3,610	5,090	5,090	5,300	7,120
19	13,000	10,900	8,590	6,150	5,230	5,090	6,010	7,660
20	13,600	7,970	8,660	6,080	5,230	5,090	6,080	2,500
21	13,600	8,900	8,660	5,940	5,230	5,090	6,010	6,970
22	13,600	8,040	9,460	5,510	5,230	5,090	6,150	8,660
23	13,600	11,100	9,300	4,950	3,740	5,090	2,500	8,040
24	12,900	11,100	10,400	4,950	5,230	5,090	3,600	7,580
25	12,300	10,300	10,300	4,870	5,370	5,090	6,640	7.730
26	12,300	8,660	10,300	4,680	5,370	5,230	6,640	7,420
27	11,700	9,780	9,460	4,460	5,490	4,950	6,600	2,000
28	11,700	9,780	9,460	4,460	6,820	5,090	6,500	4,140
29	11,700	9,680	9,460	5,650	3,740	5,090	6,520	6,370
30	11,400	9,280	8,980	5,940	5,650	4,950	2,500	7,120
31	.....	9,280	.....	6,080	5,510	.....	5,480	.....
1911.								
1	2,600	2,740	6,270	3,970	6,640	6,880	5,270	5,240
2	2,600	3,850	6,180	2,500	6,620	6,860	4,380	5,270
3	2,800	4,020	6,180	1,900	6,860	6,860	5,410	5,130
4	2,800	3,940	4,250	1,900	6,790	6,360	5,620	4,790
5	3,000	3,970	4,250	3,590	6,490	6,500	5,620	4,020
6	3,000	3,840	6,720	4,150	3,570	6,780	5,690	4,450
7	3,200	3,120	6,840	4,050	6,340	6,620	5,480	4,920
8	3,200	2,970	6,800	4,110	6,720	6,720	4,880	4,880
9	3,400	4,070	6,740	3,850	6,780	6,560	4,560	4,990
10	3,400	4,370	7,620	3,920	6,920	6,360	4,960	5,380
11	3,600	5,350	4,720	4,320	7,090	6,420	5,610	4,790
12	3,600	5,270	6,790	3,980	7,080	6,420	5,680	6,070
13	3,800	4,380	8,710	4,050	3,940	6,360	5,660	5,900
14	4,000	2,790	8,930	4,100	6,640	6,360	5,400	5,800
15	4,200	4,130	9,060	4,320	7,090	6,420	4,380	5,750
16	4,400	4,750	8,830	3,520	6,920	5,970	4,450	5,700
17	4,600	5,990	7,550	3,930	6,920	4,920	5,240	5,550
18	4,800	5,140	4,450	3,970	7,220	4,730	5,520	5,400
19	4,460	5,810	4,770	3,820	7,020	5,840	5,680	5,270
20	4,560	5,720	6,800	3,080	5,760	6,050	5,890	5,300
21	4,380	2,820	7,160	3,030	6,420	5,840	5,480	5,400
22	4,370	4,530	7,080	3,030	6,920	5,440	4,710	5,500
23	3,520	5,920	6,390	2,200	6,920	5,850	4,450	5,600
24	3,810	6,070	5,550	2,200	7,200	4,790	4,520	5,700
25	3,890	6,080	5,550	4,070	6,900	3,930	5,480	5,800
26	3,650	5,620	5,280	5,990	7,140	5,410	5,610	5,900
27	3,520	6,020	5,410	6,280	5,720	5,410	5,720	5,980
28	3,340	3,120	5,340	6,600	6,420	5,580	5,610	5,970
29	3,190	4,150	5,120	6,840	6,640	5,690	5,100	5,950
30	2,770	5,980	4,110	4,870	6,880	5,720	4,320	5,900
31	.....	6,210	.....	5,000	6,860	.....	4,990	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined below 12,000 second-feet. Discharge estimated for days of missing gage heights, except from April 1 to June 30, 1908. Discharge estimated May 15 to 18, 1909, on account of possible backwater from Little Fork River. Daily discharge estimated Aug. 25, Nov. 27 to 30, 1909; Apr. 1 to 10, 1910; Apr. 1 to 17, Nov. 13 to 18, 20 to 26, and 28 to 30, 1911. No daily discharge estimate during greater part of winter period.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1911.[a]

[Drainage area, 14,600 square miles.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6,480	5,180	4,970	5,630
2	.....	6,515	4,110	4,850	5,615
3	.....	6,586	5,250	4,890	4,815
4	.....	5,835	5,505	4,400	4,605
5	.....	6,056	5,500	4,220	5,570
6	.....	6,415	5,560	4,260	5,575
7	.....	6,180	5,220	4,770	5,605
8	.....	6,300	4,475	4,785	5,690
9	.....	6,120	4,160	5,012	6,095
10	.....	5,700	4,680	4,987	5,090

[a] From interpretation of power-house records by Canadian Department of Public Works.

Daily discharge, in second-feet, of Rainy River at International Falls, Minn., for 1911— Continued.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	5,690	5,470	4,760	4,635
12	.....	5,980	5,480	4,315	5,645
13	.....	5,990	5,490	4,250	5,670
14	4,820	5,960	5,050	5,060	5,660
15	6,750	5,930	4,180	5,350	5,650
16	6,730	5,990	4,100	5,420	5,705
17	6,470	4,948	4,675	5,445	4,940
18	6,385	4,445	5,300	5,555	4,370
19	6,650	6,055	5,490	3,070	5,670
20	5,134	5,838	5,470	3,895	5,700
21	4,847	5,660	4,880	5,630	5,670
22	6,540	5,660	4,500	5,620	5,700
23	6,585	5,570	4,480	5,595	5,640
24	6,711	4,595	5,015	5,915	1,080
25	6,510	4,225	5,435	6,190	2,000
26	6,740	5,150	5,445	5,110	5,355
27	5,294	5,270	5,475	4,090	5,990
28	4,968	5,550	5,260	5,620	6,100
29	6,500	5,520	4,410	5,650	6,085
30	6,510	5,560	3,960	5,625	5,705
31	6,500	.....	4,840	.....	3,330

Monthly discharge of Rainy River at International Falls, Minn., for 1907–1911.[a]

[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.		
1907.						
March	.....	.....	[b] 5,500	0.377	0.43	C.
April	7,020	4,860	5,550	.380	.42	B.
May	10,800	6,270	8,500	.582	.67	A.
June	11,500	9,500	10,200	.699	.78	A.
July	13,700	11,700	13,000	.890	1.03	B.
August	17,200	13,200	15,200	1.04	1.20	A.
September	18,100	17,200	17,500.	1.20	1.34	A.
October	17,800	16,400	17,200	1.18	1.36	A.
November	16,400	14,400	15,400	1.05	1.17	A.
December	.....	.....	[b] 13,000	.890	1.03	B.
1908.						
January	.....	.....	[b] 12,000	.822	.95	C.
February	.....	.....	[b] 11,100	.753	.78	C.
March	.....	.....	[b] 9,280	.636	.73	B.
April	.....	.....	[b] 7,940	.544	.61	B.
May	.....	.....	[b] 12,700	.870	1.00	B.
June	.....	.....	[b] 13,600	.932	1.04	B.
July	15,400	13,200	14,100	.966	1.11	A.
August	14,500	12,500	13,700	.938	1.08	A.
September	12,800	10,900	11,600	.795	.89	A.
October	10,900	8,710	9,680	.663	.76	A.
November	8,630	6,720	7,510	.514	.57	A.
December	.....	.....	[b] 6,500	.445	.51	B.
The year	.....	.....	10,800	.740	10.03	
1909.						
January	.....	.....	[b] 6,000	.411	.47	C.
February	.....	.....	[b] 5,500	.377	.39	C.
March	.....	.....	[b] 5,500	.377	.43	C.
April	5,550	431	2,890	.198	.22	A.
May	7,500	646	3,760	.258	.30	A.
June	10,900	976	6,850	.469	.52	A.
July	11,300	9,020	10,600	.726	.84	A.

[a] Revised since publication of "Report on water resources investigation of Minnesota during 1909–1910."
[b] Estimated.

Monthly discharge of Rainy River at International Falls, Minn., for 1907–1911—Contd.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
August	13,700	7,320	10,600	0.726	0.84	A.
September	10,300	7,940	9,250	.634	.71	A.
October	10,300	7,020	9,050	.620	.71	A.
November	8,860	3,520	5,400	.370	.41	A.
December	.....	.....	[a] 5,000	.342	.39	B.
The year	13,700	431	6,700	.459	6.23	
1910.						
January	.....	.....	[a] 4,500	.308	.36	C.
February	.....	.....	[a] 4,500	.308	.32	C.
March	.....	.....	[a] 5,000	.342	.39	C.
April	13,600	6,000	10,600	.726	.81	B.
May	12,500	7,970	10,600	.726	.84	B.
June	11,900	8,590	10,000	.685	.76	B.
July	9,780	3,610	6,630	.454	.52	B.
August	6,820	3,740	5,280	.361	.42	B.
September	5,370	4,950	5,080	.348	.39	B.
October	6,640	2,340	5,120	.351	.40	B.
November	8,660	2,000	6,020	.412	.46	B.
December	.....	.....	[b] 4,300	.295	.34	B.
The year	13,600	.....	6,470	.443	6.01	
1911.						
January	.....	.....	[b] 2,860	.196	.23	C.
February	.....	.....	[b] 2,380	.163	.17	C.
March	.....	.....	[b] 2,530	.173	.20	C.
April	4,800	[a] 2,600	3,620	.248	.28	B.
May	6,210	2,740	4,600	.315	.36	A.
June	9,060	4,110	6,320	.433	.48	A.
July	6,840	1,900	3,970	.272	.31	A.
August	7,220	3,570	6,560	.449	.52	A.
September	6,880	4,730	5,990	.410	.46	A.
October	5,890	4,320	5,210	.357	.41	A.
November	6,070	4,020	5,410	.371	.41	A.
December	.....	.....	[b] 5,900	.404	.47	B.
The year	9,060	.....	4,610	.316	4.30	

[a] Estimated. [b] Estimate based on record of Minnesota & Ontario Power Co.

Monthly discharge of Rainy River at International Falls, Minn., for 1911.

[Drainage area, 14,600 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
August 14–31	6,750	4,820	6,100	0.418	0.28
September	6,590	4,220	5,730	.392	.44
October	5,560	3,960	4,970	.340	.39
November	6,190	3,070	4,980	.341	.38
December	6,100	1,080	5,180	.355	.41

NOTE.—Computed by engineers of the United States Geological Survey from the daily discharge values determined from power-house records and furnished by S. B. Johnson, hydraulic engineer, department of public works, Canada. See also table computed from data obtained at the United States Geological Survey gaging station for the same period.

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, 1911.

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. This dam 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 datum of this gage is 489 feet above that of the Minnesota & Ontario Power Co.'s gage. Readings of the two gages indicate a slope of 0.50 feet between the two points. Thus to make the records at the two points comparable the readings on the Minnesota & Ontario gage have been reduced by 488.50 feet.

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 flow of Rainy River at International Falls are of value in determining the natural run-off.

Daily gage height, in feet, of Rainy Lake at Ranier, Minn., for 1911.

[George Schiller, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	+0.15	−0.15	−0.35	−0.90	0.55	1.35	.....	4.53	4.56	4.20	3.92	3.58
2	− .05	− .20	− .45	− .68	.55	1.43	3.75	4.58	4.55	4.20	3.82	3.56
3	− .10	− .20	− .55	− .65	.65	.....	.....	4.58	4.53	4.20	3.82	3.54
4	− .10	.....	.....	− .65	.70	1.75	3.80	4.50	4.53	4.20	3.85	3.52
5	− .15	− .05	− .45	− .67	.70	1.50	3.75	.....	4.53	4.20	3.86	3.50
6	− .45	− .15	− .60	− .65	.....	1.65	3.75	4.72	4.52	4.29	3.86	3.50
7	.....	− .20	.....	.....	.80	1.85	4.00	4.70	4.50	4.20	3.82	3.50
8	− .10	− .30	.....	− .70	.75	1.86	.....	4.68	4.48	4.20	3.83	3.50
9	− .25	− .25	.....	− .65	.67	2.00	3.90	4.61	4.46	4.20	3.79	3.50
10	− .25	− .30	− .75	− .60	.29	.....	3.80	4.63	4.44	4.20	3.70	3.48
11	− .45	.....	.....	− .37	.35	2.65	.....	4.60	4.40	4.20	.....	3.46
12	− .35	− .15	− .75	− .45	.76	2.35	4.05	4.80	4.40	4.20	3.64	3.44
13	− .40	.....	.....	− .35	.....	2.40	4.07	4.60	4.40	4.20	3.71	3.42
14	.....	.....	− .85	.....	1.23	2.50	4.10	4.65	4.38	4.20	3.76	3.40
15	− .02	.....	.....	− .10	.81	2.45	.....	4.65	4.35	4.18	3.80	3.38
16	− .15	.....	− .55	− .10	.60	2.53	4.20	4.65	4.35	4.18	3.80	3.36
17	− .35	.....	− .65	− .10	1.05	.....	4.25	4.54	4.34	4.18	3.80	3.35
18	− .20	.....	.....	.00	.73	2.75	4.30	4.55	4.26	4.16	3.80	3.35
19	− .05	.....	− .65	+ .05	.63	2.79	4.35	4.62	4.28	4.13	3.80	3.33
20	− .22	.....	− .65	+ .17	.....	2.84	4.35	4.60	4.29	4.08	3.76	3.31
21	.....	.....	− .75	+ .30	.97	2.90	4.35	4.60	4.28	4.12	3.74	3.29
22	− .15	.....	− .65	+ .33	.80	3.00	.....	4.59	4.29	4.12	3.73	3.27
23	− .10	.....	− .65	+ .37	.72	.....	4.45	4.58	4.29	4.09	3.72	3.25
24	− .05	− .25	− .65	+ .40	.85	.....	4.47	4.52	4.26	4.08	3.71	3.23
25	− .10	.....	− .65	+ .55	1.00	3.24	4.28	4.52	4.25	4.03	3.70	3.22
26	− .15	− .25	− .65	+ .60	1.00	3.25	4.25	4.54	4.20	4.03	3.68	3.20
27	− .20	− .40	− .65	.....	.....	3.34	4.32	4.60	4.20	4.00	3.66	3.18
28	.....	− .35	− .55	.....	1.20	3.55	4.28	4.61	4.20	3.89	3.64	3.17
29	− .05	.....	− .60	+ .65	1.14	3.57	.....	4.60	4.21	3.92	3.62	3.16
30	− .20	.....	− .65	.....	1.20	3.60	4.43	4.61	4.20	3.92	3.60	3.15
31	− .20	.....	.....	.....	1.25	.....	.....	4.60	.....	.....	.....	.....

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, 1911.

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.

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

Utilization.—Log driving, although there are no logging dams on the river for the purpose of controlling the natural flow.

Discharge measurements of Little Fork River at Little Fork, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Apr. 4[a]	C. R. Adams	10.80	1,400
18[b]	Robert Follansbee	15.46	3,730
19[b]	do	15.00	3,580
June 9	S. B. Soulé	11.06	2,390
July 15	do	5.20	144
Dec. 12[c]	do	6.00	156

[a] Measurement under ice cover.
[b] Backwater from log jam.
[c] Under complete ice cover about 300 feet above gage; average thickness of ice 0.71 foot; 9 inches snow on ice; water about 0.15 foot over ice.

Daily gage height, in feet, of Little Fork River at Little Fork, Minn., for 1911.

[Herman Muus, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	12.50	9.18	8.41	6.08	7.05	6.42	6.20	5.80	.....
2	.....	11.80	9.05	9.20	6.00	7.40	6.32	6.21	5.80	.....
3	.....	11.45	8.90	9.70	5.80	7.25	6.05	6.26	5.80	.....
4	.....	10.80	8.65	10.10	5.72	7.16	5.94	6.35	5.80	5.9
5	.....	10.20	8.30	10.00	5.65	7.12	6.10	6.50	5.80	.....
6	.....	9.95	7.90	10.92	5.62	6.95	6.35	6.49	5.80	.....
7	.....	9.75	7.65	11.50	5.58	6.95	6.65	6.40	5.80	5.9
8	.....	9.25	7.40	10.80	5.50	7.15	7.30	6.35	5.80	.....
9	.....	8.88	7.35	11.20	5.42	7.05	7.45	6.25	5.80	.....
10	.....	8.70	7.20	11.35	5.37	6.88	7.70	6.18	5.88	.....
11	.....	8.68	7.40	13.90	5.35	6.75	7.72	6.05	5.90	5.9
12	.....	9.75	7.55	14.80	5.31	6.35	7.70	5.95	5.90	6.0
13	.....	13.25	7.58	16.77	5.26	6.51	7.60	5.95	6.0	.....
14	.....	15.95	7.65	17.20	5.22	6.59	7.50	5.92	.....	6.05
15	.....	17.70	7.68	16.00	5.20	6.60	7.30	5.90	.....	.....
16	.....	18.30	7.69	14.72	5.20	6.42	7.15	5.92	6.35	.....
17	.....	16.45	7.58	12.74	5.20	6.32	6.80	6.00	.....	.....
18	.....	15.39	7.95	10.04	5.20	6.30	6.50	6.00	.....	6.10
19	.....	15.05	8.50	9.72	5.19	6.12	6.50	6.10	.....	.....
20	.....	14.30	8.35	9.05	5.19	5.96	6.40	6.10	5.7	.....
21	.....	12.60	8.20	8.40	5.20	5.80	6.32	6.10	.....	6.15
22	.....	12.60	8.50	7.91	5.20	5.95	6.10	6.05	.....	.....
23	.....	12.25	8.70	7.45	5.16	5.80	5.95	6.00	5.9	.....
24	.....	11.80	8.55	7.09	5.20	5.75	5.90	5.95	.....	.....
25	.....	11.34	7.70	7.00	5.24	5.74	5.95	5.80	.....	6.10
26	.....	10.75	7.70	6.81	5.25	5.96	5.85	5.80	.....	.....
27	.....	10.32	7.95	6.48	5.39	6.15	5.80	5.78	5.9	.....
28	11.30	10.00	9.31	6.37	5.64	6.42	5.90	5.72	.....	6.10
29	12.15	9.59	9.20	6.24	5.68	6.31	6.35	5.70	6.0	.....
30	12.50	9.38	8.40	6.18	5.60	6.30	6.25	5.76	.....	.....
31	12.50	.....	8.00	.....	6.60	6.30	.....	5.80	.....	.....

NOTE.—Ice present Jan. 1 to Apr. 7 and Nov. 10 to Dec. 31. Ice at gage about 8 to 16 inches thick during November and about 18 inches thick during December. Backwater from log jams Apr. 12 to 20 and June 10 to 17.

Daily discharge, in second-feet, of Little Fork River at Little Fork, Minn., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	900	1,540	1,190	363	665	458	395	289
2	1,000	1,480	1,540	365	793	429	398	289
3	1,150	1,410	1,770	312	738	354	412	289
4	1,400	1,300	1,950	269	705	325	438	289
5	1,400	1,150	2,260	252	690	368	482	289
6	1,450	989	2,320	245	630	438	479	289
7	1,500	890	2,610	235	630	529	452	289
8	1,570	793	2,260	216	701	756	438	289
9	1,400	774	2,460	198	665	811	409	289
10	1,320	719	2,540	186	605	909	390	.....
11	1,310	793	2,540	182	562	917	354	.....
12	1,790	850	2,530	173	438	909	328	.....
13	1,800	862	2,530	163	485	870	328	.....
14	1,850	890	2,520	154	510	831	320	.....
15	1,950	901	2,510	150	513	756	315	.....
16	3,000	905	2,500	150	458	701	320	.....
17	3,400	862	2,500	150	429	578	341	.....
18	3,730	1,010	1,920	150	423	482	341	.....
19	3,580	1,230	1,780	148	373	482	368	.....
20	3,370	1,170	1,480	148	331	452	368	.....
21	3,160	1,110	1,190	150	289	429	368	.....
22	3,160	1,230	993	150	328	368	354	.....
23	2,980	1,320	811	142	289	328	341	.....
24	2,760	1,250	679	150	276	315	328	.....
25	2,530	909	647	158	274	328	289	.....
26	2,240	909	581	160	331	302	289	.....
27	2,050	1,010	476	191	382	289	284	.....
28	1,900	1,590	443	250	458	315	269	.....
29	1,720	1,540	406	259	426	438	264	.....
30	1,630	1,190	390	240	423	409	279	.....
31	.....	1,030	.....	513	423	.....	289	.....

NOTE.—Daily discharge computed from a rating curve well defined below 3,000 second-feet. Discharge estimated Apr. 1 to 7 because of backwater from ice and Apr. 12 to 20 and June 10 to 17 because of backwater from log jams below. Discharge Nov. 10 to Dec. 31 estimated, because of ice, from one discharge measurement, gage observer's notes, and climatologic records. Mean discharge Nov. 10 to 30 estimated 175 second-feet, varying from about 140 to 280 second-feet. Mean discharge Dec. 1 to 31 estimated 145 second-feet, varying from about 110 to 156 second-feet.

Monthly discharge of Little Fork River at Little Fork, Minn., for 1911.

[Drainage area, 1,720 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
April	3,730	900	2,100	1.22	1.36	B.
May	1,590	719	1,080	.628	.72	A.
June	2,610	390	1,680	.977	1.09	B.
July	513	142	212	.123	.14	A.
August	793	274	492	.286	.33	A.
September	917	289	529	.308	.34	A.
October	482	264	356	.207	.24	A.
November	289	.....	209	.122	.14	C.
December	.....	.....	145	.084	.10	C.

NOTE.—See footnotes to table of 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 December 31, 1911.
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 location, 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 by means of readings taken at both gages.

Channel.—Unstable by reason of log jams forming below the gage.

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

Accuracy.—Although the new location is better than the old, it is not free from backwater caused by log jams. During the greater part of 1911 a log jam on the opposite side of the river and a short distance below extended about half way across the river and undoubtedly created some backwater at the gage. Estimates of discharge for 1911 are withheld for further data.

Discharge measurements of Big Fork River at Big Falls, Minn., 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
June 10	S. B. Soulé	[a] 7.07	1,760
12	do	[b] 3.89	193
Dec. 13	[c] do	2.65	65.5

[a] Lower gage reading 6.07, measurement made from M. & I. Ry. bridge.
[b] Lower gage reading 2.99, measurement made at cable section.
[c] Complete ice cover, measured at cable section. Average thickness of ice, 0.7 foot.

Daily gage height, in feet, of Big Fork River at Big Falls, Minn., for 1911.

[G. T. Robinson, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.94	4.89	3.73	3.20	3.70	4.05	4.10	3.0
2	.....	4.89	4.98	3.58	4.00	3.70	4.15	3.90	.....
3	.....	4.79	5.18	3.56	4.45	3.68	4.15	3.75	.....
4	.....	4.65	5.47	3.47	4.50	3.85	4.18	3.60	.....
5	.....	4.70	5.47	3.44	4.45	3.95	4.20	3.80	.....
6	.....	4.55	5.52	3.34	4.35	4.05	4.22	4.00	.....
7	.....	4.31	5.32	3.29	4.40	4.15	4.28	4.20	3.0
8	.....	4.21	5.52	3.20	4.35	4.20	4.25	4.22	.....
9	.....	4.21	5.76	3.10	4.25	4.15	4.20	4.22	.....
10	.....	4.12	6.14	3.00	4.15	4.25	4.18	4.28	.....
11	.....	4.16	6.30	2.91	4.05	4.35	4.15	4.12	3.0
12	.....	4.31	6.30	3.00	3.85	4.25	4.20	4.05	.....
13	.....	4.36	6.30	2.95	3.75	4.20	4.15	4.00	2.65
14	.....	4.31	5.90	2.85	3.70	4.15	4.10	3.65	2.65
15	.....	4.31	5.50	2.75	3.65	4.05	4.12	3.40	.....
16	.....	4.40	5.20	2.80	3.60	4.00	4.20	3.4	.....
17	.....	4.36	5.10	2.75	3.55	3.95	4.15	.....	.....
18	.....	4.45	5.10	2.72	3.45	3.85	4.20	.....	2.6
19	5.57	4.50	5.00	2.75	3.35	3.80	4.30	.....	.....
20	5.47	4.40	4.30	2.85	3.25	3.85	4.35	.....	.....
21	5.52	4.70	4.25	2.80	3.60	3.80	4.38	2.8	2.6
22	5.57	4.70	4.10	2.72	3.50	3.80	4.40	.....	.....
23	5.66	4.89	4.05	2.75	3.50	3.85	4.40	3.0	.....
24	5.57	4.70	4.60	2.80	3.45	3.80	4.38	.....	.....
25	5.47	4.65	4.36	2.85	3.40	3.80	4.35	.....	2.8
26	5.37	4.50	4.36	2.85	3.45	3.85	4.28	.....	.....
27	5.32	4.40	4.02	2.90	3.65	3.90	4.25	2.9	.....
28	5.32	4.65	3.92	2.88	3.90	3.95	4.22	.....	2.8
29	5.13	5.18	3.87	2.85	4.05	4.00	4.20	.....	.....
30	5.03	5.18	3.82	2.80	4.00	4.05	4.22	3.0	.....
31	.....	5.08	.....	2.82	3.85	.....	4.20	.....	.....

NOTE.—These gage heights are all referred to a gage established June 10, those prior to that date having been reduced by simultaneous readings of the two gages.

VERMILION RIVER BELOW LAKE VERMILION, NEAR TOWER, MINN.

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

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

Drainage area.—507 square miles.

Gage.—Vertical staff.

Channel.—Probably permanent.

Discharge measurements.—Made by means of car and cable just above the gage section.

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, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 31	C. J. Emerson	1.94	[a] 518
June 30	do	1.88	486
July 30	S. B. Soulé	1.32	262
Oct. 8	do	0.93	173

[a] With soundings corrected by measurement of June 30.

Daily gage height, in feet, of Vermilion River below Lake Vermilion, Minn., for 1911.

[Clarence M. Everett, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.90	1.90	1.35	0.90	0.85	0.71	0.70
2	.....	1.90	1.85	1.35	.90	.85	.68	.70
3	.....	1.95	1.80	1.33	.90	.84	.66	.70
4	.....	1.90	1.75	1.33	.90	.84	.64	.70
5	.....	1.90	1.73	1.32	.90	.85	.62	.70
6	.....	1.90	1.72	1.32	1.00	.85	.60	.70
7	.....	1.90	1.71	1.33	1.50	.85	.60	.70
8	.....	1.95	1.60	1.32	1.50	.84	.60	70
9	.....	1.95	1.60	1.32	1.50	.84	.60	.70
10	.....	2.05	1.50	1.31	1.30	.84	.60	.70
11	.....	2.03	1.45	1.31	1.20	.84	.60	.70
12	.....	2.01	1.40	1.30	1.10	.85	.60	.70
13	.....	2.00	1.35	1.30	1.10	.84	.60	.70
14	.....	2.00	1.33	1.25	1.10	.84	.60	.70
15	.....	2.00	1.30	1.25	1.10	.84	.60	.70
16	.....	1.95	1.35	1.20	1.10	.84	.60	.70
17	1.95	1.92	1.35	1.20	1.00	.85	.62	.70
18	2.00	1.91	1.30	1.20	1.00	.86	.63	.70
19	2.10	1.90	1.30	1.25	.98	.86	.65	.70
20	2.00	2.15	1.20	1.25	.96	.85	.68	.70
21	1.95	2.10	1.10	1.25	.94	.84	.70	.70
22	2.00	2.05	1.30	1.22	.00	.83	.70	.70
23	2.05	2.05	1.30	1.20	.90	.82	.70	.70
24	2.00	2.00	1.30	1.10	.90	.80	.70	.70
25	1.95	2.00	1.30	1.10	.90	.78	.70	.70
26	1.90	1.95	1.35	1.00	.90	.76	.70	.70
27	1.90	1.95	1.35	1.00	.90	.74	.70	.70
28	1.90	1.90	1.35	1.00	.88	.72	.70	.70
29	1.90	1.90	1.32	1.00	.86	.71	.70	.70
30	1.90	1.90	1.32	.90	.85	.70	.70	.70
31	1.95	.....	1.32	.90	.....	.70	.....	.70

Daily discharge, in second-feet, of Vermilion River below Lake Vermilion, Minn., for 1911.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	490	490	272	167	158	132	130
2	.....	490	466	272	167	158	127	130
3	.....	515	442	266	167	156	124	130
4	.....	490	420	266	167	156	120	130
5	.....	490	411	263	167	158	117	130
6	.....	490	407	263	187	158	114	130
7	.....	490	402	266	321	158	114	130
8	.....	515	358	263	321	156	114	130
9	.....	515	358	263	321	156	114	130
10	.....	568	321	260	257	156	114	130
11	.....	556	304	260	231	156	114	130
12	.....	546	287	257	208	158	114	130
13	.....	540	272	257	208	156	114	130
14	.....	540	266	244	208	156	114	130
15	.....	540	257	244	208	156	114	130
16	.....	515	272	231	208	156	114	130
17	515	500	272	231	187	158	117	130
18	540	495	257	231	187	159	119	130
19	595	490	257	244	183	159	122	130
20	540	622	231	244	179	158	127	130
21	515	595	208	244	175	156	130	130
22	540	568	257	236	167	154	130	130
23	568	568	257	231	167	152	130	130
24	540	540	257	208	167	148	130	130
25	515	540	257	208	167	144	130	130
26	490	515	272	187	167	141	130	130
27	490	515	272	187	167	137	130	130
28	490	490	272	187	163	134	130	130
29	490	490	263	187	159	132	130	130
30	490	490	263	167	158	130	130	130
31	515	.....	263	167	.....	130	.....	130

NOTE.—Discharge computed from a well-defined rating curve.

Monthly discharge of Vermilion River below Lake Vermilion, Minn., for 1911.

[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.		
May 17-31	595	490	522	1.03	0.57	A.
June	622	490	524	1.04	1.16	A.
July	490	208	309	.609	.70	A.
August	272	167	236	.466	.54	A.
September	321	158	197	.389	.43	A.
October	159	130	152	.300	.35	B.
November	132	114	122	.241	.27	B.
December	130	130	130	.256	.30	B

UPPER MISSISSIPPI RIVER DRAINAGE BASINS.

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, 1911.

Drainage area.—4,510 square miles.

Gage.—Vertical staff.

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

Cooperation.—This station is maintained by the United States Engineer Corps 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, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	652	709	720	1,088	1,116	1,917	2,327	2,310	2,084	1,951	1,270	699
2	653	709	725	1,091	1,211	1,963	2,318	2,258	2,136	1,890	1,283	690
3	653	708	731	1,094	1,305	2,009	2,309	2,206	2,187	1,829	1,296	681
4	657	708	737	1,097	1,400	2,056	2,300	2,154	2,239	1,768	1,308	672
5	658	708	742	1,100	1,494	2,102	2,291	2,103	2,290	1,707	1,321	663
6	660	707	748	1,102	1,589	2,148	2,282	2,051	2,342	1,646	1,333	654
7	663	707	754	1,105	1,684	2,195	2,274	2,000	2,393	1,585	1,346	645
8	658	707	760	1,108	1,633	2,242	2,264	1,948	2,445	1,523	1,359	636
9	653	706	766	1,111	1,582	2,205	2,321	1,896	2,496	1,526	1,372	627
10	648	706	772	1,132	1,531	2,167	2,378	1,843	2,548	1,529	1,341	621
11	645	706	778	1,153	1,480	2,130	2,436	1,802	2,599	1,532	1,310	614
12	640	705	784	1,175	1,429	2,092	2,493	1,761	2,651	1,535	1,278	608
13	637	700	792	1,196	1,378	2,054	2,551	1,720	2,703	1,538	1,246	601
14	635	694	800	1,217	1,325	2,017	2,608	1,678	2,628	1,541	1,215	595
15	639	688	807	1,239	1,455	1,979	2,666	1,637	2,552	1,544	1,183	588
16	643	683	815	1,260	1,585	1,940	2,723	1,595	2,477	1,547	1,152	582
17	648	676	823	1,282	1,715	1,869	2,781	1,554	2,401	1,549	1,120	576
18	652	670	830	1,303	1,845	1,798	2,838	1,513	2,326	1,534	1,089	592
19	657	665	838	1,325	1,975	1,727	2,895	1,472	2,250	1,519	1,057	609
20	661	670	858	1,346	2,105	1,655	2,858	1,439	2,175	1,504	1,026	625
21	665	676	879	1,368	2,235	1,584	2,821	1,519	2,099	1,489	994	642
22	669	682	899	1,390	2,199	1,513	2,784	1,609	2,023	1,474	963	658
23	673	687	920	1,413	2,163	1,615	2,747	1,698	2,022	1,459	931	674
24	677	693	941	1,358	2,126	1,718	2,711	1,787	2,020	1,443	900	690
25	681	698	980	1,302	2,090	1,820	2,675	1,876	2,019	1,417	868	692
26	686	704	1,000	1,246	2,054	1,923	2,623	1,912	2,017	1,391	837	695
27	690	709	1,022	1,191	2,017	2,025	2,570	1,928	2,016	1,365	805	698
28	695	714	1,040	1,135	1,981	2,128	2,518	1,954	2,014	1,339	774	700
29	700	.....	1,058	1,079	1,944	2,232	2,465	1,981	2,013	1,312	742	703
30	705	.....	1,072	1,022	1,908	2,335	2,413	2,007	2,012	1,286	707	706
31	710	.....	1,085	.....	1,871	.....	2,361	2,033	.....	1,258	.....	709

NOTE.—Taken from unpublished records of the United States Engineer Corps at St. Paul. Determinations of daily discharge based almost directly on frequent discharge measurements.

Monthly discharge of Mississippi River above Sandy River, Minn., for 1911.

[Drainage area, 4,510 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in millions of cubic-feet.
January	710	635	663	0.147	0.17	1,780
February	714	665	696	.154	.16	1,680
March	1,085	720	854	.189	.22	2,290
April	1,413	1,022	1,200	.266	.30	3,110
May	2,235	1,116	1,720	.381	.44	4,610
June	2,335	1,513	1,970	.437	.49	5,110
July	2,895	2,264	2,540	.563	.65	6,800
August	2,310	1,439	1,850	.410	.47	4,950
September	2,703	2,012	2,270	.503	.56	5,880
October	1,951	1,258	1,530	.339	.39	4,100
November	1,372	707	1,110	.246	.27	2,880
December	709	576	650	.144	.17	1,740
The year	2,895	576	1,430	.317	4.29	44,900

NOTE.—Above table computed by engineers of the United States Geological Survey from records of daily discharge furnished by the United States Engineer Corps.

MISSISSIPPI RIVER AT ANOKA, MINN.

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

Records available.—November 3, 1896, to September 10, 1897 (United States Engineer records); May 8, 1905, to December 31, 1911.

Drainage area.—17,100 square miles.

Gage.—Staff gage prior to 1909, now a chain gage; datum, unchanged since station established, 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 times by log jams.

Discharge measurements.—Made from the bridge.

Winter flow.—The river is frozen from December to March, inclusive, and regular observations are discontinued. The monthly discharge for this period is based on the records of flow of the St. Anthony Falls Water Power Co., Minneapolis, and of the United States Engineer Corps records at Lock and Dam 2 below Minneapolis, an allowance being made for the increase in flow between the different points.

Regulation.—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 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 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.

Discharge measurements of Mississippi River at Anoka, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
July 1	S. B. Soulé	0.12	4,650
25	do	[a] .21	3,770
Aug. 25	do	−.46	3,210

[a] Backwater from log jam.

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1911.

[Bernard J. Witte, jr., observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	−0.57	−0.30	0.27	0.14	.....	−0.38	0.10	−0.20
2	.....	−.59	−.25	.40	.13	0.45	−.42	−.10	−.18
3	.....	−.61	−.25	.45	−.02	.70	−.42	.00	−.20
4	.....	−.60	−.30	.70	.18	.88	−.46	.08	−.40
5	.....	−.50	−.37	.65	.08	.80	−.36	.12	−.35
6	.....	−.55	−.65	.65	.10	.85	−.40	.10	−.20
7	.....	−.60	−.74	.45	.08	.00	−.10	.15	−.18
8	.....	−.53	−.65	.75	.08	−.02	.10	.15	−.20
9	.....	−.55	−.58	.85	.....	−.15	.10	.15	−.20
10	.....	−.55	−.50	.67	−.03	−.08	.24	.10	−.30

Daily gage height, in feet, of Mississippi River at Anoka, Minn., for 1911—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	−0.55	−0.50	0.43	−0.02	−0.20	0.15	0.10	−0.40
12	.....	− .63	.....	.25	− .18	− .25	.28	.15	− .10
13	.....	− .45	− .40	.35	− .02	− .22	.25	.02	− .40
14	.....	− .50	.....	.15	− .17	− .30	.58	.02	− .40
15	.....	− .43	− .14	.05	− .17	− .25	.58	.08	.30
16	.....	− .34	.20	.15	.....	− .25	.55	.00	.40
17	.....	− .25	.23	.00	− .42	− .25	.52	.20	.20
18	.....	.07	.30	.15	− .40	− .32	.50	.00	.30
19	.....	− .03	.43	.15	− .30	− .38	.50	.20	.....
20	−0.36	+ .27	.45	.10	− .22	− .32	.38	.20	.....
21	− .42	− .10	.....	.10	− .10	− .42	.70	.22	.....
22	− .50	− .05	.83	.13	− .07	.34	.48	.25	.....
23	− .50	− .30	.97	.00	.08	.50	.40	.18	.....
24	− .50	− .25	1.00	− .05	.03	.45	.50	.18	.....
25	− .59	− .25	.87	− .25	.03	− .42	.60	.10	.....
26	− .56	− .30	.70	− .13	.02	− .50	.72	.17	.....
27	− .58	− .25	.60	− .05	.50	− .55	.55	.00	.....
28	− .49	− .17	.50	.00	.50	− .55	.50	.10	.....
29	− .55	− .20	.47	.25	.....	− .55	.48	− .10	.....
30	− .63	− .30	.30	.15	.....	− .50	.48	− .10	.....
31	− .71	.....	.15	.....	.....	− .42	.....	− .05	.....

NOTE.—Ice present Jan. 1 to Mar. 19 and Nov. 14 to Dec. 31. Gage heights Nov. 14 to 18 are to top of ice. Backwater from log jams July 21 to Aug. 6 and Sept. 10 to 30.

Daily discharge, in second-feet, of Mississippi River at Anoka, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1,790	3,080	3,520	4,660	4,380	3,870	3,380	4,300	3,700
2	1,860	3,050	3,600	4,960	4,360	3,740	3,310	3,880	3,730
3	1,750	3,020	3,600	5,080	4,040	4,010	3,310	4,080	3,700
4	1,770	3,040	3,520	5,720	4,470	3,970	3,250	4,250	3,340
5	1,460	3,180	3,400	5,580	4,250	4,150	3,410	4,340	3,430
6	1,920	3,110	2,960	5,580	4,300	4,100	3,340	4,300	3,700
7	1,860	3,040	2,840	5,080	4,250	4,080	3,880	4,400	3,730
8	1,820	3,140	2,960	5,870	4,250	4,040	4,300	4,400	3,700
9	2,140	3,110	3,060	6,180	4,140	3,790	4,300	4,400	3,700
10	2,280	3,110	3,180	5,640	4,020	3,920	4,300	4,300	3,520
11	2,000	3,110	3,180	5,030	4,040	3,700	4,310	4,300	3,340
12	1,920	2,990	3,260	4,620	3,730	3,600	4,300	4,400	3,340
13	2,550	3,260	3,340	4,840	4,040	3,660	4,100	4,130	3,340
14	2,540	3,180	3,580	4,400	3,750	3,520	4,090	4,130	3,200
15	1,960	3,300	3,810	4,190	3,750	3,600	4,260	4,340	3,100
16	1,700	3,450	4,510	4,400	3,530	3,600	4,390	4,080	3,100
17	2,220	3,600	4,580	4,080	3,310	3,600	4,300	4,510	3,000
18	2,610	4,230	4,730	4,400	3,340	3,480	4,300	4,080	3,000
19	2,410	4,020	5,030	4,400	3,520	3,380	4,350	4,510	2,900
20	3,410	4,660	5,080	4,300	3,660	3,480	4,250	4,510	2,900
21	3,310	3,880	5,600	4,300	3,460	3,310	4,250	4,550	2,900
22	3,180	3,980	6,120	4,360	3,690	3,450	4,490	4,620	2,800
23	3,180	3,520	6,580	4,080	3,810	3,180	4,350	4,470	2,800
24	3,180	3,600	6,680	3,980	3,570	3,260	4,300	4,470	2,800
25	3,050	3,600	6,240	3,600	3,810	3,310	4,170	4,300	2,700
26	3,100	3,520	5,720	3,830	3,470	3,180	4,170	4,450	2,700
27	3,060	3,600	5,450	3,980	3,690	3,110	4,300	4,080	2,600
28	3,200	3,750	5,200	4,080	4,210	3,110	4,350	4,300	2,600
29	3,110	3,700	5,130	4,620	4,070	3,110	4,490	3,880	2,500
30	2,990	3,520	4,730	4,400	3,800	3,180	4,700	3,880	2,500
31	2,880	.....	4,400	.....	3,540	3,310	.....	3,980	.....

NOTE.—Daily discharge computed from a well-defined rating curve. From Mar. 1 to 19, July 21 to Aug. 6, Sept. 9 to 30, Nov. 12, and from Nov. 14 to 30 the discharge has been estimated on account of obstructed channel. Discharge has been estimated for days of missing gage heights.

Monthly discharge of Mississippi River at Anoka, Minn., for 1911.

[Drainage area, 17,100 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	[a] 1,670	0.098	0.11	C.
February	.....	.....	[a] 1,700	.100	.10	C.
March	3,410	[b] 1,460	2,460	.144	.17	B.
April	4,660	2,990	3,440	.201	.22	A.
May	6,680	2,840	4,370	.256	.30	A.
June	6,180	3,600	4,670	.273	.30	A.
July	4,470	3,310	3,880	.227	.26	B.
August	[b] 4,150	3,110	3,570	.209	.24	A.
September	4,700	3,250	4,100	.240	.27	B.
October	4,620	3,880	4,280	.250	.29	A.
November	3,700	[b] 2,500	3,150	.184	.21	B.
December	.....	.....	[a] 2,120	.124	.14	B.
The year	6,680	.....	3,290	.192	2.58	

[a] Estimated from the records of the United States Engineer Corps at Lock and Dam 2, near Minneapolis, and a comparison of the discharge of the Rum at Cambridge.
[b] Estimated.

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

MISSISSIPPI RIVER AT ST. PAUL, MINN.

Location.—Near foot of Jackson 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 1911. Many discharge measurements by United States Engineer Corps prior to 1900. Measurements made by United States Geological Survey 1909 to 1911.

Drainage area.—35,700 square miles.

Gage.—Vertical staff at upper end of the Diamond Joe Line wharf at the foot of Jackson Street, St. Paul; read once a day; datum unchanged. At the lower end of the same dock is the United States Engineer Corps gage, datum of which is 0.5 feet higher than that of the Weather Bureau gage, to which all the data following are referred.

Channel.—Somewhat shifting from year to year.

Discharge measurements.—Made from the Chicago, St. Paul, Minneapolis & Omaha Railway bridge, 2 miles above the station.

Regulation.—The river is controlled to a certain extent by the Government reservoirs on the headwaters, 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.

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 2 below Minneapolis—an allowance being made for the flow of Minnesota River.

Maximum and minimum flow.—The highest recorded discharge occurred July 22, 1867, and amounted to 117,000 second-feet. Since 1891 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 was not serious, due largely to 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 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.

Discharge measurements of Mississippi River at St. Paul, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 18	C. R. Adams	−0.55	[a] 2,150
May 25	C. J. Emerson	3.30	8,620
June 3	Follansbee and Soulé	2.44	6,960
July 8	Soulé and Orbeck	1.60	5,070
Aug. 23	S. B. Soulé	0.81	3,780
Oct. 24	C. J. Emerson	4.00	9,460

[a] River open.

Daily gage height, in feet, of Mississippi River at St. Paul, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	−0.05	0.6	0.7	1.9	1.7	1.2	0.6	1.5	2.3	.....
2	.....	.....	.....	.7	1.1	1.9	1.6	1.1	.6	1.5	2.1	1.2
3	0.7	0.1	− .55	.5	1.1	2.4	1.5	1.3	.8	1.4	2.0	.....
4	.....	.....	− .4	.6	.9	2.6	1.6	1.2	.5	1.7	1.7	.....
5	.....	.....	− .4	.7	.8	2.5	1.6	1.4	.9	1.9	1.5	.....
6	.7	.....	− .3	1.0	.8	2.4	1.7	1.4	.9	2.0	1.1	.....
7	.....	.4	− .2	.7	.8	2.5	1.6	1.7	1.0	4.3	1.3	.....
8	.....	.....	− .1	.8	.2	2.0	1.6	1.6	1.0	4.8	1.4	.....
9	.....	.....	.0	.8	.6	2.3	1.6	1.5	1.2	4.5	1.5	.1
10	.7	.3	.3	.5	.5	2.4	1.2	1.4	1.3	4.4	1.6	.....
11	.....	.....	.2	.7	.6	2.2	1.4	1.4	1.3	4.1	1.5	.....
12	.....	.....	.1	.8	.7	2.0	1.2	1.1	1.3	3.8	.....	.2
13	.5	.....	.2	.9	.9	2.1	1.2	1.1	1.2	3.7	.....	.....
14	.....	.7	.5	1.0	.9	2.0	1.1	1.1	1.1	3.5	.....	.....
15	.....	.....	.....	1.2	1.5	1.9	1.0	1.3	1.3	3.5	.....	.4
16	.....	.....	.....	1.2	1.5	1.8	1.1	1.6	1.5	3.4	.....	.....
17	.4	− .5	− .2	1.0	1.9	2.0	.8	1.5	1.4	3.5	2.9	.....
18	.....	− .6	.....	1.4	1.8	1.9	.9	1.3	1.4	3.9	.....	.....
19	.....	.....	.8	1.8	2.0	1.7	1.0	1.3	1.4	4.2	.....	.4
20	.5	.....	.7	1.7	2.2	1.9	.8	1.2	1.3	4.3	.....	.....
21	.....	.3	1.2	2.0	2.4	1.9	.7	1.0	1.3	4.1	.....	.4
22	.....	.....	1.3	1.8	2.6	1.7	.9	1.0	1.5	4.1	2.1	.....
23	.....	.....	1.0	1.6	3.0	1.7	1.0	.9	1.4	4.2	.....	.....
24	.....	− .7	.8	1.1	3.2	1.6	.8	.8	1.3	4.1	.....	.....
25	.6	− .4	.7	1.3	3.2	1.6	1.0	.7	1.2	3.8	.....	.....
26	.....	− .6	.7	1.4	3.1	1.1	.8	.7	1.2	3.6	.....	.6
27	.6	− .45	.7	1.2	2.9	1.4	.9	.6	1.3	3.4	1.8	.....
28	.....	.15	.8	1.1	2.6	1.2	1.3	.4	1.3	3.2	.....	.....
29	.....	.....	.8	1.2	2.3	1.4	1.2	.5	1.5	2.9	.....	.....
30	.....	.....	.8	1.3	2.3	1.6	1.1	.5	1.6	2.7	.....	.....
31	.7	.....	.6	.....	2.3	.....	.9	.5	.....	2.4	.....	.....

NOTE.—Ice present Jan. 1 to Feb. 28 and about Nov. 7 to Dec. 31.

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2,710	3,530	3,670	5,720	5,090	4,370	3,650	4,790	6,050
2	2,400	3,670	4,260	5,720	4,940	4,240	3,650	4,790	5,720
3	2,140	3,400	4,260	6,730	4,790	4,510	3,870	4,650	5,560
4	2,310	3,530	3,950	7,150	4,940	4,370	3,540	5,090	5,090
5	2,310	3,670	3,810	6,940	4,940	4,650	3,990	5,400	4,790
6	2,420	4,100	3,810	6,730	5,090	4,650	3,990	5,560	4,240
7	2,530	3,670	3,810	6,940	4,940	5,090	4,110	10,300	.....
8	2,650	3,810	3,010	5,920	4,940	4,940	4,110	11,800	.....
9	2,770	3,810	3,530	6,520	4,940	4,790	4,370	10,900	.....
10	3,140	3,400	3,400	6,730	4,370	4,650	4,510	10,600	.....
11	3,010	3,670	3,530	6,320	4,650	4,650	4,510	9,780	.....
12	2,890	3,810	3,670	5,920	4,370	4,240	4,510	9,030	.....
13	3,010	3,950	3,950	6,120	4,370	4,240	4,370	8,790	.....
14	3,400	4,100	3,950	5,920	4,240	4,240	4,240	8,340	.....
15	3,300	4,430	4,960	5,720	4,110	4,510	4,510	8,340	.....
16	2,900	4,430	4,960	5,530	4,240	4,940	4,790	8,120	.....
17	2,530	4,100	5,720	5,920	3,870	4,790	4,650	8,340	.....
18	3,200	4,780	5,530	5,720	3,990	4,510	4,650	9,270	.....
19	3,810	5,530	5,920	5,340	4,110	4,510	4,650	10,000	.....
20	3,670	5,340	6,320	5,720	3,870	4,370	4,510	10,300	.....
21	4,430	5,920	6,730	5,720	3,760	4,110	4,510	9,780	.....
22	4,600	5,530	7,150	5,340	3,990	4,110	4,790	9,780	.....
23	4,100	5,150	8,010	5,340	4,110	3,990	4,650	10,000	.....
24	3,810	4,260	8,450	5,150	3,870	3,870	4,510	9,780	.....
25	3,670	4,600	8,450	5,150	4,110	3,760	4,370	9,030	.....
26	3,670	4,780	8,230	4,160	3,870	3,760	4,370	8,560	.....
27	3,670	4,430	7,790	4,650	3,990	3,650	4,510	8,120	.....
28	3,810	4,260	7,150	4,300	4,510	3,430	4,510	7,700	.....
29	3,810	4,430	6,520	4,620	4,370	3,540	4,790	7,110	.....
30	3,810	4,600	6,520	4,950	4,240	3,540	4,940	6,740	.....
31	3,530	.....	6,520	.....	3,990	3,540	.....	6,220	.....

NOTE.—Daily discharge computed from well-defined rating curve which was applied indirectly Mar. 1 to June 30, owing to shifting channel. Discharge Nov. 7 to 30 estimated because of ice. Mean discharge about 3,840 second-feet, ranging from about 3,600 to 4,000 second-feet.

Monthly discharge of Mississippi River at St. Paul, Minn., for 1911.

[Drainage area, 35,700 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	.....	.....	[a] 1,960	0.055	0.06	B.
February	.....	.....	[a] 2,060	.058	.06	B.
March	4,600	2,140	3,230	.090	.10	B.
April	5,920	3,400	4,290	.120	.13	B.
May	8,450	3,010	5,400	.151	.17	B.
June	7,150	4,160	5,760	.161	.18	B.
July	5,090	3,760	4,340	.122	.14	A.
August	5,090	3,430	4,280	.120	.14	A.
September	4,940	3,540	4,370	.122	.14	A.
October	11,800	4,650	8,290	.232	.27	A.
November	6,050	.....	4,120	.115	.13	B.
December	.....	.....	[a] 3,150	.088	.10	B.
The year	.....	.....	4,290	.120	1.62	

[a] Estimated from United States Engineer Corps records at Lock and Dam No. 2 near Minneapolis, an allowance (based on the Mankato records) being made for the flow of Minnesota River.

NOTE.—See footnotes to tables of daily gage height and 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, 1911.

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 frequent discharge measurements made by an employee who resides near the dam. At extreme flood stages the Mississippi drowns at 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.—The station is 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 of the headwaters of the Mississippi.

Daily discharge, in second-feet, of Sandy River below Sandy Lake reservoir, Minn., for 1911.

[0=No flow from reservoir.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5	5	5	5	5	284	152	5	0	5	75	10
2	5	5	5	5	5	283	122	5	5	5	75	10
3	5	5	5	5	5	282	92	5	5	5	75	10
4	5	5	5	5	5	292	61	5	0	5	50	10
5	5	5	5	5	5	301	30	5	0	5	50	10
6	5	5	5	5	5	311	00	5	0	5	50	10
7	5	5	5	5	5	321	50	5	0	5	50	10
8	5	5	5	5	5	331	50	5	0	5	50	10
9	5	5	5	5	242	328	100	5	0	5	50	10
10	5	5	5	5	303	325	75	5	0	5	50	10
11	5	5	5	5	300	321	5	5	0	5	50	10
12	5	5	5	5	296	318	5	5	0	5	50	10
13	5	5	5	5	291	315	5	5	0	5	50	10
14	5	5	5	5	287	312	5	5	0	268	50	10
15	5	5	5	5	294	308	0	5	0	275	10	10
16	5	5	5	5	301	305	0	5	0	282	10	10
17	5	5	5	5	308	303	0	300	0	281	10	10
18	5	5	5	5	316	301	0	307	5	272	10	10
19	5	5	5	5	324	300	0	296	5	263	10	10
20	5	5	5	5	328	467	0	285	5	255	10	10
21	5	5	5	5	332	475	0	274	5	225	10	10
22	5	5	5	5	283	483	0	263	5	195	10	10
23	5	5	5	5	104	492	0	251	5	166	10	10
24	5	5	5	5	109	501	0	239	5	162	10	10
25	5	5	5	5	114	448	0	227	5	157	10	10
26	5	5	5	5	118	395	0	198	5	153	10	10
27	5	5	5	5	123	342	0	169	5	148	10	10
28	5	5	5	5	111	289	0	140	5	144	10	10
29	5	.....	5	5	100	236	0	110	5	139	10	10
30	5	.....	5	5	293	182	0	80	5	134	10	10
31	5	.....	5	.....	285	.....	0	50	.....	129	.....	10

NOTE.—Daily discharge compiled from unpublished records in the United States Engineer Office at St. Paul.

Monthly overflow from Sandy Lake reservoir, Minn., for 1911.

Month.	Discharge in second-feet.			Run-off (in acre-feet).
	Maximum.	Minimum.	Mean.	
January	5	5	5.0	13.4
February	5	5	5.0	12.1
March	5	5	5.0	13.4
April	5	5	5.0	13.0
May	332	5	181	485
June	501	182	338	876
July	152	0	24.3	65.1
August	307	5	105	281
September	5	0	2.5	6.48
October	282	5	120	321
November	75	10	31.2	80.9
December	10	10	10.0	26.8
The year	501	0	69.6	2,190

NOTE.—Estimates computed by engineers of the United States Geological Survey from unpublished records in the United States Engineer Office at St. Paul.

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, 1911.

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 and 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.

Cooperation.—The station is 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 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	78	91	102	117	131	225	486	65	219	68	53	55
2	79	92	103	117	132	230	475	60	216	50	53	54
3	79	92	104	118	132	233	465	62	214	10	53	54
4	80	93	104	118	133	220	455	64	212	10	53	54
5	80	93	104	119	133	218	440	65	210	10	53	54
6	79	94	104	119	134	216	425	63	80	50	53	53
7	80	94	104	120	134	214	405	62	78	51	25	53
8	80	95	104	121	135	212	403	60	75	51	53	53
9	81	95	104	121	136	210	390	58	73	50	53	53
10	81	96	104	122	414	209	370	56	73	50	53	53
11	82	97	104	123	416	212	350	54	72	49	53	54
12	82	97	105	123	418	215	325	52	72	48	53	54
13	83	98	105	124	421	218	300	54	71	10	53	54
14	83	98	106	124	420	220	300	56	71	47	53	55
15	83	99	108	125	418	523	290	58	70	47	53	55
16	84	99	108	125	417	525	280	60	70	47	52	55
17	84	100	109	126	415	528	275	210	70	47	52	55
18	85	100	110	126	415	528	265	212	69	47	52	56
19	85	100	110	127	414	527	260	214	69	47	53	56
20	86	101	111	127	412	527	240	218	69	47	54	56
21	86	101	111	128	420	526	225	222	68	47	55	57
22	87	102	113	128	475	526	173	226	68	48	54	57
23	87	102	113	129	500	525	170	228	68	48	55	57
24	88	102	114	129	510	525	165	230	67	49	56	57
25	89	102	114	130	520	520	165	231	67	49	57	58
26	89	103	114	130	525	515	164	232	66	50	57	58
27	90	103	115	131	520	510	164	230	66	51	56	58
28	90	103	115	130	515	505	163	228	65	53	56	59
29	90	.....	116	131	510	495	163	226	50	53	55	59
30	91	.....	116	131	500	486	50	224	50	52	56	59
31	91	.....	115	.....	400	.....	50	222	.....	53	.....	59

NOTE.—Daily discharge compiled from unpublished records in the United States Engineer office at St. Paul.

Monthly discharge of Pine River below Pine River reservoir, Minn., for 1911.

[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 millions of cubic feet.
January	91	78	84.3	0.187	0.22	226
February	103	91	97.9	.217	.23	237
March	116	102	109	.241	.28	292
April	131	117	125	.277	.31	324
May	525	131	360	.796	.92	964
June	528	209	378	.836	.93	980
July	486	50	286	.633	.73	766
August	232	52	138	.305	.35	370
September	219	50	92.9	.206	.23	241
October	68	10	44.8	.099	.11	120
November	57	25	52.9	.117	.13	137
December	59	53	55.6	.123	.14	149
The year	528	10	152	.336	4.58	4,810

NOTE.—Computed by engineers of the United States Geological Survey from unpublished records in the United States Engineer office at St. Paul.

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 15, 1911.

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 the present datum.

Channel.—Probably permanent.

Discharge measurements.—Made from the bridge.

Regulation.—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. 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 descent of 12 feet, known as Westers Rapids.

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

Accuracy.—Discharge values below 160 and above 678 second-feet, published in the following tables, are based upon an extension of the discharge rating curve and should therefore be used with caution.

The following discharge measurement was made by S. B. Soulé:

July 11, 1911: Gage height, 4.54 feet; discharge, 186 second-feet.

Daily gage height, in feet, of Crow Wing River at Nimrod, Minn., for 1911.

[W. A. Wintermute, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	4.45	4.55	4.62	5.04	4.51	4.52	5.29	5.00
2	4.45	4.52	4.62	5.01	4.58	4.52	5.24	5.30
3	4.45	4.50	4.62	4.98	4.58	4.54	5.20	5.25
4	4.46	4.48	4.65	5.00	4.60	4.55	5.15	5.20
5	4.50	4.51	4.70	4.96	4.58	4.55	5.15	5.05
6	4.48	4.51	4.70	4.95	4.55	4.56	5.15	4.92
7	4.45	4.50	4.70	4.94	4.58	4.61	5.11	4.90
8	4.45	4.50	4.68	4.92	4.60	4.62	5.06	4.88
9	4.45	4.50	4.65	4.79	4.60	4.62	5.02	4.86
10	4.48	4.50	4.65	4.76	4.60	4.62	5.00	4.85
11	4.54	4.50	4.65	4.70	4.60	4.61	4.98	4.85
12	4.59	4.50	4.65	4.49	4.59	4.60	5.00	.....
13	4.66	4.50	4.69	4.44	4.58	4.62	5.00	.....
14	4.68	4.50	[a] 5.25	4.40	4.58	4.65	5.00	.....
15	4.70	4.51	5.60	4.40	4.56	4.65	5.00	.....
16	4.70	4.51	5.60	4.40	4.55	4.65	5.00	.....
17	4.70	4.62	5.52	4.40	4.55	4.62	4.98	.....
18	4.70	4.62	5.44	4.40	4.55	4.62	4.98	.....
19	4.71	4.60	5.40	4.38	4.55	4.62	4.95	.....
20	4.71	4.60	5.36	4.36	4.55	4.65	4.92	.....
21	4.70	4.60	5.31	4.31	4.55	[a] 5.65	4.92	.....
22	4.68	4.58	5.34	4.30	4.58	5.80	4.92	.....
23	4.64	4.58	5.45	4.40	4.58	5.76	4.92	.....
24	4.59	4.55	5.49	4.49	4.58	5.68	4.90	.....
25	4.58	4.55	5.42	4.50	4.58	5.59	4.90	.....
26	4.58	4.55	5.36	4.49	4.55	5.54	4.90	.....
27	4.58	4.55	5.29	4.48	4.55	5.46	4.88	.....
28	4.58	4.55	5.24	4.48	4.54	5.38	4.88	.....
29	4.58	4.59	5.19	4.48	4.52	5.35	4.88	.....
30	4.58	4.62	5.09	4.48	4.52	5.32	4.85	.....
31	.....	4.62	.....	4.48	4.52	.....	4.85	.....

[a] Rise caused by opening of logging dam above gaging station.

NOTE.—Ice present to Jan. 1 to Mar. 31 and Nov. 12 to Dec. 31.

