DEPARTMENT OF THE INTERIOR
HUBERT WORK, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 525

SURFACE WATER SUPPLY OF THE UNITED STATES

1921

PART V. HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS

NATHAN C. GROVER, Chief Hydraulic Engineer
W. A. LAMB, S. B. SOULÉ, H. E. GROSBACH
and E. D. BURCHARD, District Engineers

Prepared in cooperation with the States of
MINNESOTA, WISCONSIN, IOWA, and ILLINOIS

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ILLUSTRATIONS.

SURFACE WATER SUPPLY OF HUDSON BAY AND UPPER MISSISSIPPI RIVER BASINS, 1921.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of flow made on streams in the United States during the year ending September 30, 1921.

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

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 relating to irrigation in the arid West. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

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

Annual appropriations for the fiscal years ending June 30, 1895–1922.

1895	$12,500.00
1896	20,000.00
1897 to 1900, inclusive	50,000.00
1901 to 1902, inclusive	100,000.00
1903 to 1906, inclusive	200,000.00
1907	150,000.00
1908 to 1910, inclusive	100,000.00
1911 to 1917, inclusive	150,000.00
1918	175,000.00
1919	148,244.10
1920	175,000.00
1921	180,000.00
1922	180,000.00

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 9.

Measurements of stream flow have been made at about 5,200 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1921, 1,350 gaging stations were being maintained by the Survey and the cooperating organizations. Many miscellaneous discharge measurements are made at other points. In connnection 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 water-supply papers from time to time.

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 that 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 that represent the actual quantity of water, as run-off in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, and run-off in inches and acre-feet. They may be defined as follows:

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross section 1 foot wide and 1 foot deep at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"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.

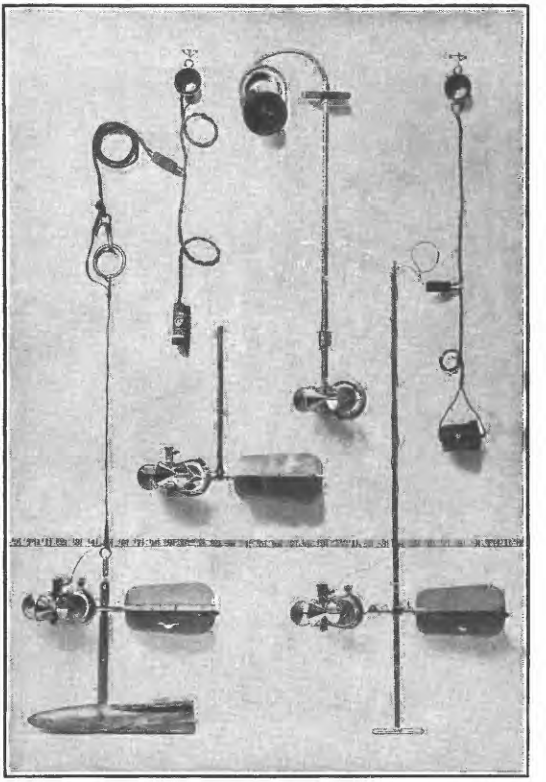
"Run-off in inches" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

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

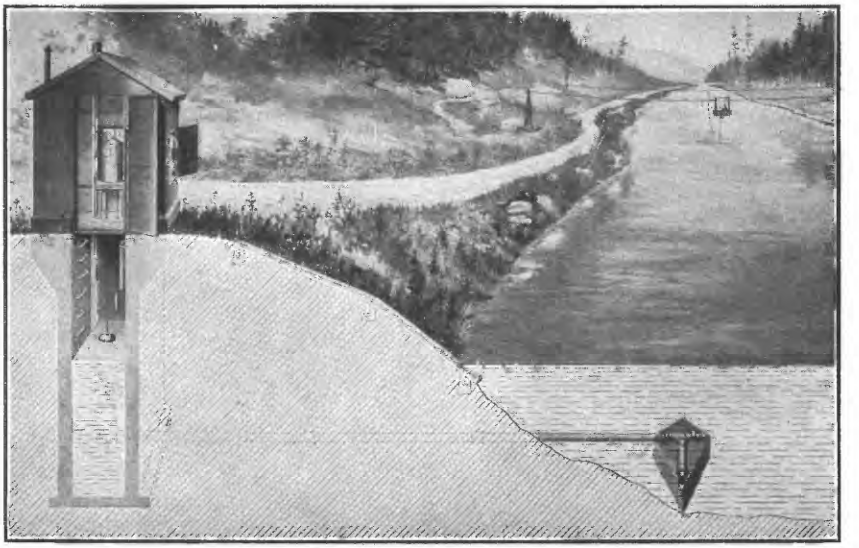
The following terms not in common use are here defined.

"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

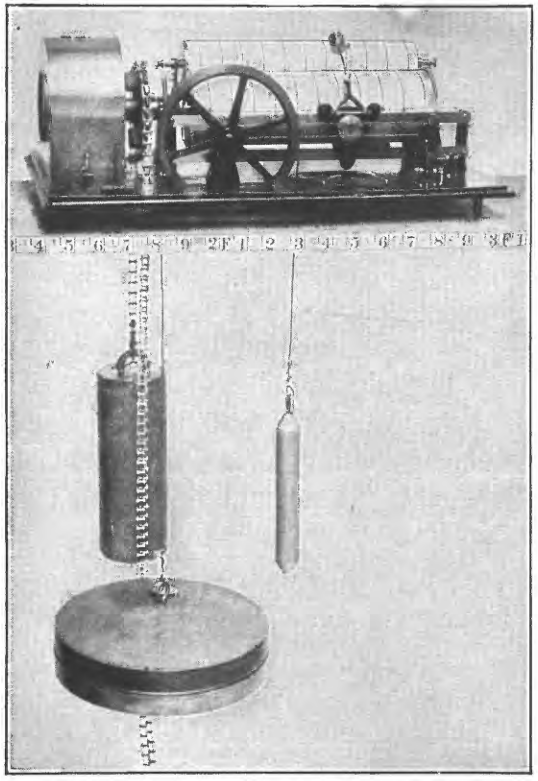
"Control," a term used to designate the section or sections of the stream below the gage which determine the stage-discharge relation at the gage. It should be noted that the control may not be the same section or sections at all stages.



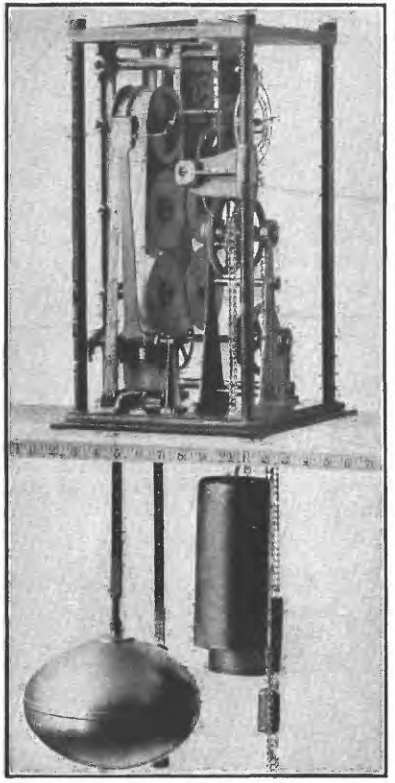
A. PRICE CURRENT METERS.



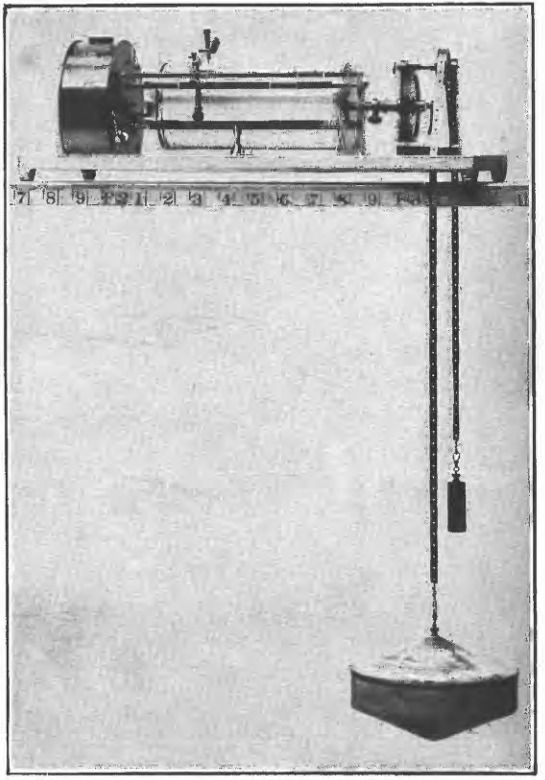
B. TYPICAL GAGING STATION.



A. STEVENS CONTINUOUS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

The "point of zero flow" for a gaging station is that point on the gage—the gage height—to which the surface of the stream would fall if there were no flow.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1920, and ending September 30, 1921. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

The base data collected at gaging stations consist of records of stage, measurements of discharge, and general information used to supplement the gage heights and discharge measurements in determining the daily flow. The records of stage are obtained either from direct readings on a staff gage or chain gage or from a water-stage recorder that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter. (See Pls. I, II.) The general methods are outlined in standard textbooks on the measurement of river discharge.

From the discharge measurements rating tables are prepared that give the discharge for any stage. The application of the daily gage heights to these rating tables gives the discharge from which the monthly and yearly mean discharge is determined.

The data presented for each gaging station in the area covered by this report comprise a description of the station, a table giving results of discharge measurements, a table showing the daily discharge of the stream, and a table of monthly and yearly discharge and run-off.

If the base data are insufficient to determine the daily discharge, tables giving daily gage heights and results of discharge measurements are published.

The description of the station gives, in addition to statements regarding location and equipment, information in regard to any conditions that may affect the constancy of the stage-discharge relation, covering such subjects as the occurrence of ice, the use of the stream for log driving, shifting of control, and the cause and effect of backwater; it gives also information as to diversions that decrease the flow at the gage, artificial regulation, maximum and minimum recorded stages, and the accuracy of the records.

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each

day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow 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 headed "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 per second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 2, are based.

ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

The accuracy of stream-flow data depends primarily (1) on the permanence of the stage-discharge relation and (2) on the accuracy of observation of stage, measurements of flow, and interpretation of records.

A paragraph in the description of the station gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

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," 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 monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and run-off in inches may be subject to gross errors caused by the inclusion of large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river

[1] For a more detailed discussion of the accuracy of stream-flow data see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53-59, 1916.

above the station. "Second-feet per square mile" and "Run-off in inches" are therefore not computed if such errors appear probable. The computations are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off in inches" previously published by the Survey should be used with caution because of possible inherent but unknown sources of error.

Many gaging stations on streams in the irrigated sections of the United States are located above most of the diversions from those streams, and the discharge recorded does not show the water supply available for further development, as prior appropriations below the stations must first be satisfied. To give an idea of the amount of prior appropriations, a paragraph on diversions is presented in each station description. Where figures are given these can not be considered exact but represent the best information available.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates; the tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on data previously published.

PUBLICATIONS.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, professional papers, annual reports, and monographs.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features, as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins; in three volumes:
A. Pacific slope basins in Washington and upper Columbia River basin.
B. Snake River basin.
C. Lower Columbia River basin and Pacific slope basins in Oregon.

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

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

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

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

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

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Trenton, N. J., State House.
Asheville, N. C., 6 Government Street.
Chattanooga, Tenn., 37 Municipal Building.
Columbus, Ohio, Brown Hall, Ohio State University.
Chicago, Ill., 1404 Kimball Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Ames, Iowa, State Highway Commission Building.
Rolla, Mo., Rolla Building, School of Mines and Metallurgy.
Topeka, Kans., 23 Federal Building.
Helena, Mont., 52 Montana National Bank Building.
Denver, Colo., 403 Post Office Building.
Salt Lake City, Utah, 313 Federal Building.
Idaho Falls, Idaho, 228 Federal Building.
Boise, Idaho, 615 Idaho Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 600 Federal Building.
Tucson, Ariz., 210 Agricultural Building, University of Arizona.
Austin, Tex., State Capitol.
Honolulu, Hawaii, 25 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

Stream-flow records have been obtained at about 5,200 points in the United States, and the data obtained have been published in the reports tabulated below:

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

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

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	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 to 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.
W 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.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River, and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	do	1903.
W 124 to 135	do	1904.
W 165 to 178	do	1905.
W 201 to 214	do	1906.
W 241 to 252	do	1907–8.
W 261 to 272	do	1909.
W 281 to 292	do	1910.
W 301 to 312	do	1911.
W 321 to 332	do	1912.
W 351 to 362	do	1913.
W 381 to 394	do	1914.
W 401 to 414	do	1915.
W 431 to 444	do	1916.
W 451 to 464	do	1917.
W 471 to 484	do	1918.
W 501 to 514	do	1919–20.
W 521 to 534	do	1921.

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

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The following table gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1921. The data for any particular station will, in general, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Maine, 1903 to 1921, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, 451, 471, 501, and 521, which contain records for the New England streams from 1903 to 1921. Results of miscellaneous measurements are published by drainage basins.

Numbers of water-supply papers containing results of stream measurements; 1899–1921.

Year.	I North Atlantic slope (St. John River to York River.)	II South Atlantic and eastern Gulf of Mexico (James Riveer to the Missis-sippi.)	III Ohio River.	IV St. Lawrence River and Great Lakes.	V Hudson Bay and upper Missis-sippi River.	VI Missouri River.	VII Lower Missis-sippi River.	VIII Western Gulf of Mexico.	IX Colorado River.	X Great Basin.	XI Pacific slope in Calif-fornia.	XII North Pacific slope basins.		
												Pacific slope in Washing-ton and upper Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope in Oregon.
1899 [a]	35	[b] 35, 36	36	36	36	[c] 36, 37	37	37	[d] 37, 38	38, [e] 39	38, [f] 39	38	38	38
1900 [g]	47, [h] 48	48	48, [i] 49	49	49	49, [j] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	65, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 78	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 83, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[k] 98, 99, [m] 100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 169, 173	174	176, [s] 177	176, [r] 177	177	178	178	[t] 177, 178
1906	[n] 201, [o] 202, [p] 203	[p] 203, 204	205	206	207	208	[k] 205, 209	210	211	212, [r] 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, [r] 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, [r] 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	326	327	328	329	330	331	332A	332B	332C
1913	351	352	353	354	355	356	357	358	359	360	361	362A	362B	362C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	420	411	412	413	404
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464
1918	471	472	473	474	475	476	477	478	479	480	481	482	483	484
1919–20	501	502	503	504	505	506	507	508	509	510	511	512	513	514
1921	521	522	523	524	525	526	527	528	529	530	531	532	533	534

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

COOPERATION.

In Montana the work was carried on in cooperation with the United States Reclamation Service. With the exception of the station on St. Mary River near Babb, Mont., all stations in Montana were maintained jointly with the Dominion Water Power Branch, Department of the Interior, Canada.

In North Dakota the work was done in cooperation with W. H. Robinson, State engineer, and at certain stations in cooperation with the Bureau of Public Roads, Department of Agriculture, and the Flood Control Commission of North Dakota.

In Minnesota the work at certain stations was carried on in cooperation with the following organizations: United States Weather Bureau (Mississippi River at St. Paul and Minnesota River near Mankato), United States Engineer Corps (Mississippi River at Elk River and Minnesota River near Montevideo).

In Wisconsin the work was carried on in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer; and at certain stations with the Wisconsin-Minnesota Light & Power Co. (Chippewa River at Chippewa Falls, Red Cedar River near Colfax, Red Cedar River at Cedar Falls, and Red Cedar River at Menomonie).

In Iowa the work was carried on in cooperation with the Iowa Geological Survey, George F. Kay, director; the Iowa Highway Commission, F. R. White, chief engineer; and the Mississippi River Power Co. of Keokuk, Iowa, R. H. Bolster, hydraulic engineer. The United States Weather Bureau paid part of the observer's salary at the station on Des Moines River near Boone, and the Interstate Power Co. of Chicago paid for the services of an observer at the station on Upper Iowa River near Decorah.

In Illinois the work was carried on in cooperation with the Division of Waterways, Department of Public Works and Buildings, W. L. Sackett, superintendent, and at certain stations with the United States Public Health Service, J. K. Hoskins, sanitary engineer (Illinois River at Peoria and at Beardstown, Kankakee River at Custer Park, Fox River at Wedron, Vermilion River near Streator Mackinaw River near Green Valley, Spoon River at Seville, Crooked Creek at Ripley, and Macoupin Creek near Kane), the United States Weather Bureau (Illinois River at Morris and at Beardstown), and the Central Illinois Public Service Co. (South Fork of Sangamon River at power plant, near Taylorville).

DIVISION OF WORK.

The data for stations in the Hudson Bay basin, in Montana and North Dakota were collected and prepared for publication under the direction of W. A. Lamb, district engineer, Helena, Mont., assisted by E. F. Chandler and A. H. Tuttle.

The data for stations in the Hudson Bay and Mississippi River basins in Minnesota were collected and prepared for publication under the direction of S. B. Soulé, district engineer, by E. F. Chandler, assisted by E. E. Foster and W. L. Stockwell.

For stations in the Mississippi River basin in Wisconsin the data were collected and prepared for publication under the direction of S. B. Soulé, district engineer, assisted by S. R. Collins, A. O. Olson, and Glenn Rittenburg.

For stations in the Mississippi River basin in Iowa the data were collected under the direction of E. D. Burchard, district engineer, assisted by R. H. Bolster, R. W. Clyde, C. Herlofson, and A. Davis.

The data for stations in the Mississippi River basin in Illinois were collected under the direction of H. E. Grosbach, district engineer, assisted by A. M. Whal.

The manuscript was reviewed and assembled by B. L. Bigwood.

GAGING-STATION RECORDS.

HUDSON BAY DRAINAGE BASIN.

ST. MARY RIVER NEAR BABB, MONT.

[Including diversion from Swiftcurrent Creek.]

LOCATION.—In SE. ¼ sec. 27, T. 36 N., R. 14 W., 1,040 feet above headworks of St. Mary canal and 2 miles south of Babb, on Blackfeet Indian Reservation, in Glacier County.

DRAINAGE AREA.—278 square miles (including area of Swiftcurrent Creek above point of diversion into St. Mary Lake); measured on topographic maps.

RECORDS AVAILABLE.—January 1, 1902, to September 30, 1921. Records for years 1902 to 1917, containing revisions of previously published records are published in Water-Supply Paper 491.

GAGE.—Chain gage on right bank used August 23, 1905, to June 15, 1918, October 1, 1918, to May 14, 1919, August 23 to September 4 and October 1 to December 7, 1919, May 14 to November 9, 1920, and May 11 to September 30, 1921, except during winter months from 1912 to 1917, when a temporary gage opposite chain gage was read. Stevens water-stage recorder on left bank, installed June 15, 1918, at same datum as chain gage, used June 16 to September 30, 1918, and May 15 to August 22, 1919. Auxiliary staff on right abutment of highway bridge over crest of diversion dam below chain gage and at different datum, was installed June 14, 1919, and used September 5–30, 1919, December 16, 1919, to May 13, 1920, and November 10, 1920, to May 10, 1921. Prior to August 23, 1905, a wire gage at same location and datum as chain gage was used. Gages read by employees of United States Reclamation Service.

DISCHARGE MEASUREMENTS.—Made from cable 560 feet below gage. In September, 1909, the cable was moved from a point about 300 feet downstream. Low-water measurements made by wading 800 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel and cobble stones; practically permanent. Banks high and not subject to overflow. Concrete diversion works for St. Mary canal, located 1,040 feet below gage, form the control. The dam is provided with flashboard sluice gates near the canal head gates. Stage-discharge relation is permanent when canal gates are closed and flashboards in sluice gates remain at level of crest of dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.80 feet (chain gage) May 27 (discharge, 4,700 second-feet); minimum stage, 5.09 feet (auxiliary gage) February 11 (discharge, 104 second-feet).

1902–1921: Maximum stage, estimated 9.4 feet June 5, 1908 (discharge, 7,980 second-feet); minimum stage recorded, 1.0 foot April 3–7, 1904 (discharge, 20 second-feet).

ICE.—Stage-discharge relation affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—Flow regulated by naturral storage in St. Mary Lakes, and since October 1, 1915, by Sherburne Lake reservoir on Swiftcurrent Creek.

ACCURACY.—Stage-discharge relation affected by ice January 13–28 and February 6–9 and 13–20, and by operation of gates of canal June 12 to August 13. Rating curve for open channel with gates closed, well defined for both gages. Chain gage read to half-tenths once daily October 1 to November 9 and May 11 to September 30. Auxiliary staff gage read to hundredths once daily November 10 to May 10. Daily discharge ascertained by applying daily gage height to rating table except for periods of ice effect, for which it was ascertained by means of gage heights, observer's notes, weather records, and comparison with flow at station near Kimball, Alberta, and except for period during which canal was being operated, for which it was ascertained by means of the shifting-control method based on discharge measurements and record of flow of canal. Records good for periods of open water with gates closed; other records fair.

The diversion dam below the gaging station was constructed by the Bureau of Reclamation for the purpose of diverting water from St. Mary River into St. Mary canal, which carries the water across the divide into North Fork of Milk River. The water then flows in the channel of Milk River through Canada, and is finally used for irrigation in the Milk River valley in Montana. The present capacity of the diversion canal is about 425 second-feet. A storage reservoir is provided on Swiftcurrent Creek by a dam at the outlet of Sherburne Lake. By means of a diversion channel connecting Swiftcurrent Creek and Lower St. Mary Lake, the run-off from Swiftcurrent Creek is made available for diversion through St. Mary canal.

Discharge measurements of St. Mary River near Babb, Mont., during the year ending Sept. 30, 1921.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 17	4.88	3,500
July 26	2.56	1,120
Aug. 22	2.04	598

Daily discharge, in second-feet, of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	568	246	267	139	118	230	209	618	3,000	2,020	958	458
2	568	246	267	139	113	222	222	673	3,360	1,970	918	458
3	568	246	267	139	108	209	297	632	3,480	1,970	918	458
4	568	246	267	139	118	222	342	618	3,480	1,930	918	458
5	568	246	222	139	113	222	342	646	3,480	1,680	846	458
6	643	199	209	144	105	222	342	833	3,740	1,680	798	458
7	718	199	222	149	110	222	342	944	4,000	1,450	758	458
8	718	199	230	149	110	237	342	1,170	4,280	1,320	680	444
9	798	199	252	149	110	237	361	1,460	4,420	1,320	680	430
10	798	190	222	144	108	260	361	1,690	4,350	1,360	606	423
11	798	190	209	139	104	260	361	2,100	4,280	1,490	598	371
12	718	190	209	139	118	237	361	2,320	4,290	1,490	620	371
13	643	178	209	130	130	222	388	2,380	4,170	1,450	590	371
14	568	165	209	125	130	222	442	2,380	4,030	1,450	643	364
15	493	165	216	120	125	237	495	2,260	4,040	1,410	643	352
16	493	165	222	115	135	237	556	2,210	3,790	1,410	643	334
17	423	165	159	110	180	260	618	2,210	3,530	1,410	643	323
18	358	165	149	110	190	260	687	2,160	2,940	1,320	643	311
19	358	159	149	110	200	260	728	2,260	3,660	1,280	643	311
20	493	159	149	110	210	260	833	2,480	3,000	1,240	643	311
21	568	159	149	115	216	260	910	2,770	2,500	1,210	606	311
22	568	159	159	115	209	260	910	3,000	2,280	1,160	606	311
23	568	159	149	115	209	260	944	3,610	2,220	1,160	606	299
24	493	159	149	115	222	260	944	3,870	2,220	1,160	590	299
25	423	190	149	110	222	260	910	4,140	2,170	1,070	590	299
26	423	190	149	120	222	260	756	4,560	2,170	1,160	568	311
27	358	190	149	120	222	260	756	4,700	2,170	1,070	516	317
28	299	222	139	120	230	244	742	4,070	2,170	1,050	486	404
29	299	222	128	123	-------	230	728	4,070	2,120	990	472	410
30	246	274	118	123	-------	222	728	3,870	2,070	990	472	486
31	246	-------	118	123	-------	209	-------	3,610	-------	990	458	-------

Monthly discharge of St. Mary River near Babb, Mont., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	798	246	527	32,400
November	274	159	195	11,600
December	267	118	189	11,600
January	149	110	127	7,810
February	230	104	157	8,720
March	260	209	241	14,800
April	944	209	565	33,600
May	4,700	618	2,400	148,000
June	4,420	2,070	3,250	193,000
July	2,020	990	1,380	84,800
August	958	458	657	40,400
September	486	299	379	22,600
The year	4,700	104	841	609,000

ST. MARY RIVER NEAR KIMBALL, ALBERTA.

LOCATION.—In SW. ¼ sec. 25, T. 1 N., R. 25 W. fourth meridian, 1 mile south and 1 mile west from Kimball, Alberta, and 5 miles north of international boundary.

DRAINAGE AREA.—472 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1921. From September 1, 1902, to December 31, 1912, records were obtained at a point half a mile north of the boundary line and are published in the water-supply

papers under the heading "St. Mary River near Cardston, Alberta," except in Water-Supply Paper 491, in which they are published with revisions under the heading "St. Mary River at Cook's ranch, Alberta, near international boundary." A station was maintained by the Alberta Railway & Irrigation Co. at a point half a mile below the present station, from 1905 to 1908. It was taken over by the Irrigation Branch (now the Reclamation Service), Department of the Interior, Canada, in April, 1908, and was operated until December 31, 1912. The records for this period are published in Water-Supply Paper 491, under the heading "St. Mary River near Kimball, Alberta, near international boundary." The discharge at the three points is practically the same.

GAGE.—Stevens continuous water-stage recorder with a concrete well and shelter on right bank; used during open-water seasons since April 10, 1916. During winters since January 1, 1915, a chain gage at different datum attached to highway bridge 3 miles below station, was read. Prior to April 10, 1916, a Friez recorder at same location and datum as present recorder was used during open-water seasons. During winters prior to January 1, 1915, a staff gage at the Canadian station about half a mile below was read.

DISCHARGE MEASUREMENTS.—Made from cable 1,200 feet above gage or by wading near gage.

CHANNEL AND CONTROL.—Bed of stream at gage and at control composed of boulders and sandstone ledges. Control formed by an outcropping ledge of sandstone covered with boulders near left bank; shifts occasionally during high water.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 6.68 feet at 2.30 p. m. May 26 (discharge, 5,310 second-feet); minimum discharge, 111 second-feet February 6 (stage-discharge relation affected by ice).

1902–1921: Maximum stage recorded, 12.75 feet June 5, 1908 (discharge, 18,000 second-feet; estimated from crest stage at station at Cook's ranch, Alberta, by comparison with record for station near Babb); minimum discharge, 46 second-feet December 1, 1919 (stage-discharge relation affected by ice). A lower minimum may have occurred during winter periods from 1902 to 1912, for which only estimates of mean monthly discharge are available.

ICE.—Stage-discharge relation seriously affected by ice during severe winters.

DIVERSIONS.—St. Mary canal, constructed by United States Reclamation Service, diverts water from St. Mary River near Babb, Mont., to the North Fork of Milk River. During 1921 approximately 72,000 acre-feet was diverted. The Alberta Railway & Irrigation Co.'s canal diverts from St. Mary River about 2 miles below the station.

REGULATION.—Flow regulated by natural storage in St. Mary Lakes and by Sherburne Lake reservoir on Swiftcurrent Creek.

ACCURACY.—Stage-discharge relation for regular gage changed during winter; affected by ice November 10–20 and December 2 to April 4. Two rating curves used for regular gage; one, applicable October 1 to November 9, well defined; the other, applicable April 5 to September 30, well defined between 300 and 4,450 second-feet. Rating curve for winter gage based on six open-water measurements, used November 21 to December 1. Mean daily gage height obtained from recorder graph by straight-edge method, October 1 to November 9 and April 3 to September 30; chain gage at highway bridge read to hundredths once daily November 10 to April 1. Daily discharge ascertained by applying daily or mean daily gage height to rating table

except for periods of ice effect for which it was ascertained by means of gage heights, seven discharge measurements, observer's notes, and weather records, and except as noted in footnote to daily-discharge table. Open-water records good; winter records fair.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch, Department of the Interior, Canada.

Discharge measurements of St. Mary River near Kimball, Alberta, during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	Lowrie[a] and Hermann[a]	3.37	700	Apr. 7	A. W. P. Lowrie	4.31	468
Dec. 1	A. W. P. Lowrie	4.12	330	8	do	2.87	441
16	do	3.77	185	May 12	do	4.83	2,203
Jan. 6	do	4.28	193	June 9	do	6.17	4,393
29	do	4.54	125	18	W. A. Lamb	5.48	3,210
Feb. 19	do	5.23	217	July 7	A. W. P. Lowrie	4.10	1,296
Mar. 12	do	5.58	281	30	do	3.46	836
26	do	5.28	246	Aug. 23	O. H. Hoover[a]	3.24	657
30	do	5.06	273	24[b]	W. A. Lamb	3.23	637
				24	A. W. P. Lowrie	2.74	399

[a] Engineer, Dominion Water Power Branch.
[b] Measurement made at highway bridge 3 miles below water-stage recorder; flow in canal of Alberta Railway & Irrigation Co. included in result.

NOTE.—Stage-discharge relation affected by ice Dec. 2 to Apr. 4; measurements made during this period referred to chain gage at highway bridge. Measurements of Dec. 1 and Apr. 7 also referred to the chain gage.

Daily discharge, in second-feet, of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	568	328	341	213	122	391	370	840	3,359	1,962	797	548
2	574	332	337	227	122	422	430	804	3,563	1,988	775	520
3	574	332	302	194	118	413	430	768	3,665	1,949	761	515
4	596	297	288	179	118	395	384	804	3,546	1,793	734	505
5	632	290	241	182	120	395	339	840	3,665	1,627	694	500
6	702	294	291	192	111	395	402	840	3,903	1,462	648	491
7	771	300	288	194	116	445	466	1,067	4,108	1,336	617	476
8	793	294	288	182	116	382	471	1,345	4,306	1,288	564	486
9	809	272	264	176	116	325	476	1,649	4,396	1,241	526	505
10	857	267	274	172	116	314	476	1,923	4,324	1,278	481	481
11	857	267	284	160	126	325	505	2,157	4,234	1,365	500	466
12	809	270	250	155	126	281	548	2,197	4,216	1,375	642	460
13	778	281	264	142	135	284	575	2,264	4,126	1,345	668	454
14	689	270	257	139	135	284	593	2,197	4,022	1,316	741	448
15	620	253	227	135	133	333	654	2,053	3,852	1,278	727	432
16	562	295	185	131	144	493	687	1,949	3,784	1,260	748	416
17	562	295	175	122	205	413	707	1,884	3,495	1,241	768	398
18	535	288	169	120	210	413	761	1,884	3,240	1,205	754	394
19	505	284	158	120	216	391	818	2,368	3,038	1,152	720	394
20	562	302	148	120	221	357	908	2,958	2,814	1,134	727	384
21	620	284	148	122	213	450	987	3,461	2,475	1,092	707	394
22	689	321	146	122	218	445	1,027	3,835	2,278	1,067	687	380
23	715	284	146	120	244	450	1,051	4,162	2,251	1,035	661	394
24	715	267	144	122	253	432	870	4,450	2,224	995	642	398
25	602	250	144	124	260	370	804	4,720	2,210	971	623	398
26	505	274	139	126	257	247	700	4,908	2,210	1,027	605	427
27	424	277	135	126	264	349	700	4,666	2,197	955	593	448
28	404	284	208	126	341	321	720	4,270	2,105	892	548	491
29	372	274	194	124	-------	299	734	4,073	2,066	840	548	526
30	364	321	197	122	-------	288	787	3,903	1,988	818	531	548
31	356	-------	192	122	-------	299	-------	3,699	-------	818	520	-------

NOTE.—Discharge interpolated on account of lack of gage-height record, Apr. 6, 30, May 2, 4, Sept. 12, 13, and 15; estimated Apr. 7. Discharge ascertained by hourly-discharge method, May 19, 22, 26, and Sept. 26.

Monthly discharge of St. Mary River near Kimball, Alberta, for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	857	356	617	37,900
November	332	250	288	17,100
December	341	135	220	13,500
January	227	120	149	9,160
February	341	111	174	9,660
March	493	247	368	22,600
April	1,051	339	646	38,400
May	4,908	768	2,550	157,000
June	4,396	1,988	3,260	194,000
July	1,988	818	1,260	77,500
August	797	481	653	40,200
September	548	380	456	27,100
The year	4,908	111	889	644,000

ST. MARY CANAL AT INTAKE, NEAR BABB, MONT.

LOCATION.—In NW. ¼ NE. ¼ sec. 27, T. 36 N., R. 14 W., 600 feet below intake of canal and 2 miles south of Babb, on Blackfeet Indian Reservation, in Glacier County.

RECORDS AVAILABLE.—June 1, 1918, to August 31, 1921.

GAGE.—Gurley printing water-stage recorder in wooden shelter on right bank; inspected by employees of United States Reclamation Service. Prior to April 17, 1919, a staff gage 300 feet above present gage was used. The two gages were set to read the same but are not at the same datum on account of the slope in canal between the two points.

DISCHARGE MEASUREMENTS.—Made from cable 10 feet above gage. Current is evenly distributed throughout cross section and has a moderate velocity at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.08 feet June 17 (discharge, 519 second-feet).

1918–1921: Maximum stage recorded, 7.04 feet August 8, 1920 (discharge 655 second-feet).

ICE.—Canal not operated during winter.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 20 and 650 second-feet. Operation of water-stage recorder unsatisfactory; staff gage 300 feet upstream, read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch, Department of the Interior, Canada.

St. Mary canal diverts water from the west bank of St. Mary River near Babb, Mont., and discharges into North Fork of Milk River. The water then flows in the natural channel of Milk River through Canada and is finally used for irrigation in Milk River valley east of Havre, Mont. Water may be returned to St. Mary River at St. Mary crossing.

Discharge measurements of St. Mary canal at intake, near Babb, Mont., during the year ending September 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	Sec.-*ft.*
May 14	A. W. P. Lowrie [a]	3.31	178	July 29	W. A. Lamb	5.01	368
25	W. A. Lamb	3.72	226	Aug. 3	A. W. P. Lowrie	5.01	371
June 10	A. W. P. Lowrie	5.21	387	12	S. G. Dawson	2.96	142
17	W. A. Lamb	5.88	498	12	E. L. Grant	2.96	147
July 7	Dawson [b] and Lowrie	5.26	383	15	do	2.35	112
26	W. A. Lamb	5.05	389				

[a] Engineer, Dominion Water Power Branch.
[b] Engineer, Canadian Reclamation Service.

Daily discharge, in second-feet, of St. Mary canal at intake, near Babb, Mont., for the year ending September 30, 1921.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1		320	412	382	16	220	483	379	18
2		332	406	383	17	221	519	379	
3		332	409	380	18	245	514	379	
4		336	406	379	19	152	514	379	
5		358	413	376	20	185	500	379	
6		349	413	371	21	167	428	379	
7		360	410	345	22	179	438	379	
8		357	410	360	23	177	427	379	
9	62	396	400	366	24	239	413	379	
10	62	418	412	362	25	232	409	379	
11	135	431	392	280	26	224	412	384	
12	179	470	392	147	27	224	410	383	
13	180	470	392	117	28	224	409	380	
14	209	431	392	68	29	246	408	380	
15	217	460	392	19	30	273	409	383	
					31	292		380	

NOTE.—Canal head gates opened May 9 and closed Aug. 16.

Monthly discharge of St. Mary canal at intake, near Babb, Mont., for the year ending September 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 9–31	292	62	198	9,030
June	519	320	417	24,800
July	413	379	391	24,000
Aug. 1–16	383	18	272	8,630
The period				66,460

ST. MARY CANAL AT ST. MARY CROSSING, NEAR BABB, MONT.

LOCATION.—In NE. ¼ sec. 30, T. 37 N., R. 13 W. Montana meridian, 250 feet east of outlet of siphon by which canal crosses St. Mary River, 10 miles below intake, and 9 miles north of Babb, in Glacier County.

RECORDS AVAILABLE.—July 6, 1918, to August 16, 1921.

GAGE.—Stevens continuous water-stage recorder in wooden shelter on right bank; installed April 22, 1919. During 1918 a Stevens water-stage recorder on concrete entrance to flume 313 feet downstream from present recorder was used.

DISCHARGE MEASUREMENTS.—Made from cable 188 feet below gage.

CHANNEL AND CONTROL.—Control is at head of the steel flume 313 feet below gage. During 1921 débris deposited between gage and flume formed a secondary control and caused a shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.32 feet June 19 (discharge, 428 second-feet).

1918–1921: Maximum discharge recorded, 487 second-feet at 11 p. m. August 8, 1920.

ICE.—Canal not operated during winter.

ACCURACY.—Stage-discharge relation changed during June by deposition of débris between gage and control. Two fairly well defined rating curves used, one applicable May 12 to June 12, and the other June 24 to August 16; indirect method for shifting control used June 13–23. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder graph by straight-edge method except for period for which shifting-control method was used and except for May 18, 21, and 23, and August 11–14 for which hourly-discharge method was used on account of considerable fluctuation in stage. Records good.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch, Department of the Interior, Canada.

Discharge measurements of St. Mary canal at St. Mary crossing, near Babb, Mont., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 13	A. W. P. Lowrie [a]	2.45	147	Aug. 12	S. G. Dawson [b]	2.31	123
June 10	do	3.84	320	12	E. L. Grant	2.33	125
July 13	do	3.76	335	14	do	1.22	38
29	W. A. Lamb	3.67	318	14	do	1.10	31
Aug. 3	A. W. P. Lowrie	3.68	323				

[a] Engineer, Dominion Water Power Branch.
[b] Engineer, Canadian Reclamation Service.

Daily discharge, in second-feet, of St. Mary canal at St. Mary crossing, near Babb, Mont., for the year ending Sept. 30. 1921.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1		252	346	321	16	177	396	322	20
2		267	346	322	17	181	408	319	
3		269	344	324	18	161	426	319	
4		273	348	321	19	121	428	319	
5		288	346	319	20	148	422	322	
6		284	348	315	21	151	376	319	
7		286	353	295	22	156	366	322	
8		288	349	295	23	142	364	321	
9		311	348	312	24	177	353	321	
10		327	342	304	25	199	353	321	
11		349	335	267	26	187	349	324	
12	138	366	335	125	27	192	349	322	
13	146	376	333	107	28	197	348	321	
14	155	366	333	42	29	207	344	321	
15	176	366	333	29	30	220	348	322	
					31	235		321	

NOTE.—Canal head gates opened May 9 and closed Aug. 16.

Monthly discharge of St. Mary canal at St. Mary crossing, near Babb, Mont., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
May 12–31	235	121	173	6,860
June	428	252	343	20,400
July	353	319	331	20,400
August 1–16	324	20	232	7,360
The period				55,000

ST. MARY CANAL AT HUDSON BAY DIVIDE, NEAR BROWNING, MONT.

LOCATION.—In NE. ¼ sec. 5, T. 37 N., R. 11 W., on Hudson Bay divide, 12 feet above first concrete drop in canal, on Blackfeet Indian Reservation, a quarter of a mile south of international boundary, and 30 miles north of Browning, in Glacier County.

RECORDS AVAILABLE.—July 3, 1917, to August 20, 1921.

GAGE.—Stevens continuous water-stage recorder in wooden shelter on left bank used since June 29, 1920. The recorder was on right bank, 40 feet above present site, during 1919 and from May 25 to June 28, 1920. Prior to 1919 a staff gage at different datum, located at Douglas bridge 1 mile above was used.

DISCHARGE MEASUREMENTS.—Made from cable 500 feet above gage.

CHANNEL AND CONTROL.—Canal has uniform section. At high stages the slope of water surface changes slightly with the change in stage. Control is V-shaped notch in the concrete drop 12 feet below gage.

EXTREME OF DISCHARGE.—Maximum stage recorded during year, 5.58 feet June 20 (discharge, 460 second-feet).

1917–1921: Maximum discharge recorded, 472 second-feet at 6 p. m. August 9, 1920.

ICE.—Canal not operated during winter.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 30 and 250 second-feet; fairly well defined outside these limits. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder graph by inspection or by straight-line method, except for May 13, June 10, 11, and August 12–18, for which it was ascertained by averaging the discharge for hourly intervals, owing to rapid fluctuation in stage. Records good.

COOPERATION.—Station maintained in cooperation with Reclamation Service, Department of the Interior, Canada.

Discharge measurements of St. Mary canal at Hudson Bay divide, near Browning, Mont., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 16	S. G. Dawson [a]	4.03	166	Aug. 13	E. L. Grant	3.58	126
June 8	A. W. P. Lowrie [b]	4.99	305	13	O. H. Hoover	3.56	123
July 12	do	5.04	333	13	S. G. Dawson	3.54	116
30	W. A. Lamb	4.86	311	15	O. H. Hoover	2.20	37
Aug. 4	A. W. P. Lowrie	4.84	313	15	S. G. Dawson	2.20	33
12	O. H. Hoover [b]	4.20	185				

[a] Engineer, Canadian Reclamation Service. [b] Engineer, Dominion Water Power Branch.

Daily discharge, in second-feet, of St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1921.

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1		244	348	311	16	165	403	326	24
2		275	344	299	17	169	430	309	19.1
3		282	370	297	18	173	445	307	7.5
4		284	348	295	19	143	455	307	1.4
5		299	346	290	20	125	460	311	.6
6		374	342	290	21	140	450	307	
7		309	346	288	22	135	398	307	
8		314	350	270	23	140	382	303	
9		307	346	268	24	137	375	305	
10		326	342	277	25	183	364	305	
11	0	384	337	275	26	187	350	311	
12	0	373	333	220	27	179	350	311	
13	131	398	331	126	28	181	350	307	
14	138	410	328	88	29	185	348	297	
15	149	393	333	39	30	204	348	297	
					31	225		311	

NOTE.—Head gates opened May 9 and closed Aug. 16.

Monthly discharge of St. Mary canal at Hudson Bay divide, near Browning, Mont., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet
	Maximum.	Minimum.	Mean.	
May 11–31	225	0	147	6,120
June	460	244	361	21,500
July	370	297	325	20,000
August 1–20	311	.6	184	7,380
The period				54,900

SWIFTCURRENT CREEK AT MANY GLACIER, MONT.

LOCATION.—In sec. 12, T. 35 N., R. 16 W., at outlet of McDermott Lake at Many Glacier, in Glacier National Park, 14 miles southwest of Babb, in Glacier County.

DRAINAGE AREA.—31.4 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 6, 1912, to September 30, 1921.

GAGE.—Stevens continuous water-stage recorder installed June 15, 1918, in shelter built by park officials and Great Northern Railway, and referred to two staff gages, one inside stilling well and one outside; inspected by C. N. McGillis. Prior to May 23, 1916, a staff gage on left bank opposite present gage was read. May 23, 1916, to June 15, 1918, a vertical staff at same location as present gage was read.

DISCHARGE MEASUREMENTS.—High-stage measurements since June 26, 1920, made from cable, 1,000 feet below gage; prior to that date from highway bridge above power house. Section at bridge poor. Low-stage measurements made by wading above crest of falls or at cable section.

CHANNEL AND CONTROL.—Control is limestone outcrop at outlet of lake; shifts slightly. Just below control is a fall and a cataract.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.97 feet at 8 a. m. May 26 (discharge, 1,100 second-feet); minimum stage, 1.46 feet February 9 (discharge, 27 second-feet).

1912–1921: Maximum stage recorded, 4.75 feet June 17, 1916 (discharge, 1,550 second-feet); minimum discharge, 8.7 second-feet April 1, 1913, by current-meter measurement (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation occasionally slightly affected by ice.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed slightly during winter. Two rating curves used; one, applicable October 1 to February 26, well defined between 60 and 400 second-feet and fairly well defined outside those limits; the other, applicable May 25 to September 30, well defined between 60 and 500 second-feet and fairly well defined outside those limits. Mean daily gage height obtained by inspection of recorder graph, October 11 to November 4, May 25 to June 8, June 14 to July 18, and July 25 to September 30; staff gage read to hundreths once daily, January 2 to February 26. Daily discharge ascertained by applying daily or mean daily gage height to rating table except for periods of no record for which it was ascertained as indicated in footnote to daily-discharge table. Records good for periods during which gage-height record was obtained; others fair.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch, Department of the Interior, Canada.

Discharge measurements of Swiftcurrent Creek at Many Glacier, Mont., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 25	W. A. Lamb	3.72	978	Aug. 2	A. W. P. Lowrie	2.22	180
June 14	do	3.40	730	22	W. A. Lamb	1.97	103
July 6	Dawson [a] and Lowrie [b]	2.62	325	24	O. H. Hoover [b]	1.94	100
28	W. A. Lamb	2.30	200				

[a] Engineer, Canadian Reclamation Service.
[b] Engineer, Dominion Water Power Branch.

Daily discharge, in second-feet, of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Jan.	Feb.	May.	June.	July.	Aug.	Sept.
1	90	67	-------	37	-------	644	491	181	103
2	96	67	41	39	-------	674	446	181	98
3	102	62	43	37	-------	565	362	178	89
4	108	59	41	35	-------	559	318	174	85
5	114	-------	39	32	-------	735	322	151	74
6	120	-------	39	30	-------	962	327	134	66
7	126	-------	37	28	-------	975	331	128	61
8	133	-------	35	28	-------	937	358	131	62
9	140	-------	35	27	-------	949	380	136	66
10	147	-------	37	28	-------	861	344	148	62
11	154	-------	37	37	-------	773	310	148	58
12	151	-------	39	125	-------	686	284	139	58
13	145	-------	41	100	-------	638	276	128	55
14	128	-------	39	79	-------	735	276	126	51
15	125	-------	37	72	-------	598	284	131	48
16	120	-------	35	54	-------	501	276	136	45
17	108	-------	34	49	-------	435	280	139	45
18	102	-------	35	47	-------	442	264	128	45
19	100	-------	37	45	-------	466	236	123	44
20	96	-------	34	39	-------	506	270	112	42
21	85	-------	34	39	-------	559	305	110	33
22	83	-------	35	41	-------	639	268	103	35
23	79	-------	37	47	-------	686	238	98	40
24	76	-------	39	62	-------	570	214	98	40
25	76	-------	39	125	962	656	214	96	38
26	76	-------	41	154	1,070	598	197	91	55
27	74	-------	41	-------	854	511	194	89	78
28	74	-------	39	-------	610	491	197	89	76
29	77	-------	37	-------	446	451	197	91	76
30	77	-------	35	-------	456	446	190	89	72
31	76	-------	35	-------	532	-------	184	87	-------

NOTE.—Recorder not operating, discharge interpolated, Oct. 1–10; discharge estimated, June 9–13 and July 19–24. No record obtained, discharge not determined, Nov. 5 to Jan. 1 and Feb. 27 to May 24.

Monthly discharge of Swiftcurrent Creek at Many Glacier, Mont., for the year ending Sept. 30, 1921.

[Drainage area, 31.4 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Inches.	Acre-feet.
October	154	74	105	3.34	3.85	6,460
November 1-4	67	59	63.8	2.03	.30	506
January 2-31	43	34	37.6	1.20	1.34	2,240
February 1-26	154	27	55.2	1.76	1.70	2,850
May 25-31	1,070	446	704	22.4	5.83	9,770
June	975	435	642	20.4	22.76	38,200
July	491	184	285	9.08	10.47	17,500
August	181	87	126	4.01	4.62	7,750
September	103	33	60.0	1.91	2.13	3,570

SWIFTCURRENT CREEK AT SHERBURNE, MONT.

LOCATION.—In sec. 35, T. 36 N., R. 15 W., 800 feet below spillway of Sherburne Lake dam, in Glacier County.

DRAINAGE AREA.—64 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 1, 1912, to September 30, 1921.

GAGE.—Stevens continuous water-stage recorder, installed May 18, 1921, on left bank 800 feet below spillway of Sherburne Lake dam; referred to staff gage which was installed at same site, August 10, 1920. From July 1, 1912, to November 9, 1914, a vertical staff gage was maintained on left bank near outlet of lake and at a different datum from present gage. November 10, 1914, to August 9, 1920, a staff gage on left bank about 300 feet below spillway of Sherburne Lake dam was read.

DISCHARGE MEASUREMENTS.—Made from cable 450 feet above gage or by wading.

CHANNEL AND CONTROL.—An outcropping limestone ledge, somewhat broken and irregular, forms the control; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.10 feet May 28 (discharge, 1,200 second-feet); minimum discharge, practically no flow, at times during period June 21 to July 8 when gates in dam were closed.

1912-1921: Maximum stage recorded, 7.85 feet June 17, 1916 (discharge, 2,280 second-feet); minimum discharge, practically no flow, occurs when gates in dam are closed.

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—Flow regulated by gate operations at dam.

ACCURACY.—Stage-discharge relation changed slightly by a landslide April 17; not affected by ice. Rating curve used October 1 to April 17, fairly well defined between 90 and 300 second-feet; curve used April 18 to September 30, well defined between 160 and 1,100 second-feet. Staff gage read to hundredths once daily October 1 to May 17; operation of water-stage recorder satisfactory thereafter. Daily discharge ascertained by applying to rating table daily gage height from staff gage or mean daily gage obtained from recorder graph by straight-edge method except for periods indicated in footnote to daily-discharge table. Records good except for periods when gates in dam were closed.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch, Department of the Interior, Canada.

Discharge measurements of Swiftcurrent Creek at Sherburne, Mont., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 23	S. G. Dawson [a]	5.50	985	Aug. 2	A. W. P. Lowrie [b]	2.98	234
25	W. A. Lamb	5.72	1,050	24	O. H. Hoover [b]	2.49	163
July 26	do	3.00	259				

[a] Engineer, Canadian Reclamation Service.
[b] Engineer, Dominion Water Power Branch.

Daily discharge, in second-feet, of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	146	72	176	44	39	82	63	156	753	0.5	255	120
2	146	72	171	41	39	82	110	155	1,080	1.2	249	120
3	189	72	187	39	38	81	161	154	1,040	1.0	241	120
4	421	72	205	41	35	92	146	154	998	.8	233	119
5	390	72	193	43	30	95	141	169	987	.8	220	119
6	327	72	178	46	30	96	134	177	1,000	.7	151	119
7	322	72	156	46	30	96	131	427	1,030	.6	163	118
8	322	72	123	45	30	98	119	539	1,050	.6	163	118
9	322	72	85	45	30	93	108	569	1,060	48	155	119
10	322	72	85	44	32	89	106	615	1,040	255	150	118
11	322	71	79	41	47	85	104	662	1,040	255	155	119
12	114	71	70	39	57	81	108	678	1,040	255	158	119
13	45	71	62	39	87	72	140	646	1,040	259	158	118
14	7.3	71	55	20	106	65	188	584	1,030	259	158	119
15	5.0	70	55	20	105	47	133	495	1,000	259	158	119
16	3.8	70	54	30	101	57	105	467	962	264	156	119
17	3.8	70	53	40	97	63	146	454	916	264	156	119
18	3.8	81	51	40	94	74	294	518	882	266	158	119
19	303	110	51	40	91	85	368	615	858	266	171	119
20	486	110	51	40	88	89	422	788	314	262	177	119
21	444	110	50	39	86	74	363	882	5.4	253	177	119
22	426	110	47	40	40	74	344	926	4.2	255	174	119
23	260	109	46	40	32	72	316	980	4.0	255	169	119
24	98	109	44	40	110	65	283	1,020	3.6	257	163	119
25	62	109	44	40	116	59	241	1,040	1.0	253	152	118
26	43	154	40	39	98	50	191	1,090	1.2	253	143	129
27	43	197	40	40	91	45	177	643	.8	255	133	143
28	43	197	39	39	83	40	169	826	.6	255	129	192
29	43	189	39	39	-------	63	161	1,150	.5	255	123	248
30	60	182	42	39	-------	60	158	1,100	.8	255	120	365
31	72	-------	46	39	-------	56	-------	793	-------	255	120	-------

NOTE.—Discharge ascertained by hourly-discharge method, Oct. 13, 14, 19, 23, 25, 30, Nov. 18, 26, Dec. 3, May, 27, 28, 31, June 1, 20, July 9, Aug. 6, and Sept. 28–30. Gates in dam closed Oct. 14–18 and June 21 to July 8; flow represents leakage through gates.

Monthly discharge of Swiftcurrent Creek at Sherburne, Mont., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet			Run off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	486	3.8	187	11,500
November	197	70	99.4	5,910
December	205	39	84.4	5,190
January	46	20	39.3	2,420
February	116	30	66.5	3,690
March	98	40	73.5	4,520
April	422	63	188	11,200
May	1,150	154	628	38,600
June	1,080	.5	638	38,000
July	266	.5	184	11,300
August	255	120	167	10,300
September	365	118	135	8,030
The year	1,150	.5	208	140,000

CANYON CREEK NEAR MANY GLACIER, MONT.

LOCATION.—At edge of heavy timber area, half a mile above mouth, in Glacier National Park, 2 miles southeast of Many Glacier, in Glacier County.

DRAINAGE AREA.—7.0 square miles (measured on topographical map).

RECORDS AVAILABLE.—July 12, 1918, to September 30, 1921.

GAGE.—Stevens continuous water-stage recorder on left bank.

DISCHARGE MEASUREMENTS.—Made from footbridge at gage or by wading.

CHANNEL AND CONTROL.—Bed of stream covered with heavy boulders and cobblestones. Control is riffle about 20 feet below gage; may shift at high stage. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.00 feet at 3 a. m. May 26 (discharge, 166 second-feet); minimum stage, 0.82 foot at 5 p. m. September 12 (discharge, 6.4 second-feet).

1918–1921: Maximum stage, 2.00 feet May 26, 1921 (discharge, 166 second-feet); minimum stage, 0.56 foot October 4, 1919 (discharge, 3.3 second-feet).

ICE.—Station not operated during winter on account of severe ice effect.

DIVERSIONS.—None.

REGULATION.—Some natural storage in small lake at head of creek; no artificial regulation.

ACCURACY.—Stage-discharge relation changed slightly during winter. Rating curve used October 1–31, fairly well defined between 16 and 52 second-feet; curve used May 25 to September 30, fairly well defined between 5 and 140 second-feet. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder graph by inspection except as indicated in footnote to table of daily discharge. Records fair.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch, Department of the Interior, Canada.

Discharge measurements of Canyon Creek near Many Glacier, Mont., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 11	W. A. Lamb	1.08	22.0	July 26	W. A. Lamb	1.23	30.0
May 25	do	1.87	138	Aug. 23	do	1.00	13.4
June 15	do	1.59	84	24	O. H. Hoover [a]	1.01	14.8
July 7	Lowrie [a] and Dawson [b]	1.43	53				

[a] Engineer, Dominion Water Power Branch. [b] Engineer, Canadian Reclamation Service.

Daily discharge, in second-feet, of Canyon Creek near Many Glacier, Mont., for the year ending Sept. 30, 1921.

Day.	Oct.	May.	June.	July.	Aug.	Sept.	Day.	Oct.	May.	June.	July.	Aug.	Sept.
1		------	93	93	27	23	16	14	------	72	45	17	10
2		------	91	77	26	15	17	13	------	68	41	18	11
3		------	77	58	26	15	18	12	------	77	36	18	13
4		------	96	54	25	14	19	11	------	79	35	16	15
5		------	114	54	21	13	20	11	------	86	40	15	15
6	20	------	124	53	19	12	21	11	------	96	41	13	21
7		------	127	56	18	11	22	11	------	112	36	12	26
8		------	120	62	18	14	23	10	------	108	34	13	23
9		------	108	64	20	14	24	10	------	96	34	14	20
10		------	104	54	22	17	25	9.4	142	116	31	14	20
							26	9.0	142	100	30	13	30
11	20	------	129	46	20	10	27	9.7	114	93	29	13	31
12	20	------	110	41	18	7.0	28	9.7	72	89	29	13	29
13	19	------	100	41	16	9.4	29	9.4	62	87	30	13	28
14	17	------	88	42	16	11	30	9.4	70	86	28	13	27
15	16	------	77	44	16	11	31	9.4	82	------	28	13	------

NOTE.—Recorder not operating, discharge estimated, Oct. 1–10, 30, and 31; discharge interpolated, June 14 and Sept. 28–30. Braced figure shows mean discharge for period indicated.

Monthly discharge of Canyon Creek near Many Glacier, Mont., for the year ending Sept. 30, 1921.

[Drainage area, 7.0 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Inches.	Acre-feet.
October	20	9.0	14.9	2.13	2.47	916
May 25-31	142	62	97.7	14.0	3.64	1,360
June	129	68	97.4	13.9	15.5	5,800
July	93	28	44.7	6.39	7.37	2,750
August	27	12	17.3	2.47	2.85	1,060
September	31	7.0	17.1	2.44	2.72	1,020

RED RIVER AT FARGO, N. DAK.

LOCATION.—At dam half a mile above highway bridge connecting Front Street, Fargo, N. Dak., with Moorhead, Minn., 10 miles above mouth of Sheyenne River, in Cass County.

DRAINAGE AREA.—6,020 square miles.

RECORDS AVAILABLE.—May 27, 1901, to September 30, 1921.

GAGE.—Vertical staff attached to tree on left bank about 6 rods above the dam; vertical staff for use at low stages attached at upper end of fishway at left end of dam; read by R. T. Jacobsen, city engineer of Fargo. Prior to September, 1914, gage readings were obtained from a vertical staff attached to breakwater for center pier of Front Street Bridge; this gage is still maintained and used by the Weather Bureau. Datum of Front Street gage is such that if the dam were removed, or if the stage were so high as to completely submerge the dam, readings on the Front Street gage would be approximately 10.4 feet greater than on the gage now used. Dam is completely submerged at gage height about 5 feet on present gage.

DISCHARGE MEASUREMENTS.—Made from footbridge at gage.

CHANNEL AND CONTROL.—Bed composed of clay and silt; nearly permanent. Control is timber-crib dam, rock filled, below gage; has settled until the lowest point of crest is about 0.7 foot above gage zero. At extreme low stage the fall over the dam is about 5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.7 feet April 6 (discharge, 1,970 second-feet); minimum stage, 1.15 feet September 24 (discharge, 48 second-feet).

1901–1921: Maximum stage recorded, 19.9 feet April 6, 1916 (stage-discharge relation affected by ice); maximum open-water stage recorded, 17.34 feet July 11, 1916 (discharge, 7,740 second-feet); minimum stage recorded, 1.0 foot February 11, 1918 (discharge not determined).

ICE.—Stage-discharge relation not seriously affected by ice.

DIVERSIONS.—None.

REGULATION.—No power plants or storage above station within 60 miles. Storage not great enough to noticeably affect discharge at station.

ACCURACY.—Stage-discharge relation changed slightly owing to settling of dam; slightly affected by ice. Two fairly well defined rating curves used; one applicable October 1 to March 31, and the other April 1 to September 30. Gage read to hundredths six times a week except during winter when it was read once a week. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to table of daily discharge. Open-water records good; winter records fair.

Discharge measurements of Red River at Fargo, N. Dak., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 10	E. F. Chandler	2.35	375	May 2	W. L. Stockwell	2.70	566
Nov. 1	W. L. Stockwell	2.38	479	30	do	2.33	456
Feb. 7	do	*1.90	234	June 16	Chandler and Stockwell	2.48	501
Apr. 2	do	2.63	755	Aug. 31	E. F. Chandler	1.56	136

* Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	485	462	420	300	475	645	475	303	284	129
2	462	462	462	340	569	619	521	210	264	129
3	462	400	440	320	844	594	1,000	222	249	72
4	462	420	440	320	1,120	569	1,150	234	257	112
5	462	420	440	327	1,600	521	1,100	246	257	152
6	462	420	440	334	1,970	569	1,060	303	224	192
7	462	441	462	340	1,240	569	945	303	192	253
8	462	462	420	300	1,000	545	890	276	159	192
9	462	485	340	300	890	521	780	260	162	92
10	462	462	262	300	822	521	752	278	192	192
11	462	440	217	280	752	498	725	295	192	159
12	462	420	258	300	698	475	672	272	129	159
13	462	400	300	310	671	475	619	272	145	144
14	462	350	340	320	569	498	594	264	160	129
15	485	300	340	320	594	510	594	295	176	129
16	485	320	340	320	545	521	475	291	162	159
17	485	400	280	320	545	475	569	297	144	176
18	485	420	192	400	545	498	498	303	166	152
19	485	400	210	530	545	498	510	303	135	129
20	462	400	214	555	521	521	521	308	159	144
21	440	400	218	580	475	475	498	264	144	102
22	485	400	222	730	475	498	475	264	129	78
23	485	400	226	755	498	521	386	257	102	57
24	474	440	230	808	522	521	386	216	129	48
25	462	430	235	835	545	475	386	176	179	69
26	462	420	240	890	594	475	386	176	176	90
27	462	440	245	835	619	475	386	179	192	68
28	440	400	250	780	594	452	344	179	201	129
29	440	400	255	730	645	452	386	159	210	210
30	462	400	260	580	671	452	303	227	213	344
31	462	-------	265	530	-------	464	-------	256	192	-------

NOTE.—Stage-discharge relation affected by ice Dec. 7 to Mar. 16; discharge ascertained by means of occasional gage readings, one discharge measurement, observer's notes, and weather records, as follows: Dec. 7–31, as given in table; Jan. 1–31, 220 second-feet; Feb. 1–28, 240 second-feet; Mar. 1–16, as given in table. Gage not read on Sundays during open-water periods, except Oct. 31, Nov. 28, and Sept. 11; discharge interpolated. Gage also not read on the following days: Nov. 25, May 31, July 4, Aug. 6, 13 and Sept. 5, discharge interpolated. During period of ice effect the gage was read only on the following days: Dec. 7–11, 13–19, 27, Jan. 3, 10, 17, 20, 21, 26, 31; Feb. 7, 8, 15, 22, 28; Mar. 1–4, 7–12, and 14–16.