Daily discharge, in second-feet, of Crow Wing River at Nimrod, Minn., for 1910–1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.								
1	.....	486	923	184	160	140	758	276
2	.....	472	923	184	160	140	758	276
3	.....	515	1,140	184	160	140	758	276
4	.....	530	880	184	160	140	758	270
5	.....	530	494	208	160	152	694	264
6	.....	530	356	208	160	144	619	264
7	.....	515	324	208	160	140	567	.....
8	.....	494	312	253	160	140	530	.....
9	.....	486	270	253	160	140	523	.....
10	.....	472	264	236	160	140	486	.....
11	.....	464	264	264	160	140	429	.....
12	.....	457	264	236	179	140	402	.....
13	.....	457	264	208	198	375	395	.....
14	.....	457	253	208	198	718	388	.....
15	530	457	219	203	184	822	362	.....
16	567	486	208	203	165	798	330	.....
17	619	537	208	160	152	457	300	.....
18	686	545	208	160	140	160	276	.....
19	742	523	208	160	140	140	312	.....
20	758	530	203	160	136	140	324	.....
21	710	574	189	160	128	128	356	.....
22	678	597	179	160	144	103	375	.....
23	678	589	165	170	140	120	375	.....
24	678	742	160	184	128	120	362	.....
25	678	906	179	184	128	422	356	.....
26	648	1,060	170	184	128	758	350	.....
27	611	1,140	184	179	128	774	337	.....
28	574	1,170	184	170	128	774	324	.....
29	523	1,280	184	170	128	774	318	.....
30	501	993	184	160	128	758	300	.....
31	.....	923	.....	160	128	.....	294	.....
1911.								
1	140	184	219	486	165	170	671	457
2	140	170	219	464	198	170	634	678
3	140	160	219	443	198	179	604	641
4	144	152	236	457	208	184	567	604
5	160	165	264	429	198	184	567	494
6	152	165	264	422	184	189	567	402
7	140	160	264	416	198	214	537	388
8	140	160	253	402	208	219	501	375
9	140	160	236	318	208	219	472	362
10	152	160	236	300	208	219	457	356
11	179	160	236	264	208	214	443	356
12	203	160	236	156	203	208	457	.....
13	242	160	258	136	198	219	457	.....
14	253	160	641	120	198	236	457	.....
15	264	165	923	120	189	236	457	.....
16	264	165	923	120	184	236	457	.....
17	264	219	855	120	184	219	443	.....
18	264	219	790	120	184	219	443	.....
19	270	208	758	113	184	219	422	.....
20	270	208	726	106	184	236	402	.....
21	264	208	686	89	184	966	402	.....
22	253	198	710	86	198	1,100	402	.....
23	230	198	798	120	198	1,060	402	.....
24	203	184	830	156	198	993	388	.....
25	198	184	774	160	198	914	388	.....
26	198	184	726	156	184	872	388	.....
27	198	184	671	152	184	806	375	.....
28	198	184	634	152	179	742	375	.....
29	198	203	597	152	170	718	375	.....
30	198	219	523	152	170	694	356	.....
31	.....	219	.....	152	170	.....	356	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between discharges 160 and 678 second-feet (gage heights 4.5 and 5.3 feet).

Monthly discharge of Crow Wing River at Nimrod, Minn., for 1910–1911.

[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.		
1910.						
April 15-30	758	501	636	0.630	0.37	A.
May	1,280	457	642	.636	.73	A.
June	1,140	160	332	.329	.37	A.
July	264	160	192	.190	.22	A.
August	198	128	151	.150	.17	B.
September	822	103	335	.332	.37	B.
October	758	276	442	.438	.50	B.
November 1-6	276	264	271	.268	.06	B.
1911.						
April	270	140	202	.200	.22	B.
May	219	152	181	.179	.21	B.
June	923	219	524	.519	.58	B.
July	486	86	227	.225	.26	A.
August	208	165	191	.189	.22	A.
September	1,100	170	435	.431	.48	B.
October	671	356	459	.454	.52	A.
November 1-11	678	356	465	.460	.19	B.

CROW WING RIVER AT PILLAGER, MINN.

Location.—At highway bridge, half a 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, 1911.

Drainage area.—3,230 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Probably permanent except during high water.

Discharge measurements.—Made from the bridge.

Regulation.—No dams near the station, as the only one on the river is a logging dam at the outlet of Lower Crow Wing Lake.

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 fairly good results, although the shifting of the river bed during high water may necessitate the use of more than one rating curve.

Discharge measurements of Crow Wing River at Pillager, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Apr. 6	C. R. Adams	5.37	542
Dec. 15[a]	S. B. Soulé	6.22	476

[a] Measurement made under ice cover. Average thickness of ice, 0.80 foot. Average distance water surface to top of ice, 0.05 foot.

Daily gage height, in feet, of Crow Wing River at Pillager, Minn., for 1911.

[Miss Eureka Holmgren, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.55	5.52	5.50	5.63	5.17	4.90	5.92	5.22	.....
2	.....	5.50	5.52	5.50	5.52	5.10	4.90	5.92	5.22	6.13
3	.....	5.50	5.46	5.68	5.42	5.15	4.90	5.95	5.55	.....
4	.....	5.50	5.40	5.80	5.50	5.22	4.92	5.92	5.54	.....
5	.....	5.40	5.40	5.80	5.51	5.32	4.98	5.85	5.70	.....
6	.....	5.45	5.40	5.78	5.48	5.30	5.03	5.84	5.72	6.12
7	.....	5.45	5.38	5.72	5.38	5.30	5.12	5.82	5.78	.....
8	.....	5.42	5.35	5.62	5.30	5.25	5.20	5.80	5.80	.....
9	.....	5.42	5.35	5.52	5.28	5.22	5.23	5.80	5.82	6.15
10	.....	5.40	5.38	5.52	5.15	5.20	5.20	5.80	5.70	.....
11	6.7	5.55	5.40	5.48	5.05	5.20	5.18	5.72	5.20	.....
12	.....	5.70	5.40	5.38	4.92	5.20	5.16	5.70	.....	.....
13	.....	5.85	5.39	5.32	4.82	5.18	5.24	5.85	.....	6.15
14	.....	5.92	5.40	5.30	4.72	5.10	5.22	5.82	.....	.....
15	6.72	5.98	5.50	5.72	4.72	5.30	5.24	5.90	.....	6.22
16	.....	5.88	5.68	6.02	4.69	5.15	5.28	5.98	.....	6.25
17	.....	5.82	5.90	6.11	4.66	5.10	5.10	6.00	.....	.....
18	.....	5.78	5.82	6.08	4.70	5.10	5.18	6.02	.....	.....
19	.....	5.80	5.78	5.92	4.70	5.00	5.27	6.00	.....	.....
20	.....	5.78	5.72	5.90	4.70	5.00	5.30	5.95	.....	6.30
21	.....	5.72	5.60	5.80	4.70	5.00	5.30	5.88	.....	.....
22	6.30	5.70	5.55	5.70	4.72	5.00	6.10	5.87	.....	.....
23	6.10	5.65	5.50	5.71	4.85	5.00	6.20	5.88	.....	6.35
24	6.15	5.62	5.48	5.78	5.05	5.00	6.20	5.90	.....	.....
25	5.95	5.52	5.50	5.70	5.10	4.98	6.18	5.90	.....	.....
26	5.80	5.55	5.38	5.78	5.05	4.90	6.05	5.80	.....	.....
27	5.45	5.52	5.29	5.70	5.05	4.92	6.00	5.75	.....	6.30
28	5.65	5.50	5.26	5.70	5.00	4.95	6.00	5.70	.....	.....
29	5.80	5.52	5.20	5.70	4.95	4.94	6.00	5.70	6.15	6.30
30	5.60	5.52	5.30	5.70	4.90	5.00	6.00	5.70	.....	.....
31	5.60	.....	5.27	.....	4.92	4.98	.....	5.35	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 25 and Nov. 12 to Dec. 31.

Daily discharge, in second-feet, of Crow Wing River at Pillager, Minn., for 1911.

Date.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	644	627	615	691	443	328	877	467
2	.....	615	627	615	627	410	328	877	467
3	.....	615	593	722	571	434	328	897	644
4	.....	615	560	797	615	467	336	877	638
5	.....	560	560	797	621	518	359	830	734
6	.....	588	560	784	604	507	380	823	747
7	.....	588	549	747	549	507	419	810	784
8	.....	571	534	685	507	482	457	797	797
9	.....	571	534	627	497	467	472	797	810
10	.....	560	549	627	434	457	457	797	734
11	.....	644	560	604	388	457	448	747	457
12	.....	734	560	549	336	457	438	734	.....
13	.....	830	555	518	299	448	477	830	.....
14	.....	877	560	507	266	410	467	810	.....
15	.....	917	615	747	266	507	477	863	.....
16	.....	850	722	945	257	434	497	917	.....
17	.....	810	863	1,010	249	410	410	931	.....
18	.....	784	810	987	260	410	448	945	.....
19	.....	797	784	877	260	367	492	931	.....
20	.....	784	747	863	260	367	507	897	.....
21	.....	747	673	797	260	367	507	850	.....
22	.....	734	644	734	266	367	1,000	843	.....
23	.....	704	615	740	310	367	1,070	850	.....
24	.....	685	604	784	388	367	1,070	863	.....
25	.....	627	615	734	410	359	1,060	863	.....

Daily discharge, in second-feet, of Crow Wing River at Pillager, Minn., for 1911—Contd.

Date.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	797	644	549	784	388	328	966	797	.....
27	588	627	502	734	388	336	931	766	.....
28	704	615	487	734	367	348	931	734	.....
29	797	627	457	734	348	344	931	734	.....
30	673	627	507	734	328	367	931	734	.....
31	673	.....	492	.....	336	359	.....	534	.....

NOTE.—Discharge Jan. 1 to Mar. 25 and Nov. 12 to Dec. 31 estimated, because of ice, from one discharge measurement, climatologic records, observer's notes, and discharge of adjacent drainage areas. Mean discharge Jan. 1 to 31 estimated 370 second-feet. Mean discharge Feb. 1 to 28 estimated 360 second-feet. Mean discharge Mar. 1 to 25 estimated 500 second-feet, varying from about 400 to 750 second-feet. Mean discharge Nov. 12 to 30 estimated 435 second-feet, varying from about 430 to 450 second-feet. Mean discharge Dec. 1 to 31 estimated 450 second-feet, varying from about 420 to 480 second-feet.

Monthly discharge of Crow Wing River at Pillager, Minn., for 1911.

[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	.....	.....	370	0.115	0.13	D.
February	.....	.....	360	.111	.12	D.
March	.....	.....	540	.167	.19	D.
April	917	560	686	.212	.24	B.
May	863	457	600	.186	.21	B.
June	1,010	507	738	.228	.25	B.
July	691	249	398	.123	.14	C.
August	518	328	415	.128	.15	C.
September	1,070	328	597	.185	.21	B.
October	945	534	824	.255	.29	B.
November	810	.....	518	.160	.18	C.
December	.....	.....	450	.139	.16	C.
The year	1,070	249	539	.167	2.27	

NOTE.—See footnotes to table of daily discharge.

LONG PRAIRIE RIVER NEAR MOTLEY, MINN.

Location.—100 yards above the highway bridge 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, 1911.

Drainage area.—973 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Fairly permanent.

Discharge measurements.—During all stages except low, discharge measurements are made from the bridge, but low-water measurements are made by wading at a short distance upstream.

Winter flow.—From November to March the river is frozen over at the gage, and observations are discontinued.

Accuracy.—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.

The following discharge measurement was made by C. R. Adams:

April 7, 1911: Gage height, 4.98 feet; discharge, 94.4 second-feet.

Daily gage height, in feet, of Long Prairie River near Motley, Minn., for 1911.

[John Greene, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	5.11	5.09	5.15	4.82	4.85	4.84	5.62	5.25
2	.....	5.09	5.09	5.16	4.76	4.82	4.84	5.62	5.19
3	.....	5.08	5.06	5.20	4.74	4.92	4.82	5.75	5.62
4	.....	5.06	5.02	5.29	4.74	4.94	4.84	5.62	5.38
5	.....	4.97	5.04	5.30	4.81	4.92	4.82	5.42	5.38
6	.....	5.06	5.04	5.24	4.88	4.94	4.85	5.14	5.42
7	.....	4.98	5.02	5.16	4.86	4.91	4.90	5.14	5.12
8	.....	5.08	5.02	5.11	4.84	4.89	4.91	5.15	5.15
9	.....	5.09	5.02	5.05	4.79	4.90	4.92	5.14	5.12
10	.....	5.11	5.02	5.04	4.76	4.91	4.92	5.12	5.00
11	.....	5.12	5.00	5.01	4.74	4.89	4.90	5.11	5.30
12	.....	5.15	4.99	4.98	4.72	4.89	4.90	5.11	.....
13	.....	5.25	5.01	4.95	4.70	4.88	4.88	5.11	.....
14	.....	5.28	5.05	4.95	4.69	4.89	5.02	5.16	.....
15	.....	5.24	5.04	4.92	4.68	4.86	5.15	5.20	.....
16	.....	5.24	5.28	4.90	4.66	4.86	5.24	5.22	.....
17	.....	5.21	5.32	4.89	4.66	4.84	5.26	5.30	.....
18	.....	5.19	5.26	4.89	4.68	4.85	5.24	5.34	.....
19	.....	5.18	5.29	4.85	4.66	4.84	5.21	5.35	.....
20	.....	5.15	5.25	4.84	4.68	4.84	5.22	5.32	.....
21	.....	5.15	5.18	4.80	4.70	4.84	5.26	5.34	.....
22	.....	5.15	5.12	4.76	4.71	4.81	5.28	5.36	.....
23	.....	5.14	5.10	4.75	4.78	4.80	5.26	5.34	.....
24	.....	5.11	5.10	4.72	4.75	4.80	5.19	5.31	.....
25	.....	5.10	5.08	4.72	4.74	4.81	5.14	5.28	.....
26	5.20	5.10	5.08	4.72	4.72	4.80	5.10	5.28	.....
27	5.18	5.09	5.06	4.72	4.72	4.80	5.08	5.25	.....
28	5.12	5.10	5.05	4.72	4.75	4.79	5.09	5.20	.....
29	5.16	5.08	5.05	4.78	4.74	4.80	5.06	5.16	.....
30	5.14	5.08	5.11	4.78	4.71	4.82	5.08	5.15	.....
31	5.10	.....	5.14	.....	4.81	4.84	.....	5.62	.....

NOTE.—Ice present Jan. 1 to Mar. 25 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Long Prairie River near Motley, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	125	120	135	67	72	70	301	163
2	.....	120	120	138	59	67	70	301	145
3	.....	117	113	148	56	84	67	361	301
4	.....	113	104	175	56	88	70	301	205
5	.....	93	108	178	66	84	67	220	205
6	.....	113	108	160	77	88	72	132	220
7	.....	95	104	138	74	82	80	132	127
8	.....	117	104	125	70	78	82	135	135
9	.....	120	104	110	63	80	84	132	127
10	.....	125	104	108	59	82	84	127	99
11	.....	127	99	101	56	78	80	125	[a]178
12	.....	135	97	95	54	78	80	125	.....
13	.....	163	101	90	51	77	77	125	.....
14	.....	172	110	90	50	78	104	138	.....
15	.....	160	108	84	49	74	135	148	.....
16	.....	160	172	80	47	74	160	154	.....
17	.....	151	185	78	47	70	166	178	.....
18	.....	145	166	78	49	72	160	192	.....
19	.....	143	175	72	47	70	151	195	.....
20	.....	135	163	70	49	70	154	185	.....
21	.....	135	143	64	51	70	166	192	.....
22	.....	135	127	59	52	66	172	198	.....
23	.....	132	122	58	61	64	166	192	.....
24	.....	125	122	54	58	64	145	181	.....
25	.....	122	117	54	56	66	132	172	.....
26	148	122	117	54	54	64	122	172	.....
27	143	120	113	54	54	64	117	163	.....
28	127	122	110	54	58	63	120	148	.....
29	138	117	110	61	56	64	113	138	.....
30	132	117	125	61	52	67	117	135	.....
31	122	.....	132	.....	66	70	.....	301	.....

[a] Probably too high.

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

Monthly discharge of Long Prairie River near Motley, Minn., for 1911.

[Drainage area, 973 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March 26–31	148	122	135	0.139	0.03	B.
April	172	93	129	.133	.15	A.
May	185	97	123	.126	.15	A.
June	178	54	94.2	.097	.11	A.
July	77	47	56.9	.058	.07	B.
August	88	63	73.2	.075	.09	A.
September	172	67	113	.116	.13	A.
October	361	125	184	.189	.22	A.
November 1–11	301	99	173	.178	.07	B.

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, 1911.

Drainage area.—816 square miles.

Gage.—Chain; attached to bridge; datum unchanged since established. The 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 the bridge.

Regulation.—At the mouth of the river there is a dam 9 feet high. The station is above the influence of the dam, and backwater from the Mississippi does not reach the station. The first dam above the station is at Cold Spring, 15 miles distant. The opening and shutting of the turbine gates at this dam affect the flow at the gaging station during the low-water season.

Winter flow.—From December to March the river is frozen completely over in the vicinity of the gaging station, and measurements are made through the ice to determine the winter discharge.

Accuracy.—The mean daily gage height during the low-water season is subject to some error resulting from daily fluctuations in the stage of the river caused by control of flow by dams above the station, and therefore the records for that period can not be considered better than fair.

Discharge measurements of Sauk River near St. Cloud, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Apr. 8	C. R. Adams	5.80	98.0
Oct. 25	S. B. Soulé	5.66	76.2
Nov. 29[a]	W. G. Hoyt	6.88	135
Dec. 29[b]	S. B. Soulé	6.53	116

[a] Complete ice cover. Average thickness of ice, 0.82 foot. Average distance water surface to top ice, —0.03 foot.

[b] Complete ice cover. Average thickness of ice, 0.87 foot. Average distance water surface to surface ice, 0.00 foot. Gage height to top of ice, 6.18 feet. Thickness of ice at gage, 1.68 feet.

Daily gage height, in feet, of Sauk River near St. Cloud, Minn., for 1911.

[Miss Ida Waite, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	6.55	5.50	5.20	5.70	5.75	5.66	5.88	5.30	6.1
2	6.5	.....	.....	6.55	5.55	5.35	5.65	5.66	5.78	5.72	5.35	.....
3	.....	.....	.....	6.45	5.55	5.50	5.50	5.70	5.92	5.90	5.55	.....
4	.....	6.8	.....	5.65	5.55	5.50	5.40	5.70	5.86	5.80	5.65	6.70
5	.....	.....	.....	5.60	5.55	5.28	5.70	5.78	5.82	5.75	5.25	.....
6	6.7	.....	.....	5.50	5.55	5.35	5.55	5.90	5.90	5.80	5.60	.....
7	.....	6.9	.....	5.50	5.55	5.45	5.46	6.00	5.95	5.66	5.70	6.30
8	.....	.....	.....	5.70	5.45	5.50	5.62	5.90	6.00	5.81	5.75	.....
9	.....	.....	.....	5.30	5.25	5.50	5.65	5.81	5.38	6.00	5.85	.....
10	6.7	.....	.....	5.55	5.45	5.50	5.60	5.71	5.50	5.94	6.20	.....
11	.....	6.8	.....	5.25	5.55	5.39	5.42	5.83	5.85	5.85	5.95	6.1
12	.....	.....	.....	5.55	5.75	5.48	5.55	5.70	5.70	5.88	.....	.....
13	.....	.....	.....	5.35	5.55	5.55	5.60	5.95	5.85	5.86	.....	.....
14	.....	.....	.....	5.55	5.95	5.40	5.70	5.85	5.95	5.88	.....	.....
15	6.7	.....	.....	5.25	5.60	5.40	5.60	5.71	5.78	5.82	.....	6.6
16	.....	.....	.....	5.50	5.60	5.54	5.85	5.88	5.88	5.72	.....	.....
17	.....	.....	.....	5.25	5.40	5.50	5.51	6.02	5.55	5.65	.....	.....
18	.....	.....	.....	5.30	5.40	5.75	5.52	5.88	5.60	5.80	.....	6.2
19	6.6	.....	6.55	5.50	5.50	5.60	5.35	5.50	5.75	5.60	.....	.....
20	.....	.....	6.6	5.55	5.55	5.48	5.59	5.55	5.85	5.95	6.0	.....
21	.....	.....	6.3	5.50	5.55	5.52	5.74	5.30	5.75	5.90	.....	.....
22	6.7	.....	6.25	5.45	5.45	5.38	5.75	5.45	5.85	5.70	.....	.....
23	.....	.....	6.5	5.50	5.70	5.16	5.78	5.55	5.95	5.68	6.2	6.1
24	.....	.....	6.55	5.25	5.55	5.40	5.85	5.50	5.99	5.80	.....	.....
25	.....	.....	6.75	5.20	5.50	5.50	5.58	5.35	5.95	5.70	.....	.....
26	6.5	.....	5.55	5.15	5.55	5.40	5.75	5.85	5.82	5.65	.....	6.1
27	.....	.....	5.55	5.55	5.60	5.65	5.68	5.60	5.85	5.55	6.20	.....
28	.....	.....	5.55	5.55	5.45	5.60	5.88	5.45	5.68	5.50	.....	.....
29	.....	.....	5.7	5.50	5.55	5.85	5.85	5.55	5.88	5.60	6.88	6.53
30	6.6	.....	5.75	5.60	5.60	5.75	5.75	5.50	5.95	5.50	.....	.....
31	.....	.....	6.7	.....	5.95	.....	5.25	5.90	.....	5.25	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 18 and from Oct. 27 to Dec. 31; average thickness from Oct. 27 to Dec. 31, about 2 feet; average thickness beginning Nov. 12, about 1 foot.

Daily discharge, in second-feet, of Sauk River near St. Cloud, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	300	56	30	82	90	76	116	37
2	.....	300	62	42	75	76	96	85	42
3	.....	266	62	56	56	82	124	120	62
4	.....	75	62	56	46	82	112	99	75
5	.....	68	62	36	82	96	103	90	34
6	.....	56	62	42	62	120	120	99	68
7	.....	56	62	51	52	142	131	76	82
8	.....	82	51	56	71	120	142	101	90
9	.....	37	34	56	75	101	44	142	110
10	.....	62	51	56	68	84	56	129	[a] 192
11	.....	34	62	45	48	105	110	110	131
12	.....	62	90	54	62	82	82	116	.....
13	.....	42	62	62	68	131	110	112	.....
14	.....	62	131	46	82	110	131	116	.....
15	.....	34	68	46	68	84	96	103	.....
16	.....	56	68	61	110	116	116	85	.....
17	.....	34	46	56	57	147	62	75	.....
18	.....	37	46	90	58	116	68	99	.....
19	300	56	56	68	42	56	90	68	.....
20	317	62	62	54	67	62	110	131	.....
21	220	56	62	58	89	37	90	120	.....
22	206	51	51	44	90	51	110	82	.....
23	282	56	82	28	96	62	131	79	.....
24	300	34	62	46	110	56	140	99	.....
25	378	30	56	56	66	42	131	82	.....

[a] Discharge may be too high as result of applying open channel rating table—that is, relation of gage height to discharge may have been affected by ice.

Daily discharge, in second-feet, of Sauk River near St. Cloud, Minn., for 1911—Contd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	62	27	62	46	90	110	103	75	.....
27	62	62	68	75	79	68	110	62	.....
28	62	62	51	68	116	51	79	56	.....
29	82	56	62	110	110	62	116	68	.....
30	90	68	68	90	90	56	131	56	.....
31	356	.....	131	.....	75	120	.....	34	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Mar. 1 to 18 and Nov. 12 to Dec. 31 estimated, because of ice, from discharge measurements, gage observer's notes, and climatologic records. Mean discharge Mar. 1 to 18 estimated 50 second-feet, varying from about 15 to 200 second-feet. Mean discharge Nov. 12 to 30 estimated 120 second-feet, varying from about 110 to 135 second-feet. Mean discharge Dec. 1 to 31 estimated 135 second-feet, varying from about 110 to 150 second-feet.

Monthly discharge of Sauk River near St. Cloud, Minn., for 1911.

[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	.....	.....	[a] 12.0	0.015	0.02	C.
February	.....	.....	[a] 10.0	.012	.01	D.
March	378	.....	117	.143	.16	B.
April	300	27	76.1	.093	.10	A.
May	131	34	64.8	.079	.09	A.
June	110	28	56.1	.069	.08	A.
July	116	42	75.5	.093	.11	A.
August	147	37	87.6	.107	.12	A.
September	142	44	104	.127	.14	A.
October	142	34	93.1	.114	.13	A.
November	.....	.....	107	.131	.15	C.
December	.....	.....	135	.164	.19	C.
The year	378	.....	78.6	.096	1.30	

[a] Estimated from one discharge measurement, semiweekly gage heights, and climatologic records.
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 half a mile east of Bailey station on the Northern Pacific Railway; in sec. 23, T. 33 N., R. 27 W., one-half mile above Tibbetts Brook and 4 miles below mouth of St. Francis River.

Records available.—Gage heights and discharge measurements from April 15, 1911, to December 31, 1911.

Drainage area.—615 square miles.

Gage.—Vertical staff.

Channel.—Probably permanent, as small rapids a short distance below are the control point.

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

Regulation.—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.

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

Discharge measurements of Elk River near Big Lake, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 10	C. J. Emerson	0.38	72.5
July 16	S. B. Soulé [a]	.22	43.4
Oct. 26	....do	.90	205
Nov. 28 [b]	Hoyt and Soulé	.98	95.6
Dec. 28 [c]	S. B. Soulé	1.08	106

[a] Wading measurement.
[b] Complete ice cover. Average thickness of ice, 0.36 foot; average distance water surface to top of ice, 0.00 foot.
[c] 90 per cent ice cover. Average thickness of ice at measuring section, 0.55 foot.

Daily gage height, in feet, of Elk River near Big Lake, Minn., for 1911.

[Michael E. Tracy, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.48	0.51	0.40	0.50	0.38	0.51	0.71	.....
2	.....	.45	.51	.36	.45	.35	.46	.66	.....
3	.....	.45	.55	.34	.41	.34	.60	.65	.....
4	.....	.44	.66	.31	.46	.39	.64	.68	0.98
5	.....	.40	.61	.45	.44	.42	.61	.68	.....
6	.....	.38	.59	.42	.42	.44	.84	.74	.....
7	.....	.38	.65	.38	.48	.45	.86	.69	.98
8	.....	.38	.78	.34	.49	.45	.79	.66	.....
9	.....	.38	.75	.32	.45	.44	.78	.64	.....
10	.....	.38	.66	.31	.44	.41	.76	.61	.....
11	.....	.34	.62	.29	.41	.50	.75	.56	1.12
12	.....	.32	.61	.26	.40	.50	.72	.55	.....
13	.....	.35	.58	.25	.39	.46	.72	.72	.....
14	0.70	.40	.54	.24	.39	.48	.88	.....	1.02
15	.65	.69	.49	.22	.38	.46	.89	.....	.....
16	.64	.76	.55	.22	.38	.44	.94	.85	.....
17	.61	.72	.60	.22	.38	.42	1.02	.....	.....
18	.59	.70	.52	.24	.34	.44	1.05	.....	.98
19	.62	.95	.49	.28	.32	.42	1.05	.....	.....
20	.65	1.00	.44	.28	.31	.41	1.05	.90	.....
21	.60	.98	.39	.26	.31	.42	1.04	.....	1.05
22	.58	1.10	.38	.24	.34	.41	.99	.....	.....
23	.55	1.11	.36	.25	.35	.40	.98	.92	.....
24	.52	1.01	.34	.25	.32	.40	.96	.....	.....
25	.52	.90	.34	.25	.31	.38	.94	.....	1.12
26	.49	.82	.54	.24	.31	.38	.89	.....	.....
27	.48	.74	.45	.22	.39	.40	.86	.98	.....
28	.48	.69	.40	.29	.36	.41	.84	.98	1.09
29	.48	.64	.48	.28	.35	.56	.81	.....	.....
30	.48	.58	.49	.26	.38	.52	.79	.98	.....
31	.....	.55	.....	.28	.38	.....	.76	.....	.....

NOTE.—Relation of gage height to discharge affected by ice about Nov. 13 to Dec. 31.

Daily discharge, in second-feet, of Elk River near Big Lake, Minn., for 1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	96	102	80	100	76	102	146
2	.....	90	102	72	90	70	92	135
3	.....	90	110	69	82	69	121	132
4	.....	88	135	63	92	78	130	139
5	.....	80	123	90	88	84	123	139
6	.....	76	119	84	84	88	178	154
7	.....	76	132	76	96	90	184	142
8	.....	76	163	69	98	90	166	135
9	.....	76	156	65	90	88	163	130
10	.....	76	135	63	88	82	158	123

Daily discharge, in second-feet, of Elk River near Big Lake, Minn., for 1911—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	69	126	59	82	100	156	113
12	.....	65	123	54	80	100	149	110
13	.....	70	117	52	78	92	149	.....
14	144	80	108	50	78	96	189	.....
15	132	142	98	47	76	92	191	.....
16	130	158	110	47	76	88	205	.....
17	123	149	121	47	76	84	228	.....
18	119	144	104	50	69	88	236	.....
19	126	208	98	57	65	84	236	.....
20	132	222	88	57	63	82	236	.....
21	121	216	78	54	63	84	233	.....
22	117	250	76	50	69	82	219	.....
23	110	253	72	52	70	80	216	.....
24	104	225	69	52	65	80	211	.....
25	104	194	69	52	63	76	205	.....
26	98	173	108	50	63	76	191	.....
27	96	154	90	47	78	80	184	.....
28	96	142	80	59	72	82	178	.....
29	96	130	96	57	70	113	171	.....
30	96	117	98	54	76	104	166	.....
31	.....	110	.....	57	76	.....	158	.....

NOTE.—Daily discharge computed from a rating curve well defined and which was determined from discharge measurements made during 1912, before the publication of this report, in addition to 1911 discharge measurements. Discharge Nov. 13 to Dec. 31 estimated, because of ice, from discharge measurements, observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Nov. 13 to 30, estimated 100 second-feet. Mean discharge Dec. 1 to 31, estimated 110 second-feet.

Monthly discharge of Elk River near Big Lake, Minn., for 1911.

[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.		
April 14-30	144	96	114	0.185	0.12	A.
May	253	65	132	.215	.25	A.
June	163	69	107	.174	.19	A.
July	90	47	59.2	.096	.11	B.
August	100	63	77.9	.127	.15	B.
September	113	69	85.9	.140	.16	B.
October	236	92	178	.289	.33	A.
November	154	.....	113	.184	.21	C.
December	.....	.....	110	.179	.21	C.

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, 1911.

Drainage area.—2,520 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Probably permanent.

Discharge measurements.—During high and medium stages discharge measurements are made from the bridge, but during low stages measurements are made from a boat and cable several hundred yards downstream.

Regulation.—A short distance above the station is the 7-foot dam of a flour mill which operates intermittently. As the turbine uses but a small portion of the flow, the effect of shutting it down is inappreciable at the gage except during extreme low water. At that time four readings per day are taken to determine the mean flow. This dam was partly destroyed May 31, 1911, and has not yet been rebuilt.

Winter flow.—Gage heights are little affected by ice. The dam is so near the station that the stream remains open for the greater part of the section and for a distance of several hundred yards below. Winter measurements show that the open channel rating curve applies throughout the year.

Accuracy.—Conditions at this station are favorable for excellent results, and therefore the records should be reliable. Stations were originally established on both branches above their junction to be used as a check on the Rockford records, but the conditions on the North Branch were so unsatisfactory that its station was discontinued June 30, 1910.

Discharge measurements of Crow River at Rockford, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 15[a]	S. B. Soulé	5.01	142
Dec. 22[b]	do	4.96	138

[a] Measurements made by wading. [b] Measurement at regular section, 26 per cent ice over.

Daily gage height, in feet, of Crow River at Rockford, Minn., for 1911.

[Geo. W. Florida, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.72	4.58	4.64	5.02	4.95	5.22	5.10	4.80	4.80	4.87	5.18	5.00
2	4.70	4.58	4.64	4.96	4.96	5.14	5.02	4.82	4.78	4.86	4.98	5.00
3	4.67	4.58	4.63	5.01	4.94	5.16	4.97	4.85	4.78	4.96	5.06	5.00
4	4.66	4.60	4.64	5.02	4.92	5.16	4.91	4.83	4.80	5.05	5.12	5.00
5	4.68	4.55	4.57	5.02	4.92	5.80	4.90	4.82	4.82	5.62	5.14	4.99
6	4.68	4.58	4.65	5.02	4.89	5.64	4.94	4.82	4.82	6.10	5.15	5.00
7	4.64	4.57	4.66	5.02	4.88	5.62	4.93	4.82	4.82	6.46	5.15	4.98
8	4.65	4.58	4.68	5.03	4.90	5.60	4.92	4.84	4.82	6.50	5.14	5.00
9	4.64	4.56	4.72	5.01	4.88	5.48	4.94	4.88	4.82	6.15	5.18	5.00
10	4.64	4.58	4.74	5.03	4.86	5.32	4.96	4.85	4.80	5.75	5.10	5.04
11	4.64	4.58	4.81	5.13	4.88	5.28	4.95	4.81	4.92	5.60	4.94	5.02
12	4.64	4.56	4.87	5.16	4.88	5.19	4.94	4.78	4.96	5.58	4.90	5.02
13	4.64	4.58	4.92	5.20	4.86	5.22	4.92	4.84	5.05	5.54	5.06	5.04
14	4.63	4.58	4.95	5.16	4.85	5.04	4.90	4.85	5.04	5.54	5.04	5.04
15	4.60	4.59	4.96	5.18	4.96	5.03	4.86	4.85	5.00	5.54	5.06	5.06
16	4.62	4.60	5.02	5.18	5.03	5.14	4.84	4.95	4.94	5.58	5.05	5.10
17	4.62	4.60	5.04	5.17	5.12	5.14	4.84	4.90	4.87	6.06	5.09	5.10
18	4.62	4.60	5.04	5.16	5.46	5.04	4.85	4.81	4.84	6.16	5.05	5.06
19	4.62	4.56	5.00	5.16	5.61	5.00	4.86	4.82	4.84	6.06	5.04	5.04
20	4.62	4.60	5.05	5.15	5.70	4.97	4.86	4.82	4.83	6.00	5.02	5.02
21	4.62	4.62	5.06	5.14	5.76	4.96	4.86	4.80	4.82	5.98	5.00	5.00
22	4.58	4.63	5.05	5.14	5.84	4.94	4.84	4.80	4.82	5.82	5.00	4.98
23	4.62	4.64	5.04	5.12	5.91	4.91	4.85	4.80	4.81	5.73	4.98	4.98
24	4.62	4.64	5.04	5.02	5.88	4.90	4.86	4.79	4.81	5.66	5.00	4.99
25	4.60	4.64	5.04	4.94	5.78	5.12	4.84	4.79	4.82	5.62	5.00	4.98
26	4.60	4.56	5.00	4.92	5.52	5.19	4.81	4.80	4.82	5.54	5.00	5.00
27	4.60	4.62	5.04	4.92	5.40	5.12	4.80	4.81	4.82	5.48	5.00	5.00
28	4.60	4.64	5.04	4.94	5.31	5.02	4.80	4.80	4.82	5.41	4.99	4.98
29	4.55	.....	5.03	4.94	5.18	5.08	4.78	4.78	4.86	5.36	4.97	5.03
30	4.58	.....	5.02	4.92	5.11	5.11	4.78	4.77	4.86	5.29	4.96	5.10
31	4.59	.....	5.02	.....	5.14	.....	4.78	4.80	.....	5.24	.....	5.18

NOTE.—Discharge measurements show that the relation of gage height to discharge is probably not affected by ice.

Daily discharge, in second-feet, of Crow River at Rockford, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	67	40	51	151	128	225	179	85	85	104	209	144
2	62	40	51	131	131	194	151	90	80	101	138	144
3	56	40	49	148	125	202	134	98	80	131	165	144
4	54	43	51	151	118	202	115	93	85	162	187	144
5	58	34	38	151	118	500	112	90	90	405	194	141
6	58	40	52	151	109	415	125	90	90	665	198	144
7	51	38	54	151	107	405	122	90	90	881	198	138
8	52	40	58	154	112	395	118	96	90	905	194	144
9	51	38	67	148	107	336	125	107	90	695	209	144
10	51	40	71	154	101	266	131	98	85	472	179	158
11	51	40	88	190	107	249	128	88	118	395	125	151
12	51	38	104	202	107	213	125	80	131	385	112	151
13	51	40	118	217	101	225	118	96	162	365	165	158
14	49	40	128	202	98	158	112	98	158	365	158	158
15	43	41	131	209	131	154	101	98	144	365	165	165
16	47	43	151	206	154	194	96	128	125	385	162	179
17	47	43	158	206	187	194	96	112	104	643	176	179
18	47	43	158	202	327	158	98	88	96	701	162	165
19	47	38	144	202	400	144	101	90	96	643	158	158
20	47	43	162	198	445	134	101	90	93	610	151	151
21	47	47	165	194	478	131	101	85	90	599	144	144
22	40	49	162	194	522	125	96	85	90	511	144	138
23	47	51	158	187	560	115	98	85	88	462	138	138
24	47	51	158	151	544	115	101	83	88	425	144	141
25	43	51	158	125	489	187	96	83	90	405	144	138
26	43	38	144	118	355	213	88	85	90	365	144	144
27	43	47	158	118	300	187	85	88	90	336	144	144
28	43	51	158	125	261	151	85	85	90	304	141	138
29	34	.....	154	125	209	172	80	80	101	283	134	154
30	40	.....	151	118	183	183	80	78	101	253	131	179
31	41	.....	151	.....	194	.....	80	85	.....	233	.....	209

NOTE.—Daily discharge determined by means of a discharge rating curve that is well defined between 62 and 3,670 second-feet (gage heights 4.7 and 10 feet).

Monthly discharge of Crow River at Rockford, Minn., for 1911.

[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	67	34	48.6	0.019	0.02	B.
February	51	34	42.4	.017	.02	B.
March	165	38	116	.046	.05	A.
April	217	118	166	.066	.07	A.
May	560	98	229	.091	.10	A.
June	500	115	218	.087	.10	A.
July	179	80	109	.043	.05	A.
August	128	78	91.2	.036	.04	A.
September	162	80	100	.040	.04	A.
October	905	101	437	.173	.20	A.
November	209	112	160	.064	.07	A.
December	209	138	152	.060	.07	B.
The year	905	34	157	.062	.83	

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 December 31, 1911.

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 a short distance upstream.

Winter flow.—Observations are discontinued from December to March, inclusive, because of ice.

Regulation.—The nearest dam is that at Delano, which is merely used as a diversion dam by the Great Northern Railway Co. The control for the station is determined by the dam at Rockford. From July 27 to August 10, 1909, and from June 1 to December 31, 1911, the dam at Rockford was open, and the control was temporarily changed.

Discharge measurements of South Fork of Crow River near Rockford, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
June 15[a]	S. B. Soulé	0.72	12.8
Sept. 2[a]	do	.66	5.40
Dec. 22[b]	do	1.61	35.9

[a] Measurement made at wading section.
[b] Measurement made through complete ice cover 500 feet above gage. Average thickness ice at measured section, 0.47 foot.

Daily gage height, in feet, of South Fork of Crow River near Rockford, Minn., for 1911.

[Jacob Horsch, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.69	1.72	0.80	0.98	0.69	0.70	0.80	1.79	.....
2	.....	1.70	1.72	.70	.92	.86	.68	.80	1.60	.....
3	.....	1.70	1.71	.70	.91	.78	.68	1.00	1.56	1.4
4	.....	1.69	1.68	.80	.90	.74	.79	1.21	1.68	.....
5	1.14	1.69	1.65	.79	.90	.70	.91	1.28	1.64	.....
6	1.20	1.71	1.61	.76	.90	.70	.90	2.92	1.65	.....
7	1.28	1.69	1.61	.70	.90	.70	.90	4.09	1.61	1.4
8	1.40	1.72	1.65	.71	.90	.70	.86	3.68	1.54	.....
9	1.56	1.72	1.62	.71	.92	.70	.84	3.22	1.51	.....
10	1.64	1.72	1.59	.70	.90	.70	.81	2.88	1.56	.....
11	1.69	1.76	1.50	.70	.88	.70	1.00	2.62	1.48	1.55
12	1.69	1.79	1.46	.64	.84	.70	1.55	2.44	.....	.....
13	1.71	1.80	1.36	.62	.81	.71	1.52	2.32	.....	.....
14	1.81	1.80	1.45	.61	.79	.94	1.29	2.32	.....	1.68
15	1.68	1.81	1.65	.72	.79	1.15	1.09	2.40	.....	.....
16	1.74	1.84	1.80	.81	.79	1.38	1.01	2.65	.....	.....
17	1.72	1.84	1.80	.80	.80	1.19	.96	3.38	.....	.....
18	1.70	1.82	1.99	.72	.76	1.05	.90	3.38	.....	1.62
19	1.72	1.85	2.12	.69	.75	.94	.88	3.16	.....	.....
20	1.71	1.81	2.20	.62	.74	.85	.84	2.92	.....	.....
21	1.78	1.81	2.22	.64	.70	.81	.85	2.76	.....	1.6
22	1.81	1.76	2.25	.61	.70	.80	.85	2.65	.....	1.61
23	1.78	1.75	2.30	.61	.70	.78	.80	2.52	1.42	.....
24	1.71	1.71	2.29	.62	.70	.71	.79	2.41	1.40	.....
25	1.71	1.72	2.21	.88	.70	.70	.76	2.16	1.40	.....
26	1.75	1.71	2.06	1.24	.70	.70	.75	2.11	1.4	1.58
27	1.71	1.70	1.96	1.04	.70	.70	.75	2.08	1.42	.....
28	1.74	1.72	1.91	1.16	.64	.70	.79	2.00	.....	1.5
29	1.72	1.72	1.86	1.12	.61	.70	.80	1.95	1.38	.....
30	1.71	1.74	1.81	1.02	.62	.70	.80	1.91	.....	.....
31	1.70	.....	1.79	.....	.64	.70	.....	1.88	.....	.....

NOTE.—Relation of gage height to discharge affected by ice about Jan. 1 to Feb. 28 and Nov. 12 to Dec. 31. Relation of gage height to discharge changed June 1 because of change in control caused by dam at Rockford being destroyed.

Daily discharge, in second-feet, of South Fork of Crow River near Rockford, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	20	78	81	80	29	12	6	10	89
2	20	79	81	65	24	21	5.3	10	68
3	20	79	80	60	24	16	5.3	19	64
4	25	78	77	55	23	10	10	33	77
5	28	78	74	50	23	8	14	38	72
6	32	80	69	45	23	8	14	272	74
7	38	78	69	40	23	8	14	557	69
8	49	81	74	35	23	8	12	450	62
9	64	81	70	30	24	8	12	341	59
10	72	81	67	25	23	8	10	264	64
11	78	86	58	20	22	8	19	212	56
12	78	89	54	15	19	8	63	180	.....
13	80	90	45	13	18	8	60	160	.....
14	91	90	54	12	16	20	39	160	.....
15	77	91	74	13	16	34	24	173	.....
16	83	95	90	12	16	51	20	218	.....
17	81	95	90	12	17	36	17	378	.....
18	79	92	114	13	15	27	14	378	.....
19	81	96	131	12	14	20	13	329	.....
20	80	91	142	8	12	15	12	272	.....
21	88	91	145	9	10	14	12	239	.....
22	91	86	150	8	10	13	12	218	.....
23	88	84	157	8	10	12	10	194	.....
24	80	80	156	8	10	8	10	175	.....
25	80	81	144	22	10	6	8	136	.....
26	84	80	123	48	10	6	8	129	.....
27	80	79	110	33	10	6	8	125	.....
28	83	81	103	42	6	6	10	115	.....
29	81	81	97	39	4	6	10	108	.....
30	80	83	91	31	5	6	10	103	.....
31	79	.....	89	.....	6	6	.....	100	.....

NOTE.—Daily discharge computed from a fairly well defined rating curve, which was applied indirectly from June 1 to Aug. 31. Daily discharge Mar. 1 to 4 estimated. Discharge Nov. 12 to Dec. 31 estimated, because of ice, from one discharge measurement, gage observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Nov. 12 to 30 estimated 25 second-feet, varying from about 20 to 45 second-feet. Mean discharge Dec. 1 to 31 estimated 35 second-feet, varying from about 15 to 45 second-feet.

Monthly discharge of South Fork of Crow River near Rockford, Minn., for 1911.

[Drainage area, 1,170 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March	91	20	67.4	0.057	0.07	B.
April	96	78	84.5	.072	.08	B.
May	157	45	95.5	.082	.09	B.
June	80	8	28.8	.024	.03	C.
July	29	4	16.0	.014	.02	C.
August	51	6	13.6	.012	.01	B.
September	63	5.3	16.1	.014	.02	B.
October	557	10	197	.168	.19	B.
November	89	.....	41.0	.035	.04	C.
December	.....	.....	35.0	.030	.03	D.

NOTE.—See footnotes to table of daily discharge.

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, 1911.

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.—Practically permanent, except as affected by grass.

Discharge measurements.—Made from the steel highway bridge.

Winter flow.—At the original location gage heights were practically unaffected by ice. At the present location, however, the river freezes over.

Regulation.—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.—The extremely low water of 1911 was favorable to the growth of grass in the river channel. This growth created an appreciable backwater effect at the gage, and therefore the records for that period are not as reliable as during the remainder of the year.

Discharge measurements of Rum River at Onamia, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
June 30	S. B. Soulé	0.40	5.2
30	do	.40	5.2
Sept. 1	do	— .04	.67
Oct. 25	do	.38	16.6

NOTE.—All 1911 measurements made by wading.

Daily gage height, in feet, of Rum River at Onamia, Minn., for 1911.

[R. Swedburg, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.30	0.38	0.25	0.45	0.05	—0.05	0.20	0.35	0.25
2	.30	.35	.28	.45	.05	— .02	.20	.35	.25
3	.30	.32	.32	.42	.08	— .02	.22	.35	.25
4	.32	.30	.34	.42	.08	— .02	.22	.35	.25
5	.32	.28	.35	.42	.08	— .02	.22	.35	.25
6	.32	.25	.38	.40	.08	.00	.25	.35	.25
7	.35	.22	.40	.38	.05	.00	.28	.35	.22
8	.35	.25	.42	.38	.05	.00	.30	.32	.22
9	.38	.25	.45	.35	.05	.00	.30	.32	.22
10	.38	.25	.48	.32	.02	.02	.32	.32	.20
11	.40	.22	.48	.30	.02	.02	.32	.32	.20
12	.40	.22	.48	.28	.02	.02	.35	.30	.20
13	.42	.20	.48	.25	.02	.05	.38	.30	.20
14	.45	.22	.50	.22	.02	.07	.38	.30	.20
15	.48	.22	.50	.10	.05	.10	.40	.30	.20
16	.50	.25	.50	.10	.05	.12	.40	.30	.....
17	.50	.25	.50	.10	.05	.15	.40	.30	.....
18	.50	.28	.48	.10	.05	.15	.40	.30	.....
19	.50	.28	.48	.10	.05	.18	.38	.30	.....
20	.50	.30	.45	.10	.05	.18	.38	.28	.....
21	.50	.30	.45	.08	.05	.18	.40	.28	.....
22	.48	.28	.48	.08	.02	.18	.40	.28	.....
23	.48	.28	.48	.08	.02	.18	.40	.28	.....
24	.48	.25	.45	.05	.02	.18	.38	.28	.....
25	.45	.22	.45	.05	.02	.20	.38	.28	.....
26	.45	.22	.45	.05	.02	.20	.38	.28	.....
27	.42	.20	.45	.02	.00	.20	.38	.25	.....
28	.42	.20	.45	.02	.00	.20	.35	.25	.....
29	.42	.20	.45	.02	— .02	.20	.35	.25	.....
30	.40	.20	.44	.02	— .05	.20	.35	.25	.....
31	.....	.22	.....	.05	— .05	.....	.35	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 20, and Dec. 16 to 31.

Daily discharge, in second-feet, of Rum River at Onamia, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.4	4.8	2.9	7.4	1.2	0.6	6.0	14.5	8.5
2	.....	3.4	4.3	3.2	7.4	1.2	.7	6.0	14.5	8.5
3	.....	3.4	3.8	3.8	6.1	1.4	.7	7.0	14.5	8.5
4	.....	3.8	3.4	4.1	6.1	1.4	.7	7.0	14.5	8.5
5	.....	3.8	3.2	4.3	6.1	1.4	.7	7.0	14.5	8.5
6	.....	3.8	2.9	4.8	5.2	1.4	.8	8.5	14.5	8.5
7	.....	4.3	2.6	5.2	4.8	1.2	.8	10.0	14.5	7.0
8	.....	4.3	2.9	6.1	4.8	1.2	.8	11.0	12.4	7.0
9	.....	4.8	2.9	7.4	4.3	1.2	.8	11.0	12.4	7.0
10	.....	4.8	2.9	8.6	3.8	.9	1.0	12.4	12.4	6.0
11	.....	5.2	2.6	8.6	3.4	.9	1.1	12.4	12.4	6.0
12	.....	5.2	2.6	8.6	3.2	.9	1.2	14 5	11.0	6.0
13	.....	6.1	2.4	8.6	2.9	.9	1.5	16.6	11.0	6.0
14	.....	7.4	2.6	9.5	2.6	.9	2.4	16.6	11.0	6.0
15	.....	8.6	2.6	9.5	1.5	1.2	3.0	18.0	11.0	6.0
16	.....	9.5	2.9	9.5	1.5	1.2	3.6	18.0	11.0	.....
17	.....	9.5	2.9	9.5	1.5	1.2	4.5	18.0	11.0	.....
18	.....	9.5	3.2	8.6	1.5	1.2	4.5	18.0	11.0	.....
19	.....	9.5	3.2	8.6	1.5	1.2	5.4	16.6	11.0	.....
20	.....	9.5	3.4	7 4	1.5	1.2	5.4	16.6	10.0	.....
21	1	9.5	3.4	7.4	1.4	1.2	5.4	18.0	10.0	.....
22	2	8.6	3.2	8.6	1.4	.9	5.4	18.0	10.0	.....
23	3	8.6	3.2	8.6	1.4	.9	5.4	18.0	10.0	.....
24	3	8.6	2.9	7.4	1.2	.9	5.4	16.6	10.0	.....
25	3	7.4	2.6	7.4	1.2	.9	6.0	16.6	10.0	.....
26	3	7.4	2.6	7.4	1.2	.9	6.0	16.6	10.0	.....
27	3	6.1	2.4	7.4	.9	.8	6.0	16.6	8.5	.....
28	3	6.1	2.4	7.4	.9	.8	6.0	14.5	8.5	.....
29	3	6.1	2.4	7.4	.9	.7	6.0	14.5	8.5	.....
30	3	5.2	2.4	6.9	.9	.6	6.0	14.5	8.5	.....
31	3	.....	2.6	.....	1.2	.6	.....	14.5	.....	.....

NOTE.—Daily discharge computed from two rating curves not well defined except from Jan. 1 to Mar. 20, when there was no flow, as the river was frozen to the bottom. Discharge Jan. 1 to Mar. 31 and Dec. 16 to 31 estimated, because of ice, from observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Dec. 16 to 31 estimated 3 second-feet, varying from about 0 to 6 second-feet.

Monthly discharge of Rum River at Onamia, Minn., for 1911.

[Drainage area, 414 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	0.0	0.0	0.00	0.0000	0.000	B.
February	.0	.0	.00	.0000	.000	B.
March	3	.0	.97	.0023	.003	B.
April	9.5	3.4	6.45	.016	.02	C.
May	4.8	2.4	2.97	.0072	.008	C.
June	9.5	2.9	7.16	.017	.02	C.
July	7.4	.9	2.89	.0070	.008	C.
August	1.4	.6	1.05	.0025	.003	C.
September	6.0	.6	3.26	.0079	.009	B.
October	18.0	6.0	13.9	.034	.04	B.
November	14.5	8.5	11.4	.028	.03	C.
December	8.5	.0	5.03	.012	.01	D.
The year	18.0	.0	4.60	.011	.15	

NOTE.—See footnote 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, 1911.

Drainage area.—1,160 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Somewhat changeable, as shown by low-water measurements.

Discharge measurements.—Made from the bridge.

Winter flow.—From December to March, discharge measurements are made through ice to determine the winter flow.

Regulation.—At St. Francis, 20 miles below Cambridge by river, there is a 10-foot dam and 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 one at Milaca, which is used to form a pool from which water is pumped.

Accuracy.—During the summer of 1911 grass grew in the channel to such an extent that it caused backwater in varying amounts at the gage. The records for that period, therefore, can not be considered better than fair. The remainder of the records are believed to be good.

Discharge measurements of Rum River at Cambridge, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 2[a]	C. R. Adams	3.16	62.7
June 2	Robert Follansbee	3.10	147
Aug. 29[b]	S. B. Soulé	3.31	59.8
Oct. 14[b]	....do	4.01	285
Nov. 27[c]	W. G. Hoyt	3.30	110
27[c]	S. B. Soulé	3.30	114
Dec. 27[d]	....do	3.45	114

[a] Measurement made under ice cover.
[b] Grass and moss in channel.
[c] Measurement under ice condition, 92 per cent ice cover; average thickness of ice, 0.51 foot; average distance water surface to top of ice, 0.01 foot.
[d] Measurement made under complete ice cover. Average thickness of ice, 0.64 foot; average gage height to top of ice, 3.51.

Daily gage height, in feet, of Rum River at Cambridge, Minn., for 1911.

[Martin Lofstrom, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	2.70	2.76	3.16	3.92	3.74	3.36	3.21	3.31	3.28
2	.....	.....	3.15	2.70	2.78	3.11	3.85	3.84	3.36	3.20	3.15	.....
3	3.00	3.15	3.20	2.66	2.74	3.14	3.74	3.90	3.30	3.32	3.19	.....
4	.....	.....	.....	2.65	2.71	3.25	3.70	3.96	3.28	3.49	3.24	3.28
5	.....	.....	.....	2.71	2.72	3.40	3.84	3.99	3.31	3.49	3.02	.....
6	3.02	.....	.....	2.72	2.71	3.45	3.90	4.05	3.38	3.71	3.21	.....
7	.....	3.15	3.15	2.69	2.68	4.80	3.85	3.98	3.36	3.95	3.12	3.30
8	.....	.....	.....	2.72	2.62	4.98	3.80	3.99	3.39	4.00	3.08	.....
9	.....	.....	3.22	2.74	2.62	4.72	3.76	4.00	3.41	4.40	3.05	.....
10	3.08	3.18	3.28	2.76	2.64	4.46	3.69	3.96	3.48	4.70	3.05	.....

Daily gage height, in feet, of Rum River at Cambridge, Minn., for 1911—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	.....	3.20	2.79	2.68	4.29	3.59	3.90	3.65	4.68	2.98	3.48
12	.....	.....	3.34	2.96	2.62	4.25	3.54	3.89	3.75	4.45	.....	.....
13	3.08	.....	3.20	3.24	2.61	4.21	3.46	3.89	3.64	4.20	3.08	.....
14	.....	3.20	3.14	3.31	2.62	4.11	3.42	3.94	3.58	4.01	.....	3.50
15	.....	.....	3.51	3.29	3.12	4.04	3.39	3.95	3.56	3.85	.....	.....
16	.....	.....	3.24	3.26	3.65	4.01	3.36	3.90	3.58	3.80	3.12	.....
17	3.10	3.15	3.14	3.18	3.75	3.96	3.35	3.85	3.51	4.06	.....	.....
18	.....	.....	3.12	3.05	3.92	3.94	3.38	3.81	3.66	4.31	.....	3.48
19	.....	.....	2.98	3.18	4.04	3.90	3.40	3.79	3.82	4.48	.....	.....
20	3.12	.....	2.92	3.28	4.11	3.88	3.41	3.78	3.80	4.60	3.18	.....
21	.....	3.12	2.94	3.22	4.50	3.85	3.42	3.74	3.76	4.54	.....	3.45
22	.....	.....	2.78	3.18	4.99	3.82	3.42	3.61	3.69	4.36	.....	.....
23	.....	.....	2.76	3.12	4.84	3.79	3.41	3.54	3.54	4.19	3.25	.....
24	3.15	3.15	2.80	3.02	4.49	3.74	3.42	3.46	3.38	4.04	.....	.....
25	.....	.....	2.75	3.00	4.24	3.70	3.45	3.42	3.29	3.92	.....	.....
26	.....	.....	2.81	2.95	4.20	3.71	3.46	3.44	3.22	3.82	.....	3.45
27	3.15	.....	2.82	2.91	3.96	3.71	3.45	3.38	3.16	3.76	3.30	3.45
28	.....	3.20	2.90	2.89	3.68	3.70	3.55	3.34	3.21	3.69	.....	.....
29	.....	.....	2.81	2.85	3.48	3.78	3.56	3.32	3.28	3.60	.....	3.42
30	.....	.....	2.75	2.81	3.35	3.88	3.64	3.34	3.25	3.48	.....	.....
31	3.15	.....	2.74	.....	3.24	.....	3.65	3.36	.....	3.39	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 9; average thickness of ice, 1 to 1.5 feet; and Nov. 11 to Dec. 31, average thickness of ice, 0.2 to 0.6 foot.

Daily discharge, in second-feet, of Rum River at Cambridge, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	63	79	87	158	319	190	70	98	168
2	63	79	89	147	301	215	72	97	140
3	65	75	84	153	275	240	68	116	146
4	70	72	80	176	262	242	76	150	157
5	75	80	82	209	299	251	80	150	118
6	80	81	80	220	302	247	90	195	155
7	100	78	77	569	287	232	88	254	139
8	125	82	69	619	275	233	89	216	135
9	150	84	69	547	265	233	96	370	130
10	183	87	71	474	246	225	115	455	130
11	166	91	77	428	220	196	145	450	.....
12	196	118	69	418	200	195	165	395	.....
13	166	174	68	407	182	194	152	345	.....
14	153	189	69	381	172	205	141	285	.....
15	233	185	149	362	169	205	139	251	.....
16	174	179	266	355	156	190	145	240	.....
17	153	162	290	342	151	172	131	305	.....
18	149	135	332	337	157	161	158	380	.....
19	121	162	362	327	160	160	198	425	.....
20	111	183	381	322	161	158	194	455	.....
21	114	174	485	314	155	135	183	450	.....
22	89	162	622	307	151	113	176	400	.....
23	87	149	580	300	150	104	146	360	.....
24	92	129	482	288	150	91	120	325	.....
25	86	125	415	278	155	84	107	295	.....
26	94	116	404	280	148	72	97	271	.....
27	95	80	342	280	145	68	87	260	.....
28	107	106	273	278	164	64	98	245	.....
29	94	100	227	297	165	60	107	225	.....
30	86	109	198	322	180	62	105	202	.....
31	84	.....	174	.....	180	64	.....	183	.....

NOTE.—Daily discharge computed from a rating curve not well defined, which was applied indirectly owing to shifting of channel. Daily discharge estimated Mar. 1 to 9. Discharge Nov. 11 to Dec. 31 estimated, because of ice, on basis of three discharge measurements, gage observer's notes, and climatologic records. Mean discharge Nov. 11 to 30 estimated 117 second-feet, varying from about 110 to 127 second-feet. Mean discharge Dec. 1 to 31 estimated 114 second-feet.

Monthly discharge of Rum River at Cambridge, Minn., for 1911.

[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.		
January	.....	.....	[a] 45.0	0.039	0.04	C.
February	.....	.....	[a] 55.0	.047	.05	D.
March	233	[a] 63	117	.101	.12	C.
April	189	72	121	.104	.12	B.
May	622	68	228	.197	.23	B.
June	619	147	330	.284	.32	B.
July	319	145	203	.175	.20	D.
August	251	60	163	.141	.16	C.
September	198	68	121	.104	.12	C.
October	455	97	285	.246	.28	C.
November	168	[b] 110	125	.108	.12	C.
December	.....	.....	[b] 114	.098	.11	C.
The year	622	.....	160	.138	1.87	

[a] Estimated from two ice measurements and semiweekly gage heights.
[b] Estimated.

NOTE.—See footnotes to table of daily discharge.

MINNESOTA RIVER BASIN.

MINNESOTA RIVER NEAR ODESSA, MINN.

Location.—At highway bridge 1 mile southwest of Odessa in sec. 32, T. 121 N., R. 45 W., half a mile below the mouth of Stony Run, a very small stream entering from the north.

Records available.—July 4, 1909, to November 19, 1911.

Drainage area.—1,560 square miles.

Gage.—Chain, attached to bridge; datum unchanged since established.

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 possibly be estimated by using the run-off per square mile of drainage area above Montevideo. (See p. 98.)

Regulation.—The flow at Odessa is entirely uncontrolled, as the nearest dam is at Granite Falls.

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 therefore it was 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.