Monthly discharge of Red River at Fargo, N. Dak., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	485	440	466	28,700
November	485	300	414	24,600
December	462	192	305	18,800
January	-------	-------	220	13,500
February	-------	-------	240	13,300
March	890	280	480	29,500
April	1,970	475	738	43,900
May	645	452	513	31,500
June	1,150	303	613	36,500
July	303	159	254	15,600
August	284	102	183	11,300
September	344	48	140	8,330
The year	1,970	48	381	276,000

NOTE.—See footnote to table of daily discharge.

RED RIVER AT GRAND FORKS, N. DAK.

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

DRAINAGE AREA.—25,000 square miles.

RECORDS AVAILABLE.—May 28, 1901, to September 30, 1921; gage-height records have been kept by the United States Engineer Corps since 1882 and a few discharge measurements were made by them in early years.

GAGE.—Vertical staff with enameled face attached to ice-breaker below center pier of Northern Pacific Railway bridge; installed by United States Weather Bureau during winter of 1916–17 beside old Geological Survey staff gage which was used prior to 1917, but at a datum 5 feet higher. The observers, H. L. Hayes and Alex. Slattery, add 5 feet to gage readings to reduce them to datum of old Geological Survey gage. Another vertical staff gage attached to the ice-breaker beside the enameled gage and at the same datum is used by the United States Engineer Corps. Prior to 1918, when the railway bridge was partly rebuilt, a chain gage, attached to middle span of the bridge, was maintained for use in case the staff gages were destroyed. This chain gage has not been replaced since 1918.

DISCHARGE MEASUREMENTS.—Made from Great Northern Railway bridge a quarter of a mile above gage.

CHANNEL AND CONTROL.—Bed composed of clay and silt; shifts only slightly.

EXTREMES OF DISCHARGE.—Maximum stage during year, 20.9 feet April 10 (discharge, 11,500 second-feet); minimum stage, 2.5 feet August 24 (discharge, 230 second-feet).

1882–1921: Maximum stage recorded, 50.2 feet April 10, 1897 (discharge, 43,000 second-feet); minimum discharge, about 100 second-feet during early part of February, 1912 (stage-discharge relation affected by ice).

ICE—Stage-discharge relation seriously affected by ice. The ice cover is usually complete and smooth from late in November until about the beginning of April and the flow steady with few fluctuations; in determining flow during spring break-up, however, corrections amounting to several feet at times must be applied to gage heights before applying them to open-water rating table owing to backwater from ice jams.

DIVERSIONS.—None.

REGULATION. No power plants above with sufficient storage to cause noticeable variations in flow.

ACCURACY—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined beween 650 and 16,000 second-feet; fairly well defined above 16,000 second-feet Gage read to quarter-tenths once daily except during period December 26 to March 14 when it was read twice weekly. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect for which it was ascertained as indicated in footnote to daily-discharge table. Open-water records good; winter records fair.

Discharge measurements of Red River at Grand Forks, N. Dak., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 13	W. L. Stockwell	[a] 5.80	729	Apr. 19	Stockwell and Oakley	8.20	2,540
Feb. 26	do	[a] 6.39	721	Aug. 5	E. E. Foster	4.69	859

[a] Measurement made through ice cover.

Daily discharge, in second-feet, of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,300	1,120	1,120	833	3,400	2,800	1,690	2,140	833	1,340
2	1,250	1,070	1,160	808	3,520	2,740	1,800	2,020	796	1,390
3	1,250	1,070	1,160	784	3,820	2,680	1,910	1,910	796	1,440
4	1,250	1,070	1,160	760	4,240	2,620	2,140	1,800	760	1,490
5	1,200	1,120	1,160	751	4,960	2,560	2,500	1,690	760	1,590
6	1,200	1,120	1,160	742	6,230	2,500	2,800	1,640	724	1,690
7	1,160	1,160	1,120	733	8,280	2,380	3,100	1,640	724	1,800
8	1,160	1,160	1,070	724	10,300	2,260	3,280	1,590	689	1,910
9	1,120	1,160	1,030	712	11,200	2,140	3,400	1,590	655	1,970
10	1,070	1,160	1,030	700	11,500	2,020	3,400	1,540	622	1,910
11	1,030	1,160	1,030	689	10,800	1,910	3,340	1,540	590	1,800
12	1,030	1,120	1,030	689	8,600	1,850	3,280	1,540	558	1,690
13	1,030	1,070	1,070	689	6,360	1,800	3,220	1,540	527	1,590
14	1,030	1,030	1,030	689	5,020	1,740	3,160	1,590	468	1,640
15	1,070	990	1,080	689	4,360	1,740	2,980	1,540	413	1,690
16	1,070	990	990	1,160	4,000	1,690	2,980	1,490	388	1,590
17	1,070	1,030	990	1,160	3,520	1,690	2,980	1,390	364	1,540
18	1,120	1,030	950	1,160	3,400	1,640	2,920	1,340	341	1,490
19	1,160	1,030	950	1,200	3,100	1,590	2,920	1,300	320	1,390
20	1,200	1,070	990	1,340	2,980	1,590	2,860	1,200	300	1,300
21	1,250	1,070	1,030	1,540	2,800	1,540	2,800	1,160	281	1,200
22	1,300	1,070	1,030	1,590	2,800	1,540	2,740	1,120	263	1,120
23	1,340	1,070	1,030	1,800	2,560	1,490	2,680	1,070	246	1,070
24	1,300	1,030	990	2,020	2,500	1,490	2,620	1,030	230	1,030
25	1,300	990	990	2,380	2,500	1,440	2,440	990	230	1,070
26	1,250	990	970	2,860	2,680	1,390	2,380	950	364	1,160
27	1,250	990	950	3,340	2,560	1,340	2,380	910	796	1,250
28	1,250	1,030	950	3,880	2,620	1,340	2,380	871	1,030	1,300
29	1,200	1,070	950	4,180	2,680	1,390	2,380	833	1,120	1,340
30	1,160	1,120	950	3,880	2,560	1,490	2,260	833	1,200	1,390
31	1,120	-------	950	3,700	-------	1,590	-------	833	1,300	-------

NOTE.—Stage-discharge relation affected by ice Nov. 9 to Apr. 6, discharge ascertained by means of gage heights, two discharge measurements, and weather records, as follows: Nov. 9 to Dec. 31, as given in table; Jan. 1–31, 800 second-feet; Feb. 1–28, 730 second-feet; Mar. 1 to Apr. 6, as given in table. During periods Dec. 26–31 and Mar. 1–14, the gage was read only on Dec. 27 and 31, Mar. 1, 4, 8, and 11; discharge for intervening days interpolated.

Monthly discharge of Red River at Grand Forks, N. Dak., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	1,340	1,030	1,180	72,600
November	1,160	990	1,070	63,700
December	1,160	950	1,030	63,300
January	-------	-------	800	49,200
February	-------	-------	730	40,500
March	4,180	689	1,550	95,300
April	11,500	2,500	4,860	289,000
May	2,800	1,340	1,870	115,000
June	3,400	1,690	2,720	162,000
July	2,140	833	1,380	84,800
August	1,300	230	603	37,100
September	1,970	1,030	1,470	87,500
The year	11,500	230	1,600	1,160,000

NOTE.—See footnote to table of daily discharge.

81182—24†—WSP 525——3

BOIS DES SIOUX RIVER NEAR TENNEY, MINN.

LOCATION.—Near center of sec. 22, T. 130 N., R. 47 W., at Soo Railway bridge 2 miles east of Fairmount, N. Dak., 5 miles west of Tenney, Wilkin County, Minn., and 15 miles below outlet of Lake Traverse.

DRAINAGE AREA.—1,460 square miles.

RECORDS AVAILABLE.—April 1, 1919, to September 30, 1921.

GAGE.—Vertical staff attached to eighth pile-pier from left end of railway bridge used August 24, 1920, to September 30, 1921. Vertical staff attached to sixth pile-pier from left end of railway bridge used April 1 to August 23, 1920; at same datum as staff gage on eighth pile-pier. Vertical staff attached underneath right end of highway bridge, half a mile above railway bridge, used April 1 to September 6, 1919. Owing to slope of water surface the gage at the highway bridge does not read the same as the gage at the railway bridge for other than low stages. Gage reader, Math Schmit.

DISCHARGE MEASUREMENTS.—Made from highway bridge, from railway bridge, or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and fine clay; overgrown with aquatic plants which may, at low stages, materially affect stage-discharge relation. Shifts not likely to occur for normal velocities are not swift enough to erode channel.

EXTREMES OF DISCHARGE.—Maximum discharge during year, 64 second-feet April 2 (stage-discharge relation affected by ice); minimum discharge, no flow, August 18 to September 12.

1919–1921: Maximum discharge recorded, 214 second-feet April 2 and 3, 1920; minimum discharge same as for 1921.

A stage of 9.0 feet occurred in April, 1916 (discharge not determined).

ICE.—Data inadequate for determining discharge during winter.

DIVERSIONS.—None.

REGULATION.—No reservoirs or power plants affect the flow. No large tributaries enter between outlet of Lake Traverse and the station and abrupt changes in stage are unusual.

ACCURACY.—Stage-discharge relation not permanent owing to growth of aquatic plants; affected by ice March 23 to April 3. Standard rating curve fairly well defined between 6 and 166 second-feet; extended above 166 second-feet. Gage read to half-tenths four or five times weekly. Daily discharge ascertained by applying to rating table the daily gage height corrected for backwater from aquatic growth, the amount of which had been determined by means of discharge measurements, and by interpolating for days when gage was not read, except for period of ice effect, for which it was ascertained by applying to rating table the daily gage height corrected for ice effect by means of observer's notes and weather records. Records fair.

Discharge measurements of Bois des Sioux River near Tenney, Minn., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	E. F. Chandler	3.04	40.6	July 9	E. F. Chandler	2.27	9.8
May 1	W. L. Stockwell	2.85	37.5	Aug. 2	E. E. Foster	1.66	1.4
June 17	E. F. Chandler	2.73	15.8				

Daily discharge, in second-feet, of Bois des Sioux River near Tenney, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	43	30	19	------	56	35	36	10	2	------
2	43	30	19	------	64	32	38	9	1	------
3	43	28	18	------	49	32	36	10	1	------
4	40	27	18	------	34	32	34	10	1	------
5	40	26	------	------	34	32	32	11	1	------
6	40	26	------	------	38	32	32	11	1	------
7	43	26	------	------	38	32	32	11	1	------
8	42	26	------	------	38	32	29	9	1	------
9	40	28	------	------	38	32	26	7	1	------
10	40	30	------	------	38	32	25	8	1	------
11	39	29	------	------	38	30	24	10	1	------
12	38	28	------	------	38	31	22	10	1	------
13	38	26	------	------	38	31	21	9	1	1
14	38	25	------	------	38	32	20	8	1	2
15	38	23	------	------	38	33	19	7	1	4
16	38	22	------	------	38	35	18	8	1	6
17	38	21	------	------	38	36	16	9	1	9
18	38	20	------	------	38	36	14	7	------	9
19	38	19	------	------	36	36	14	6	------	9
20	38	18	------	------	34	36	13	6	------	11
21	38	19	------	------	35	34	12	5	------	10
22	38	19	------	------	36	32	12	4	------	10
23	36	20	------	11	38	31	11	4	------	10
24	36	20	------	13	38	30	10	4	------	10
25	36	20	------	16	38	30	10	3	------	9
26	36	20	------	16	38	30	10	3	------	8
27	34	20	------	34	38	30	11	4	------	7
28	34	20	------	43	38	31	11	3	------	6
29	33	19	------	43	38	33	11	3	------	5
30	32	19	------	48	38	34	10	3	------	4
31	31	------	------	56	------	36	------	3	------	------

NOTE.—Discharge interpolated on account of lack of gage readings, Oct. 1, 4, 6, 8, 11, 13, 24, 26, 29, 31; Nov. 4, 7, 9, 11, 14–19, 21, 22, 24, 28; Dec. 3; Apr. 3, 7, 10, 14, 17, 21, 25; May 1, 3, 6, 9, 12, 13, 15, 16, 18, 21, 23, 25, 28, 29; June 3, 8, 10, 13, 14, 16, 21, 22, 24, 26, 28, 30; July 1, 3, 4, 6, 8, 10, 12, 14, 16, 19, 21, 29, 31; Aug. 4, 8, 10, 12, 17, 18; Sept. 14, 16, 18, 21, 24, 26, 29. Practically no flow during period Aug. 18 to Sept. 12. Only two gage readings obtained during period Dec. 5 to Mar. 22; discharge not determined.

Monthly discharge of Bois des Sioux River near Tenney, Minn., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	43	31	38.0	2,340
November	30	18	23.5	1,400
April	64	34	39.2	2,330
May	36	30	32.6	2,000
June	38	10	20.3	1,210
July	11	3	6.94	426
August	2	0	.58	36
September	11	0	4.33	258

MUSTINKA RIVER ABOVE WHEATON, MINN.

LOCATION.—On line between secs. 7 and 8, T. 127 N., R. 46 W., at steel-concrete highway bridge, 1 mile upstream from Chicago, Milwaukee & St. Paul Railway bridge, 1½ miles northeast of Wheaton, Traverse County, and 8 miles above Lake Traverse, into which the river discharges.

DRAINAGE AREA.—776 square miles.

RECORDS AVAILABLE.—March 23 to September 30, 1917, and June 25, 1919, to September 30, 1921. June 7 to November 30, 1916, at point about 3½ miles downstream.

GAGE.—Chain gage attached to bridge; read by Vernon Heggen. An auxiliary staff gage, for use during floods, is attached to the Chicago, Milwaukee & St. Paul Railway bridge, 1 mile downstream from chain gage.

DISCHARGE MEASUREMENTS.—Made from highway bridge to which gage is attached, from steel highway bridge just below Chicago, Milwaukee & St. Paul Railway bridge, or from highway bridge midway between them. Measuring section at gage poor on account of angle of current; best section at steel highway bridge below railway bridge. Flow of drainage ditch which carries water around gage must be included in all measurements made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of firm gravel overlain with thin deposits of clay and silt; practically permanent. Slope of river from station to Lake Traverse is so slight that the stage-discharge relation may possibly be affected by changes of stage of the lake.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.5 feet April 2 (discharge, 287 second-feet); minimum stage, 1.12 feet August 29 and 30 (discharge, 0.2 second-foot).

1917, 1919–1921: Maximum stage recorded, 14.7 feet April 1, 1917 (discharge, 2,340 second-feet); minimum stage occurred in 1921.

ICE.—Stage-discharge relation seriously affected by ice. Data insufficient for determination of discharge.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined below 2,400 second-feet. Gage read to hundredths once daily October 1 to November 6 and about six times weekly, April 1 to June 15; from June 15 to September 30 it was read about twice weekly. Daily discharge ascertained by applying daily gage height to rating table and by interpolating for days of no gage reading as indicated in footnote to daily-discharge table. Records fair.

Discharge measurements of Mustinka River above Wheaton, Minn., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 10	E. F. Chandler	1.39	1.6	June 19	E. F. Chandler	1.54	3.9
May 1	W. L. Stockwell	2.24	32.3	Aug. 3	E. E. Foster	1.48	3.4

Daily discharge, in second-feet, of Mustinka River above Wheaton, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.8	3.5	122	25	8.8	2.5	1.6	0.3
2	1.8	3.9	287	21	9.7	3.2	1.5	.4
3	2.1	3.9	236	21	8.2	3.9	1.4	.4
4	2.1	4.6	186	21	7.6	4.5	1.4	.5
5	2.1	4.8	136	17	7.0	5.2	1.4	.6
6	1.8	5.6	86	16	6.5	5.8	1.4	.8
7	1.6	-------	74	11	6.0	4.6	1.3	.9
8	1.6	-------	74	.8	5.4	3.5	1.2	.9
9	1.6	-------	53	1.1	5.0	3.0	1.1	2
10	1.4	-------	30	1.1	4.7	2.4	1.0	3
11	1.4	-------	26	6	3.5	1.4	.9	4
12	1.6	-------	23	14	3.5	1.2	.8	5
13	1.4	-------	22	12	3.7	1.6	.7	6
14	1.4	-------	20	11	3.4	2.1	.6	7
15	1.4	-------	19	10	3.2	2.5	.6	8
16	1.4	-------	19	10	3.2	3.0	.5	9
17	1.4	-------	19	12	3.2	3.4	.4	10
18	1.6	-------	17	17	3.2	3.9	.4	11
19	1.4	-------	17	35	3.2	3.8	.4	11.8
20	1.4	-------	17	62	2.9	3.6	.4	9.0
21	1.4	-------	19	62	2.6	3.4	.4	5.4
22	1.2	-------	21	36	2.3	3.2	.3	4.8
23	1.1	-------	25	10	2.1	3.1	.3	4.2
24	1.1	-------	30	8	1.9	3.0	.3	3.7
25	1.2	-------	35	8	1.8	2.8	.3	3.2
26	1.4	-------	38	8	1.6	2.7	.3	2.6
27	1.6	-------	38	7	1.5	2.6	.3	2.6
28	2.1	-------	35	8	1.3	2.3	.2	2.5
29	2.4	-------	32	8	1.1	2.1	.2	2.3
30	2.9	-------	28	10	1.8	1.8	.2	2.2
31	3.2	-------	-------	10	-------	1.7	.2	-------

NOTE.—Gage not read Nov. 7 to Mar. 31 except on Mar. 19; data insufficient for determination of discharge. During period Apr. 1 to June 15 gage was not read on the following days and discharge was interpolated: Apr. 3–5, 11, 13, 14, 16, 23, 24, 29, May 13, 22, 26, June 6, 7, 9, and 14. During period June 16 to Sept. 30, the gage was read on the following days only and discharge was interpolated for intervening periods: June 19, 22, 29, July 3, 6, 8, 10–12, 16, 18, 22, 27, 30, Aug. 3, 6, 11, 17, 20, 22, 23, 27, 29, 30, Sept. 3, 7, 8, 19, 21, 26, and 27.

Monthly discharge of Mustinka River above Wheaton, Minn., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	3.2	1.1	1.70	103
April	287	17	59.5	3,540
May	62	.8	16.1	990
June	9.7	1.1	4.00	238
July	5.8	1.2	3.02	186
August	1.6	.2	.71	44
September	11.8	.3	4.13	246

RED LAKE RIVER AT THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 33, T. 154 N., R. 43 W., a third of a mile below dam at Thief River Falls, Pennington County, and 1 mile below mouth of Thief River, which enters from right.

DRAINAGE AREA.—3,430 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1918, and March 25, 1920, to September 30, 1921.

GAGE.—Inclined staff on right bank; installed August 19, 1920; read by Dedrick Knutson. The old gage, in use when observations were discontinued in 1918, was found practically destroyed when station was reestablished in 1920, and could not be rebuilt until August 19, 1920, on account of high stages; a series of temporary gages was therefore used prior to August 19.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet above gage.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.7 feet April 8 (discharge, 3,200 second-feet); minimum discharge, 78 second-feet November 19 (stage-discharge relation affected by ice).

1909–1918; 1920–21: Maximum open-water stage recorded, 12.2 feet April 19-21, 1916 (discharge, 3,700 second-feet); minimum discharge, no flow, July 17 and August 27, 1911 (caused by regulation).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—A short distance above station is a dam owned by Hanson & Barzen Milling Co. and the city lighting plant. The variation in load on the turbines, due to operation of the lighting plant (at night) and of the mill (chiefly during the day), causes fluctuations in stage at the gage.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined below 4,000 second-feet and fairly well defined above that point. Gage read to half-tenths once daily except during winter when it was usually read every other day. Daily discharge ascertained by applying daily gage height to rating table except for periods of ice effect and for days of no gage reading, as indicated in footnote to daily-discharge table. Open-water records good except for days of abrupt changes in stage; winter records fair.

Discharge measurements of Red Lake River at Thief River Falls, Minn., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	W. L. Stockwell	4.85	492	May 17	K. H. Oakley	5.42	872
Jan. 15	do	[a] 5.70	392	June 25	E. F. Chandler	5.06	590
Feb. 10	do	[a] 6.00	400	Aug. 9	E. E. Foster	4.72	438
Apr. 4	do	6.57	1,410				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.
1	375	472	357	323	375	290	258	695	790	515	197	357
2	393	494	375	323	393	290	274	650	840	538	169	357
3	412	472	366	290	393	290	290	650	790	515	227	357
4	393	452	357	258	393	274	740	695	740	494	290	169
5	375	472	375	188	393	258	1,500	650	840	543	323	119
6	375	452	393	119	375	258	1,790	650	790	412	357	97
7	357	431	375	238	357	274	2,640	650	740	452	258	143
8	375	431	340	357	357	290	3,200	650	790	494	258	143
9	393	412	306	369	357	279	1,640	605	740	412	274	227
10	393	375	340	381	346	269	1,430	515	740	412	181	323
11	393	357	357	393	334	258	1,170	582	740	412	88	290
12	412	323	290	227	323	258	1,170	650	695	412	156	306
13	494	258	274	282	306	258	1,110	790	740	375	183	323
14	472	242	282	338	290	258	995	740	740	357	242	340
15	452	242	290	393	306	258	890	740	695	548	227	357
16	452	212	306	375	323	258	840	695	650	740	258	357
17	431	169	314	357	323	274	840	695	695	740	274	393
18	431	119	323	357	323	290	840	695	650	323	242	472
19	452	78	323	357	323	357	695	740	740	274	258	472
20	515	169	340	357	306	323	740	650	695	227	258	431
21	560	375	357	431	290	340	695	650	650	258	274	452
22	560	412	431	418	306	357	840	650	538	242	258	412
23	515	393	473	406	323	290	740	650	650	258	258	393
24	472	375	515	393	312	357	740	672	650	258	242	357
25	472	375	431	381	301	357	740	695	605	266	242	375
26	472	393	393	369	290	560	740	605	605	274	169	290
27	494	431	393	357	290	340	790	605	560	290	197	258
28	515	393	393	375	290	119	790	560	560	323	197	227
29	472	357	393	393	-------	131	740	515	538	393	197	258
30	452	375	357	375	-------	143	740	695	538	143	290	197
31	472	-------	340	357	-------	197	-------	740	-------	197	290	-------

NOTE.—Stage-discharge relation affected by ice Nov. 10 to Apr. 7; discharge ascertained by means of gage heights, two discharge measurements, observer's notes, and weather records. During periods of open-water the gage was not read on the following days and discharge was interpolated: Apr. 24, May 7, 11, 24, July 5, 10, 15, 25, Aug. 10 and 28.

Monthly discharge, in second-feet, of Red Lake River at Thief River Falls, Minn., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	560	357	445	May	790	515	659
November	494	78	350	June	840	538	691
December	515	274	360	July	740	143	387
January	431	119	340	August	357	88	237
February	393	290	332	September	472	97	308
March	560	119	282				
April	3,200	258	1,020	The year	3,200	78	450

RED LAKE RIVER AT CROOKSTON, MINN.

LOCATION.—In sec. 30, T. 150 N., R. 46 W., at Sampson's Addition steel highway bridge in Crookston, Polk County, a quarter of a mile below dam and powerhouse of Crookston Light, Water & Power Co. No tributaries enter within several miles.

DRAINAGE AREA.—5,320 square miles.

RECORDS AVAILABLE.—May 19, 1901, to September 30, 1921.

GAGE.—Chain gage attached to middle span of highway bridge; installed July 1, 1909, and used thereafter until September, 1911, and during 1920 and 1921. A Barrett & Lawrence water-stage recorder on right abutment of same bridge and at same datum as chain gage was used September, 1911, to September, 1919. Prior to July 1, 1909, gage was on old Sampson's Addition bridge, about 300 feet upstream; this gage read the same as present one at ordinary stages. Observers, M. J. Dean and J. A. McLean.

DISCHARGE MEASUREMENTS.—Made from highway bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of silt, gravel, and small boulders; slightly shifting. Control not well defined. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.1 feet June 11 (discharge, 1,690 second-feet); minimum stage, 3.2 feet August 4 (discharge, 284 second-feet); probably not actual extremes for the year.

1901–1921: Maximum open-water stage recorded, 21.1 feet July 5, 1919 (discharge, about 14,700 second-feet); minimum discharge recorded, 10 second-feet, by current-meter measurement made January 27, 1912. The flow is controlled to such an extent that the minimum discharge has no bearing on the minimum natural flow.

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter of 1920–21.

REGULATION.—Diurnal fluctuation in stage, particularly at low water, is caused by operation of power plant immediately above station and by another 8 miles farther upstream. Storage at each of these plants is comparatively small, so that mean monthly flow should represent nearly the natural flow.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to daily-discharge table. Records good.

Discharge measurements of Red Lake River at Crookston, Minn., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 5	W. L. Stockwell	3.80	503	May 14	E. E. Foster	4.74	943
Feb. 11	do	[a] 4.95	546	18	K. H. Oakley	4.75	1,020
Apr. 16	do	5.65	1,430	June 23	E. F. Chandler	5.19	1,110

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	595		850	990	436	675	475
2	555	900	990	1,090	475	555	397
3	555		1,090	1,140	715	515	320
4	475		1,260	1,200	760	284	515
5	515		1,040	1,140	805	555	595
6	595		990	1,260	760	515	515
7	595		1,040	1,500	595	555	555
8	555		760	1,620	475	635	595
9	535	2,900	805	1,620	555	555	515
10	555		990	1,620	595	555	595
11	475		1,090	1,690	675	515	595
12	475		1,140	1,620	635	595	515
13	495		1,140	1,560	760	475	555
14	515		1,040	1,440	715	515	515
15	495	1,600	595	1,560	515	555	595
16	495		675	1,320	595	515	675
17	515		805	1,380	515	515	635
18	515	1,090	1,040	1,380	555	436	595
19	515	1,200	1,090	1,200	515	475	595
20	635	1,260	1,040	1,090	515	475	595
21	635	675	805	1,090	555	475	595
22	635	990	1,140	1,090	475	475	595
23		895	940	1,040	320	475	555
24		1,380	1,040	760	320	475	555
25		1,140	1,090	715	320	515	555
26		1,040	1,040	715	436	515	515
27	565	1,320	940	715	475	475	515
28		1,040	940	760	475	515	515
29		1,140	850	805	515	595	555
30		1,260	675	675	515	515	515
31			805		515	515	

NOTE.—No gage-height record obtained Oct. 23 to Apr. 18; discharge not determined except for periods Oct. 23–31 and Apr. 1–18, for which it was ascertained by means of weather records and comparison with flow of adjacent streams. Discharge interpolated Aug. 20, on account of missing gage height. Braced figures show mean discharge for periods indicated.

Monthly discharge, in second-feet, of Red Lake River at Crookston, Minn., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
April			1,600	July	805	436	551
May	1,260	595	959	August	675	284	517
June	1,690	675	1,190	September	675	320	547

THIEF RIVER NEAR THIEF RIVER FALLS, MINN.

LOCATION.—In sec. 3, T. 154 N., R. 43 W., 1,000 feet above steel highway bridge in Marshall County, 5 miles north of Thief River Falls, Pennington County and 5 miles above mouth of river.

DRAINAGE AREA.—1,010 square miles.

RECORDS AVAILABLE.—July 1, 1909, to September 30, 1917; April 1, 1920, to September 30, 1921.

GAGE.—Chain gage on cantilever timber fastened to a tree on right bank; installed August 19, 1920, at same location and datum as former chain gage; read by Byron Yager and Mrs. Margaret Hillyer. During period April 2 to August 18, 1920, high stages prevented installation of the chain gage and a series of temporary gages was used. An auxiliary staff gage is attached to left abutment of highway bridge, 1,000 feet below chain gage.

DISCHARGE MEASUREMENTS.—Made from steel highway bridge 1,000 feet below gage or by wading near gage.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and boulders; practically permanent. One channel at all stages. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.9 feet April 5 (stage-discharge relation affected by ice); maximum discharge, 1,700 second-feet, occurred at gage height 9.8 feet on April 6; minimum stage 3.3 feet November 20 (no flow).

1909–1917; 1920–21: Maximum stage recorded, 14.5 feet April 23, 1916 (discharge, 4,080 second-feet); practically no flow past the gage October 1, 1910, to March 12, 1911, August 2–13, 22–26, 1911, September 1–3, 5–12, 14–18, 1911, November 10, 1911, to March 26, 1912, and November 16–21, 1920.

Flood of July, 1919, reached a stage of about 16.3 feet (discharge, about 4,900 second-feet).

REGULATION.—Dam at Thief River Falls, three-fourths of a mile below mouth of Thief River, backs up water in Thief River to a point about 1 mile below the gage, but the station is protected from influence of the dam by rapids in the intervening length of channel.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined below 3,800 second-feet. Gage read to half-tenths once daily except as noted in footnote to daily-discharge table. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to daily-discharge table. Records good except those estimated, which are fair.

Discharge measurements of Thief River near Thief River Falls, Minn., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	W. L. Stockwell	4.04	7.4	June 25	E. F. Chandler	4.20	13.8
Apr. 4	do	8.68	505	Aug. 10	E. E. Foster	4.42	19.0
May 17	K. H. Oakley	4.75	49				

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Daily discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.8	6.0	30			17	17	0.8
2	.8	5.2	60			17	17	.8
3	.8	4.0	100	105	60	36	17	.8
4	.8	4.0	486			36	17	.8
5	1.4	3.0	1,340		191	36	13	.8
6	1.4	3.0	1,700		191	28	17	.8
7	.8	2.0	1,050		218	28	17	.8
8	1.0	1.4	1,020		246	28	17	.8
9	1.8	.8	878		275	28	17	2.0
10	2.0	.6	878	60	246	22	17	2.0
11	1.4	.4	810		246	22	13	2.0
12	2.0	.4	612			22	13	4.0
13	3.0	.2	548			36	13	4.0
14	4.0	.1	486			46	6.5	6.5
15	11	.1	364	46	160	36	6.5	17
16	11	-------	304	46		28	4.0	17
17	9.0	-------	246	46		28	4.0	22
18	11	-------		36		22	4.0	28
19	11	-------		36		22	4.0	28
20	11	-------		28		17	4.0	22
21	13	-------		28		17	2.0	28
22	13	-------		22	50	13	2.0	36
23	11	-------		22		13	2.0	36
24	11	-------	180	17		13	2.0	36
25	13	-------		17	13	13	2.0	36
26	13	-------		17	36	9.5	2.0	28
27	13	-------		13	28	6.5	2.0	28
28	11	-------		13	22	6.5	2.0	22
29	9.5	-------			22	6.5	2.0	22
30	9.5	-------		20	22	13	2.0	17
31	6.5	-------	-------		-------	15	.8	-------

NOTE.—Practically no flow Nov. 16–20. No record obtained Nov. 21 to Mar. 31; discharge not determined. No record obtained Apr. 1–3, 18–30, May 1–14, 29–31, June 1–4 and 12–24; mean discharge ascertained by means of weather records and comparison with flow of adjacent streams. Braced figures show mean discharge for periods indicated.

Monthly discharge, in second-feet, of Thief River near Thief River Falls, Minn., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	13	0.8	6.76	July	46	6.5	22.0
April	1,700	-------	442	August	17	.8	8.35
May	-------	-------	48.8	September	36	.8	15.0
June	-------	-------	121				

PEMBINA RIVER AT NECHE, N. DAK.

LOCATION.—At Great Northern Railway bridge a third of a mile above Great Northern Railway dam and two-thirds of a mile north of Neche, Pembina County.

DRAINAGE AREA.—2,960 square miles (revised).

RECORDS AVAILABLE.—May 1, 1903, to September 30, 1915, and April 1, 1919, to September 30, 1921.

GAGE.—Vertical staff bolted to concrete abutment at north end of railway bridge; read by P. J. Horgan. Auxiliary staff gage attached to abutment at north end of highway bridge 350 feet downstream.

DISCHARGE MEASUREMENTS.—Made from highway bridge 350 feet below railway bridge; at very low stages made by wading below Great Northern Railway dam.

CHANNEL AND CONTROL.—Bed composed of clay and silt; slightly shifting. Control is loose rock dam a third of a mile below gage; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.4 feet April 13 (discharge, 733 second-feet); minimum stage, 3.3 feet September 23 and 24 (discharge, 4.5 second-feet).

1903–1915; 1919–1921: Maximum discharge recorded, 3,870 second-feet May 2, 1904 (gage height, 20.9 feet); a stage of 21.4 feet (discharge, 3,850 second-feet) was reached April 8, 1913; minimum stage recorded, 1.3 feet September 15, 16, 18, 19, and 21–24, 1911 (discharge, 1.0 second-foot).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—The water is raised at low stages from 1 foot to 2 feet at the gage by the loose-rock dam about 3 feet high, a third of a mile below, constructed to give sufficient depth of water for the intake of Great Northern Railway water tank. There is considerable leakage through the dam, but no permanent determination of the effect of the dam can be made because it is likely to be somewhat disturbed at its crest by ice run or spring floods in any year. There are no reservoirs or power plants that affect the flow.

ACCURACY.—Stage-discharge relation changed the latter part of May; affected by ice November 13 to March 31. Two rating curves used; one, applicable October 1 to May 27, well defined between 8 and 4,000 second-feet, the other, applicable May 28 to September 30, well defined between 1.5 and 4,000 second-feet; the two curves are identical at and above 425 second-feet. Gage read to tenths once daily except during period November 14 to March 25, when it was read but three times. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect and for a few days when gage was not read for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records fair to good; winter records poor.

Discharge measurements of Pembina River at Neche, N. Dak., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 12	E. E. Foster	4.68	165
June 28	E. F. Chandler	4.13	51
Aug. 30	do	3.81	18.1

Daily discharge, in second-feet, of Pembina River at Neche, N. Dak., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	50	129		129	201	14 6	62	35	9
2	50	129		361	182	146	62	35	9
3	112	129		403	182	128	62	35	9
4	112	129		425	164	128	62	35	9
5	112	129		601	164	128	185	35	11
6	112	129		557	164	128	185	35	13
7	129	129		518	164	110	128	35	13
8	129	129		447	146	110	185	25	18
9	129	129		403	146	110	335	25	18
10	129	129		447	129	110	312	18	16
11	129	129		447	129	110	290	18	18
12	129	129		469	129	93	290	13	18
13	129	112		733	129	93	205	13	18
14	129			601	146	93	185	13	25
15	129			403	182	93	93	13	25
16	129			382	182	93	77	13	25
17	129			340	164	77	77	13	25
18	129			320	164	77	77	13	25
19	146			280	164	77	62	13	18
20	146			240	146	77	62	13	13
21	146			240	146	77	62	13	9
22	146			240	129	77	62	13	6
23	146			240	129	77	47	13	4.5
24	146			240	164	77	47	13	4.5
25	146			220	220	77	47	13	5
26	146		38	220	260	77	47	13	5
27	146		95	220	260	77	47	13	9
28	129		95	220	226	77	47	13	25
29	129		95	201	185	77	35	13	35
30	129		95	201	185	77	35	9	47
31	129		112		146		35	9	

NOTE.—Stage-discharge relation affected by ice Nov. 13 to Mar. 31; monthly discharge estimated as follows: November, 95 second-feet; March, 50 second-feet; estimates for December, January, and February withheld on account of lack of sufficient base data. Discharge interpolated Aug. 20, 27, and Sept. 5, on account of lack of gage readings.

Monthly discharge of Pembina River at Neche, N. Dak., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	146	50	127	7,810
November			[a] 95	5,650
March	112		[a] 50	3,070
April	733	129	358	21,300
May	260	129	169	10,400
June	146	77	96.6	5,750
July	335	35	113	6,950
August	35	9	18.8	1,160
September	47	4.5	16.2	964

[a] See footnote to table of daily discharge.

ROSEAU RIVER AT CARIBOU, MINN.

LOCATION.—In sec. 34, T. 164 N., R. 45 W., at steel highway bridge in Caribou, Kittson County, 1 mile south of international boundary and 3 miles upstream from crossing of boundary line by river.

DRAINAGE AREA.—1,340 square miles.

RECORDS AVAILABLE.—April 1 to October 6, 1917; April 12, 1920, to September 30, 1921.

GAGE.—Chain gage fastened to downstream handrail of bridge, 60 feet from left abutment; read by James A. McKibbin.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Channel is artificial, of trapezoidal cross section, about 100 feet wide and 10 feet deep. Bed composed of hardpan with a few scattered large boulders. Point of zero flow, bottom of channel, gage height about 3.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.8 feet April 11 (discharge, 1,980 second-feet); minimum stage, 3.2 feet July 24 and 25 and September 3–7 (discharge, 17 second-feet).

1917 and 1920–21: Maximum stage recorded, 11.5 feet April 15, 1920 (stage-discharge relation affected by ice); maximum open-water stage, 10.8 feet April 11, 1921 (discharge, 1,980 second-feet); minimum stage, 3.15 feet September 10–12, 29, and 30, 1917 (discharge, 4 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—No diversions involving storage or loss of water. A small channel about 3½ miles long was dredged some years ago from a point about 4 miles above the station to a point 1 mile below. At stages above about 6.0 feet water flows in this channel and must be measured and included in all measurements of the main river.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Roseau River at Caribou, Minn., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	W. L. Stockwell	3.35	34	June 24	E. F. Chandler	3.66	62
Apr. 17	do	9.99	[a]1,670	Aug. 11	E. E. Foster	3.45	37

[a] Includes 265 second-feet measured in cut-off ditch.

Daily discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	38	38		688	131	24	38	20
1	38	38		606	157	28	38	20
3	33	38		580	198	38	33	17
4	28	43		554	131	33	33	17
5	24	43		434	131	33	33	17
6	20	38		391	150	38	33	17
7	20	33		312	170	43	38	17
8	20	33		312	184	38	38	20
9	20	43		312	191	33	43	24
10	20	43	1,540	294	206	33	38	28
11	24	43	1,980	277	228	33	38	33
12	24	43	1,770	277	213	28	38	38
13	24	43	1,690	260	184	33	33	43
14	24		1,810	260	164	28	33	43
15	20		1,730	260	138	28	28	43
16	20		1,650	244	119	24	24	48
17	20		1,650	228	107	24	24	48
18	20		1,570	228	102	24	24	63
19	24		1,540	228	96	24	24	80
20	24		1,390	220	85	24	20	96
21	33		1,280	206	74	20	20	107
22	43		1,080	213	68	20	20	119
23	53		950	206	63	20	20	131
24	53		920	198	58	17	20	144
25	53		890	191	58	17	20	144
26	48		830	191	48	20	20	144
27	48		800	184	43	24	20	131
28	48		772	157	38	24	20	119
29	48		772	157	33	33	20	107
30	48		744	157	28	43	20	96
31	43			144		43	20	

Monthly discharge, in second-feet, of Roseau River at Caribou, Minn., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	53	20	32.4	July	43	17	28.8
May	688	144	289	August	43	20	28.1
June	228	28	120	September	144	17	65.8

MOUSE RIVER AT MINOT, N. DAK.

LOCATION.—At Anne Street footbridge, northeast of Great Northern Railway roundhouse in Minot, Ward County.

DRAINAGE AREA.—8,400 square miles.

RECORDS AVAILABLE.—May 5, 1903, to September 30, 1921.

GAGE.—Temporary vertical staff gage on shore of river, 500 feet above Anne Street footbridge; installed by observer about April 1, 1919, when old Anne Street Bridge was taken down and the staff gage on that bridge was destroyed. About March 10, 1920, a new vertical staff gage in two sections was installed on the piers of the new Anne Street Bridge, but has been read only once a week, the temporary gage being used instead. From January, 1910, to about April 1, 1919, the vertical staff gage on the old Anne Street Bridge was used. Prior to January, 1910, gage used was a vertical staff located on a footbridge then existing about 20 rods above Anne Street. All gages referred to same datum except the present temporary gage which reads 0.60 foot higher than the gage on Anne Street Bridge, but readings on the temporary gage are reduced to correct datum. Observer, Ephriam Cox.

DISCHARGE MEASUREMENTS.—Made from Anne Street Bridge, Ninth Street Bridge, South Sixth Street Bridge, or by wading.

CHANNEL AND CONTROL.—Bed composed of clay and silt; practically permanent. Control is timber and loose-rock dam 1 mile below gage at water tank of Minneapolis, St. Paul & Sault Ste. Marie Railway. Dam is submerged at high stages causing a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.5 feet July 10 and 11 (discharge, 790 second-feet); minimum stage, 3.7 feet February 19 (discharge, about 0.3 second-foot; stage-discharge relation affected by ice.)

1093–1921: Maximum stage recorded during period, 21.9 feet April 20, 1914 (discharge, estimated 12,000 second-feet); minimum stage, 1.8 feet February 28, 1913 (discharge, 0.1 second-foot).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Dam about 5 feet high at Minneapolis, St. Paul & Sault Ste. Marie Railway tank, 1 mile below, raises water at gage about 5 feet at ordinary low stage. The dam being designed merely to give enough depth of water for the intake-pipe suction, has no sluices, but is not absolutely tight. When discharge is less than about 6 second-feet, the water level falls below crest of dam.

DIVERSIONS.—None.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined below 2,500 second-feet. Gage read to half-tenths once daily, except during winter period when it was read only once weekly. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect for which it was ascertained as indicated in footnote to daily-discharge table. Open-water records good; winter records fair to poor.

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

July 6, 1921: Gage height, 7.31 feet; discharge, 531 second-feet.

September 5, 1921: Gage height, 4.86 feet; discharge, 39 second-feet.

Daily discharge, in second-feet, of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July	Aug.	Sept.
1	9	9	------	2.4	------	------	68	104	34	260	194	18
2	9	9	------	------	------	------	82	96	34	226	174	18
3	7	9	------	------	------	------	146	75	29	237	137	18
4	7	9	7	------	------	------	164	82	29	309	104	18
5	7	9	------	------	1.1	7	194	82	34	362	75	21
6	7	9	------	------	------	------	174	75	29	469	62	21
7	9	9	------	------	------	------	164	82	29	627	56	18
8	11	9	------	1.6	------	------	184	82	29	710	50	18
9	9	------	------	------	------	------	215	75	34	730	50	14
10	7	------	------	------	------	------	248	62	34	790	44	18
11	7	------	7	------	------	------	284	68	34	790	44	18
12	7	------	------	------	1.1	11	296	68	34	710	44	18
13	7	------	------	------	------	------	248	68	29	648	39	18
14	9	7	------	------	------	------	204	62	29	469	34	21
15	9	------	------	1.6	------	------	174	68	29	418	34	21
16	9	------	------	------	------	------	184	62	25	362	34	21
16	9	------	------	------	------	------	184	56	25	309	29	21
18	7	------	4	------	------	------	194	50	25	284	25	29
19	7	------	------	------	.3	17	184	39	29	272	25	29
20	7	------	------	------	------	17	184	34	29	260	29	29
21	9	------	------	------	------	25	215	34	29	260	29	25
22	9	------	------	1.6	------	30	184	34	25	248	29	25
23	9	------	------	------	------	44	174	29	25	237	25	25
24	9	------	------	------	------	70	155	44	25	226	25	21
25	11	------	2.4	------	------	85	137	44	25	226	25	21
26	11	------	------	------	2.4	93	120	50	21	215	21	21
27	9	7	------	------	------	------	85	146	44	120	226	21	21
28	9	------	------	------	------	------	85	128	39	215	226	21	18
29	9	------	------	1.6	------	------	56	120	39	248	237	18	18
30	9	------	------	------	------	------	50	120	44	272	237	18	21
31	9	------	------	------	------	------	56	------	39	------	226	14	------

NOTE.—Stage-discharge relation affected by ice Dec. 20 to Mar. 25. During period Nov. 9 to Mar. 18, gage was read only on days for which discharge is given; mean monthly discharge estimated on basis of the occasional gage readings and weather records, as follows: November, 7.6 second-feet; December, 5.0 second-feet; January, 1.7 second-feet; February, 1.1 second-feet; and March, 28.0 second-feet. No gage reading Aug. 11; discharge interpolated.

Monthly discharge of Mouse River at Minot, N. Dak., for the year ending Sept. 30, 1921.

Month.	Discharge in second-feet.			Run-off in acre-feet.
	Maximum.	Minimum.	Mean.	
October	11	7	8.5	523
November	------	------	7.6	452
December	------	------	5.0	307
January	------	------	1.7	105
February	------	------	1.1	61.1
March	------	------	28.0	1,720
April	296	68	176	10,500
May	104	34	59.4	3,650
June	272	21	53.6	3,190
July	790	215	381	23,400
August	194	14	49.3	3,030
September	29	14	20.8	1,240
The year	790	------	66.6	48,200

NOTE.—See footnote to daily-discharge table.

UPPER MISSISSIPPI RIVER BASIN.

MISSISSIPPI RIVER AT ELK RIVER, MINN.

LOCATION.—In sec. 3, T. 121 N., R. 23 W., at highway bridge in Elk River, Sherburne County, 2,500 feet below mouth of Elk River.

DRAINAGE AREA.—14,500 square miles.

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1921.

GAGE.—Chain gage bolted to handrail of bridge, downstream side, near right bank; read by Reynard Ebner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control not well defined but practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.66 feet at 8.30 a. m. June 15 (discharge, 12,900 second-feet); minimum discharge, estimated 2,030 second-feet February 9 (stage-discharge relation affected by ice).

1915–1921: Maximum open-water stage recorded during period, 10.8 feet April 7, 1916 (discharge, 27,000 second-feet); maximum discharge probably occurred on or about April 5, 1917, and has been estimated at about 34,000 second-feet from records of discharge at Coon Rapids power plant; minimum discharge, estimated 1,880 second-feet November 13, 1919 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Nearest dam above station on the Mississippi is at St. Cloud, 40 miles upstream. An observed systematic diurnal fluctuation at gage of about 0.1 foot is doubtless due to regulation at St. Cloud, but most of the effect of regulation is eliminated before reaching the station. Flow of river is controlled by Government reservoirs on the upper river, maintained for the purpose of increasing low-water open-season flow in the interests of navigation. Daily and monthly discharge somewhat affected by regulation; yearly discharge very nearly natural.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 2,000 and 14,000 second-feet; fairly well defined between 14,000 and 26,300 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for period during which stage-discharge relation was affected by ice for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records excellent; winter records fair.

COOPERATION.—Gage-height record furnished by United States Engineer Corps.

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

September 13, 1921: Gage height, 3.46 feet; discharge, 3,310 second-feet.

Daily discharge, in second-feet, of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5,800	5,800	3,840	2,750	3,300	2,460	5,200	7,930	6,100	5,500	4,620	3,400
2	5,800	4,340	4,080	3,030	2,850	2,940	5,800	5,500	9,200	5,500	4,340	3,400
3	5,500	4,620	4,080	2,750	3,250	2,910	5,800	6,100	9,200	6,100	4,080	3,210
4	4,620	4,620	4,080	2,800	2,920	3,060	6,700	5,200	9,200	5,200	4,340	3,210
5	4,910	4,910	4,080	2,720	2,860	2,970	7,000	5,200	9,200	5,200	4,340	2,860
6	4,910	5,200	4,080	2,630	2,640	3,060	7,310	4,910	9,200	5,800	4,080	3,210
7	4,620	5,200	3,840	2,870	2,550	3,220	7,000	4,620	10,200	5,800	3,610	2,420
8	4,340	5,200	3,400	2,720	2,390	3,060	7,930	4,620	10,500	6,100	3,610	3,030
9	4,340	4,910	3,080	2,250	2,030	3,040	10,200	4,080	10,800	5,800	3,610	3,030
10	4,080	4,910	3,400	2,430	2,360	3,190	9,200	4,340	11,800	6,100	3,610	3,030
11	4,620	3,840	3,610	2,830	2,290	3,310	9,840	4,080	12,100	6,100	3,610	3,030
12	4,620	3,400	3,030	2,410	2,210	3,050	9,520	4,080	12,400	6,100	3,400	2,860
13	4,340	3,030	3,210	2,520	2,540	3,100	9,200	3,840	12,400	6,100	3,400	3,030
14	4,910	3,030	3,210	2,490	2,610	2,800	9,520	4,910	12,400	6,400	3,210	3,400
15	5,500	2,860	2,860	2,470	2,630	3,030	8,240	4,620	12,700	5,800	3,610	4,340
16	5,200	2,550	3,030	2,360	2,890	3,210	8,240	4,080	12,400	5,500	3,610	4,620
17	5,800	2,700	2,700	2,260	2,810	3,210	7,930	4,340	12,100	5,800	3,610	4,340
18	5,800	2,700		2,240	2,880	3,210	7,310	4,910	11,800	5,800	4,080	3,610
19	5,200	3,210		2,270	2,760	3,610	7,310	3,840	11,800	5,500	4,080	3,610
20	5,800	3,610		2,340	2,970	3,840	7,000	2,700	11,400	5,800	4,080	4,340
21	5,800	3,840		2,250	3,100	3,030	6,700	2,700	10,800	5,800	3,840	4,620
22	6,100	4,080		2,540	2,720	2,860	7,000	2,860	8,880	5,800	3,840	4,340
23	5,200	3,400		2,240	2,300	3,610	7,000	2,700	9,520	5,500	3,400	4,080
24	5,200	3,400		2,370	2,460	4,080	6,700	2,700	8,560	5,200	3,610	4,080
25	4,910	3,840	2,700	2,220	2,880	3,610	6,700	2,700	8,240	5,200	3,840	4,080
26	5,200	3,400		2,180	2,810	3,610	6,700	2,860	8,240	5,500	3,400	3,610
27	4,910	3,400		2,250	2,810	3,840	6,700	3,210	7,310	5,500	3,610	4,080
28	4,910	3,840		2,220	2,520	3,840	7,000	3,030	6,700	5,200	3,210	3,840
29	4,910	3,840		2,470	-------	4,080	6,700	4,620	6,100	5,200	2,860	3,840
30	4,910	3,610		2,370	-------	6,100	6,400	4,080	5,200	5,200	3,610	3,400
31	4,910	-------		2,450	-------	5,800	-------	4,340	-------	4,910	3,400	-------

NOTE.—Stage-discharge relation affected by ice Dec. 18 to Mar. 14; discharge Dec. 18–31 ascertained by means of gage heights and weather records; discharge Jan. 1 to Mar. 14, ascertained by means of discharge records from Coon Rapids power plant, computed by Northern States Power Co., allowance being made for discharge of Crow and Rum rivers, which enter between Coon Rapids and the gaging station. Braced figure shows mean discharge for period indicated.

Monthly discharge of Mississippi River at Elk River, Minn., for the year ending Sept. 30, 1921.

[Drainage area, 14,500 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	6,100	4,080	5,090	0.351	0.40
November	5,800	2,550	3,910	.270	.30
December	4,080	-------	3,140	.217	.25
January	3,030	2,180	2,470	.170	.20
February	3,300	2,030	2,690	.186	.19
March	6,100	2,460	3,440	.237	.27
April	10,200	5,200	7,460	.514	.57
May	7,930	2,700	4,180	.288	.33
June	12,700	5,200	9,880	.681	.76
July	6,400	4,910	5,650	.390	.45
August	4,620	2,860	3,730	.257	.30
September	4,620	2,420	3,600	.248	.28
The year	12,700	2,030	4,600	.317	4.30

MISSISSIPPI RIVER AT ST. PAUL, MINN.

LOCATION.—At Chicago Great Western Railway bridge near foot of Robert Street, St. Paul, Ramsey County, 6 miles below mouth of Minnesota River.

DRAINAGE AREA.—35,700 square miles.

RECORDS AVAILABLE.—March 22, 1887, to September 30, 1921. Observations of stage were begun in 1873 by United States Signal Service and continued by the Weather Bureau. Many discharge measurements were made prior to 1900 by United States Engineer Corps.

GAGE.—Chain gage installed May 9, 1913, on downstream handrail of Chicago Great Western Railway bridge; read by employee of the Weather Bureau. From 1911 to May 9, 1913, gage was a vertical staff attached to a piling on left bank of river about 800 feet upstream from present gage. Prior to 1911 a vertical staff gage on Diamond Joe Line wharf, at foot of Jackson Street, about 400 feet below present gage, was used. Datum of all three gages is the same, allowance being made for the slight slope in river between them.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.7 feet June 16 (discharge, 19,500 second-feet); minimum stage recorded, −0.3 foot September 5 and 6 (discharge, 3,360 second-feet).

1887–1921: Maximum stage recorded, 18.0 feet April 6, 1897 (discharge, 80,800 second-feet); minimum discharge recorded, 1,060 second-feet February 4, 1895.

Highest known discharge occurred July 22, 1867, and amounted to 117,000 second-feet.

DISCHARGE MEASUREMENTS.—Prior to 1915 made from Chicago, St. Paul, Minneapolis & Omaha Railway bridge, 2 miles above station. In November, 1915, and April, 1916, made from Chicago Great Western Railway bridge to which gage is attached. Since 1916 measurements have been made from Wabasha Street highway bridge, about 1,000 feet above station.

CHANNEL AND CONTROL.—Channel fairly permanent. Control not well defined. Banks moderately high; have not been overflowed in recent years.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—During extreme low water regulation of the flow through turbines at the nearest dam in Minneapolis may cause diurnal fluctuation of stage at St. Paul. Flow is regulated by Government reservoirs in the headwaters at Lake Winnebigoshish, Leach Lake, Pokegama Lake, Sandy Lake, Pine River, and Gull Lake, maintained for the purpose of increasing low-water open-season flow in the interests of navigation, but the effect of this regulation is very gradual at St. Paul.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined throughout. Gage read to tenths once daily. Daily discharge ascertained by appliyng daily gage height to rating table except for periods of ice effect for which discharge was not determined. Records good.

COOPERATION.—Gage-height record furnished by the Weather Bureau.

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

September 12, 1921: Gage height, −0.04 foot; discharge, 3,700 second-feet.

Daily discharge, in second-feet, of Mississippi River at St. Paul, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,060	8,060	6,830	-------	4,490	13,400	11,500	12,000	7,850	5,730	3,960
2	8,060	8,720	6,830	-------	4,350	12,900	11,200	14,000	7,640	5,560	4,220
3	8,500	8,060	6,830	-------	3,480	13,400	10,900	14,900	7,640	5,390	3,960
4	7,430	7,640	7,030	-------	4,770	13,700	10,700	14,900	7,850	5,070	3,480
5	7,430	7,640	7,230	-------	5,070	13,700	9,910	14,300	7,230	5,390	3,360
6	7,640	7,850	7,230	-------	5,070	14,600	9,660	14,300	7,850	5,070	3,360
7	7,230	8,060	7,230	-------	5,070	14,600	9,660	14,600	7,640	4,770	3,840
8	6,830	8,950	6,830	-------	5,390	15,200	9,180	16,100	8,280	3,960	3,600
9	6,830	8,500	6,450	-------	5,560	16,100	8,950	16,400	8,280	4,490	4,090
10	6,830	8,280	6,090	4,350	5,730	17,300	8,500	16,700	8,280	4,220	3,720
11	6,270	8,060	6,090	4,220	5,560	17,300	8,280	17,900	7,850	4,090	3,840
12	6,830	7,430	6,640	3,960	5,910	18,600	8,060	18,300	7,850	4,090	3,600
13	7,030	6,450	6,450	3,960	5,730	18,300	8,280	18,300	7,430	4,090	3,600
14	7,030	5,070	6,090	4,090	5,560	17,300	7,640	17,900	7,430	4,350	4,350
15	7,230	5,390	5,560	4,220	5,560	17,000	8,280	18,600	7,850	3,960	4,220
16	7,850	5,390	3,840	4,350	5,070	15,800	7,850	19,500	7,430	4,350	4,920
17	7,430	5,070	3,600	4,490	5,070	15,800	7,850	18,900	7,430	4,770	5,560
18	7,230	5,070	3,480	5,070	5,390	14,900	7,640	17,600	7,430	4,350	5,910
19	8,280	5,560	3,960	-------	5,560	13,700	8,500	17,600	7,030	4,770	5,070
20	7,640	6,450	-------	-------	6,830	13,400	8,280	17,300	6,830	4,630	5,230
21	8,720	6,830	-------	-------	7,030	13,200	8,060	16,400	7,030	4,490	6,640
22	8,720	7,030	-------	-------	6,830	12,900	8,060	15,800	6,830	4,220	7,430
23	8,950	7,230	-------	-------	6,450	12,900	8,500	14,600	6,830	4,350	6,830
24	9,180	7,030	-------	-------	6,450	12,600	9,180	13,400	6,090	3,960	6,450
25	8,060	7,030	-------	-------	7,640	12,300	7,850	12,300	6,090	4,350	6,270
26	8,500	7,030	-------	5,390	7,030	12,300	7,850	11,500	5,910	5,560	6,090
27	8,500	6,830	-------	5,070	8,060	12,000	7,640	11,200	6,090	4,490	5,910
28	8,500	6,830	-------	4,630	8,500	12,000	7,850	10,900	6,640	4,350	5,910
29	8,280	6,830	-------	-------	8,500	11,800	8,280	9,420	7,030	3,960	5,730
30	8,060	6,830	-------	-------	9,420	11,500	9,660	8,280	6,830	3,960	5,390
31	8,060	-------	-------	-------	12,000	-------	10,900	-------	6,450	4,090	-------

NOTE.—Stage-discharge relation affected by ice Dec. 20 to Feb. 9 and Feb. 19-25; discharge not determined.

Monthly discharge of Mississippi River at St. Paul, Minn., for the year ending Sept. 30, 1921.

[Drainage area, 35,700 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	9,180	6,270	7,780	0.218	0.25
November	8,950	5,070	7,040	.197	.22
December 1-19	7,230	3,480	6,020	.169	.12
March	12,000	3,480	6,230	.175	.20
April	18,600	11,500	14,400	.403	.45
May	11,500	7,640	8,860	.248	.29
June	19,500	8,280	15,100	.423	.47
July	8,280	5,910	7,260	.203	.23
August	5,730	3,960	4,540	.127	.15
September	7,430	3,360	4,880	.137	.15

MINNESOTA RIVER NEAR MONTEVIDEO, MINN.

LOCATION.—In sec. 17, T. 117 N., R. 40 W., at highway bridge 1 mile south of Montevideo, Chippewa County, and 500 feet below mouth of Chippewa River.

DRAINAGE AREA.—6,300 square miles.

RECORDS AVAILABLE.—July 22, 1909, to September 30, 1921.

GAGE.—Chain gage attached to upstream handrail of bridge, near left bank; read by Esther Hendricks. Datum of gage lowered 2 feet September 16, 1909, and 1 foot more July 29, 1910, to avoid negative readings. All gage heights referred to latest datum.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and sand; fairly permanent. There is a slight rapids just below gage, but the control section is not well defined. Banks are of medium height and will be overflowed at a stage of about 14 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.15 feet in afternoon of April 9 (discharge, 1,760 second-feet); minimum stage, 1.80 feet in afternoon of August 24 (discharge, 51 second-feet).

1909–1921: Maximum stage recorded, about 18.85 feet June 25, 1919 (discharge, about 22,000 second-feet); minimum discharge recorded, 6.8 second-feet February 9, 1912, by current-meter measurement.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No regulation on Minnesota River above station. Regulation of Chippewa River at plant of Chippewa Milling Co., in Montevideo, causes a slight fluctuation in stage of Minnesota River at gage.

ACCURACY.—Stage-discharge relation changed slightly during the winter; affected by ice December 17 to March 20. Standard rating curve used March 21 to September 30 fairly well defined; parallel curve used October 1 to December 16. Gage read to hundredths twice daily except during period December 28 to March 20, when it was read about three times weekly. Daily discharge ascertained by applying mean daily gage height to rating table except for period of ice effect, for which discharge was not determined on account of insufficient data. Records good.

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

September 14, 1921: Gage height, 2.40 feet; discharge, 106 second-feet.

Daily discharge, in second-feet, of Minnesota River near Montevideo, Minn., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	675	540	514	-------	1,160	1,030	462	316	108	62
2	619	566	540	-------	1,270	1,060	462	294	103	55
3	619	566	540	-------	1,270	1,030	488	264	99	54
4	619	566	566	-------	1,300	1,030	462	234	90	57
5	592	566	592	-------	1,340	967	436	244	83	59
6	566	566	592	-------	1,450	906	436	216	88	61
7	514	566	592	-------	1,530	906	410	216	89	64
8	514	566	592	-------	1,650	817	410	225	86	65
9	514	566	619	-------	1,740	788	410	234	76	68
10	488	566	619	-------	1,690	788	410	234	64	71
11	488	566	592	-------	1,610	759	410	198	62	78
12	462	592	566	-------	1,610	759	410	198	60	87
13	462	619	540	-------	1,610	788	410	180	62	105
14	488	592	540	-------	1,610	817	462	171	67	123
15	514	703	566	-------	1,570	788	514	154	68	146
16	540	675	619	-------	1,530	731	514	146	62	180
17	540	619	-------	-------	1,450	703	514	146	61	225
18	540	566	-------	-------	1,410	675	514	146	61	294
19	540	540	-------	-------	1,300	647	488	154	61	316
20	514	540	-------	-------	1,300	675	462	154	59	410
21	514	514	-------	731	1,230	675	462	146	59	462
22	514	488	-------	619	1,270	675	462	146	59	488
23	540	488	-------	566	1,270	647	410	138	57	514
24	540	462	-------	703	1,200	619	410	138	52	514
25	540	488	-------	788	1,270	619	362	146	53	540
26	566	514	-------	788	1,230	592	316	154	58	540
27	566	540	-------	731	1,230	592	316	162	63	514
28	540	540	-------	592	1,200	619	316	162	66	488
29	514	540	-------	703	1,130	540	316	146	67	462
30	514	540	-------	876	1,060	514	316	138	68	410
31	540	-------	-------	998	-------	462	-------	123	71	-------

Monthly discharge of Minnesota River near Montevideo, Minn., for the year ending Sept. 30, 1921.

[Drainage area, 6,300 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	675	462	539	0.0856	0.10
November	703	462	559	.0887	.10
December 1-16	619	514	574	.0911	.05
March 21-31	998	566	736	.117	.05
April	1,740	1,060	1,380	.219	.24
May	1,060	462	749	.119	.14
June	514	316	426	.0676	.08
July	316	123	185	.0294	.03
August	106	52	70.4	.0112	.01
September	540	54	250	.0397	.04

MINNESOTA RIVER NEAR MANKATO, MINN.

LOCATION.—In sec. 14, T. 108 N., R. 27 W., at Sibley Park, 2 miles above center of Mankato, Blue Earth County, and 1,000 feet below mouth of Blue Earth River.

DRAINAGE AREA.—14,600 square miles.

RECORDS AVAILABLE.—May 20, 1903, to October 19, 1921, when station was discontinued.

GAGE.—Chain gage on right bank of river; read by Clarence Staley, observer for the Weather Bureau. The gage support is a fairly substantial cantilever structure, supported by two heavy posts resting in concrete footings; settling somewhat; constructed and maintained by United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from new concrete highway bridge in center of Mankato 2 miles below gage, by wading a short distance below gage, or at extreme high stages, by boat near gage.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel; shifts during high stages. Banks moderately high and not subject to overflow, except at stages above gage height 15 feet. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period October 1, 1920, to October 19, 1921, 5.9 feet May 30, 1921 (discharge, 4,910 second-feet); minimum stage recorded, 0.3 foot September 7, 1921 (discharge, about 300 second-feet).

1903–1921: Maximum stage recorded, 21.2 feet June 26, 1908 (discharge, 43,800 second-feet); minimum discharge recorded, 89 second-feet, August 31 to September 2, 1911.

The highest known stage of this river occurred in 1881, and is shown in Mankato by a well-marked line about 27 feet above zero of present gage (discharge, estimated 65,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during winter.

REGULATION.—The nearest dam on Minnesota River is at Minnesota Falls, 140 miles upstream. A dam on Blue Earth River at Rapidan, a few miles above the mouth, controls the flow of that river, which is about 20 per cent of the flow at the Mankato station, and produces considerable daily fluctuation at the gage, amounting at times to over 1 foot.

ACCURACY.—Stage-discharge relation probably not permanent, although it has been assumed permanent on basis of the single discharge measurement obtained, which substantiates the 1920 rating curve reasonably close. Rating curve considered poorly defined on account of probable changes in stage-discharge relation not defined by discharge measurements. Gage read to tenths once daily. This gage reading does not represent accurately the mean daily stage on account of fluctuation caused by artificial regulation. Daily discharge ascertained by applying daily gage height to rating table. Records probably poor.

COOPERATION.—Gage-height record furnished by the Weather Bureau.

The following discharge measurement was made by S. B. Soulé:
September 15, 1921: Gage height, 0.66 foot; discharge, 406 second-feet.

Daily discharge, in second-feet, of Minnesota River near Mankato, Minn., for the period Oct. 1, 1920, to Oct. 19, 1921.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1,020	1,200	1,790	2,560	1,950	4,520	840	450	300	720
2	1,020	1,320	1,870	2,840	2,030	4,270	840	500	300	840
3	1,140	1,380	1,870	2,940	2,110	3,910	720	500	300	840
4	1,140	1,260	1,790	2,940	2,110	3,680	660	500	300	900
5	1,140	1,200	1,790	2,740	2,030	3,040	660	500	300	900
6	1,080	1,140	1,870	2,650	1,950	2,380	720	450	300	840
7	1,080	1,320	1,870	3,040	1,870	1,870	780	400	250	780
8	1,080	1,380	1,950	3,240	1,790	1,720	840	400	300	780
9	1,140	1,440	1,790	3,240	1,790	1,650	780	400	300	720
10	1,080	1,510	1,790	3,350	1,870	1,950	900	450	400	720
11	1,020	1,510	1,720	3,140	1,870	2,200	840	400	400	660
12	1,020	1,440	1,650	3,240	1,950	2,560	780	350	400	660
13	1,020	1,440	1,720	3,240	1,950	3,140	780	350	400	660
14	1,080	1,510	1,720	3,240	1,950	3,570	780	350	500	720
15	1,020	1,510	1,580	3,140	1,720	3,570	720	350	400	660
16	1,080	1,380	1,440	3,140	1,580	2,940	720	350	500	660
17	1,020	1,440	1,440	2,840	1,580	2,560	660	400	550	600
18	1,020	1,440	1,380	2,650	1,650	1,950	660	400	1,020	660
19	1,020	1,380	1,320	2,380	1,650	2,200	600	400	1,320	660
20	1,020	1,380	1,380	1,870	1,720	2,110	660	500	1,260	------
21	1,140	1,380	1,260	2,030	1,580	1,790	550	350	1,140	------
22	1,080	1,440	1,200	2,030	1,650	1,720	500	300	1,020	------
23	1,080	1,440	1,260	1,870	1,720	1,720	450	300	960	------
24	1,200	1,510	1,260	1,720	1,720	1,580	450	300	840	------
25	1,260	1,510	1,320	1,650	1,790	1,510	450	300	840	------
26	1,380	1,440	1,320	1,580	1,870	1,380	500	350	840	------
27	1,320	1,440	1,320	1,720	1,950	1,200	500	300	780	------
28	1,320	1,580	1,260	1,870	2,740	1,140	500	350	780	------
29	1,260	1,510	1,320	1,870	3,790	1,140	500	350	720	------
30	1,320	1,440	1,790	2,030	4,910	1,080	500	400	780	------
31	1,320	------	1,790	------	4,650	------	450	350	------	------

Monthly discharge of Minnesota River near Mankato, Minn., for the period Oct. 1, 1920, to Oct. 19, 1921.

[Drainage area, 14,600 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
1920.					
October	1,380	1,020	1,130	0.0774	0.09
November	1,580	1,140	1,410	.0966	.11
1921.					
March	1,950	1,200	1,580	.108	.12
April	3,350	1,580	2,560	.175	.20
May	4,910	1,580	2,110	.145	.17
June	4,520	1,080	2,340	.160	.18
July	900	450	655	.0449	.05
August	500	300	389	.0266	.03
September	1,320	250	617	.0423	.05
October 1–19	900	600	736	.0504	.04

ST. CROIX RIVER AT SWISS, WIS.

LOCATION.—In sec. 33, T. 42 N., R. 15 W., at highway bridge near post office of Swiss, Burnett County, 2 miles above point where St. Croix River becomes boundary line between Wisconsin and Minnesota, and 10 miles northeast of Danbury, Wis., on Minneapolis, St. Paul & Sault Ste. Marie Railway. Namakagon River enters from left 3½ miles above station.

DRAINAGE AREA.—1,550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 13, 1914, to September 30, 1921.

GAGE.—Chain gage on downstream side of highway bridge; installed May 16, 1918; read by Capt. Richard Goldschmidt. Prior to May 16, 1918, a cast-iron staff gage bolted to concrete pier at left end of bridge was used. Both gages at same datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; smooth. Growth of aquatic plants during summer may cause a small amount of backwater at gage. Left bank high and not subject to overflow; right bank of medium height and may possibly be overflowed during extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.78 feet at 7.05 a. m. April 8 (discharge, 2,630 second-feet); minimum stage recorded, 0.58 foot at 7.30 a. m. and 6.12 p. m. July 1 (discharge, 690 second-feet).

1914–1921: Maximum stage recorded, 6.73 feet April 22, 1916 (discharge 8,480 second-feet); minimum stage recorded same as for 1921.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice and by growth of aquatic plants. Standard rating curve well defined; was used direct October 1 to April 30, except for periods of ice effect; indirect method for shifting control used May 1 to September 30. Gage read to quarter-tenths twice daily except during winter when it was read every other day. Daily discharge ascertained by applying mean daily gage height to rating table except for periods for which shifting-control method was used, and except for periods of ice effect for which it was ascertained as indicated in footnote to daily-discharge table. Open-water records prior to winter period, good; thereafter, fair; winter records, fair.

Discharge measurements of St. Croix River at Swiss, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	D. W. Roberts	1.51	1,440	Feb. 10	G. F. Rittenberg	[a] 2.14	798
Jan. 8	G. F. Rittenberg	[a] 2.08	967	Aug. 20	A. O. Olson	[b] .86	844

[a] Stage-discharge relation affected by ice.
[b] Stage-discharge relation affected by growth of aquatic plants.

Daily discharge, in second-feet, of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	905	1,210	1,210	890	830	970	1,680	2,430	1,210	700	940	870
2	905	1,290	1,210	910	830	980	1,590	2,230	1,170	750	905	840
3	870	1,290	1,250	940	830	995	1,590	2,130	1,130	780	905	810
4	870	1,330	1,250	945	835	1,010	1,590	2,040	1,050	810	870	780
5	870	1,330	1,250	955	820	1,010	1,680	1,820	1,010	870	840	750
6	870	1,330	1,170	960	800	1,010	1,860	1,720	1,130	940	810	750
7	870	1,290	1,090	960	785	1,010	2,330	1,540	1,540	975	780	725
8	870	1,250	1,010	965	770	1,010	2,630	1,460	1,680	940	780	750
9	840	1,250	1,090	940	760	1,010	2,530	1,370	1,720	905	750	750
10	840	1,170	1,210	900	800	1,010	2,430	1,330	1,640	870	750	750
11	870	975	1,250	860	810	1,010	2,430	1,290	1,540	810	750	750
12	870	810	1,170	820	810	1,010	2,430	1,290	1,460	780	750	725
13	870	750	1,130	785	810	1,010	2,330	1,370	1,330	750	905	750
14	1,130	750	1,090	770	840	1,010	2,230	1,500	1,210	810	975	840
15	1,250	750	940	755	870	1,010	2,040	1,540	1,130	870	940	905
16	1,330	780	940	745	885	1,050	1,950	1,590	1,090	905	870	905
17	1,290	810	935	735	905	1,130	1,820	1,540	1,010	975	870	905
18	1,250	870	920	735	925	1,210	1,680	1,460	940	940	870	870
19	1,290	1,010	910	735	940	1,330	1,590	1,460	905	905	870	870
20	1,330	1,170	900	770	940	1,590	1,590	1,370	870	810	840	975
21	1,410	1,250	890	800	940	1,370	1,500	1,290	840	780	810	1,250
22	1,410	1,500	875	840	940	1,210	1,500	1,250	870	810	810	1,330
23	1,500	1,640	870	875	940	1,170	1,500	1,210	940	840	810	1,250
24	1,460	1,410	870	855	940	1,170	1,460	1,170	905	870	780	1,170
25	1,410	1,330	870	835	940	1,170	1,410	1,130	870	940	750	1,130
26	1,370	1,250	870	810	940	1,250	1,410	1,090	840	940	840	1,090
27	1,330	1,210	870	790	940	1,370	1,590	1,090	780	1,010	905	1,050
28	1,290	1,170	870	810	955	1,500	2,040	1,050	780	1,090	870	1,010
29	1,250	1,170	870	830	-------	1,590	2,330	1,090	750	1,170	870	905
30	1,250	1,170	870	830	-------	1,720	2,430	1,130	725	1,090	905	870
31	1,210	-------	870	830	-------	1,680	-------	1,210	-------	1,010	905	-------

NOTE.—Stage-discharge relation affected by ice Nov. 13–19, and Dec. 16 to Mar. 21; discharge ascertained by means of gage heights, two discharge measurements, observer's notes, and weather records. Gage read every other day during period Dec. 19 to Mar. 20.

Monthly discharge of St. Croix River at Swiss, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 1,550 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,500	840	1,130	0.729	0.84
November	1,640	750	1,150	.742	.83
December	1,250	870	1,020	.658	.76
January	965	735	845	.545	.63
February	955	760	869	.561	.58
March	1,720	970	1,180	.761	.88
April	2,630	1,410	1,910	1.23	1.37
May	2,430	1,050	1,460	.942	1.09
June	1,720	725	1,100	.710	.79
July	1,170	700	892	.575	.66
August	975	750	846	.546	.63
September	1,330	725	911	.588	.66
The year	2,630	700	1,110	.716	9.72

ST. CROIX RIVER NEAR ST. CROIX FALLS, WIS.

LOCATION.—In sec. 18, T. 34 N., R. 18 W., at power plant of Minneapolis General Electric Co., on Wisconsin side of river near St. Croix Falls, Polk County, 50 miles above mouth of river. Apple River, draining an area wholly in Wisconsin, enters from left about 20 miles below station; Snake River, draining an area in Minnesota, enters from right 35 miles above station.

DRAINAGE AREA.—5,930 square miles.

RECORDS AVAILABLE.—January 1, 1910, to September 30, 1921. Data for 1903 published in Water-Supply Paper 98, pages 176–177, under "St. Croix River near Taylors Falls, Minn." Daily and monthly discharge, January 10, 1902, to June 30, 1905, and monthly estimates, July, 1905, to December, 1909, published in the "Report of water-resources investigations of Minnesota, 1909–1912," by the Minnesota State Drainage Commission.

DISCHARGE.—Determinations of discharge based on kilowatt output of dynamo and exciters, plus flow over dam and spillway, considered as a weir.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge recorded during year, 11,500 second-feet April 9; minimum mean daily discharge recorded, 703 second-feet December 19.

1902–1921: Maximum discharge recorded, 35,800 second-feet March 26, 1920; minimum discharge recorded, 75 second-feet July 17, 1910 (caused by regulation).

REGULATION.—Low-water flow controlled by operation of gates of power plant and by storage and release of water at Never's dam several miles upstream.

ACCURACY.—Records probably reliable but have not been checked, nor have discharge measurements been made by engineers of the United States Geological Survey.

COOPERATION.—Records of daily discharge furnished by Minneapolis General Electric Co.

Daily discharge, in second-feet, of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,120	3,330	3,670	1,020	2,290	2,320	5,210	6,250	3,510	1,660	2,100	2,170
2	2,730	3,480	3,610	1,630	2,350	2,400	5,370	5,540	4,360	1,530	1,440	1,590
3	2,320	3,900	3,480	2,480	2,180	2,020	4,530	5,800	4,400	1,420	1,940	1,800
4	2,210	3,990	2,780	2,600	1,830	2,320	4,140	5,240	4,390	1,710	1,860	1,660
5	1,830	3,730	2,270	2,360	1,190	2,880	4,860	5,830	2,830	1,510	1,740	1,520
6	2,070	3,720	3,480	2,390	2,070	1,220	6,510	4,560	3,590	2,140	1,880	2,000
7	1,850	3,340	3,580	2,320	1,850	2,050	7,610	4,380	4,310	2,340	1,170	2,440
8	1,740	3,580	3,000	2,580	2,160	2,370	10,400	2,960	4,260	1,990	1,820	1,630
9	2,080	4,190	2,130	1,100	2,240	2,520	11,500	4,710	5,440	2,150	2,280	1,610
10	2,760	3,940	3,210	2,440	2,080	2,510	11,400	4,390	8,410	1,590	1,720	1,530
11	2,240	2,980	3,010	2,100	1,930	2,420	8,660	4,450	7,950	1,980	1,300	1,400
12	2,050	2,880	1,150	1,760	1,350	2,120	8,870	4,520	4,370	1,640	1,680	2,040
13	2,090	2,250	2,690	2,180	1,290	1,610	8,030	4,250	4,890	1,990	1,540	1,880
14	2,200	878	3,280	2,170	1,940	2,560	8,520	2,160	4,490	2,720	1,540	1,820
15	2,640	2,420	2,580	1,360	2,210	2,520	8,430	2,220	4,500	1,550	1,940	1,860
16	3,800	2,400	2,690	1,260	2,340	2,480	7,350	3,500	4,510	1,790	1,940	2,440
17	1,500	2,500	2,260	2,340	2,140	2,520	6,660	4,410	4,380	1,580	1,800	1,860
18	3,160	2,770	1,730	2,060	2,290	2,740	5,860	3,940	4,100	1,980	1,730	1,240
19	4,200	3,280	703	2,100	1,730	3,370	4,320	3,950	2,030	2,000	1,770	2,410
20	4,120	2,740	1,760	1,470	1,410	2,470	4,460	4,020	3,400	2,060	1,440	2,700
21	4,630	2,700	1,770	1,870	2,630	3,260	4,370	3,070	2,840	1,800	1,220	2,840
22	4,900	3,460	1,980	1,620	2,050	3,030	4,480	2,280	2,350	1,740	2,010	2,770
23	4,840	3,140	1,730	1,340	1,720	3,560	4,480	3,530	2,250	1,680	2,130	2,950
24	4,090	2,460	1,470	1,680	2,150	3,600	5,000	4,370	2,050	1,640	1,520	2,860
25	3,800	3,490	1,030	2,390	2,230	3,490	5,320	4,080	2,420	1,840	1,720	1,880
26	4,680	3,620	1,090	2,590	1,610	3,040	5,460	3,510	1,600	1,810	2,200	2,620
27	4,820	3,470	2,050	2,090	1,470	2,560	4,500	3,500	1,890	1,890	1,460	2,700
28	3,680	2,360	2,050	2,150	2,380	3,530	4,500	3,390	2,260	1,680	1,700	2,630
29	3,510	3,580	3,030	1,560	-------	4,200	5,700	1,940	1,690	1,820	1,680	2,320
30	3,560	3,710	2,920	839	-------	4,690	6,320	1,640	1,780	1,620	1,890	2,680
31	2,040	-------	2,330	2,170	-------	4,830	-------	2,960	-------	1,710	1,180	-------

Monthly discharge of St. Croix River near St. Croix Falls, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 5,930 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,900	1,500	3,040	0.513	0.59
November	4,190	878	3,140	.530	.59
December	3,670	703	2,400	.405	.47
January	2,600	839	1,940	.327	.38
February	2,630	1,190	1,970	.332	.35
March	4,830	1,220	2,810	.474	.55
April	11,500	4,140	6,430	1.08	1.20
May	6,250	1,640	3,910	.659	.76
June	8,410	1,600	3,710	.626	.70
July	2,720	1,420	1,820	.307	.35
August	2,280	1,170	1,720	.290	.33
September	2,950	1,240	2,130	.359	.40
The year	11,500	703	2,920	.492	6.67

NOTE.—Computed by U. S. Geol. Survey from records of daily discharge furnished by Minneapolis General Electric Co.

NAMAKAGON RIVER AT TREGO, WIS.

LOCATION.—In sec. 35, T. 40 N., R. 12 W., at Chicago, St. Paul, Minneapolis & Omaha Railway bridge at Trego, Washburn County, 20 miles above confluence of Namakagon and Totogatic rivers.

DRAINAGE AREA.—420 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—March 11, 1914, to September 30, 1921.

GAGE.—Enameled staff fastened to retaining wall, left bank of river, just above railroad bridge; read by G. E. Krenz and Patrick Lawton.

DISCHARGE MEASUREMENTS.—Made from lower chords of railroad bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; free from vegetation; practically permanent. Banks medium high and not subject to overflow. Small island downstream with rapids on either side forms the control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.30 feet at 11 a. m. April 10 (discharge, 803 second-feet); minimum discharge, estimated 250 second-feet January 11 and 12 (stage-discharge relation affected by ice).

1914–1921: Maximum stage recorded, 3.25 feet June 30, 1920 (discharge, 1,490 second-feet); minimum discharge, estimated 235 second-feet December 19, 1916 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 330 and 1,330 second-feet. Gage read to quarter-tenths once daily, except during winter when it was read every other day. Daily discharge ascertained by applying daily gage height to rating table except for periods of ice effect, for which it was ascertained as indicated in footnote to daily-discharge table. Open-water records excellent; winter records fair.

Discharge measurements of Namakagon River at Trego, Wis., during the year ending September 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 20	D. W. Roberts	1.77	462	Feb. 9	G. F. Rittenberg	[a] 2.38	322
Jan. 7	G. F. Rittenberg	[a] 2.55	262	Aug. 19	A. O. Olson	1.63	377

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Namakagon River at Trego, Wis., for the year ending September 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	393	444	417	280	305	290	564	768	444	320	393	369
2	393	472	417	285	305	290	532	733	417	320	393	369
3	332	472	417	280	305	290	532	698	417	320	417	369
4	332	472	417	280	310	280	532	664	417	332	393	350
5	369	444	444	270	310	270	564	597	417	332	369	350
6	369	444	444	265	310	280	597	564	393	350	369	350
7	393	444	444	260	310	290	630	532	502	369	369	332
8	393	444	444	255	315	290	630	532	532	369	350	332
9	332	444	444	255	320	300	630	502	502	369	350	369
10	369	444	417	255	330	310	803	502	502	350	350	369
11	369	417	417	250	345	310	768	502	472	350	369	350
12	350	393	393	250	350	320	733	502	472	332	350	332
13	350	385	393	260	360	330	698	502	444	332	417	332
14	393	370	393	265	385	350	664	532	417	417	417	417
15	417	370	332	265	410	369	630	532	393	417	393	417
16	472	380	330	265	415	369	597	502	369	417	369	393
17	472	390	330	270	415	369	597	502	369	417	369	417
18	472	415	320	275	395	417	564	472	369	393	417	417
19	472	445	310	280	370	444	564	502	350	369	393	393
20	472	445	310	285	330	472	532	472	350	350	369	393
21	532	444	310	290	290	472	532	472	332	332	369	597
22	532	444	310	295	290	444	532	472	350	350	350	564
23	532	444	310	290	290	444	532	444	350	369	350	532
24	502	444	305	285	280	444	502	444	332	350	350	532
25	472	417	300	280	270	444	502	417	350	350	332	502
26	472	417	295	280	260	472	502	417	332	350	350	444
27	472	417	290	280	255	630	597	417	332	472	369	444
28	472	417	285	285	270	698	698	417	332	532	369	417
29	444	417	280	290	-------	630	803	417	332	472	369	417
30	444	444	280	295	-------	597	803	417	332	444	369	417
31	444	-------	280	300	-------	597	-------	444	-------	417	369	-------

NOTE.—Stage-discharge relation affected by ice Nov. 13–20 and Dec. 16 to Mar. 14; discharge ascertained by means of gage heights, two discharge measurements, observer's notes, and weather records. Gage read every other day during period Dec. 24 to Mar. 12.

Monthly discharge of Namakagon River at Trego, Wis., for the year ending September 30, 1921.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	532	332	427	1.02	1.18
November	472	370	428	1.02	1.14
December	444	280	357	.850	.98
January	300	250	275	.655	.76
February	415	255	325	.774	.81
March	698	270	404	.962	1.11
April	803	502	612	1.46	1.63
May	768	417	513	1.22	1.41
June	532	332	397	.945	1.05
July	532	320	376	.895	1.03
August	417	332	373	.888	1.02
September	597	332	410	.976	1.09
The year	803	250	408	.971	13.21

APPLE RIVER NEAR SOMERSET, WIS.

LOCATION.—In sec. 21, T. 31 N., R. 19 W., at power plant of St. Croix Power Co., 2 miles above mouth of river and 3½ miles below Somerset, St. Croix County.

DRAINAGE AREA.—550 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—January, 1901, to September 30, 1921.

GAGE.—Vertical staff gage; readings not used in determination of flow.

DISCHARGE.—The discharge of the turbines in second-feet corresponding to the number of kilowatts is determined for each hour during day from a record of the number of wheels in operation and the load; the sum of these figures divided by 24 gives the average discharge through the turbines. To this quantity is added the leakage through the average number of wheels idle each day, the sum giving daily flow through power house. Water is seldom wasted over spillway of the dam, but when it is the quantity is computed from weir formulas and added to the flow through plant. There is a constant leakage through the gate and flashboards amounting to 3 second-feet. This quantity has not been taken into consideration in computing the records.

EXTREMES OF DISCHARGE.—Maximum daily discharge recorded during year, 671 second-feet March 29; minimum daily discharge recorded, 20 second-feet June 26.

1904–1921: Maximum daily discharge recorded, 2,280 second-feet in June, 1905; minimum daily discharge, 20 second-feet June 26, 1921. Owing to regulation minimum discharge has no bearing on natural minimum flow. No record of maximum and minimum stages are available for the period 1901 to 1903.

REGULATION.—There are a number of power plants above the station, but their pondage is small, and though the daily flow may be controlled to some extent, the mean monthly flow probably corresponds closely to the natural flow.

ACCURACY.—From 1901 to 1909 discharge through the plant was determined from tables computed from data collected and tests made on one of the turbines at flume of Holyoke Water Power Co., Holyoke, Mass. In the summer of 1909 engineers of St. Croix Power Co. made tests on the water flowing through all wheels as actually installed, by means of a sharp-crested weir 710 inches long located about 60 feet below power house. These tests gave results about 3 per cent larger than the Holyoke tests, and tables based on them have been used in determining discharge through plant from 1909 to September, 1920. In May, 1914, a series of current-meter measurements were made by the Wisconsin Railroad Commission and United States Geological Survey, and a rating curve for the tailrace was developed. Twelve tests were then run with different wheels and loads. It was found that discharge as determined by the current meter and discharge as computed by the company agreed very closely, the percentage difference for the twelve tests ranging from −6.4 per cent to +1.8 per cent, with an average of −2.0 per cent, the discharge as determined by the company being 2 per cent less than as determined by current meter. During 1919 three current-meter measurements were made to check the accuracy, under present conditions, of the data obtained in May, 1914. These measurements showed that power-plant records were about 5 per cent less than the measured discharge, due probably to increased leakage through the wheels. The records as published for 1919 and 1920 are the power-plant records increased by 5 per cent.

In September, 1920, another series of tests was made by the company by means of a sharp-crested weir, from which the tables used in computing flow through the power house were corrected. The records below are published as furnished by the company, without correction.

COOPERATION.—Records furnished by St. Paul Gas Light Co., of St. Paul, Minn., D. W. Flowers, engineer.

No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of Apple River near Somerset, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	309	279	260	185	250	355	306	441	310	193	235	167
2	298	294	261	254	263	329	418	515	275	168	131	211
3	217	323	269	246	227	287	287	439	255	110	154	270
4	228	305	354	253	256	308	404	539	344	114	156	233
5	226	274	210	295	280	295	308	414	117	155	160	170
6	249	292	278	310	198	239	432	398	261	182	170	227
7	236	256	281	286	227	281	512	391	352	162	180	158
8	229	256	241	278	229	307	427	311	314	202	160	169
9	297	321	257	176	267	282	542	392	250	258	160	187
10	216	280	273	277	242	278	445	322	327	125	137	200
11	230	263	347	212	257	272	443	383	429	179	214	199
12	243	219	204	193	277	293	405	340	263	153	167	202
13	232	332	308	270	268	283	376	340	273	179	178	235
14	275	213	224	252	248	271	498	356	279	194	130	205
15	289	232	224	281	276	290	336	292	238	216	143	291
16	361	259	189	188	320	354	484	341	227	226	127	229
17	373	273	197	209	243	292	270	343	271	144	151	293
18	318	275	225	215	290	293	275	371	335	157	177	225
19	320	251	174	194	305	350	353	355	179	146	197	299
20	349	330	256	246	224	443	320	380	210	145	194	404
21	434	206	256	295	281	459	338	402	224	154	155	429
22	407	253	233	344	277	437	329	249	225	184	175	358
23	344	295	267	256	291	343	425	303	222	147	186	353
24	297	329	238	257	300	366	274	326	492	157	129	474
25	316	199	219	253	262	405	327	331	60	160	227	312
26	294	287	218	251	321	400	336	253	20	167	221	315
27	343	352	232	269	243	589	342	290	223	235	324	309
28	247	205	217	257	305	664	467	377	213	183	96	239
29	286	297	250	302	-------	671	422	218	229	167	200	255
30	365	287	255	210	-------	394	441	232	196	170	229	281
31	200	-------	306	230	-------	573	-------	274	-------	161	235	-------

NOTE.—See note under "Discharge" in station description for method by which these records were obtained.

Monthly discharge of Apple River near Somerset, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off, in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	434	200	291	0.529	0.61
November	352	199	275	.500	.56
December	354	174	249	.453	.52
January	344	138	248	.451	.52
February	321	198	265	.482	.50
March	671	239	368	.669	.77
April	542	270	388	.705	.79
May	539	218	352	.640	.74
June	492	20	254	.462	.52
July	258	110	171	.311	.36
August	324	96	177	.322	.37
September	474	158	263	.478	.53
The year	671	20	275	.500	6.79

KINNIKINNIC RIVER NEAR RIVER FALLS, WIS.

LOCATION.—In sec. 18, T. 27 N., R. 19 W., at Clifton Hollow Bridge, a quarter of a mile downstream from abandoned plant of Clifton Falls Power Co., 2 miles above mouth of river, and 7 miles downstream from River Falls, Pierce County.

DRAINAGE AREA.—170 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—October 23, 1916, to September 30, 1921, when station was discontinued.

GAGE.—Gurley water-stage recorder with a wooden well and shelter attached to downstream side of right-hand cushing bridge pier; inspected by Fred Lindenberger.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rather heavy gravel and sand. Control is head of small rapids 150 feet below the gage; not permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.7 feet at 8 a. m. June 14 (discharge, about 410 second-feet); minimum discharge about 28 second-feet at 6 a. m. August 16.

1917–1921: Maximum stage recorded, 7.0 feet March 12, 1919 (discharge, about 3,560 second-feet); minimum stage, 1.62 feet at 5 a. m. August 30, 1920 (discharge, 11 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Daily flow is regulated by three dams in River Falls about 7 miles above station, the lower two of which are operated by the city of River Falls for municipal light and power purposes. The storage at these dams is relatively small and monthly flow is considered to be nearly the normal flow. The plant and dam of Clifton Falls Power Co., a quarter of a mile above station, are no longer operated.

ACCURACY.—Stage-discharge relation changed considerably by deposition on control of silt washed out from behind abandoned dam of Clifton Falls Power Co.; affected by ice December 15 to March 15. Standard rating curve poorly defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by means of the discharge integrator, which was operated on basis of the shifting-control method, except for period of ice effect and certain other periods, as noted in footnote to table of daily discharge. Records subject to considerable error owing to uncertainty in date and nature of shift in control.

Discharge measurements of Kinnikinnic River near River Falls, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 11 [a]	G. F. Rittenberg		63	Sept. 30	A. O. Olson	4.42	50
Apr. 15	S. B. Soulé	4.51	61				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	96	-------	76	71	90	56	56	64
2	85	-------	86	90	66	53	56	77
3	75	-------	86	80	73	42	55	74
4	70	-------	86	76	71	45	54	55
5	68	-------	82	75	62	53	52	70
6	82	-------	80	76	85	75	51	73
7	80	-------	103	82	165	46	50	65
8	86	-------	86	73	142	52	62	74
9	78	-------	84	87	76	50	64	78
10	90	-------	82	89	120	46	57	73
11	74	-------	80	82	73	64	57	60
12	74	-------	78	80	55	51	58	72
13	76	-------	84	87	66	62	55	78
14	85	-------	82	75	116	58	52	73
15	82	-------	85	64	76	55	53	56
16	76	78	80	90	76	58	70	70
17	90	65	80	93	55	60	66	66
18	90	67	92	82	60	73	70	53
19	103	66	80	80	48	55	51	52
20	100	130	84	83	68	55	53	60
21	92	132	90	84	64	53	50	42
22	101	120	92	84	62	52	62	61
23	75	83	92	85	62	48	55	64
24	79	71	65	80	58	43	51	53
25	82	71	73	72	53	62	55	62
26	80	82	82	69	48	67	107	67
27	76	85	70	66	60	63	90	64
28	73	88	70	63	61	58	62	63
29	83	80	73	60	58	66	70	60
30	70	90	84	76	60	53	60	60
31	73	66	-------	152	-------	40	62	-------

NOTE.—Water-stage recorder not operating satisfactorily Nov. 11–17; stage-discharge relation affected by ice and recorder not operating Dec. 15 to Mar. 15; discharge for the period Nov. 1 to Mar. 15 estimated as follows, by means of one discharge measurement, weather records, and comparison with flow of Apple River near Somerset: Nov. 1–30, 85 second-feet; Dec. 1–31, 75 second-feet; Jan. 1–31, 70 second-feet; Feb. 1–28, 75 second-feet; and Mar. 1–15, 90 second-feet. Recorder not operating satisfactorily Apr. 9–11, May 21, 26–28, June 25, July 23, 30, Aug. 3–6 and 13; discharge interpolated.

Monthly discharge of Kinnikinnic River near River Falls, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 170 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	103	68	82.1	0.483	0.56
November	-------	-------	85.0	.500	.56
December	-------	-------	75.0	.441	.51
January	-------	-------	70.0	.412	.48
February	-------	-------	75.0	.441	.46
March	132	65	87.9	.517	.60
April	103	65	82.2	.484	.54
May	152	60	80.8	.475	.55
June	165	48	74.3	.437	.49
July	75	40	55.3	.325	.37
August	107	50	60.2	.354	.41
September	78	42	64.6	.380	.42
The year	165	40	74.3	.437	5.95

NOTE.—See footnote to table of daily discharge.

CHIPPEWA RIVER AT BISHOP'S BRIDGE, NEAR WINTER, WIS.

LOCATION.—In sec. 23, T. 39 N., R. 6. W., at highway bridge 3 miles downstream from East Fork of Chippewa River, which enters from left, and 4 miles by road northwest of Winter, Sawyer County.

DRAINAGE AREA.—775 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 23, 1912, to September 30, 1921.

GAGE.—Chain gage fastened to bridge; used since May 23, 1916; read by John Edberg. Gages previously used as follows: February 23, 1912, to January 27, 1914, a wooden staff gage fastened to a wooden pier on right bank just above bridge; datum 3.44 feet above that of chain gage. January 27, 1914, to May 28, 1916, a vertical cast-iron staff gage fastened to same pier; at same datum as chain gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; free from vegetation; seldom shifts. Control is head of rapids about 1,000 feet below gage. One channel at all stages. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.16 feet at 4 p. m. April 30 (discharge, 2,980 second-feet); minimum stage recorded, 4.35 feet at 9 a. m. August 9 and at 4 p. m. August 12 (discharge, 287 second-feet).

1912–1921: Maximum stage recorded, 9.56 feet April 22, 1916 (discharge, 6,940 second-feet); minimum discharge, estimated 175 second-feet February 17, 1917 (stage-discharge relation affected by ice).

REGULATION.—Flow regulated to some extent by operation of storage reservoir on West Fork of Chippewa River in sec. 14, T. 41 N., R. 6 W., about 16 miles above station. This reservoir has a capacity of 550 million cubic feet and is used in connection with reservoirs on Upper Flambeau River for the purpose of regulating the flow of Chippewa River.

ACCURACY.—Stage-discharge relation practically permanent except as seriously affected by ice November 12–18, December 7, 8, and December 16 to March 25. Rating curve well defined between 270 and 6,800 second-feet. Gage read to hundredths twice daily except as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying mean daily gage height to rating table except for periods of ice effect, for which it was ascertained by means of gage heights, three discharge measurements, observer's notes, and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Chippewa River at Bishop's Bridge, near Winter, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 19	D. W. Roberts	4.81	492	Feb. 8	G. F. Rittenberg	[a] 5.57	248
Jan. 6	G. F. Rittenberg	[a] 5.66	325	Mar. 9	do	[a] 5.65	276

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	340	505	380	270	285	280	1,800	2,840	1,050	455	405	380
2	340	530	380	270	280	285	1,740	2,840	915	430	405	360
3	340	530	405	285	280	295	1,680	2,700	750	380	480	360
4	322	530	405	305	280	305	1,740	2,570	640	322	480	340
5	322	530	430	320	275	295	1,740	2,180	610	304	405	340
6	322	530	405	325	275	285	1,920	1,740	555	380	360	322
7	322	530	380	310	275	290	1,860	1,400	640	505	322	304
8	322	530	380	295	250	295	1,740	1,350	1,250	580	304	304
9	322	530	380	285	225	270	2,310	1,250	1,150	610	287	322
10	322	530	380	275	230	305	2,570	1,100	960	640	304	322
11	322	480	360	260	230	340	2,570	915	870	675	304	304
12	340	430	405	250	400	360	2,570	830	1,050	750	287	304
13	322	380	360	260	520	380	2,310	830	960	870	340	322
14	380	380	405	265	465	430	2,050	790	710	1,000	322	380
15	405	380	380	270	310	530	1,620	640	580	960	322	405
16	430	380	360	270	290	640	1,150	580	530	870	340	405
17	430	380	340	255	280	790	960	580	530	790	360	430
18	480	380	340	240	270	960	870	610	430	710	405	430
19	505	405	320	245	260	1,150	830	640	405	640	405	430
20	530	405	320	250	255	1,350	1,050	640	430	610	380	430
21	555	405	305	250	260	1,570	1,000	610	750	555	360	505
22	555	430	305	250	260	1,680	750	580	710	480	360	530
23	580	455	305	250	240	1,250	830	580	505	430	480	530
24	580	455	305	255	215	960	830	580	430	405	505	505
25	580	455	285	270	230	710	750	640	505	380	405	505
26	555	430	285	285	240	675	1,100	610	555	405	405	505
27	555	405	270	285	255	1,200	1,520	505	610	555	430	480
28	555	380	270	285	270	1,400	2,440	455	555	555	430	455
29	530	380	270	280	-------	1,570	2,840	430	530	505	430	405
30	530	380	270	280	-------	1,860	2,980	480	505	455	430	380
31	530	-------	270	280	-------	1,800	-------	610	-------	430	405	-------

NOTE.—Gage read only every other day Jan. 7 to Feb. 10 and Feb. 17 to Mar. 17.

Monthly discharge of Chippewa River at Bishop's Bridge, near Winter, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 775 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	580	322	436	0.563	0.65
November	530	380	448	.578	.64
December	430	270	344	.444	.51
January	325	240	273	.352	.41
February	520	215	282	.364	.38
March	1,860	270	791	1.02	1.18
April	2,980	750	1,670	2.15	2.40
May	2,840	430	1,070	1.38	1.59
June	1,250	405	689	.889	.99
July	1,000	304	569	.734	.85
August	505	287	382	.493	.57
September	530	304	400	.516	.58
The year	2,980	215	613	.791	10.75

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CHIPPEWA RIVER NEAR BRUCE, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 7 W., at Minneapolis, St. Paul & Sault Ste. Marie Railway bridge 1 mile east of Bruce, Rusk County. Thornapple River enters from left just above station, and Flambeau River from left about 21 miles below.

DRAINAGE AREA.—1,600 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch= 6 miles.

RECORDS AVAILABLE.—December 31, 1913, to September 30, 1921.

GAGE.—Chain gage attached to downstream side of Minneapolis, St. Paul & Sault Ste. Marie Railway bridge; read by H. C. Gardner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and small gravel; free from vegetation; first and second channels from west fairly permanent; third channel nearest east bank has a tendency to fill during low stages with sand worked in by Thornapple River. Flow, except during extreme high stages, is confined within the banks.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.12 feet at 1.45 p. m. April 29 (discharge, 8,550 second-feet); minimum discharge, estimated 360 second-feet January 16 (stage-discharge relation affected by ice).

1914–1921: Maximum stage recorded, 12.5 feet at 6 p. m. March 27, 1920 (discharge, 13,800 second-feet); minimum stage, 1.15 feet, morning and afternoon reading, August 21, 1918 (discharge, about 260 second-feet); caused by regulation.

REGULATION.—Flow regulated to some extent by reservoir on West Fork of Chippewa River, in sec. 14, T. 41 N., R. 6 W. Reservoir has a capacity of 550 million cubic feet, and is used in connection with reservoirs on upper Flambeau River, for purpose of regulating the flow of Chippewa River. No diurnal fluctuation is observed.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice November 11–19 and December 6 to March 24. Rating curve well defined between 450 and 7,000 second-feet; fairly well defined between 7,000 and 15,000 second-feet. Gage read to quarter-tenths once daily except during period November 14 to March 26, when it was read every other day. Daily discharge ascertained by applying daily gage height to rating table, except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily gage height corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records, and by interpolating for days when gage was not read. Records fair.

Discharge measurements of Chippewa River near Bruce, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	D. W. Roberts	1.88	731	May 3	S. R. Collins	5.78	4,510
Jan. 3[a]	G. F. Rittenberg	2.76	631	Aug. 14	A. O. Olson	1.57	519
Feb. 6[a]	do	2.78	508				

[a] Complete ice cover.

Daily discharge, in second-feet, of Chippewa River near Bruce, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	535	840	925	570	415	460	3,520	5,860	1,370	680	680	605
2	535	840	860	535	440	450	3,320	4,660	1,560	680	570	570
3	535	840	800	620	460	445	3,120	4,350	1,280	642	605	535
4	535	882	780	550	460	445	3,120	4,040	1,190	605	642	535
5	502	882	760	560	460	440	3,120	3,620	1,100	470	605	535
6	502	882	775	565	500	455	3,220	3,220	968	470	570	535
7	502	882	745	545	450	470	3,620	2,620	1,100	680	535	502
8	502	840	705	530	450	480	3,620	2,320	1,460	800	470	502
9	470	840	650	510	450	495	3,820	2,040	1,750	968	440	502
10	470	882	605	485	450	505	3,930	1,840	2,520	968	440	570
11	535	866	605	450	445	520	4,040	1,750	2,130	840	470	570
12	502	840	640	420	440	540	3,930	1,560	1,750	882	470	535
13	502	840	720	410	430	565	3,720	1,460	1,560	925	470	535
14	535	840	800	395	425	580	3,420	1,460	1,370	1,060	535	605
15	570	840	840	375	420	590	3,120	1,460	1,140	1,280	680	642
16	760	882	840	360	425	760	3,020	1,280	840	1,370	570	760
17	800	968	815	370	430	925	2,220	1,190	840	1,190	535	760
18	800	1,060	790	380	430	1,190	1,840	1,190	800	1,140	502	840
19	840	1,190	775	385	430	1,370	1,840	1,280	800	1,060	502	882
20	840	1,190	760	395	420	2,040	1,840	1,370	800	840	535	1,560
21	925	1,190	745	390	410	2,720	1,940	1,370	800	760	535	2,420
22	1,100	1,190	730	390	410	2,820	1,750	1,370	760	760	535	2,720
23	1,140	1,190	710	405	410	2,920	1,660	1,140	760	720	535	2,320
24	1,100	1,240	695	420	410	3,020	1,370	1,060	720	605	605	1,840
25	1,060	1,280	680	420	405	3,220	1,370	1,060	680	605	642	1,560
26	1,010	1,190	665	420	420	4,770	2,920	1,010	680	605	605	1,190
27	968	1,100	650	410	435	6,320	4,040	1,100	760	800	605	1,060
28	1,010	1,100	635	400	445	5,200	7,820	1,100	760	1,100	605	1,010
29	925	1,100	630	400	------	4,980	8,520	925	760	925	605	840
30	840	1,010	620	400	------	4,560	7,280	968	760	840	605	840
31	840	------	605	405	------	3,930	------	1,140	------	720	605	------

NOTE.—Stage-discharge relation not affected by ice, but gage was not read and discharge was interpolated, Nov. 20, 22, 24, 26, 28, 30, Dec. 2, 4, and Mar. 26. During periods of ice effect also the gage was read only every other day; discharge ascertained as indicated under "Accuracy."

Monthly discharge of Chippewa River near Bruce, Wis., for the year ending Sept. Sept. 30, 1921.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,140	470	732	0.458	0.53
November	1,280	840	991	.619	.69
December	925	605	728	.455	.52
January	620	360	447	.279	.32
February	500	405	435	.272	.28
March	6,320	440	1,880	1.18	1.36
April	8,520	1,370	3,400	2.12	2.36
May	5,860	925	1,960	1.22	1.41
June	2,520	680	1,130	.706	.79
July	1,370	470	838	.524	.60
August	680	440	558	.349	.40
September	2,720	502	963	.602	.67
The year	8,520	360	1,170	.731	9.93

CHIPPEWA RIVER AT CHIPPEWA FALLS, WIS.

LOCATION.—In SE. ¼ sec. 6, T. 28 N., R. 8 W., at highway bridge at Chippewa Falls, Chippewa County, 2,500 feet below mouth of Duncan Creek, which enters from right.

DRAINAGE AREA.—5,600 square miles.

RECORDS AVAILABLE.—June 22, 1888, to September 30, 1921. The station was originally established by Chippewa Lumber & Boom Co., which has kept a continuous record since 1889. Since 1904 United States Weather Bureau has obtained gage readings during flood season of each year. On June 1, 1906, United States Geological Survey began making measurements and obtaining gage readings.

GAGE.—On July 27, 1916, Gurley water-stage recorder was installed in place of a Friez water-stage recorder which had been in operation since January, 1914, on web between caisson piers supporting first right-hand span, about 10 feet upstream from gage formerly used by United States Weather Bureau; gage referred to original datum; inspected by F. N. Leslie.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel; fairly permanent. Banks high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.41 feet at about 11 a. m. April 29 (discharge, 33,600 second-feet); minimum stage, −0.58 foot at 8 a. m. July 5 (discharge, 236 second-feet); minimum discharge caused by regulation and does not represent natural flow.

1888–1921: Maximum stage recorded, 26.03 feet December 6, 1896 (discharge not determined on account of effect of ice jam); maximum open-water stage recorded, 17.0 feet at about 1 p. m. March 27, 1920 (discharge, 78,000 second-feet); minimum discharge recorded, about 40 second-feet February 4, 1917 (caused by regulation at Wissota dam).

A stage of 26.94 feet was reached September 10, 1884; discharge not determined.

ICE.—Stage-discharge relation seriously affected by ice at times.

REGULATION.—Flow past station controlled to considerable extent by operation of gates at the Wissota power plant of Wisconsin, Minnesota Light & Power Co., a short distance above gage. Large diurnal fluctuation.

ACCURACY.—Stage-discharge relation practically permanent except during period December 18 to March 23, when temporary backwater of uncertain nature, but probably caused by ice, was present, as evidenced by three discharge measurements; subsequent measurements indicate a slight change in control following this period. Rating curve used prior to December 18 well defined above 530 second-feet; indirect method for shifting control used December 18 to March 23; curve used after March 23 well defined above 2,000 second-feet and fairly well defined below that point. Operation of water-stage recorder satisfactory except as indicated in footnote to table of daily discharge. Daily discharge ascertained by means of the discharge integrator except for periods during which recorder did not operate for which it was ascertained as indicated in footnote to table of daily discharge. Records good to fair.

Discharge measurements of Chippewa River at Chippewa Falls, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5[a]	S. B. Soulé	0.48	1,310	Apr. 13	S. B. Soulé	4.98	13,700
Feb. 4[a]	G. F. Rittenberg	1.10	2,250	Aug. 12	A. O. Olson	.62	1,595
Mar. 4[a]	do	1.57	3,310				

[a] Stage-discharge relation probably affected by ice.

Daily discharge, in second-feet, of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,840	2,100	2,320	950	1,980	2,410	13,000	24,000	7,820	1,580	2,090	2,040
2	2,010	2,020	2,300	820	2,140	2,440	10,900	20,100	9,780	2,050	2,240	2,200
3	1,510	2,100	2,250	1,860	2,160	2,430	10,000	16,400	7,870	1,050	2,340	1,860
4	1,970	2,180	2,070	2,130	2,080	2,430	11,300	12,600	5,620	870	2,120	960
5	2,250	2,260	1,500	2,030	1,870	2,250	9,790	10,600	3,700	1,500	1,960	860
6	2,260	1,940	1,940	2,070	1,040	1,230	10,400	7,390	5,610	2,580	2,140	2,180
7	2,160	1,670	2,050	2,150	1,660	2,240	12,700	9,080	4,370	3,320	1,580	2,260
8	2,250	1,700	2,150	2,020	1,840	2,460	13,100	6,250	5,350	1,880	1,950	2,190
9	2,000	1,820	2,220	1,330	1,980	2,460	12,800	7,690	13,300	2,030	1,800	2,080
10	1,640	1,940	1,980	1,840	1,980	1,380	13,400	5,510	11,300	2,600	1,400	2,020
11	2,000	1,730	2,060	2,140	1,960	1,200	14,600	5,390	9,740	2,260	1,390	1,140
12	2,120	1,870	1,700	2,400	1,930	1,220	12,500	5,220	6,120	3,550	1,420	2,290
13	1,950	1,510	2,020	2,300	952	1,190	11,400	5,770	6,530	3,990	1,500	2,160
14	1,910	1,060	1,870	2,140	1,750	4,200	10,700	4,000	4,300	3,460	1,040	2,140
15	1,940	1,560	1,880	1,980	1,970	4,180	9,690	1,980	4,300	2,740	1,200	2,040
16	1,830	1,970	2,080	1,210	2,080	4,440	9,690	4,640	3,700	3,480	1,360	2,040
17	1,670	2,120	2,410	2,040	2,170	4,250	7,660	4,520	3,350	2,870	1,720	1,920
18	1,700	2,300	2,200	2,090	2,040	4,300	9,940	4,750	3,880	4,320	1,730	1,080
19	1,860	2,010	1,790	1,990	2,020	4,880	5,860	4,290	2,400	4,580	1,270	2,150
20	1,920	1,920	2,360	1,970	870	1,730	5,280	4,250	3,000	3,220	2,800	2,180
21	1,860	1,200	2,380	2,300	2,240	4,600	7,100	4,920	2,620	3,100	925	2,390
22	2,010	1,400	2,400	2,120	2,320	5,480	6,350	2,220	2,680	3,140	2,340	1,880
23	1,880	2,020	2,270	1,150	2,350	5,910	5,800	4,180	1,860	2,300	3,100	3,400
24	1,140	2,080	1,860	2,410	2,280	13,400	5,610	4,690	1,360	1,700	3,290	3,700
25	1,970	1,450	1,230	2,560	2,640	12,500	7,010	4,280	1,080	1,820	2,880	2,870
26	2,450	2,040	1,120	2,420	2,920	11,500	5,280	3,560	1,020	2,090	2,880	4,700
27	2,440	1,760	1,420	2,250	1,610	14,300	8,310	3,590	1,500	1,870	3,730	4,340
28	2,400	1,280	2,000	2,080	2,330	23,400	19,200	4,600	1,520	2,700	2,460	2,760
29	2,250	2,140	1,830	1,720	-------	24,100	30,100	2,900	1,500	4,750	2,780	2,130
30	2,050	2,330	1,650	1,040	-------	22,000	29,500	10,100	1,550	4,500	3,000	2,900
31	1,980	-------	1,350	2,520	-------	15,400	-------	8,680	-------	2,280	2,940	-------

NOTE.—Water-stage recorder not in perfect operation Oct. 1 and 2, Nov. 13–17, Dec. 22–24, June 29 to July 1, July 8–11, 29 and 30; discharge estimated.

Monthly discharge of Chippewa River at Chippewa Falls, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 5,600 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,450	1,140	1,970	0.352	0.41
November	2,330	1,060	1,850	.330	.37
December	2,410	1,120	1,960	.350	.40
January	2,560	820	1,940	.346	.40
February	2,920	870	1,970	.352	.37
March	24,100	1,190	6,640	1.19	1.37
April	30,100	5,280	11,300	2.02	2.25
May	24,000	1,980	7,040	1.26	1.45
June	13,300	1,020	4,620	.825	.92
July	4,750	870	2,720	.486	.56
August	3,730	925	2,110	.377	.43
September	4,700	860	2,300	.411	.46
The year	30,100	820	3,870	.691	9.39

FLAMBEAU RIVER NEAR BUTTERNUT, WIS.

LOCATION.—In NW. ¼ SE. ¼ sec. 33, T. 41 N., R. 1 E., 6 miles southeast of Butternut, Ashland County, and 7 miles upstream from Park Falls.

DRAINAGE AREA.—660 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—July 30, 1914, to September 30, 1921.

GAGE.—Chain gage supported by built-up cantilever, attached to posts set in right bank of river; installed May 26, 1916; read by Edwin Schultz. Vertical staff gage at same site and datum was used from July 30, 1914, until taken out by ice in spring of 1916.

DISCHARGE MEASUREMENTS.—Made from cable 1,500 feet below gage.

CHANNEL AND CONTROL.—Bed at gage composed of mud and rock. Left bank low and subject to overflow; right bank slopes back gradually to high-water mark. At cable site, 1,500 feet below gage, bed is rock and banks are high. Control is at head of Schultz Rapids, 200 feet below cable and 1,700 feet below gage; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.75 feet at 7.30 a. m. April 8 (discharge, 2,520 second-feet); minimum stage, 1 foot at 6 p. m. June 30 (discharge, 220 second-feet).

1914–1921: Maximum stage recorded, 9.0 feet April 22 and 23, 1916 (discharge, 5,430 second-feet); minimum stage recorded, 0.90 foot August 27 and 28, 1920 (discharge, 204 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Storage reservoirs are maintained by Chippewa & Flambeau Improvement Co., on headwaters of Flambeau River. Of these reservoirs Rest Lake, in sec. 9, T. 42 N., R. 5 E., with an allowable capacity of about 1½ billion cubic feet, is the largest.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 356 and 3,480 second-feet. Gage read to quarter-tenths twice daily except during winter, when it was read every other day. Daily discharge ascertained by applying mean daily gage height to rating table except for periods of ice effect and for days when gage was not read, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records excellent; winter records fair.

Discharge measurements of Flambeau River near Butternut, Wis., during the year ending Sept. 30, 1921.

Date	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec-ft*
Oct. 24	S. B. Soulé	1.82	432	Mar. 8[a]	G. F. Rittenberg	2.58	311
Jan 5[a]	G. F. Rittenberg	2.27	486	Aug. 16	A. O. Olson	1.71	31
Feb. 7[a]	do	2.48	372				

[a] Complete ice cover at measuring section; incomplete ice cover at control.

Daily discharge, in second-feet, of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1921.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	416	316	518	485	340	290	1,380	1,500	850	1,620	329	356
2	385	342	500	485	340	275	1,470	1,440	895	1,560	356	304
3	370	356	483	485	340	275	1,560	1,330	850	1,500	416	316
4	370	356	483	485	345	275	2,210	1,280	805	1,440	449	316
5	416	356	483	485	340	280	2,280	1,220	805	1,330	449	329
6	416	370	483	465	350	29	2,280	1,170	805	1,220	370	342
7	432	356	483	445	355	300	2,420	1,080	805	1,120	342	356
8	449	342	406	430	345	310	2,490	940	850	1,080	316	370
9	449	342	329	415	335	315	2,420	805	805	940	316	304
10	416	342	316	390	335	320	1,940	716	805	850	342	292
11	370	304	304	370	335	320	1,870	632	760	716	370	304
12	316	400	329	370	345	325	1,800	632	716	632	385	356
13	292	292	389	370	355	330	1,740	592	716	632	400	329
14	304	304	449	350	355	335	1,680	632	673	632	400	356
15	329	329	449	335	355	350	1,500	632	632	632	400	304
16	356	280	449	335	350	370	1,330	592	632	632	416	304
17	370	280	432	335	350	390	1,330	554	592	554	416	280
18	329	292	416	330	335	415	1,220	592	466	554	432	304
19	329	304	416	325	320	450	1,120	592	416	554	449	304
20	329	337	416	350	320	485	1,080	632	370	518	449	292
21	342	370	416	375	315	555	985	632	316	466	432	269
22	356	378	416	365	300	715	985	632	329	432	342	292
23	385	385	415	355	290	830	940	632	329	432	292	316
24	400	400	400	345	310	870	895	673	292	432	292	329
25	385	416	385	335	325	895	940	716	280	483	304	342
26	356	416	385	340	315	940	895	716	258	466	316	592
27	342	416	385	340	310	962	1,080	805	248	432	370	554
28	342	416	415	335	300	985	1,280	805	229	400	385	466
29	342	416	450	330	------	1,080	1,380	805	229	385	316	432
30	329	467	465	330	------	1,170	1,500	850	229	342	269	400
31	304	------	485	335	------	1,280	------	805	------	342	304	------

NOTE.—Gage read only every other day Nov. 18 to Apr. 2; for periods of open water, Nov. 18 to Dec. 22 and Mar. 26 to Apr. 2, discharge was interpolated for days of no gage reading; during period Dec. 23 to Mar. 25 stage-discharge relation was affected by ice, and discharge was ascertained by applying to rating table the daily gage height corrected for ice effect by means of three discharge measurements, observer's notes, and weather records, and then interpolating for days of no gage reading.

Monthly discharge of Flambeau River near Butternut, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	449	292	365	0.553	0.64
November	467	280	356	.539	.60
December	518	304	424	.642	.74
January	485	325	381	.577	.67
February	355	290	332	.503	.52
March	1,280	275	548	.830	.96
April	2,490	895	1,530	2.32	2.59
May	1,500	554	827	1.25	1.44
June	895	229	566	.856	.96
July	1,620	342	752	1.14	1.31
August	449	269	369	.559	.64
September	592	269	347	.526	.59
The year	2,490	229	567	.859	11.66

FLAMBEAU RIVER NEAR LADYSMITH, WIS.

LOCATION.—In SE. ¼ sec. 20, T. 35 N., R. 5 W., at H. J. Cornelissen's farm, 6 miles by road northeast of Ladysmith, Rusk County, 21 miles below mouth of South Fork of Flambeau River, which enters from left, and 28 miles above mouth of river.

DRAINAGE AREA.—1,940 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 1, 1914, to September 30, 1921. From February 15, 1903, to December 2, 1906, records were collected at a station in city of Ladysmith, three-fourths of a mile south of Minneapolis, St. Paul & Sault Ste. Marie Railway station, half a mile below dam of Menasha Pulp Co., and 6 miles below present station.

GAGE.—Chain fastened to a cantilever arm, supported by two posts, on left bank of river, on farm of H. J. Cornelissen; read by H. J. Cornelissen.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; free from vegetation; fairly permanent. At gage section, channel is divided by a small sandy island; at cable section the river flows in one channel. Banks are medium high, wooded, and not subject to overflow. Control not well defined; formed by channel below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.40 feet March 30 (discharge, 6,900 second-feet); minimum discharge, estimated 350 second-feet February 8 (stage-discharge relation affected by ice).

1903–1906; 1914–1921: Maximum discharge recorded, 17,400 second-feet April 23, 1916; minimum discharge, 350 second-feet February 8, 1921.

ICE.—Stage-discharge relation seriously affected by large quantities of frazil ice which form on the falls and rapids above station and fill the channel for a distance of several miles from the gage to pond of Paper Co.'s dam at Ladysmith.

REGULATION.—Chippewa & Flambeau Improvement Co. operates a storage reservoir at Rest Lake and smaller reservoirs on Manitowish and Turtle rivers and Bear Creek. These reservoirs have an effective capacity of 1.15 billion cubic feet. Weekly fluctuations at gate are caused by operation of power plants at Park Falls and storage reservoirs. No daily fluctuation has been observed.

ACCURACY.—Stage-discharge relation changed during high water of latter part of March; seriously affected by ice. Standard rating curve well defined between 770 and 17,000 second-feet; was used direct October 1 to March 26 except for period of ice effect; indirect method for shifting control used March 27 to September 30. Gage read to quarter-tenths once daily October 1 to December 31; read usually every other day January 1 to September 30. Daily discharge ascertained by applying daily gage height to rating table, except for period of ice effect and for days when gage was not read, for which it was ascertained as indicated in footnote to daily-discharge table, and except for period for which shifting-control method was used. Open-water records prior to winter period, good; thereafter fair; winter records fair.

Discharge measurements of Flambeau River near Ladysmith, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 18	D. W. Roberts	[a]1.98	726	Mar. 7 [b]	G. F. Rittenberg	3.12	623
Jan. 4 [b]	G. F. Rittenberg	2.98	737	Aug. 14	A. O. Olson	2.00	672
Feb. 6 [b]	do	3.50	621				

[a] Stage-discharge relation possibly affected by logs in channel. [b] Complete ice cover.