Discharge measurements of Minnesota River near Odessa, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 6	C. J. Emerson	2.32	20.9
Aug. 4[a]	S. B. Soulé	2.09	8.23

[a] Measurement made by wading at section about 100 feet above the bridge. Channel obstructed by grass and moss.

Daily gage height, in feet, of Minnesota River near Odessa, Minn., for 1911.

[Claud Shellenbarger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.91	2.48	2.05	1.94	1.91	1.78	2.24	2.45
2	.....	3.06	2.48	2.09	1.89	1.84	1.76	2.30	2.45
3	.....	2.78	2.47	2.12	.....	1.95	1.76	2.41	2.45
4	.....	2.77	2.47	2.82	.....	2.09	1.82	2.84	2.52
5	.....	2.85	2.46	2.68	.....	2.01	1.82	2.55	2.42
6	.....	2.82	2.37	2.58	1.98	1.99	1.88	2.58	2.40
7	.....	2.88	2.36	2.52	1.90	2.04	2.08	2.55	2.40
8	.....	2.86	2.40	2.30	1.84	2.00	2.21	2.39	2.38
9	.....	2.76	2.46	2.20	1.85	1.96	2.10	2.32	2.40
10	.....	2.70	2.34	2.15	1.81	2.00	2.20	2.35	2.40
11	.....	2.46	2.40	2.09	1.80	1.94	2.05	2.39	.....
12	.....	3.08	2.38	2.22	1.82	1.88	2.05	2.35	.....
13	.....	3.65	2.21	2.16	1.79	1.85	2.02	2.39	.....
14	.....	3.38	2.12	2.12	1.74	1.86	1.98	2.36	.....
15	.....	3.14	2.30	1.98	1.74	1.86	1.91	2.40	.....
16	.....	3.00	2.38	2.02	1.75	1.90	1.85	2.56	.....
17	.....	2.90	2.15	2.00	1.72	1.85	1.84	2.65	.....
18	.....	2.68	2.20	1.95	1.78	1.84	2.10	2.49	.....
19	4.71	2.66	2.36	1.92	1.86	1.85	2.00	2.48	.....
20	4.62	2.66	2.40	1.89	1.86	1.85	1.95	2.49	.....
21	4.51	2.67	2.48	1.85	1.81	1.85	1.94	2.50	.....
22	4.46	2.65	2.16	1.90	1.81	1.84	2.06	2.36	.....
23	4.12	2.66	2.25	1.88	1.84	1.82	2.12	2.35	.....
24	3.66	2.51	2.11	1.90	1.80	1.80	2.02	2.36	.....
25	3.37	2.50	2.06	1.82	1.76	1.78	1.98	2.35	.....
26	4.48	2.48	2.19	1.82	1.71	1.79	1.92	2.40	.....
27	4.74	2.47	2.12	1.86	1.70	1.84	1.90	2.39	.....
28	2.71	2.48	2.11	1.96	1.71	1.86	2.06	2.35	.....
29	2.51	2.57	2.15	2.10	1.70	1.81	2.24	2.36	.....
30	2.51	2.47	2.08	2.04	1.70	1.80	2.25	2.50	.....
31	2.50	.....	2.09	.....	1.74	1.80	.....	2.48	.....

NOTE.—Ice present Jan. 1 to Mar. 18 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Minnesota River near Odessa, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	49	25	13	9	6	5	17	24
2	.....	58	25	14	8	5	5	19	24
3	.....	41	25	14	8	6	5	22	24
4	.....	40	25	43	9	9	6	44	27
5	.....	45	24	35	9	7	6	28	23
6	.....	43	21	30	10	7	6	30	22
7	.....	47	21	27	8	8	9	28	22
8	.....	46	22	19	7	7	11	22	21
9	.....	40	24	16	7	6	9	20	22
10	.....	36	20	15	6	7	11	20	22
11	.....	24	22	14	6	6	8	22	.....
12	.....	59	21	17	6	6	8	20	.....
13	.....	94	16	15	6	6	7	22	.....
14	.....	77	14	14	5	6	7	21	.....
15	.....	62	19	12	5	6	6	22	.....

Daily discharge, in second-feet, of Minnesota River near Odessa, Minn., for 1911—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	.....	54	21	12	5	6	6	29	.....
17	.....	48	15	12	5	6	6	34	.....
18	.....	35	16	11	5	6	9	26	.....
19	180	34	21	10	6	6	7	25	.....
20	172	34	22	10	6	6	6	26	.....
21	162	34	25	9	6	6	6	26	.....
22	157	34	15	10	6	6	8	21	.....
23	130	34	18	10	6	6	9	20	.....
24	95	26	14	10	6	6	7	21	.....
25	76	26	13	8.4	6	6	7	20	.....
26	159	25	16	8.4	5	6	6	22	.....
27	183	25	14	9.2	5	6	8	22	.....
28	37	25	14	11	5	6	11	20	.....
29	26	30	15	14	5	6	15	21	.....
30	26	25	14	13	5	6	16	26	.....
31	26	.....	14	.....	5	6	.....	25	.....

NOTE.—Daily discharge computed from a well-defined rating curve which was applied indirectly from July 1 to Sept. 30 on account of obstruction in channel.

Monthly discharge of Minnesota River near Odessa, Minn., for 1911.

[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.		
Mar. 19-31	183	26	110	0.071	0.03	B.
April	94	24	41.7	.027	.03	A.
May	25	13	19.1	.012	.01	A.
June	43	8.4	15.2	.0097	.01	A.
July	10	5	6.3	.0040	.005	B.
August	9	5	6.3	.0040	.005	B.
September	16	5	7.9	.0051	.006	B.
October	44	17	23.9	.015	.02	B.
Nov. 1-10	27	21	23.1	.015	.006	B.

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, 1911.

Drainage area.—6,300 square miles.

Gage.—Chain, 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.

Regulation.—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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Jan. 10[a]	C. J. Emerson	2.48	28.6
May 5	do	2.90	180
Aug. 5[b]	S. B. Soulé	1.57	42.8
Dec. 8[c]	C. J. Emerson	3.00	112

[a] Measurement made under ice cover.
[b] Measurement made by wading.
[c] Measurement made under complete ice cover. Average thickness of ice, 0.70 foot. Average distance water surface to top of ice, 0.12 foot.

Daily gage height, in feet, of Minnesota River near Montevideo, Minn., for 1911.

[Miss Margaret Hendricks, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.90	3.35	3.24	3.24	2.68	2.29	1.46	1.66	2.14	2.76	3.20
2	.....	.....	.....	3.26	3.16	2.26	2.17	1.49	1.72	2.11	2.59	.....
3	.....	.....	.....	3.26	3.14	2.29	2.46	1.53	1.65	2.22	3.05	.....
4	2.48	2.88	3.38	3.21	3.09	2.74	2.28	1.36	1.78	2.31	3.36	3.10
5	.....	.....	.....	3.24	2.99	3.45	2.12	1.55	1.85	2.34	3.39	.....
6	.....	.....	.....	3.26	3.04	3.19	2.47	1.58	1.92	2.29	3.44	.....
7	2.60	.....	.....	3.26	2.60	3.51	2.04	1.65	1.82	2.60	3.39	.....
8	.....	2.92	3.32	3.29	2.69	3.39	1.89	1.72	1.92	2.71	3.30	.....
9	.....	.....	3.31	3.26	2.89	3.40	1.73	1.71	2.18	2.64	3.16	3.00
10	2.49	.....	3.29	3.22	2.94	3.46	2.14	1.72	2.20	2.49	3.24	.....
11	.....	3.00	3.25	3.26	2.89	3.00	2.08	1.74	2.29	2.25	3.19	3.20
12	.....	.....	3.58	3.31	2.84	3.61	2.12	1.63	2.24	2.19	.....	.....
13	.....	.....	3.68	3.41	2.76	3.20	1.94	1.56	2.06	2.48	.....	.....
14	2.68	.....	3.88	3.51	2.71	3.18	1.89	1.56	2.09	2.69	.....	.....
15	.....	3.15	3.96	3.61	2.76	2.71	1.83	1.55	2.25	2.36	.....	3.00
16	.....	.....	3.32	3.62	2.72	2.76	1.69	1.69	2.19	2.58	2.88	.....
17	.....	.....	3.22	3.56	2.74	3.12	1.79	1.74	1.91	2.74	.....	.....
18	2.70	3.38	3.34	3.54	2.76	2.79	1.72	1.61	1.86	2.84	.....	3.28
19	.....	.....	3.31	3.59	2.71	3.31	1.69	1.56	1.96	2.59	.....	.....
20	.....	.....	3.26	3.64	3.19	2.76	1.67	1.56	2.01	2.55	3.32	.....
21	2.78	.....	3.30	3.66	3.06	2.56	1.65	1.61	2.04	2.68	.....	.....
22	.....	3.22	3.34	3.69	2.95	2.74	1.73	1.55	1.99	3.28	.....	3.25
23	.....	.....	3.35	3.24	2.76	2.71	1.63	1.54	1.99	3.59	.....	.....
24	.....	.....	3.36	3.24	2.71	2.61	1.87	1.65	1.90	3.04	3.65	.....
25	2.68	3.30	3.41	3.21	2.79	2.58	1.92	1.52	1.82	3.16	.....	3.38
26	2.80	.....	3.49	3.29	2.61	2.59	1.66	1.59	1.91	3.22	.....	.....
27	.....	.....	3.58	3.26	2.88	2.79	1.47	1.46	2.01	3.26	3.22	.....
28	2.70	.....	3.52	3.19	2.86	2.79	1.41	1.81	2.01	3.29	.....	.....
29	.....	.....	3.36	3.06	2.79	2.19	1.36	1.76	2.06	3.51	.....	3.30
30	.....	.....	3.31	3.19	2.85	2.41	1.38	1.68	2.21	3.66	.....	.....
31	.....	.....	3.29	.....	2.79	.....	1.43	1.61	.....	3.48	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 7, average thickness of ice 1 foot, and Nov. 11 to Dec. 31, average thickness of ice 0.3 foot. On Dec. 11 gage observer noted: "River open on account of recent warm weather and swift current."

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	100	242	242	166	119	33	50	101	176
2	125	246	230	115	105	35	56	98	155
3	150	246	227	119	139	39	50	110	214
4	150	238	220	173	118	25	62	121	263
5	150	242	206	282	99	40	70	125	269
6	175	246	213	234	140	43	77	119	279
7	200	246	156	294	90	50	66	156	269
8	256	250	167	269	74	56	77	169	252
9	254	246	193	271	57	55	106	161	230
10	250	239	199	284	101	56	108	143	242
11	244	246	193	207	95	58	119	114	.....
12	310	254	186	316	99	48	113	107	.....
13	332	273	176	236	79	41	93	142	.....
14	379	294	169	233	74	41	96	167	.....
15	400	316	176	169	67	40	114	127	.....
16	256	318	171	176	53	53	107	154	.....
17	239	305	173	224	63	58	76	173	.....
18	260	301	176	180	56	46	71	186	.....
19	254	312	169	254	53	41	82	155	.....
20	246	323	234	176	51	41	87	150	.....
21	252	327	215	151	50	46	90	166	.....
22	260	334	200	173	57	40	85	249	.....
23	262	242	176	169	48	40	85	312	.....
24	263	242	169	157	72	50	75	213	.....
25	273	238	180	154	77	38	66	230	.....
26	290	250	157	155	50	44	76	239	.....
27	310	246	191	180	34	33	87	246	.....
28	296	234	189	180	29	65	87	250	.....
29	263	215	180	107	25	60	93	294	.....
30	254	234	188	133	27	52	109	327	.....
31	250	.....	180	.....	30	46	.....	288	.....

NOTE.—Daily discharge computed from well-defined rating curve. Daily discharge, Mar. 1 to 7, estimated. Discharge, Nov. 11 to Dec. 31, estimated, because of ice, from one discharge measurement, gage observer's notes, and climatologic records. Mean discharge, Nov. 11 to 30, estimated 130 second-feet, varying from about 110 to 200 second-feet. Mean discharge, Dec. 1 to 31, estimated 160 second-feet, varying from about 112 to 236 second-feet.

Monthly discharge of Minnesota River near Montevideo, Minn., for 1911.

[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	.....	.....	[a]40.0	0.0063	0.007	D.
February	.....	.....	[a]50.0	.0079	.008	D.
March	400	100	248	.039	.04	B.
April	334	215	265	.042	.05	A.
May	242	156	190	.030	.03	A.
June	316	107	198	.031	.03	A.
July	140	25	72.0	.011	.01	A.
August	65	25	45.6	.0072	.008	A.
September	119	50	84.4	.013	.01	A.
October	327	98	180	.029	.03	B.
November	279	.....	165	.026	.03	C.
December	.....	.....	160	.025	.03	D.
The year	400	.....	142	.023	.28	

[a] Estimated from one ice measurement, semiweekly gage heights, and comparison with climatologic data.

NOTE.—See footnotes to table of daily discharge.

MINNESOTA RIVER NEAR MANKATO, MINN.

Location.—At Sibley Park, 2 miles above the center of Mankato; a few hundred yards below the mouth of Blue Earth River, the nearest tributary.

Records available.—May 20, 1903, to December 31, 1911. Since 1906 the gage heights have been furnished by the United States Weather Bureau.

Drainage area.—14,600 square miles.

Gage.—Chain, maintained by the United States Engineer Corps; datum unchanged since established.

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.

Regulation.—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 its flow is such a small part of the entire discharge at the Mankato station that the effect of such control is very 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 value 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 was 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 0.6 in 1911, when the flow was about 160 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 as accurate as the later ones, which were based on a well-defined rating curve and show permanent channel.

Discharge measurements of Minnesota River near Mankato, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Feb. 22	C. R. Adams	1.59	[a] 200
June 21	S. B. Soulé	1.32	[b] 495
Aug. 2	do	.69	[b] 183
2	do	.69	[c] 188

[a] Measurement under ice cover.
[b] Wading measurement at cable section.
[c] Wading measurement about 500 feet below cable.

Daily gage height, in feet, of Minnesota River near Mankato, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	1.4	1.7	1.9	1.6	1.3	1.0	0.8	0.5	0.9	2.9	1.9
2	.9	1.5	1.7	1.8	1.6	1.6	1.1	.8	.5	.8	2.8	1.9
3	.9	1.5	1.8	1.8	1.5	1.5	1.1	.6	.6	.9	2.6	1.8
4	.9	1.5	1.9	1.7	1.5	1.5	1.1	.6	.6	.9	2.7	1.8
5	.9	1.3	1.7	1.8	1.5	1.5	1.2	.6	.7	.9	2.6	1.8
6	.9	1.3	1.6	1.7	1.5	1.5	1.2	.6	.7	2.0	2.6	1.8
7	.9	1.3	1.5	1.8	1.5	1.5	1.2	.9	.8	2.5	2.6	1.9
8	.9	1.3	1.5	1.9	1.5	1.4	1.1	1.0	.6	2.9	2.6	1.9
9	.9	1.3	1.6	1.9	1.5	1.3	1.0	.9	.6	4.4	2.6	1.8
10	.9	1.3	1.5	1.9	1.5	1.3	1.0	.9	.7	3.6	2.5	1.9
11	.9	1.3	1.5	1.8	1.5	1.6	.8	.9	.7	3.3	2.5	1.9
12	.9	1.2	1.7	1.8	1.4	1.5	.7	.9	.6	3.8	2.5	2.4
13	.9	1.2	2.0	2.0	1.3	1.5	.7	1.0	.6	3.4	2.3	2.9
14	.9	1.6	2.0	2.0	1.3	1.5	.7	1.0	.6	2.7	2.3	3.0
15	.9	1.7	1.9	1.9	1.3	1.4	.7	1.0	.6	2.4	2.3	3.1
16	.9	1.8	1.8	1.8	1.3	1.4	.7	1.0	.8	3.8	2.4	3.1
17	.9	2.0	1.8	1.8	1.3	1.4	.6	1.1	.8	4.4	2.4	2.9
18	.9	2.1	2.0	1.9	1.3	1.4	.6	1.1	.8	4.6	2.4	2.8
19	.9	.....	1.9	1.9	1.2	1.4	.6	1.0	.8	5.0	2.3	2.7
20	.9	1.9	1.9	1.8	1.2	1.4	.6	1.0	.7	5.3	2.3	2.6
21	.9	1.9	1.9	1.9	1.2	1.4	.6	.8	.7	4.9	2.3	2.6
22	.9	1.8	1.9	1.9	1.2	1.3	.6	.8	.7	4.7	2.3	2.4
23	.9	1.7	1.9	1.8	1.2	1.3	.6	.9	.8	4.4	2.3	2.3
24	.9	2.3	1.7	1.8	1.5	1.3	.6	.8	.7	4.2	2.3	2.2
25	1.0	1.9	1.7	1.8	1.5	1.2	.6	.8	.8	4.0	2.1	2.1
26	1.0	1.9	1.7	1.8	1.4	1.2	.6	.8	.7	3.7	2.0	2.1
27	1.4	1.9	1.7	1.8	1.4	1.2	.6	.7	.9	3.6	2.0	2.2
28	1.4	1.7	1.9	1.7	1.5	1.1	.6	.7	.8	3.5	2.0	2.3
29	1.5	.....	1.9	1.6	1.5	1.0	.7	.6	.9	3.2	1.9	2.4
30	1.5	.....	1.9	1.6	1.5	1.0	.7	.6	.9	3.3	1.9	2.6
31	1.4	.....	1.9	.....	1.4	.....	.8	.5	.....	3.0	.....	.....

NOTE.—Ice present Jan. 1 to Feb. 28 and Dec. 1 to 31.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	679	790	625	469	322	227	89	274	1,400
2	679	734	625	625	370	227	89	227	1,340
3	734	734	572	572	370	134	134	274	1,210
4	790	679	572	572	370	134	134	274	1,270
5	679	734	572	572	419	134	180	274	1,210
6	625	679	572	572	419	134	180	847	1,210
7	572	734	572	572	419	274	227	1,150	1,210
8	572	790	572	520	370	322	134	1,400	1,210
9	625	790	572	469	322	274	134	2,640	1,210
10	572	790	572	469	322	274	180	1,910	1,150
11	572	734	572	625	227	274	180	1,680	1,150
12	679	734	520	572	180	274	134	2,080	1,150
13	847	847	469	572	180	322	134	1,760	1,020
14	847	847	469	572	180	322	134	1,270	1,020
15	790	790	469	520	180	322	134	1,080	1,020
16	734	734	469	520	180	322	227	2,080	a1,020
17	734	734	469	520	134	370	227	2,640	a1,020
18	847	790	469	520	134	370	227	2,840	a1,020
19	790	790	419	520	134	322	227	3,280	1,020
20	790	734	419	520	134	322	180	3,650	1,020
21	790	790	419	520	134	227	180	3,170	1,020
22	790	790	419	469	134	227	180	2,950	1,020
23	790	734	419	469	134	274	227	2,640	1,020
24	679	734	572	469	134	227	180	2,440	1,020
25	679	734	572	419	134	227	227	2,260	905
26	679	734	520	419	134	227	180	2,000	847
27	679	734	520	419	134	180	274	1,910	847
28	790	679	572	370	134	180	227	1,830	847
29	790	625	572	322	180	134	274	1,610	790
30	790	625	572	322	180	134	274	1,680	790
31	790	.....	520	.....	227	89	.....	1,470	.....

a Daily discharge estimated.

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

Monthly discharge of Minnesota River near Mankato, Minn., for 1911.

[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	.....	.....	[a] 175	0.012	0.01	C.
February	.....	.....	[a] 190	.013	.01	C.
March	847	572	723	.050	.06	A.
April	847	625	746	.051	.06	A.
May	625	419	524	.036	.04	A.
June	625	322	502	.034	.04	A.
July	419	134	227	.016	.02	A.
August	370	89	241	.017	.02	A.
September	274	89	184	.013	.01	A.
October	3,650	227	1,790	.123	.14	A.
November	1,400	790	1,070	.073	.08	B.
December	.....	.....	[b] 740	.051	.06	C.
The year	3,650	.....	596	.041	.55	

[a] Estimated from two ice measurements, daily gage height, and climatologic records.
[b] Estimated from daily gage height and climatologic records.

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.—Gage heights and discharge measurements from September 18, 1909, to November 15, 1911. Records of United States Engineer Corps September 15, 1899, to May 14, 1904.

Drainage area.—441 square miles.

Gage.—Vertical staff.

Channel.—Somewhat shifting during flood stages.

Discharge measurements of Whetstone River near Big Stone, S. Dak., in 1909–1912.

Date.	Hydrographer.	Gage height.	Discharge.
1909.		*Feet.*	*Sec. feet.*
July 25[a]	G. A. Gray	3.8	14.2
Aug. 16[a]	C. J. Emerson	3.8	9.7
Sept. 18[a]	G. A. Gray	.65	5.0
1910.			
Mar. 15	.....do	4.66	399
Apr. 15	.....do	1.40	65.6
29[b]	Robert Follansbee	3.10	170
1911.			
May 6	C. J. Emerson	.7	5.9
1912.			
Apr. 10	S. B. Soulé	1.48	33.6
10	.....do	1.48	33.7
May 5	.....do	3.24	172
June 21[c]	W. G. Hoyt	1.20	19.4

[a] Published as miscellaneous in Water-Supply Paper 265.
[b] Made at iron bridge above Big Stone.
[c] Measurement made by wading about 100 feet above gage.

Daily gage height, in feet, of Whetstone River near Big Stone, S. Dak., for 1911.

[F. W. Thorndike, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.9	0.8	0.6	0.5	0.3	0.2	0.8	0.6
2	.....	.9	.8	.6	.5	.4	.2	.7	.6
3	.....	1.0	.7	.8	.5	.4	.2	.8	.6
4	.....	1.0	.7	1.55	.5	.55	.2	.8	.5
5	.....	1.0	.7	1.2	.85	.55	.4	.8	.5
6	.....	1.0	.7	1.7	.75	.5	.65	.95	.5
7	.....	.95	.7	1.2	.55	.6	.7	1.0	.5
8	.....	.9	.7	1.05	.5	.6	.55	1.0	.5
9	.....	.9	.7	.85	.5	.6	.5	1.0	.4
10	.....	1.0	.7	.75	.5	.6	.5	.9	.4
11	.....	1.0	.7	.7	.5	.5	.5	.9	.4
12	.....	1.1	.7	.7	.5	.6	.5	1.0	.....
13	.....	1.25	.7	.6	.5	.6	.5	1.0	.....
14	.....	1.45	.7	.6	.5	.7	.6	1.0	.....
15	.....	1.35	.75	.6	.4	.6	.6	1.0	.....
16	.....	1.15	.8	.6	.4	.5	.5	1.0	.....
17	.....	1.1	.8	.6	.35	.5	.4	1.0	.....
18	.....	1.1	.8	.6	.3	.5	.4	.9	.....
19	1.85	1.0	.7	.6	.4	.4	.4	.85	.....
20	1.65	1.0	.7	.5	.4	.4	.4	.8	.....
21	1.45	1.0	.7	.4	.35	.4	.4	.75	.....
22	1.4	.9	.7	.4	.4	.3	.4	.7	.....
23	1.25	.9	.7	.4	.4	.3	.5	.7	.....
24	1.15	.8	.7	.4	.4	.3	.5	.65	.....
25	1.1	.8	.7	.4	.3	.3	.5	.6	.....
26	1.1	.8	.7	.4	.3	.3	.4	.6	.....
27	1.05	.8	.7	.4	.3	.3	.4	.6	.....
28	1.0	.8	.6	.4	.3	.3	1.1	.6	.....
29	1.0	.8	.6	.6	.3	.2	.95	.6	.....
30	1.0	.....	.6	.55	.3	.2	.75	.6	.....
31	.9	.....	.6	.....	.3	.2	.....	.6	.....

NOTE.—Ice present from Jan. 1 to Mar. 18 and from Nov. 12 to Dec. 31.

Daily discharge, in second-feet, of Whetstone River near Big Stone, S. Dak., for 1910–11.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.									
1	.....	52	121	13	5.0	4.5	5.0	6.0	6.0
2	.....	46	106	13	4.5	4.5	5.0	6.0	6.0
3	.....	49	76	13	4.5	4.5	5.0	6.0	6.0
4	.....	49	64	10	4.5	4.5	5.0	5.5	8.0
5	.....	43	61	10	5.0	4.5	5.0	5.0	8.0
6	.....	37	55	10	5.0	4.5	5.0	5.0	8.0
7	.....	37	55	10	5.0	4.5	5.0	5.0	8.0
8	2,070	37	49	10	5.0	4.5	4.5	4.8	8.0
9	.....	37	49	16	5.0	4.5	4.5	4.5	9.0
10	.....	34	49	19	5.0	4.5	4.5	4.5	8.0
11	.....	30	43	19	5.0	4.5	4.5	4.5	14
12	.....	27	37	23	5.0	4.5	4.5	4.5	9.0
13	.....	25	37	23	5.0	5.0	4.5	4.5	9.0
14	.....	23	32	19	5.0	5.0	4.5	4.5	9.0
15	.....	25	27	16	5.0	5.0	4.5	4.5	8.0
16	248	34	27	13	5.0	6.0	4.5	4.5	13
17	206	34	27	10	5.0	6.0	4.5	4.8	9.0
18	174	27	27	10	4.5	6.0	4.5	5.0	8.0
19	158	30	27	8.0	4.5	6.0	4.5	8.0	12
20	152	34	23	6.0	4.5	6.0	4.5	10	8.0
21	141	102	23	6.0	4.5	6.0	4.5	10	14
22	131	1,300	23	5.0	4.5	6.0	4.5	10	9.0
23	116	1,030	23	5.0	4.5	6.0	4.5	8.0	10
24	102	447	19	4.5	4.5	6.0	4.5	8.0	12
25	88	308	19	4.5	4.5	5.0	4.8	8.0	8.0
26	80	255	19	7.0	4.5	5.0	7.0	8.0	9.0
27	68	227	18	10	4.5	5.0	8.0	8.0	10
28	61	192	16	7.0	4.5	5.0	8.0	6.0	10
29	58	163	16	6.0	4.5	5.0	8.0	6.0	10
30	61	136	16	5.5	4.5	5.0	8.0	6.0	10
31	55	.....	13	.....	4.5	5.0	.....	6.0	.....

Daily discharge, in second-feet, of Whetstone River near Big Stone, S. Dak., for 1910–11—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1911.									
1	.....	10	8.0	5.0	4.5	3.5	3.0	8.0	5.0
2	.....	10	8.0	5.0	4.5	4.0	3.0	6.0	5.0
3	.....	13	6.0	8.0	4.5	4.0	3.0	8.0	5.0
4	.....	13	6.0	34	4.5	4.8	3.0	8.0	4.5
5	.....	13	6.0	19	9.0	4.8	4.0	8.0	4.5
6	.....	13	6.0	43	7.0	4.5	5.5	12	4.5
7	.....	12	6.0	19	4.8	5.0	6.0	13	4.5
8	.....	10	6.0	14	4.5	5.0	4.8	13	4.5
9	.....	10	6.0	9.0	4.5	5.0	4.5	13	4.0
10	.....	13	6.0	7.0	4.5	5.0	4.5	10	4.0
11	.....	13	6.0	6.0	4.5	4.5	4.5	10	4.0
12	.....	16	6.0	6.0	4.5	5.0	4.5	13	.....
13	.....	21	6.0	5.0	4.5	5.0	4.5	13	.....
14	.....	30	6.0	5.0	4.5	6.0	5.0	13	.....
15	.....	25	7.0	5.0	4.0	5.0	5.0	13	.....
16	.....	18	8.0	5.0	4.0	4.5	4.5	13	.....
17	.....	16	8.0	5.0	3.8	4.5	4.0	13	.....
18	.....	16	8.0	5.0	3.5	4.5	4.0	10	.....
19	52	13	6.0	5.0	4.0	4.0	4.0	9.0	.....
20	40	13	6.0	4.5	4.0	4.0	4.0	8.0	.....
21	30	13	6.0	4.0	3.8	4.0	4.0	7.0	.....
22	27	10	6.0	4.0	4.0	3.5	4.0	6.0	.....
23	21	10	6.0	4.0	4.0	3.5	4.5	6.0	.....
24	18	8.0	6.0	4.0	4.0	3.5	4.5	5.5	.....
25	16	8.0	6.0	4.0	3.5	3.5	4.5	5.0	.....
26	16	8.0	6.0	4.0	3.5	3.5	4.0	5.0	.....
27	14	8.0	6.0	4.0	3.5	3.5	4.0	5.0	.....
28	13	8.0	5.0	4.0	3.5	3.5	16	5.0	.....
29	13	8.0	5.0	5.0	3.5	3.0	12	5.0	.....
30	13	8.0	5.0	4.8	3.5	3.0	7.0	5.0	.....
31	10	.....	5.0	.....	3.5	3.0	.....	5.0	.....

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.

Monthly discharge of Whetstone River near Big Stone, S. Dak., for 1910–11.

[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.		
1910.						
March 16–31	248	55	119	0.270	0.16	C.
April	1,300	23	162	.367	.41	D.
May	121	13	38.6	.088	.10	B.
June	23	4.5	11.0	.025	.03	B.
July	5.0	4.5	4.73	.011	.01	C.
August	6.0	4.5	5.10	.012	.01	C.
September	8.0	4.5	5.18	.012	.01	C.
October	10	4.5	6.16	.014	.02	C.
November	14	6.0	9.20	.021	.02	C.
1911.						
March 19–31	52	10	21.8	.049	.02	C.
April	30	8.0	12.9	.029	.03	B.
May	8.0	5.0	6.23	.014	.02	C.
June	43	4.0	8.54	.019	.02	C.
July	9.0	3.5	4.32	.0098	.01	C.
August	6.0	3.0	4.20	.0095	.01	C.
September	16	3.0	4.99	.011	.01	C.
October	13	5.0	8.82	.020	.02	C.
November 1–11	5.0	4.0	4.50	.010	.004	C.

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.—Gage heights and discharge measurements from April 27, 1910, to November 15, 1911.

Drainage area.—677 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Probably permanent except during flood stages.

Discharge measurements.—Made from the bridge.

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

Regulation.—There are no dams on the stream which control its flow at the present time.

The following discharge measurement was made by C. J. Emerson:
May 6, 1911: Gage height, 1.08 feet; discharge 15.1 second-feet.

Daily gage height, in feet, of Lac qui Parle River at Lac qui Parle, Minn., for 1911.

[Chas. A. Gould, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.50	1.20	0.70	0.60	0.38	0.30	0.60	1.40
2	.....	1.60	1.15	.70	.65	.32	.28	.60	1.30
3	.....	1.50	1.12	.75	.60	.30	.25	.70	1.10
4	.....	1.40	1.12	.80	.52	.42	.28	.62	1.10
5	.....	1.40	1.10	.85	.50	.40	.25	.60	1.10
6	.....	1.30	1.10	.80	.50	.40	.30	.82	1.05
7	.....	1.30	1.05	.80	.45	.42	.60	1.02	1.10
8	.....	1.45	1.00	.80	.42	.42	.60	1.00	1.10
9	1.20	1.50	1.00	.80	.42	.48	.61	1.05	1.20
10	2.40	1.45	1.00	.72	.42	.48	.60	1.10	1.20
11	3.20	1.45	.95	.70	.40	.48	.60	1.20	1.15
12	4.50	1.50	.90	.60	.40	.48	.61	1.22	.....
13	4.00	1.70	.90	.60	.38	.45	.70	1.38	.....
14	3.85	1.90	.95	.58	.35	.45	.70	1.35	.....
15	3.45	1.90	.85	.55	.32	.42	.60	1.50	.....
16	2.15	1.95	.85	.70	.30	.40	.55	1.60	.....
17	2.05	1.90	.88	.62	.28	.40	.52	1.70	.....
18	1.90	1.80	.85	.60	.22	.40	.50	1.60	.....
19	1.40	1.65	.88	.55	.32	.45	.50	1.52	.....
20	2.00	1.55	.85	.55	.32	.50	.50	1.52	.....
21	2.10	1.45	.90	.50	.30	.45	.50	1.58	.....
22	1.85	1.40	.92	.50	.45	.42	.50	1.55	.....
23	1.80	1.40	.92	.45	.50	.40	.50	1.60	.....
24	1.70	1.30	.90	.42	.45	.38	.55	1.60	.....
25	1.65	1.30	.88	.42	.42	.38	.60	1.55	.....
26	1.65	1.25	.85	.45	.40	.35	.55	1.50	.....
27	1.20	1.30	.82	.45	.40	.40	.42	1.45	.....
28	1.60	1.25	.80	.40	.38	.35	.50	1.40	.....
29	1.30	1.25	.78	.52	.35	.32	.50	1.35	.....
30	1.30	1.20	.75	.65	.35	.32	.50	1.30	.....
31	1.40	.....	.72	.....	.40	.30	.....	1.30	.....

NOTE.—Ice present from Jan. 1 to Mar. 8 and Nov. 12 to Dec. 31.

Daily discharge, in second-feet, of Lac qui Parle River at Lac qui Parle, Minn., for 1910–1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.								
1	.....	161	32	28	5	5	8	9
2	.....	147	30	23	5	5	8	9
3	.....	134	28	21	7	5	9	9
4	.....	121	28	19	6	5	9	12
5	.....	109	28	17	7	5	8	12
6	.....	102	29	43	6	5	7	16
7	.....	97	30	21	5	5	7	12
8	.....	95	30	19	5	5	7	10
9	.....	89	36	17	5	5	7	9
10	.....	85	48	17	5	5	7	7
11	.....	79	70	15	5	5	6	10
12	.....	75	147	19	4	4	6	12
13	.....	70	161	19	5	5	6	9
14	.....	66	134	19	5	4	6	10
15	.....	62	105	17	7	5	6	9
16	.....	62	85	17	8	5	6	.....
17	.....	66	66	15	18	5	6	.....
18	.....	66	52	14	14	5	6	.....
19	.....	66	42	11	10	5	9	.....
20	.....	75	36	10	9	5	7	.....
21	.....	68	34	9	10	5	7	.....
22	.....	64	28	8	12	5	7	.....
23	.....	62	25	8	9	5	8	.....
24	.....	56	23	7	10	5	9	.....
25	.....	52	21	7	9	5	9	.....
26	.....	48	21	6	8	7	9	.....
27	276	46	21	6	7	7	9	.....
28	254	42	21	7	7	7	9	.....
29	223	40	25	6	6	8	9	.....
30	200	35	28	6	7	8	9	.....
31	.....	34	.....	6	6	.....	9	.....

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1911.									
1	.....	35	20	5	4	3	2	4	29
2	.....	41	18	5	4	2	2	4	24
3	.....	35	17	6	4	2	2	5	16
4	.....	29	17	7	3	3	2	4	16
5	.....	29	16	8	3	3	2	4	16
6	.....	24	16	7	3	3	2	7	14
7	.....	24	14	7	3	3	4	13	16
8	.....	32	12	7	3	3	4	12	16
9	20	35	12	7	3	3	4	14	20
10	107	32	12	5	3	3	4	16	20
11	220	32	10	5	3	3	4	20	18
12	500	35	9	4	3	3	4	21	.....
13	375	47	9	4	3	3	5	28	.....
14	340	60	10	4	2	3	5	26	.....
15	263	60	8	4	2	3	4	35	.....
16	82	64	8	5	2	3	4	41	.....
17	72	60	9	4	2	3	3	47	.....
18	60	53	8	4	1	3	3	41	.....
19	29	44	9	4	2	3	3	36	.....
20	68	38	8	4	2	3	3	36	.....
21	77	32	9	3	2	3	3	40	.....
22	56	29	10	3	3	3	3	38	.....
23	53	29	10	3	3	3	3	41	.....
24	47	24	9	3	3	3	4	41	.....
25	44	24	9	3	3	3	4	38	.....
26	44	22	8	3	3	3	4	35	.....
27	20	24	7	3	3	3	3	32	.....
28	41	22	7	3	3	3	3	29	.....
29	24	22	7	3	2	2	3	26	.....
30	24	20	6	4	2	2	3	24	.....
31	29	.....	6	.....	3	2	.....	24	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between discharges 12 and 375 second-feet (gage heights 1.0 and 4.0 feet). In making the computations the rating table was used to whole second-feet only.

Monthly discharge of Lac qui Parle River at Lac qui Parle, Minn., for 1910–1911.

[Drainage area, 838 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1910.						
May	161	34	76.6	0.091	0.10	B.
June	161	21	48.8	.058	.06	B.
July	43	6	14.7	.018	.02	C.
August	18	4	7.5	.0090	.01	D.
September	8	4	5.3	.0063	.007	D.
October	9	6	7.6	.0091	.01	D.
November 1–15	16	7	10.3	.012	.007	D.
1911.						
March 9–31	500	20	113	0.135	0.12	C.
April	64	20	35.2	.042	.05	B.
May	20	6	10.6	.013	.02	C.
June	8	3	4.6	.0055	.006	D.
July	4	1	2.7	.0032	.004	D.
August	3	2	2.8	.0033	.004	D.
September	5	2	3.3	.0039	.004	D.
October	47	4	25.2	.030	.03	C.
November 1–11	29	14	18.6	.022	.009	C.

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 November 10, 1911.

Drainage area.—1,940 square miles.

Gage.—Chain gage attached to bridge; datum unchanged since established.

Channel.—Somewhat shifting.

Discharge measurements.—Made from the bridge.

Regulation.—At Montevideo there is a water-power plant utilizing a head of 7 feet, but backwater from the dam does not extend to the gaging station. The first dam above the station is at Hagan, but the effect of the control is inappreciable at Watson.

Winter flow.—From January 1 to March 18, 1911, observations were discontinued because of ice.

Accuracy.—As the discharge measurements show some change in the channel, the records can not be considered better than good.

Discharge measurement of Chippewa River near Watson, Minn., 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 6	C. J. Emerson	4.66	47.0
June 23[a]	S. B. Soulé	4.99	77.9
Aug. 4[a]	....do	4.17	13.7
Dec. 8[b]	C. J. Emerson	5.28	28

[a] Measurement made by wading.
[b] Measurement made under complete ice cover. Average thickness of ice, 0.64 foot. Average distance water surface to top of ice, 0.10 foot.

Daily gage height, in feet, of Chippewa River near Watson, Minn., for 1911.

[Clifford Bonde, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.78	4.88	4.38	4.70	4.10	4.30	4.60	.....	5.25
2	.....	.....	4.81	4.42	4.68	4.02	4.40	4.68	5.68	.....
3	.....	4.71	4.76	4.99	4.68	3.98	4.30	4.72	5.55	.....
4	.....	4.84	4.76	6.02	4.60	4.17	4.35	.....	5.60	5.25
5	.....	4.84	4.74	5.45	4.58	4.25	4.40	4.78	5.50	.....
6	.....	4.81	4.66	5.55	4.50	4.24	4.40	4.90	5.42	.....
7	.....	4.86	.....	5.60	4.48	4.30	4.50	4.90	5.40	.....
8	.....	4.81	4.72	5.60	4.42	4.32	4.50	.....	5.35	5.28
9	.....	4.81	4.68	5.52	4.48	4.32	4.45	4.92	5.35	.....
10	.....	4.84	4.65	5.50	4.50	4.32	4.50	4.80	5.20	.....
11	.....	4.98	4.52	5.60	.....	4.32	4.50	4.90	5.10	5.32
12	.....	.....	4.58	5.40	4.42	4.35	4.55	4.88	.....	.....
13	.....	5.06	4.50	5.35	4.40	4.32	4.58	4.95	5.45	.....
14	.....	5.21	.....	5.30	4.32	4.30	4.58	4.95	.....	5.30
15	.....	5.16	4.50	5.30	4.28	.....	4.55	4.95	.....	.....
16	.....	5.21	4.58	5.35	4.22	4.25	4.58	5.08	5.30	.....
17	.....	5.21	4.58	5.45	4.20	4.25	4.52	5.12	.....	.....
18	.....	5.21	4.78	5.40	4.15	4.25	4.55	5.10	.....	5.22
19	5.11	5.14	4.82	5.50	4.20	4.25	4.52	5.18	.....	.....
20	.....	5.06	5.05	5.45	4.20	.....	4.52	5.20	5.22	.....
21	.....	5.06	4.95	5.35	4.18	4.20	.....	5.22	.....	5.20
22	5.21	4.96	4.90	5.15	4.15	4.25	4.55	.....	.....	.....
23	5.26	.....	4.82	5.02	4.12	4.25	4.52	5.30	5.30	.....
24	.....	4.96	4.80	5.00	4.10	4.25	4.52	5.30	.....	.....
25	5.18	4.86	4.70	4.88	4.08	4.25	4.52	5.35	.....	.....
26	.....	4.86	4.70	4.88	4.05	4.20	4.40	5.40	.....	5.35
27	4.66	4.86	4.58	4.80	4.02	.....	4.48	5.42	5.30	.....
28	5.18	4.84	4.52	4.75	4.00	4.45	4.48	5.45	.....	5.35
29	4.96	4.86	4.45	4.98	3.98	4.32	4.55	5.50	.....	.....
30	5.06	4.86	4.42	4.80	3.95	4.35	4.52	5.50	.....	.....
31	4.96	.....	4.38	.....	4.05	4.32	.....	.....	.....	.....

NOTE.—Relation of gage height to discharge affected by ice Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Chippewa River near Watson, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	58	67	27	51	10	21	43	150
2	.....	55	61	29	49	7.6	28	49	168
3	.....	52	56	78	49	6.6	21	53	148
4	.....	64	56	228	43	14	24	55	155
5	.....	64	55	133	41	18	28	58	140
6	.....	61	48	148	35	17	28	69	129
7	.....	65	50	155	34	21	35	69	126
8	.....	61	53	155	29	22	35	70	120
9	.....	61	49	143	34	22	32	71	120
10	.....	64	47	140	35	22	35	60	101
11	.....	77	37	155	32	22	35	69	.....
12	.....	82	41	126	29	24	39	67	.....
13	.....	86	35	120	28	22	41	74	.....
14	.....	102	35	113	22	21	41	74	.....
15	.....	97	35	113	20	20	39	74	.....
16	.....	102	41	120	16	18	41	88	.....
17	.....	102	41	133	15	18	37	92	.....
18	.....	102	58	126	12	18	89	90	.....
19	91	94	62	140	15	18	37	99	.....
20	94	86	84	133	15	16	37	101	.....
21	97	86	74	120	14	15	38	103	.....
22	102	75	69	96	12	18	39	108	.....
23	108	75	62	81	11	18	37	113	.....
24	104	75	60	79	10	18	37	113	.....
25	99	65	51	67	9.4	18	37	120	.....
26	73	65	51	67	8.5	15	28	126	.....
27	48	65	41	60	7.6	24	34	129	.....
28	99	64	37	56	7	32	34	133	.....
29	75	65	32	77	6.6	22	39	140	.....
30	86	65	29	60	6	24	37	140	.....
31	75	.....	27	.....	8.5	22	.....	140	.....

NOTE.—Daily discharge computed from fairly well defined rating curve. Discharge estimated for days of missing gage heights. Discharge Nov. 11 to Dec. 31 estimated because of ice, from one discharge measurement, gage observer's notes, and climatologic records. Mean discharge Nov. 11 to 30 estimated 42 second-feet, varying from about 25 to 80 second-feet. Mean discharge Dec. 1 to 31 estimated 28 second-feet, varying from about 15 to 35 second-feet.

Monthly discharge of Chippewa River near Watson, Minn., in 1911.

[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.		
Mar. 19–31	108	48	88.5	0.046	0.02	B.
April	102	52	74.5	.038	.04	A.
May	84	27	49.8	.026	.03	A.
June	228	27	109	.056	.06	A.
July	51	6	22.7	.012	.01	B.
August	32	6.6	18.8	.0097	.01	B.
September	41	21	34.4	.018	.02	A.
October	140	43	90.0	.046	.05	B.
November	168	.....	73.2	.038	.04	C.
December	.....	.....	28.0	.014	.02	D.

NOTE.—See footnotes to table of 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 November 15, 1911.

Drainage area.—703 square miles.

Gage.—Chain gage attached to bridge; datum unchanged since established.

Channel.—Practically permanent, the flow being controlled by slight rapids just below the bridge.

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, discharge measurements are made to determine the winter flow.

Regulation.—The nearest dam, that at Redwood Falls, creates a pond extending upstream for a considerable distance, but owing to rapids just below the gaging station the backwater does not reach it.

Discharge measurements of Redwood River near Redwood Falls, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 4	C. J. Emerson	1.88	[a] 15.0
June 22	S. B. Soulé	1.68	[b] 5.2
Dec. 6	C. J. Emerson	1.94	[c] 12.0

[a] Discharge estimated.
[b] Measurement made by wading.
[c] Measurement made under complete ice cover. Average thickness of ice 0.07 foot. Average distance, water surface to top of ice 0.09 foot.

Daily gage height, in feet, of Redwood River near Redwood Falls, Minn., for 1911.

[Floyd Reynolds, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.05	1.93	1.82	1.60	1.55	1.70	1.90	.....	.....
2	.....	2.07	1.90	1.80	1.58	1.55	1.70	1.88	.....	.....
3	.....	1.95	1.86	1.75	1.58	1.60	1.70	1.88	.....	.....
4	.....	2.00	1.88	1.70	.....	1.60	1.72	1.88	.....	.....
5	.....	2.05	1.88	1.65	1.58	1.78	.....	1.88	.....	.....
6	.....	2.03	1.90	1.65	1.55	1.75	.....	2.62	.....	1.94
7	.....	2.00	1.90	1.68	1.55	1.72	.....	2.22	.....	.....
8	.....	2.05	1.90	1.70	1.55	1.70	.....	2.00	.....	.....
9	.....	2.03	1.90	1.72	.....	1.65	.....	2.10	.....	.....
10	.....	2.03	1.90	1.72	.....	1.60	.....	2.05	.....	.....
11	.....	2.05	1.88	.....	.....	1.75	.....	2.20	.....	.....
12	2.65	2.15	1.88	.....	.....	1.70	.....	2.40	.....	.....
13	2.63	2.20	1.85	.....	.....	1.65	.....	2.28	.....	.....
14	2.60	2.15	1.85	.....	.....	1.60	.....	2.20	.....	.....
15	2.60	2.10	1.85	.....	.....	1.60	.....	2.22	.....	.....
16	2.45	2.10	1.88	.....	1.55	1.58	.....	2.20	.....	.....
17	2.35	2.10	1.85	.....	1.55	1.70	1.80	2.25	.....	.....
18	2.20	2.05	1.85	.....	1.55	1.72	1.80	2.20	.....	.....
19	2.05	2.05	1.82	.....	1.52	1.75	1.80	2.30	.....	.....
20	.....	2.03	1.80	1.72	1.52	1.80	1.75	2.22	.....	.....
21	.....	2.00	1.88	1.70	1.52	1.78	1.80	2.30	.....	.....
22	.....	1.97	1.90	1.68	1.52	1.78	1.78	2.28	.....	.....
23	.....	1.95	1.90	1.65	1.64	1.80	1.75	2.22	.....	.....
24	2.13	1.95	1.88	1.65	1.62	1.80	1.72	2.22	.....	.....
25	2.10	1.95	1.88	1.64	1.60	1.75	1.70	2.20	.....	.....
26	2.10	1.93	1.85	1.65	1.58	1.78	1.75	2.15	.....	.....
27	2.05	1.93	1.85	1.62	1.81	1.75	1.78	2.10	.....	.....
28	2.00	1.90	1.82	1.60	1.65	1.75	.....	2.10	.....	.....
29	2.00	1.90	1.82	1.62	1.58	1.72	.....	2.12	.....	.....
30	2.03	1.95	1.82	1.65	1.56	1.70	.....	2.10	.....	.....
31	2.05	.....	1.82	.....	1.65	1.68	.....	2.10	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 11 and about Nov. 12 to Dec. 31. Gage not read by observer after Oct. 31. See list of discharge measurements.

Daily discharge, in second-feet, of Redwood River near Redwood Falls, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	28	17	10	2	1	5	15
2	.....	31	15	9	1.6	1	5	14
3	.....	19	13	7	1.6	2	5	14
4	.....	23	14	5	1.6	2	5.8	14
5	.....	28	14	3.5	1.6	8.2	6	14
6	.....	26	15	3.5	1	7	7	150
7	.....	23	15	4.4	1	5.8	7	54
8	.....	28	15	5	1	5	8	23
9	.....	26	15	5.8	1	3.5	9	34
10	.....	26	15	5.8	1	2	10	28
11	.....	28	14	5.8	1	7	11	50
12	158	42	14	5.8	1	5	12	92
13	153	50	12	5.8	1	3.5	11	65
14	144	42	12	5.8	1	2	10	50
15	144	34	12	5.8	1	2	10	54
16	104	34	14	5.8	1	1.6	9	50
17	80	34	12	5.8	1	5	9	60
18	50	28	12	5.8	1	5.8	9	50
19	28	28	10	5.8	.4	7	9	69
20	30	26	9	5.8	.4	9	7	54
21	32	23	14	5	.4	8.2	9	69
22	34	21	15	4.4	.4	8.2	8.2	65
23	36	19	15	3.5	3.2	9	7	54
24	39	19	14	3.5	2.6	9	5.8	54
25	34	19	14	3.2	2	7	5	50
26	34	17	12	3.5	1.6	8.2	7	42
27	28	17	12	2.6	9.6	7	8.2	34
28	23	15	10	2	3.5	7	8	34
29	23	15	10	2.6	1.6	5.8	8	37
30	26	19	10	3.5	1.2	5	8	34
31	28	.....	10	.....	3.5	4.4	.....	34

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge estimated for days of missing gage heights. Discharge estimated Nov. 1 to 11 because gage was not read. Discharge estimated Nov. 12 to Dec. 31 because of ice. Estimates for November (mean 17 second-feet) and December (mean 15 second-feet) are approximate and are based on one discharge measurement, climatologic records, and discharge of adjacent drainage areas.

Monthly discharge of Redwood River near Redwood Falls, Minn., for 1911.

[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.		
March 12–31	158	23	61.4	0.087	0.06	B.
April	50	15	26.3	.037	.04	B.
May	17	9	13.1	.019	.02	B.
June	10	2	5.03	.0072	.008	C.
July	9.6	.4	1.67	.0024	.003	C.
August	9	1	5.30	.0075	.009	C.
September	12	5	7.97	.011	.01	B.
October	150	14	47.1	.067	.08	B.
November	.....	.....	a 17	.024	.03	
December	.....	.....	a 15	.021	.02	

a Estimated; very approximate.

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 31, 1911.

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 apply 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 at a wading section.

Winter flow.—Ice exists from December to March. No record of flow January 1 to March 11. Discharge measurement made and observations continued in December.

Regulation.—Two miles below the station is the dam of the Cottonwood roller mill, which prevents any possible effect of backwater from the Minnesota reaching the gage. The low-water records show no systematic variation to indicate control from the dam, and it is therefore believed that the effect of such control is slight.

Discharge measurements of Cottonwood River near New Ulm, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 2	C. J. Emerson	1.58	42.7
Aug. 3 a	S. B. Soulé	1.06	6.1
3 a	....do	1.06	6.3
Dec. 5 b	C. J. Emerson	2.27	41

a Wading measurement 20 feet above bridge.
b Complete in cover; average thickness of ice 0.66 foot; average distance water surface to top of ice 0.06 foot.

Daily gage height, in feet, of Cottonwood River near New Ulm, Minn., for 1911.

[Esther Alvin, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.70	1.62	1.16	1.04	1.13	1.21	1.42	2.25	.....
2	.....	1.74	1.62	1.44	1.03	1.09	1.20	1.42	2.20	.....
3	.....	1.78	1.60	1.30	1.03	1.04	1.18	1.45	2.18	.....
4	.....	1.75	1.60	1.28	1.06	1.05	1.16	1.48	2.16	.....
5	.....	1.78	1.60	1.24	1.06	1.09	1.19	1.54	2.11	2.27
6	.....	1.80	1.55	1.18	1.03	1.16	1.22	1.82	2.09	.....
7	.....	1.76	1.50	1.18	1.01	1.28	1.26	2.09	2.04	1.25
8	.....	1.75	1.45	1.15	1.00	1.45	1.28	3.38	2.01	.....
9	.....	1.75	1.45	1.12	1.00	1.43	1.28	4.02	2.00	.....
10	.....	1.80	1.44	1.12	1.00	1.41	1.28	3.69	1.98	.....
11	.....	1.82	1.41	1.11	.99	1.40	1.26	3.28	1.92	1.95
12	3.28	1.82	1.40	1.10	.98	1.38	1.25	3.20	.....	.....
13	3.09	1.85	1.35	1.08	.96	1.38	1.25	3.20	.....	.....
14	2.86	1.88	1.40	1.08	.96	1.45	1.22	3.18	.....	2.1
15	2.72	1.89	1.40	1.06	.96	1.42	1.22	3.22	.....	.....
16	2.46	1.90	1.45	1.05	.95	1.41	1.20	3.51	.....	.....
17	2.29	1.90	1.49	1.05	.95	1.44	1.20	3.69	.....	.....
18	2.14	1.83	1.35	1.08	.98	1.46	1.20	3.71	.....	2.42
19	2.01	1.85	1.32	1.06	1.00	1.50	1.25	3.65	.....	.....
20	1.94	1.80	1.32	1.04	1.00	1.50	1.26	3.58	.....	.....
21	1.90	1.76	1.36	1.00	1.00	1.48	1.28	3.50	.....	2.45
22	1.90	1.68	1.40	1.00	1.00	1.44	1.32	3.30	.....	.....
23	1.88	1.69	1.38	1.00	1.00	1.41	1.35	3.02	.....	.....
24	1.86	1.70	1.35	1.00	.....	1.40	1.40	2.81	.....	.....
25	1.85	1.68	1.32	1.00	.....	1.38	1.40	2.69	.....	2.4
26	1.82	1.68	1.30	1.04	.....	1.36	1.40	2.46	.....	.....
27	1.79	1.65	1.28	.99	.....	1.35	1.40	2.38	.....	.....
28	1.76	1.65	1.25	.98	.....	1.35	1.40	2.36	.....	2.35
29	1.75	1.65	1.22	1.05	.....	1.35	1.42	2.35	.....	.....
30	1.75	1.62	1.20	1.05	.....	1.31	1.42	2.31	.....	.....
31	1.71	.....	1.19	.....	1.15	1.26	.....	2.30	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 11 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Cottonwood River near New Ulm, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	49	42	11	5.6	9.5	14	26	116
2	.....	53	42	28	5.2	7.6	13	26	109
3	.....	57	40	19	5.2	5.6	12	28	106
4	.....	54	40	18	6.4	6	11	31	103
5	.....	57	40	15	6.4	7.6	12	35	96
6	.....	59	36	12	5.2	11	14	61	94
7	.....	55	32	12	4.4	18	17	94	87
8	.....	54	28	10	4	28	18	414	83
9	.....	54	28	9	4	27	18	679	82
10	.....	59	28	9	4	26	18	537	80
11	.....	61	26	8.5	3.7	25	17	377	72
12	377	61	25	8	3.4	24	16	349	.....
13	313	64	22	7.2	2.8	24	16	349	.....
14	245	68	25	7.2	2.8	28	14	342	.....
15	209	69	25	6.4	2.8	26	14	356	.....
16	152	70	28	6.0	2.5	26	13	464	.....
17	122	70	31	7.2	2.5	28	13	537	.....
18	101	68	22	7.2	3.4	29	13	545	.....
19	83	64	20	6.4	4	32	16	520	.....
20	75	59	20	5.6	4	32	17	492	.....
21	70	55	23	4	4	31	18	460	.....
22	70	47	25	4	4	28	20	384	.....
23	68	48	24	4	4	26	22	291	.....
24	66	49	22	4	4	25	25	232	.....
25	64	47	20	4	5	24	25	202	.....
26	61	47	19	5.6	6	23	25	152	.....
27	58	44	18	3.7	7	22	25	138	.....
28	55	44	16	3.4	8	22	25	134	.....
29	54	44	14	6	9	22	26	132	.....
30	54	42	13	6	10	20	26	126	.....
31	50	.....	12	.....	10	17	.....	124	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge estimated for days of missing gage heights. Discharge Nov. 12 to Dec. 31 estimated, because of ice, from one discharge measurement, gage observer's notes, and climatologic records. Mean discharge Nov. 12 to 30 estimated 42 second-feet, varying from about 35 to 60 second-feet. Mean discharge Dec. 1 to 31 estimated 55 second-feet, varying from about 35 to 80 second-feet.

Monthly discharge of Cottonwood River near New Ulm, Minn., for 1911.

[Drainage area, 1,190 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March 12–31	377	50	117	0.098	0.07	B.
April	70	42	55.7	.047	.05	A.
May	42	12	26.0	.022	.03	A.
June	28	3.4	8.58	.0072	.008	B.
July	10	2.5	4.94	.0042	.005	B.
August	32	5.6	21.9	.018	.02	A.
September	26	11	17.8	.015	.02	B.
October	679	26	279	.234	.27	C.
November	116	.....	60.9	.051	.06	D.
December	.....	.....	55.0	.046	.05	D.

NOTE.—See footnotes to table of daily discharge.

ST. CROIX RIVER BASIN.

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.—1903 (published in Water-Supply Paper 98, pp. 176–177, under "St. Croix River near Taylors Falls, Minn."); January 10, 1902, to June 30, 1905 (published in the "Report of water-resources investigations of Minnesota during 1909–1910" by the Minnesota State Drainage Commission); January 1, 1910, to December 31, 1911.

Drainage area.—5,930 square miles.

Discharge.—The determinations of discharge are based on the kilowatt output of dynamo and exciters plus the flow over the dam and spillway, using them as a weir.

Cooperation.—Record kept and furnished for publication by the Minneapolis General Electric Co.

Accuracy.—Records have not been checked by engineers of the United States Geological Survey, but it is believed that they are reliable.