Daily discharge, in second-feet, of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	710	840	960	685	565	550	3,900	6,220	3,180	650	1,080	885
2	670	920	1,160	695	540	580	3,280	5,720	3,180	660	925	770
3	580	740	770	710	520	595	2,770	5,210	2,840	1,400	770	770
4	740	770	920	735	500	610	3,050	4,840	2,510	2,150	770	770
5	770	960	840	810	560	610	3,330	4,480	2,210	1,800	770	764
6	770	960	840	880	620	610	3,900	3,980	1,910	1,450	740	758
7	670	840	840	915	485	625	4,480	3,480	2,400	1,800	710	734
8	660	840	840	950	350	650	4,570	3,120	2,900	2,150	641	710
9	685	770	840	910	430	675	4,660	2,770	2,770	2,150	572	775
10	660	710	840	870	510	695	4,230	2,640	2,640	2,150	596	840
11	660	700	895	735	510	710	3,800	2,510	2,580	1,860	620	740
12	652	680	960	600	510	710	3,490	2,450	2,510	1,560	810	640
13	640	660	960	620	575	710	3,180	2,390	2,060	1,340	1,000	560
14	685	685	960	640	640	710	2,980	2,580	1,620	1,800	710	610
15	685	710	960	640	740	770	2,770	2,770	1,460	2,270	625	660
16	612	710	960	640	840	880	2,700	2,640	1,290	2,090	540	685
17	620	710	920	595	830	1,000	2,640	1,500	1,100	1,910	672	710
18	752	740	880	545	820	1,120	2,400	1,820	920	1,680	805	920
19	628	770	840	500	745	1,560	2,150	2,150	940	1,450	862	1,240
20	660	770	840	500	670	1,790	2,150	1,860	960	1,340	920	1,560
21	660	770	840	500	635	2,030	2,150	1,560	940	1,240	1,000	1,910
22	722	920	840	495	600	2,270	2,270	1,530	920	1,080	960	2,620
23	1,000	620	1,000	495	580	2,510	2,390	1,500	845	920	920	3,330
24	920	640	1,000	495	560	2,770	2,330	1,330	770	920	880	2,800
25	920	660	840	495	540	2,900	2,270	1,160	705	920	840	2,270
26	880	660	770	520	525	3,180	2,210	1,180	640	660	860	2,030
27	880	660	740	550	520	4,010	2,150	1,200	574	1,000	880	1,790
28	960	685	710	540	520	4,840	4,400	1,200	508	1,340	920	1,790
29	960	710	710	530	-------	5,870	6,660	1,200	574	1,340	960	1,560
30	1,160	770	685	560	-------	6,900	6,440	2,190	640	1,340	980	1,340
31	1,160	-------	685	590	-------	5,350	-------	3,180	-------	1,210	1,000	-------

NOTE.—Stage-discharge relation affected by ice Nov. 11–20, 24–29, and Dec. 4 to Mar 26; discharge ascertained by applying to rating table daily gage height corrected for effect of ice by means of three discharge measurements, observer's notes, and weather records, and by interpolating for days of no gage reading. Discharge interpolated on account of lack of gage readings Jan. 1, Jan. 5, and every other day thereafter to Jan. 17, Jan. 18, and every other day thereafter to Mar 5, Mar. 9, and every other day thereafter to July 11, July 14, and every other day thereafter to July 24, July 27, and every other day thereafter to Aug. 12, Aug. 15, 17, 19, Aug. 22, and every other day thereafter to Sept. 11, and Sept. 14, 16, 19, 22, 24, 26, and 29.

Monthly discharge of Flambeau River near Ladysmith, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 1,940 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,160	580	766	0.395	0.46
November	960	620	753	.388	.43
December	1,160	685	866	446	.51
January	950	495	643	.331	.38
February	840	350	587	.303	.32
March	6,900	550	1,900	.979	1.13
April	6,660	2,150	3,320	1.71	1.91
May	6,220	1,160	2,660	1.37	1.58
June	3,180	508	1,640	.845	.94
July	2,270	650	1,470	.758	.87
August	1,080	540	817	.421	.49
September	3,330	560	1,250	.644	.72
The year	6,900	350	1,390	.716	9.74

JUMP RIVER AT SHELDON, WIS.

LOCATION.—In sec. 26, T. 33 N., R. 5 W., at highway bridge in Sheldon, Rusk County, 11 miles above mouth of river.

DRAINAGE AREA.—510 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 22, 1915, to September 30, 1921.

GAGE.—Chain gage bolted to downstream handrail of bridge; read by Elsa Dietze.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL and CONTROL.—Bed composed of heavy gravel; clean and free from vegetation; permanent. Right bank high and not subject to overflow; left bank may be overflowed occasionally.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.70 feet at 4 p. m. March 20 (discharge, 7,230 second-feet); minimum stage recorded, 2.78 feet at 8 a. m. July 13 (discharge, 28 second-feet).

1915–1921.—Maximum stage recorded, 11.48 feet March 26, 1920 (discharge, 12,800 second-feet); minimum discharge, about 15 second-feet February 3–7, 1918 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 45 and 5,930 second-feet. Gage read to quarter-tenths twice daily, except during winter when it was read every other day. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice and days on which gage was not read, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records good; winter records fair.

Discharge measurements of Jump River at Sheldon, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 31	G. F. Rittenberg	3.61	76	Mar. 5	G. F. Rittenberg	3.76	75
Feb. 5	do	3.67	71	Aug. 13	A. O. Olson	2.90	44.1

[a] Complete ice cover.

Daily discharge, in second-feet, of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	45	80	112	85	80	55	1,400	2,950	2,110	140	77	70
2	60	94	119	100	80	60	1,300	1,860	1,620	148	74	65
3	52	116	148	110	80	60	1,200	1,300	1,020	123	65	48
4	45	122	176	140	80	60	1,200	930	760	105	58	50
5	39	108	148	165	70	75	1,300	720	540	88	48	58
6	39	88	119	150	80	75	1,300	610	380	77	45	45
7	38	102	135	140	80	85	1,400	512	610	77	44	48
8	38	94	140	130	80	95	1,400	430	2,110	98	38	50
9	45	80	140	120	70	100	1,200	380	2,650	98	32	65
10	58	68	136	110	60	110	1,200	330	2,370	50	36	70
11	102	56	136	100	60	115	1,110	280	1,300	33	33	65
12	116	45	136	100	60	120	930	270	1,110	30	33	55
13	74	45	136	100	60	120	840	255	892	29	58	48
14	70	45	136	100	60	120	760	255	675	33	50	58
15	60	60	150	95	60	140	1,020	280	458	50	55	68
16	70	70	170	90	60	180	930	280	240	50	55	70
17	58	90	180	90	60	230	840	255	190	74	65	98
18	58	88	190	90	60	280	720	280	160	70	65	98
19	52	88	195	85	70	1,400	610	330	148	50	58	98
20	62	88	180	90	85	7,230	540	305	133	50	45	112
21	88	88	170	100	80	6,290	540	280	112	70	45	160
22	180	88	165	110	70	5,570	485	240	105	58	48	270
23	180	102	150	115	60	3,400	540	190	98	42	45	380
24	140	116	140	130	50	3,250	485	190	98	32	33	305
25	130	116	135	150	45	2,950	485	172	98	33	33	240
26	116	116	120	130	40	2,950	540	180	98	36	42	205
27	105	110	110	115	45	4,880	1,980	355	65	77	60	160
28	91	105	100	100	50	5,050	4,880	1,400	77	133	70	133
29	88	105	95	80	------	3,880	5,570	2,110	105	137	77	98
30	88	105	85	80	------	2,950	4,200	2,110	140	112	88	77
31	80	------	75	80	------	1,880	------	2,370	------	105	74	------

NOTE.—Gage not read Nov. 11 and every other day thereafter to Mar. 19 except on Feb. 5 and Mar. 5; for periods of open water, Nov. 11, 12, 18–30, Dec. 1–6 and 10–14, discharge was interpolated for days of no gage reading; during periods Nov. 13–17, Dec. 7–9, and Dec. 15 to Mar. 19 stage-discharge relation was affected by ice and discharge was ascertained by applying to rating table daily gage height corrected for ice effect by means of three discharge measurements, observer's notes, and weather records, and then interpolating for days of no gage readings. Discharge interpolated also for the period June 13–15, on account of lack of gage readings.

Monthly discharge of Jump River at Sheldon, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	180	38	79.6	0.156	0.18
November	122	45	89.3	.175	.20
December	195	75	140	.275	.32
January	165	80	109	.214	.25
February	85	40	65.5	.128	.13
March	7,230	55	1,730	3.39	3.91
April	5,570	485	1,360	2.67	2.98
May	2,950	172	723	1.42	1.64
June	2,650	65	682	1.34	1.50
July	148	29	74.5	.146	.17
August	88	32	53.2	.104	.12
September	380	45	112	.220	.25
The year	7,230	29	437	.857	11.65

EAU CLAIRE RIVER NEAR AUGUSTA, WIS.

LOCATION.—In sec. 12, T. 26 N., R. 6 E., at Trouble Water Bridge, 7 miles northeast of Augusta, Eau Claire County. South Fork of Eau Claire River enters from left 4 miles above station.

DRAINAGE AREA.—500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 16, 1914, to September 30, 1921.

GAGE.—Chain gage on downstream side of bridge; read by Albert Wagner.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading at control about 500 feet below bridge.

CHANNEL AND CONTROL.—Bed at bridge and above is sandy and very shifting. A short distance below gage the channel narrows and a rock outcrop overlain with large boulders forms the control. Banks are high and not subject to overflow. Point of zero flow, September 28, 1920, at gage height −0.9 foot ±0.1 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.80 feet at 1 p. m. March 21 (discharge, 5,320 second-feet); minimum stage recorded, −0.01 foot at 4 p. m. August 9 (discharge, 45.5 second-feet, by current-meter measurement).

1914–1921: Maximum open-water stage recorded, 11.98 feet at 9 a. m. March 27, 1920 (discharge, 8,720 second-feet); minimum discharge, estimated 3.5 second-feet, January 27, 1918, from discharge measurement made through complete ice cover.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation permanent during year except as affected by ice. Rating curve well defined below 275 second-feet; extended above that point on basis of form of previous curves. Gage read to quarter-tenths once daily except as indicated in footnote to table of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except for periods of ice effect and periods during which gage was not read as indicated in footnote to table of daily discharge. Records subject to error on account of poor gage-height record.

Discharge measurements of Eau Claire River near Augusta, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29[a]	G. F. Rittenberg	0.65	65	Aug. 9	A. O. Olson	−0.01	45.5
Feb. 3	do	[b]1.06	62				

[a] Control partly open; some frazil ice.
[b] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		83	177			165	465	970	1,150	118	58	46
2		108	177			170	412	745	745	118	54	46
3		114	159			170	382	552	588	152	61	46
4		98	152			175	351	430	430	169	61	54
5		98	140			180	320	365	305	212	54	58
6		94	98			190	290	305	260	305	54	54
7		98	136		65	195	320	275	500	190	54	54
8		94	144			200	320	231	2,010	204	54	54
9	58	98	152			205	320	190	1,830	245	46	54
10		108	165			210	350	177	1,100	190	54	54
11		108	165			215	412	164	1,590	152	83	54
12		110	165			215	395	152	1,350	118	61	46
13		105	170		75	225	335	152	640	98	54	46
14		100	175		85	245	395	164	430	118	54	61
15		100	150		95	275	395	152	335	152	46	70
16		100	120	65	105	305	465	140	275	108	46	70
17	70	95	100		115	335	335	190	217	108	54	74
18	70	95	80		130	412	275	350	204	152	61	79
19	70	95	70		140	605	231	552	169	231	58	61
20	75	95	70		140	2,940	204	675	152	190	54	58
21	129	100			140	5,320	204	395	140	108	54	108
22	140	175			145	2,500	245	290	118	98	46	204
23	118	190			145	1,410	290	239	114	98	46	164
24	108	190			150	890	305	169	108	88	46	136
25	88	165			155	850	245	164	98	79	46	98
26	65	140	65		160	780	245	140	88	75	54	88
27	65	129			165	970	745	640	108	79	61	79
28	67	134			170	1,470	4,560	2,860	152	75	58	70
29	68	140			-------	745	3,990	2,150	129	70	61	65
30	70	164			-------	588	1,650	1,150	152	65	54	61
31	70	-------			-------	518	-------	1,710	-------	61	54	-------

NOTE.—Stage-discharge relation affected by ice Nov. 12-26 and Dec. 15 to Mar. 17; discharge ascertained by means of incomplete gage-height record, two discharge measurements, observer's notes, weather records, and comparison with flow of adjacent rivers. During periods of ice effect gage was not read Nov. 12-16, 24-26, Dec. 15 to Jan. 22, Jan. 26, 28, 30, 31, Feb. 1-13, 18, 20, 22, 24, 26-28, Mar. 1-5, and 10-12. During open-water periods gage was not read Oct. 1-16, 28, 29, Nov. 28, Dec. 8, 10-14, Apr. 3-5 Sept. 10 and 17: discharge estimated by comparison with flow of adjacent rivers or interpolated. Braced figures show mean discharge for periods indicated.

Monthly discharge of Eau Claire River near Augusta, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	140	-------	71.0	0.142	0.16
November	190	83	117	.234	.26
December	177	-------	112	.224	.26
January	-------	-------	65.0	.130	.15
February	170	-------	103	.206	.21
March	5,320	165	764	1.53	1.76
April	4,560	204	648	1.30	1.45
May	2,860	140	543	1.09	1.26
June	2,010	88	516	1.03	1.15
July	305	61	136	.272	.31
August	83	46	54.9	.110	.13
September	204	46	73.7	.147	.16
The year	5,320	46	268	.536	7.26

RED CEDAR RIVER NEAR COLFAX, WIS.

LOCATION.—In sec. 27, T. 30 N., R. 11 W., at highway bridge 4½ miles north of Colfax, Dunn County. Hay River enters from right 11 miles below station and Trout Creek, also from right, 3½ miles above.

DRAINAGE AREA.—1,100 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 19, 1914, to September 30, 1921.

GAGE.—Chain gage attached to downstream side of bridge; read by Andrew Lundeguam.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge, to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; small amount of grass growth during summer. Left bank high and not subject to overflow; right bank medium high and may be overflowed during extremely high water. Low-water control is probably subject to slight effect from backwater from Colfax dam, which was completed in March, 1921.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.30 feet at 10 a. m. April 28 (discharge, 2,310 second-feet); minimum discharge, estimated 325 second-feet January 17 (stage-discharge relation affected by ice).

1914–1921: Maximum stage recorded, 6.95 feet at 8 a. m. March 26, 1920 (discharge, 7,610 second-feet); minimum discharge same as for 1921.

REGULATION.[2]—The following dams and reservoirs are used to regulate the flow of Red Cedar River. Owing to operation of these reservoirs, the flow at station is not natural.

Dams and reservoirs on Red Cedar River.

Dam.	Location.	Capacity (millions of cubic feet).
Long Lake	Sec. 24, T. 37 N., R. 11 W.	400
Cedar Lake	Sec. 21, T. 36 N., R. 10 W.	400
Birch Lake	Sec. 25, T. 37 N., R. 10 W.	475
Bear Lake	Sec. 7, T. 36 N., R. 11 W.	150
		1,425

ACCURACY.—Stage-discharge relation for low stages changed after completion of Colfax dam the later part of March; seriously affected by ice. Rating curve used prior to change, well defined between 635 and 4,450 second-feet. Curve used after change, fairly well defined between 300 and 4,450 second-feet. Gage read to quarter-tenths twice daily except during winter, when it was read every other day. Daily discharge ascertained by applying mean daily gage height to rating table except for period of ice effect and days when gage was not read, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records fair; winter records subject to error.

Discharge measurements of Red Cedar River near Colfax, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30	G. F. Rittenberg	[a] 4.00	490	Aug. 11[c]	A. O. Olson	1.60	532
Feb. 4[b]	do	2.84	606	23[c]	do	1.40	451
Apr. 14	S. B. Soulé	1.80	852				

[a] Stage-discharge relation affected by ice.
[b] Ice broken up owing to release of ice jam above gage.
[c] Results of measurement questionable.

[2] From data on file in engineering department of Railroad Commission of Wisconsin.

Daily discharge, in second-feet, of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	690	785	890	470	535	560	1,200	1,760	675	495	495	610
2	690	855	855	470	635	560	985	1,300	550	495	580	522
3	690	855	855	470	635	560	860	900	550	495	610	580
4	690	785	820	450	610	560	580	820	495	445	610	610
5	750	820	820	410	585	560	710	745	470	360	550	495
6	750	720	690	410	585	560	745	745	550	675	550	470
7	750	662	820	420	560	560	780	675	745	745	522	495
8	750	585	820	385	560	560	815	675	745	710	495	550
9	820	750	820	350	560	560	820	820	610	610	445	550
10	820	855	820	380	560	585	845	710	610	495	550	550
11	820	750	820	405	535	585	860	675	550	422	675	550
12	820	662	820	400	535	610	830	942	495	360	550	522
13	820	635	750	400	535	610	800	1,070	495	495	495	522
14	820	662	785	435	535	610	782	1,070	445	610	495	675
15	890	635	785	470	535	720	710	1,160	400	610	445	642
16	820	750	560	400	510	785	900	1,070	400	522	495	580
17	820	720	585	325	510	750	710	820	495	675	610	610
18	720	635	560	360	510	750	495	675	550	610	675	610
19	750	925	560	395	510	820	642	675	550	550	675	550
20	925	925	560	430	510	1,580	642	820	342	495	610	610
21	960	890	535	490	510	1,880	675	675	445	495	675	1,870
22	890	720	535	395	510	1,480	675	675	470	550	550	1,550
23	820	785	535	340	490	1,000	675	580	495	495	580	1,160
24	785	785	510	385	490	925	610	610	470	445	610	900
25	585	785	510	440	490	890	495	610	445	400	610	820
26	585	690	510	445	510	890	675	675	400	422	710	675
27	720	690	510	450	510	1,780	1,160	642	400	550	710	610
28	750	750	490	490	535	1,980	2,200	610	445	675	642	610
29	750	690	490	535	-------	2,090	1,980	580	445	495	550	580
30	750	820	490	490	-------	1,880	1,980	495	445	470	610	610
31	750	-------	425	450	-------	1,680	-------	675	-------	495	675	-------

NOTE.—Stage-discharge relation affected by ice Dec. 17 to Mar. 13; during that period the gage was not read on Dec. 19 and every other day thereafter to Mar. 9; also not read on Feb. 16; discharge for the period ascertained by applying to rating table the daily gage height corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records, and by interpolating or estimating for days of no gage reading. Gage not read Apr. 6–13, discharge ascertained by means of precipitation records and comparison with flow of this river at Menomonie.

Monthly discharge of Red Cedar River near Colfax, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	960	585	773	0.703	0.81
November	925	585	753	.685	.76
December	890	425	662	.602	.69
January	535	325	424	.385	.44
February	635	490	539	.490	.51
March	2,090	560	965	.877	1.01
April	2,200	495	895	.814	.91
May	1,760	495	805	.732	.84
June	745	342	506	.460	.51
July	745	360	528	.480	.55
August	710	445	582	.529	.61
September	1,870	470	690	.627	.70
The year	2,200	325	678	.616	8.34

RED CEDAR RIVER AT CEDAR FALLS, WIS.

LOCATION.—In sec. 6, T. 28 N., R. 12 W., at highway bridge near Cedar Falls, Dunn County, just below power plant of Wisconsin & Minnesota Light & Power Co., and 4½ miles above crossing of Chicago, St. Paul, Minneapolis & Omaha Railway.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 1, 1909, to September 30, 1921.

GAGE.—Staff gage fastened to bridge pier; read by John G. Wood and R. D. Wilsey.

DISCHARGE MEASUREMENTS.—No discharge measurements have been made at this station, which is maintained to determine fluctuation in stage.

CHANNEL AND CONTROL.—Channel rough and rocky, straight, and free from vegetation. Banks high and not subject to overflow.

EXTREMES OF STAGE.—Maximum stage recorded during year, 4.50 feet at 5 p. m. March 30; minimum stage recorded, 0.70 foot at noon and 6 p. m. July 3, 6 p. m. July 17, noon and 6 p. m. July 24, and noon and 6 p. m. August 7.

1909–1921: Maximum stage recorded, 7.2 feet March 25 and 26, 1920; minimum stage recorded, 0.0 foot at 5 p. m. March 11, 1917. Minimum stages are caused by closing gates and wheels at power plant above station.

REGULATION.—Operation of storage reservoirs in the headwaters of the river (see "Regulation" in station description for Red Cedar River near Colfax, Wis.), together with storage at power plant above gaging station, regulates the flow.

ACCURACY.—No discharge measurements have been made, but stage-discharge relation is believed permanent. Gage read to half-tenths twice daily. Considerable diurnal fluctuation is observed, so that mean daily gage height does not represent the average stage.

COOPERATION.—Gage-height record furnished by Wisconsin & Minnesota Light & Power Co.

Daily gage height, in feet, of Red Cedar River at Cedar Falls, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.35	3.55	3.66	2.55	2.55	3.45	3.90	2.00	3.45	2.15	2.75	3.05
2	3.40	3.65	3.60	2.10	2.40	3.45	3.80	3.75	3.45	2.05	2.70	3.15
3	.75	3.65	3.50	3.55	2.45	3.35	2.60	3.80	3.45	.70	2.70	3.30
4	2.55	2.55	3.60	2.55	2.45	3.40	3.80	3.70	3.35	1.40	2.55	1.90
5	2.55	2.55	1.12	2.55	2.45	3.35	3.75	3.55	.75	2.35	2.65	1.75
6	2.45	3.05	3.55	3.05	1.55	1.60	3.70	3.45	3.45	2.20	2.25	2.85
7	2.55	1.02	3.55	3.55	2.45	3.45	3.60	3.45	3.00	3.45	.70	3.00
8	2.55	3.75	2.55	3.10	2.45	3.45	3.55	1.90	3.30	2.80	2.80	2.95
9	3.35	3.75	2.95	1.02	2.45	3.45	3.55	3.45	3.45	2.45	2.35	2.90
10	1.50	3.65	3.55	3.60	2.50	3.50	1.00	3.45	3.45	1.40	2.40	3.15
11	3.30	3.65	2.55	3.45	2.45	3.45	3.55	3.45	3.45	3.60	2.35	1.80
12	2.90	3.55	1.08	2.55	3.00	3.45	3.55	3.45	.75	2.70	2.35	2.85
13	3.25	3.10	3.45	2.55	1.12	1.08	3.55	3.45	3.35	2.70	2.40	2.80
14	3.30	.75	3.55	2.55	3.55	3.45	3.45	3.00	3.35	2.90	1.25	2.90
15	2.90	2.55	3.55	2.55	3.55	3.45	3.45	.75	3.35	2.85	2.95	3.05
16	2.55	2.55	3.45	1.12	3.60	3.45	3.35	3.45	3.35	2.80	2.90	3.00
17	.75	2.55	3.45	2.45	3.55	3.45	.75	3.45	3.35	1.5	2.85	3.40
18	3.00	2.45	2.95	2.55	3.55	3.45	3.45	3.45	3.35	2.80	2.90	1.85
19	3.05	2.45	1.02	2.40	3.55	3.55	3.45	3.45	.75	2.40	2.80	2.85
20	3.35	2.55	2.50	3.65	1.50	1.60	3.45	3.45	2.50	2.45	2.95	3.10
21	2.45	2.40	2.50	3.65	3.55	3.55	3.45	3.45	3.50	3.10	.90	3.10
22	3.55	3.55	2.45	3.60	3.55	3.80	3.45	.75	2.20	2.55	2.95	3.60
23	2.95	3.55	2.35	.75	3.45	3.85	3.00	3.45	2.80	2.60	2.90	3.45
24	2.45	3.65	2.35	3.65	3.55	3.60	.75	3.45	2.60	.70	2.95	3.30
25	3.50	2.05	.75	3.00	3.55	3.55	2.95	3.35	2.40	2.60	3.00	2.45
26	3.45	3.50	1.45	3.00	3.55	3.55	3.45	3.45	1.30	2.50	2.95	3.15
27	3.55	3.55	2.45	3.05	.75	1.12	3.45	3.45	3.15	2.40	2.90	3.10
28	3.55	1.08	2.45	3.00	3.45	3.70	3.45	3.45	2.65	2.60	1.40	3.05
29	3.45	3.55	2.35	3.55	-------	4.35	3.70	.75	2.60	2.70	3.05	3.00
30	2.45	3.55	2.45	.75	-------	4.45	3.80	1.60	3.40	2.85	3.10	2.90
31	.75	-------	3.55	3.55	-------	4.00	-------	3.45	-------	1.75	3.20	-------

RED CEDAR RIVER AT MENOMONIE, WIS.

LOCATION.—In sec. 21, T. 28 N., R. 13 W., 900 feet below power house of Wisconsin & Minnesota Light & Power Co., Menomonie, Dunn County, and 13 miles above confluence of Red Cedar and Chippewa rivers. Wilson Creek discharges from right into service reservoir just above station.

DRAINAGE AREA.—1,810 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 17, 1907, to September 3, 1908; May 9, 1913, to September 30, 1921.

GAGE.—Barrett & Lawrence water-stage recorder with a wooden well and shelter; installed May 9, 1913, on right bank of river, 1 mile above site of old gage, which was attached to a highway bridge about 200 rods west of Chicago & Northwestern Railway station west of Menomonie; read from June 17, 1907, to September 3, 1908. No relation between datums of the two gages. Gage inspected by E. Kausrud.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1 mile below gage.

CHANNEL AND CONTROL.—Bed at gage composed of heavy gravel; bed at measuring section sandy and subject to shift. Left bank at gage high and not subject to overflow; right bank of medium height and is overflowed at flood stages; both banks high at measuring section and not subject to overflow.

EXTREMES OF DISCHARGES.—Maximum stage recorded during year, 4.50 feet at 7 p. m. March 28 (discharge, 4,520 second-feet); minimum stage, 1.93 feet at 1.30 p. m. December 16 (discharge, 357 second-feet).

1907–8 and 1913–1921: Maximum discharge, estimated 14,000 second-feet March 26, 1920 (maximum gage height was about 8.0 feet; water-stage recorder not operating satisfactorily); minimum stage recorded, 0.50 foot November 8, 1907 (discharge, 100 second-feet).

REGULATION.—Considerable diurnal fluctuation in stage at gage section is caused by operation of power plants of Wisconsin & Minnesota Light & Power Co. at Menomonie and Cedar Falls. (See also "Regulation" in station description for Red Cedar River near Colfax, Wis.)

ICE.—Stage-discharge relation not affected by ice owing to relatively warm water discharged from service reservoir.

ACCURACY.—Stage-discharge relation not permanent after the winter. Standard rating curve well defined between 650 and 3,460 second-feet and fairly well defined above 3,460 second-feet; was used direct October 1 to March 20; indirect method for shifting control used March 21 to September 30. Operation of water-stage recorder very satisfactory. Daily discharge ascertained by means of the discharge integrator. Records fair.

The following discharge measurement was made by A. O. Olson:

August 10, 1921: Gage height, 2.36 feet; discharge, 728 second-feet.

Daily discharge, in second-feet, of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,240	865	1,170	1,060	1,340	1,430	2,180	1,940	1,100	970	750	1,060
2	1,010	1,190	1,370	1,830	970	1,260	1,750	1,810	1,210	680	980	1,060
3	722	1,150	1,370	1,460	965	1,380	916	1,720	1,020	568	862	1,260
4	1,020	1,110	1,400	1,100	1,090	1,160	1,760	1,850	1,060	516	837	810
5	1,200	1,110	850	1,010	980	1,340	1,530	1,520	413	516	868	770
6	868	1,310	1,070	1,020	614	585	1,550	1,650	1,040	608	843	1,190
7	1,070	540	1,380	1,270	1,030	1,360	1,740	1,330	1,290	1,120	560	1,160
8	1,080	1,360	1,500	1,440	875	1,420	2,080	873	1,320	1,130	620	1,000
9	1,140	1,630	1,050	630	974	1,350	1,360	1,270	1,280	1,310	745	1,040
10	545	1,350	1,550	1,120	1,070	1,230	700	1,460	1,720	588	743	1,100
11	1,060	1,390	1,160	1,420	950	1,440	1,770	1,560	1,640	1,150	912	604
12	1,100	1,270	1,600	1,060	1,230	1,380	1,900	1,550	571	1,170	700	890
13	1,130	1,280	1,140	865	710	620	1,390	1,520	1,340	800	762	1,110
14	1,230	658	1,400	850	1,220	1,230	1,340	1,280	1,170	1,020	468	917
15	1,170	972	1,370	1,160	1,350	1,410	1,530	470	1,010	1,070	491	1,080
16	1,200	1,200	1,190	604	1,380	1,350	1,600	1,980	1,090	933	1,080	905
17	533	895	1,120	846	1,460	1,350	650	1,470	1,170	570	1,100	1,110
18	1,120	1,110	964	1,120	1,560	1,320	1,120	1,470	915	758	950	548
19	1,460	932	515	812	1,400	1,300	1,430	1,440	573	1,090	945	928
20	1,220	1,060	798	1,010	720	905	1,600	1,360	825	1,080	893	1,100
21	1,250	1,020	922	1,430	1,200	1,910	1,490	1,390	1,060	992	550	1,200
22	1,190	1,350	924	1,490	1,290	2,430	1,190	532	587	945	592	2,040
23	1,190	1,140	876	1,050	1,310	2,400	1,210	1,450	1,180	1,000	912	2,600
24	923	1,380	700	978	1,310	2,370	500	1,500	875	588	878	2,310
25	1,190	1,340	503	1,380	1,360	2,140	937	1,200	1,000	590	1,040	2,220
26	1,320	1,350	490	1,060	1,360	1,960	1,270	1,050	544	676	1,150	2,220
27	1,340	1,210	603	1,070	722	915	1,450	1,390	710	741	1,000	1,620
28	1,340	770	556	1,200	1,130	2,260	1,570	1,500	693	855	616	975
29	1,100	1,170	1,160	1,100	-------	3,100	1,700	736	990	964	836	1,120
30	1,180	1,440	1,150	680	-------	2,840	2,570	508	980	1,080	1,440	994
31	565	-------	1,140	1,200	-------	2,430	-------	1,180	-------	620	1,080	-------

Monthly discharge of Red Cedar River at Menomonie, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 1,810 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,460	533	1,090	0.602	0.69
November	1,630	540	1,150	.635	.71
December	1,600	490	1,060	.586	.68
January	1,830	604	1,110	.613	.71
February	1,560	614	1,130	.624	.65
March	3,100	585	1,600	.884	1.02
April	2,570	500	1,460	.807	.90
May	1,980	470	1,350	.746	.86
June	1,720	413	1,010	.558	.62
July	1,310	516	861	.476	.55
August	1,440	468	845	.467	.54
September	2,600	548	1,230	.680	.76
The year	3,100	413	1,160	.641	8.69

BLACK RIVER AT NEILLSVILLE, WIS.

LOCATION.—In sec. 15, T. 24 N., R. 2 W., at lower highway bridge in Neillsville, Clark County. O'Neill Creek enters from left 1 mile above gage, and Cunningham Creek, also from left, 1½ miles below.

DRAINAGE AREA.—774 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—April 6, 1905, to March 31, 1909; December 11, 1913, to September 30, 1921.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by A. Bissell.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading near bridge.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids, a few hundred feet below gage. Banks high and rocky; will not be overflowed at gage section.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.65 feet at 8 a. m. March 20 (discharge, 11,800 second-feet); minimum discharge, estimated 25 second-feet January 14 (stage-discharge relation affected by ice).

1905–1909 and 1913–1921: Maximum stage recorded, 19.8 feet June 6, 1905 (discharge, about 29,400 second-feet); minimum discharge probably somewhat less than 5 second-feet in February, 1918 (stage-discharge relation affected by ice).

The maximum discharge during flood of October 6, 1911, probably exceeded 29,000 second-feet, but no data are available regarding the stage at the gage section.

REGULATION.—Several dams on Black River and its tributaries upstream from Neillsville are used to create a head for development of power. Operation of these plants causes a slight diurnal fluctuation at the gage, especially during winter, when the flow is at a minimum.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined between 26 and 18,400 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records fair except for extremely low stages, for which they are poor; winter records subject to error.

Discharge measurements of Black River at Neillsville, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 29[a]	G. F. Rittenberg	3.77	120	Aug. 9	A. O. Olson	2.10	29.8
Feb. 2[b]	do	3.51	60				

[a] Incomplete ice cover; considerable slush ice.
[b] No slush or frazil ice.

Daily discharge, in second-feet, of Black River at Neillsville, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	35	70	192	70	75	50	1,010	2,260	1,890	52	54	45
2	38	76	254	65	50	100	830	1,570	1,290	65	49	43
3	30	86	315	75	70	170	770	1,010	770	54	46	37
4	32	81	334	55	50	230	710	635	438	134	40	37
5	40	108	278	50	65	295	710	610	315	160	38	38
6	35	122	204	55	35	260	770	438	219	90	41	43
7	45	120	134	45	70	335	830	354	1,010	97	34	37
8	35	116	139	45	50	415	950	296	3,160	149	32	35
9	32	104	184	35	35	460	950	250	2,660	110	32	40
10	30	104	170	35	65	415	950	216	2,760	104	40	43
11	32	104	130	30	55	460	1,080	187	4,700	90	63	40
12	38	100	104	30	85	510	1,080	162	3,260	76	86	39
13	39	100	97	35	75	510	890	149	2,660	55	58	60
14	34	102	216	25	95	460	830	192	890	55	38	44
15	78	86	173	40	95	415	1,010	187	535	108	32	37
16	78	60	155	35	440	460	1,010	184	334	63	28	49
17	65	46	145	35	255	460	830	254	244	56	28	98
18	56	43	120	30	260	560	610	334	190	187	28	71
19	52	53	120	35	175	1,010	485	535	147	134	27	90
20	65	50	120	35	145	10,600	438	560	116	84	26	142
21	81	120	120	355	135	10,400	374	395	83	58	28	149
22	73	296	120	325	100	7,910	610	296	77	49	33	184
23	94	204	120	315	90	4,290	770	225	64	50	35	278
24	120	65	120	345	60	2,660	770	190	55	39	33	260
25	104	70	120	255	50	1,980	685	178	55	45	33	192
26	87	75	120	190	45	1,720	890	149	45	40	35	132
27	65	85	120	140	40	2,960	3,680	830	49	41	35	116
28	56	139	120	140	35	3,060	8,480	2,360	49	108	38	90
29	53	157	120	105	-------	2,260	6,440	1,570	40	92	43	77
30	59	173	90	105	-------	1,720	3,680	1,220	53	112	56	68
31	56	-------	70	65	-------	1,290	-------	2,260	-------	64	39	-------

NOTE.—Stage-discharge relation affected by ice Nov. 12, 13, 25–27, and Dec. 16 to Mar. 16; discharge ascertained by means of gage heights, two discharge measurements, observer's notes, and weather records.

Monthly discharge of Black River at Neillsville, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 774 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	120	30	56.0	0.0724	0.08
November	296	43	104	.134	.15
December	334	70	156	.202	.23
January	355	25	103	.133	.15
February	440	35	100	.129	.13
March	10,600	50	1,880	2.43	2.80
April	8,480	374	1,440	1.86	2.08
May	2,360	149	647	.836	.96
June	4,700	40	939	1.21	1.35
July	187	39	84.5	.109	.13
August	86	26	39.6	.0512	.06
September	278	35	87.1	.113	.13
The year	10,600	25	471	.609	8.25

LA CROSSE RIVER NEAR WEST SALEM, WIS.

LOCATION.—In sec. 32, T. 17 N., R. 6 W., at highway bridge 2 miles west of West Salem, La Crosse County, and 10 miles above mouth of river. Dutch Creek enters from right 6 miles above station.

DRAINAGE AREA.—412 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch= 6 miles).

RECORDS AVAILABLE.—December 22, 1913, to September 30, 1921.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock; free from vegetation. Right bank high and not subject to overflow; left bank, above the gage, low and subject to overflow at flood stages. Control for low stage is a rocky riffle having a fall of about 6 inches; is apparently drowned out at a stage of about 2.2 feet (discharge, 551 second-feet), causing a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.95 feet at 6 p. m. June 10 (discharge, 1,100 second-feet); minimum stage, 0.75 foot at 7 a. m. September 3 (discharge, about 96 second-feet).

1913–1921: Maximum stage recorded, 8.45 feet at 6 p. m. March 16, 1919 (discharge, about 3,620 second-feet); minimum stage recorded, 0.75 foot at 7 a. m. September 3, 1921 (discharge, about 96 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Diurnal fluctuation at the gage, amounting to from 0.10 to 0.40 foot at low stages, is caused by operation of power plants, especially at Neshonoc dam a few miles above station.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 175 and 2,300 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records good except those for low stages which are fair; winter records fair.

Discharge measurements of La Crosse River near West Salem, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 18	G. F. Rittenberg	[a] 1.86	202	Sept. 29	A. O. Olson	1.45	231
May 26	S. R. Collins	1.65	316				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	181	219	288	195	310	210	230	350	350	268	196	173
2	200	308	288	205	270	210	219	328	328	230	248	142
3	156	328	308	220	230	210	196	308	288	187	209	141
4	184	288	268	235	330	210	234	268	268	187	209	142
5	193	288	206	240	370	230	234	268	187	216	212	156
6	187	308	268	255	290	210	209	268	226	206	184	288
7	193	328	234	260	250	210	206	268	216	248	149	219
8	193	416	248	270	310	210	216	230	749	248	206	219
9	184	394	248	280	350	230	206	244	862	200	146	184
10	144	328	248	290	395	244	177	237	972	164	158	177
11	181	328	288	280	460	248	216	206	944	181	193	135
12	196	328	248	260	395	288	219	219	484	170	203	168
13	216	308	248	235	330	234	223	234	371	173	193	179
14	212	193	288	210	290	308	223	219	438	200	155	170
15	219	210	288	205	310	308	248	177	416	328	196	187
16	328	230	248	205	330	328	268	187	371	288	206	248
17	268	250	240	205	370	308	200	248	268	216	184	350
18	268	268	230	205	290	328	241	268	308	248	124	200
19	268	248	220	205	250	308	216	350	268	328	149	241
20	288	268	210	210	210	288	219	350	308	308	184	244
21	288	241	250	680	250	350	219	308	268	234	134	288
22	248	394	290	835	230	288	206	268	268	288	200	288
23	248	350	290	750	210	328	209	328	230	196	184	234
24	177	328	275	640	195	268	200	288	219	181	136	248
25	230	288	255	505	230	308	248	237	226	206	110	160
26	219	288	240	460	195	308	244	268	168	209	153	200
27	206	268	230	415	210	268	328	416	212	177	144	226
28	206	234	210	460	210	308	484	573	350	196	142	206
29	196	268	195	460	-------	268	678	438	288	193	142	181
30	219	288	185	415	-------	268	506	328	241	209	177	177
31	177	-------	175	330	-------	234	-------	371	-------	151	179	-------

NOTE.—Stage-discharge relation affected by ice Nov. 15–17 and Dec. 17 to Mar. 9; discharge ascertained by means of gage heights, one discharge measurement, observer's notes, and weather records.

Monthly discharge of La Crosse River near West Salem, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 412 square miles.]

Month.	Discharge in second-feet.				Run-off in inches
	Maximum.	Minimum.	Mean.	Per square mile.	
October	328	144	215	0.522	0.60
November	416	193	293	.711	.79
December	308	175	249	.604	.70
January	835	195	343	.833	.96
February	460	195	288	.699	.73
March	350	210	268	.650	.75
April	678	177	257	.624	.70
May	573	177	292	.709	.82
June	972	168	370	.898	1.00
July	328	151	220	.534	.62
August	248	110	174	.422	.49
September	350	135	206	.500	.56
The year	972	110	264	.641	8.72

UPPER IOWA RIVER NEAR DECORAH, IOWA.

LOCATION.—Near highway bridge in Freeport, 3 miles below Decorah, Winneshiek County, and 4 miles above upper power plant of Interstate Power Co. Nearest tributary, Trout Run, enters from right 1 mile above station.

DRAINAGE AREA.—560 square miles (measured on United States Geological Survey base map; scale, 1:500,000).

RECORDS AVAILABLE.—August 27, 1913, to November 21, 1914; May 12, 1919, to September 30, 1921.

GAGE.—Gurley 7-day water-stage recorder on left bank 500 feet above highway bridge; installed August 28, 1920. Chain gage attached to handrail of highway bridge used prior to that date. Water-stage recorder at datum 3.96 feet higher than datum of chain gage. Observer, Mrs. W. D. Gross.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed at measuring section composed of sand and gravel; shifting. Control formed by rock ledge; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.21 feet at 11 a. m. May 27 (discharge, 13,200 second-feet); minimum stage, 1.92 feet October 8 and 9 and August 25, 26, and 29 (discharge, 123 second-feet).

1913–14; 1919–1921: Maximum discharge same as for 1921; minimum stage, 2.15 feet (chain-gage datum) September 10 and 13–16, 1913 (discharge, 37 second-feet).

ICE.—Stage-discharge relation affected by ice for short periods during extremely cold weather.

REGULATION.—Operation of several mills in Decorah may cause slight diurnal fluctuation.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 100 and 12,000 second-feet. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder graph by inspection except for periods of ice effect and periods during which recorder did not operate, for which it was ascertained as indicated in footnote to daily-discharge table. Records good.

Discharge measurements of Upper Iowa River near Decorah, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 8	2.23	256	May 28	9.23	7,960	May 30	4.51	1,700
Jan. 14	2.01	166	28	8.91	6,920	June 12	3.64	1,040
May 26	6.55	3,750	29	5.91	3,020	13	3.08	700
27	10.00	11,800	29	5.19	2,370	Sept. 28	2.19	224

Daily discharge, in second-feet, of Upper Iowa River near Decorah, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	131	317	317	223	273	295	295	440	1,610	295	157	195
2	127	317	317	239	273	295	273	420	1,300	317	180	215
3	131	235	317	231	252	273	260	380	1,090	340	153	199
4	138	248	317	235	244	265	248	360	950	317	149	317
5	138	227	295	231	239	317	231	340	880	411	153	461
6	146	363	295	235	190	317	235	329	782	295	149	199
7	134	461	260	239	160	273	239	317	688	340	146	157
8	123	411	227	223	200	269	239	273	658	273	142	153
9	123	461	235	200	219	260	363	317	628	265	134	153
10	127	363	235	190	235	235	363	461	950	260	153	180
11	134	340	227	190	231	248	295	542	950	252	570	164
12	149	252	227	180	219	244	260	880	880	239	211	138
13	161	273	244	180	223	235	239	1,230	658	239	161	142
14	273	273	273	170	363	239	248	782	658	231	153	340
15	688	295	157	176	1,530	256	265	688	628	223	146	570
16	317	256	190	150	1,530	235	273	658	488	231	138	1,160
17	295	260	190	150	658	227	340	1,800	436	199	164	1,860
18	273	252	170	200	688	227	317	2,600	387	436	153	461
19	252	244	200	172	542	248	265	2,400	387	340	187	411
20	231	239	240	461	436	295	239	1,900	2,120	244	161	488
21	215	514	227	1,090	436	295	252	1,300	719	203	134	514
22	199	340	227	750	461	295	260	950	436	203	142	387
23	180	295	240	480	317	295	239	782	387	231	142	317
24	168	317	240	500	295	317	256	750	363	340	131	295
25	164	295	240	520	317	317	239	1,020	599	191	123	363
26	157	269	220	500	317	317	231	3,570	436	183	123	273
27	149	265	220	420	273	363	317	8,580	488	172	131	265
28	146	265	220	387	269	363	461	9,040	340	168	127	239
29	146	273	200	363	------	461	658	3,240	340	164	123	223
30	142	295	203	317	------	387	614	3,240	317	161	252	207
31	157	------	195	295	------	317	------	3,240	------	149	436	-----

NOTE.—Stage-discharge relation affected by ice Dec. 16–20, 23–29, Jan. 9–18, 23–27, and Feb. 6–8; discharge ascertained by means of gage heights, one discharge measurement, and weather records. Water-stage recorder did not operate satisfactorily May 1–6 and 17–20; discharge estimated from partial gage-height record.

Monthly discharge of Upper Iowa River near Decorah, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 560 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	688	123	191	0.341	0.39
November	514	227	307	.548	.61
December	317	157	238	.425	.49
January	1,090	150	319	.570	.66
February	1,530	160	407	.727	.76
March	461	227	290	.518	.60
April	658	231	297	.530	.59
May	9,040	273	1,700	3.04	3.50
June	2,120	317	718	1.28	1.43
July	436	149	255	.455	.52
August	570	123	175	.312	.36
September	1,860	138	368	.657	.73
The year	9,040	123	440	.786	10.64

WISCONSIN RIVER AT WHIRLPOOL RAPIDS, NEAR RHINELANDER, WIS.

LOCATION.—In sec. 4, T. 35 N., R. 8 E., at head of Whirlpool Rapids, 1 mile below mouth of outlet of Crescent Lake, which comes in from right, 3 miles downstream from power station of Rhinelander Power Co., and 10 miles southwest of Rhinelander, Lincoln County.

DRAINAGE AREA.—1,160 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—September 15, 1915, to September 30, 1921. December 1, 1905, to September 30, 1915, records were collected at a station about 3 miles upstream.

GAGE.—Stevens continuous water-stage recorder with wooden well and shelter, on right bank; inspected by C. W. Jewell.

DISCHARGE MEASUREMENTS.—Made from cable 150 feet upstream from gage.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Banks medium high and not subject to overflow. Control is head of rapids, 100 feet downstream from gage; well defined and permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.65 feet at 5 a. m. April 30 (discharge, 3,620 second-feet); minimum stage recorded, 0.75 foot at 6 p. m. December 12 (discharge, 196 second-feet).

1905–1921: Maximum stage recorded, 5.61 feet at 10 p. m. April 22, 1916 (discharge, 5,250 second-feet); minimum discharge, practically no flow, at old station, during August and September, 1907, and June and July, 1908; minimum stage at present location, 0.65 foot at 8 p. m. July 7, 1918 (discharge, 165 second-feet). Discharge at present location of station will probably never be zero. Minimum discharge caused almost entirely by regulation.

REGULATION.—Above the station are 14 reservoirs [3] which are operated by the Wisconsin Valley Improvement Co. for the purpose of regulating the flow of Wisconsin River. The aggregate capacity of these reservoirs is 2.8 billion cubic feet during the summer and 3.6 billion cubic feet during the winter. Owing to the operation of these various storage reservoirs and the service reservoirs of three power plants on the river above, the flow at the station is not natural.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 212 and 5,410 second-feet. Operation of water-stage recorder satisfactory except as indicated in footnote to table of daily discharge. Daily discharge ascertained by means of discharge integrator except for period of ice effect and period during which recorder was not operating for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records excellent except those for period during which recorder was not operating which are fair; winter records possibly poor.

Discharge measurements of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28 [a]	S. B. Soulé	2.66	910	May 4	S. R. Collins	4.23	3,000
Feb. 4 [a]	S. R. Collins	2.53	948	July 18	A. O. Olson	2.05	758
Mar. 4 [a]	do	2.38	856				

[a] Measurement made from highway bridge 2 miles above station and just below Hat Rapids power plant. Ice along shore.

[3] Information concerning these reservoirs, based on maps and data furnished by W. E. Brooks, manager of Wisconsin Valley Improvement Co., and data collected by the engineering department of the Railroad Commission of Wisconsin, is contained in Water-Supply Paper 405, p. 127.

Daily discharge, in second-feet, of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	830	556	579	987	844	970	2,640	3,360	1,200	671	652	821
2	514	714	550	922	902	1,010	2,620	3,220	1,130	717	652	762
3	296	898	610	857	902	872	2,680	2,900	1,260	536	544	837
4	570	851	593	1,030	792	975	2,340	2,710	1,160	410	608	695
5	590	737	438	987	968	1,000	2,220	2,810	1,040	652	750	472
6	482	600	400	909	870	1,140	2,000	2,780	1,320	766	744	510
7	459	445	538	922	844	931	2,230	2,450	1,130	682	890	728
8	478	400	562	974	870	914	2,550	1,980	1,180	705	393	598
9	452	403	496	668	883	905	1,910	2,060	1,200	678	520	606
10	500	457	362	1,090	844	916	1,950	1,720	1,210	602	520	700
11	592	576	348	922	766	878	1,970	1,380	1,300	627	492	622
12	487	543	274	857	818	880	1,980	1,860	1,180	742	744	642
13	560	478	417	692	1,600	583	1,760	1,560	1,330	738	666	742
14	521	333	976	753	1,150	544	1,660	1,500	1,030	754	738	612
15	736	371	863	844	1,160	568	1,810	1,210	1,040	800	648	654
16	781	398	766	857	1,100	736	1,780	1,170	969	881	684	672
17	640	472	923	716	1,170	570	1,500	1,020	990	762	684	762
18	618	357	850	857	1,110	623	1,420	861	979	713	453	696
19	594	340	510	883	1,060	1,060	1,360	1,080	734	992	585	584
20	734	366	495	857	992	1,580	1,060	1,070	672	885	549	848
21	942	398	728	857	1,150	1,350	1,320	1,100	1,000	917	792	1,100
22	832	413	620	844	1,030	1,420	1,040	970	975	850	905	986
23	764	576	818	883	1,110	1,520	1,000	1,090	979	761	995	960
24	780	560	779	792	1,060	1,690	1,480	1,000	715	550	792	906
25	742	540	710	935	1,040	1,770	1,420	985	665	640	702	700
26	605	514	772	902	1,020	2,080	1,680	991	474	672	1,120	640
27	772	523	740	844	688	2,500	2,300	928	505	768	950	848
28	578	330	805	922	662	2,880	3,060	1,080	540	677	1,180	980
29	616	432	909	844	-------	2,310	3,020	870	685	754	1,200	936
30	541	585	974	857	-------	2,440	3,230	1,060	661	672	1,150	1,070
31	610	-------	961	792	-------	2,890	-------	1,190	-------	686	855	-------

NOTE.—Stage-discharge relation affected by ice Dec. 19 to Feb. 13; discharge based on gage readings and discharge measurements at Hat Rapids power plant, and comparison with flow of Wisconsin River at Merrill, Wis. Recorder not operating during period Aug. 3–28; discharge ascertained by means of gage heights from Weather Bureau gage at Hat Rapids and comparison with flow of Wisconsin River at Merrill, Wis.

Monthly discharge of Wisconsin River at Whirlpool Rapids, near Rhinelander, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 1,160 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	942	296	620	0.534	0.62
November	898	330	506	.436	.49
December	976	274	657	.566	.65
January	1,090	668	873	.753	.87
February	1,600	662	979	.844	.88
March	2,890	544	1,310	1.13	1.30
April	3,230	1,000	1,970	1.70	1.90
May	3,360	861	1,610	1.39	1.60
June	1,330	474	975	.841	.94
July	992	410	718	.619	.71
August	1,200	393	747	.644	.74
September	1,100	472	756	.652	.73
The year	3,360	274	975	.841	11.43

WISCONSIN RIVER AT MERRILL, WIS.

LOCATION.—At highway bridge at east end of Merrill, Lincoln County, 1,000 feet below power house of Merrill plant of Wisconsin Valley Lighting Co. and half a mile below mouth of Prairie River, which comes in from left.

DRAINAGE AREA.—2,630 square miles.

RECORDS AVAILABLE.—November 16, 1902, to September 30, 1921.

GAGE.—Stevens water-stage recorder installed September 11, 1914. November 16, 1902, to June 17, 1903, staff gage; June 17, 1903, to September 10, 1914, chain gage attached to downstream side of highway bridge; datum same since June 17, 1903. Records prior to June 17, 1903, questionable. Recorder inspected by O. F. Lueck.

DISCHARGE MEASUREMENTS.—Made from highway bridge a few feet upstream from recording gage.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock; nearly permanent. Small island below gage and small rapids on either side probably constitute control. Banks fairly high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.12 feet at 7 p. m. April 27 (discharge, 14,800 second-feet); minimum stage recorded, 2.95 feet at 6 a. m. August 1 (discharge, about 425 second-feet); minimum discharge caused by regulation.

1902–1921: Maximum stage recorded, about 17.5 feet at 5 a. m. July 24, 1912 (discharge, about 45,000 second-feet); minimum stage, 2.45 feet September 26, 1908 (discharge, about 90 second-feet).

REGULATION.—Above the gaging station are 17 reservoirs,[4] which are operated by Wisconsin Valley Improvement Co. for the purpose of regulating the flow in Wisconsin River. The aggregate capacity of these reservoirs is about 6¼ billion cubic feet. In addition to the above reservoirs, there are on Wisconsin and Tomahawk rivers above the station eight dams operated for power.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve fairly well defined between 800 and 19,400 second-feet. Operation of water-stage recorder very satisfactory. Daily discharge ascertained by means of discharge integrator. Open-water records excellent; winter records fair.

Discharge measurements of Wisconsin River at Merrill, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 28	D. W. Roberts	4.10	1,080	Mar. 2[a]	S. R. Collins	4.83	1,870
Dec. 28[a]	S. R. Collins	5.22	1,980	July 15	A. O. Olson	4.90	1,890
Feb. 2[a]	do	4.69	1,540				

[a] Ice had formed on river wherever current was sluggish.

[4] Information concerning these reservoirs, based on maps and data furnished by the manager of Wisconsin Valley Improvement Co. and data collected by the engineering department of Wisconsin Railroad Commission, is contained in Water-Supply Paper 405, p. 127.

Daily discharge, in second-feet, of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,500	1,420	1,520	1,800	1,560	1,600	6,470	9,410	3,270	1,100	1,120	1,900
2	1,490	2,020	1,710	1,620	1,540	1,720	5,790	8,080	3,320	1,510	1,500	1,620
3	1,500	1,720	1,700	1,430	1,420	1,640	5,500	6,990	3,230	1,820	1,610	1,730
4	1,250	1,870	1,680	1,860	1,500	1,650	5,820	6,080	2,960	1,010	1,550	1,560
5	1,400	2,120	1,680	1,560	1,280	1,680	5,640	5,880	2,320	953	1,390	1,370
6	1,360	1,790	1,240	1,450	1,610	1,750	5,500	5,290	2,200	1,640	1,240	958
7	1,370	1,720	1,610	1,480	1,240	1,720	5,860	4,990	3,450	1,410	1,140	1,070
8	1,270	1,200	1,370	1,530	1,600	1,980	6,150	4,320	4,220	1,680	968	1,850
9	1,250	1,550	1,550	1,480	1,570	1,640	6,220	3,370	4,180	1,870	1,120	1,440
10	1,310	1,290	1,530	982	1,400	1,760	5,310	3,360	4,760	1,660	1,100	1,290
11	1,000	1,410	1,380	1,760	1,470	1,790	5,160	2,670	5,540	1,200	1,290	1,350
12	1,100	1,150	1,270	1,500	1,380	1,800	4,930	2,240	4,880	1,420	1,270	1,050
13	1,190	1,180	1,010	1,440	1,620	1,760	4,710	3,260	3,840	1,480	1,350	1,280
14	1,200	1,090	1,790	1,200	1,300	1,030	4,530	3,000	3,010	1,750	1,780	1,770
15	1,420	1,100	1,770	1,330	2,060	1,530	4,880	2,920	2,500	1,930	1,450	1,440
16	1,560	1,180	1,880	1,550	1,890	1,510	4,990	2,420	2,310	1,600	1,470	1,480
17	1,800	1,290	1,950	990	1,720	1,460	4,320	2,660	2,220	1,780	1,260	1,780
18	1,130	1,360	1,930	1,750	1,840	1,630	3,770	2,700	1,970	1,260	1,410	1,640
19	1,670	1,070	1,670	1,430	1,660	1,700	3,090	2,540	1,770	1,390	1,460	1,230
20	1,690	1,230	1,150	1,470	1,840	8,530	3,130	2,540	1,170	1,570	1,280	1,400
21	2,090	1,390	1,540	1,390	1,360	9,840	3,210	2,540	1,640	2,000	1,270	1,950
22	2,380	948	1,660	1,510	1,850	6,820	3,940	2,240	1,620	1,710	980	2,140
23	2,300	1,370	1,660	1,730	1,700	6,880	5,420	1,600	1,560	1,460	1,250	1,970
24	2,150	1,540	1,730	1,380	1,640	6,790	4,610	2,160	1,750	1,220	1,550	1,970
25	1,200	1,590	1,670	1,890	1,580	6,470	4,540	2,080	1,820	1,200	1,520	2,010
26	2,020	1,300	1,550	1,750	1,680	7,170	4,910	1,960	1,540	1,340	1,440	1,180
27	1,720	1,510	1,240	1,630	1,540	9,660	11,200	2,250	1,540	1,420	1,850	1,460
28	1,560	1,400	1,980	1,400	1,110	10,500	13,500	3,170	1,610	1,290	2,040	1,630
29	1,680	1,100	1,970	1,680	-------	9,600	13,500	3,320	1,480	1,250	1,430	1,630
30	1,470	1,570	2,340	1,730	-------	7,810	11,700	2,570	1,280	1,470	1,470	1,790
31	1,590	-------	2,040	1,300	-------	6,540	-------	3,240	-------	1,320	2,180	-------

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 1; discharge ascertained by means of the discharge integrator, allowance being made for the effect of backwater from ice on basis of three discharge measurements, observer's notes, and weather records.

Monthly discharge of Wisconsin River at Merrill, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 2,630 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,380	1,000	1,540	0.586	0.68
November	2,120	948	1,420	.540	.60
December	2,340	1,010	1,640	.624	.72
January	1,890	982	1,520	.578	.67
February	2,060	1,110	1,570	.597	.62
March	10,500	1,030	4,130	1.57	1.81
April	13,500	3,090	5,940	2.26	2.52
May	9,410	1,600	3,610	1.37	1.58
June	5,540	1,170	2,630	1.00	1.12
July	2,000	953	1,470	.559	.64
August	2,180	968	1,410	.536	.62
September	2,140	958	1,560	.593	.66
The year	13,500	948	2,370	.901	12.24

WISCONSIN RIVER AT KNOWLTON, WIS.

LOCATION.—In N. ½ sec. 29, T. 26 N., R. 7 E., 50 feet below left end of combination railroad and highway bridge of Chicago, Milwaukee & St. Paul Railway on State trunk highway No. 73 at Knowlton, Marathon County, 1½ miles below mouth of Big Eau Pleine River, which enters from right.

DRAINAGE AREA.—4,360 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—July 13 to September 30, 1921. Gage heights obtained since May 1, 1915, published by United States Weather Bureau in "Daily river stages."

GAGE.—Gurley water-stage recorder in wooden shelter 50 feet below left end of bridge; installed August 6, 1921; inspected by W. T. Gunther. Friez water-stage recorder in same shelter used July 13 to August 5, 1921. United States Weather Bureau used a chain gage on downstream handrail of bridge about 150 feet from left end; installed July 15, 1914. Recording gages set to same datum as Weather Bureau chain gage.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge. Extremely low-stage measurements are made by wading or from a boat opposite a small island about 2,500 feet below gage. Measuring conditions poor at bridge below a discharge of about 5,000 second-feet.

CHANNEL AND CONTROL.—Bed composed of sand and light gravel. Control not well defined; there is, however, a decided contraction of channel at island about 2,500 feet below gage. Right bank high; will seldom be overflowed. Left bank medium high; is overflowed at extreme flood stages.

EXTREMES OF DISCHARGE.—Maximum discharge during period not determined; minimum stage recorded, 1.00 foot at 2 a. m. August 15 (discharge, about 900 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No storage reservoirs discharge into Wisconsin River between Knowlton and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 85). Between Knowlton and Merrill are four dams operated for power.

ACCURACY.—Stage-discharge relation probably permanent. Rating curve, based on measurements made during 1921 and 1922, fairly well defined between 1,600 and 30,000 second-feet; poorly defined below 1,600 second-feet. Operation of water-stage recorder satisfactory except during period July 24–31. Daily discharge ascertained by means of the discharge integrator, except for period during which recorder did not operate, for which it was not determined. Records fair.

Discharge measurements of Wisconsin River at Knowlton, Wis., during the year ending Sept. 30, 1921.

[Made by S. B. Soulé.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 6	2.75	2,270
June 17	3.73	3,790
Aug. 29	3.20	2,700

Daily discharge, in second-feet, of Wisconsin River at Knowlton, Wis., for the year ending Sept. 30, 1921.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	------	2,450	2,210	11	------	1,860	1,820	21	2,200	1,630	2,340
2	------	2,500	2,620	12	------	1,790	1,730	22	2,230	1,680	2,410
3	------	2,450	2,550	13	2,550	1,800	2,230	23	2,200	2,110	2,560
4	------	2,300	1,860	14	2,340	1,460	1,960	24	------	2,020	2,830
5	------	2,390	1,610	15	2,860	1,350	1,760	25	------	1,930	2,340
6	------	2,220	2,090	16	2,700	1,900	2,040	26	------	1,960	2,630
7	------	1,640	2,140	17	2,260	1,880	2,220	27	------	1,880	2,400
8	------	1,190	2,430	18	2,220	2,050	1,980	28	------	1,400	2,240
9	------	2,320	2,390	19	2,480	2,100	1,870	29	------	2,090	2,300
10	------	2,060	2,180	20	2,460	2,060	2,480	30	------	2,500	2,410
								31	------	2,140	------

NOTE.—No record obtained, discharge not determined, July 24-31.

Monthly discharge of Wisconsin River at Knowlton, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 4,360 square miles.]

Month.	Discharge in second-feet.				Run-off, in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
August	2,500	1,190	1,970	0.452	0.52
September	2,830	1,610	2,220	.509	.57

WISCONSIN RIVER NEAR NEKOOSA, WIS.

LOCATION.—In sec. 15, T. 21 N., R. 5 E., 1½ miles below Nekoosa, Wood County. Tenmile Creek enters from left 4 miles below station, and Big Roche a Cri Creek, also from left, 38 miles below.

DRAINAGE AREA.—5,500 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—May 21, 1914, to September 30, 1921.