Daily discharge, in second-feet, of St. Croix River near St. Croix Falls, Wis., for 1910–11.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
1	3,218	3,035	3,820	5,588	2,652	3,174	1,684	1,446	1,701	1,396	1,385	1,953
2	3,470	2,925	4,035	5,455	2,413	2,165	1,112	1,451	1,701	728	1,390	1,440
3	3,204	2,790	3,825	5,170	3,878	2,044	610	1,400	1,821	1,569	1,405	1,048
4	3,164	3,565	4,255	5,588	3,478	1,923	1,122	1,398	606	1,579	1,458	648
5	2,495	3,351	3,030	5,158	2,660	2,610	1,635	1,496	1,172	1,585	1,668	1,190
6	2,710	3,725	2,952	5,118	2,893	2,584	1,425	1,258	1,699	1,583	725	1,238
7	2,946	2,825	2,875	4,744	2,656	1,903	1,555	452	1,674	1,611	1,694	1,403
8	3,220	2,795	2,940	4,779	2,335	1,928	1,685	1,353	1,773	1,951	1,543	1,725
9	3,495	3,511	2,965	2,158	2,045	2,354	1,227	1,700	1,644	602	1,549	1,741
10	2,905	2,801	3,015	2,650	5,457	2,439	500	1,501	1,591	1,638	1,502	1,743
11	2,856	2,801	3,210	4,103	1,873	1,933	1,804	1,466	680	1,766	1,557	629
12	2,797	2,960	4,563	3,093	1,407	1,760	1,363	1,399	1,736	1,777	1,508	1,417
13	3,065	3,725	5,125	3,127	4,658	1,929	1,799	1,290	1,733	1,770	671	1,343
14	2,880	2,850	5,800	3,162	5,202	1,936	1,790	393	1,411	1,738	1,291	1,139
15	2,940	2,650	6,845	3,043	1,950	1,899	1,668	1,398	1,234	1,732	1,449	1,311
16	3,725	2,810	7,240	3,163	1,835	1,937	1,268	1,554	1,383	629	1,500	1,473
17	3,020	2,620	8,018	3,725	1,510	2,227	75	1,359	1,519	1,643	1,214	1,535
18	2,960	2,900	9,393	2,949	1,185	1,398	1,838	1,412	666	1,513	997	638
19	2,561	3,212	8,959	4,278	2,043	550	1,799	1,404	1,317	1,700	1,348	1,270
20	2,921	3,525	8,525	3,113	3,325	1,822	1,774	1,320	1,446	1,725	728	1,408
21	2,770	2,458	9,871	3,079	2,057	1,853	1,815	452	1,456	1,750	1,607	1,266
22	2,850	2,545	8,010	4,625	790	1,737	1,723	1,475	1,453	1,780	1,526	1,245
23	3,725	2,876	8,203	3,923	2,330	1,622	1,297	1,637	1,221	635	1,727	1,219
24	3,080	2,715	8,238	3,675	2,628	1,672	343	1,633	1,098	1,663	691	1,518
25	3,030	2,510	8,234	4,958	3,033	1,113	1,408	1,597	759	1,776	1,362	842
26	2,821	3,520	7,911	5,159	3,553	555	1,482	1,567	1,407	1,826	1,600	850
27	3,095	4,150	7,675	4,307	4,633	1,734	1,493	1,564	1,639	1,662	674	1,106
28	2,605	4,045	6,695	1,957	4,455	2,208	1,488	521	1,659	1,699	1,474	1,296
29	3,050	.....	6,021	3,282	2,950	1,454	1,494	1,531	1,666	1,743	1,513	1,261
30	3,950	.....	6,274	2,892	2,315	1,569	1,495	1,538	1,614	634	1,518	1,306
31	2,945	.....	6,528	.....	1,493	.....	358	1,687	.....	1,578	.....	1,714
1911.												
1	653	1,580	1,508	2,816	2,580	4,456	2,160	2,030	1,505	1,597	2,669	2,000
2	935	1,429	1,543	3,161	2,662	3,633	1,111	1,870	1,466	2,582	2,474	2,213
3	1,693	1,372	1,563	2,744	2,280	3,020	1,573	2,012	1,012	2,448	2,464	1,104
4	1,413	1,616	1,574	1,851	2,181	2,327	1,188	2,032	1,552	2,450	2,431	2,256
5	1,333	1,068	819	2,065	2,180	3,362	1,970	1,824	1,725	2,480	1,213	2,173
6	807	1,556	1,458	2,473	2,440	5,241	1,845	1,011	1,576	2,871	2,216	2,165
7	1,484	1,576	1,522	2,511	962	4,771	1,620	1,887	1,577	3,250	2,486	2,208
8	719	1,591	1,557	2,494	2,099	5,207	1,623	2,133	1,699	4,106	2,462	2,247
9	1,336	1,493	1,527	2,593	2,216	5,026	1,104	2,115	1,706	4,255	2,536	2,198
10	1,301	1,457	1,476	2,625	2,164	3,960	2,134	2,084	1,022	4,914	2,463	1,149
11	1,293	1,571	1,567	2,120	2,198	5,870	2,186	2,046	1,726	3,895	2,554	2,073
12	1,116	938	1,796	2,126	2,144	3,972	2,170	2,046	1,640	3,368	1,338	2,122
13	1,130	1,597	2,243	2,840	2,234	3,014	2,109	1,158	1,798	3,143	2,426	2,200
14	1,053	1,506	2,427	4,313	4,259	3,794	2,117	1,958	1,766	3,351	1,905	2,228
15	557	1,357	2,640	4,369	4,616	3,143	2,102	2,095	2,712	4,350	1,894	2,193
16	1,200	1,343	2,168	4,346	3,763	2,960	928	1,992	3,065	4,593	1,710	2,224
17	1,109	1,268	2,394	4,373	3,330	2,702	3,468	2,148	3,214	5,010	1,994	1,063
18	1,112	1,593	2,761	3,887	4,251	1,877	2,097	2,100	2,760	5,184	1,883	2,165
19	1,077	808	2,753	3,574	5,995	2,981	1,734	2,072	4,422	4,901	1,101	2,204
20	1,102	1,440	2,634	3,830	7,249	2,831	1,669	1,000	2,678	5,193	1,730	2,227
21	1,104	1,583	2,508	4,696	6,853	2,725	1,582	1,917	2,264	4,952	1,948	2,245
22	725	1,495	2,962	5,088	7,041	2,227	1,562	1,841	2,311	4,972	2,114	2,302
23	1,297	1,589	3,287	4,780	7,496	2,124	936	1,575	2,351	5,153	2,075	2,162
24	1,231	1,535	3,326	4,818	5,572	2,184	1,555	1,646	1,605	4,654	2,082	1,043
25	1,641	1,512	3,130	4,040	5,490	1,053	1,735	1,558	3,190	5,386	2,102	884
26	1,400	793	3,154	3,285	5,251	1,607	1,838	1,558	3,065	4,879	1,099	1,987
27	1,240	1,508	3,402	4,831	4,854	2,827	2,129	841	2,330	4,571	2,080	2,238
28	1,393	1,504	3,266	4,480	5,749	1,859	2,017	1,526	2,375	3,113	1,985	2,366
29	621	.....	2,812	3,163	5,376	2,122	1,858	1,599	2,245	1,006	2,113	2,432
30	1,361	.....	2,688	2,530	4,459	2,132	989	1,763	2,277	3,089	1,298	2,380
31	1,437	.....	2,753	.....	4,801	.....	1,739	1,532	.....	2,995	.....	1,139

Monthly discharge of St. Croix River near St. Croix Falls, Wis., for 1910–11.

[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.	
1910.					
January	3,950	2,495	3,050	0.514	0.59
February	4,150	2,458	3,080	.519	.54
March	9,871	2,875	5,970	1.01	1.16
April	5,588	1,957	3,930	.663	.74
May	5,457	790	2,760	.465	.54
June	3,174	550	1,870	.315	.35
July	1,838	75	1,360	.229	.26
August	1,700	393	1,340	.226	.26
September	1,821	606	1,420	.239	.27
October	1,951	602	1,520	.256	.30
November	1,727	671	1,340	.226	.25
December	1,953	629	1,290	.218	.25
The year	9,871	75	2,410	.406	5.51
1911.					
January	1,693	557	1,160	.196	.23
February	1,597	793	1,420	.239	.25
March	3,402	819	2,300	.388	.45
April	5,088	1,851	3,430	.578	.64
May	7,249	962	4,020	.678	.78
June	5,870	1,053	3,170	.535	.60
July	3,468	928	1,770	.298	.34
August	2,148	841	1,770	.298	.34
September	4,422	1,012	2,150	.363	.40
October	5,386	1,006	3,830	.646	.74
November	2,669	1,099	2,030	.342	.38
December	2,432	884	1,990	.336	.39
The year	7,249	557	2,420	.408	5.54

KETTLE RIVER NEAR SANDSTONE, MINN.

Location.—At the quarries of the Barber Asphalt Co. at Banning, 3 miles above Sandstone; no tributaries within several miles.

Records available.—October 18, 1908, to December 31, 1911.

Drainage area.—825 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Permanent; bedrock.

Regulation.—The nearest dam is at Sandstone, 3 miles below, but as the fall between the two points is heavy, the station is above its influence.

Winter flow.—The gage is 50 feet above decided rapids, which remain open through the winter except for very short periods of extremely cold weather, when they may freeze and cause backwater. The river very seldom freezes entirely over at the gage, so it is probable that except for the few days when the rapids freeze the open channel rating curve applies closely to the winter flow. This curve has therefore been used in computing winter discharge. During January, 1911, the river at the gage remained open. Ice formed on the rapids during the night, but was dislodged by afternoon. Therefore, any gage readings taken in the morning would have been somewhat in error owing to backwater. Gage heights for January, published in the following table, are reported by the observer as having been read at 1 p. m. Effect of backwater has been considered in making the estimate of discharge for January, given in the following table of monthly discharge.

Accuracy.—As the stream flows through solid rock at the measuring section, this rating curve, which has been furnished by the Kettle River Co., should hold permanently; it has been checked by the Geological Survey. Conditions are exceptionally favorable for excellent results at this station, and the records should be reliable.

Discharge measurements of Kettle River near Sandstone, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 27	C. R. Adams	1.16	63.6
28	....do	1.86	71.3
28	....do	1.21	65.6

NOTE.—Measurements made under ice cover about one-eighth mile below gage.

Daily gage height, in feet, of Kettle River near Sandstone, Minn., for 1911.

[Fred Elstad and D. R. Smith, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	1.15	1.1	1.60	2.45	2.40	1.65	2.1	1.4	1.70	1.90	1.40
2	1.4	1.1	1.1	1.65	2.40	2.30	1.5	2.3	1.4	1.70	1.90	1.40
3	1.3	1.1	1.1	1.70	2.30	2.20	1.5	2.4	1.6	1.75	1.85	1.40
4	1.3	1.1	1.1	1.70	2.20	2.70	1.9	2.35	1.9	1.80	1.80	1.40
5	1.2	1.1	1.15	1.65	2.10	3.00	3.1	2.4	2.0	1.75	1.75	1.35
6	1.2	1.1	1.15	1.65	2.05	3.10	3.95	2.3	2.1	1.90	1.70	1.35
7	1.2	1.1	1.2	1.60	1.90	3.05	3.8	2.3	2.4	2.20	1.70	1.30
8	1.2	1.15	1.3	1.70	1.90	2.90	3.4	2.25	2.45	2.35	1.70	1.30
9	1.2	1.15	1.45	1.60	1.90	3.25	3.2	2.2	2.5	2.30	1.75	1.35
10	1.25	1.1	1.45	1.75	1.90	3.30	2.9	2.1	2.6	2.20	1.80	1.35
11	1.25	1.15	1.5	1.95	1.90	3.25	2.6	2.0	2.4	2.15	1.75	1.50
12	1.3	1.15	1.65	2.70	1.90	3.00	2.3	2.0	2.3	2.10	1.75	1.55
13	1.25	1.1	1.75	3.00	1.85	3.05	2.1	1.8	2.2	2.05	1.75	1.50
14	1.25	1.1	1.9	3.20	2.50	2.90	2.0	1.7	2.2	2.10	1.70	1.50
15	1.2	1.1	1.8	3.10	2.90	2.70	1.8	1.65	2.3	2.10	1.70	1.40
16	1.25	1.15	1.75	2.90	3.60	2.50	1.8	1.6	2.4	2.10	1.75	1.45
17	1.25	1.15	1.6	2.80	4.00	2.40	1.7	1.6	2.4	2.20	1.70	1.50
18	1.3	1.15	1.6	2.70	4.20	2.40	1.6	1.55	2.3	2.30	1.70	1.60
19	1.35	1.15	1.55	3.00	4.60	2.30	1.6	1.5	2.2	2.50	1.65	1.80
20	1.4	1.2	1.55	3.70	4.80	2.10	1.5	1.5	2.1	2.50	1.65	1.85
21	1.4	1.15	1.6	3.50	4.50	1.95	1.5	1.6	2.0	2.60	1.60	1.85
22	1.25	1.1	1.7	3.30	4.10	1.85	1.4	1.6	1.9	2.50	1.60	1.90
23	1.2	1.1	1.7	2.90	3.90	1.80	1.4	1.55	1.8	2.50	1.55	2.10
24	1.2	1.1	1.9	2.80	3.60	1.65	1.5	1.5	1.8	2.40	1.50	2.30
25	1.15	1.15	1.8	2.75	3.40	1.60	1.7	1.45	1.8	2.40	1.50	2.45
26	1.15	1.1	1.8	2.60	3.10	1.60	1.75	1.4	1.75	2.30	1.50	2.50
27	1.15	1.1	1.75	2.65	2.85	1.90	1.65	1.45	1.7	2.25	1.45	2.50
28	1.1	1.1	1.7	2.50	2.70	1.90	1.6	1.5	1.75	2.20	1.45	2.60
29	1.1	.....	1.65	2.55	2.65	1.85	1.5	1.55	1.75	2.10	1.45	2.65
30	1.1	.....	1.65	2.40	2.50	1.80	1.6	1.5	1.75	2.00	1.40	2.50
31	1.15	.....	1.6	.....	2.45	.....	1.8	1.5	.....	1.90	.....	2.70

NOTE.—Ice present from Jan. 1 to 31. Nov. 27 observer reported "river partly frozen near gage." Dec. 23 observer reported "rise in river due to ice." Relation of gage height to discharge probably affected by ice about Jan. 1 to 31 and about Dec. 19 to 31. See "Winter flow" in the station description.

Daily discharge, in second-feet, of Kettle River near Sandstone, Minn., for 1911.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	80	70	186	540	515	201	375	136	216	288	136
2	70	70	201	515	465	160	465	136	216	288	136
3	70	70	216	465	420	160	515	186	233	269	136
4	70	70	216	420	675	288	490	288	250	250	136
5	70	80	201	375	860	930	515	330	233	233	124
6	70	80	201	352	930	1,560	465	375	288	216	124
7	70	90	186	288	895	1,440	465	515	420	216	112
8	80	112	216	288	795	1,140	442	540	490	216	112
9	80	148	186	288	1,040	1,000	420	565	465	233	124
10	70	148	233	288	1,070	795	375	620	420	250	124
11	80	160	309	288	1,040	620	330	515	398	233	160
12	80	201	675	288	860	465	330	465	375	233	173
13	70	233	860	269	895	375	250	420	352	233	160
14	70	288	1,000	565	795	330	216	420	375	216	160
15	70	250	930	795	675	250	201	465	375	216	136
16	80	233	795	1,300	565	250	186	515	375	233	148
17	80	186	735	1,600	515	216	186	515	420	216	160
18	80	186	675	1,760	515	186	173	465	465	216	186
19	80	173	860	2,080	465	186	160	420	565	201	.....
20	90	173	1,370	2,240	375	160	160	375	565	201	.....
21	80	186	1,220	2,000	309	160	186	330	620	186	.....
22	70	216	1,070	1,680	269	136	186	288	565	186	.....
23	70	216	795	1,520	250	136	173	250	565	173	.....
24	70	288	735	1,300	201	160	160	250	515	160	.....
25	80	250	705	1,140	186	216	148	250	515	160	.....
26	70	250	620	930	186	233	136	233	465	160	.....
27	70	233	648	765	288	201	148	216	442	148	.....
28	70	216	565	675	288	186	160	233	420	148	.....
29	.....	201	592	648	269	160	173	233	375	148	.....
30	.....	201	515	565	250	186	160	233	330	136	.....
31	.....	186	.....	540	.....	250	160	.....	288	.....	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Dec. 19 to 31 estimated, because of ice, from observer's notes and climatologic records. Mean discharge Dec. 19 to 31 estimated 166 second-feet, varying from about 150 to 180 second-feet.

Monthly discharge of Kettle River near Sandstone, Minn., for 1911.

[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	.....	.....	[a] 65	0.079	0.09	C.
February	90	70	74.6	.090	.09	B.
March	288	70	176	.213	.25	A.
April	1,370	186	591	.716	.80	A.
May	2,240	269	863	1.05	1.21	A.
June	1,070	186	562	.681	.76	A.
July	1,560	136	411	.498	.57	A.
August	515	136	274	.332	.38	A.
September	620	136	359	.435	.49	A.
October	620	216	406	.492	.57	A.
November	288	136	209	.253	.28	A.
December	.....	.....	152	.184	.21	B.
The year	2,240	.....	347	.421	5.70	

[a] Estimated from one discharge measurement and climatologic records.

NOTE.—See footnote to table of 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, 1911.

Drainage area.—422 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Shifting.

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

Winter flow.—From December to March measurements are made through the ice to determine the approximate winter discharge.

Regulation.—The logging dams on the river have not produced marked effect on the gage heights. The only dam below Mora is at Pine City, at the outlet of Cross Lake; backwater from this dam extends to a point several miles below the gaging station.

Discharge measurements of Snake River at Mora, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Jan 12[a]	C. J. Emerson	6.63	9.5
Mar. 1[a]	C. R. Adams	6.55	23.0
June 19	S. B. Soulé	6.68	190
July 6	.....do	5.89	55.6
Sept. 14	.....do	6.59	159
Dec. 6[b]	.....do	6.50	46.9

[a] Measurement made under ice cover.
[b] Complete ice cover at gage; average thickness of ice 0.5 foot; average distance water surface to top of ice 0.04 foot.

Daily gage height, in feet, of Snake River at Mora, Minn., for 1911.

[Mrs. Alice Lasher, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	6.55	5.63	6.02	5.95	8.41	6.12	5.82	6.20	6.78	.....
2	.....	.....	.....	5.60	5.98	5.95	7.48	6.10	5.81	6.28	6.80	.....
3	6.60	6.60	6.62	5.60	6.00	6.00	6.62	6.40	5.88	6.41	6.65	.....
4	.....	.....	.....	5.54	5.94	6.26	6.00	6.38	6.01	6.36	6.40	6.4
5	.....	.....	.....	5.60	5.89	7.05	6.00	6.25	6.20	6.40	6.30	.....
6	6.50	.....	.....	5.68	5.88	7.92	5.96	6.16	6.00	6.75	6.20	6.5
7	.....	.....	6.60	5.68	5.80	8.15	6.35	6.09	5.98	7.19	6.20	6.5
8	.....	6.65	.....	5.60	5.80	7.90	6.48	6.02	6.00	7.44	6.20	.....
9	.....	.....	.....	5.60	5.78	6.88	6.42	5.96	6.02	7.42	6.20	.....
10	6.50	6.7	6.40	5.64	5.80	6.02	6.32	6.01	6.10	7.30	6.20	.....
11	.....	.....	.....	5.65	5.75	7.50	6.24	5.99	6.14	7.09	.....	6.65
12	6.62	.....	6.10	5.80	5.82	7.25	6.12	5.94	6.14	6.95	.....	.....
13	6.60	.....	6.00	6.05	5.85	7.40	6.04	5.90	6.02	6.84	6.5	.....
14	.....	6.72	5.80	6.40	5.90	7.55	5.94	5.95	6.54	6.78	.....	6.6
15	.....	.....	5.88	6.45	6.00	7.15	5.89	5.84	7.72	6.70	.....	.....
16	.....	.....	6.12	6.26	6.06	6.95	5.84	5.74	9.40	6.75	6.35	.....
17	6.55	6.80	6.02	6.15	6.25	6.90	5.79	5.68	8.32	6.76	.....	.....
18	.....	.....	6.20	6.06	6.50	6.75	5.71	5.68	7.70	6.85	.....	6.6
19	.....	.....	5.80	6.10	6.98	6.69	5.79	5.68	7.35	6.94	.....	.....
20	6.60	.....	5.85	6.18	8.45	6.59	5.76	5.68	7.06	6.90	6.6	.....
21	.....	6.60	5.80	6.55	7.74	6.32	5.71	5.75	6.85	6.88	.....	6.6
22	6.50	.....	5.68	6.60	7.51	6.24	5.69	5.88	6.67	6.92	.....	.....
23	.....	.....	5.90	6.45	7.21	6.19	5.66	5.74	6.51	7.01	6.4	.....
24	.....	6.60	5.78	6.34	7.06	6.98	5.74	5.56	6.44	7.05	.....	.....
25	.....	.....	5.69	6.26	6.91	6.18	5.71	5.50	6.31	7.10	.....	6.6
26	.....	.....	5.70	6.21	6.72	6.10	5.66	5.55	6.25	7.06	.....	.....
27	6.70	.....	6.05	6.15	6.55	5.98	5.61	5.70	6.20	7.01	6.5	.....
28	.....	.....	5.75	6.11	6.41	7.44	5.69	5.70	6.19	6.91	.....	6.5
29	.....	.....	5.70	6.10	6.25	6.35	5.79	5.70	6.18	6.78	.....	.....
30	.....	.....	5.76	6.10	6.12	7.80	5.73	5.66	6.18	6.70	6.4	.....
31	6.60	.....	5.60	.....	6.05	.....	5.85	5.80	.....	6.68	.....	.....

NOTE.—Ice present Jan. 1 to Mar. 11 (average thickness of ice about 1.5 and 2 feet) and Oct. 28 to Dec. 31; very thin Oct. 28 to Nov. 12; average thickness Nov. 13 to Dec. 31 about 0.4 to 1 foot. Relation of gage height to discharge affected by ice about Jan. 1 to Mar. 11 and Nov. 11 to Dec. 31.

Daily discharge, in second-feet, of Snake River at Mora, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	23	38	73	66	668	86	53	96	196
2	23	36	69	66	368	83	52	107	200
3	25	36	71	71	165	126	58	128	170
4	25	32	64	104	71	123	72	120	126
5	25	36	59	256	71	103	96	126	110
6	25	42	58	503	67	91	71	190	96
7	25	42	51	580	118	82	69	290	96
8	25	36	51	496	140	73	71	357	96
9	30	36	49	217	129	67	73	352	96
10	40	39	51	73	113	72	83	319	96
11	50	40	47	374	102	70	88	266	.....
12	83	51	53	306	86	64	88	232	.....
13	71	77	56	346	76	60	73	208	.....
14	51	126	60	388	64	66	150	196	.....
15	58	134	71	280	59	55	439	180	.....
16	86	104	78	232	55	46	1,000	190	.....
17	73	90	103	221	50	42	638	192	.....
18	96	78	143	190	44	42	433	210	.....
19	51	83	239	178	50	42	332	230	.....
20	56	93	682	159	48	42	258	221	.....
21	51	152	445	113	44	47	210	217	.....
22	42	161	377	102	42	58	174	226	.....
23	60	134	296	95	40	46	145	246	.....
24	49	116	258	239	46	34	133	256	.....
25	42	104	223	93	44	30	112	268	.....
26	43	97	184	83	40	33	103	258	.....
27	77	90	152	69	37	43	96	246	.....
28	47	84	128	357	42	43	95	223	.....
29	43	83	103	118	50	43	93	196	.....
30	48	83	86	464	45	40	93	180	.....
31	36	.....	77	.....	56	51	.....	176	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Mar. 1 to 11, daily discharge estimated, because of ice. Nov. 11 to 30, discharge estimated, because of ice, from semiweekly gage heights, observer's notes, discharge measurement of Dec. 6, and climatologic records; mean discharge 57 second-feet, ranging from about 43 to 90 second-feet.

Monthly discharge of Snake River at Mora, Minn., for 1911.

[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	.....	.....	[a] 10	0.024	0.03	C.
February	.....	.....	[a] 15	.036	.04	C.
March	96	23	47.7	.113	.13	B.
April	161	32	78.4	.186	.21	A.
May	682	49	144	.341	.39	A.
June	580	66	228	.540	.60	A.
July	668	37	97.7	.232	.27	A.
August	126	30	61.4	.145	.17	A.
September	1,000	52	182	.431	.48	A.
October	357	96	216	.512	.59	A.
November	200	.....	[b] 80.7	.191	.21	C.
December	.....	.....	[c] 53	.126	.15	D.
The year	1,000	.....	101	.239	3.27	

[a] Estimated from two ice measurements, semiweekly gage heights, and climatologic records.
[b] See footnotes to table of daily discharge.
[c] Estimated from ice measurement, semiweekly gage heights, observer's notes, and climatologic records.

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, 1911.

Drainage area.—1,290 square miles.

Gage.—Chain, attached to bridge; datum unchanged since established.

Channel.—Practically permanent except during high water.

Discharge measurements.—Made from the bridge.

Winter flow.—Ice is present from December to March, and during that period measurements are made to determine the winter discharge. (See fig. 1; also fig. 2, p. 124.)

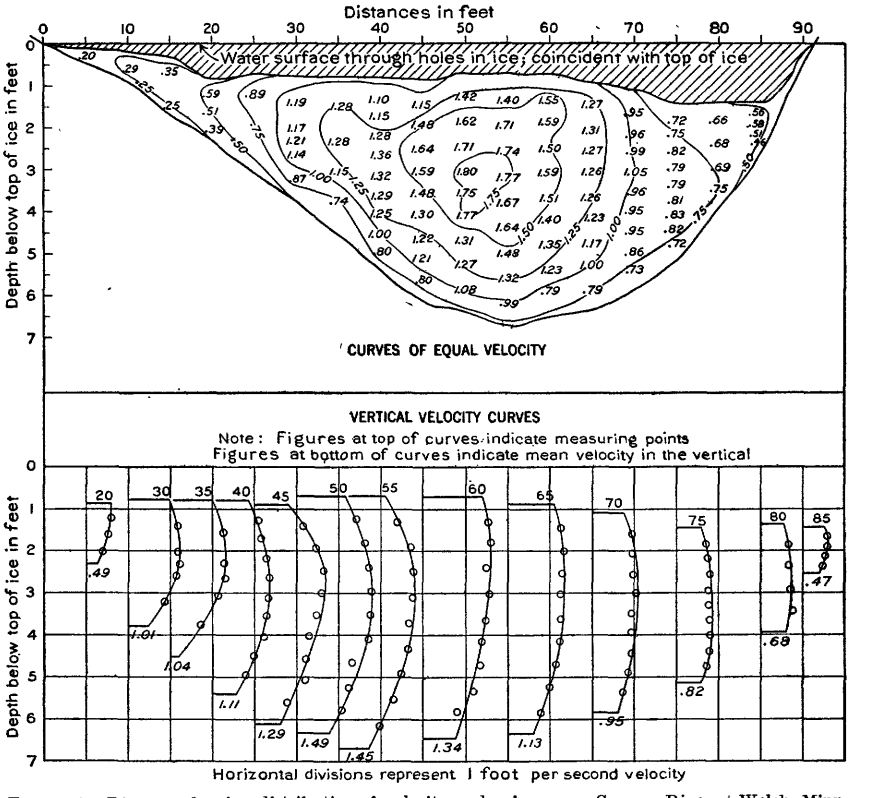

FIGURE 1.—Diagram showing distribution of velocity under ice cover, Cannon River at Welch, Minn.

Regulation.—About 800 feet above the bridge is a dam at which about 40 horsepower is developed. This dam leaks so badly that the operation of the turbine has little effect on the flow.

Maximum flow.—In April of 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.

Discharge measurements of Cannon River at Welch, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
May 23	C. J. Emerson	5.08	88.4
Oct. 17	S. B. Soulé	12.30	4,770
18	....do	12.22	4,730
Dec. 15	C. J. Emerson	7.75	1,160

Daily gage height, in feet, of Cannon River at Welch, Minn., for 1911.

[E. J. Norell, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.43	5.12	5.49	5.29	5.97	5.39	5.50	7.78	6.80
2	5.88	5.65	5.72	5.24	5.40	5.70	5.74	5.68	7.86	6.61
3	5.58	5.06	5.25	5.32	5.17	5.36	5.62	6.31	7.44	6.42
4	5.58	4.96	5.69	6.45	5.48	5.30	5.23	5.71	6.16	6.32
5	5.23	5.15	5.20	5.92	5.64	5.40	5.72	5.80	5.52	6.10
6	5.54	5.40	5.24	5.95	5.59	5.23	5.86	7.31	6.70	6.15
7	5.34	5.10	5.50	5.35	5.37	5.63	5.84	11.31	6.80	6.30
8	5.67	5.05	5.10	5.64	5.34	5.78	5.83	8.96	7.31	6.34
9	5.76	5.02	5.31	5.35	5.23	5.60	5.84	8.34	7.59	6.38
10	5.54	5.09	5.39	5.48	5.20	5.76	5.68	8.22	7.51	7.30
11	5.49	5.38	5.26	5.34	5.36	5.69	5.46	8.16	7.30	9.15
12	5.28	5.35	5.39	5.59	5.28	5.76	5.84	7.86	7.41	8.85
13	5.17	5.50	5.06	5.60	5.23	5.69	5.83	7.51	7.09	7.98
14	5.53	5.52	5.28	5.40	5.06	5.92	5.83	7.39	6.15	7.75
15	5.56	5.52	5.45	5.42	5.08	5.96	5.84	7.20	5.92	7.70
16	5.43	5.22	5.48	5.50	5.18	5.89	5.80	8.30	5.80	7.20
17	5.16	5.34	5.46	5.78	5.13	5.87	5.42	12.42	6.78	6.60
18	5.54	5.65	5.49	5.45	5.19	5.84	5.46	12.22	6.90	6.92
19	5.14	5.65	5.39	5.40	5.30	5.80	5.70	11.82	.....	6.51
20	5.16	5.45	5.20	5.60	5.39	5.12	5.80	9.62	6.60	6.41
21	5.78	5.65	5.12	5.35	5.27	5.59	5.86	9.58	6.40	6.50
22	5.56	5.66	5.10	5.50	5.03	5.84	5.86	9.15	6.30	6.70
23	5.10	5.45	5.16	5.69	5.24	5.86	5.86	8.94	6.38	6.68
24	5.19	5.18	5.35	5.38	4.98	5.82	5.67	8.32	6.46	6.55
25	5.04	5.65	5.52	5.25	4.99	5.88	5.38	8.00	6.80	6.32
26	4.95	5.28	5.59	5.40	5.23	5.63	5.81	7.49	.....	6.25
27	4.90	5.20	5.13	5.36	5.28	5.34	5.43	8.81	.....	6.32
28	5.06	5.66	5.16	5.48	5.28	5.59	5.76	8.50	.....	6.30
29	5.24	5.24	5.30	5.42	5.20	5.79	5.76	8.35	.....	6.80
30	5.44	5.48	5.14	5.50	5.24	5.36	5.52	8.20	.....	.....
31	5.25	.....	5.28	.....	5.10	5.33	.....	6.90	.....	.....

NOTE.—Ice present about Jan. 1 to Mar. 1, Nov. 12 to Dec. 9, and Dec. 27 to 31.

Daily discharge, in second-feet, of Cannon River at Welch, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	200	154	94	168	124	314	145	170	1,170
2	281	209	229	115	147	223	235	217	1,220
3	190	85	116	130	102	139	201	442	978
4	190	72	220	499	165	126	113	226	384
5	113	99	107	295	206	147	229	254	175
6	180	147	115	306	192	113	274	908	608
7	134	91	170	136	141	203	268	3,900	654
8	215	84	91	206	134	248	264	1,970	908
9	242	80	128	136	113	195	268	1,520	1,060
10	180	90	145	165	107	242	217	1,440	1,020
11	168	143	118	134	139	220	161	1,400	903
12	122	136	145	192	122	242	268	1,220	961
13	102	170	85	195	113	220	264	1,020	795
14	178	175	122	147	85	295	264	951	380
15	185	175	158	152	88	310	268	851	295

Daily discharge, in second-feet, of Cannon River at Welch, Minn., for 1911—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	154	111	165	170	104	285	254	1,500	254
17	101	134	161	248	96	278	152	4,900	.....
18	180	209	168	158	105	268	161	4,720	.....
19	97	209	145	147	126	254	223	4,350	.....
20	101	158	107	195	145	94	254	2,490	.....
21	248	209	94	136	120	192	274	2,450	.....
22	185	212	91	170	81	268	274	2,120	.....
23	91	158	101	220	115	274	274	1,950	.....
24	105	104	136	143	75	261	215	1,510	.....
25	83	209	175	116	76	281	143	1,300	.....
26	71	122	192	147	113	203	257	1,000	.....
27	65	107	96	139	122	134	154	1,850	.....
28	85	212	101	165	122	192	242	1,630	.....
29	115	115	126	152	107	251	242	1,530	.....
30	156	165	97	170	115	139	175	1,430	.....
31	116	.....	122	.....	91	132	.....	701	.....

NOTE.—Daily discharge computed from a rating curve fairly well defined between 80 and 5,000 second-feet. Discharge Mar. 1, Nov. 17 to Dec. 9, and Dec. 27 to 31 estimated, because of ice, from observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Nov. 17 to 30 estimated 230 second-feet, varying from about 200 to 260 second-feet. Mean discharge Dec. 1 to 9 estimated 280 second-feet, varying from about 270 to 300 second-feet.

Monthly discharge of Cannon River at Welch, Minn., for 1911.

[Drainage area, 1,290 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
March	281	65	149	0.116	0.13	B.
April	212	72	145	.112	.12	B.
May	229	85	133	.103	.12	B.
June	499	115	182	.141	.16	B.
July	206	75	119	.092	.11	B.
August	314	94	218	.169	.19	B.
September	274	113	224	.174	.19	B.
October	4,900	170	1,670	1.29	1.49	A.
November	1,220	175	500	.388	.43	B.
December	2,120	250	606	.470	.54	B.

NOTE.—See footnotes to table of daily discharge.

CHIPPEWA RIVER BASIN.

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, 1911. 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.

Drainage area.—5,300 square miles.

Gage.—Staff, painted on one of the cylindrical iron piers at right end of bridge. Graduated to feet and inches, but readings published to feet and hundredths. Datum has not been changed since establishment.

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.

Regulation.—The power plants of the Chippewa Lumber & Boom Co., about 2,500 feet above the gage, and the holding and releasing of water for logging, modify the normal flow markedly at times.

Accuracy.—The accuracy is affected to a greater or less extent by the operation of the lumber boom 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 is checked by additional measurements.

Daily gage height, in feet, of Chippewa River at Chippewa Falls, Wis., for 1911.

[H. P. Farvell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.7	0.9	0.7	2.4	1.9	1.8	0.5	.....	.....	1.07	2.01	.....
2	.7	.8	.7	2.3	1.9	2.2	.4	.....	.....	1.08	1.54	1.7
3	.7	.7	.7	2.1	1.9	2.2	.4	.....	.....	2.04	1.06	.....
4	.7	.7	.7	2.0	2.0	2.2	.6	.....	.....	3.06	1.05	.....
5	.7	.75	.7	1.8	2.0	2.6	.8	.....	.....	3.07	1.04	.....
6	.7	.85	.7	1.8	1.9	4.0	.7	.....	.....	7.54	1.06	.....
7	.7	.9	.75	1.7	1.9	4.1	.7	.....	.....	10.55	1.07	.....
8	.7	.8	.8	1.7	1.9	2.8	.7	.....	.....	10.54	1.06	.....
9	.7	.8	.8	1.7	1.4	2.5	.8	.....	.....	8.52	1.08	1.6
10	.7	.7	.9	1.6	1.5	2.4	1.0	.....	.....	6.54	1.08	.....
11	.7	.7	1.0	1.8	2.0	1.8	1.0	.....	.....	5.52	1.08	.....
12	.7	.7	1.35	1.2	1.7	1.8	1.0	.....	.....	4.06	1.08	.....
13	.7	.7	1.5	2.7	1.3	1.3	.8	.....	.....	3.08	1.08	.....
14	.7	.7	1.35	3.5	1.3	1.2	.8	.....	.....	3.08	1.04	.....
15	.7	.7	1.4	2.4	1.7	1.6	.5	.....	.....	3.01	1.04	.....
16	.7	.7	1.6	3.0	1.9	1.3	.3	.....	.....	3.51	1.04	3.6
17	.7	.7	1.7	2.8	1.9	1.2	.4	.....	.....	6.02	.....	.....
18	.7	.7	1.7	2.6	1.9	1.1	.3	.....	.....	6.57	.....	.....
19	.7	.8	1.7	2.5	1.9	1.1	.3	.....	.....	7.06	.....	.....
20	.7	.8	1.6	2.6	2.0	.9	.4	.....	.....	6.06	.....	.....
21	.7	.8	1.55	3.4	3.1	.8	.4	.....	.....	5.54	.....	.....
22	.7	.8	1.6	2.8	4.2	.8	.4	.....	.....	5.02	.....	.....
23	.7	.8	1.65	2.7	4.0	.7	.3	.....	.....	4.06	.....	2.6
24	.7	.8	1.85	2.8	4.5	.7	.4	.....	.....	4.00	.....	.....
25	.7	.8	2.05	2.6	4.5	.7	.4	.....	.....	3.54	1.6	.....
26	.7	.7	2.1	2.3	3.8	.7	.5	.....	.....	3.06	.....	.....
27	.7	.7	2.1	2.4	3.0	.7	.5	.....	.....	3.05	.....	.....
28	.7	.7	2.0	2.1	2.8	.6	.5	.....	.....	3.02	.....	.....
29	1.0	.....	2.75	1.8	2.5	.6	.6	.....	.....	2.08	.....	.....
30	1.0	.....	2.7	1.9	2.1	.5	.3	.....	.....	2.04	.....	2.5
31	1.0	.....	2.8	.....	1.8	.....	.5	.....	.....	2.02	.....	.....

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 1 to Mar. 15, Nov. 9 to Dec. 14, and Dec. 25 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, 1911.

Gage.—Staff fastened to bridge pier; datum unchanged since establishment.

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.

Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for 1911.

[Olaf Oas, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.0	2.2	2.5	2.4	2.4	2.3	2.2	1.9	2.2	2.8	2.6
2	2.0	2.0	2.3	2.5	2.4	2.5	2.0	2.2	1.9	2.3	2.8	2.6
3	2.0	2.0	2.3	2.5	2.4	2.6	2.3	2.2	1.7	2.4	2.8	2.6
4	2.0	2.0	2.4	2.4	2.3	2.5	2.4	2.3	2.1	2.55	2.8	2.6
5	2.0	2.0	2.5	2.4	2.3	2.7	2.35	2.3	2.1	2.8	2.8	2.6
6	2.0	2.0	2.4	2.3	2.2	2.7	2.3	2.0	2.0	3.9	2.8	2.6
7	2.0	2.0	2.4	2.3	1.9	2.7	2.2	2.2	2.0	5.35	2.8	2.6
8	2.0	2.0	2.4	2.3	2.2	2.6	2.1	2.2	2.1	5.4	2.7	2.6
9	2.0	2.0	2.4	2.2	2.1	2.6	2.0	2.1	2.2	4.15	2.7	2.6
10	2.0	2.0	2.1	2.2	2.2	2.5	2.3	2.1	2.2	3.7	2.7	2.6
11	2.0	2.0	1.8	2.2	2.1	2.3	2.2	2.1	2.2	3.35	2.6	2.6
12	2.0	2.05	2.4	2.2	2.1	2.6	2.1	2.1	2.2	3.15	2.75	2.65
13	2.0	2.25	2.8	2.2	2.1	2.55	2.1	1.9	2.2	3.0	2.85	2.7
14	2.0	2.55	2.85	2.3	1.9	2.5	2.0	2.1	2.2	3.0	2.8	2.7
15	2.0	2.45	2.75	2.3	2.25	2.4	2.0	2.1	2.1	2.7	2.8	2.7
16	2.0	2.3	2.6	2.0	2.4	2.25	1.8	2.0	2.1	3.5	2.7	2.7
17	2.0	2.3	2.65	2.6	2.4	2.0	2.1	2.0	1.9	3.6	2.7	2.7
18	2.0	2.3	2.7	2.5	2.4	1.7	2.0	2.0	2.2	4.5	2.6	2.7
19	2.0	2.2	2.8	2.4	2.4	2.0	2.0	2.0	2.2	4.75	2.6	2.6
20	2.0	2.2	2.75	2.3	2.4	2.0	2.0	1.9	2.15	4.55	2.6	2.6
21	2.0	2.1	2.7	2.3	2.1	2.0	2.0	2.1	2.1	4.25	2.6	2.6
22	1.6	2.1	2.6	2.2	2.45	2.0	2.0	2.0	2.0	4.0	2.5	2.5
23	1.6	2.1	2.5	2.1	2.55	2.1	1.9	2.0	2.0	3.95	2.5	2.5
24	1.75	2.1	2.5	2.4	2.7	2.1	2.1	2.0	2.0	3.8	2.5	2.5
25	1.85	2.1	2.5	2.3	2.55	1.7	2.0	2.0	2.0	3.8	2.5	2.5
26	1.95	2.1	2.5	2.3	2.45	2.0	2.0	2.0	2.0	3.65	2.5	2.5
27	2.0	2.1	2.5	2.3	2.3	2.2	2.0	1.8	2.0	3.45	2.5	2.5
28	2.0	2.1	2.6	2.3	2.0	2.2	2.1	2.1	2.1	3.25	2.5	2.5
29	1.7	.....	2.5	2.3	2.4	2.2	2.05	2.1	2.2	3.1	2.5	2.5
30	1.9	.....	2.5	2.0	2.35	2.3	1.9	2.0	2.3	3.05	2.5	2.5
31	1.9	.....	2.5	.....	2.3	.....	2.2	2.0	.....	3.0	.....	2.5

ZUMBRO RIVER AT ZUMBRO FALLS, MINN.

Location.—At the highway bridge at Zumbro Falls, about 8 miles below the mouth of South Branch.

Records available.—June 8, 1909, to December 31, 1911.

Drainage area.—1,120 square miles.

Gage.—Chain, attached to bridge; datum unchanged since established.

Channel.—Slightly shifting.

Discharge measurements.—Made from the bridge.

Winter flow.—Owing to the presence of rapids a short distance above the station and also of springs, open water is practically continuous throughout the winter from the rapids for a distance of several miles downstream. For this reason the daily gage readings are maintained during the winter months. (See fig. 2, p. 124; also fig. 1, p. 119.)

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.

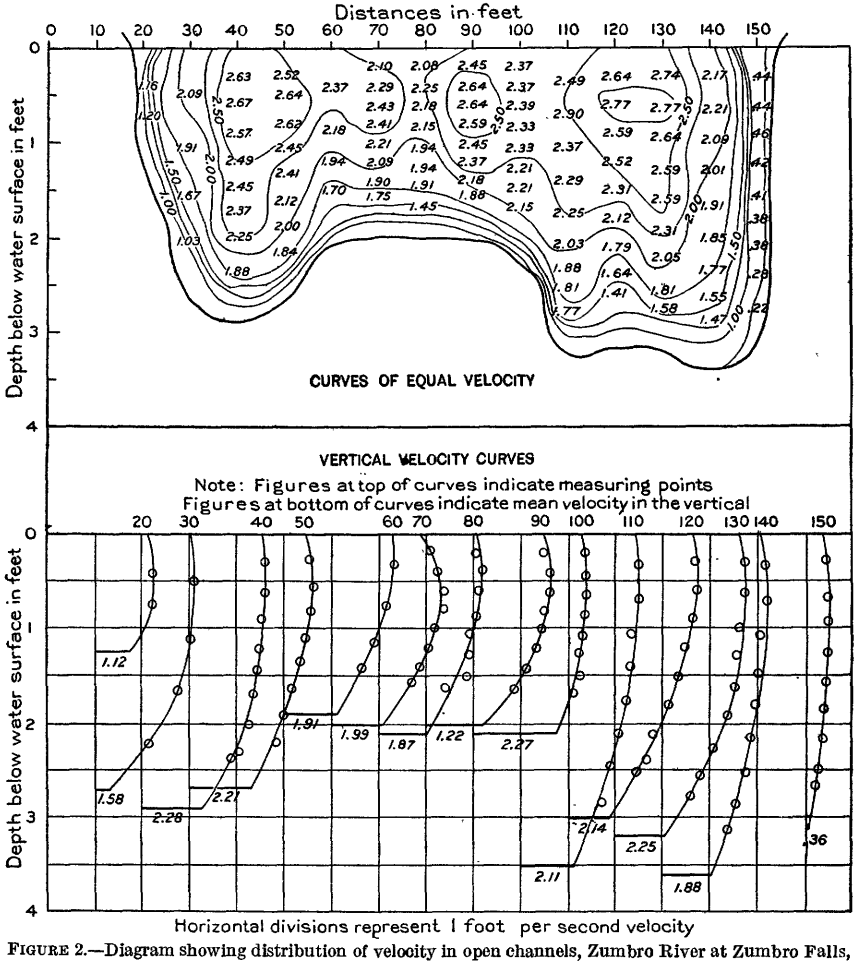

FIGURE 2.—Diagram showing distribution of velocity in open channels, Zumbro River at Zumbro Falls, Minn.

Regulation.—The nearest dam is at Jarretts, but on account of the fall in the river the station is above its influence. The effect of the dams above Zumbro Falls is not felt at the gaging station.

Discharge measurements of Zumbro River at Zumbro Falls, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 29	C. R. Adams	5.26	211
June 17	S. B. Soulé	5.18	191
Oct. 6	Robert Follansbee	9.48	2,260
7	do	10.57	3,250
Dec. 5[a]	W. G. Hoyt	5.26	247
14[a]	C. J. Emerson	7.02	964
14[a]	do	6.99	932

[a] Open, no backwater.

Daily gage height, in feet, of Zumbro River at Zumbro Falls, Minn., for 1911.

[A. H. Sugg, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.98	4.97	5.57	5.30	5.20	5.24	4.94	4.80	5.10	5.06	6.09	5.44
2	5.00	5.01	5.57	5.29	5.21	5.34	4.88	4.81	5.09	4.99	6.01	5.39
3	.....	4.95	5.54	5.29	5.20	5.29	4.84	4.88	5.04	5.15	5.91	5.30
4	.....	4.97	5.49	5.26	5.20	5.60	4.86	4.85	5.10	5.15	5.86	5.21
5	.....	4.93	5.45	5.26	5.14	5.51	4.85	4.82	5.15	5.38	5.85	5.28
6	5.04	4.87	5.45	5.26	5.10	5.48	4.86	4.95	5.09	9.42	5.82	5.32
7	5.14	4.97	5.45	5.22	5.09	5.30	4.84	5.12	5.05	10.51	5.90	5.32
8	5.10	4.95	5.45	5.26	5.10	5.29	4.84	5.46	5.05	8.76	6.12	5.31
9	5.08	4.95	5.49	5.22	5.09	5.21	4.84	5.22	5.02	7.65	6.10	5.32
10	5.06	4.96	5.56	5.22	5.06	5.20	4.82	5.25	4.98	7.01	6.00	7.25
11	5.04	4.95	5.59	5.24	5.08	5.20	4.82	5.20	4.94	6.62	5.95	11.32
12	5.04	4.96	5.57	5.35	5.06	5.19	4.82	5.16	5.00	6.35	5.78	8.82
13	5.02	5.07	5.56	5.38	5.00	5.10	4.83	5.34	5.00	6.15	5.58	7.55
14	5.03	7.92	5.54	5.38	5.04	5.09	4.80	8.60	4.99	6.20	5.69	7.01
15	5.02	9.55	5.54	5.40	5.28	5.09	4.80	8.38	4.96	6.22	5.58	6.69
16	4.99	8.15	5.40	5.40	5.16	5.19	4.80	7.19	4.94	10.83	5.51	6.35
17	5.00	8.60	5.44	5.35	5.09	5.22	4.78	6.54	4.94	15.93	7.29	6.09
18	5.02	8.00	5.35	5.35	5.10	5.30	.....	6.24	5.16	13.03	7.90	5.89
19	5.00	6.85	5.35	5.35	5.52	5.22	4.85	5.90	5.02	10.92	.....	5.81
20	5.02	6.15	5.37	5.32	5.62	5.15	4.82	5.72	5.09	9.21	7.16	5.80
21	5.06	6.10	5.40	5.30	5.72	5.10	4.80	5.61	5.04	8.20	6.38	5.82
22	4.99	5.83	5.36	5.30	6.65	5.06	4.80	5.50	5.01	7.42	6.05	5.72
23	4.99	5.75	5.35	5.25	6.59	5.06	4.80	5.48	5.02	7.12	5.55	5.66
24	4.98	5.77	5.35	5.21	6.20	5.06	4.80	5.39	5.00	6.88	5.14	5.55
25	4.98	5.79	5.35	5.20	5.88	5.04	4.80	5.30	4.96	6.85	5.45	5.50
26	4.99	5.80	5.34	5.19	5.69	5.04	4.80	5.29	4.99	7.24	5.45	5.38
27	5.03	5.70	5.34	5.12	5.58	5.04	4.80	5.22	4.98	7.05	5.48	5.06
28	5.00	5.60	5.34	5.15	5.46	5.04	4.86	5.16	5.00	6.75	5.19	5.11
29	5.03	.....	5.32	5.18	5.35	5.02	4.80	5.14	4.99	6.54	5.04	5.39
30	5.07	.....	5.34	5.18	5.32	5.02	4.80	5.12	5.04	6.40	5.24	5.41
31	4.99	.....	5.29	.....	5.30	.....	4.79	5.15	.....	6.22	.....	5.41

NOTE.—Relation of gage height to discharge affected by ice about Nov. 17 to 23 and Dec. 29 to 31.

Daily discharge, in second-feet, of Zumbro River at Zumbro Falls, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	146	144	287	210	187	196	139	116	167	158	520	296
2	149	151	287	208	189	220	129	118	165	147	480	282
3	150	140	278	208	187	208	122	129	156	177	442	256
4	151	144	262	201	187	297	126	124	167	177	424	232
5	154	137	250	201	175	268	124	119	177	236	424	256
6	156	127	250	201	167	259	126	140	165	2,250	406	256
7	175	144	250	192	165	210	122	171	158	3,190	442	256
8	167	140	250	201	167	208	122	253	158	1,960	520	256
9	163	140	262	192	165	189	122	192	153	1,280	520	256
10	160	142	284	192	160	187	119	198	146	938	480	1,070
11	156	140	294	196	163	187	119	187	139	738	461	3,840
12	156	142	287	223	160	185	119	179	149	624	406	1,990
13	153	162	284	231	149	167	121	220	149	540	340	1,230
14	154	1,340	278	231	156	165	116	1,730	147	560	372	938
15	153	2,360	278	236	205	165	116	1,600	142	560	340	788
16	147	1,460	236	236	179	185	116	951	139	3,440	310	624
17	149	1,730	248	223	165	192	113	657	139	8,340	300	520
18	153	1,380	223	223	167	210	118	535	179	5,290	280	442
19	149	792	223	223	271	192	124	404	153	3,520	260	406
20	153	500	228	215	304	177	119	338	165	2,250	250	406
21	160	480	236	210	338	167	116	300	156	1,610	240	406
22	147	373	226	210	704	160	116	265	151	1,150	260	372
23	147	349	223	199	678	160	116	259	153	990	230	356
24	146	356	223	189	519	160	116	233	149	888	221	325
25	146	363	223	187	397	156	116	210	142	863	296	310
26	147	367	220	185	328	156	116	208	147	1,040	296	297
27	154	331	220	171	291	156	116	192	146	964	310	202
28	149	297	220	177	253	156	126	179	149	811	232	212
29	154	.....	215	183	223	153	116	175	147	714	200	240
30	162	.....	220	183	215	153	116	171	156	646	244	230
31	147	.....	208	.....	210	.....	114	177	.....	560	.....	230

NOTE.—Daily discharge computed from two rating curves fairly well defined below 4,000 second-feet. Daily discharge Nov. 17 to 23 and Dec. 29 to 31, estimated, because of ice, from observer's notes climatologic records, and the flow of the South Branch.

Monthly discharge of Zumbro River at Zumbro Falls, Minn., for 1911.

[Drainage area, 1,120 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	175	146	153	0.137	0.16	B.
February	2,360	127	512	.457	.48	B.
March	294	208	248	.221	.25	A.
April	236	171	205	.183	.20	A.
May	704	149	252	.225	.26	A.
June	297	153	188	.168	.19	A.
July	139	113	120	.107	.12	A.
August	1,730	116	346	.309	.36	A.
September	177	139	154	.138	.15	A.
October	8,340	147	1,500	1.34	1.54	B.
November	520	200	350	.312	.35	A.
December	3,840	202	573	.512	.59	B.
The year	8,340	113	384	.343	4.65	

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, 1911.

Drainage area.—821 square miles.

Gage.—Chain, attached to bridge.

Channel.—Apparently permanent, data too incomplete to be conclusive. Between the station and the mouth of the river there is a fall of several feet which prevents backwater from the North Branch reaching the station.

Discharge measurements.—Made from the highway bridge.

Winter flow.—From December to March the river is frozen over; measurements are made to determine the winter discharge.

Discharge measurements of South Branch of Zumbro River near Zumbro Falls, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 25	Robert Follansbee	2.44	291
June 16	S. B. Soulé	2.04	120
July 19	....do	1.91	84.5
Oct. 7	Robert Follansbee	6.06	2,590
8	....do	4.82	1,490
Dec. 5[a]	W. G. Hoyt	2.14	184

[a] No ice in river in vicinity of gage.

Daily gage height, in feet, South Branch of Zumbro River near Zumbro Falls, Minn., for 1911.

[Wallace M. Whipple, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.98	1.88	1.98	1.94	2.82	2.18
2	.....	1.95	1.85	1.97	1.93	2.80	2.22
3	.....	1.90	1.83	1.94	2.03	2.75	2.18
4	.....	1.94	1.83	1.97	2.03	2.70	2.15
5	.....	1.94	1.83	2.02	1.99	2.65	2.14
6	.....	1.88	1.94	1.99	3.62	2.69	2.12
7	.....	1.89	1.91	1.98	5.83	2.73	2.14
8	.....	1.88	1.94	1.98	4.70	2.74	2.15
9	.....	1.90	1.94	1.93	3.75	2.75	2.19
10	.....	1.88	2.05	1.93	3.20	2.68	4.00
11	.....	1.82	2.05	1.91	2.93	2.59	6.88
12	.....	1.88	2.04	1.93	2.80	2.52	4.95
13	.....	1.91	2.07	1.91	2.59	2.45	4.00
14	.....	1.82	4.69	1.92	2.55	2.45	3.49
15	.....	1.90	4.44	1.93	2.58	2.45	3.45
16	2.05	1.92	3.49	1.93	5.23	2.34	2.90
17	2.09	1.89	2.97	1.91	10.91	2.34	2.72
18	2.11	1.89	2.64	1.97	7.79	2.33	2.60
19	2.06	1.88	2.43	1.91	6.24	2.25	2.59
20	2.04	1.86	2.30	1.97	5.39	2.20	2.51
21	2.02	1.85	2.24	1.97	4.58	2.19	2.46
22	1.99	1.85	2.18	1.97	4.04	2.22	2.39
23	2.01	1.85	2.19	1.95	3.76	2.23	2.34
24	2.00	1.86	2.09	1.95	3.52	2.23	2.26
25	2.00	1.86	2.09	1.92	3.46	2.20	2.25
26	1.95	1.82	1.98	1.93	3.66	2.20	2.18
27	1.92	1.84	2.02	1.91	3.59	2.13	2.08
28	1.96	1.88	1.99	1.90	3.39	2.00	2.22
29	2.01	1.87	2.02	1.90	3.15	2.08	2.25
30	1.98	1.87	1.98	1.90	3.02	2.20	2.25
31	.....	1.87	1.99	.....	2.90	.....	2.28

NOTE.—Ice present along shore during latter part of December.

Daily discharge, in second-feet, South Branch of Zumbro River near Zumbro Falls, Minn., for 1911.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	108	80	108	97	427	174	16	130	91	745	94	1,820	233	461
2	.....	100	72	105	94	418	188	17	143	82	492	88	6,820	233	384
3	.....	85	68	97	124	397	174	18	150	82	351	105	3,980	229	335
4	.....	97	68	105	124	376	164	19	133	80	268	88	2,660	200	331
5	.....	97	68	120	111	356	160	20	127	75	218	105	1,950	181	299
6	.....	80	97	111	814	372	153	21	120	72	196	105	1,380	178	279
7	.....	82	88	108	2,310	389	160	22	111	72	174	105	1,050	188	252
8	.....	80	97	108	1,450	393	164	23	117	72	178	100	890	192	233
9	.....	85	97	94	884	397	178	24	114	75	143	100	761	192	202
10	.....	80	130	94	598	368	1,020	25	114	75	143	91	729	181	200
11	.....	65	130	88	474	331	2,860	26	100	65	108	94	835	181	174
12	.....	80	127	94	418	303	1,620	27	91	70	120	88	798	156	140
13	.....	88	136	88	331	276	1,020	28	102	80	111	85	693	114	175
14	.....	65	1,450	91	315	276	745	29	117	78	120	85	574	140	165
15	.....	85	1,290	94	327	276	724	30	108	78	108	85	514	181	165
								31	.....	78	111	.....	461	.....	160

NOTE.—Daily discharge computed from a rating curve well defined below 2,900 second-feet. Daily discharge Dec. 28 to 31 estimated, because of ice, from daily gage heights and climatologic records. Data collected during 1912, before the publication of this report, indicate that the maximum discharge in the above table (6,820 second-feet on Oct. 17) may be about 10 per cent too low, but the data are not such as to warrant a revision of the computations at this time.

Monthly discharge of South Branch of Zumbro River near Zumbro Falls, Minn., for 1911.

[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.		
June 16-30	150	91	118	0.144	0.08	B.
July	108	65	80.7	.098	.11	A.
August	1,450	68	245	.298	.34	A.
September	120	85	97.4	.119	.13	A.
October	6,820	94	1,110	1.35	1.56	B.
November	427	114	271	.330	.37	A.
December	2,860	140	434	.529	.61	B.

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 an insignificant stream, but during heavy rains overflowing its banks badly and flooding considerable area.

Records available.—May 28, 1909, to December 31, 1911.

Drainage area.—1,560 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Shifting, scouring out during floods, and gradually filling in afterwards; nearly permanent at low stages.

Discharge measurements.—Made from the bridge.

Winter flow.—From December to March discharge measurements are made through the ice to determine the approximate winter flow.

Regulation.—There is no dam below the station, and the 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 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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Jan. 14	C. J. Emerson	2.25	[a] 310
Mar. 30	C. R. Adams	1.41	352
May 26	Robert Follansbee	1.97	544
Aug. 11	S. B. Soulé	1.55	455
17	....do	4.64	[b] 1,790
18	....do	3.85	[b] 1,260
19	....do	3.32	[b] 1,050
Sept. 22	....do	1.59	498
Oct. 19	C. J. Emerson	5.97	2,690
20	....do	5.07	2,130
Dec. 13	....do	4.14	1,580

[a] Measurement made under ice cover.
[b] River bottom scoured out from 7 to 8 feet deeper by flood since Aug. 11.

Daily gage height, in feet, of Root River near Houston, Minn., for 1911.

[Olaf Larson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	2.00	1.35	1.50	1.50	1.02	1.02	1.60	1.55	2.21	.....
2	.....	.....	2.05	1.25	1.60	1.45	1.00	.99	1.55	1.34	2.16	.....
3	1.90	.....	2.00	1.35	1.44	1.45	.90	.90	1.48	2.29	2.06	.....
4	.....	2.30	1.75	1.30	1.36	1.75	.91	1.02	1.45	3.26	1.99	.....
5	.....	.....	1.65	1.45	1.35	1.66	1.06	1.08	1.42	3.05	1.95	.....
6	.....	.....	1.65	1.42	1.31	1.65	.95	1.30	1.46	3.91	2.00	.....
7	2.00	2.30	1.65	1.36	1.30	1.52	.90	2.06	1.41	6.25	2.05	.....
8	.....	.....	1.55	1.35	1.28	1.40	.90	2.59	1.40	c6.53	2.15	.....
9	.....	.....	1.60	1.31	1.28	1.39	.91	1.71	1.36	4.28	2.20	.....
10	2.20	2.30	1.60	1.36	1.26	1.32	.91	1.56	1.34	3.45	2.21	3.95
11	.....	.....	1.65	1.32	1.25	1.28	.84	1.50	1.30	3.00	2.15	8.15
12	.....	.....	1.60	1.35	1.16	1.25	.85	1.45	1.28	2.70	2.05	5.95
13	2.20	2.60	1.55	1.42	1.14	1.25	.85	5.36	1.25	2.50	1.62	4.02
14	2.25	.....	1.55	1.45	1.22	1.25	.82	b9.95	1.18	2.40	1.61	3.18
15	.....	a9.00	1.40	1.49	1.36	1.15	.92	9.55	1.15	2.34	1.84	2.82
16	2.10	6.55	1.40	1.45	1.24	1.20	.90	6.25	1.11	3.52	1.68	2.55
17	.....	6.00	1.40	1.42	1.22	1.30	.80	4.45	1.11	6.80	1.81	2.32
18	.....	6.35	1.40	1.40	1.18	1.25	.85	3.72	3.58	d9.10	1.76	2.10
19	.....	4.30	1.35	1.42	1.15	1.20	.89	3.28	2.71	6.56	3.49	1.80
20	2.20	3.25	1.45	1.39	1.30	1.18	.90	2.91	1.94	4.94	.....	1.80
21	.....	2.75	1.45	1.40	1.44	1.15	.90	2.69	1.74	4.24	.....	1.98
22	.....	2.55	1.40	1.36	3.64	1.08	.82	2.92	1.56	3.75	.....	2.00
23	.....	2.55	1.35	1.32	2.69	1.04	.89	2.80	1.45	3.39	.....	1.90
24	.....	2.60	1.35	1.35	2.44	1.09	.85	2.40	1.40	3.09	.....	1.80
25	2.10	2.40	1.35	1.35	2.14	1.05	.89	2.21	1.34	2.98	.....	1.70
26	.....	2.30	1.35	1.25	1.90	1.05	.85	2.08	1.29	2.80	.....	1.60
27	.....	2.35	1.50	1.25	1.80	1.01	.86	1.94	1.20	2.76	.....	.....
28	2.30	1.95	1.45	1.29	1.68	1.05	.88	1.82	1.21	2.62	.....	.....
29	.....	.....	1.45	1.28	1.58	1.00	.91	1.80	1.26	2.52	.....	.....
30	.....	.....	1.45	1.25	1.44	1.00	.94	1.65	1.29	2.40	.....	.....
31	2.30	.....	1.35	.....	1.41	.....	.82	1.65	.....	2.31	.....	.....

a Maximum stage, 9 feet.
b Maximum stage, 10.8 feet.
c Maximum stage, 6.9 feet.
d Maximum stage, 9.4 feet.

NOTE.—Ice present Jan. 1 to Feb. 14 and Nov. 19 to Dec. 31. Average thickness of ice, 1 foot.

Daily discharge, in second-feet, of Root River near Houston, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	550	347	407	430	314	314	492	479	666
2	.....	.....	570	320	447	418	309	307	479	425	651
3	.....	.....	550	347	389	418	287	287	461	690	621
4	.....	.....	458	332	365	496	289	314	453	1,040	601
5	.....	.....	422	377	362	472	323	327	445	957	590
6	.....	.....	422	368	350	469	298	380	456	1,360	604
7	.....	.....	422	350	347	435	287	585	443	2,980	618
8	.....	.....	390	347	342	405	287	772	440	3,240	648
9	.....	.....	405	335	342	402	289	485	430	1,560	663
10	.....	.....	405	350	337	385	289	446	425	1,130	666
11	.....	.....	422	338	335	375	275	430	415	937	648
12	.....	.....	405	347	313	368	277	418	410	824	618
13	.....	.....	390	368	310	368	277	2,240	403	756	497
14	310	.....	390	377	328	368	271	7,280	386	724	.....
15	.....	4,000	345	389	365	344	291	6,780	380	705	.....
16	.....	3,090	345	377	333	356	287	2,980	370	1,160	.....
17	.....	2,680	345	368	328	380	267	1,660	370	3,510	.....
18	.....	1,570	345	370	318	368	277	1,260	1,190	6,220	.....
19	.....	1,500	330	383	312	356	285	1,050	828	3,270	.....
20	.....	1,010	360	374	347	351	287	902	587	1,960	.....
21	.....	750	360	377	389	344	287	820	530	1,540	.....
22	.....	685	345	365	1,200	327	271	906	482	1,280	.....
23	.....	685	330	353	809	318	285	860	453	1,100	.....
24	.....	700	330	362	717	330	277	724	440	973	.....
25	.....	648	330	362	612	320	285	666	425	929	.....

Daily discharge, in second-feet, of Root River near Houston, Minn., for 1911—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	.....	612	330	335	537	320	277	627	413	860	.....
27	.....	620	375	335	509	311	279	587	391	846	.....
28	.....	530	360	345	477	320	283	553	393	796	.....
29	.....	.....	360	342	451	309	289	547	405	763	.....
30	.....	.....	360	335	415	309	296	506	413	724	.....
31	.....	.....	340	.....	408	.....	271	506	.....	696	.....

NOTE.—Daily discharge computed from two rating curves fairly well defined below 3,600 second-feet, one of which was applied indirectly prior to May 22. Discharge estimated Jan. 1 to Feb. 14 and Nov. 14 to Dec. 31, because of ice, from two discharge measurements, observer's notes, climatologic records, and comparison with flow of the North Branch near Lanesboro, Minn. Mean discharge Feb. 1 to 14 estimated 320 second-feet, varying from about 300 to 500 second-feet. Mean discharge Nov. 14 to 30, estimated 468 second-feet, varying from about 450 to 495 second-feet. Mean discharge Dec. 1 to 31 estimated 875 second-feet, varying from about 400 to 4,700 second-feet.

Monthly discharge of Root River near Houston, Minn., for 1911.

[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	.....	.....	[a]310	0.199	0.23	C.
February	4,000	.....	841	.539	.56	C.
March	570	330	390	.250	.29	B.
April	389	320	356	.228	.25	B.
May	1,200	310	436	.279	.32	B.
June	496	309	372	.238	.27	B.
July	323	267	286	.183	.21	B.
August	7,280	287	1,180	.756	.87	B.
September	1,190	370	474	.304	.34	A.
October	6,220	425	1,430	.917	1.06	B.
November	666	.....	535	.343	.38	C.
December	.....	.....	[a]875	.561	.65	C.
The year	7,280	.....	624	.400	5.43	

[a] Estimated.

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.—Gage heights and discharge measurements from January 30, 1910, to December 31, 1911.

Drainage area.—647 square miles.

Gage.—Chain; datum unchanged since established.

Channel.—Probably permanent. As there is more than 10 feet fall between the station and the mouth of the South Branch, there is no danger of backwater from that stream. 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 commences 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 about March the river is frozen over; measurements are made to determine the winter discharge.

Discharge measurements of North Branch of Root River near Lanesboro, Minn., in 1910–11.

Date.	Hydrographer.	Gage height.	Discharge.
1910.		*Feet.*	*Sec.-feet.*
Apr. 29	G. A. Gray	2.28	191
June 24	Robert Follansbee	2.09	134
Sept. 2	.....do	2.09	137
1911.			
Mar. 31	C. R. Adams	1.96	90.2
May 26	Robert Follansbee	2.32	217
Aug. 17	S. B. Soulé	3.04	550
Oct. 18[a]	C. J. Emerson	5.87	3,230
18[b]	.....do	5.11	2,400
19	.....do	4.30	1,520
Dec. 12	.....do	3.84	1,070

[a] Morning. [b] Afternoon.

Daily gage height, in feet, of North Branch of Root River near Lanesboro, Minn., for 1911.

[Kresten E. Hoium, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.31	2.02	2.04	2.08	1.85	2.05	2.14	2.20	2.60	2.39
2	.....	2.32	2.02	2.12	2.12	1.85	1.90	2.14	2.34	2.54	2.38
3	.....	2.30	2.00	2.10	2.18	1.85	1.94	2.14	3.15	2.50	2.32
4	.....	2.31	1.98	2.05	2.32	1.85	2.05	2.14	3.45	2.45	2.25
5	.....	2.32	1.98	2.08	2.40	1.90	2.02	2.18	3.35	2.45	2.22
6	.....	2.35	1.98	2.08	2.30	1.88	2.05	2.18	5.52	2.49	2.28
7	.....	2.32	2.02	2.05	2.18	1.85	2.95	2.16	6.40	2.62	2.30
8	.....	2.32	1.98	2.05	2.20	1.89	2.29	2.19	4.45	2.70	2.28
9	.....	2.32	1.98	2.02	2.12	1.84	2.28	2.15	3.55	2.70	2.32
10	.....	2.35	2.22	2.02	2.12	1.84	2.14	2.10	3.15	2.70	5.08
11	.....	2.35	2.25	2.00	2.08	1.95	2.10	2.08	2.98	2.68	5.80
12	.....	2.32	2.25	1.98	2.02	1.80	2.06	2.08	2.80	2.60	4.20
13	.....	2.35	2.18	1.98	2.02	1.84	10.30	2.08	2.75	2.21	3.30
14	.....	2.32	2.16	2.02	1.98	1.71	9.80	2.08	2.70	2.30	2.85
15	.....	2.36	2.18	1.98	1.98	1.86	4.98	2.10	2.70	2.50	2.72
16	.....	2.34	2.12	1.92	2.02	1.86	3.65	2.05	4.00	2.48	2.64
17	.....	2.34	2.12	1.98	2.12	1.80	3.31	2.05	6.74	2.65	2.32
18	.....	2.31	2.12	1.98	2.05	1.82	2.86	3.45	5.65	2.50	2.55
19	2.86	2.30	2.12	1.92	2.09	1.86	2.68	2.61	4.25	2.45	2.45
20	2.80	2.32	2.08	1.98	2.08	1.82	2.58	2.32	3.72	2.48	2.50
21	2.74	2.31	2.08	3.48	1.98	1.81	2.50	2.30	3.39	2.30	2.42
22	2.69	2.30	2.08	3.25	1.91	1.80	6.02	2.25	3.18	2.32	2.35
23	2.62	2.28	2.05	2.95	1.90	1.81	2.52	2.22	3.00	2.50	2.35
24	2.56	2.28	2.02	2.60	1.95	1.82	2.40	2.26	2.90	2.32	2.35
25	2.54	2.30	1.95	2.35	1.92	1.82	2.35	2.21	2.90	2.38	2.38
26	2.50	2.32	1.95	2.32	1.98	1.80	2.32	2.12	2.80	2.38	2.42
27	2.46	2.38	2.02	2.25	1.90	1.81	2.25	2.09	2.78	2.32	2.42
28	2.44	2.45	2.02	2.20	1.89	1.85	2.32	2.10	2.76	2.32	2.48
29	.....	2.48	2.02	2.18	1.92	1.82	2.22	2.28	2.70	2.35	2.52
30	.....	2.40	2.05	2.12	1.88	1.80	2.22	2.20	2.64	2.38	2.54
31	.....	2.32	.....	2.08	.....	1.82	2.14	.....	2.60	.....	2.59

NOTE.—Gage record, Mar. 4 to 31, 1911, is questionable. It was found on Mar. 31 that the observer was reading the gage 0.3 foot high. Gage heights above are as reported by the observer. Relation of gage height to discharge affected by ice about Jan. 30 to Mar. 8, 1910, and about Dec. 27 to 31, 1911. May 21, maximum, 4.3 feet at 10 a. m. Oct. 17, maximum, 7.2 feet at 12 noon.

Daily discharge, in second-feet, of North Branch of Root River near Lanesboro, Minn., for 1910–11.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.									
1	.....	924	167	196	134	128	199	189	160
2	.....	924	167	185	134	134	189	181	160
3	.....	850	203	185	141	134	171	167	164
4	.....	850	203	196	137	141	171	154	164
5	.....	779	167	185	137	141	1,040	147	160
6	.....	711	185	174	137	141	476	141	164
7	.....	711	203	174	141	150	306	137	154
8	.....	647	167	171	134	160	276	134	154
9	2,040	587	203	181	134	171	234	134	164
10	1,940	587	203	185	134	185	181	131	164
11	1,940	587	203	174	134	185	171	131	160
12	1,080	647	167	171	141	167	167	122	154
13	1,940	647	167	167	137	167	171	122	171
14	1,940	647	185	160	134	203	181	128	171
15	1,830	647	167	154	134	181	185	131	171
16	1,620	647	203	150	137	189	181	128	164
17	1,080	587	242	141	141	199	181	128	164
18	1,080	587	242	141	137	203	171	141	167
19	1,000	587	242	134	134	211	171	141	171
20	924	530	242	141	141	203	181	141	174
21	924	530	242	137	141	196	185	141	181
22	924	530	284	150	141	196	189	150	196
23	425	587	284	150	141	203	181	154	196
24	425	530	250	150	134	189	174	154	174
25	376	425	263	150	134	185	181	160	174
26	376	425	242	150	134	174	185	160	167
27	425	376	234	150	128	167	189	150	167
28	425	376	222	147	122	167	196	150	160
29	476	329	219	137	119	196	189	160	160
30	476	284	203	134	119	203	189	150	160
31	425	.....	199	.....	119	203	.....	160	.....

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1911.											
1	.....	203	110	116	128	66	119	147	167	329	238
2	.....	195	110	141	141	66	77	147	219	302	235
3	.....	185	104	134	160	66	88	147	617	284	210
4	.....	175	99	119	211	66	119	147	814	263	185
5	.....	170	99	128	242	77	110	160	745	263	175
6	.....	165	99	128	203	72	119	160	2,840	280	196
7	.....	162	110	119	160	66	503	154	3,890	338	203
8	.....	159	99	119	167	75	199	164	1,670	376	196
9	.....	156	99	110	141	63	196	150	887	376	210
10	.....	153	174	110	141	63	147	134	617	376	2,350
11	.....	150	185	104	128	90	134	128	519	367	3,160
12	.....	147	185	99	110	54	122	128	425	329	1,430
13	.....	144	160	99	110	63	9,380	128	400	171	711
14	.....	141	160	110	99	38	8,660	128	376	203	450
15	.....	138	160	99	99	68	2,240	134	376	284	385
16	.....	135	141	82	110	68	962	119	1,250	276	348
17	.....	132	141	99	141	54	718	119	4,320	352	210
18	.....	129	141	99	119	59	456	814	2,990	284	306
19	456	126	141	82	131	68	367	334	1,480	263	263
20	425	123	128	99	128	59	320	211	1,020	276	284
21	396	120	128	834	99	56	284	203	772	203	250
22	371	117	128	679	80	54	3,430	185	635	210	222
23	338	114	119	503	77	56	293	174	530	284	222
24	311	111	110	329	90	59	242	189	476	210	222
25	302	108	90	222	82	59	222	171	476	235	234
26	284	105	90	211	99	54	211	141	425	235	250
27	267	102	110	185	77	56	185	131	415	210	240
28	259	99	110	167	75	66	211	134	405	210	220
29	.....	96	110	160	82	59	174	196	376	222	210
30	.....	93	119	141	72	54	174	167	348	235	200
31	.....	90	.....	128	.....	59	147	.....	329	.....	200

NOTE.—Daily discharge computed from a rating curve well defined below 4,000 second-feet. Discharge estimated Mar. 1 to 31, 1911, because of errors in observed gage heights. Discharge Feb. 1 to Mar. 8, 1910, and Dec. 27 to 31, 1911, estimated, because of ice, from observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Mar. 1 to 8, 1910, estimated 200 second-feet, varying from about 150 to 350 second-feet.

Monthly discharge of North Branch of Root River near Lanesboro, Minn., for 1910–11.

[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.		
1910.						
February			150	0.232	0.24	D.
March	2,040	150	829	1.28	1.48	C.
April	924	284	602	.930	1.04	B.
May	284	167	212	.328	.38	B.
June	196	134	161	.249	.28	B.
July	141	119	134	.207	.24	B.
August	203	128	177	.274	.32	B.
September	1,040	167	229	.354	.40	C.
October	189	122	146	.226	.26	C.
November	196	154	167	.258	.29	C.
1911.						
February 19–28	456	259	341	.527	.20	C.
March	203	90	137	.212	.24	D.
April	185	90	125	.193	.22	A.
May	834	82	186	.287	.33	A.
June	242	72	123	.190	.21	A.
July	90	38	62.4	.096	.11	A.
August	9,380	77	987	1.53	1.76	A.
September	814	119	181	.280	.31	A.
October	4,320	167	994	1.54	1.78	A.
November	376	171	275	.425	.47	A.
December	3,160	175	459	.709	.82	B.

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 T. 36 N., R. 8 E., sec. 27, 8 miles below the mouth of Pelican River.

Records available.—December 1, 1905, to December 31, 1911.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Practically 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.

Regulation.—The natural flow of the stream is much modified by the operation of power plants and by storage above the station.

Accuracy.—The fluctuations 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 is checked by further discharge measurements.

Daily gage height, in feet, of Wisconsin River near Rhinelander, Wis., for 1911.

[Geo. N. Kramer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.6	2.4	3.3	2.5	2.9	2.2	3.4	3.4	3.4	3.6	2.4
2	2.6	2.3	2.5	3.0	2.3	3.1	1.9	3.9	3.1	3.5	3.5	2.3
3	2.5	2.3	2.3	3.1	2.9	3.0	2.1	3.7	2.2	3.5	3.5	2.5
4	2.5	2.1	2.3	2.9	2.4	1.9	1.8	3.7	2.4	3.4	3.0	2.5
5	2.4	2.0	1.8	2.8	2.5	2.7	2.7	3.7	3.7	3.5	2.7	2.6
6	2.6	2.0	2.4	2.8	2.4	2.7	3.1	2.5	3.7	3.9	3.2	2.3
7	2.4	2.0	2.4	2.8	1.6	2.9	3.4	3.7	3.4	4.5	3.2	2.7
8	2.0	3.1	2.6	2.9	2.2	2.9	3.0	3.7	3.4	5.0	3.0	2.5
9	2.5	3.1	2.6	1.9	2.2	2.7	1.7	3.7	3.4	5.2	3.0	2.6
10	2.5	2.6	3.5	3.1	2.1	2.9	3.1	3.8	2.1	5.0	3.0	3.1
11	2.4	2.7	2.9	3.1	2.5	1.8	3.1	3.7	3.4	4.9	3.0	3.2
12	2.6	2.0	2.0	3.0	2.3	2.5	3.0	3.7	3.5	4.8	2.8	3.6
13	2.5	2.3	2.5	3.1	2.3	2.5	3.0	1.9	3.5	4.5	2.9	3.4
14	2.6	2.4	2.6	3.1	2.2	2.3	2.9	3.8	3.6	4.5	2.7	3.5
15	2.2	2.5	3.0	3.0	2.8	2.3	2.8	3.4	3.4	3.8	2.5	3.4
16	2.5	2.5	2.5	1.9	2.6	2.4	1.8	3.5	3.4	4.5	2.5	3.6
17	2.6	2.7	2.5	3.0	2.6	2.3	3.3	3.7	2.0	4.4	2.6	3.3
18	2.5	2.7	2.8	3.1	2.6	1.8	3.3	3.5	3.6	4.6	2.5	3.4
19	2.6	2.1	1.9	3.4	2.9	2.4	2.7	3.6	3.4	3.9	2.7	3.6
20	2.9	2.6	2.8	3.0	3.5	2.4	2.3	2.1	3.4	3.7	2.5	3.5
21	3.2	2.8	2.9	3.2	2.4	2.4	2.9	3.9	3.5	4.9	2.5	3.3
22	2.0	2.7	2.9	3.4	3.7	2.3	3.0	3.9	3.3	5.2	2.6	3.3
23	2.7	2.9	2.9	2.5	3.6	2.3	1.9	3.8	3.3	4.7	2.4	3.4
24	2.7	3.1	3.0	3.1	3.6	2.4	4.4	3.6	2.1	4.6	2.6	3.7
25	3.1	3.1	3.1	3.0	3.9	1.8	3.6	3.9	3.3	4.4	2.7	3.8
26	2.9	2.7	1.9	2.9	3.9	2.4	3.4	4.0	3.3	4.5	2.9	3.6
27	2.8	2.9	3.3	3.2	2.6	2.4	3.2	2.4	3.4	4.8	2.6	3.2
28	2.8	2.8	3.4	3.2	2.4	2.5	3.2	3.6	3.5	4.6	2.8	3.3
29	2.6	.....	3.3	2.6	2.8	2.5	3.3	3.7	3.5	4.3	2.6	3.4
30	2.9	.....	3.3	2.0	2.9	2.3	1.7	3.7	3.4	4.2	2.5	3.5
31	2.7	.....	3.2	.....	2.9	.....	3.9	3.7	.....	3.4	.....	3.3

NOTE.—No ice reported by observer; relation of gage height to discharge probably not affected by ice.

WISCONSIN RIVER AT MERRILL, WIS.

Location.—At highway bridge at east end of Merrill, Wis., half a mile below the mouth of Prairie River.

Records available.—November 17, 1902, to December 31, 1911.

Drainage area.—2,630 square miles.

Gage.—Standard chain 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, caused by ice at or below the gage.

Regulation.—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. The records are, however, reliable and accurate except as the gage readings may be affected by conditions above noted. As this station has not been visited since February, 1909, estimates of discharge are withheld until the discharge rating curve is checked by further discharge measurements.

Daily gage height, in feet, of Wisconsin River at Merrill, Wis., for 1911.

[A. F. Luck, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	4.3	4.25	6.4	4.5	5.5	3.95	5.55	4.5	6.75	6.3	5.55
2	4.15	4.2	4.3	6.25	4.45	5.4	3.9	5.7	4.5	6.4	5.95	5.55
3	4.2	4.35	3.9	5.9	4.65	5.0	3.65	5.75	4.5	6.90	6.2	5.45
4	4.1	4.5	4.6	5.55	5.05	4.9	3.5	5.15	4.2	7.85	5.2	5.1
5	4.4	4.1	4.4	5.55	5.2	6.25	3.4	4.85	4.6	7.7	5.35	5.45
6	4.65	3.75	4.55	5.45	5.25	6.3	4.0	4.8	4.4	10.85	5.8	5.35
7	4.35	4.5	4.35	5.3	4.4	6.25	4.7	4.95	4.85	11.1	6.05	5.6
8	4.2	4.5	4.5	5.0	4.35	5.45	4.6	5.0	5.8	10.15	5.45	5.5
9	4.05	4.25	4.05	5.25	4.85	5.25	3.6	5.15	4.4	9.1	5.9	5.5
10	3.65	4.8	4.1	5.2	5.35	5.45	4.45	5.4	4.5	8.5	5.8	5.75
11	4.2	4.65	4.6	5.35	5.25	4.85	4.4	5.25	4.7	7.5	5.5	6.4
12	4.15	4.35	4.45	5.9	4.65	4.7	4.55	5.35	4.55	7.5	5.9	6.7
13	4.2	4.1	4.6	6.25	4.85	4.55	4.2	5.35	4.7	7.2	5.0	7.0
14	4.25	4.25	4.9	6.35	4.6	4.4	4.4	5.4	6.55	7.15	5.15	7.0
15	4.1	4.75	4.75	6.55	4.5	4.25	4.35	4.7	6.15	6.95	5.65	6.85
16	4.15	4.7	4.65	6.25	5.75	4.3	4.0	4.75	5.75	7.65	5.75	6.45
17	4.45	4.55	5.2	6.6	5.8	4.1	4.0	4.65	7.2	8.95	5.35	6.45
18	4.45	4.5	5.15	6.05	5.65	4.0	4.15	4.3	6.45	8.95	5.4	6.2
19	4.6	4.45	4.6	6.25	5.65	3.55	5.05	4.65	5.9	9.3	5.45	5.95
20	4.35	4.4	4.6	6.8	6.6	4.0	4.85	4.0	5.35	8.45	5.5	6.15
21	4.85	4.35	5.05	6.3	6.95	4.05	4.3	4.15	5.9	8.0	5.3	6.2
22	4.4	4.2	5.8	6.4	7.0	4.05	4.9	4.8	5.85	7.5	5.45	6.1
23	4.25	4.2	5.9	6.45	7.35	4.05	4.05	5.2	5.55	7.35	5.5	6.1
24	4.4	4.2	5.9	6.2	7.35	4.05	4.8	5.1	5.4	7.2	5.55	5.95
25	4.65	4.45	5.6	5.8	7.25	3.95	4.4	4.9	5.65	7.2	5.5	5.9
26	4.65	4.35	5.95	5.8	6.65	3.6	4.8	5.0	5.15	7.35	5.5	5.85
27	4.3	4.45	6.35	6.05	6.4	3.55	4.75	4.9	5.75	6.95	5.45	5.85
28	4.3	4.3	6.25	4.7	6.6	4.0	4.75	5.15	5.75	6.35	5.65	5.45
29	4.3	.....	6.5	5.2	5.8	4.05	4.75	4.8	6.05	6.2	5.65	5.45
30	4.25	.....	6.6	5.45	5.75	4.05	4.55	4.3	6.4	6.15	5.65	5.5
31	4.55	.....	6.25	.....	5.6	.....	3.95	4.55	.....	6.35	.....	5.35

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 mouth of Big Roche a Cri Creek.

Records available.—December 2, 1902, to December 31, 1911.

Drainage area.—About 5,800 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Shifts during floods.

Discharge measurements.—Made from bridge to which gage is attached.

Winter flow.—Ice forms from 1 to 2 feet in thickness, lasts about three months, and modifies the relation between gage heights and discharge.

Accuracy.—As the station was last visited in February, 1909, estimates of discharge are withheld from publication.

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1911.

[Michael Coughlin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	8.55	6.2	7.65	5.2	5.6	5.45	6.95	8.3	9.0
2	6.0	.....	.....	7.9	6.3	7.25	5.2	5.1	5.4	7.95	8.1	9.35
3	.....	.....	.....	7.55	6.55	7.55	5.4	5.55	5.0	8.25	7.95	9.2
4	.....	.....	.....	7.15	6.45	7.35	5.45	5.8	5.0	8.75	7.45	8.75
5	.....	.....	.....	7.1	6.35	7.65	5.0	6.2	4.5	9.2	7.35	8.8
6	.....	6.1	6.0	7.1	6.35	7.75	5.1	6.1	4.95	10.0	8.35	8.95
7	.....	.....	.....	6.95	6.5	8.8	4.9	5.7	4.75	11.2	7.25	8.8
8	.....	.....	.....	6.85	6.8	9.45	4.75	6.0	5.0	12.55	7.35	8.7
9	5.7	.....	.....	6.7	6.4	8.95	4.9	5.6	5.1	13.7	7.5	8.75
10	.....	.....	.....	6.55	5.8	8.3	5.1	5.9	5.4	16.9	7.7	8.8

Daily gage height, in feet, of Wisconsin River near Necedah, Wis., for 1911—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	.....	.....	7.0	6.3	7.7	5.3	5.75	5.1	15.4	7.8	7.0
12	.....	.....	5.2	6.45	6.2	7.4	5.0	5.8	5.75	14.0	8.0	7.5
13	.....	6.85	5.0	6.9	6.3	7.25	4.85	5.95	5.45	12.45	8.2	8.4
14	.....	6.25	5.4	7.2	6.35	6.6	5.2	5.7	5.45	11.4	8.0	9.35
15	.....	6.2	5.45	7.55	6.55	6.55	5.4	6.1	5.15	10.4	7.9	10.45
16	5.8	6.15	5.9	8.0	6.5	6.3	5.4	5.7	5.45	10.0	7.4	10.6
17	.....	6.0	6.3	7.9	6.2	6.15	5.1	5.75	6.0	9.9	7.0	10.0
18	.....	6.2	6.5	8.0	7.75	6.25	5.45	5.8	7.1	10.5	6.6	9.2
19	.....	6.1	6.45	7.65	8.75	6.0	5.0	5.75	7.3	12.1	6.55	8.8
20	.....	6.1	6.2	7.4	8.45	6.35	5.35	5.65	7.3	13.6	6.65	8.55
21	.....	6.0	6.4	7.2	8.1	5.75	5.2	5.35	7.1	13.85	7.1	8.0
22	.....	5.8	6.15	7.6	7.95	5.8	5.25	5.55	6.65	12.9	6.9	7.7
23	5.8	5.75	6.2	7.8	9.35	5.7	5.15	5.15	6.7	11.85	7.1	7.6
24	.....	6.0	6.2	7.55	10.35	5.6	5.0	5.55	6.51	10.9	7.0	7.8
25	.....	6.0	7.0	7.6	10.8	5.55	5.35	5.6	6.7	10.0	7.1	7.3
26	.....	6.2	7.4	7.15	11.0	5.45	4.9	5.6	6.85	9.6	6.85	7.1
27	.....	5.7	8.15	6.85	10.8	5.75	5.3	5.1	6.95	9.4	6.8	7.5
28	.....	.....	8.35	6.8	9.8	5.25	5.3	5.25	6.75	9.75	6.8	7.7
29	.....	.....	8.55	6.8	9.1	5.2	5.35	5.45	6.9	9.55	6.75	8.4
30	6.25	.....	9.5	6.6	8.45	5.3	5.55	5.0	7.1	9.1	9.5	8.6
31	.....	.....	8.85	.....	8.2	.....	5.4	5.4	.....	8.45	.....	8.9

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 1 to Mar. 11. No ice reported by observer during November and December.

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, 1911.

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 23, 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.—Probably permanent.

Discharge measurements.—Made from upstream side of the bridge.

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.—The gage heights at this station are furnished by Frank Dearborn.

Accuracy.—Although only one measurement of discharge has been made since 1906, that one bears out the assumption of permanency of regimen.

The following discharge measurement was made by Follansbee and Kay:

August 2, 1911: Gage height, 2.60 feet; discharge, 118 second-feet.

Daily gage height, in feet, of Wapsipinicon River at Stone City, Iowa, for 1911.

[Frank Dearborn, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.50	4.02	2.90	3.05	3.68	2.55	2.58	3.22	7.00	3.80	3.45
2	.....	.....	3.95	2.95	3.10	3.55	2.50	2.67	3.18	6.05	3.67	3.32
3	.....	.....	3.90	2.88	3.18	3.90	2.50	2.48	3.15	4.42	3.48	3.15
4	2.34	.....	3.78	2.83	3.15	4.10	2.52	2.73	3.10	3.92	3.60	3.10
5	.....	.....	3.72	3.00	3.15	4.88	2.52	2.65	3.10	3.75	3.52	3.10
6	.....	.....	3.70	3.05	3.15	4.62	2.52	2.60	3.08	3.68	3.50	3.32
7	.....	.....	3.60	3.02	3.10	4.40	2.50	2.78	3.05	3.73	3.55	3.45
8	.....	2.45	3.60	3.05	3.02	3.92	2.48	2.62	3.25	3.85	3.58	3.60
9	.....	.....	3.48	3.00	3.00	3.60	2.48	3.82	3.18	3.88	3.65	3.82
10	.....	.....	3.35	3.00	3.00	3.42	2.70	4.58	2.96	3.88	4.15	4.10

Daily gage height, in feet, of Wapsipinicon River at Stone City, Iowa, for 1911—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.35	.....	3.28	3.02	2.98	3.30	2.58	4.85	2.98	4.05	4.22	4.05
12	.....	.....	3.10	3.05	2.95	3.22	2.50	5.92	3.05	3.95	4.80	4.20
13	.....	.....	3.08	3.62	2.92	3.15	2.50	4.95	3.13	3.92	5.25	4.42
14	.....	9.05	3.00	3.45	3.10	3.10	2.48	4.25	3.08	4.05	5.10	4.40
15	.....	11.00	3.03	3.30	3.32	2.98	2.45	5.22	2.97	4.35	4.85	4.01
16	.....	10.90	3.00	3.28	3.25	3.00	2.45	6.00	2.88	4.20	4.60	2.98
17	.....	13.33	2.98	3.28	3.18	3.02	2.40	6.22	2.94	4.15	4.45	2.98
18	2.35	10.30	2.95	3.25	3.12	3.15	2.37	5.82	2.90	4.08	4.12	3.40
19	.....	8.10	2.92	3.25	3.05	3.08	2.35	5.60	3.15	4.62	3.25	4.10
20	.....	6.75	2.90	3.30	3.10	3.00	2.38	5.33	2.98	4.92	3.25	6.25
21	.....	5.20	2.95	3.25	3.60	2.95	2.33	5.00	2.95	4.95	3.40	6.52
22	.....	4.65	2.98	3.20	3.80	2.90	2.28	5.40	2.95	4.90	3.65	5.87
23	.....	4.65	2.95	3.18	4.00	2.90	2.28	5.35	2.92	5.20	3.72	4.40
24	.....	4.80	2.95	3.05	3.88	2.90	2.50	4.82	3.05	5.45	3.54	4.05
25	2.85	4.70	2.95	3.00	4.12	2.80	2.32	4.30	2.98	5.70	3.30	3.82
26	.....	4.58	2.98	2.94	3.85	2.75	2.28	3.98	2.95	5.58	3.50	3.80
27	.....	4.40	3.00	2.92	3.55	2.70	2.26	3.72	2.95	5.10	3.85	4.80
28	.....	4.15	3.03	2.90	3.48	2.65	2.25	3.58	2.92	4.28	3.70	5.02
29	.....	.....	2.98	2.98	3.42	2.62	2.38	3.41	3.05	4.10	3.65	5.44
30	.....	.....	2.95	3.02	3.99	2.55	2.45	3.32	3.40	4.08	3.60	4.95
31	.....	.....	2.95	.....	3.80	.....	2.55	3.30	.....	3.88	.....	.....

NOTE.—Feb. 15, observer reported, "Ice breaking up; moved out 4 p. m." Gage heights Feb. 8, Nov. 13 to 30, and Dec. 26 to 30 are to top of ice. Relation of gage height to discharge affected by ice about Jan. 1 to Feb. 15, Nov. 13 to 30, and Dec. 26 to 31.

Daily discharge, in second-feet, of Wapsipinicon River at Stone City, Iowa, for 1911.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	730	209	263	560	112	119	333	2,450	620	445
2	.....	695	226	282	495	101	140	316	1,850	555	380
3	.....	670	203	316	670	101	97	303	930	460	303
4	.....	610	187	303	770	105	157	282	680	520	282
5	.....	580	244	303	1,170	105	136	282	595	480	282
6	.....	570	263	303	1,030	105	123	274	560	470	380
7	.....	520	252	282	920	101	171	263	585	495	445
8	.....	520	263	252	680	97	128	347	645	510	520
9	.....	460	244	244	520	97	630	316	660	545	630
10	.....	395	244	244	430	148	1,010	230	660	795	770
11	.....	361	252	237	370	119	1,160	237	745	830	745
12	.....	282	263	226	333	101	1,770	263	695	1,130	820
13	.....	274	530	216	303	101	1,210	295	680	.....	930
14	.....	244	445	282	282	97	845	274	745	.....	920
15	.....	255	370	380	237	92	1,360	234	895	.....	725
16	5,430	244	361	347	244	92	1,820	203	820	.....	237
17	8,220	237	361	316	252	82	1,950	223	795	.....	237
18	4,890	226	347	290	303	77	1,710	209	760	.....	420
19	3,190	216	347	263	274	74	1,580	303	1,030	.....	770
20	2,290	209	370	282	244	79	1,420	237	1,200	.....	1,970
21	1,350	226	347	520	226	70	1,240	226	1,210	.....	2,140
22	1,050	237	324	620	209	62	1,460	226	1,180	.....	1,740
23	1,050	226	316	720	209	62	1,430	216	1,350	.....	920
24	1,130	226	263	660	209	101	1,140	263	1,490	.....	745
25	1,080	226	244	780	177	68	870	237	1,640	.....	630
26	1,010	237	223	645	162	62	710	226	1,570	.....	550
27	920	244	216	495	148	59	580	226	1,300	.....	450
28	795	255	209	460	136	58	510	216	860	.....	350
29	.....	237	237	430	128	79	425	263	770	.....	300
30	.....	226	252	715	112	92	380	420	760	.....	270
31	.....	226	.....	620	.....	112	370	.....	660	.....	250

NOTE.—High discharge Dec. 20, 21, and 22 is not justified by climatologic records; the relation of gage height to discharge may have been affected by ice, but since there is no evidence of this other than the abnormally high discharge, the open channel rating curve has been applied. Discharge Nov. 13 to 30 and Dec. 26 to 31 estimated, because of ice, from daily gage heights, observer's notes, climatologic records, and discharge of adjacent drainage areas. Mean discharge Nov. 13 to 30 estimated 460 second-feet, varying from about 300 to 900 second-feet.

Monthly discharge of Wapsipinicon River at Stone City, Iowa, for 1911.

[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.		
February 16-28	8,220	795	2,490	1.90	0.92	B.
March	730	209	350	.267	.31	B.
April	530	187	287	.219	.24	B.
May	780	216	397	.303	.35	B.
June	1,170	112	393	.300	.33	B.
July	148	58	90.7	.069	.08	B.
August	1,950	97	860	.656	.76	B.
September	420	203	265	.202	.23	B.
October	2,450	560	993	.758	.87	B.
November	1,130	.....	523	.399	.45	C.
December	2,140	237	663	.506	.58	C.

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

ROCK RIVER BELOW MOUTH OF PECATONICA RIVER, AT ROCKTON, ILL.

Location.—At highway bridge 1 mile below the dam and three-fourths mile below the 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 the downstream side of the first span from the left end of the bridge. Datum raised 1.0 foot October 1, 1906, so that the gage readings since that date are 1.0 foot less than they would have been by the former datum.

Channel.—Practically permanent; bed composed of gravel and small rocks; broken by four piers.

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 records of floods are available.

Winter flow.—The winters in this vicinity are comparatively severe, ice forms on the river but open places generally exist at the gage. Ice jams frequently form below the station and cause backwater at the gage.

Regulation.—The dam and power plant above the station may modify the flow during periods of low water.

Diversions.—A small amount of water is diverted around this station for one or two small power plants.

Accuracy.—Since the amount of the change in datum on October 1, 1906, is only approximately known, the estimates since that date are liable to some error. It is believed, however, that errors from this cause are small. Data are published in this report as recomputed for the 1911 report of the Rivers and Lakes Commission of the State of Illinois. Data were originally published in Water-Supply Papers 98, 128, 171, 207, 245, and 265.

Daily discharge, in second-feet, of Rock River below mouth of Pecatonica River, at Rockton, Ill., for 1903–1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.								1903.							
1	.....	2,100	4,770	5,350	4,040	3,030	2,400	16	.....	4,400	4,040	8,270	5,350	3,360	.....
2	.....	2,250	4,770	5,150	3,870	3,190	2,550	17	.....	4,580	5,150	8,770	5,150	3,190	.....
3	.....	2,710	4,770	4,960	4,040	3,190	2,400	18	.....	4,220	4,960	9,020	5,150	2,400	.....
4	.....	4,040	4,770	4,770	3,700	3,030	2,400	19	.....	7,070	4,220	8,270	4,580	2,870	.....
5	.....	3,700	4,770	4,580	4,040	3,030	2,550	20	.....	8,270	3,870	7,300	4,770	2,710	.....
6	.....	3,530	4,770	4,400	4,040	2,870	2,400	21	.....	9,520	3,700	6,620	4,580	2,870	.....
7	.....	3,530	4,770	3,870	5,970	2,710	2,250	22	.....	11,300	3,530	6,180	4,580	2,710	.....
8	.....	3,360	4,770	3,870	9,020	2,250	2,250	23	.....	12,000	3,530	5,760	4,220	2,710	.....
9	.....	2,870	4,770	4,580	7,540	2,400	2,400	21	.....	11,500	3,700	5,350	4,220	2,550	.....
10	.....	3,360	4,580	4,770	6,840	2,250	2,250	25	.....	10,800	3,530	4,580	3,870	2,550	.....
11	.....	3,700	3,870	5,150	6,620	2,550	2,400	26	.....	8,520	3,360	4,400	3,870	2,100	.....
12	.....	4,400	3,190	5,550	5,970	2,710	2,250	27	.....	5,760	3,870	4,220	3,700	3,030	.....
13	.....	5,970	3,190	5,150	5,760	3,190	.....	28	1,960	5,760	4,400	4,580	3,530	2,400	.....
14	.....	5,760	3,030	6,620	5,350	3,530	.....	29	1,690	4,770	5,150	4,400	3,360	2,710	.....
15	.....	4,770	3,530	7,300	5,350	3,360	.....	30	2,400	4,960	5,760	4,220	3,360	2,710	.....
								31	.....	4,960	5,350	.....	3,030	.....	.....

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.										
1	.....	20,600	5,610	4,010	1,690	1,560	1,620	3,700	2,320	1,690
2	.....	18,000	5,550	4,010	1,690	1,320	1,620	3,280	2,250	1,620
3	.....	16,100	5,150	3,720	1,760	1,210	1,690	3,110	2,030	1,690
4	.....	14,900	4,920	2,870	1,690	1,210	1,590	2,870	2,100	1,690
5	.....	14,200	4,680	3,190	1,620	1,210	1,820	2,630	2,030	1,760
6	.....	13,600	4,600	3,030	1,620	1,320	2,250	3,190	2,030	1,690
7	.....	13,000	4,580	3,030	1,820	1,380	2,030	3,280	1,760	1,690
8	.....	13,000	4,940	3,050	1,960	1,320	1,890	3,030	2,030	1,690
9	.....	13,000	5,550	2,870	2,100	1,230	1,820	2,480	2,030	1,690
10	.....	13,000	6,290	2,790	2,040	1,320	1,830	2,870	2,030	1,690
11	.....	13,000	6,160	2,790	1,890	1,260	1,820	3,530	2,030	1,690
12	.....	12,600	6,100	2,630	1,890	1,160	1,690	4,240	2,100	1,690
13	.....	11,800	6,200	2,550	1,960	1,210	1,690	5,060	1,960	.....
14	.....	11,100	6,200	2,480	1,760	1,100	1,770	5,060	1,690	.....
15	.....	10,300	6,420	2,400	1,690	1,260	1,690	5,550	1,820	.....
16	.....	10,000	6,510	2,250	1,600	950	1,620	4,220	2,030	.....
17	.....	9,520	6,600	2,280	1,440	1,160	1,560	3,360	2,030	.....
18	.....	8,800	6,200	2,180	1,560	1,320	1,690	3,110	1,890	.....
19	.....	8,500	6,180	2,320	1,560	1,160	2,710	3,700	2,030	.....
20	14,900	8,020	5,930	2,100	1,560	1,320	4,580	2,710	1,960	.....
21	14,900	7,730	5,760	2,100	1,440	1,380	4,220	2,480	1,690	.....
22	25,900	7,420	5,510	2,100	1,440	2,100	3,280	2,400	1,820	1,900
23	27,100	6,980	5,190	2,100	1,440	2,550	2,550	2,400	1,820	2,000
24	24,100	7,020	5,110	2,030	1,440	2,870	2,180	2,480	1,690	2,100
25	24,600	7,850	5,170	1,960	1,160	3,030	1,890	2,400	1,820	2,200
26	25,400	7,900	4,920	1,890	1,560	2,400	2,320	2,320	1,960	2,300
27	25,000	7,320	4,770	1,620	2,100	1,820	3,440	2,320	1,690	2,400
28	24,800	6,710	4,400	1,690	1,560	1,960	4,960	2,400	1,690	2,500
29	23,600	6,180	4,310	1,690	1,440	1,560	4,810	2,250	1,690	2,600
30	22,600	5,820	4,200	1,690	1,440	1,690	3,960	2,180	1,820	2,700
31	21,900	.....	4,220	.....	1,440	1,820	.....	2,480	.....	2,800

Daily discharge, in second-feet, of Rock River below mouth of Pecatonica River, at Rockton, Ill., for 1903–1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.										
1	.....	19,300	4,960	5,150	5,150	2,550	2,550	1,820	2,250	3,700
2	.....	17,500	4,770	5,060	5,150	2,480	2,790	1,500	2,250	3,700
3	.....	16,300	4,220	4,960	5,150	2,400	4,310	1,690	2,400	2,870
4	.....	15,800	4,220	4,960	4,770	2,320	3,530	1,690	2,250	3,190
5	.....	15,000	3,870	5,150	4,580	3,110	3,700	1,620	2,320	3,030
6	.....	14,800	3,960	6,620	4,400	3,030	3,620	1,690	2,870	3,110
7	.....	14,300	3,870	6,290	4,580	2,870	3,530	1,620	2,710	2,950
8	.....	13,500	3,780	6,400	4,680	2,870	3,530	1,560	3,030	2,950
9	.....	13,000	3,530	6,840	4,490	2,480	3,360	1,320	3,030	2,870
10	.....	12,500	3,780	7,300	4,490	2,400	3,360	1,440	3,110	2,870
11	.....	12,000	4,490	7,070	4,580	2,320	3,530	1,440	2,870	3,030
12	.....	11,000	8,520	7,540	4,680	2,250	3,110	1,560	2,550	2,790
13	.....	10,300	9,020	7,540	4,960	2,100	2,950	1,500	2,550	2,630
14	.....	9,770	10,000	7,540	4,960	2,550	2,710	1,560	2,870	2,790
15	.....	9,020	11,500	7,300	4,770	2,320	2,710	1,500	2,480	2,480
16	.....	8,520	12,300	7,300	4,580	2,250	2,550	1,500	2,400	2,400
17	.....	8,020	11,300	7,300	4,040	2,400	2,480	1,690	2,400	2,480
18	.....	7,300	10,300	7,540	3,780	2,030	2,710	2,100	2,400	2,100
19	.....	7,070	9,770	7,300	3,440	2,260	2,400	4,770	2,400	2,320
20	.....	6,400	10,000	6,840	3,530	3,360	2,180	5,150	2,480	2,250
21	.....	7,070	8,770	7,070	3,360	3,030	2,100	4,580	2,320	2,250
22	.....	7,300	8,020	7,070	3,190	2,480	2,100	4,310	2,400	2,250
23	.....	6,840	7,300	7,300	3,030	2,400	2,100	3,870	2,480	2,250
24	.....	6,400	6,840	7,070	3,030	2,400	2,100	3,620	2,400	2,320
25	21,800	5,970	5,970	6,620	3,030	2,320	1,820	3,530	2,400	1,820
26	22,500	5,550	6,080	5,970	2,550	3,030	2,100	3,440	2,100	2,320
27	22,500	5,550	5,970	5,760	2,550	3,030	2,030	3,190	2,100	2,550
28	21,500	5,450	5,760	5,660	2,630	3,360	1,960	3,190	2,480	2,250
29	21,500	5,250	5,760	5,350	3,030	3,360	1,820	2,950	3,110	2,950
30	21,300	4,770	5,550	4,960	3,030	2,870	1,890	2,950	3,030	5,760
31	20,800	.....	5,550	.....	2,790	2,630	.....	2,790	.....	3,700

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	3,360	7,660	14,000	15,800	4,860	3,110	3,360	.....	.....	1,560	2,100	5,060
2	2,790	6,620	16,000	15,100	4,860	2,870	3,190	.....	.....	1,960	2,250	4,580
3	2,630	8,320	21,900	13,900	4,770	2,550	3,110	.....	.....	1,820	1,960	4,310
4	4,400	7,660	21,000	11,500	4,770	2,030	2,950	.....	.....	1,690	2,100	4,040
5	4,600	10,900	19,000	9,640	4,580	2,550	2,870	.....	.....	1,560	2,030	3,870
6	5,000	11,300	19,600	9,400	4,400	2,550	2,710	.....	.....	1,500	2,180	4,400
7	5,400	8,400	18,600	9,270	4,490	2,550	2,630	.....	.....	1,960	2,180	3,960
8	5,800	.....	17,600	9,400	4,310	2,550	2,400	.....	.....	1,620	2,100	3,280
9	6,200	.....	17,100	10,600	4,220	2,250	2,400	.....	.....	1,560	1,960	3,530
10	6,600	.....	15,900	11,500	4,040	2,250	2,250	.....	.....	1,440	1,960	3,530
11	6,290	.....	15,000	11,500	3,870	2,180	2,250	.....	.....	1,560	1,960	3,440
12	4,580	.....	11,000	10,100	3,870	2,400	2,100	.....	.....	1,560	1,890	3,440
13	3,700	.....	9,140	11,000	3,530	2,250	1,960	.....	.....	1,560	2,030	3,360
14	3,030	.....	9,520	10,000	3,700	2,100	2,030	.....	.....	1,560	1,960	3,360
15	3,530	.....	9,520	9,400	3,700	2,100	2,100	.....	.....	1,440	1,960	3,360
16	15,000	.....	9,020	9,640	3,620	2,100	2,030	.....	.....	1,380	1,820	2,870
17	12,100	.....	9,640	9,140	3,190	1,820	2,100	.....	.....	1,440	1,620	2,870
18	11,800	.....	8,070	8,770	3,110	1,820	1,960	.....	.....	1,440	1,820	2,870
19	12,300	.....	7,320	8,400	2,870	2,030	1,820	.....	.....	1,380	1,560	3,110
20	12,300	.....	6,620	8,020	2,790	1,890	1,960	.....	.....	1,440	1,820	3,190
21	18,100	.....	6,080	7,540	2,950	2,400	.....	.....	.....	1,760	1,820	2,870
22	17,800	.....	5,150	7,420	2,710	2,250	.....	.....	.....	1,760	2,480	2,870
23	13,600	.....	5,550	7,180	2,710	2,400	.....	.....	.....	1,820	2,790	2,870
24	15,800	.....	5,350	6,620	2,710	2,320	.....	.....	.....	1,760	2,480	2,870
25	17,300	.....	5,350	6,180	2,630	2,250	.....	.....	.....	1,820	2,550	2,100
26	17,800	.....	5,860	5,970	2,710	2,480	.....	.....	.....	1,890	3,530	3,700
27	16,900	.....	14,600	5,660	3,030	2,250	.....	.....	.....	1,960	5,350	2,100
28	14,800	.....	14,800	5,610	3,530	2,100	.....	.....	.....	2,100	6,400	2,100
29	13,500	.....	15,800	5,550	3,190	3,030	.....	.....	.....	2,250	6,290	2,320
30	11,800	.....	16,000	4,980	3,870	3,360	.....	.....	.....	2,250	5,860	2,030
31	9,140	.....	15,900	.....	3,700	.....	.....	.....	.....	2,400	.....	4,600

Daily discharge, in second-feet, of Rock River below mouth of Pecatonica River, at Rockton, Ill., for 1903–1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	7,070	.....	4,040	12,300	5,550	4,580	3,190	4,960	3,030	9,270	2,790	.....
2	5,970	.....	3,870	11,500	5,550	4,400	3,110	4,580	2,950	9,400	2,630	.....
3	5,760	.....	3,700	9,270	5,060	4,040	3,030	4,310	3,030	8,140	2,480	.....
4	7,540	.....	3,700	8,520	5,250	3,780	2,870	4,220	2,870	7,070	2,630	.....
5	7,180	.....	3,700	8,400	4,580	4,770	5,760	4,220	2,710	6,730	2,870	.....
6	6,730	.....	3,960	8,140	4,400	4,860	5,350	3,870	2,550	6,290	2,630	.....
7	6,730	.....	3,700	8,020	4,220	5,970	4,960	3,700	2,480	5,550	2,480	.....
8	8,770	.....	3,530	8,770	4,220	6,840	4,580	3,530	2,400	5,350	2,550	.....
9	7,300	.....	3,360	9,640	4,220	8,270	4,860	3,780	2,320	4,960	2,480	.....
10	6,960	.....	3,360	9,770	3,530	7,780	4,770	3,700	2,550	4,580	2,320	.....
11	6,400	.....	3,360	9,520	3,700	7,070	3,960	3,440	2,400	4,310	2,250	.....
12	5,550	.....	3,360	8,900	3,360	6,620	7,300	3,190	2,550	4,310	2,400	.....
13	5,350	.....	3,870	8,270	3,030	6,840	7,070	3,110	2,480	4,220	2,400	.....
14	4,490	.....	3,700	8,020	2,550	6,620	6,960	3,030	2,320	3,870	2,030	.....
15	4,490	.....	5,550	7,660	3,030	6,400	5,970	2,870	2,180	3,780	2,400	.....
16	3,360	.....	5,150	7,300	2,870	5,860	5,060	2,870	1,760	3,870	2,250	.....
17	3,360	.....	4,960	6,840	3,030	5,450	4,960	3,700	2,030	3,760	2,180	.....
18	3,360	5,970	4,960	6,840	3,110	4,960	4,580	5,550	3,780	3,620	2,250	.....
19	14,300	6,620	4,860	6,840	2,870	5,550	4,490	4,960	5,760	3,620	2,180	.....
20	16,500	6,840	4,860	6,290	2,710	4,960	4,130	4,860	7,900	3,700	2,250	.....
21	8,270	7,300	4,770	6,180	2,710	4,770	3,870	4,960	9,640	3,360	2,400	.....
22	.....	7,540	4,770	5,550	2,710	4,310	5,150	4,960	9,900	3,190	2,870	.....
23	.....	9,020	4,860	5,250	3,190	4,310	7,780	5,060	9,900	3,030	2,870	.....
24	.....	7,420	5,250	5,350	3,870	4,220	8,520	4,860	8,520	2,870	3,360	.....
25	.....	6,400	5,350	5,350	4,220	4,400	10,300	4,220	5,970	2,870	3,360	.....
26	.....	5,550	5,250	5,060	5,150	4,490	11,100	3,700	4,860	2,870	3,030	.....
27	.....	4,580	5,550	4,580	5,450	4,130	11,000	3,700	4,400	2,710	2,870	.....
28	.....	4,400	5,550	4,580	5,760	3,530	9,770	3,620	5,150	2,870	2,870	.....
29	.....	.....	6,400	4,680	5,150	3,700	9,020	3,280	7,780	2,710	3,030	.....
30	.....	.....	9,520	5,110	4,960	3,360	5,860	3,280	8,520	2,710	3,030	.....
31	.....	.....	10,600	.....	4,580	.....	5,350	3,190	.....	2,710	.....	.....
1908.												
1	2,250	.....	11,600	10,400	8,520	8,270	3,110	2,070	1,540	1,540	1,690	2,400
2	2,790	.....	11,500	9,520	8,470	7,730	3,160	2,030	1,620	1,440	1,560	1,890
3	2,550	.....	11,100	8,770	7,900	7,180	3,360	1,960	1,540	1,440	1,560	1,560
4	2,630	.....	11,300	8,140	7,900	6,730	4,260	1,930	1,560	1,380	1,620	1,960
5	3,030	.....	10,900	7,540	7,970	6,510	5,250	1,720	1,540	1,420	1,590	1,890
6	2,870	.....	14,800	7,730	8,270	6,220	4,920	1,850	1,620	1,380	1,590	1,620
7	2,710	.....	15,300	7,590	8,570	6,730	4,360	1,820	1,420	1,440	1,660	1,960
8	2,710	.....	15,500	7,830	9,020	8,820	3,960	1,760	1,560	1,420	1,380	2,100
9	3,630	.....	15,400	7,660	9,140	7,610	3,560	1,620	1,560	1,420	1,500	2,100
10	2,870	.....	15,800	7,350	8,640	6,660	3,360	1,560	1,440	1,590	1,560	2,180
11	2,400	.....	15,500	6,840	8,400	6,010	2,900	1,590	1,440	1,500	1,540	2,030
12	2,400	8,000	14,800	7,780	8,020	5,390	2,710	1,660	1,500	1,500	1,560	2,100
13	2,870	14,500	14,100	5,970	8,640	6,290	3,060	1,720	1,380	1,380	1,560	1,960
14	2,400	12,700	12,800	6,220	9,070	7,300	2,950	1,850	1,620	1,540	1,460	1,760
15	2,630	10,900	10,600	5,760	10,900	6,960	2,870	1,990	1,440	1,460	1,500	1,890
16	2,550	9,100	10,300	5,860	10,100	5,760	2,950	2,480	1,440	1,380	1,500	1,890
17	2,870	7,300	9,900	5,390	9,770	5,150	3,160	2,280	1,590	1,380	1,320	1,960
18	2,480	7,350	9,770	5,250	10,100	4,770	5,150	2,070	1,500	1,380	1,540	2,130
19	2,710	7,700	9,470	5,060	11,400	4,310	6,080	1,960	1,420	1,440	1,560	2,480
20	2,320	8,720	8,770	5,110	11,900	4,130	6,400	1,990	1,380	1,500	1,540	2,790
21	1,960	8,550	8,140	4,920	11,400	4,580	5,310	1,790	1,380	1,590	1,590	2,630
22	.....	7,980	7,780	4,680	11,000	7,540	3,960	1,660	1,380	1,540	1,620	2,480
23	.....	9,410	7,420	4,580	10,500	8,270	3,160	1,890	1,380	1,560	1,790	2,480
24	.....	7,540	7,070	4,920	10,000	8,470	2,870	1,560	1,440	1,660	2,070	2,320
25	.....	5,820	6,960	4,580	8,770	8,900	2,680	1,660	1,380	1,620	2,370	2,320
26	.....	9,970	6,440	4,580	8,270	8,140	2,630	1,540	1,440	1,590	2,220	2,630
27	.....	9,770	6,620	6,800	7,660	6,140	2,550	1,500	1,380	1,660	2,370	1,760
28	.....	10,300	8,270	7,780	7,070	4,580	2,400	1,790	1,460	1,660	2,370	1,890
29	.....	12,400	9,900	8,570	7,900	3,870	2,100	1,540	1,440	1,720	2,100	2,030
30	.....	.....	10,400	8,520	8,220	3,280	2,070	1,690	1,440	1,660	2,400	2,030
31	.....	.....	10,200	.....	8,400	.....	2,130	1,500	.....	1,690	.....	2,180

Daily discharge, in second-feet, of Rock River below mouth of Pecatonica River, at Rockton, Ill., for 1903–1909—Continued.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1909.				1909.				1909.			
1	2,480	6,520	11,600	11	.....	6,010	12,200	21	.....	4,040	6,180
2	2,520	6,180	11,000	12	.....	6,840	12,200	22	.....	8,220	7,540
3	1,890	4,860	10,000	13	.....	6,290	11,500	23	.....	10,900	8,270
4	1,690	4,960	8,720	14	.....	5,350	9,520	24	.....	13,700	8,770
5	1,890	6,730	8,570	15	.....	.....	6,960	25	.....	11,800	9,270
6	.....	9,900	8,820	16	.....	.....	6,220	26	9,400	12,600	8,770
7	.....	8,770	9,020	17	.....	.....	5,450	27	10,400	13,000	8,520
8	.....	9,140	9,400	18	.....	.....	5,510	28	11,100	12,600	7,900
9	.....	8,640	10,100	19	.....	.....	5,550	29	11,400	.....	7,300
10	.....	6,140	12,000	20	.....	.....	5,660	30	7,180	.....	6,890
								31	6,850	.....	6,730

NOTE.—Daily discharge computed from two rating curves well defined between 1,800 and 9,000 second-feet and fairly well defined above 9,000 second-feet.

Discharge estimated from climatologic and other data, because of ice, as follows:

1903: Dec. 13–18, mean discharge estimated 1,800 second-feet; Dec. 19–25, mean discharge estimated 2,200 second-feet; Dec. 26–31, mean discharge estimated 2,000 second-feet.

1904: Jan. 1 to 31, mean discharge estimated 1,560 second-feet, varying from about 1,400 to 2,000 second-feet; Feb. 1 to 29, mean discharge estimated 1,630 second-feet, varying from about 1,400 to 2,000 second-feet; Mar. 1 to 19, mean discharge estimated about 8,800 second-feet, varying from about 1,600 to 15,000 second-feet; Dec. 13 to 31, mean discharge estimated about 1,950 second-feet, varying from about 1,500 to 2,800 second-feet.

1905: Jan. 1 to 31, mean discharge estimated 2,170 second-feet, varying from about 1,800 to 2,800 second-feet; Feb. 1. to 28, mean discharge estimated 1,780 second-feet. varying from about 1,600 to 2,500 second-feet; Mar. 1 to 24, mean discharge estimated about 10,100 second-feet, varying from about 3,000 to 21,000 second-feet.

1906: Jan. 5 to 10 and Mar. 1 and 2, as listed; Feb. 8 to 28, mean discharge estimated about 10,300 second-feet, varying from about 5,200 to 18,600 second-feet.

1907: Jan. 22 to 28, mean discharge estimated 7,000 second-feet.

1908: Jan. 22 to 31, mean discharge estimated about 1,720 second-feet, varying from about 1,500 to 2,000 second-feet; Feb. 1 to 11, mean discharge estimated about 2,170 second-feet, varying from about 1,500 to 3,000 second-feet; Feb. 12 to 23, as listed.

1909: Jan. 6 to 13, mean discharge estimated 1,400 second-feet; Jan. 14 to 20, mean discharge estimated 1,900 second-feet; Jan. 21 to 23, mean discharge estimated 3,030 second-feet; Jan. 23 to 25, mean discharge estimated 9,000 second-feet; Feb. 15 to 20, mean discharge estimated 4,500 second-feet.

Discharge interpolated Aug. 2 to 8, 1903, Nov. 9, 1904, Jan. 31 and Feb. 1, 1909. Gage was not read Jan. 29 to Mar. 17, nor during December, 1907.

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	0.910	1.05
August	5,760	3,030	4,270	.690	.80
September	9,020	3,870	5,600	.905	1.01
October	9,020	3,030	4,830	.780	.90
November	3,530	2,100	2,820	.455	.51
December	2,550	.....	2,150	.347	.40
1904.					
January	.....	.....	1,560	.252	.29
February	.....	.....	1,630	.263	.28
March	27,100	.....	1,430	.231	.27
April	20,600	5,860	10,800	1.74	1.94
May	6,600	4,200	5,420	.876	1.01
June	4,010	1,620	2,510	.405	.45
July	2,100	1,160	1,650	.266	.31
August	3,030	950	1,550	.250	.29
September	4,960	1,560	2,420	.229	.26
October	5,550	2,180	3,130	.506	.58
November	2,320	1,690	2,930	.473	.53
December	.....	.....	2,790	.451	.52
The year	27,100	950	4,070	.646	6.73

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.	
1905.					
January	.....	.....	2,170	0.345	0.40
February	.....	.....	1,780	.283	.30
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	6,760	1.07	1.23
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	.416	.48
September	4,310	1,820	2,720	.432	.48
October	5,150	1,320	2,570	.408	.47
November	3,110	2,100	2,550	.405	.45
December	5,760	1,820	2,800	.445	.51
The year	22,500	1,320	4,780	.760	10.33
1906.					
January	18,100	2,630	9,620	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	3,660	.582	.67
June	3,360	1,820	2,360	.375	.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
The period	21,900	.....	5,820	.924	10.08
1907.					
Jan. 1–28	.....	3,360	6,940	1.10	1.15
Feb. 18–28	9,020	4,400	6,510	1.04	.43
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	4,030	.640	.74
June	8,270	3,360	5,230	.832	.93
July	11,100	2,870	5,960	.948	1.09
August	5,550	2,870	3,980	.632	.73
September	9,900	1,760	4,490	.714	.80
October	9,400	2,710	4,460	.708	.82
November	3,360	2,030	2,600	.413	.46
The period	.....	1,760	5,030	.800	9.35
1908.					
January	3,030	.....	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	9,100	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	.236	.26
October	1,720	1,380	1,510	.240	.28
November	2,400	1,380	1,720	.273	.30
December	2,790	1,560	2,110	.335	.39
The year	15,800	1,380	4,520	.717	9.76
1909.					
January	11,100	.....	4,010	.638	.74
February	13,700	.....	7,520	1.20	1.25
March	12,200	5,450	8,590	1.37	1.58

NOTE.—See footnotes to tables of daily discharge.

IOWA RIVER BASIN.

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, 1911.

Gage.—Vertical staff fastened to a maple tree on the north bank of the river.

Channel.—Rock bottom; permanent.

Discharge measurements.—Made at low water by wading in the vicinity of the gage; at high stages made from bridge.

Winter flow.—Affected by ice.

Regulation.—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 natural.

The following discharge was estimated by Follansbee and Kay:

August 4, 1911: Gage height, 0.50 foot; discharge, 16 second-feet. The velocity was determined by floats.

Daily gage height, in feet, of Iowa River near Iowa Falls, Iowa, for 1911.