GAGE.—Stevens water-stage recorder, installed July 18, 1916, in wooden shelter on right bank; prior to that date Gurley water-stage recorder at same location. Gage attended by Henry Mans.

DISCHARGE MEASUREMENTS.—Made from a cable a short distance upstream from gage.

CHANNEL AND CONTROL.—Bed composed of gravel; clean; practically permanent. Banks high and are seldom overflowed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.2 feet at 11.30 p. m. March 22 (discharge, 39,400 second-feet); minimum discharge, estimated 635 second-feet February 1 (stage-discharge relation affected by ice).

1914–1921: Maximum stage recorded, about 15.3 feet during the flood of June 6–9, 1914, as determined by levels run to high-water marks after water had receded (discharge, about 54,000 second-feet); minimum stage recorded, 0.45 foot at 11 a. m. November 7, 1915 (discharge, 595 second-feet); minimum flow caused by regulation.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—No storage reservoirs discharge into Wisconsin River between Nekoosa and Merrill. See "Regulation" in station description of Wisconsin River at Merrill (p. 85). Between Nekoosa and Merrill are 12 dams operated for power.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined. Operation of water-stage recorder very satisfactory. Daily discharge ascertained by means of discharge integrator, except for period of ice effect for which it was ascertained as indicated in footnote to daily-discharge table. Open-water records excellent; winter records subject to considerable error.

Discharge measurements of Wisconsin River near Nekoosa, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 18	S. B. Soulé	2.73	4,160	July 12	A. O. Olson	1.40	1,940

Daily discharge, in second-feet, of Wisconsin River near Nekoosa, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,280	2,890	2,780	2,840	1,550	2,500	11,600	29,500	5,730	2,810	1,930	1,900
2	2,360	1,870	3,020	2,580	1,890	2,580	10,200	21,000	6,100	2,720	2,000	2,520
3	1,920	2,880	2,960	2,840	2,580	2,420	9,440	15,700	5,680	3,140	2,650	3,200
4	2,000	2,580	3,270	2,580	2,040	2,340	8,150	12,300	5,120	2,900	2,370	2,720
5	1,630	3,020	3,180	2,110	2,110	2,180	8,730	10,400	4,750	1,500	2,060	2,380
6	1,740	3,180	3,410	1,960	2,110	2,620	8,180	9,020	3,680	1,380	2,200	1,010
7	1,860	2,960	2,680	1,820	2,260	2,840	8,510	8,080	3,620	1,020	1,800	1,980
8	1,860	2,730	2,800	1,960	2,340	2,250	9,170	7,800	5,020	2,080	1,920	2,280
9	1,880	2,730	2,700	1,890	2,420	2,960	9,350	7,520	8,720	2,100	1,760	2,270
10	1,790	2,810	2,420	1,750	2,500	2,640	10,400	5,710	9,020	1,990	1,590	2,780
11	1,880	2,420	2,300	1,430	2,340	2,960	10,300	5,300	10,400	1,660	2,050	1,740
12	1,540	2,480	2,740	1,380	1,680	2,760	9,250	4,860	15,300	1,840	1,720	2,010
13	2,720	1,730	2,280	1,750	1,890	2,900	8,830	4,140	17,000	2,440	1,810	1,550
14	2,020	2,030	2,120	1,890	1,820	2,950	8,230	4,500	11,800	2,670	1,490	2,020
15	2,030	2,260	2,910	2,260	2,110	2,850	8,160	5,200	8,080	2,180	1,610	2,040
16	2,220	1,930	2,740	1,960	1,490	3,150	8,640	4,610	6,120	3,570	1,660	1,870
17	1,950	1,750	2,340	2,750	3,100	3,200	8,300	4,280	5,280	2,560	1,950	1,820
18	1,880	1,940	3,100	2,580	3,100	3,020	8,340	4,540	4,380	2,200	1,670	2,120
19	1,740	2,010	2,670	2,040	2,660	3,220	6,200	4,830	3,690	2,720	1,670	2,080
20	1,870	2,100	3,540	2,420	2,580	7,160	6,000	4,700	2,100	2,970	1,840	2,060
21	2,680	2,240	2,880	2,340	3,370	18,400	5,200	4,600	3,530	2,230	1,640	2,980
22	2,290	2,070	2,610	1,960	2,110	34,800	5,520	4,740	2,990	2,180	1,900	2,300
23	2,640	1,880	2,790	1,820	2,660	33,100	5,980	3,860	3,230	2,010	1,690	2,750
24	3,390	2,280	2,670	2,110	2,580	20,400	9,760	4,080	2,850	2,040	1,860	2,900
25	2,900	2,580	2,500	1,890	2,260	15,800	10,300	3,780	2,190	1,540	1,850	3,190
26	2,920	2,730	2,260	2,500	2,340	13,200	9,300	2,830	2,310	1,620	1,740	2,250
27	3,340	2,800	2,180	2,580	2,580	12,900	12,300	3,240	2,320	2,100	2,010	3,040
28	2,520	1,980	2,840	2,580	2,840	16,100	21,400	4,460	2,070	2,620	1,840	2,490
29	2,720	2,640	3,190	2,580	-------	20,100	33,500	8,590	2,720	2,100	1,850	1,780
30	2,200	1,920	3,550	2,040	-------	18,300	38,200	8,720	2,650	2,060	1,720	2,330
31	1,810	-------	3,190	2,110	-------	15,200	-------	7,080	-------	1,920	3,040	-------

NOTE.—Stage-discharge relation affected by ice Dec. 25 to Mar. 4; discharge ascertained by means of gage heights from recorder graph, weather records, and comparison with flow of this river at Merrill, Wis., taking into account the effect of regulation at storage reservoirs.

Monthly discharge of Wisconsin River near Nekoosa, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 5,500 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,390	1,540	2,210	0.402	0.46
November	3,180	1,730	2,380	.433	.48
December	3,550	2,120	2,790	.507	.58
January	2,840	1,380	2,170	.395	.46
February	3,370	1,490	2,330	.424	.44
March	34,800	2,180	8,960	1.63	1.88
April	38,200	5,200	10,900	1.98	2.21
May	29,500	2,830	7,420	1.35	1.56
June	17,000	2,070	5,620	1.02	1.14
July	3,570	1,020	2,220	.404	.47
August	3,040	1,490	1,900	.345	.40
September	3,200	1,010	2,280	.415	.46
The year	38,200	1,010	4,270	.776	10.54

WISCONSIN RIVER AT MUSCODA, WIS.

LOCATION.—In sec. 1, T. 8 N., R. 1 W., at highway bridge 1 mile north of Muscoda, Grant County. Eagle Mill Creek enters from right half a mile below station, and Underwood Creek enters from left, 4½ miles above.

DRAINAGE AREA.—10,300 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 20, 1902, to December 31, 1903; December 1, 1913, to September 30, 1921. Gage heights November 1, 1908, to December 31, 1912, published in United States Weather Bureau bulletin, Daily River Stages, parts 9, 10, and 11.

GAGE.—Chain gage fastened to handrail on upstream side of bridge; read by William Hessler. Elevation of zero of present gage about 12.62 feet above that of gage maintained December 20, 1902, to December 3, 1913; elevation of gage read by United States Weather Bureau during period November, 1908, to December 3, 1913, was approximately the same as that of present gage, sea-level elevation of which is about 666.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.74 feet at 7 a. m. May 6 (discharge, 39,000 second-feet); minimum discharge, estimated 1,600 second-feet December 20 (stage-discharge relation affected by ice).

1903 and 1914–1921: Maximum stage recorded, 10.10 feet April 2, 1920 (discharge, 64,400 second-feet); minimum discharge same as for 1921.

According to records of United States Weather Bureau [5] (see note under "Gage"), on June 11, 1881, the river reached a stage of 11.1 feet and during August, 1868, zero on gage; discharge not determined owing to probable changes in channel and datum of gage.

REGULATION.—Nearest power plant above station is at Prairie du Sac, about 40 miles distant; since latter part of 1915 considerable diurnal fluctuation has been observed at gage. Owing to regulation by storage in the headwaters, flow at this station is not natural.

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice. Standard rating curve fairly well defined between 3,000 and 45,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by indirect method for shifting control except for period of ice effect for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records poor; winter records subject to error.

[5] Daily river stages, pt. 10, p. 98.

Discharge measurements of Wisconsin River at Muscoda, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 11	Soulé and Roberts	0.56	3,090	May 24	Soulé and Collins	2.74	8,820
Mar. 24	Soulé and Collins	3.71	14,000	Sept. 27	A. O. Olson	1.84	6,090

Daily discharge, in second-feet, of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4,690	3,560	6,700	4,820	5,990	5,480	19,200	17,700	12,200	5,480	3,780	4,220
2	4,450	4,690	6,380	2,120	6,540	5,480	28,800	20,300	12,600	5,480	4,000	4,000
3	4,220	4,690	6,060	4,480	5,900	5,200	21,400	25,100	12,200	4,450	4,220	3,780
4	3,120	4,450	5,200	6,850	5,240	5,200	21,400	33,200	10,900	4,000	4,450	4,000
5	4,220	4,450	6,060	7,460	5,190	5,760	17,700	36,800	8,900	3,780	4,000	4,450
6	4,690	4,450	5,200	7,050	5,140	5,760	14,800	37,700	10,500	4,220	3,560	4,450
7	4,690	4,450	6,700	6,330	1,890	4,940	12,600	28,500	8,140	4,690	3,340	5,760
8	4,450	3,120	6,700	6,810	6,040	6,060	14,400	20,300	7,040	4,690	3,340	4,940
9	4,450	4,450	6,380	6,740	5,590	6,700	14,800	15,800	7,400	4,690	3,780	4,940
10	4,220	5,200	6,380	5,170	4,930	6,060	13,500	15,300	7,040	4,450	4,000	4,940
11	3,340	4,940	6,380	7,040	4,930	7,040	11,300	13,900	8,140	3,780	4,220	4,940
12	4,000	5,760	6,060	6,680	4,840	7,400	14,400	10,900	8,520	4,000	4,220	4,220
13	4,450	6,060	4,450	5,980	5,040	7,760	12,200	9,700	10,100	4,220	4,000	4,690
14	4,690	4,940	6,060	5,490	2,170	5,200	13,900	10,900	13,500	4,220	4,000	4,690
15	4,690	3,560	5,250	4,980	6,410	8,140	14,800	10,900	14,400	4,000	3,340	4,450
16	4,690	4,450	5,800	4,980	6,040	8,900	14,800	8,140	14,800	3,780	3,560	6,700
17	4,450	4,690	6,140	1,900	5,550	6,700	13,500	7,760	18,200	3,560	3,780	8,520
18	3,340	4,690	4,850	5,180	6,380	7,400	13,000	8,520	15,300	3,340	4,000	8,520
19	4,000	4,690	4,440	5,240	6,380	8,520	12,200	11,300	10,100	3,780	3,780	6,380
20	4,220	5,200	1,600	5,240	6,380	7,040	11,300	9,300	11,300	4,000	4,000	6,700
21	4,000	4,940	4,720	5,000	7,040	6,380	13,500	7,400	8,140	4,220	3,780	8,140
22	4,000	4,690	4,750	5,130	7,400	7,400	14,800	8,900	6,700	4,220	3,560	7,760
23	4,000	5,480	5,340	5,200	7,040	8,900	12,200	9,300	6,700	4,000	3,560	7,400
24	4,000	5,200	4,330	4,500	9,300	13,900	9,700	8,140	6,700	3,780	3,780	5,760
25	3,120	5,200	3,820	7,100	7,040	20,300	10,100	10,900	7,040	3,780	3,780	6,700
26	3,780	4,940	2,310	7,100	5,760	21,900	10,100	11,300	6,700	5,200	3,560	5,760
27	4,220	5,480	2,120	6,730	5,480	26,400	12,600	12,200	6,060	4,000	3,560	6,060
28	4,220	5,480	4,500	6,250	4,000	36,800	15,300	13,900	6,380	4,000	3,560	6,060
29	4,220	4,450	4,400	5,980	-------	28,500	17,200	10,500	5,760	4,000	2,900	5,760
30	4,220	6,380	4,500	6,700	-------	19,700	17,200	7,760	5,200	4,220	3,560	5,480
31	4,000	-------	4,530	4,720	-------	19,700	-------	9,700	-------	4,220	4,450	-------

NOTE.—Stage-discharge relation affected by ice Dec. 15 to Feb. 17; discharge ascertained by means of gage heights, observer's notes, weather records, and comparison with flow at Prairie du Sac plant of Wisconsin Power, Light & Heat Co., as determined by kilowatt output.

Monthly discharge of Wisconsin River at Muscoda, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 10,300 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,690	3,120	4,160	0.404	0.47
November	6,380	3,120	4,820	.468	.52
December	6,700	1,600	5,100	.495	.57
January	7,460	1,900	5,640	.548	.63
February	9,300	1,890	5,700	.553	.58
March	36,800	4,940	11,000	1.07	1.23
April	23,800	9,700	14,600	1.42	1.58
May	37,700	7,400	14,900	1.45	1.67
June	18,200	5,200	9,560	.928	1.04
July	5,480	3,340	4,200	.408	.47
August	4,450	2,900	3,790	.368	.42
September	8,520	3,780	5,670	.550	.61
The year	37,700	1,600	7,430	.721	9.79

81182—24†—WSP 525——7

TOMAHAWK RIVER NEAR BRADLEY, WIS.

LOCATION.—In sec. 16, T. 36 N., R. 6 E., 2 miles west of Cassion, 4 miles north of Bradley, Oneida County, 4 miles downstream from mouth of Bearskin Creek, which comes in from right, and 8 miles above mouth of river.

DRAINAGE AREA.—422 square miles.

RECORDS AVAILABLE.—September 18, 1914, to September 30, 1921.

GAGE.—Slope gage fastened to concrete posts on right bank of river, installed September 24, 1919; prior to that date, chain gage fastened to cantilever arm on right bank; both gages at same datum; read by Frank Sutherland.

DISCHARGE MEASUREMENTS.—Made from cable about half a mile below gage.

CHANNEL AND CONTROL.—Bed at gage and a short distance below composed of sand; subject to shift; bed at cable composed of heavy gravel. Control is formed by rapids about 2,000 feet below gage. When a head of 15 feet is maintained on Rice Lake storage dam, in sections 4 and 9, T. 35 N., R. 6 E., backwater will extend half way up the rapids and may affect stage-discharge relation. The maximum head maintained during the year was considerable less than 15 feet.

EXTREMES OF DISCHARGE.—Maximum discharge, estimated because of lack of, gage readings, 1,650 second-feet April 8; minimum stage recorded, 1.27 feet at 6.50 a. m. July 1 and 6.40 a. m. August 9 and 13 (discharge, 132 second-feet).

1914–1921: Maximum stage recorded, 6.9 feet April 24, 1916 (discharge, 2,200 second-feet); minimum stage recorded July 1 and August 9 and 13, 1921.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATIONS.—The following reservoirs are maintained upstream from the station, for the purpose of regulating the flow of Wisconsin River.

Dams and reservoirs on Tomahawk River.

Name.	Location of reservoir.	Location of dam.	Area of reservoir.	Drainage area.	Capacity (millions of cubic feet).	
					Summer.	Winter.
			Square miles	*Square miles*		
Squirrel	T. 39 N., R. 5 E.	Sec. 30, T. 39 N., R. 5 E.	3.00	17.07	152	152
Minocqua	Tps. 38–40 N., Rs. 6–7 E.	Sec. 10, T. 39 N., R. 6 E.	11.31	81.60	291	651
			14.31	98.67	443	803

ACCURACY.—Stage-discharge relation probably permanent except as affected by ice. Rating curve well defined above 350 second-feet; fairly well defined below that point. Gage read to hundredths twice daily except during period November 18 to April 23, when gage was read only on days when discharge measurements were made. Discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice and other periods during which gage was not read for which it was ascertained as indicated in footnote to table of daily discharge. High-water records for periods during which gage was read, good; low-water records fair; records for periods during which gage was not read, subject to considerable error.

Discharge measurements of Tomahawk River near Bradley, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1921.		*Feet.*	*Sec.-ft.*	1921.		*Feet.*	*Sec.-ft.*
Oct. 24	S. B. Soulé	2.58	389	Mar. 3[b]	S. R. Collins	2.50	246
Dec. 29[a]	S. R. Collins	2.70	295	July 16	A. O. Olson	1.99	288
Feb. 3[b]	do	2.65	283				

[a] Complete ice cover; some frazil ice. [b] Complete ice cover.

Daily discharge, in second-feet, of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	257	312	295	315	290	250	925	1,000	746	132	237	209
2	247	323	295	320	285	245	985	961	713	152	218	200
3	247	323	295	325	285	245	1,050	850	589	209	200	200
4	247	334	300	330	285	245	1,470	815	502	209	183	200
5	237	323	305	345	280	240	1,520	746	447	200	175	237
6	237	323	310	355	280	250	1,520	650	421	192	167	218
7	237	312	315	365	280	255	1,610	589	421	200	145	209
8	237	312	315	375	280	265	1,650	530	474	237	138	200
9	237	312	310	385	275	270	1,610	502	447	257	132	192
10	257	300	300	395	275	275	1,290	474	447	257	145	192
11	257	314	295	405	275	275	1,230	447	421	228	145	183
12	257	328	290	410	270	275	1,190	447	395	218	138	175
13	257	342	280	410	270	280	1,150	559	358	218	132	167
14	257	356	270	390	270	285	1,110	619	334	247	160	167
15	278	370	265	360	270	300	990	589	300	268	152	175
16	300	312	260	340	265	315	880	447	278	257	152	192
17	300	289	255	320	265	330	880	395	247	237	152	218
18	289	290	250	315	265	355	805	370	237	228	152	257
19	289	290	245	310	260	385	735	358	218	209	160	247
20	312	295	245	305	260	330	710	346	209	192	167	247
21	395	295	250	305	260	375	645	334	192	175	160	289
22	421	295	255	300	260	485	645	323	183	175	160	312
23	421	295	260	300	255	560	620	312	175	175	160	502
24	395	295	270	300	255	590	589	312	167	175	152	530
25	370	295	275	295	255	605	589	289	160	192	145	530
26	346	295	280	295	250	635	619	268	160	209	167	502
27	334	295	285	295	250	650	746	300	152	289	268	447
28	323	295	290	290	250	660	886	370	145	323	300	421
29	323	295	295	290	-------	725	923	502	145	300	289	358
30	323	295	300	290	-------	785	961	559	145	278	268	358
31	323	-------	305	290	-------	860	-------	713	-------	247	247	-------

NOTE.—Gage not read during period Nov. 18 to Apr. 23; during this period stage-discharge relation was affected by ice for the greater part of December, January, February, and March; discharge for the entire period ascertained by means of three discharge measurements, weather records, record of water released from reservoirs above station, and comparison with flow of Flambeau River near Butternut and of Pine River near Florence. Gage not read Nov. 11–14; discharge interpolated.

Monthly discharge of Tomahawk River near Bradley, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 422 square miles]

Month.	Discharge in second feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	421	237	297	0.704	0.81
November	370	289	310	.735	.82
December	315	245	283	.671	.77
January	410	290	333	.789	.91
February	290	250	269	.637	.66
March	860	240	406	.962	1.11
April	1,650	589	1,020	2.42	2.70
May	1,000	268	515	1.22	1.41
June	746	145	328	.777	.87
July	323	132	222	.526	.61
August	300	132	180	.427	.49
September	530	167	278	.659	.74
The year	1,650	132	369	.874	11.90

PRAIRIE RIVER NEAR MERRILL, WIS.

LOCATION.—On line between secs. 20 and 29, T. 32 N., R. 7 E., at highway bridge 4½ miles northeast of Merrill, Lincoln County, and 5½ miles above mouth of river. Haymeadow Creek enters from left 5 miles above station.

DRAINAGE AREA.—164 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.

RECORDS AVAILABLE.—January 17, 1914, to September 30, 1921.

GAGE.—Chain gage attached to upstream side of bridge; read by Mrs. Meta Krause.

DISCHARGE MEASUREMENTS.—Made from highway bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel; clean and free from vegetation. Right bank high and not subject to overflow; left bank maybe overflowed at extreme high stages; both banks wooded. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.50 feet April 28 (discharge, 1,780 second-feet); minimum discharge, estimated 70 second-feet February 3, 4, 9–11, and 13–19 (stage-discharge relation affected by ice).

1914–1921: Maximum stage recorded, 6.1 feet April 22, 1916 (discharge, 2,290 second-feet); minimum discharge same as for 1921.

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 103 and 2,200 second-feet. Gage read to half-tenths once daily except as indicated in footnote to table of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records good; winter records fair.

Discharge measurements of Prairie River near Merrill, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28 [a]	S. R. Collins	2.08	96	Mar. 2 [b]	S. R. Collins	1.84	92
Feb. 2 [b]	do	1.92	75	July 15	A. O. Olson	1.77	102

[a] Ice cover about two-thirds complete.
[b] Ice along right shore; main channel open.

Daily discharge, in second-feet, of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	106	124	172	85	75	85	825	781	172	103	83	118
2	103	131	184	95	75	90	384	574	148	101	85	109
3	103	159	184	95	70	90	384	458	133	101	87	103
4	103	159	184	95	70	90	366	421	122	96	87	98
5	101	159	172	90	75	90	402	330	118	93	87	93
6	101	148	159	85	75	85	402	278	115	91	85	91
7	101	148	137	90	75	85	458	244	159	91	85	91
8	101	135	137	90	75	85	458	212	244	96	83	91
9	101	135	133	80	70	80	458	184	228	93	83	93
10	103	131	129	80	70	85	440	172	244	91	89	98
11	129	128	129	80	70	90	440	159	384	91	228	103
12	133	124	133	80	75	96	421	159	348	89	159	101
13	126	124	133	80	70	101	366	159	261	89	148	96
14	124	116	130	80	70	98	278	159	212	98	101	96
15	122	110	120	85	70	96	313	159	172	101	96	93
16	133	110	105	80	70	100	313	159	137	96	93	96
17	159	105	100	80	70	103	278	159	129	98	91	184
18	172	100	90	80	70	110	244	172	115	103	91	198
19	159	95	85	80	70	118	244	184	109	101	96	172
20	148	95	80	80	75	870	212	159	101	93	102	159
21	184	90	105	85	75	1,160	212	148	98	93	101	198
22	184	90	105	90	75	535	278	137	93	91	101	228
23	184	90	105	85	75	655	402	137	93	91	98	212
24	172	95	80	85	75	825	614	126	98	101	98	172
25	148	95	75	85	75	825	458	118	96	96	96	148
26	137	100	80	80	75	781	535	118	93	93	96	129
27	133	105	90	80	85	870	1,420	148	91	91	184	118
28	129	131	95	80	85	781	1,780	313	91	91	212	112
29	126	131	95	75	-------	738	1,420	278	106	96	198	103
30	122	148	95	75	-------	655	1,060	228	118	102	159	103
31	118	-------	95	75	-------	535	-------	212	-------	89	133	-------

NOTE.—Stage-discharge relation affected by ice Nov. 15–27 and Dec. 14 to Mar. 11; during the later period the gage was not read Jan. 3, 5, 7, 10, 12, 14, 17, 19, 21, 24, 26, 28, 31, Feb. 2, 4, 7, 9, 11, 14, 16, 18, 21, 23, 25, 28, Mar. 2, 4, 6, 8, and 10; discharge for both periods ascertained by applying to rating table daily gage height corrected for effect of ice by means of three discharge measurements, observer's notes, and weather records, and by interpolating or estimating for days of no gage reading. Discharge interpolated Oct. 14, Mar. 12, 14, 16, and 18, on account of lack of gage readings.

Monthly discharge of Prairie River near Merrill, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 164 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	184	101	131	0.799	0.92
November	159	90	120	.732	.82
December	184	75	120	.732	.84
January	95	75	83.4	.509	.59
February	85	70	73.6	.449	.47
March	1,160	80	355	2.16	2.49
April	1,780	212	529	3.23	3.60
May	781	118	234	1.43	1.65
June	384	91	154	.939	1.05
July	103	89	95.1	.580	.67
August	228	83	114	.695	.80
September	228	91	127	.774	.86
The year	1,780	70	178	1.09	14.76

EAU CLAIRE RIVER AT KELLY, WIS.

LOCATION.—In sec. 13, T. 28 N., R. 8 E., at highway bridge three-quarters of a mile northeast of Kelly, Marathon County, 1 mile above mouth of Big Sandy Creek, which enters from right, and 4½ miles above mouth of river.

DRAINAGE AREA.—326 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 1, 1914, to September 30, 1921.

GAGE.—Chain gage fastened to downstream side of highway bridge; read by Merle Rossmiller and August Krueger.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Gage is in rapids which form control. Banks medium high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.05 feet at 10.30 a. m. March 20 (discharge, 5,830 second-feet); minimum discharge, estimated 45 second-feet at 1.30 p. m. January 9 (stage-discharge relation affected by ice).

1914–1921: Maximum stage recorded same as for 1921; minimum discharge, estimated 30 second-feet December 6, 1917 (stage-discharge relation affected by ice).

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 70 and 3,150 second-feet. Gage read to quarter-tenths twice daily except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying mean daily gage height to the rating table except as indicated in footnote to table of daily discharge. Open-water records good; winter records fair.

Discharge measurements of Eau Claire River at Kelly, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 27[a]	S. R. Collins	2.14	108	Mar. 1[b]	S. R. Collins	1.92	75
Feb. 1[b]	do	1.83	67	July 13	S. B. Soulé	.81	93

[a] Complete ice cover; small amount of frazil ice.
[b] Complete ice cover.

Daily discharge, in second-feet, of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	112	148	236	70	70	75	557	1,070	166	108	94	108
2	108	211	263	100	70	70	519	677	166	108	94	101
3	101	263	269	125	70	55	481	560	156	117	90	101
4	101	238	255	100	70	70	443	443	141	117	94	94
5	101	209	248	70	65	85	481	390	131	112	90	101
6	101	192	241	70	65	105	519	340	131	117	90	94
7	101	190	187	65	65	130	557	340	200	101	90	90
8	101	187	136	55	65	130	572	284	300	112	86	90
9	101	194	130	45	65	130	587	269	246	108	86	101
10	124	200	130	55	75	140	539	246	617	101	101	108
11	161	200	130	60	85	155	491	241	990	90	161	108
12	174	195	124	60	80	155	443	248	990	90	141	94
13	148	190	200	60	80	155	404	255	677	90	108	90
14	146	130	300	65	80	155	365	269	390	108	108	94
15	151	130	340	70	80	155	378	246	269	117	108	94
16	174	134	340	70	80	180	390	228	246	108	101	94
17	182	136	320	75	75	210	345	228	228	108	94	136
18	166	141	300	80	70	240	300	241	187	174	94	187
19	161	141	265	90	65	265	284	255	166	174	90	182
20	166	141	240	90	65	5,760	269	255	156	136	94	174
21	190	166	155	95	60	3,850	342	228	141	112	94	214
22	214	166	105	100	60	1,940	416	214	131	108	94	228
23	198	177	105	115	65	1,580	483	187	117	94	90	209
24	182	187	105	125	65	1,220	550	187	117	90	86	187
25	177	174	105	100	70	862	617	166	108	136	80	200
26	174	174	105	75	70	1,160	2,260	166	108	112	86	174
27	164	161	110	75	70	1,450	3,910	182	108	136	101	148
28	148	161	100	75	70	1,740	3,090	246	117	131	148	136
29	141	174	90	75	-------	1,300	2,280	241	141	124	136	124
30	136	187	80	75	-------	862	1,460	200	131	112	136	117
31	136	-------	65	75	-------	710	-------	187	-------	101	117	-------

NOTE.—Stage-discharge relation affected by ice Nov. 14, 15, Dec. 9–11, and Dec. 15 to Mar. 19; during these periods the gage was not read Dec. 15–25, 28, 30, Jan. 2, 4, 6, 8, 10, 12, 14, 16, 18, 19, 21, 23, 25, 27, 29, 30, Feb. 1, 3, 5, 6, 8, 10, 12, 13, 15, 17, 19, 20, 22, 24, 25, 27, Mar. 1, 2, 4, 6, 8, 10, 12, 13, 15, 16, and 18; discharge for the periods ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of three discharge measurements, observer's notes, and weather records, and by interpolating or estimating for days of no gage reading. Gage not read Oct. 23, Nov. 7, 9, 12, Dec. 5, Mar. 21, 23, 24, 26, 27, 29, 31, Apr. 2, 3, 5, 6, 8, 10, 11, 13, 15, 17, 19, 21, 23, 24, 26, 28, 29, May 1, 3, 12, and Aug. 16; discharge interpolated.

Monthly discharge of Eau Claire River at Kelly, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 326 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	214	101	146	0.448	0.52
November	263	130	177	.545	.61
December	340	65	186	.571	.66
January	125	45	79.4	.214	.28
February	85	60	70.4	.216	.22
March	5,760	55	809	2.48	2.86
April	3,910	269	811	2.49	2.78
May	1,070	166	300	.920	1.06
June	990	108	259	.794	.89
July	174	90	115	.353	.41
August	161	80	103	.316	.36
September	228	90	133	.408	.46
The year	5,760	45	266	.816	11.11

BIG EAU PLEINE RIVER NEAR STRATFORD, WIS.

LOCATION.—In sec. 13, T. 27 N., R. 3 E., at Weber farm, 2 miles north of Stratford, Marathon County, and 1 mile above Chicago & Northwestern Railway bridge. Dill Creek enters from right 5 miles above station.

DRAINAGE AREA.—223 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1921.

GAGE.—Slope gage, graduated from 1.0 foot to 15.6 feet, on right bank of river, and vertical staff gage, graduated from 15 to 18 feet, at upper end of slope gage; read by Christian Weber.

DISCHARGE MEASUREMENTS.—Made from highway bridge about half a mile below gage or by wading. Measuring conditions poor at low stages.

CHANNEL AND CONTROL.—Bed composed of heavy gravel and rock. Control at head of rapids 400 feet below gage; practically permanent. Banks at gage high and are overflowed only at stages above about 15 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.3 feet at 6 p. m. April 27 (discharge, 7,670 second-feet); minimum stage, 1.26 feet at 6.30 a. m. and 6.30 p. m. August 25, and 7 a. m. August 26 (discharge, about 2.6 second-feet).

1914–1921: Maximum stage recorded, 10.9 feet at 4.30 p. m. November 10, 1919 (discharge, 8,630 second-feet); minimum stage recorded, 1.25 feet August 28 and 29, 1920 (discharge, about 2.5 second-feet).

The flood of June, 1914, reached a maximum height of 20.7 feet as determined by levels run to high-water marks.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 47 and 4,000 second-feet; poorly defined outside these limits. Gage read to quarter-tenths twice daily except during period of ice effect, January 1 to March 26, when no readings were obtained. Daily discharge ascertained by applying mean daily gage height to rating table. Records for medium and high stages good; for ordinary low stages, fair; for extremely low stages, possibly poor.

Discharge measurements of Big Eau Pleine River near Stratford, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	S. B. Soulé	1.80	27.8	July 14	A. O. Olson	1.60	10.1
17	D. W. Roberts	1.78	20.7				

Daily discharge, in second-feet, of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3	16	115		182	336	258	11	6	7
2	3	37	137		159	206	170	11	6	6
3	3	37	115		148	141	111	11	6	5
4	3	31	98		148	117	83	10	6	5
5	3	30	81		148	96	63	8	6	5
6	3	27	55		148	75	47	11	5	5
7	3	27	41		244	63	605	17	5	4
8	4	27	37		287	57	1,390	31	4	5
9	4	30	30		287	47	580	18	4	5
10	5	31	25		336	41	1,630	15	4	5
11	9	31	24		374	37	2,510	13	4	5
12	8	27	22		287	33	1,050	10	4	5
13	7	22	24		206	41	302	8	4	5
14	7	18	244		244	83	182	12	4	5
15	12	14	231		460	111	111	12	3	6
16	24	14	206		272	57	83	10	3	6
17	20	12	395		141	52	63	12	3	12
18	20	12	287		117	75	47	18	3	11
19	20	12	159		117	133	34	22	3	12
20	20	13	87		100	159	31	17	3	12
21	31	27	58		100	104	28	15	3	24
22	43	58	50		194	69	24	12	3	23
23	33	58	46		438	130	24	12	3	22
24	25	50	43		244	89	19	10	3	18
25	22	43	41		182	57	18	10	3	18
26	20	41	33		680	44	17	7	3	13
27	17	33	41	1,390	4,510	990	15	10	4	11
28	17	33	27	705	3,860	1,550	13	10	6	8
29	16	33	27	336	990	605	12	10	7	7
30	14	58	27	258	530	395	12	8	8	6
31	14		27	218		374		7	10	

NOTE.—No gage readings obtained Jan. 1 to Mar. 26; discharge not determined.

Monthly discharge of Big Eau Pleine River near Stratford, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 223 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	43	3	14.0	0.0628	0.07
November	58	12	30.1	.135	.15
December	395	22	91.4	.410	.47
March 27-31			581	2.61	.49
April	4,510	100	538	2.41	2.69
May	1,550	33	206	.924	1.07
June	2,510	12	318	1.43	1.60
July	31	7	12.5	.0561	.06
August	10	3	4.48	.0201	.02
September	24	4	9.37	.0420	.05
The year	4,510	3	143	.641	6.67

81182—24†—WSP 525——8

BARABOO RIVER NEAR BARABOO, WIS.

LOCATION.—In sec. 33, T. 12 N., R. 7 E., at highway bridge 4 miles downstream from Baraboo, Sauk County, 3 miles below creek that rises near Devils Lake and comes in from right, and 15 miles above mouth of river.

DRAINAGE AREA.—572 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 18, 1913, to September 30, 1921.

GAGE.—Chain gage, attached to upstream side of bridge; read by Theodore Schneider.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud. Control not well defined. Water is confined to one channel except at flood stages when right bank is overflowed for a distance of 1,000 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.20 feet at 6 p. m. May 28 (discharge, about 2,110 second-feet); minimum stage, 1.05 feet at 7 a. m. August 30 (discharge, about 110 second-feet).

1914–1921: Maximum stage recorded, about 17.5 feet March 26, 1917 (discharge, about 7,900 second-feet); minimum stage, 0.71 foot at 7.30 a. m. July 26, 1916 (discharge, 76 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—There are four dams near Baraboo, 4 miles above station, and one at Reedsburg, 18 miles above station. Smaller plants are also operated on tributaries. Operation of these various plants causes diurnal fluctuation at gage of about 0.3 foot at low stages. Mean monthly discharge probably represents nearly the natural flow.

ACCURACY.—Stage-discharge relation not permanent; affected by ice December 17 to January 2, January 10–19, January 24 to February 6, February 17–24, and March 16–24. Standard rating curve poorly defined. Gage read to quarter-tenths twice daily. Daily discharge ascertained by the indirect method for shifting control except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of three discharge measurements, observer's notes, and weather records. Records poor.

Discharge measurements of Baraboo River near Baraboo, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 7	S. B. Soulé	2.56	254	Apr. 30	S. R. Collins	5.99	821
24[a]	G. F. Rittenberg	2.56	206	May 28	do	11.16	2,110
Jan. 29[b]	S. R. Collins	2.65	224	July 11	A. O. Olson	2.00	230
Mar. 19[c]	do	4.96	501				

[a] Nearly complete ice cover below gage.
[b] Shore ice and some ice floating.
[c] Control apparently normal, but stage-discharge relation probably affected by an ice jam below.

Daily discharge, in second-feet, of Baraboo River near Baraboo, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	186	224	313	240	205	212	313	671	575	278	264	162
2	168	257	327	265	155	238	285	515	425	271	192	168
3	151	369	327	327	155	244	285	440	397	205	198	144
4	162	455	313	341	145	244	299	397	313	174	186	198
5	149	355	278	341	150	244	271	397	278	231	192	560
6	180	411	278	341	170	327	257	327	299	205	156	799
7	180	440	264	327	218	397	285	278	285	244	168	890
8	174	455	238	313	250	545	313	271	327	174	186	910
9	156	470	238	254	231	530	313	271	327	180	162	560
10	154	455	238	230	192	485	313	285	327	151	224	285
11	186	383	205	230	198	355	341	278	285	198	180	238
12	180	327	244	220	198	341	341	231	257	192	180	218
13	168	244	257	190	205	313	313	257	355	192	180	156
14	174	238	327	180	231	341	299	257	383	186	168	162
15	180	257	341	155	383	440	299	238	383	186	212	218
16	212	250	411	155	799	500	327	299	411	154	192	425
17	397	238	385	145	765	485	355	238	383	124	198	530
18	500	192	370	145	765	470	411	313	327	198	192	560
19	411	224	315	190	655	500	411	411	313	186	192	440
20	278	238	255	271	425	470	397	470	355	180	186	470
21	285	341	240	440	220	485	397	397	327	180	154	1,360
22	285	383	225	703	205	500	591	327	192	168	198	1,600
23	271	397	220	767	190	455	671	313	174	151	180	1,290
24	238	397	205	735	180	355	607	560	168	174	186	1,150
25	224	411	205	575	231	355	530	515	180	271	192	930
26	244	369	200	425	231	355	500	500	174	198	174	515
27	212	327	190	285	231	440	799	1,070	205	238	154	341
28	205	313	190	245	218	440	1,030	2,050	205	369	134	285
29	192	369	190	225	------	425	910	1,840	218	313	168	186
30	205	313	220	180	------	369	799	1,090	285	238	168	244
31	180	------	245	190	------	327	------	687	------	231	174	------

Monthly discharge of Baraboo River near Baraboo, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 572 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	500	149	222	0.388	0.45
November	470	192	337	.589	.66
December	411	190	266	.465	.54
January	767	145	310	.542	.62
February	799	145	293	.512	.53
March	545	212	393	.687	.79
April	1,030	257	442	.773	.86
May	2,050	231	522	.913	1.05
June	575	168	304	.531	.59
July	369	124	208	.364	.42
August	264	134	184	.322	.37
September	1,600	144	533	.932	1.04
The year	2,050	124	334	.584	7.92

KICKAPOO RIVER AT GAYS MILLS, WIS.

LOCATION.—In sec. 28, T. 10 N., R. 4 W., at highway bridge immediately below Norwood Mill, in Gays Mills, Crawford County, 25 miles above mouth of river, and 2 miles below mouth of Tainter Creek, which enters from right.

DRAINAGE AREA.—629 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—December 25, 1913, to September 30, 1921.

GAGE.—Chain gage attached to downstream side of bridge; read by George Atwood.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rock covered by a deposit of sand. Banks at gage section fairly high and not subject to overflow at ordinary high stages. Control is at head of small rapids about 300 feet below gage; not permanent; the plotting of discharge measurements indicates that at a stage of about 2 feet on the gage, the control is changed to some point below, causing a reversal in the rating curve.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.31 feet at 7 a. m. September 6 (discharge, about 2,440 second-feet); minimum stage, 1.06 feet at 5.30 a. m. August 27 (discharge, 123 second-feet).

1914–1921: Maximum stage recorded, 15.05 feet March 24, 1917 (discharge, about, 6,300 second-feet); minimum discharge, about 100 second-feet during latter part of January, 1915 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice at times.

REGULATION.—Mills at Gays Mills immediately above the station, at Soldiers Grove, about 7 miles upstream, and at several points above Soldiers Grove, use comparatively little storage, so that the recorded flow past the station represents nearly the natural flow. During low stages slight diurnal fluctuation is observed at the gage.

ACCURACY.—Stage-discharge relation not permanent; not affected by ice. Standard rating curve poorly defined. Gage read to quarter-tenths twice daily. Daily discharge ascertained by the indirect method for shifting control. Records fair.

Discharge measurements of Kickapoo River at Gays Mills, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 19[a]	G. F. Rittenberg	1.89	286	Sept. 28	A. O. Olson	2.29	393
May 25	S. R. Collins	3.53	652				

[a] Probably no backwater from ice.

Daily discharge, in second-feet, of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	285	455	405	420	235	345	285	455	515	194	154	272
2	285	565	390	465	246	315	285	435	455	201	188	192
3	272	515	375	455	246	285	285	405	435	258	185	179
4	285	435	345	405	235	258	285	360	375	235	176	595
5	285	375	345	405	235	285	235	315	375	194	158	1,640
6	258	405	315	375	201	770	246	285	285	186	143	2,360
7	285	565	300	345	212	495	285	272	285	181	139	1,560
8	258	580	285	315	224	345	315	258	535	224	143	495
9	258	535	315	246	246	272	272	246	610	212	136	405
10	258	475	315	285	235	258	300	246	455	201	143	435
11	258	435	315	235	235	285	258	258	435	176	475	272
12	285	375	315	212	212	300	258	258	375	176	224	246
13	272	235	285	235	235	315	246	258	300	176	148	246
14	315	360	580	246	455	405	285	272	515	186	194	272
15	970	345	625	246	700	495	345	246	515	246	176	345
16	1,020	272	390	258	1,200	680	375	235	345	212	158	1,670
17	475	285	330	300	745	580	285	285	285	186	167	1,920
18	405	300	285	285	315	345	258	475	258	190	167	580
19	345	300	224	285	300	375	258	550	246	258	150	445
20	345	285	258	580	315	475	235	465	246	208	149	1,960
21	315	375	315	1,020	285	495	285	330	235	186	157	2,160
22	315	895	330	1,200	300	405	345	285	212	172	149	2,060
23	315	610	330	920	235	330	375	285	212	176	142	870
24	315	475	300	515	272	375	330	945	208	176	142	550
25	315	455	345	345	235	465	285	640	190	176	149	550
26	285	420	405	285	258	405	360	1,050	224	495	146	515
27	315	375	435	345	181	420	515	1,230	345	210	128	445
28	300	375	435	315	246	405	845	1,020	375	185	142	390
29	285	375	420	285	-------	315	920	610	258	176	146	375
30	285	405	435	272	-------	285	495	495	235	158	224	375
31	285	-------	405	235	-------	300	-------	640	-------	148	920	-------

Monthly discharge of Kickapoo River at Gays Mills, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 629 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,020	258	347	0.552	0.64
November	895	235	429	.682	.76
December	625	224	360	.572	.66
January	1,200	212	398	.633	.73
February	1,200	181	323	.514	.54
March	770	258	390	.620	.71
April	920	235	345	.548	.61
May	1,230	235	455	.723	.83
June	610	190	345	.548	.61
July	495	148	205	.326	.38
August	920	128	194	.308	.36
September	2,360	179	813	1.29	1.44
The year	2,360	128	383	.609	8.27

TURKEY RIVER AT GARBER, IOWA.

LOCATION.—In sec. 36, T. 92 N., R. 4 W., at single-span highway bridge at Garber, Clayton County, 800 feet above mouth of Wayne Creek, which enters from right, and 1 mile below mouth of Volga River, which enters from right.

DRAINAGE AREA.—1,530 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—August 29, 1913, to November 30, 1916; May 14, 1919, to September 30, 1921.

GAGE.—Chain gage attached to downstream handrail of bridge; read by E. J. Prolow.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and mud; shifting. Right bank high and not subject to overflow; left bank subject to overflow above gage height about 22 feet. Low-water control is a gravel bar.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.5 feet at 9 a. m. May 31 (discharge, about 10,400 second-feet); minimum stage 3.60 feet at 6 p. m. October 6, 9, and 10 (discharge, 290 second-feet).

1913–1916; 1919–1921: Maximum stage recorded, 22 feet June 3, 1916 (discharge, about 20,300 second-feet); minimum stage, 2.70 feet September 5 and 7, 1913 (discharge, 100 second-feet).

The highest stage within the last 30 years probably occurred May 18, 1902, when a stage of about 23.7 feet referred to gage datum was reached, as indicated by high-water marks on A. F. Grafe's residence in Garber.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued.

REGULATION.—Operation of an electric-light plant and gristmill at Elkader, about 15 miles upstream, may cause slight diurnal fluctuation at gages.

ACCURACY.—Stage-discharge relation changed during high water of October; affected by ice December 23 to February 13. Shifting-control method used October 1–15. Rating curve used October 16 to September 30, well defined between 250 and 11,000 second-feet. Gage read to hundredths twice daily except during period of ice effect, when observations were discontinued. Daily discharge ascertained by applying mean daily gage height to rating table except for period during which stage-discharge relation was affected by ice, for which mean discharge was ascertained by comparison with flow of Upper Iowa River near Decorah and Squaw Creek at Ames, and except for period for which shifting-control method was used. Open-water records good, although prior to the latter part of May changes in stage-discharge relation may have occurred which are indeterminate on account of lack of discharge measurements; winter records subject to error.

Discharge measurements of Turkey River at Garber, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 30	7.77	3,060	June 13	6.52	2,010
May 31	14.48	10,300	Sept. 29	5.36	1,110
June 11	8.53	3,850			

Daily discharge, in second-feet, of Turkey River at Garber, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	370	665	775			560	535	1,150	4,880	720	438	720
2	330	610	775			485	460	1,020	3,030	665	1,150	955
3	330	585	665			460	460	895	2,310	720	665	895
4	330	560	665			438	460	895	1,880	775	510	775
5	330	560	610			460	485	835	1,720	1,020	460	895
6	290	610	585			485	485	775	1,580	835	485	585
7	310	610	560		500	560	485	665	1,290	665	460	485
8	310	720	535			535	460	610	3,490	665	460	485
9	290	955	485			510	460	585	2,580	665	415	460
10	290	955	460			415	438	720	2,760	560	350	460
11	330	835	485			460	438	2,850	3,960	585	4,780	460
12	330	775	485			460	392	1,720	2,850	510	2,760	460
13	330	720	485			510	415	2,490	2,040	510	1,800	438
14	370	610	485		955	2,040	460	1,800	1,960	895	1,290	1,020
15	1,710	560	485		1,020	2,040	585	1,360	1,880	610	720	460
16	2,220	460	510	650	955	1,080	585	1,020	1,880	510	610	3,870
17	1,800	460	510		835	835	665	1,150	1,020	510	2,400	3,960
18	895	438	510		835	720	835	4,560	1,220	3,120	1,500	2,040
19	510	485	510		835	720	1,220	5,820	1,220	775	835	438
20	438	510	535		835	835	1,430	4,780	1,020	665	610	4,670
21	438	665	560		775	1,150	1,580	3,300	3,400	560	560	4,360
22	370	665	610		665	1,080	1,650	2,040	1,430	510	485	2,670
23	370	665			610	955	1,150	1,430	1,020	460	560	1,650
24	392	665			560	955	955	1,800	895	485	560	1,500
25	415	585			535	895	1,150	2,220	895	485	460	4,160
26	370	510	500		510	895	1,020	4,780	835	510	415	2,040
27	370	485			510	895	895	5,620	1,080	610	460	1,580
28	350	585			510	895	1,800	6,900	1,020	460	438	1,220
29	330	775			-------	895	1,650	6,040	835	438	438	1,150
30	330	835			-------	775	1,360	3,960	775	415	392	1,080
31	415	-------			-------	665	-------	8,720	-------	415	1,080	-------

NOTE.—Braced figures show estimated mean discharge for periods indicated.

Monthly discharge of Turkey River at Garber, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 1,530 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,220	290	525	0.343	0.40
November	955	438	637	.416	.46
December	775	----------	541	.354	.41
January	----------	----------	650	.425	.49
February	1,020	----------	623	.407	.42
March	2,040	415	796	.520	.60
April	1,800	392	832	.544	.61
May	8,720	585	2,660	1.74	2.01
June	4,880	775	1,890	1.24	1.38
July	3,120	415	688	.450	.52
August	4,780	350	921	.602	.69
September	4,670	438	1,530	1.00	1.12
The year	8,720	290	1,030	.673	9.11

MAQUOKETA RIVER BELOW NORTH FORK OF MAQUOKETA RIVER, NEAR MAQUOKETA, IOWA.

LOCATION.—In southwest corner NE. ¼ sec. 17, T. 84 N., R. 3 E., at Bridgeport Bridge, 1,200 feet above mouth of Mill Creek, 2 miles below mouth of North Fork of Maquoketa River, and 3 miles northeast of Maquoketa, Jackson County.

DRAINAGE AREA.—1,600 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000). Drainage area at mouth, 1,960 square miles.

RECORDS AVAILABLE.—September 1, 1913, to September 30, 1921.

GAGE.—Chain gage attached to downstream handrail of bridge, 100 feet from right abutment; read by John Strodthoff.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of mud and sand; shifts during high water. Two channels at stages below 12 feet; about 12 feet overflow occurs under pile trestle approach at left end of bridge. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum discharge during year, estimated 7,500 second-feet September 20 (gage not read during period September 19–25); minimum stage recorded, 2.00 feet August 1, 9–12, and 14 (discharge, 315 second-feet).

1913–1921: Maximum stage recorded, 22.0 feet March 27, 1916 (discharge, 21,300 second-feet); minimum stage, 1.59 feet December 25, 1918 (discharge, about 245 second-feet).

A stage of about 23.5 feet (discharge, about 24,300 second-feet) occurred prior to 1913, probably in 1905.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined below 3,000 second-feet; extended above that point on basis of form of previous curves. Gage read to hundredths once daily except as indicated in footnote to table of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect and days when gage was not read for which it was ascertained as indicated in footnote to table of daily discharge. Records good.

Discharge measurements of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 21	E. D. Burchard	2.49	509	June 10	E. D. Burchard	4.19	1,350
Apr. 20	do	6.28	2,640	Sept. 30	Burchard and Clyde	4.26	1,400

Daily discharge, in second-feet, of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	880	550	510		510	450	510	1,540	1,100	780	315	510
2	470	730	510		470	470	510	1,360	1,190	650	410	410
3	470	640	510		470	450	470	1,240	1,140	595	430	370
4	470	595	595		510	430	470	1,140	880	640	420	390
5	450	550	595		470	430	470	1,060	730	600	410	1,080
6	450	600	550		370	470	450	930	640	510	390	830
7	430	650	510		430	456	470	930	595	510	350	595
8	450	685	500		470	510	510	850	595	595	332	470
9	450	780	510		470	450	550	780	640	500	315	410
10	450	730	470		470	450	510	730	1,190	450	315	410
11	450	640	470		510	430	470	830	1,300	450	315	730
12	470	510	470	550	510	470	450	1,030	1,080	440	315	880
13	450	390	510		510	500	450	1,060	1,140	410	332	980
14	470	410	550		595	3,000	470	1,060	980	550	315	3,140
15	470	510	550		730	1,540	470	930	830	390	350	2,290
16	640	510	470		780	1,300	595	730	685	380	332	6,980
17	550	450	430		640	1,190	510	730	730	350	390	7,240
18	550	550	390		390	980	595	685	640	332	430	4,640
19	510	685	332		450	880	1,140	730	595	450	640	4,400
20	510	685	510		410	450	2,360	700	550	640	1,140	7,500
21	510	640			430	500	3,590	685	550	470	510	6,500
22	510	595			595	600	3,200	640	595	470	430	4,800
23	550	550			410	685	2,740	595	640	410	510	4,000
24	550	550		640	430	700	2,030	595	595	400	460	4,000
25	510	550		595	550	730	1,540	730	510	390	410	6,500
26	510	510	450	550	550	595	1,660	880	780	350	370	3,780
27	470	510		470	470	600	2,420	980	930	350	350	2,480
28	510	510		550	470	550	2,740	1,420	2,940	350	350	1,960
29	470	510		550	-------	510	2,620	1,900	1,240	350	350	1,600
30	470	550		550	-------	510	2,030	1,190	1,030	332	332	1,420
31	470	-------		510	-------	550	-------	1,030	-------	332	595	-------

NOTE.—Stage-discharge relation affected by ice Dec. 21 to Jan. 23; mean discharge ascertained by means of observer's notes, weather records, and comparison with flow of adjacent rivers; gage not read Dec. 25 to Jan. 23. Gage not read Nov. 6, 7, Dec. 8, Mar. 13, 21, 22, 24, 27, May 8, 20, June 1, July 2, 4, 9, 12, 16, 24, Aug. 4, 24, and Sept. 19–25; discharge ascertained by means of observer's notes, weather records, and comparison with flow of adjacent rivers. Braced figures show mean discharge for periods indicated.

Monthly discharge of Maquoketa River below North Fork of Maquoketa River, near Maquoketa, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	880	430	502	0.314	0.36
November	780	390	578	.361	.40
December	595	332	480	.300	.35
January	-------	-------	550	.344	.40
February	780	370	502	.314	.33
March	3,000	430	704	.440	.51
April	3,590	450	1,230	.769	.86
May	1,900	595	960	.600	.69
June	2,940	510	901	.563	.63
July	780	332	465	.291	.34
August	1,140	315	417	.261	.30
September	7,500	370	2,710	1.69	1.89
The year	7,500	315	831	.519	7.06

ROCK RIVER AT AFTON, WIS.

LOCATION.—On line between secs. 22 and 27, T. 2 N., R. 12 E., at highway bridge in Afton, Rock County, 9 miles above Illinois State line. Bass Creek enters from right three-fourths of a mile below station.

DRAINAGE AREA.—3,190 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.

RECORDS AVAILABLE.—February 5, 1914, to September 30, 1921.

GAGE.—Chain gage fastened to the downstream side of bridge; read by George Robb.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and clean silt; practically permanent. Banks medium high and are not overflowed to any extent at flood stages. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.28 feet at 5.30 p. m. May 2 (discharge, 8,200 second-feet); minimum stage, 0.60 foot at 6.10 p. m. July 24 and 5.10 p. m. July 31 (discharge, about 487 second-feet).

1914–1921: Maximum stage recorded, 10.51 feet at noon March 26, 1918 (discharge, 12,700 second-feet); minimum stage recorded, 0.38 foot at 4.50 p. m., August 31, 1919 (discharge, about 428 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

REGULATION.—Operation of power plants at Janesville and above causes slight fluctuation at the gage during low stages.

ACCURACY.—Stage-discharge relation permanent except as affected by ice December 17 to January 1 and January 10–22. Rating curve well defined between 638 and 12,700 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of observer's notes and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Rock River at Afton, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 1[a]	G. F. Rittenberg	1.96	1,090	Sept. 23	A. O. Olson	4.55	3,100

[a] No ice present.

Daily discharge, in second-feet, of Rock River at Afton, Wis., for the year ending Sept. 30, 1921.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	912	820	912	1,110	1,170	1,060	2,310	8,030	2,310	1,230	774	1,010
2	820	960	866	1,110	1,060	1,010	2,140	8,200	2,060	1,010	774	1,010
3	820	820	912	1,203	1,110	1,060	2,140	8,030	1,980	912	820	1,060
4	820	866	960	1,110	1,110	1,060	2,060	7,530	1,980	912	774	1,010
5	728	820	960	1,110	1,060	960	2,060	7,370	1,660	1,010	774	1,110
6	820	866	1,010	1,110	1,110	960	2,140	6,910	1,500	1,010	728	1,230
7	820	960	1,110	1,110	1,110	1,010	1,820	6,630	1,170	1,010	595	1,170
8	774	1,010	1,060	1,110	1,110	1,110	1,430	6,210	866	960	638	1,010
9	728	960	1,010	1,170	1,060	1,170	1,230	5,940	912	960	683	1,110
10	728	960	912	1,060	1,010	1,110	1,230	5,550	1,010	912	866	1,010
11	820	912	960	1,060	1,010	1,060	1,430	5,290	1,110	960	1,360	1,230
12	820	1,010	820	1,010	960	1,110	1,430	4,900	1,010	912	1,060	1,500
13	820	912	1,060	1,010	820	1,230	1,500	4,400	1,060	728	820	1,980
14	774	820	1,060	1,010	1,060	1,820	1,580	3,800	1,230	912	820	2,140
15	820	960	774	960	1,110	2,220	1,580	3,680	1,170	960	820	1,980
16	820	912	774	960	1,010	2,140	2,220	3,680	1,170	912	866	2,220
17	820	820	775	960	820	2,310	2,060	3,340	1,060	683	960	2,220
18	866	820	775	960	960	2,400	2,220	3,450	1,010	728	1,010	2,140
19	820	912	775	960	960	2,310	2,140	3,240	912	820	912	2,490
20	866	912	775	960	1,110	2,140	2,310	2,940	1,010	774	912	2,670
21	820	820	775	960	1,170	2,400	2,580	2,850	960	728	912	2,850
22	820	912	820	960	1,110	2,670	2,940	2,490	912	728	774	2,940
23	774	866	820	960	1,110	2,580	3,040	2,580	866	638	960	3,240
24	728	820	960	1,110	1,110	2,580	3,240	2,580	912	555	912	3,560
25	820	774	960	1,230	1,110	2,400	3,800	2,490	728	683	960	3,920
26	866	912	960	1,170	1,110	2,670	5,160	2,580	774	638	912	4,040
27	866	912	960	1,230	1,010	2,140	5,940	2,400	1,820	595	866	3,680
28	912	820	960	1,170	1,060	2,670	6,070	2,400	1,580	595	866	3,560
29	866	960	1,010	1,110	-------	2,490	7,060	2,310	1,230	638	912	3,340
30	728	960	1,010	1,170	-------	2,310	7,530	2,220	1,290	728	866	3,340
31	728	-------	1,060	1,230	-------	2,400	-------	2,310	-------	595	960	-------

Monthly discharge of Rock River at Afton, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 3,190 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	912	728	0.811	0.254	0.29
November	1,010	774	.893	.280	.31
December	1,110	774	921	.289	.33
January	1,230	960	1,080	.339	.39
February	1,170	820	1,050	.329	.34
March	2,670	960	1,820	.571	.66
April	7,530	1,230	2,810	.881	.98
May	8,200	2,220	4,400	1.38	1.59
June	2,310	728	1,240	.389	.43
July	1,230	555	820	.257	.30
August	1,360	595	867	.272	.31
September	4,040	1,010	2,190	.687	.77
The year	8,200	555	1,580	.495	6.70

ROCK RIVER AT LYNDON, ILL.

LOCATION.—In sec. 21 T. 20 N., R. 5 E., at highway bridge known as Lyndon Bridge, in eastern part of Lyndon, Whiteside County, 10 miles above Rock Creek, and 20 miles below dam at Sterling.

DRAINAGE AREA.—9,010 square miles.

RECORDS AVAILABLE.—November 24, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by George Cady.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.6 feet at 7 p. m. April 28 (discharge, 25,600 second-feet); minimum stage recorded, 4.23 feet at 6 a. m. July 26 (discharge, 867 second-feet).

1915–1920: Maximum stage recorded, 19.6 feet February 16, 1918 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 17.0 feet March 28, 1916 (discharge, 39,500 second-feet); minimum stage, 3.72 feet September 27, 1918 (discharge, 536 second-feet).

DIVERSIONS.—Water is diverted at Sterling dam to feed Illinois and Mississippi Canal; probably averages about 100 second-feet.

REGULATION.—Flow past gage is regulated by power plants in city of Sterling and above. Owing to this regulation the mean of two daily gage readings, during low stages, is probably somewhat less than true mean daily gage height.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 700 and 25,000 second-feet; fairly well defined beyond these limits. Gage read to hundredths twice daily except as indicated in footnote to table of daily discharge. Daily discharge ascertained by applying mean daily gage height to rating table except for period of ice effect and periods during which gage was not read for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records for medium stages, good; for ordinary low and for high stages, fair; for extremely low stages, poor; winter records, poor.

Discharge measurements of Rock River at Lyndon, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 4	5.26	2,210
Apr. 27	12.78	22,500

Daily discharge, in second-feet, of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	-------	2,400	2,220		4,190	2,740	4,830	14,700	6,250	2,570	1,430	2,400
2	-------	2,400	2,270		3,980	2,740	4,610	14,700	6,500	3,250	1,370	2,220
3	-------	2,400	2,320		3,980	2,740	4,400	13,200	5,500	3,250	1,300	2,570
4	-------	2,400	2,360		3,980	2,400	4,190	13,500	5,270	3,420	1,240	2,070
5	-------	2,570	2,400		3,600	2,570	4,400	13,200	3,600	3,420	1,560	3,600
6	-------	2,230	2,740		3,170	3,080	4,400	12,600	3,420	2,570	1,980	3,780
7	-------	2,400	2,740		2,740	3,600	4,400	11,500	3,420	2,230	2,400	3,600
8	-------	2,400	2,740		2,740	3,780	3,980	10,500	2,740	2,230	2,070	3,980
9	-------	2,400	2,910		2,740	6,250	4,400	10,000	3,080	2,570	2,070	4,610
10	2,230	2,570	2,910		2,910	5,750	3,780	9,880	3,420	2,570	1,690	4,830
11	2,230	2,570	2,740		3,250	5,050	3,250	9,750	3,080	2,570		5,050
12	2,230	2,570	2,910	5,200	2,230	5,750	2,570	9,250	2,400	2,070		5,160
13	2,230	2,740	2,570		2,070	6,000	3,250	8,500	2,570	2,400		5,270
14	2,230	2,740	2,570		3,250	6,000	3,080	8,000	2,540	2,570		4,830
15	2,230	2,570	2,740		3,080	6,250	3,250	6,500	2,510	2,740	4,000	5,050
16	2,070	2,570	2,740		2,740	6,500	3,600	7,000	2,480	2,230		4,830
17	2,230	2,570	2,740		3,250	7,250	3,420	6,750	2,460	2,070		5,500
18	2,230	2,400	2,740		3,250	7,500	4,190	6,500	2,430	2,400		5,750
19	2,230	2,400	3,420		2,740	7,000	4,610	5,270	2,400	1,910		6,250
20	2,230	2,230	2,570		2,740	7,000	6,000	5,270	2,740	1,910		6,000
21	2,400	2,400	3,420		2,740	7,000	9,250	5,270	2,570	1,560	5,270	9,750
22	2,400	2,230	3,420		2,740	6,500	9,250	5,270	2,740	1,620	4,830	10,800
23	2,230	2,230	3,420		2,570	4,400	10,000	5,160	3,080	1,620	4,400	9,250
24	2,070	2,230	2,740	6,500	2,740	2,230	11,500	5,050	3,250	1,560	4,610	9,500
25	2,400	2,230		4,400	2,570	2,400	12,100	4,830	2,740	1,560	4,190	10,200
26	2,570	2,230		5,050	2,400	3,980	13,500	4,400	2,070	1,180	3,780	-------
27	2,570	2,230	3,600	5,500	2,740	6,250	21,200	4,610	2,280	1,240	3,600	-------
28	2,070	2,070		5,500	2,740	6,250	25,600	5,050	2,490	1,620	3,200	-------
29	2,230	2,120		5,270	-------	5,270	23,000	6,000	2,700	1,420	2,800	-------
30	2,400	2,170		4,840	-------	5,050	19,400	6,000	2,910	1,240	2,400	-------
31	2,230	-------		4,400	-------	5,050	-------	6,000	-------	1,490	2,400	-------

NOTE.—Stage-discharge relation affected by ice Dec. 25 to Jan. 23; discharge ascertained by means of gage heights, observer's notes, and weather records; during this period the gage was not read Dec. 26–29, Jan. 2–5, 12–19, and 23. Gage not read Oct. 1–9 and Sept. 26–30; discharge not determined. Gage not read, discharge interpolated Nov. 29 to Dec. 4, Dec. 17, 22, Jan. 30, Feb. 6, May 10, 20, 23, June 14–18, 27–29, Aug. 1–3, 6, 28, 29, and Sept. 12. Gage not read Aug. 11–20; discharge ascertained by comparison with flow of Pecatonica River at Freeport, Ill. Braced figures show mean discharge for periods indicated.