[Albert Kulas, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.40	0.70	0.52	0.70	16	0.59	0.50	0.75	0.60	0.90
2	.....	.42	.65	.50	.75	17	.54	.52	.78	.88	.99
3	.....	.44	.66	.50	.75	18	.55	.60	.62	.56	.94
4	.....	.40	.68	.55	.85	19	.50	.64	.68	.68	.85
5	0.50	.46	.68	.50	.74	20	.50	.50	.65	.71	.88
6	.49	.49	.68	.70	.78	21	.54	.61	.58	.65	.91
7	.48	.46	.68	.55	.78	22	.52	.50	.58	.90	.90
8	.49	.46	.58	.70	.79	23	.50	.52	.72	.55	.86
9	.50	.46	.74	.56	.76	24	.52	.52	.70	.68	.85
10	.58	.56	.65	.72	1.00	25	.49	.65	.58	.70	.92
11	.68	.69	.66	.75	.99	26	.54	.50	.74	.75	.88
12	.70	.52	.58	.65	.85	27	.48	.61	.58	.75	.86
13	.60	.68	.72	.84	.95	28	.50	.50	.72	.71	.84
14	.60	.49	.71	.72	.99	29	.46	.65	.58	.72	.85
15	.58	.65	.50	.62	.92	30	.40	.51	.68	.78	.90
						31	.40	.....	.60	.....	.....

NOTE.—On Nov. 12 the observer reported, "River froze over last night."

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, 1911.

Drainage area.—425 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Somewhat shifting.

Discharge measurements.—Made from a bridge a short distance below the gage.

Winter flow.—The relation between gage height and discharge is little affected by ice, as the gage is near the tailrace of the mill where the river remains open through most of the winter.

Regulation.—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 consider-

ably 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.

Accuracy.—During the summer of 1911 grass grew in the channel to such an extent that it caused backwater in varying amount at the gage, as shown by discharge measurements. Therefore the low-water records of 1911 can not be considered better than fair.

Discharge measurements of Cedar River near Austin, Minn., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 1	C. R. Adams	4.41	87.9
May 27	Robert Follansbee	4.41	102
Aug. 12	S. B. Soulé	4.98	a106
19	....do	4.64	b88.6
Sept. 21	....do	4.63	c105
Oct. 17	C. J. Emerson	11.73	3,970
Dec. 12	....do	6.36	803

a Measurement made by wading. Grass and moss in channel.
b Measurement made by wading. River nearly clear of grass.
c Measurement made by wading.

Daily gage height, in feet, of Cedar River near Austin, Minn., for 1911.

[J. C. King, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	a3.58	3.98	4.28	4.02	4.21	4.39	4.11	4.34	4.29	3.52	4.91	4.44
2	4.29	4.10	4.20	a3.58	4.16	4.74	a3.50	4.32	4.20	4.28	4.86	3.60
3	4.41	4.00	4.18	4.05	4.12	4.56	4.20	4.28	a3.48	4.23	4.23	3.60
4	4.42	4.03	4.14	4.04	4.07	a4.57	a3.59	4.32	4.33	4.70	4.76	4.30
5	4.21	a3.50	a3.97	4.16	4.05	4.66	4.21	4.23	a3.49	4.70	3.96	3.60
6	3.97	4.15	4.20	4.12	4.07	4.38	4.22	a4.01	4.33	6.16	4.62	3.63
7	3.94	4.00	4.18	4.11	a3.80	4.25	a3.71	4.61	4.45	6.92	4.80	4.31
8	a3.91	4.00	4.20	4.14	4.15	4.20	4.24	4.56	a3.44	6.00	4.80	4.52
9	a3.87	4.02	4.26	a3.89	4.08	4.17	a3.72	4.59	a3.50	5.34	4.79	4.67
10	4.12	a3.44	4.26	4.18	4.02	4.16	4.36	4.94	a3.56	5.01	4.72	5.88
11	4.11	4.08	4.10	4.07	4.04	a3.90	4.15	4.91	4.39	4.77	4.84	8.00
12	4.01	a3.58	a4.11	4.19	4.00	4.09	4.28	4.68	4.12	4.60	3.95	6.30
13	4.00	3.98	4.30	4.34	4.03	4.21	4.19	8.75	4.06	4.61	4.71	5.57
14	4.07	5.41	4.22	4.36	a3.77	4.12	a3.68	b10.59	a3.49	4.68	4.60	5.14
15	a3.42	6.68	4.13	4.32	4.08	4.09	4.28	6.61	a3.50	5.17	4.77	5.09
16	4.12	6.18	4.06	a4.13	4.08	4.14	3.86	5.44	4.34	c10.44	4.46	4.72
17	4.04	6.13	4.07	4.25	4.06	4.18	4.34	4.97	a3.51	11.58	4.31	4.42
18	4.03	5.96	4.12	4.18	4.03	a3.91	4.22	4.71	4.31	8.00	4.45	4.66
19	3.98	5.17	a3.86	4.12	4.04	4.19	a3.63	4.44	4.33	6.65	4.01	4.58
20	3.95	4.99	4.14	4.12	4.14	4.18	4.30	4.27	a3.52	6.08	4.43	4.47
21	4.04	4.65	4.14	4.12	a4.32	4.14	a3.74	4.60	4.33	5.48	4.23	4.30
22	a3.45	4.44	4.08	4.09	5.10	4.19	4.32	4.70	a3.49	5.20	4.27	4.36
23	4.08	4.44	4.04	a3.83	4.98	4.15	a3.75	4.58	a3.61	5.09	4.85	4.38
24	4.04	4.44	4.02	4.16	4.69	4.19	4.14	4.36	a3.73	5.02	3.68	4.11
25	3.98	4.28	3.91	4.07	4.50	a3.95	4.17	a3.52	4.50	5.00	4.14	4.25
26	4.00	a4.09	a3.38	4.02	4.28	4.28	4.20	4.32	4.42	4.97	3.66	4.42
27	4.03	4.32	4.08	4.06	4.22	4.18	4.37	a3.56	a3.52	4.94	4.43	4.33
28	4.02	4.20	4.06	4.05	a4.00	4.12	4.23	4.35	a3.54	4.82	3.66	4.27
29	a3.52	.....	4.10	4.06	4.20	4.08	4.20	4.32	a3.56	4.71	3.60	4.26
30	4.09	.....	4.04	a3.81	a3.95	4.09	a3.76	4.32	4.34	4.69	3.62	4.27
31	4.02	.....	3.99	.....	4.26	.....	4.32	4.04	.....	4.81	.....	3.98

a Turbines closed all day.
b Maximum stage recorded during day 10.95 feet.
c Maximum stage recorded during day 13.68 feet.

NOTE.—Relation of gage height to discharge probably not affected by ice during 1911.

Daily discharge, in second-feet, of Cedar River near Austin, Minn., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7	40	75	44	66	105	30	32	47	8	227	109
2	77	53	65	7	60	141	0	31	38	61	212	24
3	75	42	63	48	55	108	38	27	6	55	73	24
4	70	45	58	46	50	110	0	30	46	132	184	85
5	66	1	39	60	48	126	39	22	6	132	45	24
6	39	59	65	55	50	79	38	5	46	637	148	25
7	36	42	63	54	23	59	5	56	61	1,010	195	86
8	33	42	65	58	59	52	39	51	5	565	195	126
9	29	44	73	31	51	49	5	54	5	315	192	160
10	55	0	73	63	44	47	52	105	8	212	173	578
11	54	51	53	50	46	22	26	98	67	148	206	1,680
12	43	7	54	64	42	37	39	63	35	111	44	774
13	42	40	78	84	45	50	30	2,000	29	113	171	451
14	50	380	68	86	21	41	1	3,200	6	128	144	299
15	0	965	57	81	51	38	38	835	6	261	187	283
16	55	715	49	57	51	42	3	330	61	3,180	113	173
17	46	685	50	72	49	44	38	159	6	3,880	86	105
18	45	640	55	63	45	19	29	104	57	1,680	111	158
19	40	290	28	55	46	45	0	60	58	951	49	139
20	37	223	58	55	58	43	34	41	7	669	107	115
21	46	142	58	55	81	37	1	84	58	416	73	84
22	0	98	51	52	260	41	36	101	6	318	79	94
23	51	98	46	26	217	38	1	82	8	283	209	98
24	46	98	44	60	145	41	20	50	11	261	28	59
25	40	75	33	50	107	20	22	5	84	254	62	76
26	42	52	0	44	75	51	22	45	71	245	26	105
27	45	81	51	47	68	41	37	5	8	236	107	89
28	44	65	49	47	39	35	25	49	8	201	26	79
29	2	.....	53	48	61	31	22	45	8	171	24	78
30	52	.....	46	24	34	32	0	45	66	165	25	79
31	44	.....	41	.....	69	.....	32	22	.....	198	.....	46

NOTE.—Daily discharge computed from a fairly well defined rating curve that was applied indirectly because of shift.

Monthly discharge of Cedar River near Austin, Minn., for 1911.

[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	77	0	42.3	0.100	0.12	B.
February	965	0	181	.426	.44	B.
March	78	0	53.6	.126	.15	B.
April	86	7	52.9	.124	.14	B.
May	260	21	68.3	.161	.19	B.
June	141	19	54.1	.127	.14	C.
July	52	0	22.6	.053	.06	D.
August	3,200	5	253	.595	.69	D.
September	84	5	30.9	.073	.08	C.
October	3,880	8	548	1.29	1.49	B.
November	227	24	117	.275	.31	B.
December	1,680	24	203	.478	.55	B.
The year	3,880	0	136	.320	4.36	

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

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, 1911.
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.

Regulation.—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.

Accuracy.—On August 1, 1911, it was found by levels that the gage had been raised, presumably by frost, so that footmarks from 8 to 15 feet are from 0.05 to 0.14 foot too high, the maximum error being at 15 feet. The gage was not changed and no corrections have been applied to published gage heights on this account. It will be noted that there are only four days between April 1, 1909, and December 31, 1911, upon which the gage height is greater than 8 feet, so that the effect of the error in gage upon the accuracy of the records is negligible.

On August 1, 1911, it was discovered that the gage observer was making a mistake of 1 foot in his readings, recording them too low by that amount. He stated that the error was made during the high water of 1911. As a result of the discharge comparison noted below it is believed that the observer's statement was in error and that his mistake of 1 foot began with the high water of 1910 rather than with that of 1911. Although the date of beginning this correction is by no means definite, gage heights in the following tables are 1 foot greater than reported by the observer from March 14, 1910, to July 31, 1911. The daily discharge has been computed from corrected gage heights. The period of correction was decided upon after a comparison of the flow of Cedar River at Cedar Rapids and Wapsipinicon River at Stone City, Iowa, from September, 1903, to December, 1911. Although the comparisons indicate that the estimates of discharge for this period are good, the estimates should be used with caution, because the correction applied to the observed gage heights causes changes amounting to several hundred per cent in the estimates of discharge at low water.

The discharge measurement of August 1, 1911, agrees well with measurements in previous years, and the discharge rating curve is well defined between 600 and 34,000 second-feet. The records from August 1 to December 31, 1911, are considered accurate and reliable.

The following discharge measurement was made by Follansbee and Kay:
August 1, 1911: Gage height, 2.78 feet; discharge, 645 second-feet.

Daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1909–1911.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.									
1	7.2	6.3	4.2	5.8	3.4	3.4	3.2	2.9	6.7
2	6.8	6.5	4.4	5.6	3.4	3.3	3.2	3.1	7.4
3	6.2	6.8	4.5	5.3	3.3	3.3	3.1	3.2	7.2
4	6.2	6.3	4.6	5.2	3.2	3.3	3.1	3.2	6.6
5	6.1	5.8	4.6	5.0	3.2	3.2	3.1	3.3	6.2
6	6.2	5.5	4.8	4.9	3.2	3.2	3.1	3.3	6.4
7	6.2	5.3	4.8	4.7	3.2	3.2	3.0	3.4	5.8
8	6.0	5.1	4.9	4.6	3.2	3.2	3.0	3.4	5.4
9	5.8	4.9	5.2	4.4	3.2	3.2	3.0	3.5	5.3
10	5.7	4.7	5.4	4.4	3.2	3.2	3.0	3.5	7.5
11	5.6	4.5	5.4	4.4	3.3	3.2	3.0	3.5	8.3
12	5.4	4.4	5.3	4.3	3.3	3.3	3.0	3.5	8.3
13	5.3	4.3	5.2	4.4	3.4	3.3	3.0	3.6	7.8
14	5.3	4.2	5.0	4.4	3.4	3.4	3.0	3.8	7.4
15	5.4	5.5	4.7	4.3	3.4	3.4	3.1	3.8	5.9

Daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1909–1911—Contd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.									
16	5.5	6.7	4.6	4.2	3.6	3.4	3.1	4.9	5.9
17	5.4	5.2	4.4	4.1	3.8	3.6	3.0	5.6	.....
18	5.6	5.4	4.3	4.0	4.2	3.8	3.0	6.5	.....
19	5.8	5.6	4.3	3.9	4.4	3.9	3.1	7.6	5.2
20	6.1	5.5	4.3	3.8	4.6	3.8	3.2	7.9	.....
21	6.9	5.3	4.2	3.8	4.2	3.6	3.2	6.7	.....
22	7.4	5.1	4.2	3.7	4.1	3.6	3.2	6.2	.....
23	6.8	4.9	4.2	3.7	4.0	3.5	3.1	5.6	4.4
24	6.3	4.6	4.4	3.6	3.8	3.4	3.1	5.7	.....
25	5.9	4.6	4.5	3.6	3.7	3.4	3.1	5.7	.....
26	5.7	4.4	4.8	3.6	3.6	3.4	3.0	5.5	4.5
27	5.7	4.3	5.4	3.6	3.6	3.3	3.0	5.5	.....
28	5.3	4.2	5.2	3.6	3.5	3.2	3.0	5.6	.....
29	6.9	4.2	5.3	3.6	3.5	3.2	3.0	5.8	.....
30	6.4	4.2	5.6	3.5	3.4	3.2	3.0	5.8	4.2
31	.....	4.2	.....	3.5	3.4	.....	3.0	.....	.....

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
1	.....	4.0	3.9	4.4	3.8	3.4	3.1	2.8	2.8	2.8	2.7	2.8
2	4.2	.....	.....	4.4	3.7	3.4	3.1	2.8	2.8	2.8	2.7	2.7
3	.....	.....	4.3	4.3	3.6	3.4	3.1	2.8	2.8	2.8	2.7	2.7
4	.....	.....	.....	4.3	3.6	3.4	3.1	2.8	2.8	2.8	2.7	2.7
5	3.9	3.9	4.6	4.4	3.5	3.4	3.0	2.8	2.8	2.8	2.8	.....
6	.....	.....	5.7	4.6	3.5	3.3	3.0	2.8	2.8	2.8	2.7	.....
7	.....	.....	6.0	4.4	3.5	3.3	3.0	2.8	2.8	2.8	2.7	2.9
8	.....	3.8	5.8	4.2	3.5	3.3	3.0	2.7	2.8	2.8	2.7	.....
9	.....	.....	5.5	4.2	3.4	3.3	3.0	2.7	2.8	2.8	2.7	2.9
10	3.7	.....	5.6	4.0	3.4	3.2	3.0	2.7	2.8	2.8	2.7	.....
11	.....	3.9	5.8	4.0	3.4	3.2	3.0	2.6	2.8	2.8	2.8	.....
12	.....	.....	7.6	3.9	3.4	3.2	2.9	2.6	2.8	2.8	2.8	2.8
13	.....	.....	8.6	3.9	3.4	3.2	2.9	2.6	2.7	2.8	2.8	.....
14	3.9	4.0	9.5	3.9	3.3	3.2	2.9	2.6	2.7	2.8	2.8	3.0
15	.....	.....	8.6	4.1	3.3	3.2	2.9	2.6	2.7	2.8	2.8	.....
16	4.2	.....	8.2	4.1	3.3	3.2	2.9	2.7	2.7	2.7	2.8	3.0
17	.....	3.9	7.9	4.0	3.5	3.2	2.8	2.7	2.7	2.7	2.8	.....
18	.....	.....	7.5	3.9	3.6	3.1	2.8	2.8	2.8	2.7	2.8	.....
19	.....	.....	7.1	3.8	3.6	3.1	2.8	2.8	2.8	2.7	2.8	3.1
20	4.3	.....	6.5	3.8	3.6	3.1	2.8	2.8	2.8	2.7	2.8	.....
21	.....	.....	6.0	3.8	3.6	3.1	2.8	3.1	2.8	2.7	2.7	.....
22	.....	3.7	5.6	3.8	3.6	3.1	2.8	3.0	2.8	2.7	2.7	2.9
23	.....	.....	5.7	3.7	3.7	3.1	2.8	2.9	2.8	2.8	2.7	.....
24	.....	.....	5.5	3.7	3.7	3.1	2.8	2.9	2.9	2.8	2.7	2.9
25	4.3	3.6	5.4	3.8	3.8	3.0	2.8	2.8	3.4	2.8	2.7	.....
26	.....	.....	5.3	3.8	3.7	3.0	2.8	2.8	3.3	2.7	2.7	3.0
27	.....	3.6	5.1	3.7	3.6	3.0	2.8	2.8	3.2	2.7	2.7	.....
28	4.3	.....	4.9	3.7	3.5	3.1	2.8	2.9	3.0	2.7	2.7	2.9
29	.....	.....	4.8	3.7	3.5	3.1	2.8	2.9	2.9	2.7	2.7	.....
30	.....	.....	4.6	3.8	3.4	3.1	2.8	2.8	2.9	2.7	2.8	.....
31	.....	.....	4.5	.....	3.4	.....	2.8	2.8	.....	2.7	.....	2.8
1911.												
1	2.5	.....	3.8	3.0	3.1	3.6	2.8	2.9	3.0	5.5	3.6	3.1
2	.....	2.7	3.7	3.0	3.1	3.6	2.8	2.8	3.0	4.6	3.6	3.1
3	2.6	.....	3.7	3.0	3.1	4.1	2.8	2.9	3.0	4.1	3.5	3.2
4	.....	2.8	3.8	3.1	3.1	4.3	2.7	2.9	3.0	3.9	3.5	3.1
5	.....	.....	3.9	3.1	3.1	4.1	2.7	2.8	2.9	3.8	3.5	3.2
6	2.8	2.8	3.8	3.1	3.2	4.0	2.7	2.8	2.9	3.7	3.5	3.3
7	.....	.....	3.8	3.1	3.2	3.9	2.7	2.8	2.9	3.7	3.5	3.2
8	.....	3.0	3.6	3.1	3.2	3.8	2.7	2.8	3.0	3.6	3.6	3.2
9	2.6	.....	3.4	3.0	3.2	3.6	2.7	2.8	3.0	3.7	3.7	3.2
10	.....	3.1	3.3	3.0	3.1	3.6	2.7	4.3	3.0	3.7	3.8	3.4
11	2.3	.....	3.3	3.0	3.0	3.4	2.7	3.8	2.9	3.7	3.8	3.8
12	.....	3.3	3.3	3.0	3.0	3.3	2.7	3.9	2.9	3.7	3.9	4.0
13	.....	3.4	3.3	3.1	3.0	3.3	2.6	4.1	3.2	3.8	3.6	4.2
14	2.4	5.9	3.3	3.2	3.0	3.2	2.6	3.7	3.1	3.8	3.1	4.3
15	.....	5.7	3.2	3.2	3.2	3.2	2.6	3.8	3.0	3.8	3.2	4.2

Daily gage height, in feet, of Cedar River at Cedar Rapids, Iowa, for 1909–1911—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1911.												
16	2.6	6.8	3.2	3.2	3.2	3.1	2.6	4.0	3.0	3.8	3.3	4.2
17	.....	6.2	3.2	3.2	3.3	3.1	2.6	4.3	3.1	4.0	3.4	4.2
18	.....	6.6	3.2	3.2	3.3	3.1	2.6	4.9	3.5	4.3	3.4	4.0
19	2.4	5.2	3.1	3.2	3.3	3.1	2.6	5.0	3.3	4.8	3.8	3.8
20	.....	4.9	3.1	3.2	3.3	3.0	2.6	4.4	3.2	4.6	3.3	3.6
21	.....	4.6	3.1	3.2	3.9	3.0	2.6	3.9	3.2	5.1	3.3	3.5
22	.....	4.2	3.1	3.1	3.8	3.0	2.6	3.7	3.2	5.8	3.2	3.4
23	2.5	4.0	3.1	3.1	3.8	3.0	2.6	3.5	3.3	4.7	3.2	3.4
24	.....	4.1	3.0	3.0	3.1	3.0	2.5	3.4	3.3	4.4	3.2	3.5
25	2.7	4.1	3.0	3.0	4.3	3.0	2.5	3.3	3.2	4.1	3.2	3.6
26	.....	4.2	3.0	2.9	4.2	2.9	2.5	3.2	3.1	4.0	3.1	3.8
27	2.9	4.1	3.1	2.9	4.1	2.9	2.5	3.2	3.2	3.9	3.1	3.7
28	.....	4.0	3.0	2.9	2.9	2.9	2.5	3.1	3.2	3.8	3.1	3.5
29	2.6	.....	3.0	3.1	2.8	2.8	2.7	3.1	3.4	3.7	3.1	3.4
30	.....	.....	3.0	3.0	2.7	2.8	2.8	3.1	3.6	3.7	3.1	3.4
31	2.4	.....	3.0	.....	2.5	.....	2.8	3.0	.....	3.7	.....	3.4

NOTE.—Daily gage height January, February, and March, 1909, published in Water-Supply Paper 265, p. 171. Gage heights from Mar. 14, 1910, to July 31, 1911, as published above, are 1.0 foot greater than reported by the observer. See discussion under "Accuracy" in station description. On days of missing gage height during January, February, March, and December observer reported "Frozen." Relation of gage height to discharge probably affected by ice about Dec. 16, 1909, to Mar. 4, 1910, and Dec. 4, 1910, to Feb. 11, 1911.

Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for 1909–1911.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.											
1	.....	.....	14,600	11,200	3,790	9,340	1,630	1,630	1,260	810	12,700
2	.....	.....	13,100	12,000	4,430	8,610	1,630	1,440	1,260	1,100	15,400
3	.....	.....	10,800	13,100	4,760	7,530	1,440	1,440	1,100	1,260	14,600
4	.....	.....	10,800	11,200	5,090	7,170	1,260	1,440	1,100	1,260	12,300
5	.....	.....	10,400	9,340	5,090	6,470	1,260	1,260	1,100	1,440	10,800
6	.....	.....	10,800	8,250	5,770	6,120	1,260	1,260	1,100	1,440	11,600
7	.....	.....	10,800	7,530	5,770	5,430	1,260	1,260	950	1,630	9,340
8	.....	.....	10,100	6,820	6,120	5,090	1,260	1,260	950	1,630	7,890
9	.....	.....	9,340	6,120	7,170	4,430	1,260	1,260	950	1,840	7,530
10	.....	.....	8,970	5,430	7,890	4,430	1,260	1,260	950	1,840	15,800
11	.....	.....	8,610	4,760	7,890	4,430	1,440	1,260	950	1,840	19,000
12	.....	.....	7,890	4,430	7,530	4,110	1,440	1,440	950	1,840	19,000
13	.....	.....	7,530	4,110	7,170	4,430	1,630	1,440	950	2,070	17,000
14	.....	.....	7,530	3,790	6,470	4,430	1,630	1,630	950	2,590	15,400
15	.....	.....	7,890	8,250	5,430	4,110	1,630	1,630	1,100	2,590	9,710
16	.....	.....	8,250	12,700	5,090	3,790	2,070	1,630	1,100	6,120	.....
17	.....	.....	7,890	7,170	4,430	3,480	2,590	2,070	950	8,610	.....
18	.....	.....	8,610	7,890	4,110	3,170	3,790	2,590	950	12,000	.....
19	.....	.....	9,340	8,610	4,110	2,870	4,430	2,870	1,100	16,200	.....
20	.....	.....	10,400	8,250	4,110	2,590	5,090	2,590	1,260	17,400	.....
21	.....	.....	13,500	7,530	3,790	2,590	3,790	2,070	1,260	12,700	.....
22	.....	.....	15,400	6,820	3,790	2,320	3,480	2,070	1,260	10,800	.....
23	.....	.....	13,100	6,120	3,790	2,320	3,170	1,840	1,100	8,610	.....
24	.....	.....	11,200	5,090	3,790	2,070	2,590	1,630	1,100	8,970	.....
25	.....	.....	9,710	5,090	4,760	2,070	2,320	1,630	1,100	8,970	.....
26	.....	.....	8,970	4,430	5,770	2,070	2,070	1,630	950	8,250	.....
27	.....	.....	8,970	4,110	7,890	2,070	2,070	1,440	950	8,250	.....
28	.....	.....	7,530	3,790	7,170	2,070	1,840	1,260	950	8,610	.....
29	.....	.....	13,500	3,790	7,530	2,070	1,840	1,260	950	9,340	.....
30	.....	.....	11,600	3,790	8,610	1,840	1,630	1,260	950	9,340	.....
31	.....	.....	.....	3,790	.....	1,840	1,630	.....	950	.....	.....
1910.											
1	.....	2,870	4,430	2,590	1,630	1,100	690	690	690	580	.....
2	.....	3,500	4,430	2,320	1,630	1,100	690	690	690	580	.....
3	.....	4,110	4,110	2,070	1,630	1,100	690	690	690	580	.....
4	.....	4,600	4,110	2,070	1,630	1,100	690	690	690	580	.....
5	.....	5,090	4,430	1,840	1,630	950	690	690	690	690	.....

Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for 1909–1911—Con.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.											
6	.....	8,970	5,090	1,840	1,440	950	690	690	690	580	.....
7	.....	10,100	4,430	1,840	1,440	950	690	690	690	580	.....
8	.....	9,340	3,790	1,840	1,440	950	580	690	690	580	.....
9	.....	8,250	3,790	1,630	1,440	950	580	690	690	580	.....
10	.....	8,610	3,170	1,630	1,260	950	580	690	690	580	.....
11	.....	9,340	3,170	1,630	1,260	950	490	690	690	690	.....
12	.....	16,200	2,870	1,630	1,260	810	490	690	690	690	.....
13	.....	20,200	2,870	1,630	1,260	810	490	580	690	690	.....
14	.....	23,700	2,870	1,440	1,260	810	490	580	690	690	.....
15	.....	20,200	3,480	1,440	1,260	810	490	580	690	690	.....
16	.....	18,600	3,480	1,400	1,260	810	580	580	580	690	.....
17	.....	17,400	3,170	1,840	1,260	690	580	580	580	690	.....
18	.....	15,800	2,870	2,070	1,100	690	690	690	580	690	.....
19	.....	14,300	2,590	2,070	1,100	690	690	690	580	690	.....
20	.....	12,000	2,590	2,070	1,100	690	690	690	580	690	.....
21	.....	10,100	2,590	2,070	1,100	690	1,100	690	580	580	.....
22	.....	8,610	2,590	2,070	1,100	690	950	690	580	580	.....
23	.....	8,970	2,320	2,320	1,100	690	810	690	690	580	.....
24	.....	8,250	2,320	2,320	1,100	690	810	810	690	580	.....
25	.....	7,890	2,590	2,590	950	690	690	1,630	690	580	.....
26	.....	7,530	2,590	2,320	950	690	690	1,440	580	580	.....
27	.....	6,820	2,320	2,070	950	690	690	1,260	580	580	.....
28	.....	6,120	2,320	1,840	1,100	690	810	950	580	580	.....
29	.....	5,770	2,320	1,840	1,100	690	810	810	580	580	.....
30	.....	5,090	2,590	1,630	1,100	690	690	810	580	690	.....
31	.....	4,760	.....	1,630	.....	690	690	.....	580	.....	.....
1911.											
1	450	2,590	950	1,100	2,070	690	810	950	8,250	2,070	1,100
2	580	2,320	950	1,100	2,070	690	690	950	5,090	2,070	1,100
3	600	2,320	950	1,100	3,480	690	810	950	3,480	1,840	1,260
4	690	2,590	1,100	1,100	4,110	580	810	950	2,870	1,840	1,100
5	690	2,870	1,100	1,100	3,480	580	690	810	2,590	1,840	1,260
6	690	2,590	1,100	1,260	3,170	580	690	810	2,320	1,840	1,440
7	800	2,590	1,100	1,260	2,870	580	690	810	2,320	1,840	1,260
8	950	2,070	1,100	1,260	2,590	580	690	950	2,070	2,070	1,260
9	1,000	1,630	950	1,260	2,070	580	690	950	2,320	2,320	1,260
10	1,100	1,440	950	1,100	2,070	580	4,110	950	2,320	2,590	1,630
11	1,200	1,440	950	950	1,630	580	2,590	810	2,320	2,590	2,590
12	1,440	1,440	950	950	1,440	580	2,870	810	2,320	2,870	3,170
13	1,630	1,440	1,100	950	1,440	490	3,480	1,260	2,590	2,070	3,790
14	9,710	1,440	1,260	950	1,260	490	2,320	1,100	2,590	1,100	4,110
15	8,970	1,260	1,260	1,260	1,260	490	2,590	950	2,590	1,260	3,790
16	13,100	1,260	1,260	1,260	1,100	490	3,170	950	2,590	1,440	3,790
17	10,800	1,260	1,260	1,440	1,100	490	4,110	1,100	3,170	1,630	3,790
18	12,300	1,260	1,260	1,440	1,100	490	6,120	1,840	4,110	1,630	3,170
19	7,170	1,100	1,260	1,440	1,100	490	6,470	1,440	5,770	2,590	2,590
20	6,120	1,100	1,260	1,440	950	490	4,430	1,260	5,090	1,440	2,070
21	5,090	1,100	1,260	2,870	950	490	2,870	1,260	6,820	1,440	1,840
22	3,790	1,100	1,100	2,590	950	490	2,320	1,260	9,340	1,260	1,630
23	3,170	1,100	1,100	2,590	950	490	1,840	1,440	5,430	1,260	1,630
24	3,480	950	950	1,100	950	410	1,630	1,440	4,430	1,260	1,840
25	3,480	950	950	4,110	950	410	1,440	1,260	3,480	1,260	2,070
26	3,790	950	810	3,790	810	410	1,260	1,100	3,170	1,100	2,590
27	3,480	1,100	810	3,480	810	410	1,260	1,260	2,870	1,100	2,320
28	3,170	950	810	2,870	810	410	1,100	1,260	2,590	1,100	1,840
29	.....	950	1,100	2,590	690	580	1,100	1,630	2,320	1,100	1,630
30	.....	950	950	2,320	690	690	1,100	2,070	2,320	1,100	1,630
31	.....	950	.....	1,840	.....	690	950	.....	2,320	.....	1,630

NOTE.—Daily discharge January, February, and March, 1909, published in Water-Supply Paper 265, page 171. Daily discharge Mar. 14, 1910, to July 31, 1911, computed from corrected gage heights. See discussion under "Accuracy" in station description. Daily discharge May 28 to 31, 1911, corresponds to gage heights 1.0 foot higher than published above, because of apparent additional error in gage heights. Discharge Dec. 16, 1909, to Feb. 28, 1910; Mar. 2 and 4, 1910; Dec. 1, 1910, to Jan. 31, 1911; and Feb. 1, 3, 5, 7, 9, and 11, 1911, estimated because of ice. Mean discharge Dec. 16 to 31, 1909, estimated 5,000 second-feet.

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for 1909–1911.

[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.		
1909.						
January	9,300	840	1,660	0.263	0.30	B.
February	7,020	2,300	4,850	.767	.80	B.
March	21,000	4,290	8,780	1.39	1.60	B.
April	15,400	7,530	10,200	1.61	1.80	C.
May	13,100	3,790	6,950	1.10	1.27	C.
June	8,610	3,790	5,640	.892	1.00	C.
July	9,340	1,840	3,900	.617	.71	C.
August	5,090	1,260	2,120	.335	.39	C.
September	2,870	1,260	1,620	.256	.29	C.
October	1,260	950	1,050	.166	.19	C.
November	17,400	810	5,980	.946	1.06	C.
December	19,000	.....	[a] 8,970	1.42	1.64	D.
The year	21,000	810	5,140	.813	11.05	
1910.						
January	.....	.....	[b] 2,500	.396	.46	D.
February	.....	.....	[b] 2,000	.316	.33	D.
March	23,700	2,870	10,100	1.60	1.84	(c)
April	4,430	2,320	3,210	.508	.57	(c)
May	2,590	1,440	1,920	.304	.35	(c)
June	1,630	950	1,260	.199	.22	(c)
July	1,100	690	821	.130	.15	(c)
August	1,100	490	677	.107	.12	(c)
September	1,630	580	768	.122	.14	(c)
October	690	580	644	.102	.12	(c)
November	690	580	624	.099	.11	(c)
December	.....	.....	[b] 550	.087	.10	(c)
The year	23,700	.....	2,100	.332	4.51	
1911.						
January	.....	.....	[b] 400	.063	.07	(c)
February	13,100	[b] 450	3,910	.619	.64	(c)
March	2,870	950	1,520	.241	.28	(c)
April	1,260	810	1,060	.168	.19	(c)
May	4,110	950	1,740	.275	.32	(c)
June	4,110	690	1,630	.258	.29	(c)
July	690	410	538	.085	.10	(c)
August	6,470	690	2,120	.335	.39	B.
September	2,070	810	1,150	.182	.20	B.
October	9,340	2,070	3,610	.571	.66	B.
November	2,870	1,100	1,700	.269	.30	B.
December	4,110	1,100	2,130	.337	.39	C.
The year	13,100	410	1,780	.282	3.83	

[a] Partly estimated. See footnotes to table of daily discharge.
[b] Estimated.
[c] See station description for discussion of accuracy.

NOTE.—Monthly discharge January, February, and March, 1909, same as published in Water-Supply Paper 265, p. 171. The open-channel rating was applied during the period, the relation of gage height to discharge probably affected only slightly by ice.

DES MOINES RIVER AT JACKSON, MINN.

Location.—At highway bridge half a mile below the dam in Jackson, 100 yards above the nearest tributary, a small stream entering from the west.

Records available.—May 31, 1909, to November 30, 1911.

Drainage area.—1,160 square miles.

Gage.—Vertical staff; datum unchanged since established.

Channel.—Practically permanent.

Discharge measurements.—Made from the bridge.

Winter flow.—Observations are discontinued from December to March because of ice.

Regulation.—At the dam half a mile above the station is a power plant which develops 35 horsepower under a head of 6½ feet. The plant operates only six hours a day on the average, but so far the morning and evening gage heights do not show any appreciable change in the stage of the river owing to water being held back in the low-water season after the turbines have been shut down.

The following discharge measurement was made by C. J. Emerson:
May 3, 1911: Gage height, 2.92 feet; discharge, 39.4 second-feet.

Daily gage height, in feet, of Des Moines River at Jackson, Minn., for 1911.

[Albert Strobel, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.02	2.99	2.75	2.40	2.50	2.80	2.95	3.46	.....
2	.....	2.94	2.92	2.89	2.40	2.68	2.79	2.95	3.29	.....
3	.....	2.91	2.84	2.80	2.42	2.66	2.78	2.96	3.34	.....
4	.....	2.85	2.79	2.74	2.45	2.58	2.70	3.00	3.26	.....
5	.....	2.98	2.69	2.71	2.45	2.60	2.88	3.21	3.25	.....
6	.....	2.96	2.82	2.60	2.42	2.66	3.00	4.51	3.31	.....
7	.....	2.98	2.79	2.60	2.41	3.12	3.05	4.30	3.41	.....
8	.....	2.99	2.80	2.60	2.44	2.99	3.01	4.44	3.36	.....
9	.....	2.98	2.80	2.59	2.40	2.82	2.94	4.25	3.36	.....
10	.....	3.04	2.70	2.58	2.36	3.65	2.92	4.18	3.38	3.40
11	.....	2.84	2.66	2.54	2.35	3.21	2.96	4.20	3.42	3.30
12	.....	2.80	2.65	2.52	2.35	2.99	2.94	4.18	3.65	3.18
13	3.00	2.85	2.65	2.50	2.38	2.98	2.92	4.15	3.32	3.18
14	3.05	2.92	2.65	2.48	2.38	3.15	2.89	4.09	3.12	3.16
15	3.20	3.01	2.66	2.45	2.36	3.10	2.84	4.02	3.08	3.14
16	3.02	2.96	2.68	2.44	2.35	2.94	2.86	3.99	3.02	3.24
17	3.09	3.02	2.70	2.46	2.35	3.08	2.95	4.11	3.11	3.21
18	2.99	2.86	2.72	2.40	2.36	3.02	3.32	4.05	3.05	3.40
19	3.08	2.84	2.79	2.40	2.75	3.18	3.40	4.01	3.00	3.16
20	3.05	3.02	2.66	2.40	2.65	2.96	3.55	4.00	3.01	3.12
21	3.08	3.02	2.65	2.40	2.72	2.91	3.48	3.92	3.02	3.11
22	3.08	2.99	2.68	2.40	2.68	2.88	3.32	3.90	3.05	3.10
23	2.96	2.86	2.71	2.40	2.61	2.86	3.18	3.79	3.54	3.39
24	2.91	2.90	2.88	2.40	2.51	2.88	3.05	3.90	3.42	3.25
25	2.89	2.84	2.90	2.42	2.50	2.85	3.01	3.72	3.12	3.25
26	2.90	2.70	2.79	2.49	2.56	2.95	3.00	3.69	3.09	.....
27	2.91	2.69	2.72	2.48	2.55	2.90	3.06	3.66	3.00	.....
28	2.88	2.68	2.71	2.48	2.49	2.82	3.00	3.60	.....	.....
29	2.80	2.81	2.70	2.48	2.49	2.80	2.96	3.55	.....	.....
30	2.82	2.75	2.68	2.41	2.48	2.80	2.96	3.40	.....	.....
31	2.95	.....	2.69	.....	2.49	2.79	.....	3.52	.....	.....

NOTE.—Ice present about Jan. 1 to Mar. 12, Nov. 28 to Dec. 9, and Dec. 23 to 31, 1911.

Daily discharge, in second-feet, of Des Moines River at Jackson, Minn., for 1911.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	48	46	34	20	23	36	44	90	.....
2	.....	43	42	40	20	30	36	44	70	.....
3	.....	42	38	36	21	29	35	45	75	.....
4	.....	38	36	33	22	26	31	47	67	.....
5	.....	46	31	32	22	27	40	63	66	.....
6	.....	45	37	27	21	29	47	267	72	.....
7	.....	46	36	27	20	56	50	226	88	.....
8	.....	46	36	27	21	46	48	253	78	.....
9	.....	46	36	27	20	37	43	216	78	.....
10	.....	50	31	26	19	116	42	207	80	82
11	.....	38	29	25	18	63	45	207	85	71
12	.....	36	29	24	18	46	43	207	116	60
13	47	38	29	23	19	46	42	198	73	60
14	50	42	29	22	19	58	40	189	56	59
15	62	48	29	22	19	54	38	172	53	57

Daily discharge, in second-feet, of Des Moines River at Jackson, Minn., for 1911—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	48	45	30	21	18	43	39	172	48	66
17	53	48	31	22	18	53	44	189	55	63
18	46	39	32	20	19	48	73	180	50	82
19	53	38	36	20	34	60	82	172	47	59
20	50	48	29	20	29	45	102	172	48	56
21	53	48	29	20	32	42	92	155	48	55
22	53	46	30	20	30	40	73	155	50	54
23	45	39	32	20	27	39	60	139	102	.....
24	42	41	40	20	23	40	50	155	85	.....
25	40	38	41	21	23	38	48	124	56	.....
26	41	31	36	23	25	44	47	124	53	.....
27	42	31	32	22	25	41	51	116	47	.....
28	40	30	32	22	23	37	47	109	.....	.....
29	36	36	31	22	23	36	45	102	.....	.....
30	37	34	30	20	22	36	45	82	.....	.....
31	44	.....	31	.....	23	36	.....	98	.....	.....

NOTE.—Daily discharge computed from a well-defined rating curve. Discharge Nov. 28 to Dec. 9 and Dec. 23 to 31 estimated, because of ice, from climatologic records and discharge of adjacent drainage areas. Mean discharge Nov. 28 to Dec. 9, estimated 40 second-feet, varying from about 35 to 55 second-feet. Mean discharge Dec. 23 to 31, estimated 50 second-feet, varying from about 30 to 70 second-feet.

Monthly discharge of Des Moines River at Jackson, Minn., for 1911.

[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.		
March 13–31	62	36	46.4	0.040	0.03	A.
April	50	30	41.5	.036	.04	A.
May	46	29	33.4	.029	.03	A.
June	40	20	24.6	.021	.02	A.
July	34	18	22.4	.019	.02	A.
August	116	23	44.0	.038	.04	A.
September	102	31	50.5	.044	.05	A.
October	267	44	149	.128	.15	A.
November	116	35	64.7	.056	.06	B.
December	82	.....	53.0	.046	.05	C.

NOTE.—See footnotes to table of daily discharge.

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 1905–6. 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, 1911.

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 if heavy rains occur in the basin of that stream.

On August 4, 1911, at a gage height of 0.80 foot, Follansbee and Kay estimated the discharge as 29 second-feet, stating that a current-meter measurement was not possible because of low velocity.

Daily gage height, in feet, of Des Moines River near Fort Dodge, Iowa, for 1911.

[Ole C. Hanson, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.00	1.50	1.65	1.60	16	1.22	1.18	1.70	1.55	1.68
2	.....	1.10	1.50	1.80	1.60	17	1.00	1.22	1.75	1.50	1.70
3	.....	1.00	1.55	1.75	1.60	18	1.10	1.22	1.75	1.50	1.70
4	.80	1.10	1.50	1.70	1.60	19	1.25	1.20	1.70	1.55	1.72
5	.90	1.00	1.45	1.65	1.58	20	1.22	1.20	1.70	1.58	1.70
6	.90	1.18	1.45	1.60	1.55	21	1.25	1.25	1.70	1.60	1.70
7	.98	1.25	1.50	1.62	1.50	22	1.28	1.20	1.65	1.60	1.70
8	1.00	1.20	1.45	1.60	1.50	23	1.20	1.20	1.70	1.60	1.70
9	.95	1.20	1.40	1.60	1.50	24	1.18	1.20	1.70	1.60	1.70
10	1.02	1.60	1.45	1.55	1.50	25	1.18	1.25	1.70	1.60	1.68
11	1.05	1.40	1.45	1.60	1.75	26	1.20	1.25	1.68	1.60	1.65
12	1.10	1.25	1.60	1.55	1.80	27	1.15	1.20	1.70	1.60	1.62
13	1.05	1.95	1.65	1.60	1.78	28	1.20	1.20	1.70	1.60	1.60
14	1.10	1.40	1.70	1.60	1.75	29	1.10	1.22	1.70	1.58	1.60
15	1.10	1.30	1.75	1.60	1.70	30	1.22	1.25	1.65	1.60	1.60
						31	1.20	.....	1.65	.....	1.60

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, 1910, to December 31, 1910 (Army Engineers); August 3, 1911, to December 23, 1911.

Drainage area.—14,300 square miles.

Gage.—Chain gage attached to downstream side of bridge; same gage used throughout period of records. On August 3, 1911, a possible discrepancy of 0.20 or 0.26 foot was found, by levels, in the gage as referred to the original bench marks.

Channel.—Composed of sand and gravel on the left and rock on the right. Shifting of the sand occurs at flood stages.

Discharge measurements.—Made from the downstream side of the bridge.

Winter flow.—Relation of gage height to discharge is sometimes affected by ice.

Accuracy.—Gage heights and estimates of discharge for 1910 and 1911 are being withheld from publication until sufficient data are collected to eliminate the possible errors noted under "Gage."

Discharge measurements of Des Moines River at Keosauqua, Iowa, in 1910–11.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
1910. Aug. 4 [a]	A. D. Llewellyn	0.5	719
1911. Aug. 3	Follansbee and Kay	.10	266

[a] Measurement furnished by U. S. Army Engineers.

NOTE.—The gage heights above may be from 0.20 to 0.26 foot too low when referred to the original gage datum. See "Accuracy" paragraph in station description.

ILLINOIS RIVER BASIN.

SANGAMON RIVER NEAR MONTICELLO, ILL.

Location.—At Illinois Central Railroad bridge about half a mile west of Monticello, Ill.

Records available.—February 4, 1908, to December 31, 1911.

Drainage area.—550 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Section is at a pool; measurements to date indicate that control is permanent.

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 affects the relation between gage height and discharge during portions of December, January, and February.

The following discharge measurement was made by Monk and Brown:
October 11, 1911: Gage height, 5.22 feet; discharge, 356 second-feet.

Daily gage height, in feet, of Sangamon River near Monticello, Ill., for 1911.

[Martin Doyle, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.74	4.08	3.82	5.68	3.18	1.90	1.87	1.76	.....	4.38	6.21
2	3.75	6.00	4.00	.....	5.70	3.15	.....	1.78	1.70	8.83	4.22	6.10
3	a3.7	5.45	3.95	3.68	5.55	2.90	1.90	1.77	.....	8.97	4.03	.....
4	a3.45	5.18	3.85	4.15	5.23	.....	1.89	1.73	1.66	9.16	3.95	5.52
5	a3.3	.....	.....	6.20	5.00	2.75	1.86	1.68	1.67	8.96	.....	5.30
6	a3.05	4.65	3.65	7.90	4.72	2.68	1.81	.....	1.67	8.23	4.08	5.08
7	a2.9	4.15	4.32	7.98	.....	2.68	1.78	1.69	1.78	7.43	4.15	5.00
8	.....	4.00	5.31	7.28	4.40	2.55	1.78	1.69	1.76	.....	4.25	4.92
9	a2.7	4.00	6.60	.....	4.39	2.47	.....	1.68	2.14	6.07	4.37	4.86
10	a2.6	3.55	7.20	5.85	4.25	2.40	2.30	1.68	.....	5.63	4.30	.....
11	a2.7	3.31	6.55	5.45	4.80	.....	2.14	1.68	2.78	5.29	4.30	5.10
12	2.79	.....	.....	5.33	3.98	2.28	2.02	1.66	4.68	5.02	.....	5.34
13	3.25	3.84	5.64	5.38	3.81	2.24	1.96	.....	4.68	4.78	8.48	5.41
14	9.8	4.00	5.38	7.60	.....	2.20	1.84	1.61	3.73	4.58	8.88	5.32
15	.....	4.80	5.29	9.60	3.51	2.18	.....	1.60	3.37	.....	8.51	5.22
16	9.70	6.41	4.95	10.10	3.51	2.12	1.94	1.60	4.39	4.31	7.59	5.20
17	10.05	6.38	4.61	9.88	3.45	2.10	1.88	1.60	.....	4.48	8.34	.....
18	a7.95	6.00	4.60	8.61	3.40	.....	1.84	1.60	4.73	4.81	9.95	4.82
19	a7.2	.....	.....	7.80	3.35	2.01	1.79	1.58	4.23	4.61	10.15	4.68
20	a6.75	6.40	4.21	7.30	3.30	2.08	1.79	.....	4.48	4.28	10.20	4.62
21	a6.7	.....	4.00	7.30	.....	2.12	1.78	1.58	4.58	4.18	9.33	5.01
22	.....	4.95	4.00	7.30	3.41	2.08	.....	1.58	3.88	.....	8.60	6.50
23	a4.9	4.75	3.98	.....	3.38	2.01	.....	1.71	3.40	5.89	8.05	7.90
24	a4.5	5.00	3.72	6.20	3.22	2.04	1.84	1.93	.....	6.75	7.50	.....
25	4.71	4.61	3.60	5.81	3.15	.....	1.78	1.87	5.47	6.12	7.02	8.29
26	6.69	4.40	.....	5.55	3.02	2.18	1.77	1.86	8.63	5.68	.....	7.56
27	8.07	4.40	3.85	5.32	2.99	2.29	1.77	.....	9.10	5.26	6.38	7.55
28	9.95	4.23	4.05	5.32	.....	2.18	1.71	2.21	9.46	4.94	6.30	7.38
29	9.88	.....	4.23	5.40	2.89	2.08	1.78	1.80	9.56	.....	6.35	7.00
30	9.32	.....	4.08	.....	2.88	1.90	.....	1.78	8.83	4.56	6.42	7.29
31	8.02	.....	4.00	.....	2.98	.....	1.76	1.76	.....	4.50	.....	.....

a Gage read to top of ice Jan. 3 to 11 and Jan. 18 to 24. Ice 6 to 8 inches in thickness on Jan. 9.

NOTE.—Gage not read on Sunday. Relation of gage height to discharge affected by ice about Jan. 1 to 29.

Daily discharge, in second-feet, of Sangamon River near Monticello, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	646	180	150	444	88	8	7.4	5.2	1,180	219	545
2	.....	505	170	143	448	86	8	5.6	4	1,180	197	524
3	.....	401	164	136	420	66	8	5.4	4	1,230	174	469
4	.....	352	154	188	361	60	7.8	4.6	3.2	1,310	164	414
5	.....	306	144	543	320	54	7.2	3.6	3.4	1,230	172	374
6	.....	260	133	895	271	49	6.2	3.7	3.4	985	180	334
7	.....	188	211	915	246	49	5.6	3.8	5.6	784	188	320
8	.....	170	376	752	222	40	5.6	3.8	5.2	651	201	306
9	.....	170	619	614	221	35	4	3.6	17	518	218	295
10	.....	123	735	476	201	31	25	3.6	40	435	208	316
11	.....	100	610	401	284	27	17	3.6	56	356	208	338
12	.....	126	524	379	168	24	12	3.2	265	324	634	381
13	.....	152	437	388	149	22	10	2.7	265	281	1,060	394
14	.....	170	388	822	134	20	6.8	2.2	141	249	1.200	378
15	.....	284	372	1,580	119	19	8	2	105	236	1,070	360
16	.....	583	311	2,020	119	16	9.2	2	221	222	820	356
17	.....	577	254	1,810	113	15	7.6	2	250	233	1,020	322
18	.....	505	252	1,100	108	13	6.8	2	273	286	1,880	288
19	.....	548	224	870	104	11	5.8	1.6	198	254	2,070	265
20	.....	581	195	756	99	14	5.8	1.6	233	205	2,120	255
21	.....	446	170	756	125	16	5.6	1.6	249	192	1,410	322
22	.....	311	170	756	109	14	6.0	1.6	157	338	1,100	600
23	.....	276	168	650	106	11	6.4	4.2	108	484	934	895
24	.....	320	140	543	92	13	6.8	8.9	100	648	799	948
25	.....	254	128	469	86	16	5.6	7.4	405	528	699	1,000
26	.....	222	150	420	76	19	5.4	7.2	1,110	444	638	813
27	.....	222	154	378	73	24	5.4	15	1,280	367	577	810
28	.....	198	176	378	66	19	4.2	20	1,490	309	562	773
29	.....	.....	198	392	65	14	5.6	6	1,550	278	572	695
30	1,390	.....	180	400	64	8	5.5	5.6	1,180	246	585	754
31	926	.....	170	.....	72	.....	5.2	5.2	.....	236	.....	658

NOTE.—Daily discharge determined by means of a discharge rating curve well defined between 11 and 1,390 second-feet (gage heights 2 and 9.3 feet); fairly well defined between 1,450 and 7,360 second-feet (gage heights 9.4 and 14 feet). Above gage height 12.6 feet the curve was extended as a tangent. Daily discharge interpolated on days when gage was not read. Daily discharge Jan. 1 to 29 estimated, because of ice, from observer's notes, climatologic records, and discharge at Riverton, Ill. Mean discharge Jan. 1 to 29 estimated about 508 second-feet, varying from about 20 to 1,740 second-feet.

Monthly discharge of Sangamon River near Monticello, Ill., for 1911.

[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[a]	.....	.....	550	1.00	1.15	B.
February	646	100	321	.584	.61	A.
March	735	128	266	.484	.56	A.
April	2,020	136	669	1.22	1.36	B.
May	448	64	177	.322	.37	A.
June	88	8	29.8	.054	.06	B.
July	25	4	7.62	.014	.02	C.
August	20	1.6	4.86	.0088	.01	C.
September	1,550	3.2	324	.589	.66	A.
October	1,310	192	523	.951	1.10	A.
November	2,120	164	729	1.33	1.48	B.
December	1,000	255	500	.909	1.05	A.
The year	2,120	1.6	341	.620	8.43	

[a] For notes relative to estimated discharge during January see footnotes to table of daily discharge.

SANGAMON RIVER AT RIVERTON, ILL.

Location.—At Wabash Railroad bridge about a quarter of a mile west of depot at Riverton, Ill., about 2½ miles below the mouth of South Fork.

Records available.—February 13, 1908, to December 31, 1911.

Drainage area.—2,560 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Slightly shifting; section is at a pool and measurements to date indicate that the point of control is not changing; broken by two bridge piers.

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—December, January, and February—in the milder weather the formation of ice is prevented by warm water wasted from the factories.

Discharge measurements of Sangamon River at Riverton, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 20	P. S. Monk	11.80	1,180
Oct. 5	Monk and Brown	25.36	15,400

Daily gage height, in feet, of Sangamon River at Riverton, Ill., in 1911.

[J. H. Steele, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	14.5	17.7	13.45	10.9	14.4	10.0	9.3	7.4	7.8	27.1	12.3	14.3
2	14.1	17.65	13.1	10.7	16.0	9.8	8.7	7.35	7.6	26.6	12.1	14.2
3	13.5	17.4	12.55	10.9	16.1	9.6	8.4	7.3	7.4	26.5	11.9	14.1
4	12.1	16.65	12.25	13.0	16.0	9.4	8.1	7.3	7.3	26.4	11.6	13.9
5	11.6	14.9	11.85	15.9	15.8	9.3	8.0	7.2	7.2	25.4	11.5	13.6
6	11.3	13.8	11.65	17.9	15.4	9.1	7.9	7.15	7.2	24.8	11.5	13.3
7	11.25	13.25	11.9	18.5	14.4	9.4	7.7	7.1	7.4	23.9	11.8	13.1
8	11.2	12.9	14.25	18.4	13.45	9.0	7.6	8.0	8.2	23.2	12.0	12.9
9	10.8	12.85	15.75	18.2	12.7	8.8	7.5	8.2	10.7	22.6	12.1	12.7
10	10.2	12.5	16.55	17.8	12.3	8.5	7.5	8.4	12.8	21.9	12.1	12.6
11	10.0	12.4	16.75	17.0	12.0	8.5	7.4	8.1	11.0	21.0	12.0	12.8
12	9.9	12.25	15.8	15.6	11.7	8.4	7.4	7.9	10.1	19.6	16.0	13.0
13	9.8	12.0	15.45	14.7	11.5	8.2	7.7	7.6	10.0	17.5	17.4	13.1
14	17.3	11.85	14.75	17.1	11.2	8.2	7.5	7.4	13.2	16.0	17.8	13.1
15	20.5	12.2	13.85	20.3	10.9	8.1	7.3	7.3	13.9	15.0	17.8	13.1
16	21.6	12.35	13.15	20.9	10.7	8.1	7.25	7.2	13.8	14.4	17.7	13.0
17	20.5	12.65	12.7	20.6	10.6	8.0	7.2	7.1	14.4	13.9	17.9	13.0
18	19.5	13.6	12.35	20.5	10.5	8.0	7.1	7.0	14.1	13.6	19.1	12.8
19	18.9	14.45	12.15	20.4	10.3	7.9	7.0	6.9	14.2	13.3	20.2	12.6
20	18.7	15.0	11.85	19.8	10.2	7.85	7.0	6.8	14.5	13.0	20.1	12.6
21	18.9	15.75	11.6	19.0	11.8	7.9	7.0	6.7	14.6	12.8	19.9	13.2
22	17.2	15.55	11.4	17.7	13.4	8.0	7.0	6.7	13.9	12.9	19.5	16.2
23	15.65	15.3	11.2	16.0	12.6	7.9	7.0	6.7	12.8	13.1	19.2	17.4
24	14.0	14.75	11.0	14.8	11.4	7.9	7.0	7.0	11.8	13.4	18.8	17.45
25	13.45	14.3	10.8	14.1	10.8	10 6	7.0	7.55	16.9	13.7	18.4	17.1
26	13.3	13.95	10.7	13.6	10.4	9.5	7.0	7.9	19.7	13.9	17.8	16.8
27	13.9	13.75	10.9	13.1	10.2	9.7	7.0	8.0	19.8	13.9	17.1	17.3
28	16.25	13.6	10.9	12.9	10.0	9.4	6.9	7.9	20.3	13.6	16.1	17.5
29	17.1	.....	10.9	12.9	9.8	9.2	6.9	10.4	23.55	13.1	15.3	18.0
30	17.35	.....	11.0	13.0	9.8	9.4	6.9	9.6	26.4	12.7	14.8	16.4
31	17.5	.....	11.0	.....	10.2	.....	6.85	8.3	.....	12.5	.....	16.0

NOTE.—Relation of gage height to discharge probably not affected by ice during 1911.

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,380	4,190	1,850	888	2,320	603	411	128	168	19,200	1,390	2,260
2	2,160	4,160	1,710	824	3,200	542	287	124	148	18,100	1,310	2,210
3	1,870	4,010	1,480	888	3,260	486	240	119	128	17,800	1,240	2,160
4	1,310	3,580	1,370	1,660	3,200	435	202	119	119	17,600	1,130	2,050
5	1,130	2,600	1,220	3,140	3,090	411	190	110	110	15,300	1,100	1,920
6	1,020	2,000	1,150	4,310	2,870	366	179	106	110	14,000	1,100	1,790
7	1,010	1,770	1,240	4,690	2,320	435	158	101	128	12,100	1,200	1,710
8	990	1,620	2,240	4,620	1,850	344	148	190	214	10,700	1,280	1,620
9	856	1,600	3,060	4,490	1,540	305	138	214	824	9,620	1,310	1,540
10	665	1,460	3,520	4,250	1,390	254	138	240	1,580	8,460	1,310	1,500
11	603	1,420	3,640	3,780	1,280	254	128	202	920	7,180	1,280	1,580
12	572	1,370	3,090	2,980	1,170	240	128	179	634	5,610	3,200	1,660
13	542	1,280	2,900	2,480	1,100	214	158	148	603	4,070	4,010	1,710
14	3,950	1,220	2,510	3,840	990	214	138	128	1,750	3,200	4,250	1,710
15	6,560	1,350	2,030	6,340	888	202	119	119	2,050	2,650	4,250	1,710
16	8,010	1,410	1,730	7,060	824	202	114	110	2,000	2,320	4,190	1,660
17	6,560	1,520	1,540	6,680	792	190	110	101	2,320	2,050	4,310	1,660
18	5,520	1,920	1,410	6,560	760	190	101	92	2,160	1,920	5,160	1,580
19	4,990	2,350	1,330	6,450	696	179	92	83	2,210	1,790	6,220	1,500
20	4,840	2,650	1,220	5,800	665	174	92	75	2,380	1,660	6,120	1,500
21	4,990	3,060	1,130	5,070	1,200	179	92	67	2,430	1,580	5,900	1,750
22	3,900	2,950	1,060	4,190	1,830	190	92	67	2,050	1,620	5,520	3,320
23	3,010	2,820	990	3,200	1,500	179	92	67	1,580	1,710	5,240	4,010
24	2,100	2,510	920	2,540	1,060	179	92	92	1,200	1,830	4,910	4,040
25	1,850	2,260	856	2,160	856	792	92	143	3,720	1,960	4,620	3,840
26	1,790	2,080	824	1,920	728	460	92	179	5,700	2,050	4,250	3,660
27	2,050	1,980	888	1,710	665	513	92	190	5,800	2,050	3,840	3,950
28	3,340	1,920	888	1,620	603	435	83	179	6,340	1,920	3,260	4,070
29	3,840	.....	888	1,620	542	388	83	728	11,400	1,710	2,820	4,370
30	3,980	.....	920	1,660	542	435	83	486	17,600	1,540	2,540	3,430
31	4,070	.....	920	.....	665	.....	79	227	.....	1,460	.....	3,200

NOTE.—Daily discharge determined by means of a discharge rating curve well defined between 138 and 4,370 second-feet (gage heights 7.5 and 18.0 feet). Above 4,370 second-feet (gage height 18.0 feet) the rating curve is based on one discharge measurement at gage height 25.4 feet.

Monthly discharge of Sangamon River at Riverton, Ill., for 1911.

[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	8,010	542	2,920	1.14	1.31	B.
February	4,190	1,220	2,250	.879	.92	A.
March	3,640	824	1,630	.637	.73	A.
April	7,060	824	3,580	1.40	1.56	A.
May	3,260	542	1,430	.559	.64	A.
June	792	174	333	.130	.14	B.
July	411	79	137	.054	.06	B.
August	728	67	165	.064	.07	B.
September	17,600	110	2,610	1.02	1.14	A.
October	19,200	1,460	6,280	2.45	2.82	A.
November	6,220	1,100	3,280	1.28	1.43	B.
December	4,370	1,500	2,410	.941	1.09	B.
The year	19,200	67	2,250	.879	11.91	

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, and December 10 to 31, 1911.

Drainage area.—5,000 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

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 or no 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 on 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 trestle 2½ miles below the gaging station may at times affect the relation between gage height and discharge.

Discharge measurements of Sangamon River near Oakford, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 21	P. S. Monk	5.95	2,300
Oct. 10	Monk and Brown	16.60	16,400

Daily gage height, in feet, of Sangamon River near Oakford, Ill., for 1911.

[Ed. J. Bonnett, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.9	11.1	6.7	4.9	6.95	4.05	.....	.....	.....	.....	.....	.....
2	6.5	10.25	6.55	4.8	7.85	3.9	.....	.....	.....	.....	.....	.....
3	6.5	9.9	6.35	4.9	8.05	3.85	.....	.....	.....	.....	.....	.....
4	8.6	9.6	6.0	5.25	8.35	3.7	.....	.....	.....	20.6	.....	.....
5	8.0	9.15	5.8	7.35	8.1	3.6	.....	.....	.....	.....	.....	.....
6	7.8	8.0	5.7	9.05	7.9	3.55	.....	.....	.....	.....	.....	.....
7	a 7.7	7.3	5.6	9.95	7.8	3.4	.....	.....	.....	.....	.....	.....
8	a 7.5	6.75	6.9	10.35	7.1	3.3	.....	.....	.....	.....	.....	.....
9	a 6.8	6.5	8.4	10.3	6.5	3.15	.....	.....	.....	.....	.....	.....
10	a 6.7	6.2	9.0	10.05	6.1	3.05	.....	.....	.....	16.6	.....	6.9
11	a 6.5	6.1	9.2	9.85	5.8	3.0	.....	.....	.....	.....	.....	6.8
12	a 5.9	6.0	9.1	9.4	5.55	2.65	.....	.....	.....	.....	.....	6.85
13	7.1	5.95	9.0	9.25	5.35	2.6	.....	.....	.....	.....	.....	6.95
14	9.1	5.9	8.6	9.2	5.15	2.55	.....	.....	.....	.....	.....	7.1
15	10.2	6.0	8.1	9.9	4.9	2.5	.....	.....	.....	.....	.....	7.05
16	11.0	6.85	7.5	11.1	4.7	2.4	.....	.....	.....	.....	.....	7.1
17	12.1	7.0	7.0	12.0	4.55	2.35	.....	.....	.....	.....	.....	7.0
18	12.0	7.2	6.5	12.2	4.45	2.3	.....	.....	.....	.....	.....	7.0
19	11.8	7.5	6.5	12.3	4.35	2.3	.....	.....	.....	.....	.....	6.8
20	11.5	8.0	6.2	12.0	4.25	2.25	.....	.....	.....	.....	.....	6.5
21	11.4	8.6	5.9	11.8	4.2	2.2	.....	.....	.....	.....	.....	6.8
22	10.9	8.55	5.65	11.35	5.85	2.15	.....	.....	.....	.....	.....	8.2
23	10.55	8.25	5.4	10.7	6.5	2.15	.....	.....	.....	.....	.....	10.1
24	9.3	8.1	5.2	9.05	5.8	2.2	.....	.....	.....	.....	.....	11.0
25	8.0	7.9	5.15	8.6	5.45	4.35	.....	.....	.....	.....	.....	11.2
26	8.3	7.4	5.0	7.7	4.8	3.75	.....	.....	.....	.....	.....	11.0
27	9.95	7.1	4.95	7.2	4.5	3.9	.....	.....	.....	.....	.....	10.95
28	11.45	6.9	5.0	7.0	4.25	3.05	.....	.....	.....	.....	.....	10.9
29	12.9	.....	5.0	6.9	4.15	4.2	.....	.....	.....	.....	.....	10.8
30	12.5	.....	5.0	6.9	4.15	3.5	.....	.....	.....	.....	.....	10.65
31	11.6	.....	5.0	.....	4.15	.....	.....	.....	.....	.....	.....	10.3

a Jan. 7 to 12, gage heights to top of ice.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 4 to 14. Record lacking July 1 to Dec. 9 because no observer could be obtained.

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,000	6,960	2,840	1,610	3,030	1,170	.....	.....	.....	.....	.....	.....
2	2,700	6,040	2,730	1,560	3,740	1,100	.....	.....	.....	.....	.....	.....
3	2,700	5,680	2,580	1,610	3,900	1,080	.....	.....	.....	.....	.....	.....
4	.....	5,360	2,320	1,820	4,180	1,020	.....	.....	.....	26,300	.....	.....
5	.....	4,910	2,180	3,340	3,950	980	.....	.....	.....	.....	.....	.....
6	.....	3,860	2,110	4,810	3,780	960	.....	.....	.....	.....	.....	.....
7	.....	3,300	2,040	5,730	3,700	900	.....	.....	.....	.....	.....	.....
8	.....	2,880	3,000	6,150	3,140	860	.....	.....	.....	.....	.....	.....
9	.....	2,700	4,220	6,100	2,700	800	.....	.....	.....	.....	.....	.....
10	.....	2,470	4,760	5,830	2,400	760	.....	.....	.....	16,300	.....	3,000
11	.....	2,400	4,960	5,620	2,180	740	.....	.....	.....	.....	.....	2,920
12	.....	2,320	4,860	5,160	2,000	608	.....	.....	.....	.....	.....	2,960
13	.....	2,280	4,760	5,010	1,880	590	.....	.....	.....	.....	.....	3,030
14	.....	2,250	4,400	4,960	1,760	572	.....	.....	.....	.....	.....	3,140
15	5,990	2,320	3,950	5,680	1,610	555	.....	.....	.....	.....	.....	3,110
16	6,850	2,960	3,460	6,960	1,500	520	.....	.....	.....	.....	.....	3,140
17	8,120	3,070	3,070	8,000	1,420	502	.....	.....	.....	.....	.....	3,070
18	8,000	3,220	2,700	8,240	1,360	485	.....	.....	.....	.....	.....	3,070
19	7,760	3,460	2,700	8,360	1,320	485	.....	.....	.....	.....	.....	2,920
20	7,400	3,860	2,470	8,000	1,260	468	.....	.....	.....	.....	.....	2,700
21	7,290	4,400	2,250	7,760	1,240	450	.....	.....	.....	.....	.....	2,920
22	6,740	4,360	2,080	7,240	2,220	432	.....	.....	.....	.....	.....	4,040
23	6,360	4,080	1,910	6,520	2,700	432	.....	.....	.....	.....	.....	5,880
24	5,060	3,950	1,790	4,810	2,180	450	.....	.....	.....	.....	.....	6,850
25	3,860	3,780	1,760	4,400	1,940	1,320	.....	.....	.....	.....	.....	7,070
26	4,130	3,380	1,670	3,620	1,560	1,040	.....	.....	.....	.....	.....	6,850
27	5,730	3,140	1,640	3,220	1,390	1,100	.....	.....	.....	.....	.....	6,800
28	7,340	3,000	1,670	3,070	1,260	760	.....	.....	.....	.....	.....	6,740
29	9,100	.....	1,670	3,000	1,220	1,240	.....	.....	.....	.....	.....	6,630
30	8,600	.....	1,670	3,000	1,220	940	.....	.....	.....	.....	.....	6,460
31	7,520	.....	1,670	.....	1,220	.....	.....	.....	.....	.....	.....	6,100

NOTE.—Daily discharge determined from a discharge rating curve well defined between 380 and 8,000 second-feet (gage heights 2.0 and 12.0 feet). Above 8,000 second feet (gage height 12.0 feet) the rating curve is based on one measurement at gage height 16.6 feet. Above 14,800 second-feet (gage height 16.0 feet) the rating curve is a tangent. Daily discharge Jan. 4 to 14 estimated, because of ice, from climatologic records and discharge at Riverton, Ill. Mean discharge Jan. 4 to 14 estimated about 2,240 second-feet, varying from about 1,400 to 4,000 second-feet.

Monthly discharge of Sangamon River near Oakford, Ill., for 1911.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	9,100	.....	4,800	0.960	1.11	B.
February	6,960	2,250	3,660	.732	.76	A.
March	4,960	1,640	2,770	.554	.64	A.
April	8,360	1,560	5,040	1.01	1.13	A.
May	4,180	1,220	2,220	.444	.51	A.
June	1,320	432	777	.155	.17	A.
December 10–31	7,070	2,700	4,520	.904	.74	A.

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 December 31, 1911.

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. From September 2, 1909, to date the gage heights 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 by 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 the 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 portions of December, January, and February.

Discharge measurements of South Fork of Sangamon River near Taylorville, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 18	P. S. Monk	5.31	184
Oct. 7	Monk and Brown	10.33	1,360

Daily gage height, in feet, of South Fork of Sangamon River near Taylorville, Ill., for 1911.

[Joseph Ethridge, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.15	8.9	7.1	4.55	8.8	3.3	4.3	1.65	1.9	15.55	5.2	5.9
2	8.4	8.25	6.45	4.4	9.75	3.2	2.95	1.7	1.7	14.0	5.0	5.95
3	7.15	7.3	6.25	5.6	10.05	3.1	2.75	1.7	1.65	13.0	4.75	5.7
4	a7.15	6.7	5.9	7.85	9.7	3.0	2.55	1.9	1.6	12.4	4.7	5.55
5	a7.1	6.25	5.6	8.3	8.9	2.85	2.4	1.8	1.65	11.65	4.75	5.45
6	a6.9	6.05	5.35	9.95	7.45	2.8	2.5	1.75	1.65	11.10	4.9	5.3
7	a5.1	6.4	5.65	10.4	6.6	2.85	2.2	1.75	2.85	10.65	5.25	5.3
8	a4.55	6.45	8.25	9.95	6.05	2.7	2.15	1.8	2.95	10.0	5.35	5.25
9	a4.2	6.7	9.4	9.1	5.7	2.7	2.1	1.65	6.10	9.45	5.55	5.3
10	a4.15	6.65	9.45	7.85	5.55	2.65	2.05	2.15	6.7	8.4	5.45	5.4
11	4.2	6.35	9.15	6.95	5.4	2.6	2.0	2.3	5.55	7.85	5.4	5.9
12	4.7	5.85	8.25	6.55	5.15	2.5	1.95	2.9	3.55	7.1	8.1	6.4
13	4.7	5.7	7.25	6.45	4.85	2.45	1.95	2.4	2.95	6.65	9.25	6.45
14	10.2	5.65	6.55	10.15	4.65	2.4	2.0	2.0	6.15	6.2	9.7	6.15
15	13.5	6.0	6.2	11.65	4.45	2.4	1.9	1.8	7.05	6.0	9.8	5.9
16	12.5	6.45	5.8	11.4	4.3	2.4	1.85	1.7	8.35	5.85	9.7	5.9
17	13.55	6.6	5.35	10.5	4.2	2.4	1.8	1.6	9.1	5.6	9.25	5.85
18	10.25	7.5	5.4	9.9	4.15	3.7	1.75	1.6	9.3	5.45	9.2	5.95
19	9.5	8.2	5.3	9.15	4.1	3.6	1.75	1.6	9.1	5.2	9.85	6.15
20	7.9	8.95	5.0	8.15	4.05	2.7	1.8	1.5	8.4	5.1	9.5	6.5
21	6.85	8.85	4.95	7.4	3.95	2.5	1.8	1.55	7.05	5.05	9.4	7.0
22	7.15	8.55	4.7	6.8	5.0	2.4	1.75	1.5	5.6	5.35	8.95	9.85
23	7.1	8.15	4.55	5.95	4.4	2.3	1.75	1.5	4.75	6.45	8.15	9.9
24	5.9	7.55	4.4	5.2	3.95	2.5	1.75	2.4	4.15	6.35	7.35	9.85
25	5.45	7.4	4.3	5.55	3.7	2.5	1.85	3.15	4.8	7.4	6.75	8.3
26	5.9	7.7	4.3	5.4	3.55	5.2	1.8	3.6	7.8	6.8	6.35	7.5
27	7.8	8.45	4.7	5.25	3.45	5.8	1.7	2.9	8.75	6.05	6.25	7.65
28	7.9	8.15	5.35	5.4	3.35	4.8	1.7	2.45	9.85	5.75	6.0	7.95
29	8.85	.....	5.35	5.85	3.3	4.65	1.7	2.2	11.9	5.4	6.1	8.55
30	9.3	.....	5.05	6.2	3.25	4.3	1.7	1.95	15.9	5.25	6.0	7.95
31	9.3	.....	4.85	.....	3.2	.....	1.7	2.0	.....	5.2	.....	6.5

a Gage heights to top of ice Jan. 4 to 10.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 3 to 12.

Daily discharge, in second-feet, of South Fork of Sangamon River near Taylorville, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	782	674	343	130	638	62	115	8	13	3,970	177	234
2	530	500	284	121	1,070	58	48	9	9	3,200	161	238
3	.....	363	266	209	1,220	54	40	9	8	2,700	144	217
4	.....	306	234	432	1,050	50	32	13	7	2,400	140	205
5	.....	266	209	509	674	44	27	11	8	2,020	144	197
6	.....	248	189	1,170	380	42	30	10	8	1,740	154	185
7	.....	279	213	1,400	297	44	21	10	44	1,520	181	185
8	.....	284	500	1,170	248	38	20	11	48	1,200	189	181
9	.....	306	901	758	217	38	18	8	252	926	205	185
10	.....	302	926	432	205	36	16	20	306	530	197	193
11	.....	274	782	328	193	34	15	24	205	432	193	234
12	.....	230	500	292	173	30	14	46	74	343	472	279
13	140	217	358	284	150	28	14	27	48	302	829	284
14	1,300	213	292	1,270	136	27	15	15	256	261	1,050	256
15	2,940	243	261	2,020	124	27	13	11	338	243	1,100	234
16	2,440	284	225	1,900	115	27	12	9	520	230	1,050	234
17	2,970	297	189	1,440	109	27	11	7	758	209	829	230
18	1,320	385	193	1,150	106	82	10	7	853	197	805	238
19	950	490	185	782	103	77	10	7	758	177	1,120	256
20	439	694	161	481	100	38	11	5	530	169	950	288
21	320	656	158	374	94	30	11	6	338	165	901	333
22	348	566	140	315	161	27	10	5	209	189	694	1,120
23	343	481	130	238	121	24	10	5	144	284	481	1,150
24	234	391	121	177	94	30	10	27	106	274	368	1,120
25	197	374	115	205	82	30	12	56	147	374	310	509
26	234	410	115	193	74	177	11	77	424	315	274	385
27	424	542	140	181	70	225	9	46	622	248	266	404
28	439	481	189	193	64	147	9	28	1,120	221	243	447
29	656	.....	189	230	62	136	9	21	2,140	193	252	566
30	853	.....	165	261	60	115	9	14	4,140	181	243	447
31	853	.....	150	.....	58	.....	9	15	.....	177	.....	288

NOTE.—Daily discharge determined from a discharge rating curve well defined between 58 and 1,440 second-feet (gage heights, 3.2 and 10.5 feet). Daily discharge, Jan. 3 to 12, estimated, because of ice, from climatologic records and discharge of adjacent drainage areas. Mean discharge, Jan. 3 to 12, estimated 118 second-feet, varying from about 40 to 300 second-feet.

Monthly discharge of South Fork of Sangamon River near Taylorville, Ill., for 1911.

[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 [a]	2,970	.....	642	1.50	1.73	C.
February	694	213	384	.899	.94	B.
March	926	115	285	.667	.77	A.
April	2,020	121	622	1.46	1.63	B.
May	1,220	58	266	.623	.72	A.
June	225	24	60.1	.141	.16	B.
July	115	9	19.4	.045	.05	C.
August	77	5	18.3	.043	.05	C.
September	4,140	7	481	1.13	1.26	C.
October	3,970	165	819	1.92	2.21	B.
November	1,120	140	471	1.10	1.23	C.
December	1,150	181	365	.855	.99	B.
The year	4,140	5	369	.864	11.74	

[a] See footnotes to table of 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 of a mile below the Vandalia Railroad bridge.

Records available.—February 14, 1908, to December 31, 1911.

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 not changing.

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 datum.

Winter flow.—Ice affects the relation between gage height and discharge during portions of December, January, and February.

Discharge measurements of Salt Creek near Kenney, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 22	P. S. Monk	2.36	119
Oct. 12	Monk and Brown	3.83	383

Daily gage height, in feet, of Salt Creek near Kenney, Ill., for 1911.

[Chris. McDermott, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	a2.9	3.75	2.5	2.25	3.2	1.95	1.2	1.55	0.95	7.1	2.8	3.9
2	2.85	3.5	2.4	2.2	3.2	1.85	1.15	1.3	.95	8.0	2.75	3.5
3	2.55	3.3	2.4	2.25	3.0	1.75	1.15	1.2	.95	7.9	2.6	3.45
4	2.5	3.2	2.3	2.8	2.85	1.75	1.15	1.0	.95	7.0	2.6	3.25
5	2.45	3.0	2.25	3.25	2.75	1.7	1.0	1.0	.95	6.7	2.6	3.1
6	2.25	2.8	2.2	3.6	2.6	1.7	1.1	1.0	.9	5.9	2.8	3.0
7	2.1	2.5	3.0	3.45	2.5	1.75	1.0	1.0	1.0	4.4	2.9	2.95
8	2.0	2.65	4.4	3.6	2.45	1.7	1.15	1.0	2.85	4.9	3.0	2.95
9	2.0	2.75	4.4	3.25	2.4	1.6	1.05	1.0	1.85	4.6	2.95	3.0
10	2.0	2.5	4.0	3.1	2.4	1.55	1.0	1.0	1.5	4.3	2.9	3.05
11	1.9	2.55	3.25	2.9	2.3	1.5	1.0	1.0	4.1	4.05	2.9	3.2
12	1.9	2.5	3.55	2.9	2.25	1.45	2.25	.95	5.6	3.85	4.95	3.35
13	1.9	2.45	3.35	3.7	2.2	1.35	1.8	.95	6.15	3.7	5.7	3.3
14	8.0	3.0	3.25	5.8	2.1	1.4	1.35	.95	3.7	3.5	5.4	3.2
15	8.2	4.0	3.25	6.0	2.0	1.35	1.2	.95	3.5	3.4	5.0	3.0
16	8.7	3.85	2.85	5.7	2.0	1.35	1.2	1.2	4.25	3.3	4.45	3.15
17	7.8	3.65	2.75	5.2	2.0	1.25	1.1	1.0	4.2	3.5	5.7	3.1
18	5.0	3.6	2.7	4.5	2.0	1.3	1.2	1.0	3.65	3.45	6.55	3.0
19	4.85	3.65	2.65	4.2	1.9	1.4	1.05	.95	3.65	3.25	6.45	2.85
20	4.75	3.7	2.5	4.0	1.9	1.4	1.0	1.0	3.6	3.0	6.1	2.85
21	5.0	3.4	2.4	4.0	2.2	1.3	1.0	1.0	3.1	3.0	5.35	3.6
22	4.8	3.3	2.5	3.9	2.0	1.3	1.0	1.0	2.95	3.25	4.8	4.7
23	4.65	3.2	2.25	3.6	2.0	1.3	1.0	1.0	2.5	3.8	4.6	5.7
24	4.05	2.85	2.2	3.3	1.9	1.35	1.0	1.1	2.45	3.7	4.3	5.5
25	4.1	2.8	2.15	3.1	1.85	1.5	1.0	1.0	9.7	3.5	4.1	5.05
26	a6.2	2.75	2.25	3.0	1.75	1.45	1.05	1.2	9.7	3.3	3.9	4.7
27	9.5	2.55	2.6	3.0	1.7	1.5	1.1	1.1	9.0	3.2	3.75	5.2
28	7.2	2.55	2.5	2.95	1.7	1.35	1.0	1.0	8.2	3.0	4.2	4.85
29	6.85	.....	2.45	3.05	2.1	1.3	1.0	1.0	9.1	2.9	3.8	4.4
30	5.25	.....	2.4	3.2	1.8	1.25	1.0	1.0	8.1	2.85	3.65	4.5
31	4.5	.....	2.3	.....	1.9	.....	1.0	1.0	.....	2.9	.....	4.3

a Jan. 1 to 26, observer reported gage heights read to top of ice; Jan. 3, ice from 5 to 9 inches thick, and Jan. 10 ice 7 to 10 inches thick in the vicinity of the gage. It is probable that, subsequent to Jan. 13, the effect of backwater was very small.

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 4 to 13.

Daily discharge, in second-feet, of Salt Creek near Kenney, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	206	399	137	102	266	64	10	28	2	1,530	188	439
2	197	335	122	95	266	54	8	14	2	1,950	179	335
3	145	288	122	102	225	44	8	10	2	1,900	153	323
4	.....	266	108	188	197	44	8	3	2	1,490	153	277
5	.....	225	102	277	179	40	3	3	2	1,370	153	245
6	.....	188	95	360	153	40	6	3	1	1,070	188	225
7	.....	137	225	323	137	44	3	3	3	584	206	216
8	.....	162	584	360	130	40	8	3	197	738	225	216
9	.....	179	584	277	122	32	4.5	3	54	645	216	225
10	.....	137	467	245	122	28	3	3	25	554	206	235
11	.....	145	277	206	108	25	3	3	495	481	206	266
12	.....	137	348	206	102	22	102	2	966	426	754	300
13	.....	130	300	386	95	16	49	2	1,150	386	999	288
14	1,950	225	277	1,030	82	19	16	2	386	335	900	266
15	2,050	467	277	1,100	70	16	10	2	335	311	770	225
16	2,290	426	197	999	70	16	10	10	539	288	599	256
17	1,850	373	179	834	70	12	6	3	524	335	999	245
18	770	360	170	614	70	14	10	3	373	323	1,310	225
19	722	373	162	524	59	19	4.5	2	373	277	1,270	197
20	692	386	137	467	59	19	3	3	360	225	1,140	197
21	770	311	122	467	95	14	3	3	245	225	884	360
22	707	288	137	439	70	14	3	3	216	277	707	676
23	660	266	102	360	70	14	3	3	137	412	645	999
24	481	107	95	288	59	16	3	6	130	386	554	933
25	495	188	88	245	54	25	3	3	2,790	335	495	786
26	1,170	179	102	225	44	22	4.5	10	2,790	288	439	676
27	2,690	145	153	225	40	25	6	6	2,430	266	399	834
28	1,580	145	137	216	40	16	3	3	2,050	225	524	722
29	1,430	.....	130	235	82	14	3	3	2,480	206	412	584
30	850	.....	122	266	49	12	3	3	2,000	197	373	614
31	614	.....	108	.....	59	.....	3	3	.....	206	.....	554

NOTE.—Daily discharge determined from a discharge rating curve fairly well defined between 10 and 467 second-feet (gage heights 1.2 and 4 feet). Above 4 feet the rating curve is based on one discharge measurement at gage height 10.5 feet. Recent measurements appear to indicate that some of the early low-water discharge measurements are not reliable. Daily discharge Jan. 4 to 13 estimated, because of ice, from climatologic records, discharge of adjacent drainage areas, and observer's notes. Mean discharge Jan. 4 to 13 estimated about 62 second-feet, varying from about 45 to 100 second-feet.

Monthly discharge of Salt Creek near Kenney, Ill., for 1911.

[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 [a]	2,690	.....	740	1.61	1.86	C.
February	467	130	252	.549	.57	A.
March	584	88	199	.434	.50	A.
April	1,100	95	389	.847	.94	A.
May	266	40	105	.229	.26	C.
June	64	12	26	.057	.06	C.
July	102	3	10.1	.022	.03	C.
August	28	2	4.9	.011	.01	D.
September	2,790	1	703	1.53	1.71	B.
October	1,950	197	588	1.28	1.48	B.
November	1,310	153	542	1.18	1.32	A.
December	999	197	417	.908	1.05	A.
The year	2,790	1	331	.721	9.79	

[a] See footnotes to tables of daily gage height and daily discharge.

CAHOKIA CREEK NEAR POAG, ILL.

Location.—At the Wabash Railroad bridge about three-fourths of a mile northeast of the Wabash Railroad station at Poag, Ill.

Records available.—December 13, 1909, to December 31, 1911.

Drainage area.—259 square miles.

Gage.—Standard chain gage fastened to bridge; datum unchanged.

Channel.—Probably permanent.

Discharge measurements.—Made from downstream side of bridge.

Floods.—Maximum gage height since establishment of gage—19.0 feet (discharge estimated about 3,600 second-feet)—occurred in October, 1911. See footnotes to tables of daily gage height and daily discharge. No record of floods prior to the establishment of the gage is available.

Winter flow.—Ice may affect the relation between gage height and discharge during short periods in December, January, and February.

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. Cahokia Creek will soon be diverted westward into Mississippi River north of East St. Louis instead of flowing into the river south of East St. Louis.

Discharge measurements of Cahokia Creek near Poag, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 15	P. S. Monk	4.22	74
Oct. 18	Monk and Brown	3.13	39.5

Daily gage height, in feet, of Cahokia Creek near Poag, Ill., for 1911.

[S. T. Sanders, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.0	4.2	6.2	3.6	15.9	2.2	2.5	1.8	3.2	8.2	3.4	4.8
2	6.8	4.0	5.0	3.5	16.0	2.2	2.4	1.7	3.1	14.6	3.3	4.5
3	7.0	3.7	4.2	4.2	14.0	2.1	2.3	1.6	3.0	[a]19.0	3.2	4.3
4	6.2	3.6	3.2	5.0	10.2	2.1	2.3	2.0	2.9	[a]17.2	3.1	4.1
5	5.0	3.7	3.0	6.2	7.0	2.0	2.2	2.7	7.0	12.0	3.0	4.0
6	4.8	4.7	3.0	5.1	5.2	2.2	2.2	2.6	9.0	8.3	6.0	3.9
7	4.6	5.2	11.2	4.4	4.1	2.4	2.1	2.4	6.2	6.1	9.0	3.8
8	4.5	4.7	12.7	4.2	4.0	2.2	2.0	3.0	4.6	8.0	8.1	3.7
9	4.4	4.2	16.2	4.0	3.9	2.0	1.9	7.2	3.0	7.2	5.0	5.9
10	4.4	4.0	7.0	3.8	3.8	2.0	1.9	5.0	4.0	5.0	4.2	5.2
11	4.3	4.7	6.0	3.6	3.7	1.9	1.9	8.0	6.2	4.6	3.8	6.0
12	4.3	3.9	5.3	4.7	3.6	1.9	1.8	5.2	4.2	4.3	8.0	8.2
13	4.2	3.9	4.2	5.0	3.5	1.8	1.8	4.0	3.0	4.1	10.2	6.0
14	4.6	4.0	4.2	13.5	3.5	1.8	1.8	3.5	2.8	3.9	8.2	5.6
15	5.0	5.0	4.1	13.0	3.4	1.8	1.7	3.4	2.6	3.8	7.4	5.4
16	4.3	6.0	4.1	12.0	3.4	1.8	1.7	3.3	9.0	3.7	6.2	6.0
17	4.0	8.5	4.1	8.0	3.3	1.8	1.7	3.3	13.2	3.5	5.5	5.4
18	3.8	6.5	4.3	5.4	3.2	1.8	1.6	3.2	10.0	3.4	8.0	6.2
19	3.6	10.0	4.1	5.0	3.1	1.9	1.6	5.0	6.4	3.2	10.2	6.0
20	3.5	9.2	4.1	10.6	3.0	1.9	1.6	3.8	5.0	3.0	8.0	6.8
21	3.4	6.4	3.9	8.0	2.7	1.8	1.5	3.5	3.4	2.9	7.2	10.0
22	3.4	4.3	3.9	6.2	2.8	1.8	1.5	3.2	3.0	5.0	6.0	12.1
23	3.3	5.0	3.8	4.6	2.8	1.7	1.5	3.0	2.8	5.4	5.4	8.0
24	3.3	4.2	3.8	4.3	3.0	1.7	1.5	3.4	2.5	4.0	5.8	6.2
25	3.2	5.6	3.7	4.1	3.4	1.9	1.6	8.4	6.0	3.4	5.4	5.8
26	3.2	11.0	4.0	4.0	2.7	3.0	1.7	6.0	16.0	3.2	5.0	5.7
27	3.8	10.5	6.0	3.9	2.6	3.4	1.6	4.2	12.2	3.1	4.5	8.0
28	10.3	8.0	5.2	4.7	2.5	3.0	1.5	3.6	7.0	3.0	4.3	10.3
29	6.0	.....	4.3	9.0	2.4	2.8	1.5	3.6	5.1	2.9	6.3	7.1
30	5.1	.....	3.5	14.7	2.3	2.6	4.0	3.4	3.4	3.0	5.0	6.4
31	4.5	.....	3.4	.....	2.3	.....	2.0	3.3	.....	3.7	.....	6.0

[a] Oct. 3 and 4, extremely high stage caused by levee built by the East Side Levee and Sanitary District, which cut off flow into flood channel and confined entire flow to the main channel.

Daily discharge, in second-feet, of Cahokia Creek near Poag, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	167	75	180	53	2,520	19	25	11	41	383	47	103
2	230	67	113	50	2,630	19	23	9	38	1,610	44	88
3	249	56	75	75	1,440	17	21	7	35	a3,600	41	79
4	180	53	41	113	675	17	21	15	33	a2,700	38	71
5	113	56	35	180	249	15	19	29	249	1,000	35	67
6	103	98	35	118	123	19	19	27	488	395	167	63
7	93	123	849	83	71	23	17	23	180	173	488	59
8	88	98	1,150	75	67	19	15	35	93	359	371	56
9	83	75	675	67	63	15	13	269	35	269	113	161
10	83	67	249	59	59	15	13	113	67	113	75	123
11	79	68	167	53	56	13	13	359	180	93	59	167
12	79	63	128	98	53	13	11	123	75	79	359	383
13	75	63	75	113	50	11	11	67	35	71	675	167
14	93	67	75	1,330	50	11	11	50	31	63	383	143
15	113	113	71	1,210	47	11	9	47	27	59	289	133
16	79	167	71	1,000	47	11	9	44	488	56	180	167
17	67	420	71	359	44	11	9	44	1,260	50	138	133
18	59	204	79	133	41	11	7	41	641	47	359	180
19	53	641	71	113	38	13	7	113	196	41	675	167
20	50	517	71	743	35	13	7	59	113	35	359	230
21	47	196	63	359	29	11	5	50	47	33	269	641
22	47	79	63	180	31	11	5	41	35	113	167	1,020
23	44	113	59	93	31	9	5	35	31	133	133	359
24	44	75	59	79	35	9	5	47	25	67	155	180
25	41	143	56	71	47	13	7	407	167	47	133	155
26	41	811	67	67	29	35	9	167	2,630	41	113	149
27	59	726	167	63	27	47	7	75	1,040	38	88	359
28	692	359	123	98	25	35	5	53	249	35	79	692
29	167	.....	79	488	23	31	5	53	118	33	188	259
30	118	.....	50	1,640	21	27	67	47	47	35	113	196
31	88	.....	47	.....	21	.....	15	44	.....	56	.....	167

a Daily discharge Oct. 3 and 4 estimated (because of change in relation of gage height to discharge as noted under table of daily gage height) by means of an extension of discharge rating curve for unrestricted flow, above about 1,740 second-feet (gage height 15 feet), based upon a discharge measurement, in main channel only, of 2,320 second-feet at gage height 16.25 feet, as determined on Oct. 7, 1910.

NOTE.—Daily discharge determined from a discharge rating curve well defined between 35 and 1,350 second-feet (gage heights 3 and 13.6 feet). Above 1,350 second-feet (gage height 13.6 feet) the discharge rating curve is based on one discharge measurement at gage height 16.25 feet, made Oct. 7, 1910. No ice reported at this station; relation of gage height to discharge probably not affected by ice during 1911.

Monthly discharge of Cahokia Creek near Poag, Ill., for 1911.

[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	692	41	114	0.440	0.51	B.
February	811	53	201	.776	.81	A.
March	1,150	35	165	.637	.73	A.
April	1,640	50	305	1.18	1.32	A.
May	2,630	21	280	1.08	1.24	A.
June	47	9	17.5	.068	.08	C.
July	67	5	13.4	.052	.06	C.
August	407	7	80.8	.312	.36	A.
September	2,630	25	290	1.12	1.25	A.
October	a 3,600	33	382	1.47	1.70	B.
November	675	35	211	.815	.91	A.
December	1,020	56	223	.861	.99	A.
The year	a 3,600	5	190	.734	9.96	

a October maximum estimated. See footnotes to tables of daily gage height and daily discharge.

KASKASKIA RIVER BASIN.

KASKASKIA RIVER NEAR ARCOLA, ILL.

Location.—At highway bridge known as the Bagdad Bridge, about 4 miles west of Arcola, Ill., in the northeast part of T. 14 N., R. 7 E.

Records available.—April 11, 1908, to December 31, 1911.

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.

Floods.—The flood of May, 1908, reached a height of 17.3 feet on the gage.

Winter flow.—Ice affects the relation between gage height and discharge during portions of December, January, and February.

The following discharge measurement was made by Monk and Brown:
Oct. 13, 1911: Gage height, 6.20 feet; discharge, 344 second-feet.

Daily gage height, in feet, of Kaskaskia River near Arcola, Ill., for 1911.

[L. L. Pfeifer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.6	9.8	5.4	4.7	7.5	2.9	1.65	0.9	1.7	14.6	5.1	6.9
2	5.4	9.1	5.3	6.7	7.4	2.8	1.6	.75	1.65	14.2	5.1	6.7
3	5.3	7.4	5.2	7.9	7.2	2.65	1.45	.8	1.75	13.8	5.0	6.5
4	5.3	6.7	5.2	8.1	7.0	3.0	1.5	.75	1.85	13.2	5.0	6.4
5	5.3	6.1	5.1	9.3	6.9	3.15	1.45	.75	1.9	11.1	4.9	6.2
6	5.2	6.0	6.7	9.9	6.7	3.0	1.4	.85	2.0	8.6	4.9	6.0
7	5.2	6.0	7.3	9.7	6.4	3.55	1.4	1.0	1.95	7.75	4.8	5.8
8	5.0	5.9	7.8	9.5	6.0	4.0	1.25	1.1	2.05	7.7	4.7	5.8
9	5.0	5.9	7.9	9.1	5.9	3.3	1.3	1.05	2.05	7.65	4.5	5.7
10	4.9	5.8	7.8	9.0	5.7	2.75	1.15	.95	2.2	7.55	4.5	5.4
11	4.8	5.7	7.7	8.6	5.7	2.2	1.2	.95	3.0	7.2	4.4	5.2
12	4.6	5.6	7.6	8.9	5.6	2.45	1.15	1.0	3.25	7.05	7.6	5.0
13	4.9	5.5	7.6	9.0	5.5	2.4	1.1	1.0	4.05	6.4	7.8	4.9
14	6.2	5.5	7.5	9.3	5.3	2.15	1.0	.95	4.35	6.0	8.0	4.9
15	7.4	5.7	6.9	10.0	5.1	2.1	.95	.95	4.8	6.0	8.1	4.8
16	7.2	5.8	6.9	9.8	5.0	2.1	1.0	1.2	5.1	5.9	8.2	4.7
17	7.2	6.0	6.8	9.6	5.0	2.05	.85	1.2	5.3	5.9	8.2	4.6
18	7.1	6.1	6.7	9.6	4.9	2.0	.9	1.15	6.0	5.8	8.3	4.6
19	7.1	6.3	6.5	9.4	4.9	1.95	.75	1.15	6.1	5.6	8.4	4.5
20	7.0	6.3	6.2	9.3	4.8	1.9	.8	1.15	6.15	5.9	8.4	4.6
21	6.9	6.2	6.0	9.0	4.6	1.85	.8	1.6	6.25	6.0	8.4	4.8
22	6.4	6.1	5.8	8.8	4.35	1.7	.75	2.0	6.25	6.1	8.3	4.9
23	6.3	6.0	5.7	8.7	4.3	1.6	.8	2.05	6.5	6.2	8.1	5.0
24	6.1	5.8	5.7	8.6	4.25	1.55	.75	2.05	6.6	6.1	7.9	5.1
25	6.8	5.7	5.5	8.5	4.1	1.8	.7	1.95	6.55	6.0	7.8	5.3
26	7.4	5.6	5.2	8.4	4.0	2.15	.55	2.0	6.75	5.8	7.6	5.3
27	9.1	5.5	5.2	8.4	3.75	2.1	.6	1.9	6.95	5.7	7.6	5.2
28	9.2	5.4	5.1	8.3	3.6	1.95	.6	1.85	10.0	5.4	7.4	5.2
29	10.3	.....	5.0	8.0	3.35	1.8	.65	1.75	14.2	5.4	7.2	5.4
30	10.2	.....	5.0	7.9	3.0	1.8	.9	1.75	15.1	5.2	7.0	5.6
31	10.0	.....	4.9	.....	2.85	.....	.85	1.7	.....	5.1	.....	5.9

NOTE.—No notes relative to ice given by gage observer. Relation of gage height to discharge probably not affected by ice during 1911.

Daily discharge, in second-feet, of Kaskaskia River near Arcola, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	276	1,190	254	187	557	53	7	0.7	8	2,900	224	448
2	254	971	244	416	537	48	6	.4	7	2,750	224	416
3	244	537	234	642	500	40	4.5	.5	9	2,610	214	386
4	244	416	234	689	465	58	5	.4	11	2,390	214	372
5	244	332	224	1,030	448	67	4.5	.4	12	1,640	205	345
6	234	320	416	1,230	416	58	4	.6	15	822	205	320
7	234	320	518	1,160	372	94	4	1	14	609	196	298
8	214	309	620	1,100	320	130	2.5	1.5	16	598	187	298
9	214	309	642	971	309	77	3	1.2	16	588	170	287
10	205	298	620	940	287	46	1.8	.8	21	567	170	254
11	196	287	598	822	287	21	[a] 2	[a] .8	58	500	162	234
12	178	276	577	909	276	31	1.8	1	74	474	577	214
13	205	265	577	940	265	29	1.5	1	134	372	620	205
14	345	265	557	1,030	244	20	1	.8	158	320	665	205
15	537	287	448	1,260	224	18	.8	.8	196	320	689	196
16	500	298	448	1,190	214	18	1	2	224	309	714	187
17	500	320	432	1,130	214	16	.6	2	244	309	714	178
18	482	332	416	1,130	205	15	.7	1.8	320	298	740	178
19	482	358	386	1,070	205	14	.4	1.8	332	276	767	170
20	465	358	345	1,030	196	12	.5	1.8	338	309	767	178
21	448	345	320	940	178	11	.5	6	352	320	767	196
22	372	332	298	879	158	8	.4	15	352	332	740	205
23	358	320	287	850	154	6	.5	16	386	345	689	214
24	332	298	287	822	150	5.5	.4	16	401	332	642	224
25	432	287	265	794	138	10	.3	14	394	320	620	244
26	537	276	234	767	130	20	0	15	424	298	577	244
27	971	265	234	767	110	18	.1	12	456	287	577	234
28	1,000	254	224	740	98	14	.1	11	1,260	254	537	234
29	1,360	.....	214	660	80	10	.2	9	2,750	254	500	254
30	1,330	.....	214	642	58	10	.7	9	3,080	234	465	276
31	1,260	.....	205	.....	50	.....	.6	8	.....	224	.....	309

[a] July 11 and Aug. 11, observer reported river "standing in pools, not running." Determinations of daily discharge during July and August are approximate, but the flow is believed not to have been zero on July 11 and Aug. 11. The gage is in a large pool and the gage reader would probably be unable to detect very low velocities.

NOTE.—Daily discharge determined from a discharge rating curve well defined between 43 and 665 second-feet (gage heights 2.7 and 8 feet) and fairly well defined between 689 and 1,360 second-feet (gage heights 8.1 and 10.3 feet).

Monthly discharge of Kaskaskia River near Arcola, Ill., for 1911.

[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	1,360	178	473	1.21	1.40	B.
February	1,190	254	372	.954	.99	A.
March	642	205	373	.956	1.10	A.
April	1,260	187	891	2.28	2.54	B.
May	557	50	253	.649	.75	A.
June	130	5.5	32.6	.084	.09	C.
July	7	[a] .0	1.82	.0047	.005	D.
August	16	[a] .4	4.91	.013	.01	D.
September	3,080	7	402	1.03	1.15	B.
October	2,900	224	715	1.83	2.11	B.
November	767	162	485	1.24	1.38	A.
December	448	170	258	.662	.76	A.
The year	3,080	.0	354	.908	12.28	

[a] See footnotes 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 December 31, 1911.

Drainage area.—1,030 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Somewhat shifting; section is at a pool, and the point of control has remained unchanged.

Discharge measurements.—Made from downstream side of bridge and short approaches.

Floods.—Maximum gage height since establishment of the gage is 25.8 feet, which occurred in May, 1908. No records of floods prior to establishment of gage are available.

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 Monk and Brown:
October 4, 1911: Gage height, 19.92 feet; discharge, 6,940 second-feet.

Daily gage height, in feet, of Kaskaskia River at Shelbyville, Ill., for 1911.

[Homer Pound, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.9	12.5	8.3	7.1	10.4	6.25	5.25	5.05	5.15	22.25	8.3	8.3
2	9.0	12.3	8.1	7.1	10.1	6.2	5.5	5.1	5.05	21.5	8.0	8.2
3	9.1	11.9	7.9	7.7	9.65	6.1	5.35	5.15	5.05	20.55	7.4	8.1
4	9.9	10.4	7.8	10.2	9.2	6.05	5.4	5.2	5.1	19.15	7.6	8.0
5	a 10.3	9.5	7.7	14.5	8.65	6.1	5.25	5.2	5.15	18.4	7.8	7.9
6	a 10.3	9.4	7.6	18.9	8.4	6.05	5.3	5.25	5.25	17.4	7.9	7.7
7	a 10.3	9.3	9.4	14.5	8.1	6.1	5.3	5.3	5.45	15.8	7.7	7.1
8	a 9.6	9.2	11.6	13.3	7.85	6.1	5.25	5.25	5.75	14.8	7.6	7.2
9	a 9.9	8.2	11.7	13.1	7.7	6.05	5.3	5.2	5.7	13.3	7.6	7.4
10	a 8.1	8.1	11.4	12.3	7.6	6.1	5.25	5.15	5.45	12.2	7.7	7.6
11	7.6	8.4	10.9	11.5	7.45	6.0	5.8	5.05	6.45	11.4	7.8	7.7
12	7.1	8.2	10.6	10.6	7.3	5.95	5.25	5.05	7.75	10.9	10.2	7.8
13	10.4	7.9	10.1	10.1	7.15	5.9	5.2	5.05	11.15	10.2	10.5	7.8
14	14.8	7.1	9.6	14.7	7.1	5.8	5.2	5.05	9.6	9.8	10.7	7.9
15	15.8	8.4	8.9	16.6	7.0	5.7	5.15	5.1	8.65	9.4	10.5	8.0
16	13.8	8.7	8.6	16.1	6.85	5.65	5.1	5.05	9.15	9.0	10.4	8.0
17	11.5	9.1	8.3	15.1	6.8	5.7	5.1	4.95	9.75	8.9	12.2	8.1
18	10.4	9.8	8.0	13.6	6.7	5.55	5.05	4.95	8.85	8.7	12.4	8.0
19	10.1	10.4	7.8	13.1	6.65	5.6	5.2	4.95	8.8	8.5	12.5	7.9
20	9.7	10.5	7.7	12.15	6.9	5.55	5.15	5.0	8.85	9.0	12.0	8.2
21	9.2	10.2	7.6	11.1	8.45	5.6	5.2	4.95	8.15	10.0	11.8	8.6
22	9.2	9.8	7.4	10.15	7.5	5.6	5.2	4.85	7.75	10.9	11.5	8.9
23	8.6	9.5	7.3	9.6	7.3	5.55	5.05	4.75	7.35	11.0	11.2	8.0
24	8.3	9.2	7.2	9.1	7.05	5.6	5.1	5.25	7.1	11.2	10.7	9.1
25	7.9	9.1	7.1	8.75	6.8	5.55	5.05	5.3	11.05	11.4	10.2	9.0
26	8.1	9.1	7.2	8.5	6.6	5.8	5.1	5.35	12.75	11.7	9.8	9.2
27	8.7	8.9	7.4	8.15	6.35	5.75	5.05	5.45	12.35	11.0	9.5	9.0
28	12.4	8.6	7.3	8.3	6.3	5.7	5.1	5.35	16.55	9.9	9.1	8.9
29	13.1	.....	7.3	8.3	6.45	5.5	5.1	5.25	19.7	9.5	8.8	8.7
30	12.9	.....	7.3	9.35	6.4	5.35	5.05	5.3	22.75	9.0	8.5	8.5
31	12.7	.....	7.1	.....	6.4	.....	5.1	5.15	.....	8.6	.....	8.8

a Gage heights to top of ice Jan. 5 to 10.

NOTE.—Relation of gage height to discharge affected by ice about Jan. 3 to 10.

Daily discharge, in second-feet, of Kaskaskia River at Shelbyville, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,150	2,850	918	494	1,810	208	22	12	16	8,450	918	918
2	1,190	2,750	846	494	1,680	192	45	13	12	8,000	810	882
3	a1,100	2,550	774	702	1,470	160	30	16	12	7,430	596	846
4	a1,000	1,810	738	1,720	1,270	145	34	18	13	6,590	666	810
5	a 950	1,400	702	3,920	1,050	160	22	18	16	6,150	738	774
6	a 910	1,360	666	6,440	956	145	25	22	22	5,560	774	702
7	a 860	1,310	1,360	3,920	846	160	25	25	40	4,650	702	494
8	a 810	1,270	2,400	3,260	756	160	22	22	82	4,090	666	528
9	a 760	882	2,450	3,160	702	145	25	18	73	3,260	666	596
0	a 714	846	2,300	2,750	666	160	22	16	40	2,700	702	666
11	666	956	2,050	2,350	613	130	90	12	273	2,300	738	702
12	494	882	1,910	1,910	562	120	22	12	720	2,050	1,720	738
13	1,810	774	1,680	1,680	511	109	18	12	2,180	1,720	1,860	738
14	4,090	494	1,450	4,040	494	90	18	12	1,450	1,540	1,960	774
15	4,650	956	1,150	5,100	460	73	16	13	1,050	1,360	1,860	810
16	3,540	1,070	1,030	4,820	409	66	13	12	1,250	1,190	1,810	810
17	2,350	1,230	918	4,260	392	73	13	9	1,520	1,150	2,700	846
18	1,810	1,540	810	3,430	358	52	12	9	1,130	1,070	2,800	810
19	1,680	1,810	738	3,160	341	58	18	9	1,110	994	2,850	774
20	1,490	1,860	702	2,680	426	52	16	10	1,130	1,190	2,600	882
21	1,270	1,720	666	2,150	975	58	18	9	864	1,630	2,500	1,030
22	1,270	1,540	596	1,700	630	58	18	7	720	2,050	2,350	1,150
23	1,030	1,400	562	1,450	562	52	12	5.5	579	2,100	2,200	810
24	918	1,270	528	1,230	477	58	13	22	494	2,200	1,960	1,230
25	774	1,230	494	1,090	392	52	12	25	2,120	2,300	1,720	1,190
26	846	1,230	528	994	324	90	13	30	2,980	2,450	1,540	1,270
27	1,070	1,150	596	864	240	82	12	40	2,780	2,100	1,400	1,190
28	2,800	1,030	562	918	224	73	13	30	5,070	1,580	1,230	1,150
29	3,160	.....	562	918	273	45	13	22	6,920	1,400	1,110	1,070
30	3,050	.....	562	1,340	256	30	12	25	8,750	1,190	994	994
31	2,950	.....	494	.....	256	.....	13	16	.....	1,030	.....	1,110

a Daily discharge Jan. 3 to 10, estimated, because of ice, from climatologic records, run-off in adjacent drainage areas, and observer's notes.

NOTE.—Daily discharge determined from a discharge rating curve well defined between 224 and 7,100 second-feet (gage heights 6.3 and 20 feet). Above 6,500 second-feet (gage height 19.0 feet) the rating curve is a tangent. The relation of gage height to discharge during high water is liable to be affected by backwater caused by drift lodging at the two railroad bridges below the gaging station.

Monthly discharge of Kaskaskia River at Shelbyville, Ill., for 1911.

[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 a	4,650	494	1,650	1.60	1.84	B.
February	2,850	494	1,400	1.36	1.42	A.
March	2,450	494	1,020	.990	1.14	A.
April	6,540	494	2,430	2.36	2.63	A.
May	1,810	224	657	.638	.74	A.
June	208	30	102	.099	.11	B.
July	90	12	21.2	.021	.02	C.
August	40	5.5	16.8	.016	.02	C.
September	8,750	12	1,450	1.41	1.57	A.
October	8,450	994	2,950	2.86	3.30	A.
November	2,850	596	1,500	1.46	1.63	A.
December	1,270	494	880	.854	.98	A.
The year b	8,750	5.5	1,170	1.14	15.40	

a See footnotes to tables of daily gage height and daily discharge.

b Attention is called to the fact that yearly mean discharge for 1909, published as 1,240 second-feet (Water-Supply Paper U. S. Geol. Survey No. 265, p. 197) should be 1,170 second-feet.

KASKASKIA RIVER AT VANDALIA, ILL.

Location.—At highway bridge at the east end of Main Street, Vandalia, Ill.

Records available.—February 26, 1908, to December 31, 1911.

Drainage area.—1,980 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Somewhat shifting; section is at a pool and the 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.

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 claimed that the levees, by confining the floods, cause unusual floods along the right bank, and lawsuits to recover damages have resulted. During extreme floods the levees sometimes give way and so reduce the flood flow; 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 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 17	P. S. Monk	7.04	1,280
Oct. 17	Monk and Brown	8.19	1,760

Daily gage height, in feet, of Kaskaskia River at Vandalia, Ill., for 1911.

[W. F. Radcliff, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.7	11.6	9.35	5.2	16.3	5.4	2.15	1.15	1.15	17.6	8.35	7.3
2	9.6	10.95	8.45	4.95	16.5	4.75	2.1	1.15	1.2	19.75	7.4	7.05
3	10.35	10.65	7.9	7.35	14.85	3.85	2.85	1.2	1.15	20.4	6.6	6.95
4	8.95	10.2	7.6	11.0	9.3	3.0	2.8	1.15	1.15	20.0	6.0	6.75
5	8.8	9.3	8.15	13.05	7.95	2.85	2.75	1.15	2.25	19.75	6.1	6.65
6	8.5	8.95	9.75	14.8	6.7	2.8	2.75	1.15	3.1	18.75	7.2	6.4
7	7.9	8.6	12.15	14.75	6.6	2.65	2.65	1.7	4.1	18.5	8.8	6.15
8	7.7	8.55	14.95	14.15	5.1	2.5	2.5	2.2	4.5	18.25	8.15	5.9
9	7.2	8.4	16.2	13.55	4.7	2.5	2.4	2.05	4.85	17.7	7.6	5.9
10	6.6	8.3	14.65	13.3	4.1	2.45	2.25	1.5	5.2	16.45	6.75	6.1
11	6.15	8.1	12.0	12.95	3.85	2.45	2.7	1.3	5.05	15.35	6.35	7.4
12	5.6	7.65	10.45	12.35	3.75	2.35	3.6	1.15	5.65	13.9	5.85	8.7
13	5.35	7.15	9.55	11.25	3.65	2.75	2.25	1.2	8.55	11.75	5.7	9.5
14	10.9	6.9	8.75	11.05	3.6	2.3	1.4	1.15	11.05	9.45	5.4	9.35
15	14.1	6.6	8.55	14.75	3.45	2.15	1.35	1.15	11.9	8.5	5.5	8.4
16	14.9	7.35	7.55	16.05	3.35	2.15	1.35	1.15	13.3	7.95	9.75	8.85
17	12.95	8.7	7.15	16.1	3.3	1.95	1.35	1.15	15.55	7.75	12.2	9.5
18	11.95	9.2	6.75	15.4	3.15	1.7	1.3	1.1	14.0	7.75	14.3	9.5
19	10.5	11.15	6.8	14.95	2.75	1.55	1.3	1.05	10.6	7.55	13.3	8.25
20	9.6	12.25	6.25	14.4	3.0	1.35	1.25	.85	9.35	7.3	11.3	10.2
21	8.65	12.8	6.0	11.4	6.75	1.35	1.25	.85	8.55	6.9	10.2	12.8
22	7.6	11.0	5.8	10.25	10.05	1.35	1.25	.75	7.35	10.1	9.7	12.15
23	7.85	9.95	5.55	9.05	9.6	1.35	1.15	.8	6.65	14.15	9.8	9.75
24	7.1	9.8	5.3	8.6	9.25	1.3	1.2	1.25	6.1	13.55	9.8	9.0
25	6.7	10.2	5.0	8.25	8.7	1.25	1.15	1.7	5.55	11.65	9.6	8.75
26	6.5	11.9	5.5	7.85	8.5	1.2	1.15	1.7	12.3	11.15	9.05	8.25
27	9.55	12.05	6.1	7.4	8.2	1.15	1.15	1.4	15.2	9.75	8.8	8.1
28	12.15	10.4	6.95	7.25	7.4	2.55	1.15	1.3	15.7	9.2	8.5	7.85
29	14.0	.....	6.8	7.2	6.9	2.8	1.2	1.15	16.35	8.7	8.3	7.75
30	13.35	.....	5.65	13.1	6.5	2.25	1.15	1.15	16.8	8.5	7.8	7.65
31	12.45	.....	5.45	.....	6.05	.....	1.15	1.15	.....	8.35	.....	8.2

NOTE.—No ice notes kept by observer. Relation of gage height to discharge probably affected by ice Jan. 3 and 4. Relation of gage height to discharge affected by break in levee on east bank about Oct. 2 to 9.

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,830	3,050	2,090	678	5,270	732	73	10	10	5,920	1,710	1,300
2	2,190	2,760	1,730	612	5,370	563	68	10	12	[b]9,000	1,340	1,200
3	[a]2,000	2,630	1,520	1,320	4,560	351	156	12	10	12,000	1,070	1,200
4	[a]1,900	2,430	1,410	2,780	2,070	180	149	10	10	13,000	900	1,140
5	1,870	2,070	1,620	3,710	1,540	156	142	10	83	13,000	928	1,070
6	1,750	1,930	2,250	4,530	1,100	149	142	10	198	12,000	1,270	1,010
7	1,520	1,790	3,300	4,510	1,070	128	128	35	408	10,000	1,870	956
8	1,450	1,770	4,610	4,220	651	110	110	78	503	8,000	1,640	872
9	1,270	1,710	5,220	3,940	551	110	99	64	588	[b]7,000	1,410	872
10	1,070	1,670	4,460	3,830	408	104	83	24	678	5,320	1,140	928
11	942	1,600	3,230	3,670	351	104	135	15	638	4,820	1,010	1,340
12	788	1,430	2,540	3,390	329	94	296	10	802	4,100	844	1,830
13	718	1,250	2,170	2,890	307	142	83	12	1,770	3,140	816	2,150
14	2,740	1,170	1,850	2,800	296	88	19	10	2,800	2,110	732	2,110
15	4,200	1,070	1,770	4,510	266	73	17	10	3,180	1,750	760	1,710
16	4,580	1,320	1,390	5,140	246	73	17	10	3,830	1,560	2,270	1,870
17	3,670	1,830	1,250	5,170	236	54	17	10	4,900	1,480	3,320	2,150
18	3,210	2,030	1,120	4,820	207	35	15	9	4,150	1,480	4,290	2,150
19	2,560	2,850	1,140	4,610	142	26	15	8	2,600	1,410	3,830	1,640
20	2,190	3,340	970	4,340	180	17	14	4.5	2,090	1,300	2,910	2,430
21	1,810	3,600	900	2,960	1,120	17	14	4.5	1,770	1,170	2,430	3,600
22	1,410	2,780	844	2,460	2,370	17	14	3.5	1,320	2,390	2,230	3,320
23	1,500	2,330	774	1,970	2,190	17	10	4	1,090	4,250	2,270	2,270
24	1,230	2,270	705	1,790	2,050	15	12	14	928	3,970	2,270	1,950
25	1,100	2,430	625	1,660	1,830	14	10	35	774	3,050	2,190	1,870
26	1,040	3,180	760	1,500	1,750	12	10	35	3,370	2,870	1,950	1,640
27	2,170	3,250	928	1,340	1,640	10	10	19	4,730	2,270	1,870	1,600
28	3,300	2,520	1,180	1,280	1,340	116	10	15	4,970	2,030	1,750	1,480
29	4,150	.....	1,140	1,270	1,170	149	12	10	5,300	1,830	1,670	1,480
30	3,850	.....	802	3,740	1,040	83	10	10	5,520	1,750	1,480	1,410
31	3,440	.....	746	.....	914	.....	10	10	.....	1,710	.....	1,640

[a] Daily discharge Jan. 3 and 4 estimated, because of ice, from climatologic records and run-off in adjacent drainage areas.

[b] Daily discharge Oct. 2 to 9 estimated, because break in levee on east bank allowed portion of flow to pass around gaging section, by comparison with discharge at Carlyle, Ill.

NOTE.—Daily discharge determined from a discharge rating curve well defined between 78 and 4,150 second-feet (gage heights 2.2 and 14 feet).

Monthly discharge of Kaskaskia River at Vandalia, Ill., for 1911.

[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 [a]	4,580	718	2,180	1.10	1.27	B.
February	3,600	1,070	2,220	1.12	1.17	A.
March	5,220	625	1,780	.899	1.04	A.
April	5,170	612	3,050	1.54	1.72	A.
May	5,370	142	1,370	.692	.80	A.
June	732	10	125	.063	.07	B.
July	296	10	61.3	.031	.04	C.
August	78	3.5	16.8	.0085	.01	D.
September	5,520	10	1,970	.995	1.11	B.
October [a]	[b] 13,000	1,170	4,700	2.37	2.73	C.
November	4,290	732	1,810	.914	1.02	B.
December	3,600	872	1,680	.849	.98	B.
The year	[b] 13,000	3.5	1,740	.879	11.96	

[a] See footnotes to table of daily discharge.

[b] October maximum discharge estimated.

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 December 31, 1911.

Drainage area.—2,680 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably shifting. Measurements to date indicate that the point of control is probably permanent. Main channel is broken by three bridge piers and flood channel by four additional piers.

Discharge measurements.—Made from downstream side of bridge.

Floods.—The flood of 1882, which is the highest known, is said to have attained a height of 1½ feet above the flood of 1908, or about 32.5 feet on the present gage.

Winter flow.—Ice may affect the relation between gage height and discharge during portions of December, January, and February.

Regulation.—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 sewerage system and some private sewers are above the section, so that the diversion is negligible.

Discharge measurements of Kaskaskia River at Carlyle, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Mar. 16	P. S. Monk	16.62	3,010
Oct. 19	Monk and Brown	18.38	3,160
Nov. 2	P. S. Monk	12.24	1,470

Daily gage height, in feet, of Kaskaskia River at Carlyle, Ill., for 1911.

[A. J. Marcham and Geo. Klier, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.9	18.6	18.95	10.3	19.8	7.7	6.2	.....	5.8	18.6	12.6	13.7
2	12.3	18.2	16.7	9.9	20.8	7.7	6.1	.....	5.8	20.2	12.0	12.7
3	13.8	17.8	14.2	9.8	21.4	7.5	6.0	.....	5.7	20.5	11.4	12.1
4	15.1	16.9	12.85	10.5	21.7	7.45	5.95	.....	5.75	24.4	11.0	11.8
5	16.3	16.1	11.9	13.4	21.8	7.2	5.9	.....	5.7	26.6	10.5	11.5
6	15.7	15.0	11.55	17.4	21.6	7.15	6.0	.....	5.6	27.1	10.6	11.3
7	14.3	14.7	11.6	18.5	19.8	7.0	5.95	.....	5.6	27.2	12.5	10.9
8	13.2	15.5	15.9	19.0	17.7	6.9	5.9	5.6	5.9	26.8	13.3	10.7
9	12.8	15.6	18.65	19.4	13.6	6.8	5.85	5.55	6.5	26.2	12.7	10.5
10	12.3	15.1	19.4	19.6	11.9	6.7	5.8	.....	6.9	25.5	12.1	10.5
11	11.9	13.55	20.0	19.5	11.1	6.65	5.75	5.7	7.6	25.0	11.7	11.9
12	11.4	12.6	20.5	19.3	10.7	6.0	5.7	5.9	7.8	24.5	12.2	14.3
13	10.7	11.75	20.7	19.0	10.4	6.0	6.0	5.8	8.1	24.1	16.8	14.3
14	9.9	11.5	20.6	19.1	9.8	6.5	5.9	5.7	8.0	23.5	18.6	12.7
15	10.8	11.6	19.4	19.9	9.7	6.6	5.85	5.6	7.0	23.2	19.1	11.6
16	14.7	11.95	16.75	20.7	9.4	6.55	5.75	5.7	14.2	22.7	19.0	11.5
17	17.4	13.1	14.0	20.9	9.0	6.4	5.65	5.8	15.4	21.8	19.4	13.7
18	18.6	14.75	12.8	21.2	8.95	6.35	5.6	5.9	16.7	21.0	19.1	16.1
19	19.0	15.8	12.05	21.5	8.7	6.3	5.6	5.8	18.8	18.2	18.9	15.7
20	18.6	16.9	11.9	21.55	8.55	6.25	5.55	5.7	19.1	15.0	19.4	14.0
21	16.2	18.05	10.75	21.6	8.4	6.15	.....	5.6	19.2	12.9	19.9	15.2
22	14.4	18.9	10.1	21.65	8.3	6.1	.....	5.55	19.0	13.4	20.1	17.9
23	12.8	19.35	10.6	21.7	12.7	6.15	.....	.....	18.3	17.1	20.4	18.6
24	12.4	18.9	10.25	21.65	13.3	6.1	.....	.....	17.2	18.1	20.2	18.4
25	12.0	17.8	10.0	21.0	11.8	6.05	.....	.....	16.6	18.9	19.5	16.6
26	11.5	17.65	10.05	19.3	9.7	6.15	.....	.....	15.8	19.1	18.2	14.5
27	11.0	17.2	10.4	15.7	8.9	8.0	.....	.....	16.1	18.6	17.1	14.3
28	11.0	18.9	13.4	13.2	8.5	7.1	.....	.....	16.5	17.6	15.1	14.3
29	13.7	.....	13.95	12.2	8.2	6.4	5.6	5.5	16.9	15.1	14.7	15.6
30	17.8	.....	12.3	14.3	7.9	6.3	5.55	5.6	17.7	14.2	14.3	14.4
31	18.4	.....	10.95	.....	7.85	.....	.....	5.7	.....	13.4	.....	13.6

NOTE.—No ice notes kept by observer. Relation of gage height to discharge probably not affected by ice during 1911. July 21 to 28, July 31 to Aug. 7, Aug. 10, and Aug. 23 to 28, observer reported "Dry beneath gage," with a recorded gage height of 5.5 feet.