Monthly discharge of Rock River at Lyndon, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 9,010 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October 10–31	2,570	2,070	2,270	0.252	0.21
November	2,740	2,070	2,390	.265	.30
December	-------	2,220	2,950	.327	.38
January	-------	-------	5,200	.577	.67
February	4,190	2,070	3,000	.333	.35
March	7,500	2,230	4,980	.553	.64
April	25,600	2,570	7,850	.871	.97
May	14,700	4,400	8,200	.910	1.05
June	6,500	2,070	3,190	.354	.40
July	3,420	1,180	2,160	.240	.28
August	-------	1,240	3,180	.353	.41
September 1–25	10,800	2,070	5,470	.607	.56
The year	25,600	1,180	4,270	.474	6.22

PECATONICA RIVER AT FREEPORT, ILL.

LOCATION.—In sec. 32, T. 27 N., R. 8 E., at highway bridge on Hancock Avenue, half a mile east of Illinois Central Railroad station at Freeport, Stephenson County, and 2 miles above mouth of Yellow Creek.

DRAINAGE AREA.—1,330 square miles.

RECORDS AVAILABLE.—September 11, 1914, to September 30, 1921.

GAGE.—Chain gage attached to upstream side of bridge; read by W. C. Krueger.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and silt; somewhat shifting. Left bank of medium height and is overflowed at stages above about 16.0 feet and part of the flow passes through East Freeport.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.9 feet at 5 p. m. August 20 (discharge, 2,640 second-feet); minimum stage, 3.34 feet at 5 p. m. July 16 (discharge, 286 second-feet).

1914–1921: Maximum stage recorded, 19.4 feet March 28, 1916 (discharge, 17,000 second-feet); minimum discharge, 200 second-feet at 5 p. m. December 14, 1917.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Operation of dam and power plant three-fourths of a mile upstream regulates flow past gage to some extent; only slight diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation changed slightly following the high water of August; affected by ice December 19 to January 2 and January 12–20. Rating curve well defined between 350 and 3,000 second-feet and fairly well defined beyond these limits; was used direct October 1 to August 31 except for periods of ice effect; indirect methods for shifting control used September 1–30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods for which shifting-control method was used, and except for periods during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, observer's notes, and weather records. Open-water records good; winter records poor.

Discharge measurements of Pecatonica River at Freeport, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 3	4.43	476
Apr. 27	9.45	1,760

Daily discharge, in second-feet, of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.
1	467	585	525	585	545	485	485	1,220	778	525	377	1,280
2	467	690	525	850	525	485	485	1,100	734	467	413	1,050
3	467	756	545	925	505	467	467	1,000	850	467	467	690
4	449	712	565	850	505	449	467	950	712	467	485	413
5	467	605	605	778	505	413	467	900	646	485	485	1,460
6	467	525	625	756	545	413	431	850	625	545	413	2,240
7	449	605	585	712	565	449	431	800	605	467	377	2,400
8	449	585	545	668	545	505	467	756	585	467	360	2,200
9	467	690	505	646	485	505	485	712	625	505	360	2,080
10	449	668	505	605	485	485	545	756	712	690	360	1,000
11	449	605	505	485	467	467	525	712	756	585	1,610	875
12	449	467	565		485	467	505	690	712	505	2,020	1,310
13	431	467	565		485	505	485	734	646	413	1,580	1,120
14	467	377	545		505	825	467	690	605	431	950	1,340
15	485	485	525		712	1,790	467	668	545	413	625	1,400
16	525	485	545	490	1,050	2,050	525	625	505	343	525	1,730
17	545	467	431		778	1,670	485	625	585	431	850	1,790
18	525	525	505		545	1,080	467	625	690	413	1,580	1,520
19	505	545			565	778	734	850	585	449	1,340	1,310
20	505	545			449	668	1,490	950	525	485	2,600	1,640
21	485	545		565	449	668	1,820	756	565	431	2,440	1,940
22	467	525		734	505	668	1,790	646	545	431	1,940	2,160
23	467	545		875	545	605	1,700	605	485	395	1,100	2,160
24	545	545		800	449	585	1,520	585	413	360	778	1,610
25	668	545	500	734	485	585	1,150	605	545	413	756	1,460
26	605	525		646	525	625	1,280	1,120	545	395	646	1,580
27	525	505		525	467	605	1,790	1,610	800	377	585	1,640
28	505	525		505	395	585	1,880	1,670	734	449	545	1,640
29	505	505		545	-------	545	1,760	1,340	668	449	505	1,490
30	485	525		545	-------	505	1,490	1,080	625	431	485	1,640
31	712	-------		525	-------	505	-------	900	-------	395	950	-------

Monthly discharge of Pecatonica River at Freeport, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,330 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	668	431	498	0.374	0.43
November	756	377	556	.418	.47
December	625	431	523	.393	.45
January	925	----------	622	.468	.54
February	1,050	395	538	.405	.42
March	2,050	413	692	.520	.60
April	1,880	431	902	.678	.76
May	1,670	585	875	.658	.76
June	850	413	632	.475	.53
July	690	343	454	.341	.39
August	2,600	360	920	.692	.80
September	2,400	413	1,540	1.16	1.29
The year	2,600	343	729	.548	7.44

SUGAR RIVER NEAR BRODHEAD, WIS.

LOCATION.—In sec. 26, T. 2 N., R. 9 E., at highway bridge 2 miles southwest of Brodhead, Green County, and 12 miles above Illinois State line. Jordan Creek enters from right 2 miles below station, and Little Jordan Creek, also from right, 4 miles above.

DRAINAGE AREA.—529 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 7, 1914, to September 30, 1921.

GAGE.—Chain gage attached to upstream side of bridge; read by Arthur Christensen.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Control not well defined. Right bank of medium height; seldom overflowed; left bank at gage is overflowed at stage of approximately 6.8 feet on gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.75 feet at 5 p. m. September 24 (discharge, about 1,090 second-feet); minimum stage, 0.99 foot at 7 p. m. July 23 (discharge, 78 second-feet).

1914–1921: Maximum stage recorded, 11.4 feet September 13, 1915 (discharge, about 13,000 second-feet); minimum stage recorded, 0.7 foot at 5 a. m. September 8, 1918 (discharge, determined from extension of rating curve, about 54 second-feet); water was undoubtedly being held at dam at Brodhead.

ACCURACY.—Stage-discharge relation not permanent; affected by ice November 13, December 16 to January 3, and January 13–20. Standard rating curve fairly well defined between 80 and 510 second-feet; poorly defined outside those limits; was used direct except for periods February 23 to March 31, April 8 to July 9, and August 16 to September 30, for which the indirect method for shifting control was used. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, one discharge measurement, observer's notes, and weather records, and except for periods for which shifting-control method was used. Records fair.

Discharge measurements of Sugar River near Brodhead, Wis., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 18[a]	S. R. Collins	2.43	202	Aug. 2	A. O. Olson	1.11	97
Mar. 29	do	1.68	227	Sept. 22	do	2.98	752
Apr. 27	do	3.36	945				

[a] Ice cover above gage; channel open below gage.

Daily discharge, in second-feet, of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	209	276	262	185	235	178	222	419	291	235	144	402
2	196	336	262	210	196	170	196	402	291	248	109	336
3	180	336	276	250	196	188	196	368	306	235	196	291
4	196	306	276	276	196	183	222	385	276	180	191	248
5	191	276	222	291	222	196	196	336	222	209	193	352
6	235	276	276	248	134	188	222	336	291	209	158	491
7	196	222	321	276	222	209	209	321	276	222	134	419
8	180	291	248	222	222	235	262	276	248	222	173	352
9	209	306	248	306	209	235	235	321	276	235	100	262
10	156	306	222	209	196	222	222	352	248	209	158	306
11	180	262	222	262	209	235	291	306	196	222	276	306
12	173	222	186	235	209	222	248	306	235	222	306	385
13	196	190	222	235	170	178	235	336	262	222	291	385
14	209	173	262	220	248	336	276	321	248	186	222	336
15	235	248	276	210	436	454	276	306	248	196	222	321
16	196	276	195	210	368	550	262	306	209	158	222	402
17	180	262	170	210	291	454	196	306	262	151	146	510
18	248	235	145	210	222	336	248	352	235	222	235	630
19	248	248	140	210	209	352	336	402	165	111	248	590
20	248	209	135	215	235	291	710	436	183	151	419	590
21	248	175	135	222	248	276	885	352	235	151	368	670
22	196	209	135	336	222	276	885	276	196	180	454	795
23	209	222	135	336	235	262	885	291	196	141	402	930
24	148	248	135	183	196	262	710	276	209	160	291	1,020
25	248	222	135	321	222	262	550	336	141	136	235	750
26	222	235	135	590	222	262	590	472	148	107	209	710
27	248	262	135	248	158	291	930	472	235	175	222	750
28	222	191	135	209	170	248	1,020	590	248	180	148	550
29	235	248	140	235	-------	235	930	550	419	113	235	368
30	248	235	145	170	-------	222	590	472	262	165	193	368
31	196	-------	165	222	-------	209	-------	368	-------	151	321	-------

Monthly discharge of Sugar River near Brodhead, Wis., for the year ending Sept. 30, 1921.

[Drainage area, 529 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	248	148	209	0.395	0.46
November	336	173	250	.473	.53
December	321	135	197	.372	.43
January	590	170	250	.473	.55
February	436	134	225	.425	.44
March	550	170	265	.501	.58
April	1,020	196	441	.834	.93
May	590	276	366	.692	.80
June	419	141	242	.457	.51
July	248	107	184	.348	.40
August	454	100	233	.440	.51
September	1,020	248	494	.934	1.04
The year	1,020	100	279	.527	7.18

IOWA RIVER AT MARSHALLTOWN, IOWA.

LOCATION.—In sec. 23, T. 84 N., R. 18 W., at Third Avenue highway bridge, 1 mile north of Marshalltown, Marshall County, and 1 mile below site of old gaging station. Asher Creek enters from left 1 mile above station, Burnett Creek enters from left 1 mile below, and Linn Creek enters from right 2 miles below.

DRAINAGE AREA.—1,380 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 21, 1915, to September 30, 1921. February 23 to August 8, 1903, from old site 1 mile above present station.

GAGE.—Chain gage attached to downstream handrail of bridge, 60 feet from right pier; read by B. S. Beehrle.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of mud and sand; subject to shift. Banks subject to overflow, the left bank at stages above 13 feet. Gravel bar forms control for extremely low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.23 feet at 10.15 a. m., September 17 (discharge, 8,140 second-feet); minimum stage, 1.80 feet August 8–10, 13–15, 20, 29, and 30 (discharge, 80 second-feet).

1915–1921: Maximum stage recorded, 17.74 feet June 4, 1918 (discharge, 42,000 second-feet); minimum stage, 1.86 feet November 24, 1917 (discharge, about 2 second-feet).

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

REGULATION.—Operation of power plant at Eldora, about 25 miles upstream, cause slight diurnal fluctuation at gage during periods of low water.

ACCURACY.—Stage-discharge relation changed following the period of ice effect; affected by ice December 20 to February 14. Two well-defined rating curves used, applicable October 1 to February 14, and February 15 to September 30. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table the daily gage height corrected for effect of ice by means of one discharge measurement, observer's notes, and weather records. Open-water records good; winter records fair.

Discharge measurements of Iowa River at Marshalltown, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 13	[a] 4.01	473	May 23	4.33	910	Sept. 19	7.87	2,560
Feb. 15	6.03	1,680	23	4.33	958			
Apr. 19	5.47	1,440	July 9	2.30	180			

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	420	610	985	380	480	705	785	745	1,880	270	178	505
2	350	770	985	400	320	705	745	1,090	1,880	300	215	545
3	332	895	1,030	400	320	705	625	1,220	1,500	270	178	585
4	285	985	1,080	440	240	705	625	1,270	1,450	240	140	470
5	285	895	985	500	220	705	585	1,180	1,220	240	120	300
6	270	985	940	600	220	705	665	1,090	1,040	215	90	228
7	270	1,080	810	800	220	625	785	955	910	190	90	202
8	255	1,310	730	900	200	625	825	910	665	190	80	140
9	242	2,080	730	850	200	625	825	785	665	190	80	190
10	230	1,610	730	800	200	585	785	785	625	165	80	240
11	230	1,510	650	600	180	585	745	825	625	165	90	315
12	230	1,410	610	500	180	585	665	785	625	165	110	330
13	218	1,410	610	480	240	585	625	745	585	152	80	315
14	205	1,360	610	380	600	705	625	665	665	202	80	330
15	350	1,310	610	360	1,680	910	665	625	625	178	80	382
16	730	985	530	360	2,380	865	1,270	585	585	152	120	3,600
17	610	895	472	340	2,080	825	1,400	585	585	140	130	7,820
18	650	850	420	320	1,940	785	1,580	585	545	140	140	4,050
19	610	770	402	240	1,740	785	1,450	585	545	130	100	2,740
20	570	730	380	280	1,680	745	1,220	665	470	130	80	3,300
21	530	730	380	420	1,640	745	1,140	705	435	120	110	2,700
22	610	730	380	460	1,500	665	1,180	745	382	120	120	2,080
23	570	730	360	550	1,220	745	1,040	910	365	110	255	1,780
24	570	730	340	650	1,040	745	1,040	865	348	110	190	1,540
25	472	730	340	800	825	705	1,000	865	300	100	140	1,500
26	455	730	340	750	785	705	1,000	745	300	100	130	1,450
27	455	730	340	600	785	705	1,000	825	300	90	120	1,180
28	455	730	340	460	745	705	955	955	300	140	90	865
29	368	940	360	420	------	705	865	955	300	152	80	785
30	350	940	360	420	------	865	785	1,270	270	120	80	705
31	385	------	360	460	------	825	------	1,640	------	152	705	------

Monthly discharge of Iowa River at Marshalltown, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 1,380 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	730	205	405	0.293	0.34
November	2,080	610	1,010	.732	.82
December	1,080	340	587	.425	.49
January	900	240	514	.372	.43
February	2,380	180	852	.617	.64
March	910	585	715	.518	.60
April	1,580	585	917	.664	.74
May	1,640	585	876	.635	.73
June	1,880	270	700	.507	.57
July	300	90	166	.120	.14
August	255	80	138	.100	.12
September	7,820	140	1,370	.993	1.11
The year	7,820	80	683	.495	6.73

IOWA RIVER AT IOWA CITY, IOWA.

LOCATION.—In sec. 15, T. 79 N., R. 6 W., at highway bridge about 500 feet below Chicago, Rock Island & Pacific Railway main-line bridge in Iowa City, Johnson County, three-quarters of a mile below Iowa State University's power plant, and three-quarters of a mile below old station, which was at county highway bridge a short distance above dam.

DRAINAGE AREA.—3,140 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 30, 1913, to September 30, 1921. June 1, 1903, to July 21, 1906, from station three-quarters of a mile upstream.

GAGE.—Chain gage attached to upstream handrail of bridge about 40 feet from left pier of first span from left bank; read by August Wiese.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or from a boat about 1,000 feet downstream from bridge.

CHANNEL AND CONTROL.—Bed composed of sand; shifting. No well-defined control. Right bank high and not subject to overflow; left bank is overflowed at ordinary high stages under a pile trestle approach to the bridge, and at extreme high stages, beyond left end of the approach also.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.20 feet at 6.15 p. m. September 23 (discharge, 14,300 second-feet); minimum stage, 0.37 foot at 7.50 p. m. July 31 (discharge, 190 second-feet).

1903–1906; 1913–1921: Maximum stage recorded, 19.45 feet June 7, 1918 (discharge, 36,200 second-feet); minimum discharge, about 10 second-feet December 26, 1916.

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

REGULATION.—Considerable diurnal fluctuation is caused at low stages, owing to operation of power plant above station.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 25–31, and January 11–19. Rating curve well defined throughout. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table daily gage height corrected for ice effect by means of one discharge measurement, observer's notes, and records obtained at power plant above station. Records good.

Discharge measurements of Iowa River at Iowa City, Iowa, during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 20	E. D. Burchard	1.50	760	June 8	E. D. Burchard	2.95	1,720
Dec. 7	do	2.30	1,340	Sept. 21	Mercer [b] and Erickson [b]	12.46	14,700
Jan. 15	do	[a] 2.49	1,010	22	do	11.29	11,700
Apr. 21	do	5.49	4,020	23	do	12.18	14,000

[a] Stage-discharge relation affected by ice.

[b] Student of graduate school, University of Iowa, working under supervision of Prof. F. A. Nagler, of the hydraulics department.

Daily discharge, in second-feet, of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	672	672	1,140	820	1,140	1,640	880	2,260	2,100	1,080	672	345
2	672	535	1,080	820	1,080	1,490	945	2,180	2,680	945	1,140	590
3	700	645	1,140	880	945	1,080	1,010	2,430	2,260	730	1,210	618
4	672	672	1,420	945	820	1,080	1,080	2,680	2,340	820	945	1,140
5	730	672	1,210	945	820	1,080	945	2,600	2,430	730	760	880
6	700	1,210	1,350	945	760	1,010	1,010	2,430	2,340	645	1,140	760
7	300	1,210	1,280	945	820	1,010	880	2,340	2,020	562	700	880
8	345	1,780	1,280	945	820	1,010	1,010	2,180	1,780	590	590	820
9	300	1,280	1,280	1,010	672	1,010	1,080	2,100	1,490	370	280	730
10	562	1,350	1,280	1,080	618	1,010	945	2,940	1,490	480	345	672
11	300	1,490	1,140	1,040	618	945	945	4,090	1,420	452	280	618
12	320	1,490	1,080	1,000	672	1,010	945	3,110	1,280	508	300	508
13	320	1,490	1,140	1,000	672	880	1,010	2,520	1,210	398	300	562
14	320	1,380	1,210	1,000	730	1,780	945	2,340	1,140	618	590	1,010
15	264	1,380	1,140	1,000	1,140	1,780	820	2,180	1,080	508	300	1,080
16	300	1,350	1,140	945	1,420	1,280	1,780	1,860	1,490	398	345	6,820
17	508	820	1,080	920	1,560	1,280	1,420	1,780	1,420	370	280	6,000
18	264	1,210	820	900	1,780	1,280	2,020	1,640	1,280	2,520	345	4,920
19	672	1,420	562	910	2,680	1,420	2,020	1,560	1,140	590	345	6,110
20	618	1,490	618	945	1,710	1,280	3,550	1,420	1,280	452	1,010	11,400
21	672	1,560	645	945	1,640	1,140	3,820	1,420	1,140	452	562	13,900
22	760	1,280	645	820	1,710	1,140	3,370	1,350	1,210	398	300	12,300
23	760	1,140	590	760	1,860	1,080	2,940	1,210	1,140	345	672	14,300
24	645	1,140	452	820	1,780	1,080	2,430	1,280	1,010	398	370	13,300
25	730	1,010	500	945	1,780	1,010	2,430	1,350	945	280	370	10,200
26	730	1,080	590	880	1,860	1,010	2,430	1,640	880	280	452	7,970
27	820	1,140	600	1,010	1,640	945	2,860	1,560	1,140	280	300	6,000
28	700	945	600	1,010	1,420	1,010	2,600	1,560	1,140	248	345	3,910
29	508	945	600	1,080	-------	945	2,600	1,350	1,210	236	280	3,280
30	618	1,080	600	1,010	-------	945	2,430	1,280	1,140	228	345	2,940
31	508	-------	650	1,010	-------	1,010	-------	1,350	-------	190	452	-------

Monthly discharge of Iowa River at Iowa City, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 3,140 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	820	264	548	0.175	0.20
November	1,780	535	1,160	.369	.41
December	1,420	452	931	.296	.34
January	1,080	760	945	.301	.35
February	2,680	618	1,260	.401	.42
March	1,780	880	1,150	.366	.42
April	3,820	820	1,770	.564	.63
May	4,090	1,210	2,000	.637	.73
June	2,680	880	1,490	.475	.53
July	2,520	190	552	.176	.20
August	1,210	280	527	.168	.19
September	14,300	345	4,490	1.43	1.60
The year	14,300	190	1,390	.442	6.02

IOWA RIVER AT WAPELLO, IOWA.

LOCATION.—In sec. 27, T. 74 N., R. 3 W., at highway bridge half a mile from railroad station at Wapello, Louisa County, and 20 miles above mouth of river. No important tributaries enter near station.

DRAINAGE AREA.—At gaging station, 12,480 square miles; at mouth, 12,600 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—February 26, 1915, to September 30, 1921.

GAGE.—Chain gage attached to highway bridge near center of first span from right abutment; read by C. W. Warren.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifting. Right bank high and not subject to overflow; levee along left bank, which broke during flood of June, 1918.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.6 feet at 7 a. m. September 24 (discharge, 32,400 second-feet); minimum discharge, 1,420 second-feet September 1 and 2.

1915–1921: Maximum stage recorded, 14.94 feet June 8, 1918 (discharge, 63,100 second-feet); minimum discharge, about 400 second-feet December 15–17, 1916 (stage-discharge relation affected by ice).

The flood of June, 1892, was probably much higher than the flood of June, 1918.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed gradually during the year; affected by ice December 17 to February 2. Standard rating curve fairly well defined. Gage read to hundredths at least once daily except during brief periods in January. Daily discharge ascertained by shifting control method except for periods during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, observer's notes, and weather records. Records good.

Discharge measurements of Iowa River at Wapello, Iowa, during the year ending Sept. 30, 1921.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 19	1.79	4,040	Apr. 23	4.48	11,800
Feb. 4	1.54	3,600	July 20	1.73	3,790

Daily discharge, in second-feet, of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,820	2,560	3,880	3,000	4,000	5,320	4,410	9,570	10,700	4,410	1,700	1,420
2	2,820	2,560	3,880	3,000	4,200	5,320	4,410	8,940	13,200	3,980	5,690	1,420
3	2,640	2,560	4,090	3,000	4,520	4,860	4,200	8,330	16,500	3,780	10,700	1,840
4	2,480	2,560	4,300	3,000	3,670	5,080	4,200	8,330	18,400	3,570	5,940	2,310
5	2,390	2,730	4,520	3,000	3,280	4,410	4,200	8,330	18,800	3,380	4,520	2,640
6	2,390	2,730	4,520	3,500	2,910	4,410	4,200	8,030	18,000	3,570	3,280	3,980
7	2,310	2,910	4,520	3,500	2,560	4,200	3,780	7,740	10,700	3,180	4,970	2,640
8	2,310	2,910	4,300	3,500	3,280	4,200	3,780	7,740	9,410	3,180	3,880	2,310
9	2,310	2,910	4,300	3,500	3,090	3,980	3,980	7,160	8,180	3,000	2,910	2,230
10	2,230	3,470	4,090	3,500	2,910	3,980	3,980	8,330	7,590	2,820	2,390	4,410
11	2,230	4,520	4,090	4,000	2,910	3,780	3,380	12,600	7,020	2,640	2,150	4,200
12	2,150	4,970	4,090	4,000	2,910	3,780	3,180	14,100	6,740	2,480	2,070	3,570
13	2,150	5,690	3,880	4,000	2,910	3,780	3,780	11,200	6,470	2,480	2,000	2,640
14	2,070	6,200	3,880	5,000	3,280	3,980	3,780	10,200	7,300	2,390	2,910	3,180
15	2,070	5,940	3,670	5,000	3,280	5,820	3,780	11,900	8,180	2,310	2,310	3,780
16	2,000	5,440	3,670	4,000	3,280	5,820	5,080	10,900	7,880	2,820	2,070	6,600
17	2,000	4,970	3,600	3,500	4,300	5,560	6,070	8,640	7,590	2,310	1,920	15,900
18	2,070	4,520	2,900	3,500	4,970	5,560	6,070	7,440	8,790	2,310	1,770	22,300
19	2,070	4,090	2,700	3,500	5,690	5,320	8,030	6,880	7,020	5,080	1,840	24,500
20	2,070	4,300	2,600	3,800	6,470	5,320	10,900	6,340	6,470	3,780	2,390	23,200
21	2,150	4,520	2,500	3,800	7,020	4,860	12,600	6,070	6,200	2,480	4,300	26,200
22	2,390	4,520	2,400	3,800	6,470	4,630	13,700	4,200	5,940	2,310	2,910	27,600
23	2,820	4,090	2,300	3,800	6,470	4,630	11,900	7,740	5,440	2,000	2,560	31,400
24	2,820	3,880	2,200	3,800	6,470	4,410	10,500	8,030	5,440	1,920	2,390	31,900
25	2,820	3,880	2,400	3,800	5,940	4,410	9,570	8,330	4,970	1,840	2,230	28,100
26	2,820	3,880	2,600	3,800	5,440	4,630	9,260	8,640	4,740	1,700	2,070	24,900
27	2,820	3,880	2,600	3,900	5,440	4,630	9,890	7,740	4,520	1,700	1,920	21,500
28	2,640	3,880	2,800	3,900	5,440	4,410	10,900	7,160	4,740	1,770	1,840	17,900
29	2,640	3,880	2,800	4,000	-------	4,200	10,900	7,160	4,970	1,700	1,700	16,700
30	2,480	3,880	2,800	4,000	-------	3,980	10,500	7,440	4,970	1,490	1,630	10,900
31	2,480	-------	2,800	4,000	-------	4,200	-------	8,640	-------	1,560	1,490	-------

NOTE.—Gage not read Jan. 3, 4, 6, 7, 16, 18, 19, 21, 23, 24, and 26–28; discharge interpolated or estimated after discharge for intervening days had been ascertained as explained under "Accuracy" in station description.

Monthly discharge of Iowa River at Wapello, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 12,480 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,820	2,000	2,400	0.192	0.22
November	6,200	2,560	3,960	.317	.35
December	4,520	2,200	3,410	.273	.31
January	5,000	3,000	3,720	.298	.34
February	7,020	2,560	4,400	.353	.37
March	5,820	3,780	4,630	.371	.43
April	13,700	3,180	6,830	.547	.61
May	14,100	4,200	8,510	.682	.79
June	18,800	4,520	8,560	.686	.77
July	5,080	1,490	2,710	.217	.25
August	10,700	1,490	2,980	.239	.28
September	31,900	1,420	12,400	.994	1.11
The year	31,900	1,420	5,360	.429	5.83

CEDAR RIVER AT JANESVILLE, IOWA.

LOCATION.—In sec. 35, T. 91 N., R. 14 W., at highway bridge in Janesville, Bremer County, a quarter of a mile above old gaging station and 3 miles above junction with Shellrock River.

DRAINAGE AREA.—1,660 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—April 26, 1905, to September 30, 1906; May 26, 1915, to September 30, 1921.

GAGE.—Chain gage attached to downstream handrail of middle span of highway bridge; installed July 26, 1919. Prior to that date a chain gage attached to Illinois Central Railroad bridge, a quarter of a mile downstream, was used. Gage read by Mrs. Lizzie Ulrich.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Ruins of an old grist mill dam forms control; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.45 feet at 9.45 a. m. May 29 (discharge, about 27,000 second-feet); minimum stage recorded, 1.61 feet at 5.45 p. m. July 8 (discharge, 122 second-feet).

1905–6 and 1915–1921: Maximum stage recorded same as for 1921; minimum discharge recorded, 100 second-feet November 3, 1915; minimum flow caused by regulation at Waverly dam.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during winter.

REGULATION.—Slight diurnal fluctuation at low stages is caused by operation of power plant at Waverly, 9 miles above station.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 150 and 3,500 second-feet; extended above 3,500 second-feet and may be in error. Gage read to hundredths once daily except during periods October 17 to November 13 and December 18 to February 14, when no gage readings were obtained. Daily discharge ascertained by applying daily gage height to rating table except for periods during which gage was not read for which it was ascertained by comparison with flow of this river at Cedar Rapids and of Shellrock River near Clarksville. Records good, except those for high stages.

Discharge measurements of Cedar River at Janesville, Iowa, during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 9	E. D. Burchard	2.31	503	June 1	E. D. Burchard	4.56	2,980
May 24	do	3.16	1,280	Sept. 27	Burchard and Clyde	2.48	680

Daily discharge, in second-feet, of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	316		620			542	542	750	3,060	542	340	240
2	316		620			580	620	705	1,920	542	310	260
3	299		620			542	250	705	1,460	505	182	272
4	304		620			505	225	750	1,140	470	160	260
5	299		620			505	428	660	1,460	435	282	272
6	299		620			505	542	705	1,360	370	255	255
7	282	650	580			542	428	660	1,140	340	250	294
8	282		542		460	580	505	620	1,140	122	255	282
9	294		505			435	580	422	1,100	220	225	260
10	310		505			470	750	660	1,100	174	230	255
11	316		505			505	580	4,880	1,100	505	230	240
12	310		505			505	580	2,920	1,140	340	255	230
13	322		505			580	505	1,040	1,410	470	282	205
14	328	470	505			1,200	580	705	1,250	282	255	230
15	310	422	505		660	1,460	542	660	1,140	255	230	272
16	316	390	505	500	1,140	660	542	620	1,100	230	205	750
17		383	505		1,360	435	660	2,660	995	282	255	2,280
18		396			1,800	370	580	2,280	798	255	230	895
19		402			1,410	542	620	2,400	798	182	182	620
20		409			1,250	580	580	2,660	620	205	230	1,580
21		470			1,300	620	620	2,660	620	182	230	542
22		470			1,100	580	505	2,400	620	182	230	1,040
23		470			798	620	580	1,920	580	230	255	798
24	360	470	360		750	660	705	1,300	580	310	282	705
25		470			660	660	396	1,140	580	182	272	660
26		505			660	620	409	1,580	620	205	240	660
27		542			542	660	995	3,340	620	230	230	580
28		620			505	705	945	14,700	580	230	230	470
29		620				750	895	25,500	580	255	230	505
30		620				705	750	10,300	542	282	205	316
31						660		7,320		310	230	

NOTE.—Braced figures show estimated mean discharge for periods indicated.

Monthly discharge of Cedar River at Janesville, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October		282	332	0.200	0.23
November		383	553	.333	.37
December	620		465	.280	.32
January			500	.301	.35
February	1,800		728	.439	.46
March	1,460	370	622	.375	.43
April	995	225	581	.350	.39
May	25,500	422	3,210	1.93	2.22
June	3,060	542	1,040	.627	.70
July	542	122	301	.181	.21
August	340	160	241	.145	.17
September	2,280	205	541	.326	.36
The year	25,500	122	761	.458	6.21

CEDAR RIVER AT CEDAR RAPIDS, IOWA.

LOCATION.—In sec. 28, T. 83 N., R. 7 W., in central part of Cedar Rapids, Linn County, half a mile below a dam and power plant and 1,000 feet above Eighth Avenue Bridge.

DRAINAGE AREA.—At gaging station, 6,640 square miles; at junction with Iowa River, 7,930 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—February 14, 1903, to September 30, 1921.

GAGE.—Gurley water-stage recorder on right bank in rear of plant of Iowa Windmill & Pump Co.; installed August 20, 1920. Prior to that date an inclined staff gage at same location and datum was used. Elevation of zero of both gages, from Northwestern Railroad levels, 723.03 feet above sea level. Observer, R. S. Toogood.

DISCHARGE MEASUREMENTS.—Made from upstream side of Eighth Avenue Bridge.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; free from vegetation; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.4 feet at 8 p. m. June 1 (discharge, 17,900 second-feet); minimum stage, 2.23 feet at 7 a. m. September 9 (discharge, about 190 second-feet).

1902–1921: Maximum stage recorded, 17.2 feet April 1, 1912, and March 26, 1917 (discharge, 54,100 second-feet); minimum stage recorded same as for 1921.

Greatest known flood probably occurred in June, 1851, when the maximum stage was about 20 feet (discharge, about 65,000 second-feet).

ICE.—Stage-discharge relation affected by ice during extremely cold weather. The swift current and the proximity of the power plant keeps measuring section open during mild winters.

REGULATION.—Since 1917, operation of power plant half a mile above gage has caused marked diurnal fluctuation during periods of low water. There is no dam below gage which might cause backwater.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 21 to January 18. Rating curve well defined above 1,000 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained from recorder graph by inspection except for period during which stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for ice effect by means of one discharge measurement, observer's notes, and weather records. Open-water records excellent; winter records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

Discharge measurements of Cedar River at Cedar Rapids, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 15	[a] 3.61	1,780
Apr. 19	4.74	5,070

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,970	1,370	2,670	1,900	2,320	3,590	3,320	4,590	16,300	2,200	879	1,120
2	1,860	1,560	2,920	1,900	2,320	3,870	3,180	4,300	15,900	2,080	1,040	1,120
3	1,760	1,760	3,180	1,900	2,200	2,800	2,920	4,010	11,400	1,860	1,280	1,280
4	1,760	2,200	3,450	2,000	2,080	2,670	2,800	3,870	8,010	1,970	1,040	1,200
5	1,560	2,670	3,450	1,900	2,080	2,670	2,670	4,010	6,410	1,860	1,120	1,280
6	1,560	2,800	3,450	1,900	2,320	2,670	2,550	4,300	5,480	1,860	1,120	1,200
7	1,560	2,920	3,320	2,000	2,200	2,550	2,430	3,590	4,590	1,760	1,040	1,040
8	1,560	2,920	3,050	2,200	1,660	2,670	2,430	3,450	4,300	1,760	975	1,040
9	1,370	3,450	2,920	2,400	1,370	2,670	2,430	3,320	4,010	1,660	905	788
10	1,200	4,300	2,800	2,000	1,660	2,670	2,430	3,320	3,870	1,460	905	1,120
11	1,760	4,590	2,550	2,200	1,660	2,550	2,670	3,730	3,870	1,460	905	989
12	1,370	4,590	2,430	2,400	1,860	2,550	2,670	4,590	4,590	1,460	905	1,370
13	1,370	4,300	2,430	2,600	1,970	2,550	2,670	7,050	5,480	1,370	905	1,200
14	1,370	3,320	2,430	1,900	2,430	2,920	2,550	7,050	5,480	1,280	989	1,370
15	1,280	2,800	2,670	1,900	2,800	3,450	2,550	4,880	5,180	1,280	1,120	1,280
16	1,370	3,050	2,080	2,000	3,870	3,590	2,920	3,870	4,590	1,370	853	5,790
17	2,080	2,800	2,080	1,900	4,010	3,590	3,050	3,450	4,300	975	1,280	5,480
18	2,430	2,550	1,660	1,400	4,300	3,450	3,450	3,180	4,010	1,370	1,280	5,480
19	2,430	2,920	1,040	1,120	5,790	3,320	4,880	3,050	3,590	1,460	1,120	6,730
20	2,320	3,050	801	1,660	5,790	3,180	5,790	3,730	3,320	1,280	1,120	10,700
21	2,080	2,430	850	1,860	5,180	3,050	5,480	5,180	3,180	1,040	1,040	11,100
22	1,970	2,320	950	1,860	4,880	3,050	5,180	5,790	2,800	1,020	1,120	7,370
23	1,970	2,430	1,500	1,970	4,880	3,320	5,180	6,100	2,670	1,020	1,030	6,410
24	1,970	2,430	2,000	2,080	3,730	3,450	5,180	5,790	2,550	1,120	1,030	5,790
25	1,860	2,430	2,200	2,430	3,590	3,320	4,590	4,880	2,320	905	975	5,180
26	1,970	2,550	1,800	3,050	3,870	3,180	4,300	4,590	2,550	961	1,030	4,300
27	1,860	2,550	1,800	3,050	4,300	3,180	4,590	4,300	2,320	919	1,120	3,870
28	1,760	2,550	1,800	2,670	3,450	3,050	5,180	4,880	2,430	975	933	3,870
29	1,660	2,430	1,800	2,550	-------	3,050	4,880	6,100	2,320	1,020	933	3,450
30	1,660	2,550	1,900	2,550	-------	3,320	4,880	8,010	2,320	1,120	1,000	3,180
31	1,460	-------	1,900	2,550	-------	3,450	-------	11,100	-------	975	1,120	-------

Monthly discharge of Cedar River at Cedar Rapids, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 6,640 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,430	1,200	1,750	0.264	0.30
November	4,590	1,370	2,820	.425	.47
December	3,450	801	2,250	.339	.39
January	3,050	1,120	2,120	.319	.37
February	5,790	1,370	3,160	.476	.50
March	3,870	2,550	3,080	.464	.53
April	5,790	2,430	3,660	.551	.61
May	11,100	3,050	4,840	.729	.84
June	16,300	2,320	5,000	.753	.84
July	2,200	905	1,380	.208	.24
August	1,280	853	1,040	.157	.18
September	11,100	788	3,540	.533	.59
The year	16,300	788	2,880	.434	5.86

81182—24†—WSP 525——9

SHELLROCK RIVER NEAR CLARKSVILLE, IOWA.

LOCATION.—In T. 92 N., R. 16 W., at highway bridge 1¼ miles northwest of Clarksville, Butler County, and 25 miles above junction with Cedar River. No large tributaries enter for several miles above or below.

DRAINAGE AREA.—1,660 square miles at station; 2,680 square miles at junction with Cedar River (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 28, 1915, to September 30, 1921.

GAGE.—Chain gage attached to handrail on upstream side of bridge, 75 feet from right abutment; read by Mrs. H. H. Sherburne.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of rock and sand; probably permanent. Right bank high and not subject to overflow; left bank probably subject to overflow at extreme high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.33 feet at 5.30 a. m. May 28 (discharge, 7,860 second-feet); minimum stage recorded, 1.10 feet at 7 a. m. August 15 and September 5 (discharge, 140 second-feet).

1915–1921: Maximum discharge recorded, 12,200 second-feet June 2, 1916; minimum discharge, estimated 100 second-feet December 10–13, 1916.

In April, 1907, a stage of about 16.5 feet was reached (discharge, about 19,000 second-feet).

ICE.—Stage-discharge relation affected by ice; observations discontinued during winter.

REGULATION.—Slight diurnal fluctuation may occur during low water, owing to operation of power plant at Greene, 10 miles upstream.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 16 to February 16. Rating curve well defined between 125 and 10,000 second-feet. Gage read to hundredths once daily except during period of ice effect and a few other brief periods, when no gage readings were obtained. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect and a few other brief periods when gage was not read for which it was ascertained as indicated in footnote to table of daily discharge. Records good.

Discharge measurements of Shell Rock River near Clarksville, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 24	2.66	905
June 1	4.53	2,390
Sept. 27	1.79	364

Daily discharge, in second-feet, of Shell Rock River near Clarksville, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	402	255	1,060			570	758	430	2,390	375	220	205
2	348	790	1,060			540	692	430	1,970	348	255	192
3	348	700	985			540	660	430	1,730	298	255	205
4	348	650	855			512	600	485	1,500	298	235	205
5	320	550	855			512	570	540	1,270	298	220	140
6	298	692	790			512	570	600	920	298	205	170
7	275	1,900	725			630	630	485	855	298	220	160
8	255	1,810	660		500	600	692	430	790	298	180	180
9	235	1,730	660			570	790	430	758	298	180	150
10	220	1,500	630			512	725	920	2,140	275	180	160
11	220	1,340	630			512	630	692	2,050	275	205	180
12	220	1,120	630			512	630	430	1,890	275	160	170
13	220	855	630			512	660	375	1,500	255	170	160
14	205	692	630			512	692	320	1,200	255	180	205
15	600	660	485			512	670	320	985	255	140	235
				550								
16	512	630			3,800	512	650	298	655	255	160	1,420
17	430	600			1,970	485	600	348	758	235	192	2,760
18	402	600			1,500	485	570	1,200	660	235	205	1,570
19	375	570			1,270	485	540	2,570	570	205	180	1,270
20	402	680			1,120	600	512	2,660	540	205	170	790
21	430	790			1,060	790	725	1,890	540	205	170	1,120
22	375	725			920	758	692	1,420	485	205	160	855
23	375	692			855	692	630	1,060	458	220	192	700
24	348	758	420		692	660	660	855	458	235	192	570
25	320	725			630	660	692	985	458	205	192	458
26	320	692			570	860	540	1,340	430	180	180	430
27	298	692			570	1,060	790	3,980	540	205	170	320
28	298	660			512	1,270	600	7,280	458	205	205	298
29	275	630			------	1,060	570	4,780	430	192	205	275
30	275	985			------	920	485	3,760	430	180	205	275
31	275	------			------	855	------	2,760	------	205	205	------

NOTE.—Stage-discharge relation affected by ice Dec. 16 to Feb. 16; gage not read except on Feb. 16; discharge ascertained by comparison with flow of Cedar River at Cedar Rapids and at Janesville. Gage not read Nov. 3–5, 7, 20, Feb. 18, 19, Mar. 13, 26, Apr. 15 and 16; discharge ascertained by comparison with flow at gaging stations on Cedar River. Braced figures show mean discharge for periods indicated.

Monthly discharge of Shell Rock River near Clarksville, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 1,660 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	600	205	330	0.199	0.23
November	1,900	255	856	.516	.58
December	1,060	------	581	.350	.40
January	------	------	550	.331	.38
February	3,800	------	820	.494	.51
March	1,270	485	652	.393	.45
April	790	485	641	.386	.43
May	7,280	298	1,440	.867	1.00
June	2,390	430	1,000	.602	.67
July	375	180	251	.151	.17
August	255	140	193	.116	.13
September	2,760	140	531	.320	.36
The year	7,280	140	651	.392	5.31

SKUNK RIVER NEAR AMES, IOWA.

LOCATION.—In sec. 23, T. 84 N., R. 24 W., at site of old county bridge, 2½ miles north of Ames, Story County, 5 miles above mouth of Squaw Creek, and 3½ miles below Keigley Branch.

DRAINAGE AREA.—320 square miles (measured on topographic map and on United States post-route map).

RECORDS AVAILABLE.—July 28, 1920, to September 30, 1921.

GAGE.—Stevens continuous water-stage recorder on left bank; installed August 25, 1921; inspected by W. P. Coon. Prior to August 25, 1921, inclined staff gage at same location and datum was used.

DISCHARGE MEASUREMENTS.—Made from new county highway bridge a quarter of a mile downstream from gage or by wading.

CHANNEL AND CONTROL.—Left bank not subject to overflow; right bank subject to overflow at extreme high stages. Backwater is caused at gage at times, by débris lodged against new county bridge, a quarter of a mile downstream. Natural control formed by rock ledge; permanent. Construction of an artificial concrete control was begun August 30 and continued until the middle of September, when high water destroyed part of the forms. Nothing further has been done toward completing the structure. Discharge measurements made after the flood indicate that the remains of the structure changed the stage-discharge relation at the gage for low stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.2 feet at noon September 17 (discharge, about 3,540 second-feet); minimum stage recorded, 1.60 feet July 31 (discharge, 1.5 second-feet).

1920–21: Maximum and minimum stages same as for 1921.

ICE.—Stage-discharge relation possibly affected by ice for brief periods during extreme cold weather; observations discontinued during winter.

ACCURACY.—Stage-discharge relation for low stages changed during the high water of September (see under "Channel and control"); affected by backwater from forms for concrete control, below gage August 30 to September 15 (see under "Channel and control"), and by ice December 16 to February 14. Two rating curves used; one, applicable October 1 to September 15, well defined below 2,500 second-feet, the other, applicable September 16–30, is a revision of the previous curve below 700 second-feet, and is well defined between 30 and 2,500 second-feet. Staff gage read to hundredths once daily prior to August 25, except as noted in footnote to table of daily discharge; operation of water-stage recorder satisfactory August 25 to September 30. Daily discharge ascertained by applying to rating table daily gage height from staff gage or mean daily gage height obtained from recorder graph by inspection, except as indicated in footnote to table of daily discharge. Records good.

Discharge measurements of Skunk River near Ames, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 12	2.83	116	Aug. 31	[a]3.24	101	Sept. 17	[b]7.90	2,470
July 26	1.63	1.6	Sept. 16	7.40	2,260			

[a] Stage-discharge relation affected by backwater from forms for artificial concrete control below gage.
[b] Stage-discharge relation affected by backwater from drift lodged against county bridge, a quarter of a mile below gage.

Daily discharge, in second-feet, of Skunk River near Ames, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	27	132	210			80	79	140	85	48	2.0	151
2	27	374	200			65	79	325	124	36	2.5	162
3	26	264	192			79	86	320	134	29	29	102
4	24	249	182			40	79	309	94	27	6.5	72
5	22	210	174			79	65	264	94	25	3.9	64
6	21	222	164			86	94	210	83	28	2.8	57
7	19	480	154		65	102	151	185	72	25	2.4	47
8	21	408	144			111	210	173	69	18	1.9	42
9	19	408	136			102	162	162	65	11	1.8	79
10	19	325	126			102	143	197	65	9.5	1.6	151
11	19	264	126			102	113	550	82	7.5	10	185
12	25	236	126			102	113	325	66	6.0	109	114
13	23	222	130			111	113	210	61	4.5	51	102
14	102	197	130		950	151	120	180	52	5.0	21	210
15	185	162	126		1,700	120	170	151	80	5.4	11	197
16	236	185		115	1,200	197	731	130	151	4.5	17	1,700
17	197	185			550	162	578	130	120	3.5	9.0	2,910
18	136	173			340	162	426	151	99	2.5	7.0	2,020
19	124	162			170	151	341	151	86	2.3	5.7	1,520
20	111	136				151	341	151	65	2.2	3.6	1,340
21	147	147				111	309	120	52	2.1	3.0	1,180
22	130	147				102	278	120	50	2.0	40	1,030
23	115	145				102	249	120	41	1.9	264	730
24	102	143	80		170	106	222	90	36	1.8	210	520
25	92	140				102	210	100	36	1.7	91	414
26	86	140				97	210	102	36	1.6	68	356
27	79	140				97	185	102	36	1.6	50	303
28	71	173				97	173	120	29	1.6	41	254
29	65	185			-------	94	140	124	58	1.6	32	239
30	65	197			-------	94	136	111	53	1.6	26	196
31	102	-------			-------	86	-------	94	-------	1.5	130	-------

NOTE.—Stage-discharge relation affected by ice Dec. 16 to Feb. 14; gage not read; discharge ascertained by comparison with flow of Squaw Creek at Ames. Stage-discharge relation affected by backwater from forms for concrete control below gage, Aug. 30 to Sept. 15; discharge ascertained by applying to rating table mean daily gage height corrected for backwater by means of one discharge measurement (see under "Channel and control"). Staff gage not read Nov. 22, 23, 25, 26, 29, 30, Dec. 2–9, 11, Feb. 19 to Mar. 1, Apr. 14, 15, May 3, 11, 14, 25, June 6, 26, July 4, 12, 14, 16, 17, 19–22, 25, 27, 29, 30, Aug. 1, and 21; discharge ascertained by comparison with flow of Squaw Creek at Ames. Braced figures show mean discharge for periods indicated.

Monthly discharge of Skunk River near Ames, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 320 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	236	19	78.6	0.246	0.28
November	480	132	218	.681	.76
December	210	-------	116	.362	.42
January	-------	-------	115	.359	.41
February	1,700	-------	260	.812	.85
March	197	40	108	.338	.39
April	731	65	210	.656	.73
May	550	90	181	.566	.65
June	151	29	72.5	.227	.25
July	48	1.5	10.3	.032	.04
August	264	1.6	40.4	.126	.15
September	2,910	42	548	1.71	1.91
The year	2,910	1.5	161	.503	6.84

SKUNK RIVER AT COPPOCK, IOWA.

LOCATION.—In sec. 1, T. 73 N., R. 8 W., at highway bridge an eighth of a mile above Chicago, Burlington & Quincy Railroad bridge at Coppock, Henry County, and a quarter of a mile above junction with Crooked Creek.

DRAINAGE AREA.—2,890 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 21, 1913, to September 30, 1921.

GAGE.—Chain gage attached to downstream side of bridge; read by J. W. Ricks.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.60 feet at 9 a. m. September 27 (discharge, 11,000 second-feet); minimum discharge, 168 second-feet August 1.

1913–1921: Maximum stage recorded, 19.7 feet June 9, 1918 (discharge, 19,600 second-feet); minimum stage, 2.10 feet August 15, 18, and 25–27, 1914 (discharge, 33 second-feet).

A stage of about 22 feet (discharge, 25,000 second-feet) was reached on or about May 31, 1903.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation changed during winter and again during high water of May; affected by ice December 17 to February 12 and February 22 and 23, and by drift lodged against railroad bridge June 18–27. Three fairly well-defined rating curves used, applicable October 1 to February 17, February 18 to May 11, and May 12 to September 30. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect and period of backwater from drift at railroad bridge, for which it was ascertained by means of gage heights and comparison with flow of this river at Augusta, Iowa. Open-water records good; winter records fair.

Discharge measurements of Skunk River at Coppock, Iowa, during the year ending Sept. 30, 1921.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Nov. 18	3.51	429
Apr. 23	7.38	2,820
July 20	3.23	317

Daily discharge, in second-feet, of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	268	297	463	350	450	645	464	1,720	818	1,150	168	269
2	254	282	463	350	450	645	464	2,120	1,270	979	3,200	255
3	254	268	500	400	450	600	464	2,180	1,040	979	2,640	768
4	240	282	520	400	425	560	464	2,470	1,270	924	1,700	584
5	240	297	520	400	425	520	447	2,470	1,090	924	979	1,210
6	226	463	580	450	425	520	447	2,320	979	1,700	1,090	2,050
7	226	482	540	450	425	560	430	2,120	870	1,040	979	1,330
8	213	500	520	450	375	560	447	1,780	768	672	979	870
9	213	520	500	450	425	560	447	1,650	719	584	719	719
10	213	520	482	450	350	540	520	1,780	672	503	465	3,620
11	201	715	463	500	300	540	520	5,480	672	465	378	4,060
12	201	765	445	500	300	540	600	4,240	768	429	378	2,640
13	201	765	445	500	359	560	560	3,360	818	395	378	1,510
14	189	665	482	500	376	645	540	2,720	768	378	503	1,840
15	201	500	463	500	410	945	520	2,120	627	346	584	1,770
16	189	392	427	450	625	1,160	1,160	1,840	1,150	484	362	3,360
17	189	376	400	400	815	945	1,460	1,580	1,210	362	314	4,340
18	178	427	350	400	1,460	840	1,580	1,390	7,480	330	284	4,060
19	201	580	300	400	1,580	840	2,840	1,330	7,480	330	255	4,060
20	343	500	300	400	1,580	740	3,920	1,210	2,960	314	284	5,040
21	410	500	250	400	1,160	740	4,100	1,090	1,390	284	362	6,860
22	376	540	200	400	850	645	3,740	1,090	768	255	378	6,140
23	343	625	200	400	700	645	2,770	979	1,150	241	1,040	6,370
24	343	520	200	400	890	645	2,040	924	924	234	543	6,980
25	359	500	200	400	945	560	1,840	870	870	228	870	8,130
26	343	482	200	500	840	560	1,980	818	924	215	584	10,700
27	327	463	200	500	740	520	2,540	818	1,390	215	447	11,000
28	312	463	200	500	690	520	3,230	768	1,390	215	395	9,380
29	297	445	250	500	-------	520	2,400	768	1,700	215	378	7,740
30	282	445	250	500	-------	501	2,040	719	1,390	203	330	5,910
31	282	-------	300	450	-------	482	-------	672	-------	191	284	-------

Monthly discharge of Skunk River at Coppock, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 2,890 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	410	178	262	0.091	0.10
November	765	268	486	.168	.19
December	580	200	375	.130	.15
January	500	350	440	.152	.18
February	1,580	300	672	.233	.24
March	1,160	482	639	.221	.25
April	4,100	430	1,500	.519	.58
May	5,480	672	1,790	.619	.71
June	7,480	627	1,510	.522	.58
July	1,700	191	509	.176	.20
August	3,200	168	718	.248	.29
September	11,000	255	4,120	1.43	1.60
The year	11,000	168	1,080	.374	5.07

SKUNK RIVER AT AUGUSTA, IOWA.

LOCATION.—In sec. 26, T. 69 N., R. 4 W., at highway bridge a third of a mile from Augusta post office, Des Moines County, and 12.2 miles above point where Skunk River empties into pond of Mississippi River Power Co., 32.2 miles above dam at Keokuk, Iowa.

DRAINAGE AREA.—At gaging station, 4,290 square miles; at mouth, 4,350 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 1 to November 15, 1913; May 27, 1915, to September 30, 1921.

GAGE.—Chain gage attached to downstream handrail of bridge about 95 feet from left abutment; read by J. A. Schroder. Zero of chain gage 528.55 feet above mean sea level, Memphis datum. Staff gage attached to downstream left side of middle pier, used by engineers of the Hydraulic Engineering Co. of Maine during 1913; taken out by ice in spring of 1914. Datum of staff gage approximately 0.73 foot higher than datum of chain gage.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; shifting. Right bank high and is not overflowed; left bank is overflowed at extremely high stages. Remains of old mill dam 600 feet below gage forms control; practically permanent. The fall over the dam is about 3 feet at medium low stages. Backwater from Mississippi River occurs once in about 50 years.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.95 feet at 5.30 p. m. September 21 (discharge, 12,200 second-feet); minimum stage recorded, 1.52 feet October 14 and 19 (discharge, 73 second-feet).

1913; 1915–1921: Maximum discharge recorded, 30,800 second-feet March 28, 1916; minimum stage, 1.29 feet September 8, 1919 (discharge, 26 second-feet, by current-meter measurement).

ICE.—Stage-discharge relation seriously affected by ice at times.

REGULATION.—Natural discharge at Augusta occasionally affected at extreme low stages by storage of water at Oakland mills, 26 miles upstream.

ACCURACY.—Stage-discharge relation permanent except as affected by ice November 17–19, December 17 to February 4, and February 23 and 24. Rating curve well defined throughout. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, observer's notes, and weather records. Open-water records excellent; winter records good.

Discharge measurements of Skunk River at Augusta, Iowa, during the year ending Sept. 30, 1921.

[Made by C. Herlofson.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 21	4.83	3,430	Sept. 27	10.09	10,900	Nov. 17	2.29	358
Sept. 22	9.66	10,200	Sept. 30	7.78	7,640			

Daily discharge, in second-feet, of Skunk River at Augusta, Iowa, for the year ending Sept 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	352	325	468	300	400	712	575	3,000	865	2,020	252	325
2	310	352	435	600	350	665	538	3,420	1,090	1,470	468	310
3	310	300	468	600	350	620	500	4,400	2,720	1,090	4,540	285
4	285	275	538	550	400	538	500	4,120	1,740	1,090	3,420	2,300
5	285	252	538	500	468	575	468	3,840	1,600	1,030	2,440	2,020
6	113	300	538	450	380	620	500	3,280	1,470	1,150	1,540	1,670
7	285	325	575	400	352	812	575	2,720	1,270	1,600	1,210	2,300
8	180	352	575	400	380	1,340	865	2,720	1,090	1,540	1,210	1,540
9	113	620	575	400	435	1,270	975	2,440	1,030	865	1,210	1,090
10	261	538	538	450	408	975	712	2,160	920	665	975	2,440
11	261	575	500	450	408	812	620	3,280	812	575	712	7,480
12	261	665	468	400	408	812	620	7,760	760	538	538	6,500
13	239	812	500	350	380	812	620	5,660	865	500	712	3,840
14	73	865	500	350	408	920	665	5,240	975	468	3,280	2,440
15	285	665	500	350	380	865	712	3,700	1,150	435	1,740	4,540
16	261	575	500	350	380	1,340	4,540	2,860	1,210	408	975	5,240
17	198	380	450	350	380	1,400	5,380	2,440	1,210	435	712	5,100
18	218	408	400	350	352	1,270	5,800	2,160	4,540	435	468	6,220
19	73	380	300	400	760	1,210	4,680	1,880	11,500	408	380	5,240
20	162	575	250	450	1,880	1,090	5,240	1,740	9,300	380	352	6,080
21	145	575	250	450	1,740	1,030	5,940	1,600	4,400	352	352	10,300
22	310	500	250	450	1,340	920	5,520	1,470	2,440	325	325	10,800
23	408	468	200	500	1,300	812	4,680	1,400	2,160	300	310	8,880
24	408	575	200	500	1,800	712	3,560	1,270	1,740	300	1,210	7,760
25	380	575	200	500	865	760	2,860	1,090	1,600	275	665	8,180
26	352	500	200	500	975	712	3,980	1,090	1,740	275	760	9,300
27	380	500	200	500	865	712	4,820	1,030	1,740	275	575	10,700
28	352	500	200	600	760	665	6,220	1,030	2,020	252	500	11,300
29	325	468	200	500	-------	575	5,520	1,030	2,160	300	435	10,300
30	325	468	250	500	-------	575	3,980	975	2,300	275	408	8,460
31	300	-------	200	450	-------	575	-------	920	-------	275	352	-------

Monthly discharge of Skunk River at Augusta, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 4,290 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	408	73	265	0.062	0.07
November	865	252	489	.114	.13
December	575	200	386	.090	.10
January	600	300	448	.104	.12
February	1,880	350	689	.161	.17
March	1,400	538	861	.201	.23
April	6,220	468	2,740	.639	.71
May	7,760	920	2,640	.615	.71
June	11,500	760	2,280	.531	.59
July	2,020	252	655	.153	.18
August	4,540	252	1,070	.249	.29
September	11,300	285	5,430	1.27	1.42
The year	11,500	73	1,490	.347	4.72

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SQUAW CREEK AT AMES, IOWA.

LOCATION.—In sec. 3, T. 83 N., R. 24 W., at footbridge 1,700 feet above Chicago & Northwestern Railway bridge in Ames, Story County, and 2 miles above junction with Skunk River.

DRAINAGE AREA.—210 square miles (measured on topographic map and United States post-route map).

RECORDS AVAILABLE.—May 24, 1919, to September 30, 1921.

GAGE.—Vertical staff gage attached to middle pile of left bent of bridge; read by E. D. Burchard.

DISCHARGE MEASUREMENTS.—Made from Chicago & Northwestern Railroad bridge at extreme high stages; at other stages from footbridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; sand shifts during high water. Left bank high; right bank subject to overflow at stages above 7 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.35 feet at 6.30 a. m. September 17 (measured discharge, 1,870 second-feet); minimum stage, 0.77 foot at 12.30 p. m. July 31 (discharge, 4.2 second-feet).

1919–1921: Maximum stage recorded, 8.51 feet at 7.20 p. m. October 4, 1919 (discharge, 2,210 second-feet); minimum discharge, no flow, August 26 to September 17, 1919.

Maximum stage in recent years, about 14.5 feet June 4, 1918 (discharge, about 6,900 second-feet). The creek is practically dry for a short period nearly every summer.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed during rise in early part of November; affected by ice December 16 to February 26. Rating curve well defined between 5 and 2,500 second-feet. Gage read to hundredths twice daily or oftener during high water. Daily discharge ascertained by applying mean daily gage height to rating table except for period during which stage-discharge relation was affected by ice, for which it was ascertained by means of twelve discharge measurements, gage heights, observer's notes, and weather records; shifting-control method used October 1 to November 7, in transition from curve used prior to October 1. Open-water records good; winter records fair.