Daily discharge, in second-feet, of Kaskaskia River at Carlyle, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,250	3,630	3,780	1,100	4,210	442	132	35	72	3,630	1,720	2,030
2	1,630	3,470	2,960	994	4,950	442	116	30	72	4,460	1,550	1,750
3	2,060	3,330	2,180	968	5,660	394	100	30	59	4,690	1,390	1,580
4	2,450	3,030	1,790	1,150	6,110	382	93	30	66	10,200	1,280	1,500
5	2,830	2,760	1,520	1,950	6,270	324	86	25	59	13,600	1,150	1,420
6	2,640	2,420	1,430	3,200	5,960	313	100	25	47	14,300	1,180	1,360
7	2,210	2,330	1,440	3,580	4,210	280	93	35	47	14,500	1,690	1,250
8	1,890	2,580	2,700	3,800	3,300	260	86	47	86	13,900	1,920	1,200
9	1,770	2,610	3,650	3,990	2,000	240	79	41	184	13,000	1,750	1,150
10	1,630	2,450	3,990	4,100	1,520	220	72	37	260	11,900	1,580	1,150
11	1,520	1,990	4,330	4,050	1,310	211	66	59	418	11,100	1,470	1,520
12	1,390	1,720	4,690	3,940	1,200	100	59	86	466	10,400	1,610	2,210
13	1,200	1,480	4,860	3,800	1,120	100	100	72	540	9,760	2,990	2,210
14	994	1,420	4,770	3,850	968	184	86	59	515	8,850	3,630	1,750
15	1,230	1,440	3,990	4,270	942	202	79	47	280	8,390	3,850	1,440
16	2,330	1,540	2,980	4,860	865	193	66	59	2,180	7,630	3,800	1,420
17	3,200	1,860	2,120	5,050	765	166	53	72	2,540	6,270	3,990	2,030
18	3,630	2,340	1,770	5,380	752	157	47	86	2,960	5,150	3,850	2,760
19	3,800	2,670	1,560	5,810	690	148	47	72	3,710	3,470	3,760	2,640
20	3,630	3,030	1,520	5,890	652	140	41	59	3,850	2,420	3,990	2,120
21	2,800	3,420	1,220	5,960	615	124	35	47	3,890	1,800	4,270	2,480
22	2,240	3,760	1,050	6,040	590	116	35	41	3,800	1,950	4,390	3,370
23	1,770	3,970	1,180	6,110	1,750	124	30	35	3,510	3,090	4,610	3,630
24	1,660	3,760	1,080	6,040	1,920	116	30	35	3,130	3,440	4,460	3,550
25	1,550	3,330	1,020	5,150	1,500	108	25	30	2,930	3,760	4,050	2,930
26	1,420	3,280	1,030	3,940	942	124	25	30	2,670	3,850	3,470	2,270
27	1,280	3,130	1,120	2,640	740	515	25	30	2,760	3,630	3,090	2,210
28	1,280	3,760	1,950	1,890	640	302	35	35	2,900	3,260	2,450	2,210
29	2,030	.....	2,110	1,610	565	166	47	40	3,030	2,450	2,330	2,610
30	3,330	.....	1,630	2,210	490	148	41	47	3,300	2,180	2,210	2,240
31	3,550	.....	1,270	.....	478	.....	35	59	.....	1,950	.....	2,000

NOTE.—Daily discharge determined by means of a discharge rating curve well defined between 72 and 7,180 second-feet (gage heights 5.8 and 22.4 feet). Daily discharge July 21 to 28, July 31 to Aug. 7, Aug. 10, and Aug. 23 to 29, estimated, because of observer's inability to obtain gage height, from comparison with hydrograph of daily discharge at Vandalia and New Athens, Ill.

Monthly discharge of Kaskaskia River at Carlyle, Ill., for 1911.

[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	3,800	994	2,140	0.799	0.92	A.
February	3,970	1,420	2,730	1.02	1.06	A.
March	4,860	1,020	2,340	.873	1.01	A.
April	6,110	968	3,780	1.41	1.57	A.
May	6,270	478	2,050	.765	.88	A.
June	515	100	225	.084	.09	A.
July[a]	132	[b] 25	63.4	.024	.03	C.
August[a]	86	[b] 25	46.3	.017	.02	D.
September	3,890	47	1,680	.627	.70	B.
October	14,500	1,800	6,740	2.52	2.90	B.
November	4,610	1,150	2,780	1.04	1.16	A.
December	3,630	1,150	2,060	.769	.89	A.
The year	14,500	[b] 25	2,220	.829	11.23	

[a] See footnote to tables of daily gage height and daily discharge for notes relative to periods of estimated discharge during July and August.
[b] July and August minima estimated.

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 December 31, 1911. A record of river heights from January 23, 1907, to October 28, 1909, was kept by 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; broken by one bridge pier at ordinary stages and three piers at high stages. 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 by the present datum.

Winter flow.—The relation between gage height and discharge may be slightly affected by ice during portions of December, January, and February.

Discharge measurements of Kaskaskia River at New Athens, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
1911.		*Feet.*	*Sec.-feet.*
Mar. 13	P. S. Monk	18.48	8,630
Oct. 23	Monk and Brown	15.18	5,080
Nov. 4	P. S. Monk	8.65	1,930

Daily gage height, in feet, of Kaskaskia River at New Athens, Ill., for 1911.

[C. J. von Roth Roffy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	14.2	18.0	9.25	22.6	5.55	4.2	2.6	2.75	19.35	10.4	11.5
2	8.1	13.9	17.8	8.3	24.55	5.35	3.95	2.6	2.7	19.75	9.7	11.0
3	8.5	13.65	16.85	7.75	24.8	5.25	3.9	3.8	2.65	20.0	9.2	10.3
4	[a]9.6	13.25	14.6	7.5	24.4	5.15	3.75	3.15	2.6	19.98	8.7	9.65
5	[a]9.9	12.75	12.0	8.5	24.1	5.1	3.6	3.05	2.6	19.8	8.3	9.2
6	[a]10.55	12.1	10.55	11.8	23.7	5.0	3.45	3.45	2.6	19.8	8.0	8.9
7	[a]10.7	11.5	10.45	15.0	23.3	4.75	3.35	3.3	4.1	19.95	8.1	8.6
8	[a]10.35	11.55	12.8	16.45	22.7	4.55	3.25	3.5	7.65	20.35	8.9	8.3
9	9.2	12.1	15.45	16.5	21.9	4.45	3.15	3.0	7.55	20.95	10.7	8.05
10	8.25	12.1	17.0	15.7	20.9	4.35	3.1	3.2	6.8	21.6	11.0	7.85
11	7.7	11.55	17.95	14.85	18.35	4.25	4.35	3.5	6.8	22.2	10.1	7.9
12	8.0	10.65	18.5	14.45	12.6	4.1	4.0	5.6	6.75	22.75	9.2	8.4
13	8.0	9.75	18.55	16.35	9.55	4.05	3.5	6.05	8.3	23.05	12.8	10.2
14	7.5	9.15	17.9	18.85	8.6	4.0	3.2	5.25	7.9	23.1	15.3	11.8
15	7.2	8.7	17.0	19.75	8.05	3.95	3.15	4.15	6.45	22.9	16.55	11.25

[a] Jan. 4 to 8 gage heights to top of ice. River reported frozen over from Jan. 4 to 6.

Daily gage height, in feet, of Kaskaskia River at New Athens, Ill., for 1911—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	7.2	8.5	16.1	19.9	7.6	3.9	3.3	3.5	5.4	22.65	16.95	10.05
17	9.05	8.75	14.85	20.1	7.25	3.9	3.2	3.15	8.2	22.35	16.5	10.05
18	11.05	10.25	12.7	20.3	6.95	3.85	3.05	3.0	13.95	21.95	15.5	11.1
19	12.05	12.6	10.85	20.5	6.7	3.8	2.95	2.8	15.8	21.55	15.05	12.55
20	12.9	15.3	10.05	20.35	6.45	3.7	2.9	2.75	16.35	21.05	15.9	13.1
21	13.25	16.7	9.55	19.95	6.25	3.65	2.85	2.7	16.5	20.5	16.55	12.9
22	12.65	17.5	9.2	19.5	8.05	3.6	2.8	3.2	16.2	19.35	16.3	14.4
23	11.15	17.8	8.75	19.0	7.25	3.55	2.75	2.9	14.95	16.2	15.7	16.0
24	9.75	17.8	8.3	18.4	6.9	3.55	2.75	2.75	12.3	14.25	15.4	17.05
25	9.1	17.55	7.85	17.9	8.95	3.5	2.7	2.65	9.5	14.7	15.5	17.4
26	8.8	17.5	7.7	17.4	8.75	3.5	2.7	2.6	8.8	14.5	15.35	16.6
27	8.45	17.65	8.25	16.95	7.65	3.95	2.65	2.55	15.7	14.15	14.95	14.55
28	8.2	17.85	9.2	15.85	6.75	4.0	2.65	2.5	17.55	13.9	14.05	13.0
29	8.45	.....	10.45	12.85	6.15	5.05	2.6	2.65	18.4	13.5	12.9	13.35
30	12.05	.....	11.4	19.35	5.8	4.7	2.6	2.9	18.95	12.5	11.95	13.6
31	14.2	.....	10.65	.....	5.85	.....	2.6	2.75	.....	11.3	.....	13.2

NOTE.—Relation of gage height to discharge affected by ice about Jan. 4 to 10.

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,130	5,160	8,130	2,340	17,900	724	414	174	192	9,520	2,970	3,580
2	1,750	4,970	7,950	1,850	24,600	669	369	174	186	10,000	2,580	3,300
3	1,950	4,820	7,140	1,580	25,500	643	360	344	180	10,300	2,310	2,920
4	a1,900	4,580	5,440	1,470	24,100	618	336	243	174	10,300	2,050	2,560
5	a1,850	4,280	3,850	1,950	23,000	606	312	229	174	10,100	1,850	2,310
6	a1,800	3,900	3,050	3,740	21,700	582	288	288	174	10,100	1,700	2,150
7	a1,750	3,580	3,000	5,720	20,300	527	272	264	396	10,300	1,750	2,000
8	a1,700	3,600	4,310	6,820	18,200	484	257	296	1,540	10,900	2,150	1,850
9	a1,650	3,900	6,040	6,860	15,500	464	243	222	1,490	12,200	3,140	1,720
10	a1,600	3,900	7,260	6,230	12,100	444	236	250	1,170	14,400	3,300	1,630
11	1,560	3,600	8,080	5,620	8,460	424	444	296	1,170	16,500	2,800	1,650
12	1,700	3,110	8,610	5,340	4,190	396	378	738	1,150	18,400	2,310	1,900
13	1,700	2,610	8,660	6,740	2,500	387	296	887	1,850	19,400	4,310	2,860
14	1,470	2,280	8,040	8,960	2,000	378	250	643	1,650	19,600	5,930	3,740
15	1,340	2,050	7,260	10,000	1,720	369	243	405	1,030	18,900	6,900	3,440
16	1,340	1,950	6,540	10,200	1,510	360	264	296	682	18,000	7,220	2,780
17	2,230	2,080	5,620	10,500	1,360	360	250	243	1,800	17,000	6,860	2,780
18	3,330	2,890	4,250	10,800	1,230	352	229	222	5,000	15,600	6,070	3,360
19	3,880	4,190	3,220	11,100	1,130	344	216	198	6,310	14,200	5,760	4,160
20	4,370	5,930	2,780	10,900	1,030	328	210	192	6,740	12,500	6,390	4,490
21	4,580	7,020	2,500	10,300	956	320	204	186	6,860	11,100	6,900	4,370
22	4,220	7,680	2,310	9,700	1,720	312	198	250	6,620	9,520	6,700	5,300
23	3,380	7,950	2,080	9,120	1,360	304	192	210	5,680	6,620	6,230	6,470
24	2,610	7,950	1,850	8,510	1,210	304	192	192	4,020	5,200	6,000	7,300
25	2,260	7,730	1,630	8,040	2,180	296	186	180	2,480	5,510	6,070	7,600
26	2,100	7,680	1,560	7,600	2,080	296	186	174	2,100	5,370	5,960	6,940
27	1,920	7,820	1,820	7,220	1,540	369	180	168	6,230	5,120	5,680	5,400
28	1,800	8,000	2,310	6,350	1,150	378	180	162	7,730	4,970	5,060	4,430
29	1,920	.....	3,000	4,340	921	594	174	180	8,510	4,730	4,370	4,640
30	3,880	.....	3,520	9,520	802	516	174	210	9,060	4,130	3,820	4,790
31	5,160	.....	3,110	.....	819	.....	174	192	.....	3,460	.....	4,550

a Daily discharge Jan. 4 to 10, estimated, because of ice, from observer's notes, climatologic records, and comparison with discharge at other stations in the Kaskaskia drainage basin.

NOTE.—Daily discharge determined from a discharge rating curve well defined between discharges 378 and 12,400 second-feet (gage heights 4.0 and 21.0 feet).

Monthly discharge of Kaskaskia River at New Athens, Ill., for 1911.

[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 [a]	5,160	1,130	2,380	0.456	0.53	B.
February	8,000	1,950	4,830	.925	.96	B.
March	8,660	1,560	4,670	.895	1.03	B.
April	11,100	1,470	6,980	1.34	1.50	A.
May	25,500	802	7,830	1.50	1.73	A.
June	724	296	438	.084	.09	A.
July	444	174	255	.049	.06	C.
August	887	162	281	.054	.06	C.
September	9,060	174	3,080	.590	.66	A.
October	19,600	3,460	11,100	2.13	2.46	B.
November	7,220	1,700	4,500	.862	.96	B.
December	7,600	1,630	3,770	.722	.83	B.
The year	25,500	162	4,180	.801	10.87	

[a] See footnotes to tables of daily gage height and 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 December 31, 1911.

Drainage area.—760 square miles.

Gage.—Standard chain gage attached to bridge, datum unchanged.

Channel.—Practically permanent; rough; rock was 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 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 records of floods prior to establishment of gage are available.

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 pumping system is about one-fourth mile above the section, but the diversion is negligible.

Remarks.—The stream is fed by springs and has never been known to go dry at this point.

Discharge measurements of Shoal Creek near Breese, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 16	P. S. Monk	2.60	185
Oct. 20	Monk and Brown	1.78	116

Daily gage height, in feet, of Shoal Creek near Breese, Ill., for 1911.

[John Nordman, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	3.4	8.5	2.0	16.4	1.6	1.4	1.15	1.3	11.2	1.7	2.2
2	2.9	3.1	4.4	1.95	16.55	1.55	1.4	1.1	1.25	12.45	1.7	2.1
3	4.5	2.5	3.65	2.25	16.9	1.5	1.4	1.1	1.2	15.6	1.7	2.05
4	3.6	2.0	3.2	3.7	16.95	1.5	1.4	1.15	1.2	17.6	1.7	2.0
5	3.0	1.9	2.85	8.3	14.5	1.5	1.4	1.15	1.4	19.55	1.7	2.0
6	2.3	2.7	2.7	13.3	6.2	1.45	1.35	1.1	2.1	19.5	2.0	1.9
7	1.95	4.1	6.05	11.2	5.3	1.4	1.35	1.1	2.8	18.2	5.8	1.9
8	1.85	6.2	14.35	5.6	3.25	1.4	1.35	1.1	3.6	16.85	5.2	1.9
9	1.7	3.9	15.7	4.1	2.8	1.3	1.3	2.4	5.35	10.2	4.7	1.9
10	1.7	2.8	15.95	3.75	2.2	1.3	1.25	4.2	3.7	5.7	2.1	2.1
11	1.7	2.45	11.75	2.4	1.95	1.3	1.2	3.9	3.9	3.85	1.9	3.2
12	1.7	2.2	6.4	2.3	1.4	1.25	1.2	2.65	3.6	3.2	4.5	5.4
13	1.85	1.95	3.75	7.15	1.35	1.25	1.2	2.1	3.55	2.45	12.1	4.0
14	2.1	2.1	3.7	12.05	1.9	1.25	1.2	1.9	3.5	2.2	12.0	2.75
15	1.85	2.55	3.15	15.2	1.85	1.25	1.15	1.45	3.25	2.15	6.3	2.5
16	5.7	3.45	2.6	15.7	1.8	1.25	1.15	1.4	6.1	2.0	4.4	3.1
17	3.3	4.8	2.4	9.5	1.8	1.25	1.15	1.35	12.6	1.9	4.0	3.7
18	2.8	6.85	2.35	5.9	1.7	1.25	1.15	1.3	12.4	1.85	10.5	4.9
19	2.1	9.2	2.5	5.7	1.6	1.25	1.15	1.2	9.2	1.8	12.8	3.4
20	1.9	13.8	2.3	5.2	1.55	1.25	1.15	1.2	6.15	1.8	9.1	4.1
21	1.85	12.85	2.1	4.9	1.5	1.25	1.15	1.2	2.9	1.85	5.85	8.8
22	1.75	10.1	2.0	4.5	1.7	1.25	1.15	1.2	1.95	2.7	3.6	13.6
23	1.7	6.85	1.95	4.2	1.65	1.25	1.15	1.2	1.7	8.75	3.45	12.9
24	1.75	6.75	1.9	3.9	1.5	1.3	1.15	1.2	1.65	5.25	3.4	8.9
25	1.85	6.7	1.8	3.7	1.6	1.4	1.1	1.2	6.2	2.9	3.0	7.2
26	1.8	10.2	1.85	3.4	1.55	2.5	1.1	1.2	13.9	2.4	2.7	3.8
27	1.95	13.2	4.65	2.05	1.4	2.2	1.1	1.2	14.9	2.0	2.35	5.2
28	6.6	13.75	5.6	2.2	1.3	1.7	1.05	1.35	12.2	1.9	2.2	9.4
29	12.4	.....	3.4	4.25	1.3	1.55	1.05	1.5	7.8	1.9	2.0	5.1
30	7.45	.....	2.2	7.6	1.4	1.4	1.2	1.6	10.55	1.8	2.4	3.5
31	4.1	.....	2.1	.....	1.45	.....	1.15	1.55	.....	1.75	.....	4.2

NOTE.—No ice reported by observer. Relation of gage height to discharge probably not affected by ice during 1911.

Daily discharge, in second-feet, of Shoal Creek near Breese, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	132	299	1,200	123	3,050	90	74	54	66	1,740	98	141
2	221	251	468	118	3,130	86	74	51	62	2,000	98	132
3	485	172	340	146	3,450	82	74	51	58	2,740	98	128
4	332	123	267	349	3,510	82	74	54	58	4,290	98	123
5	235	114	214	1,170	2,450	82	74	54	74	6,820	98	123
6	151	195	195	2,190	786	78	70	51	132	6,750	123	114
7	118	417	759	1,740	624	74	70	51	208	5,060	714	114
8	110	786	2,420	678	275	74	70	51	332	3,400	606	114
9	98	383	2,770	417	208	66	66	161	633	1,540	519	114
10	98	208	2,860	358	141	66	62	434	349	696	132	132
11	98	166	1,850	161	118	66	58	383	383	374	114	267
12	98	141	822	151	74	62	58	189	332	267	485	642
13	110	118	358	957	70	62	58	132	324	166	1,920	400
14	132	132	349	1,910	114	62	58	114	315	141	1,900	202
15	110	178	259	2,620	110	62	54	78	275	136	804	172
16	696	307	183	2,770	106	62	54	74	768	123	468	251
17	283	536	161	1,400	106	62	54	70	2,030	114	400	349
18	208	903	156	732	98	62	54	66	1,990	110	1,600	553
19	132	1,340	172	696	90	62	54	58	1,340	106	2,080	299
20	114	2,300	151	606	86	62	54	58	777	106	1,320	417
21	110	2,090	132	553	82	62	54	58	221	110	723	1,260
22	102	1,520	123	485	98	62	54	58	118	105	332	2,250
23	98	903	118	434	94	62	54	58	98	1,250	307	2,100
24	102	885	114	383	82	66	54	58	94	615	299	1,280
25	110	876	106	349	90	74	51	58	786	221	235	966
26	106	1,540	110	299	86	172	51	58	2,320	161	195	366
27	118	2,160	510	128	74	141	51	58	2,550	123	156	606
28	858	2,280	678	141	66	98	48	70	1,940	114	141	1,380
29	1,990	.....	299	442	66	86	48	82	1,070	114	123	588
30	1,010	.....	141	1,040	74	74	58	90	1,610	106	161	315
31	417	.....	132	.....	78	.....	54	86	.....	102	.....	434

NOTE.—Daily discharge determined from a discharge rating curve well defined between 90 and 400 second-feet (gage heights 1.6 and 4 feet); poorly defined between 417 and 4,170 second-feet (gage heights 4.1 and 17.5 feet); and simply an extension above 4,170 second-feet (gage height 17.5 feet).

Monthly discharge of Shoal Creek near Breese, Ill., for 1911.

[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	1,990	98	290	0.382	0.44	A.
February	2,300	114	780	1.03	1.07	B.
March	2,860	106	594	.782	.90	A.
April	2,770	118	785	1.03	1.15	B.
May	3,510	66	629	.828	.95	B.
June	172	62	76.7	.101	.11	C.
July	74	48	59.4	.078	.09	C.
August	434	51	95.7	.126	.15	C.
September	2,550	58	710	.934	1.04	A.
October	6,820	102	1,280	1.68	1.94	B.
November	2,080	98	545	.717	.80	A.
December	2,250	114	527	.693	.80	A.
The year	6,820	48	529	.696	9.44	

SILVER CREEK NEAR LEBANON, ILL.

Location.—At highway bridge at Wright's Crossing, about 2 miles west of Lebanon, Ill., between the Baltimore & Ohio Southwestern and East St. Louis & Suburban Railroad bridges across Silver Creek.

Records available.—March 3, 1908, to December 31, 1911.

Drainage area.—335 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged. 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. Upon 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.

Channel.—Probably permanent.

Discharge measurements.—Made from downstream side of bridge and small approach spans, and also, at high stages, from downstream side of three steel viaducts on road west of bridge.

Floods.—The maximum gage height since establishment of gage is 15.9 feet, which occurred in May, 1908. No records of floods prior to the establishment of the station are available.

Winter flow.—Ice may affect the relation of gage height to discharge during portions of December, January, and February.

Discharge measurements of Silver Creek near Lebanon, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 14	P. S. Monk	3.80	84
Oct. 21	Monk and Brown	2.77	32.3

Daily gage height, in feet, of Silver Creek near Lebanon, Ill., for 1911.

[E. C. Turner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.6	6.2	3.25	14.8	.....	1.95	0.85	1.4	10.8	2.6	4.05
2	.....	3.4	4.8	3.2	14.5	.....	1.8	.8	1.4	10.0	2.7	3.5
3	.....	3.3	4.3	3.2	13.1	.....	1.7	.7	1.4	10.3	2.6	3.3
4	3.05	3.2	4.0	5.0	12.3	.....	1.6	1.6	1.3	11.1	2.6	3.2
5	.....	3.1	4.0	9.3	11.2	2.1	1.55	1.8	4.0	12.9	2.6	3.1
6	.....	5.6	4.0	10.3	6.1	2.1	1.4	1.7	6.1	12.45	3.35	3.0
7	.....	4.9	4.0	9.0	4.3	2.1	1.3	1.5	8.3	11.0	4.45	2.95
8	.....	4.9	10.05	5.1	3.6	2.0	1.2	1.55	5.4	9.6	6.0	2.95
9	.....	4.5	10.8	3.8	3.4	1.9	1.1	2.5	5.4	7.0	4.6	10.1
10	.....	4.0	11.9	3.4	3.3	1.85	1.05	2.7	4.4	3.95	3.6	(a)
11	3.0	3.6	11.1	3.3	3.2	1.8	1.0	9.5	4.0	3.3	3.0	(a)
12	3.0	3.2	9.9	3.4	3.1	1.7	1.2	8.8	6.95	2.9	9.7	(a)
13	3.0	3.25	5.3	8.3	3.0	1.6	1.5	4.4	4.1	2.9	10.0	(a)
14	3.0	3.3	3.8	10.7	2.9	1.6	1.9	2 8	2.6	2.6	10.4	(a)
15	3.0	3.3	3.5	11.0	2.8	1.65	1.8	2.2	1.95	2.6	7.9	(a)
16	.....	3.35	3.3	12.2	2.7	1.6	1.8	1.9	7.4	2.5	4.9	(a)
17	.....	6.2	3.25	11.95	2.6	1.6	1.7	1.6	9.4	2.5	4.3	(a)
18	3.0	5.3	3.9	10.0	2.7	1.55	1.5	1.5	10.2	2.4	6.1	6.05
19	3.0	7.6	4.4	6.6	2.6	1.5	1.2	1.65	10.6	2.3	9.7	4.1
20	3.0	9.0	3.6	8.6	2.5	1.5	1.2	6.7	11.2	2.4	8.3	7.8
21	3.0	8.7	3.4	5.9	5.9	1.5	1.15	3.0	10.8	2.55	4.9	10.1
22	3.0	7.4	3.25	4.2	4.1	1.45	1.1	2.25	7.6	3.6	4.3	8.7
23	3.0	5.5	3.2	3.6	3.9	1.4	1.1	1 8	3.1	8.2	4.4	10.3
24	3.0	5.45	3.1	3.3	2.6	1.35	.95	1.8	2.6	6.8	4.2	4.9
25	3.0	5.9	3.05	3.1	2.5	5.6	1.0	1.5	2.1	4.0	4.1	4.7
26	3.0	8.9	3.1	3.0	2.45	2.9	.95	1.5	10.7	3.3	4.0	4.2
27	3.0	10.25	5.6	2.9	2.4	2.2	.9	2.4	11.1	3.0	3.4	4.8
28	5.6	9.8	5.3	3.35	2.3	2.45	.85	2.3	13.2	2.8	4.05	7.4
29	7.1	.....	4.3	3.9	2.3	2.3	.8	2.0	13.05	2.8	4.6	5.0
30	6.15	.....	3.6	13.3	.....	2.2	.9	1.7	12.3	2.6	4.9	3.8
31	4.0	.....	3.3	.....	.....	.....	.85	1.6	.....	2.7	.....	.....

(a) Dec. 10 to 17, gage out of order; chain stolen.

NOTE.—Relation of gage height to discharge probably affected by ice about Jan. 3 to 11. Ice reported 3 to 5 inches thick Jan. 4 to 11.

Daily discharge, in second-feet, of Silver Creek near Lebanon, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	69	253	52	4,030	15	9	0.6	3	814	26	95
2	.....	59	143	49	3,720	14	7	.4	3	665	29	64
3	.....	54	110	49	2,280	13	6	.2	3	712	26	54
4	.....	49	92	157	1,490	12	5	5	2.5	885	26	49
5	.....	45	92	576	915	12	4.5	7	3	2,080	26	45
6	.....	203	92	712	244	12	3	6	244	1,630	56	41
7	.....	150	92	540	110	12	2.5	4	458	860	119	39
8	.....	150	672	164	69	10	2	4.5	187	613	235	39
9	.....	122	814	80	59	8	1.5	23	187	325	129	679
10	.....	92	1,190	59	54	7.5	1.2	29	116	89	69	.....
11	.....	69	885	54	49	7	1	600	92	54	41	.....
12	41	49	652	59	45	6	2	516	320	37	626	.....
13	41	52	179	458	41	5	4	116	98	37	665	.....
14	41	54	80	792	37	5	8	33	26	26	730	.....
15	41	54	64	860	33	5.5	7	14	9	26	415	.....
16	200	56	54	1,400	29	5	7	8	365	23	150	.....
17	150	253	52	1,220	26	5	6	5	588	23	110	.....
18	41	179	86	665	29	4.5	4	4	695	20	244	240
19	41	385	116	289	26	4	2	5.5	770	17	626	98
20	41	540	69	492	23	4	2	298	915	20	458	405
21	41	504	59	227	227	4	1.8	41	814	24	150	679
22	41	365	52	104	98	3.5	1.5	16	385	69	110	504
23	41	195	49	69	86	3	1.5	7	45	447	116	712
24	41	191	45	54	26	2.8	.8	7	26	307	104	150
25	41	227	43	45	23	203	1	4	12	92	98	136

Daily discharge, in second-feet, of Silver Creek near Lebanon, Ill., for 1911—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	41	528	45	41	22	37	.8	4	792	54	92	104
27	41	704	203	37	20	14	.7	20	885	41	59	143
28	203	639	179	56	17	22	.6	17	2,380	33	95	365
29	335	.....	110	86	17	17	.4	10	2,230	33	129	157
30	248	.....	69	2,480	17	14	.7	6	1,490	26	150	80
31	92	.....	54	.....	16	.....	.6	5	.....	29	.....	140

NOTE.—Daily discharge determined 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 1,780 second-feet (gage heights 6.9 and 12.6 feet). Daily discharge Jan. 1 to 11, 16, 17, May 30 to June 4, Dec. 10 to 17, and Dec. 31 estimated by comparison with discharge of Shoal Creek near Breese, Ill., and Cahokia Creek near Poag, Ill. Mean discharge Jan. 1 to 11 estimated about 54 second-feet, varying from about 35 to 90 second-feet. Mean discharge Dec. 10 to 17 estimated about 327 second-feet, varying from about 100 to 600 second-feet.

Monthly discharge of Silver Creek near Lebanon, Ill., for 1911.

[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 [a]	335	.....	77.2	0.230	0.27	D.
February	704	45	216	.645	.67	A.
March	1,190	43	216	.645	.74	A.
April	2,480	37	398	1.19	1.33	B.
May [a]	4,030	16	448	1.34	1.54	C.
June [a]	203	2.8	16.2	.048	.05	D.
July	9	.4	3.07	.0092	.01	D.
August	600	.2	58.6	.175	.20	C.
September	2,380	2.5	471	1.41	1.57	C.
October	2,080	17	326	.973	1.12	C.
November	730	26	197	.588	.66	A.
December [a]	712	39	246	.734	.85	C.
The year	4,030	.2	222	.663	9.01	

[a] See footnotes under table of daily discharge for notes relative to estimates of discharge during period in January, May, June, and December.

BIG MUDDY RIVER NEAR CAMBON, ILL.

Location.—At the Chicago, Burlington & Quincy Railroad bridge about 1 mile north of Cambon station and about 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 December 31, 1911.

Drainage area.—735 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably permanent.

Discharge measurements.—Made from downstream side of bridge and wooden approach trestles. Low-water measurements are rendered difficult by collections of drift and should be used with caution.

Floods.—Maximum gage height since establishment of the gage is 25.3 feet, which occurred in May, 1911. No records of floods prior to establishment of station are available.

Point of zero flow.—A determination by leveling, October 25, 1911, indicates that there would be no flow past the station if the stream were to fall to about 1.4 feet by the gage datum.

Winter flow.—Ice may affect the relation between gage height and discharge during portions of December, January, and February.

Discharge measurements of Big Muddy River near Cambon, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 10	P. S. Monk	10.25	932
Oct. 25	Monk and Brown	2.42	24.3

Daily gage height, in feet, of Big Muddy River near Cambon, Ill., for in 1911.

[Joel Prine, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.7	6.55	9.45	4.3	20.25	1.95	1.55	1.75	2.65	12.9	2.5	4.4
2	9.15	5.35	7.65	3.9	24.6	2.05	1.7	2.6	2.4	14.0	2.4	4.4
3	9.8	4.65	7.25	3.6	25.3	2.1	1.65	4.15	2.25	17.7	2.2	4.3
4	9.0	4.0	6.95	3.45	25.05	1.95	1.65	3.85	2.15	13.4	2.1	4.2
5	8.15	3.45	5.85	7.5	24.3	2.1	1.65	6.55	3.2	11.4	2.0	4.1
6	7.6	4.95	5.6	10.0	23.25	2.05	2.95	4.9	5.35	8.3	3.6	4.0
7	6.25	5.25	5.4	11.2	21.9	2.45	2.5	4.0	5.0	6.3	6.7	3.8
8	4.2	6.8	6.45	10.45	20.15	6.75	2.25	3.2	6.15	7.4	10.5	3.5
9	4.0	6.2	9.0	8.0	18.2	6.6	1.75	3.55	6.0	6.6	10.0	3.3
10	3.65	5.65	10.1	5.85	15.8	5.0	1.95	3.0	5.25	6.0	8.4	3.2
11	3.2	5.2	10.9	4.7	12.75	3.8	2.0	2.65	4.6	5.7	6.1	3.3
12	3.85	4.4	8.75	4.2	9.7	3.2	2.3	2.4	3.3	4.6	7.4	3.5
13	3.8	4.1	6.35	6.55	6.95	2.75	2.0	2.25	3.65	4.0	9.6	7.8
14	3.95	3.9	5.2	15.95	4.3	2.45	1.95	2.4	4.2	3.45	11.4	9.2
15	4.9	4.2	4.6	17.9	3.4	2.3	1.65	2.5	4.2	3.5	10.9	9.6
16	4.2	4.8	4.1	20.45	3.0	2.1	1.8	2.2	3.7	3.9	8.8	7.7
17	4.2	6.3	3.75	20.7	2.8	2.0	1.75	2.25	4.3	2.8	6.4	8.7
18	4.2	9.5	3.5	20.2	2.7	2.1	1.75	6.8	4.4	2.7	5.9	10.2
19	3.85	12.9	3.35	19.35	2.55	2.2	1.7	4.55	5.4	2.5	5.4	10.0
20	3.65	14.65	3.25	18.0	2.45	1.9	1.7	3.0	6.6	2.4	5.4	8.6
21	3.6	15.5	3.15	16.6	2.4	1.85	1.7	2.65	6.55	2.4	5.9	9.4
22	3.45	16.45	3.15	15.2	2.4	1.75	1.5	2.3	5.9	2.4	5.5	11.3
23	3.5	17.85	3.1	12.55	2.35	1.85	1.65	2.15	4.25	2.4	5.1	12.2
24	3.5	17.8	3.4	9.1	2.25	2.0	1.7	2.1	4.5	2.4	5.3	12.3
25	3.6	17.2	3.2	6.4	2.2	1.85	1.55	2.4	4.2	2.5	5.6	11.9
26	3.6	16.15	3.5	4.4	2.1	1.8	1.55	2.6	4.0	2.6	5.2	10.4
27	3.8	14.55	3.65	3.8	2.1	1.9	1.55	2.55	10.05	2.5	5.5	7.7
28	5.1	12.25	3.8	3.65	2.05	1.8	1.5	3.2	12.1	2.4	5.2	6.6
29	6.0	.....	5.25	3.65	2.7	1.8	1.35	3.45	11.05	2.8	5.1	6.8
30	6.8	.....	6.2	14.9	2.0	1.6	1.6	2.7	11.0	2.6	4.6	6.6
31	7.35	.....	4.9	.....	2.0	.....	1.6	2.65	.....	2.5	.....	9.2

NOTE.—Relation of gage height to discharge affected by ice about Jan. 3 to 6.

Daily discharge, in second-feet, of Big Muddy River near Cambon, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	806	318	761	99	5,800	6.5	0.5	2.5	29	1,530	23	104
2	707	181	461	79	10,300	9.5	2	27	20	1,880	20	104
3	700	120	408	67	11,000	11	1.5	92	16	3,770	14	99
4	600	84	370	61	10,700	6.5	1.5	77	12	1,680	11	94
5	450	61	234	441	9,940	11	1.5	318	51	1,160	8	89
6	300	144	206	860	8,840	9.5	41	140	181	558	67	84
7	280	171	186	1,110	7,420	22	23	84	148	286	337	75
8	94	350	304	950	5,720	344	16	51	268	428	960	63
9	84	274	680	510	4,120	324	2.5	65	250	324	860	55
10	69	212	880	234	2,650	148	6.5	43	171	250	574	51
11	51	166	1,050	124	1,490	75	8	29	117	217	262	55
12	77	104	635	94	806	51	17	20	55	117	428	63
13	75	89	292	318	370	33	8	16	69	84	788	482
14	82	79	166	2,720	99	22	6.5	20	94	61	1,160	716
15	140	94	117	3,910	59	17	1.5	23	94	63	1,050	788

Daily discharge, in second-feet, of Big Muddy River near Cambon, Ill., for 1911—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	94	132	89	5,980	43	11	3	14	71	79	644	468
17	94	286	73	6,210	35	8	2.5	16	99	35	298	626
18	94	770	63	5,760	31	11	2.5	350	104	31	239	900
19	77	1,530	57	5,020	25	14	2	114	186	23	186	860
20	69	2,140	53	3,980	22	5	2	43	324	20	186	608
21	67	2,500	49	3,060	20	4	2	29	318	20	239	752
22	61	2,980	49	2,360	20	2.5	.0	17	239	20	196	1,140
23	63	3,880	47	1,430	18	4	1.5	12	96	20	157	1,340
24	63	3,840	59	698	16	8	2	11	110	20	176	1,360
25	67	3,420	51	298	14	4	.5	20	94	23	206	1,270
26	67	2,820	63	104	11	3	.5	27	84	27	166	940
27	75	2,100	69	75	11	5	.5	25	870	23	196	468
28	157	1,350	75	69	9.5	3	.0	51	1,310	20	166	324
29	250	.....	171	69	31	3	.0	61	1,080	35	157	350
30	350	.....	274	2,240	8	1	1	31	1,070	27	117	324
31	422	.....	140	.....	8	.....	1	29	.....	23	.....	716

NOTE.—Daily discharge determined from a discharge rating curve fairly well defined. Daily discharge Jan. 3 to 6 estimated, because of ice, from climatologic records and record of run-off in adjacent drainage areas.

Monthly discharge of Big Muddy River near Cambon, Ill., for 1911.

[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 [a]	806	51	212	0.288	0.33	C.
February	3,880	61	1,080	1.47	1.53	B.
March	1,050	47	262	.356	.41	B.
April	6,210	61	1,630	2.22	2.48	B.
May	11,000	8	2,570	3.50	4.04	B.
June	344	1	39.2	.053	.06	C.
July	41	.0	5.10	.0069	.008	D.
August	350	2.5	59.9	.081	.09	C.
September	1,310	12	254	.346	.39	B.
October	3,770	20	415	.565	.65	B.
November	1,160	8	330	.449	.50	B.
December	1,360	51	496	.675	.78	B.
The year	11,000	0	609	.829	11.27	

[a] See footnotes 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 December 31, 1911. During 1908 the gage was read only when the observer happened to be in the vicinity. Except for a few days, however, fairly accurate results will be obtained if the discharge is interpolated on days when gage was not read.

Drainage area.—227 square miles.

Gage.—Standard chain gage attached to bridge; datum unchanged.

Channel.—Probably permanent; poor for low-water measurements because of low velocity and old piles in channel.

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 on the present gage.

Winter flow.—Ice affects the relation between gage height and discharge during portions of December, January, and February.

Remarks.—The creek goes dry at times, the water then standing in pools near the gage.

Discharge measurements of Beaucoup Creek near Pinckneyville, Ill., in 1911.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-feet.*
Mar. 11	P. S. Monk	4.31	95.4
Oct. 24	Monk and Brown	2.68	[a] 18.2

[a] Oct. 24, measurement made by wading one-half mile above regular section.

Daily gage height, in feet, of Beaucoup Creek near Pinckneyville, Ill., for 1911.

[R. C. Huggins, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
1	4.0	2.3	3.7	2.85	21.05	2.0	1.95	2.0	2.4	3.8	2.25	3.0
2	3.8	2.3	4.4	2.8	20.0	2.0	.....	1.95	2.4	.....	2.2	2.85
3	4.35	2.8	4.6	2.7	14.5	2.0	1.95	5.15	.....	6.0	2.2	2.7
4	3.7	2.7	4.25	2.8	8.5	.....	1.95	.....	.....	3.7	2.15	2.6
5	3.2	.....	3.9	5.6	4.3	2.0	1.9	5.25	.....	.....	2.15	2.55
6	2.8	2.8	3.7	5.6	3.65	2.0	1.9	.....	4.95	3.0	4.5	2.5
7	2.65	2.95	3.85	4.0	.....	2.0	1.9	2.9	7.5	.....	4.4	2.5
8	2.55	3.1	8.3	3.0	3.0	2.0	1.9	4.0	.....	.....	5.4	2.5
9	2.5	3.0	.....	3.0	2.9	2.0	.....	4.2	.....	3.05	3.05	2.6
10	2.5	2.1	4.9	2.8	2.8	2.0	1.85	2.7	3.3	.....	3.0	4.8
11	2.5	2.75	4.35	.....	2.8	1.95	1.85	2.65	3.45	.....	2.8	5.9
12	2.5	2.65	3.9	2.7	2.6	1.9	1.95	2.6	2.8	2.05	3.15	6.0
13	2.5	2.6	3.55	10.5	2.5	1.9	1.95	.....	3.0	2.5	5.2	4.3
14	2.6	2.6	3.15	16.0	2.5	1.9	1.95	2.25	2.7	2.4	4.75	3.3
15	2.6	2.6	.....	17.7	2.5	.....	1.9	2.15	2.45	2.35	3.9	.....
16	2.6	2.9	2.8	7.4	2.5	1.9	1.95	2.1	2.7	2.35	3.2	5.0
17	2.6	3.5	2.7	4.4	2.4	1.9	1.95	2.0	3.45	.....	2.3	5.6
18	2.6	4.35	2.6	3.9	2.4	.....	1.9	2.0	5.85	2.3	2.3	3.5
19	2.5	.....	2.6	7.4	2.4	2.2	1.9	1.95	8.9	2.3	3.2	3.3
20	2.55	15.0	2.6	8.6	2.4	2.0	1.9	.....	3.9	2.25	3.2	.....
21	2.5	12.0	2.6	5.0	.....	2.0	2.0	1.9	.....	2.25	3.1	6.8
22	2.5	5.65	2.6	3.95	2.3	2.0	1.95	1.9	.....	2.6	2.9	8.85
23	2.6	4.95	.....	.....	2.3	2.0	.....	1.9	3.9	2.4	2.85	5.85
24	2.55	4.6	1.85	3.0	2.6	2.0	1.95	.....	.....	2.4	2.8	4.85
25	2.6	5.55	1.9	2.85	2.5	2.0	1.9	2.2	2.5	2.9	2.85	3.7
26	2.6	6.3	.....	2.8	2.4	2.0	1.9	2.2	6.25	2.7	3.6	3.5
27	2.6	6.1	3.45	.....	2.3	2.0	1.9	.....	9.0	2.55	3.1	3.3
28	4.6	4.5	3.5	2.75	2.15	2.0	1.9	2.4	5.0	2.4	3.0	4.1
29	.....	.....	3.85	7.05	2.2	2.0	1.9	.....	3.7	2.4	2.8	3.4
30	4.3	.....	3.15	19.05	2.0	2.0	.....	2.5	3.1	2.4	.....	4.3
31	3.6	.....	3.0	.....	2.0	.....	1.95	2.4	.....	2.4	.....	.....

NOTE.—Relation of gage height to discharge affected by ice, Jan. 3 to 9.

Daily discharge, in second-feet, of Beaucoup Creek near Pinckneyville, Ill., for 1911.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	80	8	65	26	2,170	3	3	3	11	70	7	32
2	70	8	105	24	2,020	3	3	3	11	148	6	26
3	50	24	119	20	1,250	3	3	159	11	227	6	20
4	40	20	95	24	468	3	3	163	11	65	5	17
5	30	20	75	195	98	3	3	167	20	48	5	16
6	25	24	65	195	62	3	3	98	144	32	112	14
7	20	30	72	80	42	3	3	28	363	33	105	14
8	20	36	446	32	32	3	3	80	300	33	179	14
9	15	32	500	32	28	3	3	92	200	34	34	17
10	14	4	140	24	24	3	2.5	20	45	24	32	133
11	14	22	102	22	24	3	2.5	18	52	14	24	219
12	14	18	75	20	17	3	3	17	24	3.5	38	227
13	14	17	58	705	14	3	3	12	32	14	163	98
14	17	17	38	1,460	14	3	3	7	20	11	130	45
15	17	17	31	1,700	14	3	3	5	12	9.5	75	96
16	17	28	24	353	14	3	3	4	20	9.5	40	147
17	17	55	20	105	11	3	3	3	52	8.8	8	195
18	17	102	17	75	11	4	3	3	215	8	8	55
19	14	1,200	17	353	11	6	3	3	512	8	40	45
20	16	1,320	17	479	11	3	3	3	75	7	40	172
21	14	900	17	147	10	3	3	3	75	7	36	299
22	14	199	17	78	8	3	3	3	75	17	28	506
23	17	144	9.8	55	8	3	3	3	75	11	26	215
24	16	119	2.5	32	17	3	3	4	45	11	24	136
25	17	191	3	26	14	3	3	6	14	28	26	65
26	17	254	30	24	11	3	3	6	250	20	60	55
27	17	236	52	23	8	3	3	8	523	16	36	45
28	119	112	55	22	5	3	3	11	147	11	32	86
29	108	.....	72	322	6	3	3	12	65	11	24	50
30	98	.....	38	1,890	3	3	3	14	36	11	28	98
31	60	.....	32	.....	3	.....	3	11	.....	11	.....	185

NOTE.—Daily discharge determined from a discharge rating curve well defined between 8 and 227 second-feet (gage heights 2.3 and 6 feet), and fairly well defined between 236 and 640 second-feet (gage heights 6.1 and 10 feet). Daily discharge Jan. 3 to 9 estimated, because of ice, from climatologic and run-off records in adjacent drainage areas and gage observer's notes. Daily discharge interpolated or estimated from climatologic records and run-off in adjacent drainage areas on days when gage was not read.

Monthly discharge of Beaucoup Creek near Pinckneyville, Ill., for 1911.

[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	119	14	32.8	0.144	0.17	C.
February	1,320	4	184	.811	.84	B.
March	500	2.5	77.7	.342	.39	A.
April	1,890	20	285	1.26	1.41	B.
May	2,170	3	207	.912	1.05	B.
June	6	3	3.1	.014	.02	D.
July	3	2.5	3.0	.013	.01	D.
August	167	3	31.3	.138	.16	C.
September	523	11	114	.502	.56	B.
October	227	3.5	31.0	.137	.16	B.
November	179	5	45.9	.202	.23	A.
December	506	14	102	.450	.52	A.
The year	2,170	2.5	92.2	.406	5.52	

NOTE.—See footnotes to tables of daily gage height and daily discharge for notes relative to discharges estimated.

MISCELLANEOUS MEASUREMENTS.

HUDSON BAY DRAINAGE BASIN.

Miscellaneous measurements in St. Mary River (Montana) drainage basin in 1911.

[By W. A. Lamb and B. E. Jones.]

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. miles.*	*Sec.-ft.*
Dec. 6	Swiftcurrent Creek.	St. Mary River..	McDermott Lake, near Babb, Mont.[a]	.....	19.1	32	0.597
May 5	Kennedy Creek	.....do.....	Babb, Mont.[b]	.....	171	.....	.....
July 18	.....do.....	.....do.....	.....do.[b]	.....	153	.....	.....
Aug. 26	.....do.....	.....do.....	.....do.[b]	.....	81	.....	.....
Oct. 12	.....do.....	.....do.....	.....do.[b]	.....	94	.....	.....

[a] Dec. 6. Measurement made by wading about 200 feet below the falls at the outlet of McDermott Lake. Gage height not referenced.
[b] Measurements made by wading near the ford. Gage heights not referenced.

Miscellaneous measurements in Red River drainage basin in 1911.

[By E. F. Chandler, Goric Monley, and George Ebner.]

Mar. 4	Red Lake River.	Red River.....	Mouth, East Grand Forks, Minn.	[a] 4.54	134	5,760	0.023
May 13	.....do.....	.....do.....	.....do.....	7.20	360	5,760	.063
July 18	.....do.....	.....do.....	.....do.....	3.83	173	5,760	.030
June 28	Roseau River .	.....do.....	Near Roseau City, Minn.	2.50	28.9	.....	.....
Sept. 14	.....do.....	.....do.....	.....do.....	1.89	3.2	.....	.....
June 27	East Branch of Roseau River.	Roseau River...	Near Malone, Minn..	1.52	17.9	.....	.....
Sept. 13	.....do.....	.....do.....	.....do.....	.92	2.3	.....	.....

[a] Mean lower surface of ice=2.10 feet.

Miscellaneous measurements in Rainy River drainage basin in 1911.

[By Robert Follansbee, C. R. Adams, and C. J. Emerson.]

Feb. 2	Little Fork River.	Rainy River.....	Tps. 62-63, R. 21 W., near Hughes, Minn.	.....	36	.....	.....
June 18	Vermilion River.	.....do.....	Crane Lake, Portage, Minn.	3.0	652	.....	.....

UPPER MISSISSIPPI RIVER DRAINAGE BASIN.

Miscellaneous measurements in upper Mississippi River drainage basin in 1911.

[By Robert Follansbee and G. L. Rosing.]

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.	Drainage area.	Discharge per square mile.
				Feet.	*Sec.-ft.*	*Sq. miles.*	*Sec.-ft.*
Aug. 20	Prairie River..	Mississippi River	Near Grand Rapids, Minn.	8.17	96	.....	.....
July 7	Yellow Medicine River.	Minnesota River	Hauley Falls, Minn..	.....	10.7	.....	.....

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 artificial storage. The most important fact worth noting 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 basins for 1911.

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	0.48	0.44	0.43	0.87	5.58	11.0	5.60	2.99	3.39	1.87	0.73	0.30	2.81
St. Mary River below Swiftcurrent Creek, at Babb, Mont.	298	.52	.47	.44	1.20	5.64	10.2	5.37	2.78	3.42	1.60	.70	.33	2.72
St. Mary River near Cardston, Alberta, Canada.	452	.38	.33	.32	1.06	4.51	7.68	3.72	2.32	2.79	1.37	.76	.43	2.14
Otter Tail River near Fergus Falls, Minn.	1,310	.06	.06	.10	.18	.17	.13	.08	.10	.10	.12	.10	.08	.11
Red River at Fargo, N. Dak.	6,020	....	....	.04	.06	.05	.04	.02	.03	.03	.04	....	....	....
Red River at Grand Forks, N. Dak.	25,000	.01	.01	.03	.08	.06	.07	.02	.02	.02	.02	.02	.01	.03
Pelican River near Fergus Falls, Minn.	433	(a)	(a)	.02	.09	.08	.08	.03	.04	.04	.08	.05	.02	.04
Wild Rice River at Twin Valley, Minn.	805	.03	.02	.09	.30	.25	.13	.16	.04	.03	.17	.04	.04	.11
Red Lake River at Thief River Falls, Minn.	3,430	.04	.03	.04	.11	.08	.18	.02	.01	.01	.01	(a)	(a)	.04
Red Lake River at Crookston, Minn.	5,320	.03	.02	.08	.12	.08	.18	.03	.02	.02	.02	.01	.02	.05
Thief River near Thief River Falls, Minn.	1,010	.00	.00	.01	.05	.01	.01	(a)	(a)	(a)	(a)	(a)	.00	.01
Clearwater River at Red Lake Falls, Minn.	1,310	.03	.03	.04	.18	.07	.14	.02	.05	.04	.04	....	....	....
South Branch of Two Rivers at Hallock, Minn	776	....	....	....	....	.06	.42	.04	.01	.02	.06	.02	.01	....
Pembina River at Neche, N. Dak.	2,940	....	....	....	.10	.08	.05	.02	.01	(a)	.01	....	....	....
West Branch of Roseau River near Malung, Minn.	265	....	....	....	....	....	.34	.02	.01	.01	.01	.01	.01	....
Mouse River at Minot, N. Dak.	8,400	....	....	....	.04	.05	.02	(a)	(a)	(a)	(a)	(a)	(a)	....
Rainy River at International Falls, Minn.	14,600	.20	.16	.17	.25	.32	.43	.27	.45	.41	.36	.37	.40	.32
Little Fork River at Little Fork, Minn.	1,720	....	....	....	1.22	.63	.98	.12	.29	.31	.21	.12	.08	....
Vermilion River below Lake Vermilion, Minn	507	....	....	....	....	....	1.04	.61	.47	.39	.30	.24	.26	....
Mississippi River above Sandy River, Minn.	4,510	.15	.15	.19	.27	.38	.44	.56	.41	.50	.34	.25	.14	.32
Mississippi River at Anoka, Minn.	17,100	.10	.10	.14	.20	.26	.27	.23	.21	.24	.25	.18	.12	.19
Mississippi River at St. Paul, Minn.	35,700	.06	.06	.09	.12	.15	.16	.12	.12	.12	.23	.12	.09	.12
Pine River below Pine River reservoir, Minn.	452	.19	.22	.24	.28	.80	.84	.63	.30	.21	.10	.12	.12	.34
Crow Wing River at Nimrod, Minn.	1,010	....	....	....	.20	.18	.52	.22	.19	.43	.45	.46	....	....
Crow Wing River at Pillager, Minn.	3,230	.12	.11	.17	.21	.19	.23	.12	.13	.18	.26	.16	.14	.17
Long Prairie River near Motley, Minn.	973	....	....	....	.13	.13	.10	.06	.08	.12	.19	....	....	....
Sauk River near St. Cloud, Minn.	816	.02	.01	.14	.09	.08	.07	.09	.11	.13	.11	.13	.16	.10
Elk River near Big Lake, Minn.	615	....	....	....	....	.22	.17	.10	.13	.14	.29	.18	.18	....
Crow River at Rockford, Minn.	2,520	.02	.02	.05	.07	.09	.09	.04	.04	.04	.17	.06	.06	.06
South Branch of Crow River near Rockford, Minn.	1,170	....	....	.06	.07	.08	.02	.01	.01	.01	.17	.04	.03	....
Rum River at Onamia, Minn.	414	.00	.00	(a)	.02	.01	.02	.01	(a)	.01	.03	.03	.01	.01
Rum River at Cambridge, Minn.	1,160	.04	.05	.10	.10	.20	.28	.18	.14	.10	.25	.11	.10	.14

a Discharge per square mile less than 0.005 second-foot.

Summary of discharge, in second-feet per square mile, in Hudson Bay and upper Mississippi River basins for 1911—Continued.

Station.	Drainage area.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	Sq.mi.													
Minnesota River near Odessa, Minn.	1,560	....	....	....	.03	.01	.01	(a)	(a)	.01	.02	....	....	....
Minnesota River near Montevideo, Minn.	6,300	.01	.01	.04	.04	.03	.03	.01	.01	.01	.03	.03	.02	.02
Minnesota River near Mankato, Minn.	14,600	.01	.01	.05	.05	.04	.03	.02	.02	.01	.12	.07	.05	.04
Lac qui Parle River at Lac qui Parle, Minn.	838	....	....	....	.04	.01	.01	(a)	(a)	(a)	.03	.02	....	....
Chippewa River near Watson, Minn.	1,940	....	....	....	.04	.03	.06	.01	.01	.02	.05	.04	.01	....
Redwood River near Redwood Falls, Minn.	703	....	....	....	.04	.02	.01	(a)	.01	.01	.07	.02	.02	....
Cottonwood River near New Ulm, Minn.	1,190	....	....	....	.05	.02	.01	(a)	.02	.02	.23	.05	.05	....
St. Croix River near St. Croix Falls, Wis.	5,930	.20	.24	.39	.58	.68	.54	.30	.30	.36	.65	.34	.34	.41
Kettle River near Sandstone, Minn.	825	.08	.09	.21	.72	1.05	.68	.50	.33	.44	.49	.25	.18	.42
Snake River at Mora, Minn.	422	.02	.04	.11	.19	.34	.54	.23	.14	.43	.51	.19	.13	.24
Cannon River at Welch, Minn.	1,290	....	....	.12	.11	.10	.14	.09	.17	.17	1.29	.39	.47	....
Zumbro River at Zumbro Falls, Minn.	1,120	.14	.46	.22	.18	.22	.17	.11	.31	.14	1.34	.31	.51	.34
South Branch of Zumbro River near Zumbro Falls, Minn.	821	....	....	....	....	....	....	.10	.30	.12	1.35	.33	.53	....
Root River near Houston, Minn.	1,560	.20	.54	.25	.23	.28	.24	.18	.76	.30	.92	.34	.56	.40
North Branch of Root River near Lanesboro, Minn.	647	....	....	.21	.19	.29	.19	.10	1.53	.28	1.54	.42	.71	....
Wapsipinicon River at Stone City, Iowa.	1,310	....	....	.27	.22	.30	.30	.07	.66	.20	.76	.40	.51	....
Cedar River near Austin, Minn.	425	.10	.43	.13	.12	.16	.13	.05	.60	.07	1.29	.28	.48	.32
Cedar River at Cedar Rapids, Iowa.	6,320	.06	.62	.24	.17	.28	.26	.08	.34	.18	.57	.27	.34	.28
Des Moines River at Jackson, Minn.	1,160	....	....	....	.04	.03	.02	.02	.04	.04	.13	.06	.05	....
Sangamon River at Monticello, Ill.	550	1.00	.58	.48	1.22	.32	.05	.01	.01	.59	.95	1.33	.91	.62
Sangamon River at Riverton, Ill.	2,560	1.14	.88	.64	1.40	.56	.13	.05	.06	1.02	2.45	1.28	.94	.88
Sangamon River near Oakford, Ill.	5,000	.96	.73	.55	1.01	.44	.16	....	....	....	....	....	....	....
South Fork of Sangamon River near Taylorville, Ill.	427	1.50	.90	.67	1.46	.62	.14	.04	.04	1.13	1.92	1.10	.86	.86
Salt Creek near Kenney, Ill.	459	1.61	.55	.43	.85	.23	.06	.02	.01	1.53	1.28	1.18	.91	.72
Cahokia Creek near Poag, Ill.	259	.44	.78	.64	1.18	1.08	.07	.05	.31	1.12	1.47	.82	.86	.73
Kaskaskia River near Arcola, Ill.	390	1.21	.95	.96	2.28	.65	.08	.00	.01	1.03	1.83	1.24	.66	.91
Kaskaskia River at Shelbyville, Ill.	1,030	1.60	1.36	.99	2.36	.64	.10	.02	.02	1.41	2.86	1.46	.85	1.14
Kaskaskia River at Vandalia, Ill.	1,980	1.10	1.12	.90	1.54	.69	.06	.03	.01	1.00	2.37	.91	.85	.88
Kaskaskia River at Carlyle, Ill.	2,680	.80	1.02	.87	1.41	.76	.08	.02	.02	.63	2.52	1.04	.77	.83
Kaskaskia River at New Athens, Ill.	5,220	.46	.92	.90	1.34	1.50	.08	.05	.05	.59	2.13	.86	.72	.80
Shoal Creek near Breese, Ill.	760	.38	1.03	.78	1.03	.83	.10	.08	.13	.93	1.68	.72	.69	.70
Silver Creek near Lebanon, Ill.	335	.23	.64	.64	1.19	1.34	.05	.01	.18	1.41	.97	.59	.73	.66
Big Muddy River near Cambon, Ill.	735	.29	1.47	.36	2.22	3.50	.05	.01	.08	.35	.56	.45	.68	.83
Beaucoup Creek near Pinckneyville, Ill.	227	.14	.81	.34	1.26	.91	.01	.01	.14	.50	.14	.20	.45	.41

a Discharge per square mile less than 0.005 second-foot.

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