Discharge measurements of Squaw Creek at Ames, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 11	1.53	69	Feb. 10	[a] 2.08	37	May 17	1.71	76
23	[a] 1.71	43	14	[a] 4.85	493	June 14	1.16	24
28	1.79	27	16	[a] 4.81	742	29	3.97	501
Jan. 4	[a] 2.25	75	19	[a] 2.38	140	July 26	.82	5.2
12	[a] 1.94	42	26	[a] 1.85	73	Aug. 31	4.23	550
20	[a] 2.20	64	Apr. 5	1.36	35	Sept. 16	6.20	1,280
26	[a] 1.87	39	16	3.45	430	17	7.35	1,870
Feb. 4	[a] 1.95	43	18	2.60	195			

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Squaw Creek at Ames, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	18	172	96	46	40	84	54	78	44	180	13	198
2	17	189	90	60	38	84	52	216	72	124	132	226
3	17	140	90	65	42	72	49	198	84	110	60	163
4	16	124	84	75	44	72	44	155	78	84	34	124
5	14	96	78	110	42	78	41	132	65	110	21	96
6	14	124	72	130	26	78	52	117	50	117	18	84
7	14	314	66	110	22	84	64	110	43	84	14	65
8	14	254	72	95	30	84	66	96	40	62	12	60
9	13	235	63	75	34	72	54	90	46	42	9.5	59
10	12	189	60	80	38	78	51	96	40	36	12	189
11	12	140	60	55	36	78	50	314	36	31	55	254
12	14	117	59	40	34	72	48	189	30	25	24	155
13	17	132	58	42	34	78	46	132	26	22	16	124
14	18	124	56	46	500	117	52	110	25	20	12	254
15	172	96	60	50	1,300	132	72	90	117	19	9.5	294
16	198	90	46	46	650	117	377	84	235	17	12	1,280
17	117	90	30	40	300	110	274	78	117	15	13	1,520
18	103	84	16	36	190	96	216	84	180	14	9.5	1,090
19	96	84	60	44	140	96	180	78	235	12	8.0	803
20	96	84	40	60	120	90	147	72	103	10	7.0	558
21	90	90	38	80	140	72	147	69	84	9.0	4.5	600
22	72	90	36	80	110	66	147	66	54	7.5	21	558
23	60	84	42	65	65	65	124	54	56	9.0	72	420
24	54	78	34	55	90	72	124	50	47	10	49	377
25	48	72	32	46	55	65	110	59	41	7.5	29	335
26	45	78	34	38	75	72	103	54	35	6.0	20	294
27	40	78	30	55	72	65	96	53	59	6.0	16	254
28	36	90	26	55	90	51	84	84	60	4.5	14	226
29	35	84	28	55	-------	66	78	64	254	4.8	12	198
30	32	90	30	55	-------	64	72	59	398	4.5	9.5	172
31	35	-------	38	38	-------	55	-------	50	-------	4.2	509	-------

NOTE.—Gage not read May 21 and Sept. 21; discharge estimated.

Monthly discharge of Squaw Creek at Ames, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 210 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	198	12	49.6	0.236	0.27
November	314	72	124	.590	.66
December	96	16	52.4	.250	.29
January	130	36	62.2	.296	.34
February	1,300	22	156	.743	.77
March	132	51	80.2	.382	.44
April	377	41	102	.486	.54
May	314	50	103	.490	.56
June	398	25	91.8	.437	.49
July	180	4.2	38.9	.185	.21
August	509	4.5	40.2	.191	.22
September	1,520	59.	368	1.75	1.95
The year	1,520	4.2	104	.495	6.74

DES MOINES RIVER AT KALO, IOWA.

LOCATION.—In sec. 17, T. 88 N., R. 28 W., at highway bridge in Kalo, Webster County, 1½ miles east of Otho, a station on Minneapolis & St. Louis Railroad, and 1½ miles above mouth of Holiday Creek, which enters from left.

DRAINAGE AREA.—4,170 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—October 18, 1913, to September 30, 1921.

GAGE.—Chain gage attached to downstream side of bridge in middle of right span; read by S. C. Fuller.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel; practically permanent Control not well defined. Point of zero flow estimated to be at gage height about −0.5 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.2 feet at 7.30 a. m. May 28 (discharge, 6,600 second-feet); minimum stage recorded, 0.26 foot at 7.30 a. m. August 20 (discharge, 57 second-feet).

1913–1921: Maximum stage recorded, 14.0 feet May 30, 1915 (discharge, 18,500 second-feet); minimum discharge, estimated 28 second-feet January 22, 1920 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice at times.

REGULATION.—Operation of city power plant at Fort Dodge, about 7 miles upstream, causes diurnal fluctuation during low water.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined above 400 second-feet; below that point somewhat uncertain. Gage read to hundredths once daily except as noted in footnote to daily-discharge table. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect and days when gage was not read, for which it was ascertained as indicated in footnote to daily-discharge table. Open-water records excellent except those for low stages which are subject to error on account of diurnal fluctuation and uncertainty in rating curve; winter records fair.

Discharge measurements of Des Moines River at Kalo, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 29	1.32	452
Apr. 28	1.86	792

Daily discharge, in second-feet, of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,070	700	1,310			1,390	1,840	1,050	5,460	1,750	320	470
2	910	1,230	1,570			1,310	1,660	1,310	5,040	1,390	284	220
3	750	1,390	1,570			1,230	1,550	1,750	4,640	1,250	264	320
4	595	1,570	1,660			1,150	1,570	2,480	4,140	1,230	264	300
5	530	1,660	1,600			1,230	1,570	2,020	4,000	1,750	340	280
6	530	1,660	1,570			1,250	1,570	1,930	3,700	1,840	252	240
7	470	1,900	1,390			1,310	1,570	1,750	3,280	1,750	240	280
8	440	2,200	1,230		950	1,390	1,480	1,700	3,180	1,750	244	230
9	470	2,480	1,230			1,230	1,750	1,660	2,880	1,660	220	280
10	410	2,480	1,070			1,230	1,700	1,230	2,780	1,400	284	320
11	340	2,290	1,150			1,230	1,660	1,570	2,780	1,150	220	200
12	415	1,930	1,150			1,150	1,660	1,750	2,750	910	224	210
13	390	1,750	1,150			1,150	1,750	1,660	2,780	840	300	240
14	365	1,600	1,070			1,230	1,570	1,480	2,780	770	280	390
15	665	1,480	1,070			1,230	1,480	1,350	2,880	840	264	660
16	665	1,310	990	940	4,500	1,150	1,480	1,310	3,380	530	264	3,380
17	640	1,480	840		5,460	1,070	1,450	1,230	3,480	530	470	2,680
18	665	1,660	560		3,080	1,070	1,390	1,310	3,480	530	224	2,750
19	770	1,390			3,180	1,070	1,230	2,880	3,200	500	284	2,880
20	665	1,390			2,850	1,150	1,230	3,810	2,880	470	280	3,080
21	595	1,250			2,780	1,150	1,480	3,810	2,580	340	380	2,680
22	530	1,150			2,480	1,230	1,480	3,500	2,200	320	530	2,780
23	470	1,230			1,750	1,750	1,310	3,080	1,840	320	470	2,290
24	520	1,230			1,660	1,930	1,350	2,680	1,750	390	415	2,200
25	560	1,150	640		1,230	2,110	1,480	2,780	1,660	470	365	2,100
26	470	1,150			1,390	2,110	1,230	3,380	1,700	288	365	2,110
27	500	1,230			1,350	2,110	1,230	6,450	1,750	320	284	2,110
28	500	1,300			1,390	2,110	1,230	6,600	1,390	280	260	2,020
29	440	1,390			-------	2,020	990	6,500	1,930	288	224	1,930
30	440	1,070			-------	2,020	910	6,160	2,200	288	595	1,840
31	580	-------			-------	2,020	-------	5,880	-------	280	665	-------

NOTE.—Stage-discharge relation affected by ice Dec. 19 to Feb. 16; gage read only Dec. 20–23 and 27–31; discharge ascertained by means of weather records and by comparison with flow of this river near Boone, Iowa. Gage not read on Sundays; discharge estimated by comparison with flow at gaging station near Boone. Discharge also estimated by comparison with flow near Boone, on account of great diurnal fluctuation, Aug. 9, 11, 20, Sept. 5, 6, 8, and 12. Braced figures show mean discharge for periods indicated.

Monthly discharge of Des Moines River at Kalo, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 4,170 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,070	340	560	0.134	0.15
November	2,480	700	1,520	.365	.41
December	------	------	984	.236	.27
January	------	------	940	.225	.26
February	5,460	------	1,690	.405	.42
March	2,110	1,070	1,440	.345	.40
April	1,840	910	1,460	.350	.39
May	6,600	1,050	2,780	.667	.77
June	5,460	1,390	2,950	.707	.79
July	1,840	280	852	.204	.24
August	665	220	325	.078	.09
September	3,380	210	1,380	.331	.37
The year	6,600	210	1,400	.336	4.56

DES MOINES RIVER NEAR BOONE, IOWA.

LOCATION.—In sec. 12, T. 84 N., R. 27 W., at highway bridge in Centerville 2½ miles northwest of Boone, Boone County, 1 mile above Boone waterworks, and 3 miles above Bluff Creek, which enters from right.

DRAINAGE AREA.—5,480 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—April 1, 1920, to September 30, 1921. Scattered record of stage were obtained by United States Weather Bureau at gage 3½ miles downstream at Chicago & Northwestern Railroad crossing, during period 1905 to 1917.

GAGE.—Chain gage attached to downstream side of bridge, 20 feet from left end of right span; read by S. A. Elliott.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; practically permanent. Control is remains of old dam, 300 feet below bridge; well defined and practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.3 feet at 7 a. m. May 30 (discharge, 10,400 second-feet); minimum stage, 1.80 feet at 7 a. m. August 7 (discharge, 265 second-feet).

1920–21: Maximum stage recorded, 13.39 feet at 6.30 a. m. July 11, 1920 (discharge, 16,900 second-feet); minimum stage same as for 1921.

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

REGULATION.—The city power plant at Fort Dodge, about 40 miles upstream, causes some diurnal fluctuation during extremely low water.

ACCURACY.—Stage-discharge relation permanent except as affected by ice December 19 to January 5 and February 6–9. Rating curve well defined between 250 and 18,000 second-feet. Gage read to hundreths once daily or oftener during days of rapidly changing stage except as noted in footnote to daily discharge table. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice for which it was ascertained by means of occasional gage readings and weather records. Open-water records excellent; winter records fair.

Discharge measurements of Des Moines River near Boone, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 2	2.90	1,160	Apr. 15	3.43	1,950	July 31	1.92	320
13	2.61	869	May 20	5.77	5,320			

Daily discharge, in second-feet, of Des Moines River near Boone, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	950	1,120	2,460		1,240	1,730	2,600	1,380	9,270	2,740	365	1,060
2	1,000	2,160	2,600		1,450	1,730	2,310	2,020	8,260	2,160	665	1,000
3	1,000	2,600	2,460	1,000	1,380	1,880	2,310	2,310	7,530	1,660	500	622
4	1,000	2,740	2,460		1,240	1,730	2,160	3,040	6,800	1,450	444	540
5	755	2,740	2,460		900	1,660	2,020	3,760	6,520	1,450	404	424
6	580	2,600	2,310	1,240		1,660	2,020	3,040	5,500	2,020	384	384
7	622	2,890	2,160	1,240	875	1,680	2,020	2,740	5,060	2,160	265	348
8	665	4,200	2,020	1,240		1,590	2,020	2,460	4,630	1,730	321	360
9	710	4,480	1,880	1,520		1,590	2,020	2,160	4,200	2,160	365	423
10	710	4,780	1,730	1,520	950	1,590	2,460	2,160	3,900	1,730	665	622
11	665	4,480	1,730	1,450	950	1,590	2,310	2,020	3,760	1,520	580	580
12	622	4,200	1,730	1,380	950	1,520	2,160	2,160	3,760	1,310	500	500
13	622	3,470	1,660	1,240	850	1,520	2,020	2,310	3,620	1,000	444	479
14	622	3,180	1,590	1,120	1,180	1,450	2,020	2,310	3,620	1,000	444	540
15	1,060	3,040	1,590	1,000	1,310	1,520	1,880	2,020	4,780	900	417	1,060
16	950	2,740	1,520	1,000	9,120	1,590	2,020	1,880	3,900	900	404	6,080
17	1,060	2,460	1,240	1,000	10,100	1,520	2,460	1,730	4,480	755	417	7,380
18	1,310	2,160	755	1,000	6,800	1,520	2,310	1,880	4,630	710	410	5,640
19	1,060	2,160		1,060	5,500	1,520	2,160	1,730	4,340	710	391	5,640
20	1,000	1,880		1,180	4,200	1,520	2,020	4,200	3,900	665	444	5,940
21	900	2,020		1,240	4,200	1,590	1,880	5,940	3,320	580	332	5,640
22	1,060	2,160		1,880	3,900	1,730	1,880	5,640	3,040	500	710	4,920
23	1,060	2,020		2,600	2,740	1,660	2,310	5,060	2,600	500	1,240	4,200
24	1,000	2,020		2,740	2,160	1,660	2,310	4,340	2,160	486	802	3,470
25	1,000	2,020	930	2,600	2,160	1,660	2,160	3,320	2,020	417	540	3,320
26	950	1,880		3,040	2,020	1,660	2,160	4,340	1,880	417	500	2,890
27	850	1,880		2,310	1,880	1,880	1,880	5,640	1,880	365	500	3,900
28	665	1,730		1,590	1,730	2,740	1,880	9,270	1,880	404	391	3,320
29	665	1,880		1,730	-------	3,180	1,660	10,000	2,740	354	365	2,740
30	665	2,020		1,660	-------	3,040	1,450	10,400	2,600	500	365	2,460
31	1,060	-------		1,240	-------	2,890	------	10,100	-------	338	665	-------

NOTE.—Gage not read during period of ice effect Dec. 19 to Jan. 5, except on Dec. 20 and 31 and Jan. 2 and 4; discharge ascertained as explained under "Accuracy" in station description. Gage not read October 3 and 13, discharge interpolated. Braced figures show estimated mean discharge for periods indicated.

Monthly discharge of Des Moines River near Boone, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 5,480 square miles.]

Month.	Discharge in second-feet.				Run-off in inches
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,310	580	866	0.158	0.18
November	4,780	1,120	2,660	.486	.54
December	2,600	-------	1,500	.274	.32
January	3,040	-------	1,480	.270	.31
February	10,100	850	2,590	.473	.49
March	3,180	1,450	1,800	.328	.38
April	2,600	1,450	2,100	.383	.43
May	10,400	1,380	3,910	.714	.82
June	9,270	1,880	4,220	.770	.86
July	2,740	338	1,080	.197	.23
August	1,240	265	492	.090	.10
September	7,380	348	2,550	.465	.52
The year	10,400	265	2,090	.381	5.18

DES MOINES RIVER NEAR TRACY, IOWA.

LOCATION.—In sec. 19, T. 75 N., R. 17 W., in Mahaska County, at highway bridge in Bellefontaine, near Tracy, Marion County, 3 miles above mouth of Cedar Creek, and 6 miles below mouth of English Creek, both of which enter from right.

DRAINAGE AREA.—12,400 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—March 1, 1920, to September 30, 1921. From about April 22 to December 31, 1910, the United States Engineer Corps obtained daily readings at the same site.

GAGE.—Chain gage attached to downstream side of bridge near right end of second span from right end of bridge; read by D. M. Coleman. Sea-level elevation of zero of gage, 671.78 feet.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of solid rock overlain in places with sand and gravel. Right bank high; left bank subject to overflow at high stages. Low-water control well defined; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.3 feet at 7 a. m. September 17 (discharge, 26,900 second-feet); minimum stage, 3.00 feet at 7 a. m. July 31 and August 1 (discharge, 1,180 second-feet).

1920–21: Maximum stage recorded, 14.74 feet at 7 p. m. May 14, 1920 (discharge, 31,900 second-feet); minimum discharge, estimated 750 second-feet March 1, 1920 (stage-discharge relation affected by ice).

Maximum stage since 1850 about 25 feet May 31, 1903 (discharge, estimated 100,000 second-feet).

ICE.—Stage-discharge relation affected by ice during periods of extremely cold weather.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 23 to February 13. Rating curve well defined between 1,000 and 25,000 second-feet; extended beyond these limits and may be in error. Gage read to hundredths twice daily except during period January 16–31 when observations were discontinued. Daily discharge ascertained by applying mean daily gage height to rating table except for period during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, weather records, and comparison with flow of Raccoon River at Van Meter, Iowa, and of Des Moines River at Des Moines, Iowa. Open-water records excellent; winter records fair.

Discharge measurements of Des Moines River near Tracy, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Oct. 7	3.53	1,760
May 6	5.99	5,790

Daily discharge, in second-feet, of Des Moines River near Tracy, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,140	1,460	3,000			4,200	4,380	4,200	14,800	7,200	1,180	1,360
2	2,010	1,560	3,160			4,020	4,380	6,540	18,000	5,920	2,140	2,010
3	2,010	1,670	3,320			3,840	4,200	9,040	18,600	4,760	3,490	2,700
4	1,890	2,010	3,490			3,840	3,840	7,420	16,700	4,200	3,660	3,490
5	1,780	2,700	3,660			3,660	3,490	5,720	13,900	3,320	2,850	2,550
6	1,780	3,490	3,840			3,660	3,490	5,720	11,100	3,320	2,550	1,890
7	1,670	3,840	3,660		2,000	3,490	3,490	5,920	9,760	3,320	2,270	1,670
8	1,670	3,840	3,490			3,490	3,490	5,330	8,570	3,490	1,780	1,460
9	1,670	4,020	3,320			3,490	3,320	5,140	7,880	3,320	1,560	1,360
10	1,560	4,950	3,320			3,320	3,160	5,520	7,420	3,000	1,670	4,380
11	1,560	5,720	3,160			3,320	3,160	7,880	7,650	3,000	1,360	7,650
12	1,460	5,920	3,000			3,320	3,490	7,200	7,200	2,850	1,460	6,980
13	1,460	5,720	3,000			3,320	3,490	5,920	6,540	2,550	2,010	5,720
14	1,460	5,140	3,000		3,350	3,490	3,490	5,330	6,980	2,410	1,890	4,200
15	1,460	4,380	2,850		3,350	3,660	3,160	4,950	6,980	2,270	1,780	8,800
16	1,560	4,020	2,850	2,200	4,000	3,840	3,840	4,950	6,980	2,270	1,670	24,200
17	1,560	3,660	2,700		8,210	3,490	5,140	4,570	6,980	2,270	1,460	26,500
18	1,780	3,490	2,270		14,200	3,490	6,980	4,200	6,330	2,140	1,460	23,100
19	2,010	3,320	2,010		15,700	3,320	11,400	4,020	6,330	2,010	1,270	19,900
20	2,010	3,490	1,780		11,900	3,160	13,300	3,840	6,120	1,780	2,410	23,500
21	2,010	3,490	1,460		10,500	3,160	10,500	4,020	6,120	1,670	2,410	22,800
22	1,890	3,490	1,270		8,340	3,000	7,880	6,120	5,520	1,560	1,890	20,200
23	1,780	3,660			7,650	3,000	5,720	7,880	4,950	1,560	1,670	16,700
24	1,780	3,160			6,760	3,000	5,140	7,650	4,570	1,560	1,360	13,000
25	1,670	3,160			6,120	3,000	5,140	6,760	4,760	1,560	1,360	11,100
26	1,670	3,000	1,400		5,140	3,000	5,140	6,120	4,200	1,460	1,560	9,040
27	1,670	3,000			4,760	3,000	5,140	5,720	4,380	1,360	1,560	7,880
28	1,560	2,850			4,380	3,000	4,950	6,120	4,380	1,360	1,460	7,200
29	1,560	3,000			-------	3,000	4,570	7,880	4,200	1,360	1,270	6,540
30	1,560	3,000			-------	3,000	4,200	11,600	5,140	1,270	1,270	6,120
31	1,560	-------			-------	3,000	-------	14,200	-------	1,180	1,270	-------

NOTE.—Braced figures show mean discharge for periods indicated.

Monthly discharge of Des Moines River near Tracy, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 12,400 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,140	1,460	1,720	0.139	0.16
November	5,920	1,460	3,540	.285	.32
December	3,840	----------	2,460	.198	.23
January	----------	----------	2,200	.177	.20
February	15,700	----------	5,010	.404	.42
March	4,200	3,000	3,370	.272	.31
April	13,300	3,160	5,100	.411	.46
May	14,200	3,840	6,370	.514	.59
June	18,600	4,200	8,100	.653	.73
July	7,200	1,180	2,620	.211	.24
August	3,660	1,180	1,840	.148	.17
September	26,500	1,360	9,800	.790	.88
The year	26,500	----------	4,310	.348	4.71

DES MOINES RIVER AT OTTUMWA, IOWA.

LOCATION.—At Market Street Bridge, Ottumwa, Wapello County. No large tributary within several miles up or down stream.

DRAINAGE AREA.—13,200 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—March 28, 1917, to September 30, 1921. Fragmentary high-water observations were obtained from 1902 to 1916.

GAGE.—Chain gage attached to downstream handrail of bridge; read by Henry Eilers. Staff gage painted on northeast face of north pier used prior to August 2, 1917.

DISCHARGE MEASUREMENTS.—Made from Vine Street Bridge, about 1,500 feet below gage, or by wading.

CHANNEL AND CONTROL.—Channel forms control; practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.3 feet September 17 (discharge, 31,200 second-feet); minimum discharge, estimated about 700 second-feet during last week of December (stage-discharge relation affected by ice).

1917–1921: Maximum stage recorded, 16.5 feet June 11, 1917 (discharge, 60,000 second-feet); minimum stage, 1.2 feet, to surface of ice, on several days during December, 1917 (discharge probably less than 350 second-feet).

Maximum discharge since 1850 and probably in the last century occurred May 31, 1903, and exceeded 100,000 second-feet.

ICE.—Stage-discharge relation affected by ice during extremely cold weather; observations are discontinued when serious ice conditions prevail.

REGULATION.—Operation of power plant a short distance above gage probably causes some diurnal fluctuation at low stages.

ACCURACY.—Stage-discharge relation changed during winter of 1919–20; affected by ice as noted in footnote to table of daily discharge. Rating curve used March 28, 1917, to December 2, 1919, well defined above 500 second-feet; curve used March 13, 1920, to September 30, 1921, well defined between 1,500 and 35,000 second-feet and fairly well defined outside those limits. Gage read to tenths once daily except during periods noted in footnote to table of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except as noted in footnote to table of daily discharge. Open-water records good except those for extremely low stages, which are subject to error; winter records fair to poor.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

Discharge measurements of Des Moines River at Ottumwa, Iowa, during the year ending Sept. 30, 1921.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 5	4.43	6,890
Sept. 21	9.61	24,500

Daily discharge, in second-feet, of Des Moines River at Ottumwa, Iowa, for the years ending Sept. 30, 1917–1921.

Day	Mar.	Apr.	May.	June.	Aug.	Sept.	Day.	Mar.	Apr.	May.	June.	Aug.	Sept.
1917							1917.						
1		18,400	15,900	6,680	2,060	845	16		7,840	7,260	40,600	1,330	1,330
2		14,100	15,500	12,100	2,060	735	17		7,840	6,970	35,200	1,330	1,330
3		12,100	12,100	20,600	1,900	735	18		7,550	6,680	19,100	1,200	1,330
4		10,900	15,900	18,800	1,900	735	19		7,260	6,400	18,400	960	1,200
5		10,600	18,400	27,700	1,600	735	20		6,970	6,120	14,100	960	1,200
6		9,930	15,500	31,700	1,600	2,720	21		6,970	5,850	12,800	960	960
7		8,430	16,200	39,500	1,600	7,550	22		6,680	6,400	11,500	960	960
8		8,430	13,500	42,300	1,460	6,970	23		6,680	6,680	10,200	960	735
9		8,430	11,200	42,900	1,460	4,340	24		7,260	6,120	9,330	960	735
10		8,430	9,330	56,600	1,460	2,380	25		7,550	6,680	8,430	960	625
11		8,130	9,030	60,000	1,460	1,750	26		7,260	6,970	7,840	960	625
12		8,130	8,430	53,800	1,330	1,600	27		7,260	6,970	7,260	845	625
13		7,840	8,130	58,000	1,330	1,600	28		24,500	7,260	6,680	9,030	845	625
14		7,840	7,840	53,800	1,330	1,600	29		26,100	7,550	6,680	8,430	845	625
15		7,840	7,550	47,200	1,330	1,460	30		25,300	9,930	6,680	8,430	845	625
							31		22,100		6,680		845	

Daily discharge, in second-feet, of Des Moines River at Ottumwa, Iowa, for the years ending Sept. 30, 1917–1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1917–18.												
1	625	625				2,220	1,750	1,080	9,330	2,280	1,080	2,720
2	625	625				2,380	1,750	960	11,200	2,720	1,080	2,900
3	525	435				3,900	1,750	960	12,100	2,220	1,080	4,120
4	525	525				3,900	1,460	845	14,100	2,220	1,330	2,900
5	525	525				3,480	1,460	845	19,100	2,380	1,200	2,380
6	435	435				4,120	1,460	845	22,900	2,380	1,200	1,750
7	525	525				4,120	1,460	845	27,300	2,220	1,200	1,600
8	525	525				3,090	1,330	845	28,900	2,030	1,200	1,600
9	435	435				2,720	1,330	735	34,700	2,060	1,080	1,460
10	525	525				2,720	1,460	735	42,900	2,060	1,080	1,460
11	525	525				2,720	1,330	735	41,200	2,060	1,080	1,200
12	435	435			5,850	2,220	1,200	735	38,400	2,060	960	1,200
13	435	525			8,130	1,900	1,200	735	28,900	2,380	960	1,200
14	435	525			7,550	2,220	1,080	625	23,700	2,220	845	1,200
15	435	435			6,680	2,220	1,080	625	15,200	2,220	845	1,080
16	435	525			3,690	2,060	1,080	625	12,800	2,060	845	1,080
17	435	525			2,220	2,060	1,080	845	9,030	2,060	960	845
18	435	435				2,220	1,080	2,720	7,260	1,750	1,080	845
19	525	525				2,220	1,080	2,720	6,400	1,600	1,330	960
20	525	525				1,900	1,080	1,750	5,580	1,750	1,750	960
21	435	435				2,060	1,080	1,330	4,810	1,750	2,550	960
22	525	525				2,060	1,200	2,550	3,900	1,600	1,900	960
23	525	525				2,220	1,200	2,220	3,690	1,600	2,550	845
24	435	435				2,720	1,200	2,720	16,900	1,330	3,280	845
25	525	525				3,090	1,200	3,280	32,100	1,330	2,220	845
26	625	525			2,550	3,280	1,080	7,840	12,800	1,330	2,550	845
27	525	435			1,750	3,280	1,080	6,400	7,260	1,330	2,550	735
28	625	525			1,600	2,550	1,080	6,400	5,320	1,200	2,550	735
29	625	435				2,380	1,080	14,800	3,900	1,200	2,720	735
30	525	435				2,060	1,080	13,500	3,280	1,200	2,900	735
31	625					2,060		9,930		1,080	2,900	
1918–19.												
1	845	2,060	1,900		2,550		9,330	18,400	4,340	15,200	3,090	960
2	845	2,060	2,220		2,220		8,730	20,200	11,800	12,500	3,090	960
3	735	2,720	2,060		2,220		8,430	21,800	23,300	10,600	3,090	735
4	735	3,090	1,900		2,060		8,130	30,900	27,300	9,330	2,720	960
5	735	2,900	1,900	1,000		2,450	7,840	36,200	30,200	11,200	2,720	960
6	735	2,900	2,060				7,260	38,400	32,100	8,730	2,380	960
7	735	2,720	2,220				6,680	44,700	36,700	7,550	4,340	960
8	625	2,720	2,060				7,550	40,600	37,800	5,320	2,720	960
9	525	2,550	2,060		1,150		7,840	24,500	31,300	6,400	2,380	960
10	525	2,550	2,060			4,120	13,500	19,900	21,000	9,930	1,750	735
11	625	2,220	2,060			6,120	17,700	18,000	18,000	11,200	1,750	735
12	625	2,060	2,220			7,840	22,500	16,600	25,700	8,130	1,750	735
13	625	2,060	2,220		2,220	6,680	20,200	14,800	22,500	8,730	2,060	735
14	625	2,060	2,220		3,480	5,850	18,000	13,500	18,000	7,550	1,750	735
15	625	2,060	2,380	1,600	3,480	6,680	20,200	12,100	16,600	8,730	2,060	525
16	625	2,060	2,380		3,690	31,700	22,100	11,200	19,500	7,550	2,060	525
17	625	2,380	3,090		3,900	35,200	22,100	10,200	18,800	6,400	2,060	525
18	625	2,380	3,090		3,900	38,900	19,500	9,330	17,300	5,320	1,750	525
19	625	2,060	3,280		5,320	32,900	18,800	8,430	17,300	4,810	1,750	2,060
20	625	2,060	3,280		6,400	32,500	18,800	8,430	19,500	4,340	1,750	1,750
21	735	2,060	3,280		6,970	19,900	18,400	8,430	18,000	4,340	1,460	4,340
22	735	2,220	3,280	3,950	6,120	16,200	20,600	8,430	18,000	4,340	1,460	6,970
23	735	2,380	2,900		5,580	14,500	23,300	7,550	18,800	3,900	1,460	5,320
24	735	2,380	2,900		5,580	13,500	27,700	6,970	20,200	3,480	1,200	4,340
25	625	2,380	2,900	2,380	5,320	12,100	29,700	6,400	18,800	3,480	1,460	3,090
26	625	2,550		2,550	5,060	11,200	32,900	6,120	17,300	3,090	1,460	2,060
27	625	2,380		2,550	3,690	10,600	29,300	5,580	16,600	3,090	1,460	1,750
28	1,900	3,090	1,500	2,550	2,000	10,200	19,500	5,320	16,600	2,720	1,200	2,380
29	1,460	2,060		2,550		10,200	18,400	5,060	15,900	2,720	1,200	2,380
30	1,460	2,060		2,550		9,630	18,400	4,810	15,600	2,720	1,200	3,900
31	2,060			2,550		9,330		4,810		2,720	1,200	

Daily discharge, in second-feet, of Des Moines River at Ottumwa, Iowa, for the years ending Sept. 30, 1917–1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	5,850	2,220	2,220				12,800	17,000	7,390	4,150	4,660	4,920
2	7,260	1,900	2,220				14,200	16,600	10,300	4,400	4,400	4,400
3	9,930	1,750					19,900	15,200	7,970	5,440	4,150	4,400
4	7,840	1,750					18,400	13,900	7,390	5,980	3,910	4,660
5	6,400	1,900					12,800	13,500	6,530	7,970	3,670	5,980
6	5,850	1,900					10,600	12,800	6,250	12,800	3,440	8,260
7	9,030	1,900					10,000	11,900	6,250	11,900	3,210	7,970
8	6,680	2,720					10,000	10,900	6,250	14,200	3,670	6,530
9	5,060	2,220					10,000	10,000	5,980	14,600	4,920	7,100
10	4,120	19,900					9,130	9,430	8,260	15,600	5,710	12,200
11	3,480	19,500					8,260	9,130	8,840	18,400	4,920	13,900
12	3,480	19,900					7,680	17,400	7,390	18,800	4,400	10,900
13	3,090	16,600				13,200	7,680	26,500	5,980	19,600	3,910	8,840
14	3,090	11,800				21,800	8,260	30,000	5,180	26,900	3,440	8,550
15	2,720	8,430				21,100	8,260	31,600	4,660	28,000	3,210	8,550
16	3,090	6,400				27,300	7,970	30,400	4,400	30,000	2,980	6,530
17	3,090	5,060				23,800	7,970	18,400	3,910	20,300	2,980	5,440
18	2,380	4,810				20,700	7,390	17,400	3,670	17,000	2,770	5,180
19	2,220	4,810				21,400	7,970	16,300	3,670	14,900	2,560	4,660
20	2,060	4,570				19,200	28,000	15,200	3,670	12,800	2,560	4,150
21	1,900	4,340				16,000	34,000	13,900	4,400	11,200	2,560	3,910
22	1,600	4,120				14,200	24,500	12,800	4,660	10,300	2,370	3,440
23	1,900	3,900				12,500	24,500	11,900	4,920	10,600	2,770	3,210
24	1,900	3,690				11,600	21,800	11,200	4,660	9,130	8,550	2,980
25	1,900	3,690				28,400	21,800	10,600	4,660	8,260	9,430	2,980
26	1,900	3,690				35,300	16,000	10,600	4,660	7,680	8,840	2,770
27	1,900	3,480				34,400	19,200	10,300	4,150	7,390	7,680	2,770
28	1,750	3,280				31,600	20,300	9,430	4,150	6,810	6,530	2,560
29	1,600	3,280				24,900	18,800	8,840	4,150	6,250	5,180	2,560
30	1,460	2,900				19,600	16,600	8,550	4,150	5,440	5,180	2,560
31	4,120					14,900		7,970		5,180	5,180	
1920–21.												
1	2,180	1,670	2,980		3,670	4,400	4,150	4,660	13,900	7,970	1,230	1,230
2	2,180	1,830	3,210		2,980	4,150	4,660	6,810	17,700	7,390	2,370	1,370
3	2,180	1,830	3,210	1,750	2,980	3,670	4,660	10,900	17,400	5,710	2,980	2,000
4	2,000	1,830	3,670		2,980	3,670	4,150	9,430	17,400	4,920	4,400	2,770
5	2,000	2,370	3,670		2,560	3,910	4,150	7,680	15,200	5,440	3,440	4,400
6	1,670	3,440	4,150	2,180	2,770	4,150	3,670	5,980	12,200	3,910	2,980	3,210
7	1,670	4,400	4,150	2,370	2,980	3,910	3,670	5,980	10,300	3,670	3,440	2,180
8	1,670	4,660	4,150	2,370	2,000	3,910	3,910	5,980	9,130	3,440	3,440	1,520
9	1,830	4,400	3,910	3,210	1,700	3,670	3,670	5,710	8,260	3,440	2,000	1,520
10	1,830	4,400	3,910	2,980	1,500	3,670	3,440	7,680	7,680	3,210	1,520	2,560
11	1,670	5,440	3,670		2,180	3,440	3,210	10,900	8,550	2,980	2,000	11,200
12	1,670	5,980	3,440		2,000	3,440	3,210	11,200	7,680	2,980	1,670	11,200
13	1,520	6,250	3,440		2,180	3,210	3,440	7,970	7,390	2,770	1,520	7,390
14	1,520	5,710	3,440		2,180	4,660	3,670	6,530	6,530	2,560	2,980	5,710
15	1,520	5,180	3,440	2,170	3,210	5,440	3,670	5,440	7,970	2,560	2,370	6,250
16	1,670	4,700	3,210		3,670	4,400	7,390	5,440	7,970	2,370	2,000	18,100
17	1,830	4,200	2,980		6,810	4,150	8,550	4,920	6,810	2,000	1,830	31,200
18	1,670	3,700	2,770		11,200	3,910	8,550	4,660	7,970	2,000	1,670	29,200
19	1,670	4,150	2,770		15,200	3,440	13,900	4,400	6,250	2,000	1,370	21,800
20	2,370	3,670	2,180	1,830	14,600	3,440	16,600	4,150	6,250	1,830	1,370	19,600
21	2,180	3,670	2,180	1,670	11,600	3,440	13,500	3,910	6,250	1,830	2,560	24,900
22	2,180	3,670	1,520	2,560	9,430	3,210	10,600	3,910	5,980	1,670	2,560	22,200
23	2,180	3,670	1,370	2,770	8,840	2,980	7,680	6,810	5,440	1,670	2,000	20,700
24	2,180	3,670			7,390	2,980	5,980	7,970	5,180	1,520	1,830	15,600
25	2,000	4,150			6,810	2,980	5,440	7,390	4,920	1,370	1,230	13,900
26	2,000	3,670			6,250	2,770	5,440	6,810	5,180	1,370	1,100	11,200
27	2,000	3,440	790	2,520	5,440	2,980	7,100	6,250	5,440	1,370	1,100	9,130
28	2,000	2,980			4,920	2,980	6,250	5,710	5,180	1,370	1,670	7,970
29	1,830	2,980				3,210	5,710	6,250	4,660	1,370	1,670	7,390
30	1,830	2,980				3,210	4,920	8,550	4,400	1,230	1,370	6,810
31	1,670					2,980		12,200		1,230	1,230	

NOTE.—The above record of daily discharge supersedes previously published records. Stage-discharge relation affected by ice Dec. 1, 1917, to Feb. 11, 1918, Feb. 18–25, 1918, and Dec. 3, 1919, to Mar. 12, 1920; discharge not determined. During these periods the gage was read only during December, 1917, and Feb. 18–21, 1918. Stage-discharge relation also affected by ice Dec. 26, 1918, to Jan. 24, 1919, Feb. 5–12, 1919, Feb. 28 to Mar. 9, 1919, Nov. 16–18, 1920, Dec. 24, 1920, to Jan. 5, 1921, Jan. 11–19, 24–31, 1921, and Feb. 9 and 10, 1921; discharge ascertained by means of gage heights, weather records, and comparison with flow of this river at Keosauqua. During these periods the gage was not read Jan. 2–24, Feb. 8–12, and Mar. 2–9, 1919, and Dec. 27–31, 1920. Gage-height record unreliable for July, 1917; discharge not determined. Discharge interpolated June 30, 1919, on account of missing gage reading. Braced figures show mean discharge for periods included.

Monthly discharge of Des Moines River at Ottumwa, Iowa, for the years ending Sept. 30, 1917–1921.

[Drainage area, 13,200 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
1917.					
March 28–31	26,100	22,100	24,500	1.86	0.28
April	18,400	6,680	8,710	.660	.74
May	18,400	5,850	9,370	.710	.82
June	60,000	6,680	26,400	2.00	2.23
August	2,060	845	1,280	.097	.11
September	7,550	625	1,640	.124	.14
1917–18.					
October	625	435	512	.039	.04
November	625	435	499	.038	.04
March	4,120	1,900	2,650	.201	.23
April	1,750	1,080	1,260	.095	.11
May	14,800	625	2,960	.224	.26
June	42,900	3,280	16,800	1.27	1.42
July	3,280	1,080	1,890	.143	.16
August	3,280	845	1,640	.124	.14
September	4,120	735	1,390	.105	.12
1918–19.					
October	2,060	525	806	.061	.07
November	3,090	2,060	2,370	.180	.20
December	3,280	----------	2,290	.173	.20
January	----------	----------	1,920	.145	.17
February	6,970	----------	3,250	.246	.26
March	38,900	----------	11,900	.902	1.04
April	32,900	6,680	17,400	1.32	1.47
May	44,700	4,810	15,700	1.19	1.37
June	37,800	4,340	20,800	1.58	1.76
July	15,200	2,720	6,650	.504	.58
August	4,340	1,200	1,990	.151	.17
September	6,970	525	1,820	.138	.15
The year	44,700	525	7,240	.548	7.44
1919–20.					
October	9,930	1,460	3,830	.290	.33
November	19,900	1,750	5,880	.445	.50
March 13–31	35,300	11,600	21,700	1.64	1.16
April	34,000	7,390	14,800	1.12	1.25
May	31,600	7,970	14,800	1.12	1.29
June	10,300	3,670	5,620	.426	.48
July	30,000	4,150	12,600	.955	1.10
August	9,430	2,370	4,510	.342	.39
September	13,900	2,560	5,760	.436	.49
1920–21.					
October	2,370	1,520	1,880	.142	.16
November	6,250	1,670	3,820	.289	.32
December	4,150	----------	2,570	.195	.22
January	----------	----------	2,270	.172	.20
February	15,200	----------	5,360	.406	.42
March	5,440	2,770	3,620	.274	.32
April	16,600	3,210	6,160	.467	.52
May	12,200	3,910	6,840	.518	.60
June	17,700	4,400	8,510	.645	.72
July	7,970	1,230	2,880	.218	.25
August	4,400	1,100	2,090	.158	.18
September	31,200	1,230	10,800	.818	.91
The year	31,200	----------	4,700	.356	4.82

DES MOINES RIVER AT KEOSAUQUA, IOWA.

LOCATION.—In sec. 36, T. 69 N., R. 10 W., at county bridge in Keosauqua, Van Buren County, a quarter of a mile above old dam site and Government locks. No important tributary within several miles up or down stream.

DRAINAGE AREA.—At gaging station, 13,900 square miles; at mouth, 14,300 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 29, 1903, to July 21, 1906; April 5 to December 31, 1910 (United States Engineer Corps); August 3, 1911, to September 30, 1921.

GAGE.—Chain gage attached to upstream handrail of bridge; read by Frank Schreckengast.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached.

CHANNEL AND CONTROL.—Channel shifts considerably at flood stages. Control is gravel bar about a quarter of a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.45 feet at 8 a. m. September 21 (discharges, 27,100 second-feet); minimum discharge, estimated 750 second-feet December 26–29 (stage-discharge relation affected by ice).

1903–1906 and 1910–1921: Maximum stage recorded, 27.85 feet June 1, 1903 (discharge, 97,000 second-feet; gage height referred to datum used since 1910); minimum stage, 0.0 foot August 28 to September 6, 1911 (discharge, 160 second-feet).

Flood of June 1, 1851, reached a stage of about 24 feet (discharge, about 80,000 second-feet).

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation changed several times during period; seriously affected by ice during most winters. All rating curves fairly well defined. Gage read to half-tenths once daily except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying daily gage height to rating table except as noted in footnote to table of daily discharge. Open-water records good except possibly those for extremely low stages, which are subject to error; winter records fair to poor.

Discharge measurements of Des Moines River at Keosauqua, Iowa, during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 12	C. Herlofson	2.67	5,610	July 19	C. Herlofson	1.20	2,290
Dec. 3	do	1.71	3,250	Sept. 22	E. D. Burchard	8.57	23,800
Jan. 31	do	1.75	3,300				

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the period May 11, 1913, to Sept. 30, 1921.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1913.						1913.					
1		15,000	5,000	882	730	16	22,400	3,970	1,310	1,500	588
2		14,000	5,540	805	655	17	11,000	3,370	1,220	1,400	588
3		14,400	2,790	805	655	18	24,800	3,370	1,220	2,460	655
4		12,500	2,460	730	588	19	25,800	2,900	1,130	2,240	655
5		11,300	2,340	655	588	20	24,800	2,900	1,130	1,500	805
6		9,810	2,240	655	588	21	26,200	2,460	1,130	1,500	730
7		9,230	2,120	655	588	22	26,200	7,210	1,130	1,400	655
8		8,070	2,020	588	520	23	25,500	5,810	1,130	1,310	655
9		7,210	1,800	588	520	24	25,500	6,650	1,040	1,220	655
10		6,930	1,600	588	520	25	25,500	6,650	1,040	1,130	655
11	10,700	5,810	1,600	882	655	26	25,800	14,400	1,040	960	588
12	10,100	5,540	1,500	882	1,130	27	24,800	13,400	1,040	960	588
13	10,100	5,000	1,400	1,040	655	28	23,500	11,600	960	960	588
14	11,300	5,000	1,310	1,130	655	29	20,800	9,810	960	882	588
15	18,200	3,970	1,310	1,500	588	30	18,800	8,360	882	805	655
						31	16,600		882	730	

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the period May 11, 1913, to Sept. 30, 1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913-14.												
1	730	655	960				3,370	3,370	5,540	7,490	1,600	1,910
2	730	655	960				3,370	4,740	5,270	6,370	1,600	1,800
3	730	655	882				2,900	4,220	5,000	6,090	1,400	1,400
4	805	655	882				2,560	3,850	4,480	5,540	1,310	960
5	882	588	805				2,240	3,730	3,970	5,540	1,310	882
6	882	588	805				2,240	3,020	3,490	5,540	1,400	1,500
7	1,130	588	805				2,120	2,900	3,250	5,540	1,400	1,220
8	1,220	588	805				2,020	3,850	2,680	6,090	1,220	1,220
9	1,220	588	960				2,020	3,020	2,680	4,740	1,130	1,130
10	1,800	520	882				1,700	2,460	2,900	4,740	1,130	3,370
11	1,220	520	960				1,700	2,900	3,610	4,740	1,040	5,000
12	1,040	588	960				1,600	6,650	3,970	4,220	1,130	3,970
13	1,040	588	960				1,600	10,100	3,970	4,740	960	3,370
14	1,040	655	1,040				1,600	12,500	5,000	4,480	960	3,140
15	1,220	588	960				1,500	8,940	5,540	3,970	882	13,100
16	1,700	588	960				1,400	6,090	7,210	3,730	882	23,500
17	1,700	588	882				1,310	3,970	8,650	3,970	882	28,600
18	1,400	588	882				1,220	2,460	8,940	3,850	730	31,900
19	1,310	655	960				1,220	2,340	8,940	3,250	730	30,400
20	1,310	588	882				1,130	2,240	8,070	2,790	960	30,400
21	1,220	588	805				1,040	2,020	8,360	2,680	882	16,200
22	1,130	588	805				1,040	1,910	7,780	2,460	805	11,300
23	1,040	588	730				1,040	1,800	7,780	2,460	730	8,360
24	960	655	805				1,130	1,600	7,780	2,240	730	11,900
25	960	588	805				1,220	1,500	7,210	2,020	655	10,700
26	882	588	882				1,220	2,340	7,780	2,020	588	8,360
27	960	588	960				1,220	2,790	7,780	1,800	655	6,370
28	960	588	882				1,600	5,000	10,100	1,800	805	5,000
29	882	655	882				1,500	4,480	11,300	1,600	655	3,970
30	882	730	730				1,700	4,740	8,650	1,600	655	3,730
31	730		730					5,810		1,600	588	
1914-15.												
1	3,500	3,020						5,810	42,200	16,900	49,600	6,370
2	3,300	2,790						5,000	50,400	14,400	52,600	5,810
3	3,100	2,680						5,000	52,600	12,500	59,200	5,540
4	2,900	2,560						5,000	49,600	13,700	34,100	5,000
5	2,800	2,460						5,270	45,900	11,900	22,100	5,000
6	2,800	2,240					13,100	6,090	42,600	8,940	18,500	4,740
7	2,900	2,240					12,500	6,090	38,500	11,300	16,900	4,480
8	3,300	2,240					11,900	5,810	32,200	12,500	15,600	4,220
9	4,500	2,120					11,900	6,090	27,200	12,500	16,900	6,930
10	8,500	2,120					11,600	6,090	23,500	13,100	15,000	7,210
11	10,700	2,120					11,000	5,540	22,800	17,500	13,700	10,700
12	11,900	2,020					10,700	5,540	21,400	12,800	12,800	11,300
13	10,700	2,020					10,700	5,000	22,400	12,500	11,900	8,360
14	9,520	1,910					10,700	4,480	18,200	13,700	11,300	5,810
15	8,360	1,800					10,400	4,480	15,000	19,500	11,300	5,270
16	7,780	1,600			29,000		9,810	4,220	13,100	15,300	11,300	5,540
17	7,780	1,600			28,600		9,520	3,730	12,500	18,200	11,900	5,810
18	8,650	1,600			22,100		8,650	3,490	12,200	20,800	14,400	20,100
19	8,360	1,500			19,500		8,360	3,370	17,500	28,000	14,700	17,200
20	7,780	1,500			18,000		7,780	3,490	17,200	29,700	14,000	12,500
21	6,090	1,400			23,000		7,210	5,540	15,000	30,100	15,000	8,360
22	5,540	1,310			27,600		6,930	6,000	12,800	30,400	14,400	9,230
23	5,270	1,220			32,600		6,650	5,850	11,300	33,000	10,700	7,780
24	5,000	1,130			36,300		6,090	5,970	10,700	54,800	8,360	7,780
25	4,480	1,220			37,000		6,090	6,090	9,520	43,000	8,360	6,650
26	3,970	1,220			35,900		5,810	13,700	11,300	27,600	8,070	7,780
27	3,850	1,220					5,540	20,800	8,940	19,500	7,210	26,200
28	3,730	1,130					5,000	24,800	11,900	29,000	6,650	28,600
29	3,370	1,220					5,000	26,900	11,900	41,500	6,090	27,600
30	3,250	1,220					6,650	30,800	12,500	45,900	5,810	26,900
31	3,250							34,800		48,900	5,810	

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the period May 13, 1913, to Sept. 30, 1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	29,000	6,650	5,810	3,000	5,540	12,500	19,500	17,500	11,000	3,490	1,040	534
2	29,400	6,370	5,540	6,090	4,740	10,400	18,200	16,600	10,100	3,490	1,040	534
3	27,600	6,090	5,270	6,090	3,970	8,940	16,900	12,200	9,230	3,490	960	503
4	25,500	5,810	5,000	5,000	3,000	6,930	15,000	11,600	8,940	3,020	960	472
5	22,100	5,540	4,480	6,090	2,500	6,090	13,700	10,400	8,650	4,220	1,040	358
6	18,800	5,270	4,480	5,000	2,000	5,540	12,500	9,230	15,000	3,020	922	412
7	16,200	5,000	4,480	3,500	1,800	5,540	11,900	8,500	14,400	2,680	805	412
8	15,000	4,740	4,480	2,000		5,270	11,300	7,780	11,600	2,560	805	358
9	13,700	4,480	4,480			4,740	10,700	7,210	10,700	2,450	805	412
10	12,500	4,480	4,220			4,740	10,100	6,650	9,230	2,340	805	412
11	11,900	4,480	4,220		1,500	5,000	9,520	6,090	8,080	2,240	1,220	412
12	11,000	4,480	4,220			5,540	9,230	9,520	6,930	2,120	882	412
13	10,400	5,000	4,220			6,650	8,940	15,300	6,090	1,910	961	412
14	9,520	6,090	4,220	1,800		12,800	8,650	25,200	5,540	1,800	1,040	412
15	9,230	9,520	3,730		1,460	13,700	8,360	28,000	5,000	1,800	1,130	412
16	8,940	11,900	2,920		2,000	15,300	8,220	21,100	4,740	1,960	1,130	412
17	9,520	11,900	2,120		3,000	17,800	8,070	20,400	4,480	2,120	1,040	750
18	9,810	11,300	2,120		5,000	17,800	7,780	21,400	4,220	1,910	960	960
19	9,230	10,700	2,000		10,000	16,600	7,780	17,500	3,970	2,020	882	805
20	9,520	10,100	1,800		13,700	15,300	8,360	14,700	3,730	1,910	844	730
21	11,900	9,230		12,000	15,000	15,000	8,940	14,200	4,220	1,910	805	655
22	13,100	8,650		20,100	14,000	13,700	8,940	13,700	4,480	1,700	655	655
23	13,100	8,070		12,500	29,700	13,100	8,900	15,000	4,220	1,600	655	601
24	12,200	7,210		8,940	28,600	12,800	13,700	29,400	4,480	1,500	655	536
25	11,300	7,210		8,940	24,800	15,600	13,100	24,100	3,980	1,400	588	472
26	10,100	7,780	1,500	9,520	22,100	36,700	11,900	17,500	3,490	1,310	484	472
27	9,230	7,210		16,600	18,200	42,600	10,700	16,200	3,250	1,310	454	805
28	8,360	6,650		13,100	16,200	25,500	9,810	15,100	3,250	1,220	424	737
29	7,780	6,650		11,600	13,700	20,800	9,230	14,000	3,250	1,130	424	669
30	7,490	6,090		7,210	-------	20,800	14,000	13,100	3,490	1,130	424	601
31	6,930	-------		7,210	-------	20,100	-------	12,200	-------	1,130	484	-------
1916–17.												
1	530	508	730				18,900	20,800	6,200	8,140	1,740	825
2	460	574	882				15,000	18,200	11,900	7,860	1,740	782
3	520	574	844				12,500	13,700	28,300	7,300	1,640	740
4	655	574	805				11,300	21,100	28,000	6,750	1,740	825
5	730	541	805			600	10,100	22,100	41,800	5,660	1,740	740
6	655	508	730				9,560	19,800	46,700	5,400	1,740	1,120
7	588	508	730				8,990	17,500	41,100	4,880	1,740	6,750
8	696	588	730				8,990	15,000	40,000	4,630	1,740	6,200
9	805	730	588				8,990	12,500	41,500	4,380	1,540	4,580
10	655	730	554		350	1,540	8,990	10,700	45,900	4,380	1,430	2,950
11	520	730	520			2,190	8,700	9,560	50,700	4,380	1,430	1,960
12	460	692	520			2,840	8,700	8,420	48,900	4,620	1,430	1,960
13	400	655				4,620	8,990	7,720	55,500	4,880	1,430	1,960
14	400	655				10,100	8,420	7,020	57,800	4,620	1,430	1,740
15	348	1,040				13,100	7,860	6,480	51,100	4,380	1,320	1,430
16	295	1,310		400		12,200	7,300	5,660	37,400	4,130	1,320	1,320
17	295	805				12,800	7,300	5,400	29,000	4,130	1,320	1,220
18	348	730				11,600	6,750	4,880	19,100	4,130	1,220	1,120
19	400	730				10,400	7,580	4,620	16,200	4,130	1,220	1,120
20	348	730				7,860	6,750	4,380	13,700	3,650	1,220	1,120
21	295	805				6,200	6,200	4,130	12,200	3,420	1,220	922
22	295	805	300			8,420	6,200	13,700	10,700	3,420	1,120	825
23	295	882				12,500	6,200	7,860	10,400	3,420	1,120	782
24	295	960			500	13,700	7,300	5,400	9,410	2,950	1,320	740
25	400	882				18,800	7,580	7,300	8,420	3,420	1,220	831
26	400	844				20,800	7,300	7,300	7,860	2,950	1,170	922
27	520	805				22,800	7,300	7,020	7,300	3,180	1,120	740
28	460	805				24,800	6,750	6,750	10,400	2,950	1,120	740
29	490	655				26,200	10,900	6,750	8,700	2,780	1,020	740
30	520	655				25,800	15,000	6,750	8,420	2,610	922	700
31	520	-------				22,800	-------	7,300	-------	2,060	825	-------

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the period May 11, 1913, to Sept. 30, 1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1917–18.												
1	655	520	400				2,060	1,020	9,850	4,380	1,320	3,800
2	655	460	400				1,960	922	11,300	3,420	1,320	7,300
3	655	520	400				1,960	740	12,800	3,180	1,640	6,480
4	655	490	400				1,740	825	14,700	2,840	1,540	4,130
5	588	460	400				1,640	1,070	20,100	2,610	1,430	2,950
6	588	520					1,540	1,320	22,800	2,610	1,430	2,610
7	588	460					1,480	1,120	25,200	2,560	1,320	2,060
8	588	460					1,430	1,020	28,300	2,500	1,220	1,850
9	520	460					1,320	628	33,300	2,500	1,220	1,640
10	520	460					1,320	628	39,300	2,390	1,220	1,540
11	520	460					1,220	628	39,300	2,390	1,020	1,540
12	520	460					1,120	628	36,700	2,500	825	1,540
13	460	460					1,120	628	28,600	2,610	1,120	1,430
14	490	460					1,070	740	19,800	2,560	825	1,320
15	520	460					1,020	628	15,600	2,500	825	1,320
16	520	460					1,120	628	12,400	2,500	825	1,320
17	588	520					1,120	1,430	9,280	2,280	1,020	1,120
18	1,220	520					1,120	1,850	7,860	2,170	1,150	1,120
19	655	520					1,120	1,800	6,750	2,060	1,640	1,120
20	588	460				2,150	1,120	1,740	5,930	1,960	1,640	1,120
21	524	460				2,220	1,120	3,180	5,140	1,850	2,950	1,120
22	460	460				2,280	1,120	3,890	4,620	1,740	2,390	1,070
23	460	460				2,500	1,120	2,500	4,300	1,740	2,170	1,020
24	520	400				2,720	1,120	3,890	10,400	2,500	4,880	1,020
25	460	400				2,950	1,120	3,180	40,000	1,740	3,690	922
26	588	400				2,950	1,540	4,960	14,700	1,740	2,500	922
27	588	460				3,180	1,020	6,750	8,700	1,640	2,840	922
28	588	400				2,950	1,070	15,000	5,660	1,800	2,950	922
29	588	400				2,610	1,120	25,500	5,140	2,950	2,950	874
30	588	400				2,500	1,020	15,900	4,760	1,430	3,180	825
31	520					2,280		11,000		1,320	3,420	
1918–19.												
1	825	2,280	2,120	1,600	2,720	1,000	9,560	18,500	4,400	16,200	3,180	875
2	825	2,060	2,060	1,200	2,610	1,100	9,280	20,400	6,480	14,000	3,180	1,340
3	740	2,400	1,850	1,200	2,500	1,430	8,990	25,500	24,500	11,900	3,060	1,150
4	740	2,600	1,960	1,000	2,170	2,610	8,700	38,900	27,600	10,500	2,950	710
5	642	2,950	1,960	1,000	1,900	3,180	8,420	38,900	31,200	9,850	2,720	875
6	608	2,950	2,170	1,000	1,100	3,180	8,140	37,000	31,200	9,000	2,720	792
7	574	2,950	2,390	1,000	1,000	3,650	7,860	38,500	34,400	8,420	2,950	792
8	574	2,840	2,340	1,100	1,000	4,130	7,860	41,800	35,900	7,580	4,380	875
9	574	2,610	2,280	1,200	1,100	4,380	8,700	29,400	30,800	7,020	2,950	875
10	574	2,500	2,280	1,200	1,200	4,620	11,300	21,100	21,100	7,580	2,500	792
11	574	2,390	2,280	1,200	1,430	6,480	16,600	17,500	18,500	12,500	2,170	792
12	508	2,170	2,390	1,200	1,320	7,860	21,800	16,900	24,800	8,420	2,060	792
13	478	2,060	2,390	1,600	1,850	6,750	22,100	15,300	22,800	8,700	1,960	710
14	448	2,060	2,610	1,600	4,130	6,480	18,800	14,000	19,800	8,990	1,960	610
15	508	2,170	2,780	1,700	4,880	7,020	22,400	12,500	19,600	7,300	2,170	510
16	642	2,170	2,950	1,900	4,630	29,000	22,400	11,600	19,500	7,860	2,500	640
17	740	2,280	3,180	2,000	4,380	43,700	23,100	10,700	18,500	7,300	2,280	570
18	642	2,390	3,300	2,100	3,890	37,800	20,800	9,990	17,200	6,200	2,060	640
19	508	2,280	3,420	2,200	5,140	32,600	19,800	9,280	17,200	5,400	1,960	710
20	541	2,170	3,420	2,600	6,480	32,600	19,300	8,420	18,800	5,140	1,740	2,060
21	574	2,060	3,420	3,180	7,020	23,500	18,800	7,580	17,800	4,880	1,740	4,130
22	574	1,960	3,180	5,140	6,750	17,500	21,100	8,140	17,800	4,620	1,640	6,200
23	574	2,390	2,950	5,400	6,480	15,900	25,800	7,300	19,500	4,380	1,540	6,750
24	574	2,620	3,180	2,840	6,200	14,700	28,600	6,480	20,400	3,890	1,490	5,660
25	642	2,840	2,950	3,650	6,200	13,100	29,400	6,200	18,800	3,890	1,440	4,130
26	574	2,840	2,200	3,080	5,400	11,900	31,900	5,930	17,500	3,420	1,440	3,180
27	574	2,610	1,900	2,500	4,620	11,000	31,500	5,660	17,200	3,300	1,440	2,280
28	574	2,500	1,600	2,390	2,500	10,700	20,800	4,880	17,200	3,180	1,440	2,900
29	1,740	2,390	1,600	2,610		10,400	19,100	4,620	17,000	3,180	1,240	4,380
30	1,640	2,170	1,600	2,500		10,100	18,800	4,620	16,900	3,180	1,150	3,180
31	2,390		1,600	2,610		9,850		4,380		3,180	1,010	

Daily discharge, in second-feet, of Des Moines River at Keosauqua, Iowa, for the period May 11, 1913, to Sept. 30, 1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1919–20.												
1	9,850	4,620	2,100	1,800	1,000	1,100	13,700	16,900	8,140	3,890	4,760	4,130
2	7,300	3,450	1,800	1,800	1,100	1,200	13,100	16,600	8,140	6,750	4,380	3,150
3	10,700	2,280	1,400	1,800	1,100	1,100	17,500	16,200	10,100	4,620	4,130	3,150
4	9,560	2,060	1,200	1,900	1,100	1,000	19,100	14,400	8,140	5,550	3,420	4,130
5	7,880	2,280	1,400	1,900	1,200	2,000	14,700	13,400	6,750	6,480	3,650	5,160
6	6,200	2,280	1,700	1,900	1,300	4,000	11,300	13,100	7,160	10,700	3,420	6,200
7	9,560	1,740	2,400	1,900	1,400	6,000	10,700	12,200	7,580	11,900	3,180	8,420
8	8,420	3,650	3,200	1,900	1,600	6,000	10,700	11,300	6,200	14,400	3,200	7,300
9	6,200	3,000	3,000	1,800	2,000	5,500	10,400	10,400	5,660	14,400	3,650	5,660
10	4,880	11,300	2,800	1,800	2,600	5,000	9,560	9,560	6,750	15,900	5,140	11,000
11	4,130	22,400	2,600	1,700	4,000	4,000	8,700	8,990	8,140	17,200	5,140	13,700
12	3,890	22,100	2,500	1,700	4,800	10,000	8,420	24,100	8,140	18,500	4,620	12,500
13	3,650	20,100	2,400	1,600	6,000	15,000	9,850	28,000	6,640	24,500	4,130	9,850
14	2,950	13,700	2,400	1,600	4,800	13,000	8,420	28,600	5,140	32,200	3,650	8,360
15	3,180	10,700	2,300	1,500	4,000	18,800	8,140	29,700	4,620	29,000	3,300	9,230
16	3,180	8,590	2,300	1,500	3,500	23,500	7,860	29,000	4,130	29,400	2,950	7,210
17	3,420	6,480	2,200	1,400	2,800	24,500	7,580	22,100	3,890	22,400	2,840	6,090
18	2,840	5,660	2,200	1,400	2,600	20,800	7,500	18,200	3,420	19,000	2,500	5,270
19	2,620	5,400	2,100	1,300	2,200	20,400	16,200	17,200	3,180	15,600	2,500	4,740
20	2,390	5,400	1,900	1,400	2,000	20,800	29,000	15,900	3,200	13,400	2,390	4,220
21	2,280	5,140	1,900	1,400	1,900	17,900	33,300	14,400	3,890	11,900	2,950	3,730
22	2,280	4,620	1,900	1,300	1,800	15,000	27,600	13,400	4,380	10,400	2,780	3,490
23	1,740	4,380	1,900	1,200	1,600	13,400	23,800	12,500	4,380	10,400	2,610	3,020
24	2,280	4,130	1,900	1,100	1,500	11,900	22,800	11,600	4,620	9,560	2,840	2,790
25	2,170	4,130	1,900	1,100	1,500	34,800	19,500	11,000	4,380	8,570	9,280	2,680
26	2,170	3,890	1,800	1,100	1,400	44,100	16,600	10,400	4,380	7,580	8,990	2,740
27	2,170	3,890	1,900	1,100	1,400	38,900	18,800	10,400	4,350	7,300	7,860	2,790
28	1,960	3,890	1,900	1,000	1,300	33,300	21,100	9,850	3,890	6,200	6,750	2,340
29	1,740	3,890	2,000	1,000	1,200	27,200	19,800	8,990	3,890	5,930	5,940	2,340
30	1,740	3,500	1,800	1,000	------	20,400	17,200	8,560	4,380	5,660	5,140	2,340
31	3,180	------	1,800	1,000	------	15,900	------	8,140	------	5,140	4,620	------
1920–21.												
1	2,340	1,700	3,020	1,600	3,260	4,740	3,730	5,500	14,400	5,930	1,150	1,150
2	2,340	1,700	3,250	1,800	3,020	4,480	4,480	9,810	14,700	8,140	2,840	1,150
3	2,230	1,600	3,250	1,950	2,900	4,220	4,400	13,100	18,500	6,770	4,620	1,150
4	2,120	1,600	3,490	2,100	2,790	3,970	4,220	11,900	18,200	5,400	3,180	2,280
5	1,910	1,800	3,730	2,200	2,790	3,020	4,220	9,230	16,200	4,620	4,620	3,890
6	2,120	2,560	3,970	2,350	2,790	3,500	3,970	7,210	14,000	5,140	3,420	4,130
7	2,020	3,260	3,970	2,460	2,790	3,970	3,730	6,370	11,300	3,650	3,300	3,180
8	1,910	3,970	3,970	2,720	2,460	4,220	4,220	6,370	10,100	3,650	3,180	2,170
9	1,600	3,970	3,970	2,980	1,800	3,970	3,970	6,090	8,990	3,180	2,390	1,640
10	1,600	3,970	3,730	3,250	1,600	3,970	3,700	6,650	8,420	3,180	1,740	3,180
11	1,600	4,480	3,570	2,960	2,120	3,730	3,250	7,780	7,860	3,180	2,170	11,600
12	1,600	5,540	3,410	2,680	2,020	3,730	3,250	14,700	7,700	3,180	1,960	13,700
13	1,500	6,090	3,250	2,500	2,070	3,490	3,490	9,810	7,580	3,180	1,640	8,700
14	1,500	5,820	3,250	2,350	2,120	3,490	3,730	7,490	7,300	2,840	3,000	7,300
15	1,500	5,540	3,250	2,200	2,790	5,540	3,730	7,000	7,020	2,720	2,390	6,750
16	1,500	5,000	3,250	2,100	3,250	5,270	10,100	5,810	8,700	2,390	2,390	9,560
17	1,500	4,480	3,250	1,950	4,220	4,480	11,900	5,270	7,860	2,280	2,060	23,500
18	1,500	3,970	3,020	1,900	8,360	4,220	11,300	5,270	7,300	2,280	1,740	25,200
19	1,700	3,730	2,520	1,900	14,400	3,730	13,700	4,740	6,890	2,280	1,540	22,400
20	2,020	5,540	2,020	1,900	15,000	3,730	17,200	4,480	6,480	2,170	1,450	20,100
21	2,240	4,520	1,800	2,100	12,800	3,490	15,900	3,970	6,750	1,960	2,800	26,900
22	2,120	3,490	1,600	2,300	10,700	3,490	12,800	4,480	6,750	1,850	3,000	24,100
23	2,120	3,490	960	2,600	7,780	3,250	9,810	5,000	5,930	1,740	2,300	20,100
24	2,020	3,490	960	2,560	7,780	3,250	8,300	7,780	5,400	1,440	2,000	17,200
25	1,910	3,490	850	2,400	7,210	3,250	6,090	7,780	5,140	1,440	1,850	15,300
26	1,800	3,490	750	2,300	6,650	3,250	6,650	7,210	5,940	1,440	1,600	13,700
27	1,700	3,250	750	2,300	5,820	3,250	8,940	6,650	6,750	1,340	1,400	10,100
28	1,800	3,250	750	2,450	5,000	3,250	9,230	6,090	5,660	1,240	1,640	8,940
29	1,700	3,250	750	2,700	------	3,250	6,650	6,510	5,400	1,440	1,640	7,780
30	1,700	3,250	1,000	3,050	------	3,250	5,810	6,930	5,900	1,240	1,340	7,210
31	1,700	------	1,300	3,490	------	3,020	------	11,300	------	1,240	1,240	------

NOTE.—The above record of daily discharge supersedes previously published records for the period. Stage-discharge relation affected by ice Dec. 19, 1915, to Jan. 1, 1916, Jan. 6–21 and Feb. 5–19, 1916, Dec. 13, 1916, to Mar. 9, 1917, Dec. 26, 1918, to Jan. 20, 1919, Feb. 5–10, 28, and Mar. 1–2, 1919, Dec. 1, 1919, to Mar. 14, 1920, Dec. 25, 1920, to Jan. 6, 1921, and Jan. 13–22 and 25–30, 1921; discharge ascertained by means of gage heights, occasional discharge measurements, observer's notes, weather records, and comparison with flow of this river at Des Moines or Keosauqua. The gage was not read during the following winter periods and discharge was not determined: Jan. 1 to Mar. 31, 1914, Dec. 1, 1914, to Feb. 15, 1915, Feb. 27 to Apr. 5, 1915, and Dec. 6, 1917, to Mar. 19, 1918. Stage-discharge relation may have been affected by ice during December, 1913. No gage readings Oct. 1–10, 1914, and Feb. 20–21, 1915; discharge estimated. During open-water periods from 1916–1921, the gage was not read on Sundays, except during high water, and occasionally readings are missing for week days; discharge was estimated or interpolated for such days. The mean discharge for December, 1914, was less than 1,000 second-feet. Braced figures show mean discharge for periods included.

Monthly discharge of Des Moines River at Keosauqua, Iowa, for the period May 11, 1913, to Sept. 30, 1921—Continued.

[Drainage area, 13,900 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
1913.					
May 11–31	26,200	10,100	20,400	1.47	1.15
June	15,000	2,460	7,890	.568	.63
July	5,540	882	1,690	.122	.14
August	2,460	588	1,080	.078	.09
September	1,130	520	643	.046	.05
1913–14.					
October	1,800	730	1,090	.078	.09
November	730	520	606	.044	.05
December	1,040	730	878	.063	.07
April	3,370	1,040	1,720	.124	.14
May	12,500	1,500	4,110	.296	.34
June	11,300	2,680	6,260	.450	.50
July	7,490	1,600	3,860	.278	.32
August	1,600	588	981	.071	.08
September	31,900	882	9,160	.659	.74
1914–15.					
October	11,900	2,800	5,710	.411	.47
November	3,020	1,130	1,810	.130	.14
April 6–30	13,100	5,000	8,780	.632	.59
May	34,800	3,370	8,900	.640	.74
June	52,600	8,940	23,100	1.66	1.85
July	54,800	8,940	23,200	1.67	1.92
August	59,200	5,810	16,900	1.22	1.41
September	28,600	4,220	10,500	.755	.84
1915–16.					
October	29,400	6,930	13,600	.978	1.13
November	11,900	4,480	7,160	.515	.57
December	5,810		3,110	.224	.26
January	20,100		6,000	.432	.50
February	29,700		8,670	.624	.67
March	42,600	4,740	14,000	1.01	1.16
April	19,500	7,780	11,100	.799	.89
May	29,400	6,090	15,200	1.09	1.26
June	15,000	3,250	6,660	.479	.53
July	4,220	1,130	2,130	.153	.18
August	1,220	424	817	.059	.07
September	960	358	544	.039	.04
The year	42,600	358	7,420	.534	7.26
1916–17.					
October	805	295	471	.034	.04
November	1,310	508	734	.053	.06
December	882		456	.033	.04
January			400	.029	.03
February			393	.028	.03
March	26,200		9,600	.691	.80
April	18,900	6,200	9,080	.653	.73
May	22,100	4,130	10,200	.734	.85
June	57,800	6,200	26,800	1.93	2.15
July	8,140	2,060	4,370	.314	.36
August	1,740	825	1,360	.098	.11
September	6,750	700	1,610	.116	.13
The year	57,800		5,450	.392	5.33
1917–18.					
October	1,220	460	580	.042	.05
November	520	400	461	.033	.04
March 20–31	3,180	2,150	2,610	.188	.08
April	2,060	1,020	1,300	.094	.10
May	25,500	628	3,730	.268	.31
June	40,000	4,300	16,800	1.21	1.35
July	4,380	1,320	2,350	.169	.19
August	4,880	825	1,890	.136	.16
September	7,300	825	1,900	.137	.15

Monthly discharge of Des Moines River at Keosauqua, Iowa, for the period May 11, 1913, to Sept. 30, 1921—Continued.

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
1918–19.					
October	2,390	448	732	.053	.06
November	2,950	1,960	2,420	.174	.19
December	3,420	1,600	2,460	.177	.20
January	5,400	1,000	2,110	.152	.18
February	7,020	1,000	3,590	.258	.27
March	43,700	1,000	12,500	.899	1.04
April	31,900	7,860	18,100	1.30	1.45
May	41,800	4,380	16,200	1.17	1.35
June	35,900	4,400	20,800	1.50	1.67
July	16,200	3,180	7,130	.513	.59
August	4,380	1,010	2,16	.155	.18
September	6,750	510	2,000	.144	.16
The year	43,700	448	7,510	.540	7.34
1919–20.					
October	10,700	1,740	4,400	.317	.37
November	22,400	1,740	6,620	.476	.53
December	3,200	1,200	2,080	.150	.17
January	1,900	1,000	1,480	.106	.12
February	6,000	1,000	2,230	.160	.17
March	44,100	1,000	15,400	1.11	1.28
April	33,300	7,500	15,400	1.11	1.24
May	29,700	8,140	15,300	1.10	1.27
June	10,100	3,180	5,590	.402	.45
July	32,200	3,890	13,000	.935	1.08
August	9,280	2,390	4,280	.308	.36
September	13,700	2,340	5,620	.404	.45
The year	44,100	1,000	7,650	.550	7.49
1920–21.					
October	2,340	1,500	1,840	.132	.15
November	6,090	1,600	3,710	.267	.30
December	3,970	750	2,540	.183	.21
January	3,490	1,600	2,390	.172	.20
February	15,000	1,600	5,220	.376	.39
March	5,540	3,020	3,790	.273	.31
April	17,200	3,250	7,080	.509	.57
May	14,700	3,970	7,360	.529	.61
June	18,500	5,140	8,970	.645	.72
July	8,140	1,240	2,980	.214	.25
August	4,620	1,150	2,310	.166	.19
September	26,900	1,150	10,800	.777	.87
The year	26,900	750	4,880	.351	4.77

RACCOON RIVER AT VAN METER, IOWA.

LOCATION.—In SW. ¼ sec. 22, T. 78 N., R. 27 W., at highway bridge a third of a mile from railroad station at Van Meter, Dallas County, 1 mile below mouth of South Raccoon River, and 30 miles above junction with Des Moines River.

DRAINAGE AREA.—At gaging station, 3,410 square miles; at mouth, 3,590 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—April 25, 1915, to September 30, 1921.

GAGE.—Chain gage attached to downstream handrail of bridge about 25 feet from right abutment; read by George Cotton.

DISCHARGE MEASUREMENTS.—Made from bridge to which gage is attached or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; subject to change; River divided into two channels at low and medium stages by an island; water surface slightly higher in left channel than in right at extremely low water. Right bank high and not subject to overflow; left bank subject to overflow at a stage of about 13 feet; at extremely high stage this overflow extends for several hundred feet beyond left end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.0 feet at 7.15 a. m. September 20 (discharge, 9,510 second-feet); minimum stage, 2.25 feet at 7.15 a. m. July 30 (discharge, 194 second-feet).

1915–1921: Maximum stage recorded, 17.5 feet June 7, 1917 (discharge, 31,800 second-feet); minimum stage, 1.56 feet October 22, 1918 (discharge, about 28 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during severe winters; observations generally discontinued under such conditions.

ACCURACY.—Stage-discharge relation permanent except as affected by ice December 21 to February 13. Rating curve well defined between 75 and 15,000 second-feet. Gage read to hundredths once daily except during period of ice effect when observations were discontinued. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records good; winter records fair.

The following discharge measurement was made by E. D. Burchard:

July 19, 1921: Gage height, 2.81 feet; discharge, 414 second-feet.

Daily discharge, in second-feet, of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	298	384	870			1,490	1,310	907	5,120	907	210	1,230
2	298	543	945			1,400	1,230	1,020	4,530	665	2,530	1,230
3	408	1,020	1,020			1,310	1,140	870	4,300	633	799	907
4	318	1,230	1,060			1,310	1,020	907	3,540	543	1,360	907
5	298	1,230	1,060	540		1,230	907	1,060	3,330	1,140	907	408
6	298	1,140	1,020			1,230	870	1,230	2,820	764	633	318
7	279	1,230	983		550	1,140	870	1,230	2,330	665	486	318
8	279	1,230	945			1,140	764	1,140	2,050	514	408	318
9	298	1,580	870			1,140	764	1,060	1,950	459	361	298
10	298	1,760	834			1,140	764	1,400	2,240	434	340	602
11	279	1,760	799			1,060	870	1,490	2,050	434	1,670	1,950
12	298	1,490	799			1,020	870	1,230	1,860	384	633	2,430
13	318	1,310	799			945	799	1,310	1,580	361	602	1,860
14	279	983	799		3,860	1,020	730	1,310	1,400	408	572	1,310
15	298	983	730		2,720	1,060	730	1,310	1,580	834	459	4,880
16	543	983	633	500	5,990	983	945	1,230	1,860	514	384	5,490
17	730	983	408		6,910	983	1,310	1,060	1,310	486	340	7,310
18	602	945	486		6,380	945	1,760	983	1,140	486	340	7,040
19	459	1,020	434		5,990	945	1,670	983	983	408	318	6,910
20	384	1,230	434		4,080	907	1,490	1,670	1,060	361	361	9,510
21	384	1,140			3,120	834	1,400	2,330	834	318	261	6,380
22	340	983			2,720	834	1,310	2,330	834	318	261	5,120
23	340	870			2,720	799	1,310	2,050	799	361	243	3,970
24	340	870			2,240	799	1,400	1,760	697	361	361	3,120
25	384	834			1,950	799	1,400	1,580	572	298	486	2,720
26	384	764	350	800	1,760	799	1,310	1,490	602	279	459	2,530
27	340	764			1,670	834	1,140	1,400	1,310	279	408	2,240
28	340	764			1,580	834	1,060	1,580	834	261	384	1,950
29	340	764			-------	1,060	1,020	4,080	633	261	279	1,760
30	340	834			-------	1,400	945	3,750	1,670	194	279	1,580
31	340	-------			-------	1,490	-------	3,640	-------	210	279	-------

NOTE.—Braced figures show mean discharge for periods indicated, estimated by comparison with flow of Des Moines River at Des Moines, Iowa.

Monthly discharge of Raccoon River at Van Meter, Iowa, for the year ending Sept. 30, 1921.

[Drainage area, 3,410 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	730	279	359	0.105	0.12
November	1,760	384	1,050	.308	.34
December	1,060	----------	638	.187	.22
January	----------	----------	620	.182	.21
February	6,910	----------	2,180	.640	.67
March	1,490	799	1,060	.311	.36
April	1,760	730	1,100	.323	.36
May	4,080	870	1,590	.466	.54
June	5,120	572	1,860	.545	.61
July	1,140	194	469	.138	.16
August	2,530	210	562	.165	.19
September	9,510	298	2,890	.848	.95
The year	9,510	194	1,180	.346	4.73

ILLINOIS RIVER AT MORRIS, ILL.

LOCATION.—In sec. 9, T. 33 N., R. 7 E. third principal meridian, at highway bridge in Morris, Grundy County, 7 miles below station formerly maintained near Minooka, and 10 miles below mouth of Kankakee River.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—October 1, 1919, to September 30, 1921, January 1, 1903, to December 13, 1904, records were obtained at a station near Minooka.

GAGE.—Chain gage attached to highway bridge; installed March 1, 1916, by United States Weather Bureau; read by employee of the Weather Bureau. A staff gage at practically the same site and datum was read once daily under the direction of United States Engineer Corps, December 10, 1899, to November 30, 1900, and April 20, 1903, to December 11, 1904.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Bed composed of sand. Dam at Marseilles, 16 miles below gage, forms control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.2 feet April 27 (discharge, 19,500 second-feet); minimum stage, 5.4 feet November 29 and January 17 (discharge, 8,000 second-feet).

1919–1921: Maximum stage recorded, 17.8 feet April 21, 1920 (discharge, 48,000 second-feet); minimum stage, 5.2 feet August 9, 1920 (discharge, 7,600 second-feet).

A discharge of 67,800 second-feet was recorded at station near Minooka at 8 a. m. March 26, 1904 (gage height, 78.25 feet).

REGULATION.—Flow at this station includes the water diverted from Lake Michigan through the Chicago Drainage Canal. Operation of power plants at Lockport and Joliet causes considerable diurnal fluctuation at low and medium stages.

ACCURACY.—Stage-discharge relation practically permanent except as slightly affected by ice December 28–31. Rating curve well defined between 8,000 and 30,000 second-feet; fairly well defined between 30,000 and 55,000 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period of ice effect for which it was estimated. Records fair.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

The following discharge measurement was made by H. E. Grosbach:

August 1, 1921: Gage height, 5.64 feet; discharge, 8,270 second-feet.

Daily discharge, in second-feet, of Illinois River at Morris, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept
1	9,860	8,800	9,200	9,420	9,640	9,420	14,800	17,700	9,860	9,640	8,600	9,420
2	9,420	9,860	9,200	9,860	9,640	9,420	13,800	17,200	9,860	9,420	9,000	9,860
3	9,200	9,860	9,420	9,200	9,640	9,640	12,900	17,400	8,800	9,420	9,420	9,000
4	8,600	10,100	8,800	10,100	9,420	9,640	11,900	16,400	11,000	9,860	9,200	9,420
5	9,200	9,860	9,420	10,100	9,640	9,860	11,900	15,100	9,860	8,600	9,420	9,420
6	9,200	9,420	8,600	10,500	10,500	10,300	11,900	14,400	9,640	9,200	9,420	9,640
7	9,860	9,640	9,000	10,800	9,420	8,800	11,200	13,600	9,860	9,200	9,200	9,860
8	9,860	8,600	8,800	10,500	10,500	10,500	11,400	12,600	9,860	9,000	8,600	9,420
9	8,600	9,860	9,640	10,800	10,500	11,000	11,700	11,900	9,640	9,640	8,600	9,860
10	9,000	9,640	9,640	9,120	10,500	13,100	11,400	11,900	9,420	9,640	9,000	9,860
11	8,400	9,200	9,860	9,860	10,800	12,900	10,500	11,900	9,200	9,640	8,800	10,300
12	9,640	9,200	9,860	9,420	11,000	13,800	11,000	11,700	9,000	9,000	8,800	9,420
13	9,420	9,640	8,200	9,200	11,000	14,100	11,000	11,700	8,800	9,000	8,800	9,640
14	9,420	9,420	10,300	9,200	9,640	12,600	11,000	11,400	8,800	9,200	9,200	10,300
15	9,860	8,600	9,420	9,000	10,800	14,400	11,400	10,800	9,000	9,200	8,800	9,640
16	9,860	9,420	9,420	9,200	10,300	14,800	11,400	10,100	9,000	9,200	9,000	9,860
17	9,640	9,640	9,200	8,000	10,300	14,800	15,100	10,800	9,000	9,420	9,000	10,300
18	8,600	9,200	9,420	9,420	10,100	14,400	15,600	10,500	8,800	9,000	8,800	11,400
19	9,640	9,640	9,860	9,420	10,100	13,800	16,100	10,500	8,800	8,800	9,000	11,000
20	9,420	9,640	8,600	9,000	10,800	13,100	16,100	10,300	9,000	9,200	8,800	11,400
21	9,860	9,200	9,860	9,000	9,640	11,900	15,600	9,640	9,000	9,640	8,800	11,900
22	9,860	8,400	9,640	10,500	9,640	13,800	15,400	10,300	9,000	9,420	9,000	11,000
23	9,420	9,860	9,860	10,500	10,100	13,800	17,700	9,860	9,000	9,200	9,200	9,860
24	9,640	9,640	9,000	9,200	10,100	13,600	19,000	9,640	9,000	8,400	9,200	9,860
25	8,600	9,640	9,860	9,640	9,420	13,800	18,000	9,860	9,000	8,400	9,420	9,860
26	9,420	8,400	9,200	9,640	9,860	15,400	18,500	9,860	9,860	8,600	9,640	9,200
27	9,200	9,200	8,600	9,860	10,300	15,600	19,500	9,860	9,860	8,600	10,100	9,200
28	9,420	9,200	[illegible]	10,100	8,800	14,800	19,300	9,640	9,420	9,000	9,640	9,200
29	9,420	8,000	9,200	9,860	[illegible]	15,100	18,500	9,640	9,420	8,800	9,420	9,000
30	9,420	9,000	[illegible]	10,500	[illegible]	15,600	18,200	9,420	9,860	8,400	9,420	9,420
31	9,860	[illegible]	[illegible]	8,800	[illegible]	15,600	[illegible]	9,200	[illegible]	9,000	9,860	[illegible]

NOTE.—Braced figure shows estimated mean discharge for period indicated.

Monthly discharge, in second-feet, of Illinois River at Morris, Ill., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	9,860	8,400	9,380	May	17,700	9,200	11,800
November	10,100	8,000	9,330	June	11,000	8,800	9,350
December	10,300	8,200	9,310	July	9,860	8,400	9,120
January	10,800	8,000	9,680	August	10,100	8,600	9,130
February	11,000	8,800	10,100	September	11,900	9,000	9,920
March	15,600	9,420	12,900				
April	19,500	10,500	14,400	The year	19,500	8,000	10,400

ILLINOIS RIVER AT PEORIA, ILL.

LOCATION.—In sec. 2, T. 8 N., R. 8 E., at foot of Grant Street, Peoria, Peoria County, 3½ miles above station formerly maintained at Peoria & Pekin Union Railroad bridge and 4½ miles above mouth of Kickapoo Creek.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—March 8, 1910, to September 30, 1921; also March 10, 1903, to July 21, 1906, for station at Peoria & Pekin Union Railroad bridge

GAGE.—Vertical staff attached to wooden pile; read by employee of United States Engineer Corps.

DISCHARGE MEASUREMENTS.—Made from downstream side of Lower Free bridge, about 2 miles below gage.

CHANNEL AND CONTROL.—Bed of river, which forms control for medium and high stages, composed of mud; may shift. Dam at Copperas Creek probably forms control for lowest stages; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.45 feet May 2 (discharge, 25,300 second-feet); minimum stage, 9.50 feet October 2 (discharge, 9,300 second-feet).

1910–1921: Maximum discharge recorded, 55,000 second-feet March 30 to April 2, 1913 (gage height, 22.4 feet); minimum discharge, somewhat less than 7,250 second-feet during period December 11, 1916, to January 10, 1917.

The highest known flood occurred in 1844, when a stage of about 26.6 feet on present gage was reached.

REGULATION.—Flow at this station includes water diverted from Lake Michigan through the Chicago Drainage Canal. No diurnal fluctuation is noticeable.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice during period December 26-31. Rating curve well defined between 10,000 and 50,000 second-feet; extended beyond these limits. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except for period during which stage-discharge relation was affected by ice for which it was estimated. Open-water records good; winter records poor.

COOPERATION.—Gage-height record furnished by United States Engineer Corps.

The following discharge measurement was made by Grosbach and Williams.

March 16, 1921: Gage height, 12.39 feet; discharge, 14,100 second-feet.

Daily discharge, in second-feet, of Illinois River at Peoria, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9,440	10,000	10,300	10,900	11,200	10,900	16,400	24,400	13,800	10,600	9,580	10,000
2	9,300	9,720	10,300	11,200	11,000	10,900	16,400	25,100	13,400	10,600	10,000	9,860
3	9,440	10,000	10,000	11,200	11,000	11,000	16,900	25,100	13,800	10,400	10,000	10,200
4	9,720	10,200	10,200	11,500	11,000	10,800	16,400	25,100	14,200	10,300	10,200	10,600
5	9,720	10,300	10,300	11,600	11,200	10,600	16,400	24,800	13,800	10,400	10,000	10,900
6	9,580	10,300	10,300	11,800	11,200	11,200	16,200	24,400	13,600	10,300	10,300	10,900
7	9,440	10,300	10,400	11,800	11,500	11,200	15,900	24,000	13,400	10,300	10,200	10,900
8	9,440	10,400	10,300	11,800	11,200	11,200	16,400	23,700	13,000	10,300	10,000	10,900
9	9,440	10,300	10,300	11,800	11,200	11,500	15,600	23,100	12,800	10,300	10,000	10,800
10	9,440	10,300	10,300	11,600	11,200	11,200	15,900	22,500	12,600	10,300	9,720	10,900
11	9,440	10,300	10,300	11,800	11,200	11,800	14,800	21,900	12,600	10,200	10,000	11,000
12	9,440	10,300	10,200	11,600	11,200	12,600	14,600	21,300	12,600	10,200	10,000	11,200
13	9,440	10,300	10,300	11,500	11,200	13,000	14,800	20,700	12,400	10,000	9,860	11,400
14	9,440	10,000	10,000	11,500	11,400	13,400	14,600	20,100	12,200	10,000	10,200	11,400
15	9,440	10,300	10,300	11,200	11,200	13,600	14,400	19,500	11,800	10,300	9,860	11,200
16	9,720	10,300	10,800	11,000	10,900	14,200	15,900	18,900	11,600	10,200	9,720	11,200
17	9,860	10,200	10,800	10,900	11,200	14,200	15,200	18,200	11,500	9,720	9,580	11,600
18	9,860	10,000	10,800	10,900	11,500	15,000	14,600	17,900	11,500	10,000	9,720	12,400
19	9,720	10,000	10,800	10,600	11,500	15,000	14,800	17,400	11,500	10,200	9,720	12,600
20	9,720	10,000	10,600	10,600	11,500	14,800	15,000	16,900	11,200	10,200	9,720	12,800
21	9,720	10,000	10,600	10,800	11,200	14,600	15,000	16,400	11,000	10,000	9,860	13,000
22	9,860	10,000	10,600	11,200	11,000	15,400	16,600	15,600	10,900	10,000	9,720	13,000
23	10,000	10,300	10,600	11,200	11,200	15,400	17,200	15,400	10,900	10,000	9,720	13,600
24	10,300	10,300	10,800	11,400	11,200	15,400	17,200	15,000	10,800	10,000	10,300	13,400
25	10,300	10,300	10,800	11,500	11,200	15,400	17,400	14,800	10,800	9,860	10,300	13,600
26	10,000	10,300	10,600	11,200	11,000	15,900	18,900	14,600	10,600	9,720	10,200	13,400
27	10,000	10,300		11,200	11,200	15,900	20,100	14,600	10,600	9,580	10,200	13,000
28	10,000	10,300		11,000	10,900	16,900	21,600	14,400	10,800	9,860	10,000	13,000
29	10,000	10,300		11,200	-------	16,200	22,500	14,200	10,800	10,000	10,000	12,600
30	10,000	10,300		11,500	-------	16,200	23,700	14,200	10,800	9,720	10,000	13,000
31	10,000	-------		11,200	-------	16,400	-------	13,800	-------	9,720	10,000	-------

NOTE.—Braced figure shows estimated mean discharge for period indicated.

Monthly discharge, in second-feet, of Illinois River at Peoria, Ill., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	10,300	9,300	9,720	May	25,100	13,800	19,300
November	10,400	9,720	10,200	June	14,200	10,800	12,000
December	10,800	10,000	10,500	July	10,600	9,580	10,100
January	11,800	10,600	11,300	August	10,300	9,580	9,960
February	11,500	10,900	11,200	September	13,600	9,860	11,800
March	16,400	10,900	13,600				
April	23,700	14,400	16,700	The year	25,100	9,300	12,200

ILLINOIS RIVER AT BEARDSTOWN, ILL.

LOCATION.—In sec. 15, T. 18 N., R. 12 W., at highway bridge on State Street, Beardstown, Cass County, 1,000 feet below Chicago, Burlington & Quincy Railroad bridge, 5 miles above mouth of Crooked Creek and 9½ miles below mouth of Sangamon River.

DRAINAGE AREA.—Prior to January 17, 1900, 23,445 square miles; since that date natural run-off increased by diversion from St. Lawrence River basin through Chicago Drainage Canal.

RECORDS AVAILABLE.—Discharge record, October 1, 1920, to September 30, 1921. Gage readings obtained under direction of United States Engineer Corps, October 28, 1878, to May 30, 1881, November 9, 1881, to June 26, 1884, and January 5, 1885, to June 30, 1891. Gage readings obtained under direction of United States Weather Bureau June 30, 1891, to September 30, 1921. Gage-height record, 1878 to 1904, published in House Document 263, Fifty-ninth Congress; since 1904 gage heights appear in United States Weather Bureau publications.

GAGE.—Vertical staff attached to pile on inside of cribbing, about 40 feet above center span of highway bridge; read by employee of United States Weather Bureau.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached.

CHANNEL AND CONTROL.—Bed composed of sand and mud. Except at very high stages, control is formed by LaGrange dam about 11 miles downstream; probably permanent. Point of zero flow at gage height, about 5.4 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.6 feet May 4–6 (discharge, 34,800 second-feet); minimum stage, 7.7 feet December 26 (discharge, 9,640 second-feet).

Maximum stage recorded at this station, 21.8 feet April 5, 1913 (discharge not determined). According to the United States Engineer Corps, the flood of 1844 reached a stage of 22.2 feet on present gage, and the discharge on April 4, 1904, was determined as 115,000 second-feet (gage height, 20.0 feet).

ICE.—Stage-discharge relation only slightly affected by ice.

REGULATION.—Flow at this station includes flow of Chicago Drainage Canal. The stage is occasionally slightly affected by backwater from Mississippi River and from Crooked Creek.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined between 10,000 and 35,000 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

COOPERATION.—Gage-height record furnished by United States Weather Bureau.

Discharge measurements of Illinois River at Beardstown, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 14	Grosbach and Williams	9.28	15,700	May 3	L. G. Williams	14.57	34,200
Apr. 13	L. G. Williams[a]	10.70	20,900	Aug. 1	do	8.07	10,700
23	do	11.84	22,100				

[a] Engineer, United States Public Health Service.

Daily discharge, in second-feet, of Illinois River at Beardstown, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10,400	10,700	10,700	11,100	12,600	12,600	21,300	32,600	18,000	15,100	11,100	10,700
2	10,400	10,700	10,700	11,500	12,600	12,200	21,700	33,700	17,700	14,400	11,800	10,700
3	10,400	10,700	10,700	11,800	12,900	12,200	22,800	34,500	16,600	14,000	14,400	10,700
4	10,000	10,700	10,700	11,800	12,900	12,200	23,500	34,800	15,500	14,000	14,000	11,100
5	10,000	10,700	10,700	12,600	12,900	12,200	23,900	34,800	18,800	12,900	13,600	15,100
6	10,000	10,700	10,700	12,600	12,900	12,200	24,200	34,800	19,900	12,200	13,300	16,200
7	10,000	10,700	10,700	12,900	12,600	12,600	24,200	34,500	19,500	11,800	12,900	16,200
8	10,000	10,700	10,700	12,900	12,900	13,300	24,200	34,100	18,800	12,200	12,600	15,800
9	10,000	10,700	10,700	12,900	12,600	15,100	23,500	33,400	18,000	12,200	12,600	15,800
10	10,000	10,700	10,700	12,900	12,600	15,800	22,800	32,600	17,700	11,800	12,200	14,700
11	10,000	10,700	10,700	12,900	12,600	16,200	22,000	32,300	17,700	11,500	11,500	15,100
12	10,000	10,700	10,700	12,900	12,600	15,800	21,300	31,500	17,300	11,100	11,500	15,100
13	10,000	10,700	10,700	12,600	12,600	15,500	20,600	30,800	16,900	10,700	11,100	14,700
14	10,000	10,700	10,700	12,600	12,900	15,500	20,600	30,100	16,200	10,700	11,100	14,400
15	10,000	10,700	11,100	12,600	12,900	15,500	20,200	29,300	15,800	10,700	11,100	14,400
16	10,000	10,700	11,100	12,200	12,900	16,200	21,000	28,200	16,900	10,700	10,700	15,800
17	10,000	10,700	11,500	12,200	12,900	16,600	21,700	27,500	16,200	10,700	12,200	15,800
18	10,000	10,700	11,500	12,200	12,600	16,600	22,000	26,400	15,500	10,700	12,600	15,500
19	10,000	10,700	11,500	12,200	12,600	16,600	22,400	25,700	15,100	11,500	12,200	15,100
20	10,000	10,700	11,500	11,800	12,600	16,600	22,400	25,000	14,700	11,800	11,800	16,900
21	10,000	10,700	11,500	12,600	12,600	17,700	22,000	23,900	15,800	11,500	11,500	17,300
22	10,400	10,700	11,500	12,600	12,600	17,700	22,800	23,100	15,500	11,500	11,100	16,600
23	10,400	10,700	11,500	12,900	12,600	17,700	24,200	22,000	15,100	11,100	10,700	16,200
24	10,700	10,700	11,100	12,600	12,600	17,700	25,000	21,300	14,700	11,100	10,700	15,800
25	11,100	10,700	10,000	12,900	12,600	17,700	25,300	20,600	14,400	11,500	10,700	15,500
26	11,100	10,700	9,640	12,600	12,600	18,000	26,400	20,200	14,700	12,200	10,700	16,600
27	10,700	10,700	10,400	12,600	12,600	18,400	28,200	20,200	15,100	11,100	10,700	16,200
28	10,700	10,700	10,700	12,200	12,600	18,800	30,100	19,900	15,500	11,100	10,700	15,800
29	10,400	10,700	11,100	12,600	-------	19,500	31,200	19,900	15,500	11,100	10,700	15,500
30	10,400	10,700	12,200	12,600	-------	19,900	31,900	19,100	15,500	10,700	10,400	15,500
31	10,400	-------	11,800	12,900	-------	20,200	-------	18,800	-------	10,700	10,700	-------

Monthly discharge, in second-feet, of Illinois River at Beardstown, Ill., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	11,100	10,000	10,200	May	34,800	18,800	27,600
November	10,700	10,700	10,700	June	19,900	14,400	16,500
December	12,200	9,640	10,900	July	15,100	10,700	11,800
January	12,900	11,100	12,500	August	14,400	10,400	11,700
February	12,900	12,600	12,700	September	17,300	10,700	15,000
March	20,200	12,200	16,000				
April	31,900	20,200	23,800	The year	34,800	9,640	14,900

KANKAKEE RIVER AT MOMENCE, ILL.

LOCATION.—In sec. 24, T. 31 N., R. 13 E., at highway bridge in Momence, Kankakee County, half a mile below Chicago & Eastern Illinois Railroad bridge and 1½ miles above Tower Creek.

DRAINAGE AREA.—2,340 square miles.

RECORDS AVAILABLE.—February 24, 1905, to July 20, 1906; December 3, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge over left channel; read by Henry Hanson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel; may shift. River at gage divided into two channels by an island. Aquatic plants occasionally grow in bed of river during summer.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.14 feet December 27 (stage-discharge relation affected by an ice jam); maximum discharge, 2,970 second-feet, occurred at gage height 3.29 feet at 8 a. m. March 25; minimum stage, 1.41 feet August 31 and September 1 (discharge 342 second-feet).

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1905–6 and 1915–21: Maximum stage recorded, 7.75 feet January 4, 1919 (discharge not determined because of backwater from ice); maximum open-water stage, 6.4 feet January 22, 1916 (discharge, from extension of rating curve, 12,600 second-feet); minimum stage, 1.37 feet September 1, 16, and 17, 1919 (discharge, 306 second-feet).

ACCURACY.—Stage-discharge relation not permanent; seriously affected by ice December 23 to January 4 and January 17–20; affected by growth of aquatic plants May 2 to July 10 and September 1–30. Standard rating curve well defined between 400 and 2,500 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by growth of aquatic plants, for which it was ascertained by the indirect method for shifting control, and except for periods during which stage-discharge relation was affected by ice, for which it was ascertained by means of gage heights, observer's notes, and weather records. Open-water records good, except those for May and June, which are fair; winter records poor.

Discharge measurements of Kankakee River at Momence, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Feb. 14	2.67	1,800	July 14	1.58	480
May 20[a]	2.32	1,180	Sept. 23[a]	1.64	502

[a] Stage-discharge relation affected by growth of aquatic vegetation.

Daily discharge, in second-feet, of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	418	590	580		1,220	1,150	2,290	2,290	910	640	342	640
2	444	571	590	2,000	1,220	1,150	2,290	2,380	910	690	427	640
3	461	590	590		1,220	1,150	2,200	2,290	910	640	461	590
4	452	690	640		1,220	1,150	2,120	2,200	910	640	495	590
5	436	590	745	2,030	1,410	1,150	2,030	2,120	855	571	504	640
6	427	590	800	1,860	1,410	1,150	1,940	2,030	855	524	495	640
7	418	590	855	1,550	1,550	1,220	2,030	1,940	800	533	452	640
8	418	590	910	1,480	1,620	1,280	1,940	1,780	745	542	410	590
9	410	590	910	1,480	1,780	2,200	1,700	1,780	690	514	402	590
10	410	640	910	1,340	1,860	2,200	1,700	1,620	690	504	350	590
11	410	640	910	1,280	1,940	2,290	1,620	1,480	745	524	365	640
12	402	590	910	1,220	1,860	2,380	1,620	1,480	690	514	395	590
13	395	380	855	1,220	1,860	2,200	1,620	1,410	640	504	402	640
14	395	590	970	1,340	1,860	2,200	1,620	1,340	640	486	436	745
15	388	533	1,030	1,280	1,780	2,200	1,700	1,280	590	478	418	745
16	402	542	910	1,030	1,780	2,200	1,780	1,280	580	470	418	800
17	410	571	910		1,700	2,200	2,290	1,280	542	461	436	800
18	418	590	970	1,050	1,550	2,120	2,380	1,280	524	444	227	745
19	418	590	910		1,550	2,030	2,380	1,220	542	444	418	690
20	418	580	800		1,410	2,030	2,290	1,150	542	418	514	640
21	418	580	855	1,150	1,410	2,770	2,200	1,150	562	418	590	640
22	418	590	910	1,150	1,340	2,770	2,120	1,090	552	410	745	590
23	418	590		1,410	1,280	2,770	2,380	1,030	552	410	800	590
24	410	590		1,410	1,340	2,570	2,380	970	533	436	745	427
25	427	590		1,410	1,090	2,970	2,380	910	524	402	745	533
26	436	590	920	1,340	1,150	2,770	2,290	910	542	402	690	563
27	478	590		1,340	1,150	2,970	2,200	910	562	380	640	563
28	478	580		1,280	1,150	2,770	2,380	855	640	365	690	552
29	495	571		1,220	-------	2,570	2,770	855	640	365	690	552
30	542	590		1,280	-------	2,570	2,570	800	640	358	690	640
31	590	-------		1,280	-------	2,380	-------	855	-------	342	690	-------

NOTE.—Braced figures show mean discharge for periods indicated.

Monthly discharge of Kankakee River at Momence, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 2,340 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	590	388	434	0.185	0.21
November	690	533	590	.252	.28
December		580	863	.369	.43
January			1,410	.603	.70
February	1,940	1,090	1,490	.637	.66
March	2,970	1,150	2,110	.902	1.04
April	2,770	1,620	2,110	.902	1.01
May	2,380	800	1,420	.607	.70
June	910	524	669	.286	.32
July	690	342	478	.204	.24
August	800	342	525	.224	.26
September	800	427	628	.268	.30
The year	2,970	342	1,060	.453	6.15

KANKAKEE RIVER AT CUSTER PARK, ILL.

LOCATION.—In sec. 19, T. 32 N., R. 10 E., at Wabash Railroad bridge in Custer Park, Will County, half a mile above Horse Creek and 15 miles below dam and power plant at Kankakee.

DRAINAGE AREA.—4,870 square miles.

RECORDS AVAILABLE.—November 6, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by J. H. Swords.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of solid rock strewn with boulders and gravel. Right half of channel deep with fissures in bed; left half shallow; somewhat shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.30 feet March 30 (discharge, 7,000 second-feet); minimum discharge, 392 second-feet July 25.

1914–1921: Maximum stage recorded, 14.0 feet February 24, 1918 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 13.45 feet April 20, 1920 (discharge, 24,300 second-feet); minimum stage, 4.09 feet November 15, 1914 (discharge not determined); minimum mean daily discharge, 250 second-feet November 15 and 18, 1914.

ICE.—Stage-discharge relation seriously affected by ice at times.

REGULATION.—Operation of power plant at Kankakee causes slight fluctuation at gage.

ACCURACY.—Stage-discharge relation changed slightly during year; affected by ice for short periods during winter and by vegetation during summer. Two fairly well defined rating curves used, applicable respectively, October 1 to May 25 and May 26 to September 30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice for which it was ascertained as indicated in footnote to table of daily discharge, and except for period May 1 to August 31 for which it was ascertained by the shifting-control method. Records fair except those for periods of ice effect and for very low stages, for which they are poor.

Discharge measurements of Kankakee River at Custer Park, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 9	Grosbach and Williams [a]	6.53	2,890
June 30	H. E. Grosbach	[b] 5.48	935
Sept. 16	do	5.64	[c] 1,260

[a] Engineer, U. S. Public Health Service.
[b] Stage-discharge relation affected by growth of aquatic vegetation in channel.
[c] Discharge corrected for changing stage = 1,210 second-feet.

Daily discharge, in second-feet, of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	492	685	600		1,730	1,420	5,650	5,910	1,200	880	452	770
2	600	642	642	1,500	1,650	1,500	4,910	6,170	1,270	880	670	820
3	525	642	600		1,650	1,500	4,210	5,400	1,270	820	540	770
4	430	600	685	2,400	1,730	1,420	3,770	4,670	1,340	880	580	720
5	562	685	835	2,580	1,810	1,500	3,560	4,210	1,340	880	620	770
6		685	890	2,760	1,980	1,500	3,150	3,770	1,200	720	770	720
7	520	685	890	2,400	2,230	1,570	2,950	3,350	1,130	670	620	770
8		685	1,010	1,980	2,580	1,890	2,760	3,150	1,060	670	500	880
9		685	890	1,940	2,760	2,950	2,580	2,760	1,000	670	520	720
10	492	642	1,010	1,890	2,950	3,770	2,760	2,580	940	670	540	770
11	525	732	950	1,730	3,150	4,440	2,580	2,400	940	720	540	720
12	525	685	950	1,500	2,950	4,670	2,580	2,230	880	670	492	880
13	525	660	950	2,580	2,960	4,210	2,580	2,230	820	670	460	770
14	492	732	1,010		2,760	4,210	2,580	2,060	820	620	580	880
15	492	642	1,080		2,580	4,440	2,580	1,980	770	620	770	1,200
16	492	685	1,010		2,580	4,440	3,510	1,890	720	580	770	1,270
17	525	600	950		2,400	3,990	4,440	1,810	670	540	670	1,480
18	525	642	950	1,500	2,230	3,770	5,650	1,730	670	540	580	1,890
19	492	685	950		2,230	3,350	6,170	1,650	770	540	540	2,610
20	492	600	780		1,980	3,350	5,910	1,570	880	580	580	2,610
21	492	642			1,890	4,010	5,150	1,420	720	540	580	1,980
22	492	685		1,500	1,810	4,670	4,670	1,350	820	540	620	1,410
23	492	685		1,650	1,730	4,210	4,910	1,280	820	540	770	2,800
24	492	600		1,890	1,650	4,210	5,150	1,280	770	484	1,000	1,000
25	460	642		1,980	1,570	4,910	5,150	1,140	770	392	880	770
26	460	642	950	2,230	1,500	5,650	5,150	1,200	720	460	880	820
27	430	600		1,650	1,500	5,910	5,150	1,200	720	468	770	770
28	562	600		1,980	1,420	6,040	4,910	1,200	720	540	670	820
29	525	642		1,730	-------	6,170	4,910	1,270	820	468	770	770
30	562	562		1,730	-------	7,000	5,650	1,270	880	484	820	1,000
31	562	-------		1,730	-------	6,720	-------	1,270	-------	468	770	-------

NOTE.—Stage-discharge relation affected by ice Dec. 21 to Jan. 3 and Jan. 14–21; discharge ascertained by means of gage heights, observer's notes, and weather records. Gage not read, discharge estimated, Oct. 6–9. Gage not read, discharge interpolated, Oct. 20, Jan. 9, Feb. 17, Mar. 21, 28, Apr. 16, and Aug. 9. Braced figures show mean discharge for periods indicated.

Monthly discharge of Kankakee River at Custer Park, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 4,870 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	600	430	510	0.105	0.12
November	732	562	651	.134	.15
December	-------	600	906	.186	.21
January	2,760	-------	1,820	.374	.43
February	3,150	1,420	2,140	.439	.46
March	7,000	1,420	3,850	.790	.91
April	6,170	2,580	4,190	.860	.96
May	6,170	1,140	2,430	.499	.58
June	1,340	670	915	.188	.21
July	880	392	619	.127	.15
August	1,000	452	656	.135	.16
September	2,800	720	1,140	.234	.26
The year	7,000	392	1,650	.339	4.60

DES PLAINES RIVER AT LEMONT, ILL.

LOCATION.—In sec. 20, T. 37 N., R. 11 E., at concrete highway bridge on Stephens Street, a quarter of a mile north of main section of Lemont, Cook County, and 8 miles above junction of Des Plaines River and Chicago Drainage Canal.

DRAINAGE AREA.—705 square miles.

RECORDS AVAILABLE.—November 4, 1914, to September 30, 1921.

GAGE.—Enameled staff gage attached to bridge; read by William Weck, jr.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading below dam.

CHANNEL AND CONTROL.—A concrete dam, forming a new control and changing former stage-discharge relation, was built across channel about 500 feet below gage August 20, 1916; permanent except for slight repairs in August, 1920.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.2 feet at 8.30 a. m. April 28 (discharge, 2,620 second-feet); minimum discharge, no flow, July 26–31.

1915–1921: Maximum stage recorded, 6.6 feet February 16, 1918 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 6.5 feet March 18, 1919 (discharge, 5,520 second-feet); minimum discharge, no flow, September 7, 8, 14–21, and 24–27, 1919, and July 26–31, 1921.

DIVERSIONS.—During high water part of flow spills over into Chicago Drainage Canal at Willow Springs, 7 miles above station. Overflow during 1921 was probably negligible. See under "Diversions" and "Accuracy" in the description of this station in Water-Supply Paper 505, p. 246.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 5,500 second-feet; fairly well defined below 50 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for medium and high stages; fair for low stages.

Published results for discharge in second-feet per square mile and run-off in inches for months in which high stages occurred during the period 1915 to 1918 are incorrect, owing to fact that overflow into Chicago Drainage Canal was not considered in making the computations. See under "Diversions" in the description of this station in Water-Supply Paper 505, p. 246.

Discharge measurements of Des Plaines River at Lemont, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Aug. 5	2.50	[a] 5.0
Sept. 15	2.60	31.0

[a] Estimated.

Daily discharge, in second-feet, of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2	6	18	18	6	68	385	2,310	68	48	0.5	18
2	2	6	6	48	18	31	385	2,040	68	48	2	6
3	2	6	.5	68	25	31	315	1,780	68	31	2	6
4	6	18	6	68	31	48	245	1,360	68	31	6	18
5	6	6	18	93	48	48	245	980	68	31	6	31
6	2	18	31	93	31	68	245	745	68	31	6	18
7	2	18	31	68	48	68	212	540	48	31	2	18
8	2	31	31	48	48	120	180	460	48	31	2	31
9	2	31	18	48	48	180	150	422	48	18	2	31
10	2	18	18	37	31	245	120	385	48	18	2	18
11	2	18	18	31	40	315	120	315	68	18	2	31
12	2	18	18	31	48	350	180	315	48	18	6	31
13	2	18	18	48	68	385	180	280	68	18	6	31
14	2	18	31	31	60	500	180	245	68	18	6	31
15	2	18	31	31	48	580	245	212	48	18	6	18
16	6	18	68	31	31	1,080	315	180	48	18	6	31
17	18	18	68	31	18	1,080	540	180	48	6	6	48
18	18	6	68	31	31	980	620	180	48	6	18	31
19	18	6	68	31	31	930	745	150	31	18	12	31
20	6	6	68	31	31	835	745	150	31	18	6	31
21	6	6	68	18	48	700	1,140	120	31	6	6	48
22	6	6	68	18	68	540	1,480	120	31	6	18	48
23	6	6	48	31	68	540	1,910	120	18	6	31	48
24	18	6	48	40	48	460	2,310	93	6	2	31	68
25	31	6	48	40	48	500	2,460	93	6	.5	18	68
26	31	6	48	48	31	540	2,460	93	18	0	18	68
27	48	6	31	31	31	620	2,460	93	31	0	18	68
28	48	6	48	31	68	700	2,620	93	48	0	18	48
29	31	6	18	31	-------	620	2,620	93	48	0	18	68
30	18	18	18	18	-------	540	2,460	93	48	0	18	180
31	18	-------	18	18	-------	500	-------	93	-------	0	18	-------

Monthly discharge of Des Plaines River at Lemont, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 705 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	48	2	11.8	0.017	0.02
November	31	6	12.5	.018	.02
December	68	5.5	35.3	.050	.06
January	93	18	40.0	.057	.07
February	68	6	41.1	.058	.06
March	1,080	31	458	.650	.75
April	2,620	120	942	1.34	1.50
May	2,310	93	462	.655	.76
June	68	6	46.4	.066	.07
July	48	0	16.0	.023	.03
August	31	.5	10.2	.014	.02
September	180	6	40.7	.058	.06
The year	2,620	0	178	.252	3.42

DES PLAINES RIVER AT JOLIET, ILL.

LOCATION.—In NE. ¼ sec. 9, T. 35 N., R. 10 E., at Jackson Street Bridge, Joilet Will County, 1,200 feet upstream from Cass Street Bridge.

DRAINAGE AREA.—Indeterminate.

RECORDS AVAILABLE.—December 4, 1914, to September 30, 1921; from Cass Street Bridge, September 5 to December 19, 1914.

GAGE.—Gurley 7-day water-stage recorder installed December 3, 1914. Chain gage attached to upstream side of Cass Street Bridge used September 5 to December 19, 1914.

DISCHARGE MEASUREMENTS.—Made from upstream side of Cass Street Bridge.

CHANNEL AND CONTROL.—Channel excavated in solid rock, with a concrete wall on either side; permanent.

EXTREMES OF DISCHARGE—Maximum mean daily discharge during days of record for the year, 11,100 second-feet, April 26 and 28; minimum mean daily discharge, 6,070 second-feet, February 13.

1914–1921: Maximum mean daily discharge during days of record, 18,400 second-feet, March 18, 1919; minimum mean daily discharge, 5,420 second-feet, April 25, 1915.

DIVERSIONS.—Water is diverted to the Illinois and Michigan Canal at Dam No. 1, about 100 feet above gage.

REGULATION.—Flow past gage is largely regulated by operation of power plant of Chicago Sanitary District at Lockport, which utilizes the flow of Chicago Drainage Canal and, to a lesser extent, by operation of Economy Light & Power Co.'s plant, about 100 feet above gage.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined; verified by discharge measurement in September, 1922. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator except as noted in footnote to table of daily discharge. Records excellent.

No discharge measurements were made at this station during the year.

Discharge measurements of Illinois and Michigan Canal at Joliet, Ill., during the years ending Sept. 30, 1920 and 1921.

Date.	Made by—	Discharge.	Date.	Made by—	Discharge.
1919–20.		*Sec.-ft.*	1921.		*Sec.-ft.*
Oct. 3	H. C. Beckman	294	Sept. 27	H. E. Grosbach	366
27	Beckman and Dean	359			
May 10	Dean and Kane	302			

Daily discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8,640	8,710	8,400	8,000	8,020	8,000	7,940	9,760	8,010	8,060	8,020	8,380
2	8,660	8,480	8,650	[a] 6,700	7,780	8,030	7,410	9,950	7,120	7,860	8,940	7,960
3	7,260	9,090	7,940	8,100	7,830	8,140	6,560	10,200	7,300	8,600	8,650	7,730
4	8,660	8,560	8,620	7,920	7,770	[a] 8,000		9,470	[a] 7,500	7,700	8,340	8,250
5	8,600	8,040	7,320	7,920	7,450	[a] 7,640		9,160	7,640	8,260	8,300	8,560
6	8,820	8,770	9,260	8,150	6,630	6,760	[b] 8,000	8,980	7,880	8,640	8,390	8,260
7	9,160	8,280	7,160	8,030	8,180	[a] 8,540		7,950	8,160	8,170	8,490	8,280
8	7,690	9,960	8,780	8,250	8,030	[a] 8,400		7,640	8,320	8,690	8,340	8,140
9	8,520	9,830	8,880	7,150	7,780	[a] 8,520		8,220	7,820	8,360	8,120	8,310
10	7,050	9,170	8,670	8,460	[a] 7,440	8,210	[a] 6,580	8,740	7,800	9,000	8,160	7,980
11	9,140	9,520	8,860	8,280	[b] 6,880	8,380	8,030	8,580	7,120	8,430	7,960	8,320
12	8,720	9,730	6,730	8,290	[a] 6,220	7,620	7,960	8,670	7,200	8,620	8,470	8,180
13	8,740	8,460	8,700	8,380	[a] 6,070	7,310	8,170	8,300	7,970	8,940	8,200	8,130
14	9,080	6,940	8,680	7,860	[a] 7,950	8,720	8,080	7,410	8,140	8,950	8,530	8,240
15	9,330	8,780	7,760	7,550	[a] 7,920	9,200	[a] 7,960	6,980	8,160	9,120	8,340	8,240
16	9,010	8,670	8,220	6,660	7,680	9,480	10,300	8,290	8,020	8,460	8,110	8,260
17	7,640	8,430	8,200	8,360	7,930	9,440	[a] 9,430	8,080	7,920	9,000	8,000	7,750
18	9,150	8,460	8,660	8,190	7,760	9,260	[a] 8,680	8,290	7,060	8,880	8,160	[b] 7,800
19	9,000	8,270	7,000	8,180	7,820	8,560	8,650	7,910	7,460	8,760	7,940	[b] 7,850
20	9,400	8,260	9,020	7,500	7,000	7,430	8,560	7,570	7,830	9,280	7,780	[a] 7,900
21	9,240	7,060	8,320	7,980	8,290	9,030	[b] 8,840	[a] 7,550	8,120	9,050	8,680	8,460
22	8,840	9,080	8,330	7,460	8,210	8,900	[b] 9,120	6,960	8,040	8,980	8,260	7,840
23	8,960	9,140	8,250	6,980	8,390	8,580	[a] 9,400	7,880	7,970	8,860	8,300	8,010
24	7,400	8,900	[a] 8,000	8,320	7,660	[a] 8,530	9,610	7,770	7,860	8,580	8,310	7,560
25	8,970	7,900		8,630	7,890	[a] 7,000	10,700	7,790	8,480	8,840	8,270	7,650
26	8,850	8,500		8,550	[a] 7,430	[a] 7,100	11,100	7,890	8,600	8,300	8,190	8,260
27	8,840	8,390	[b] 8,000	8,550	[a] 6,500	7,190	11,000	7,390	8,020	8,240	7,800	8,050
28	8,940	6,880		8,080	8,130	7,840	11,100	7,030	8,250	8,020	8,620	7,960
29	8,760	8,620		7,180	-------	9,110	10,800	7,240	8,120	8,000	8,400	8,000
30	9,040	8,420		6,250	-------	8,520	9,690	6,870	8,460	7,940	8,260	8,170
31	7,430	-------		8,450	-------	8,140	-------	7,780	-------	8,650	8,000	-------

[a] Discharge partly estimated because of incomplete gage-height record.
[b] No gage-height record; discharge estimated.

NOTE.—Daily discharge in the above table does not include flow in Illinois and Michigan Canal (see "Diversions" in station description). Braced figures show mean discharge for periods indicated.

Monthly discharge, in second-feet, of Des Plaines River at Joliet, Ill., for the year ending Sept. 30, 1921.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	9,400	7,050	8,630	May	10,200	6,870	8,140
November	9,960	6,880	8,580	June	8,600	7,060	7,880
December	9,260	6,730	8,210	July	9,280	7,700	8,560
January	8,630	6,250	7,880	August	8,940	7,780	8,270
February	8,390	6,070	7,590	September	8,560	7,560	8,080
March	9,480	6,760	8,280				
April	11,100	6,560	8,790	The year	11,100	6,070	8,240

FOX RIVER AT ALGONQUIN, ILL.

LOCATION.—In NW. ¼ sec. 34, T. 43 N., R. 8 E. third principal meridian, at Chicago Street Bridge in Algonquin, McHenry County, 100 feet above Public Service Co.'s dam and 500 feet above Crystal Lake outlet.

RECORDS AVAILABLE.—October 1, 1915, to September 30, 1921.

DRAINAGE AREA.—1,340 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

GAGE.—Enameled staff gage attached to concrete abutment of bridge; read by Edward Pedersen.

CHANNEL AND CONTROL.—Control is a concrete dam about 100 feet below gage; repaired during August, 1919; practically permanent.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading below dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.15 feet at 7 a. m. May 1 (discharge, 4,950 second-feet); minimum stage, 0.87 foot August 3 (discharge, 117 second-feet).

1916–1921: Maximum stage recorded, 5.3 feet March 31, 1916 (discharge, 7,120 second-feet); minimum stage, 0.59 foot August 31, 1918 (discharge, 67 second-feet).

REGULATION.—Water is diverted at dam below gage to operate a grist mill which runs on an average of about 4 hours a day, except Sundays, during September to March, inclusive, and one day a week during remainder of year. Effect of operation is appreciable at gage only at low stages, and mill head gates are closed when gage readings or discharge measurements are made.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined above and fairly well defined below 400 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for medium and high stages; fair for low stages.

Discharge measurements of Fox River at Algonquin, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Mar. 2	1.26	[a] 236	July 26 [b]	0.88	146
Apr. 26	3.06	2,840	Sept. 7	1.31	453

[a] Accuracy doubtful on account of low velocities. [b] Mill head gates open.

Daily discharge, in second-feet, of Fox River at Algonquin, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	275	299	323	483	436	373	1,040	4,850	521	180	123	275
2	283	307	339	483	436	382	980	4,650	502	180	123	291
3	283	323	355	483	427	391	920	4,450	483	187	117	315
4	283	339	373	492	427	400	860	4,250	464	187	123	347
5	275	364	391	492	427	409	860	3,850	445	194	129	391
6	275	400	409	502	427	427	860	3,470	427	187	123	427
7	268	427	427	502	418	464	805	3,100	427	187	129	454
8	260	445	436	502	418	540	805	2,750	409	187	129	483
9	260	464	427	512	427	640	750	2,580	409	180	135	502
10	260	464	409	502	427	805	750	2,420	391	187	135	521
11	268	474	400	502	445	920	695	2,260	391	194	142	540
12	268	483	391	483	445	1,040	695	2,100	373	200	148	560
13	275	483	391	454	464	1,230	695	1,950	347	200	148	570
14	275	464	400	418	464	1,300	640	1,880	315	208	154	580
15	275	445	409	382	454	1,440	640	1,720	283	215	154	580
16	283	445	409	364	445	1,440	695	1,580	260	215	161	600
17	291	427	418	355	445	1,510	750	1,510	245	215	161	610
18	291	427	427	355	445	1,510	805	1,370	245	222	168	620
19	291	409	427	373	445	1,510	860	1,230	230	230	174	640
20	299	391	436	391	454	1,440	980	1,160	230	230	187	695
21	299	373	445	409	454	1,370	1,100	1,040	222	222	200	805
22	307	373	445	436	464	1,370	1,300	980	215	215	215	920
23	307	364	445	474	464	1,300	1,720	860	215	208	215	1,040
24	307	355	454	502	445	1,300	2,100	805	208	200	222	1,160
25	315	355	454	512	445	1,300	2,260	750	200	200	230	1,230
26	307	347	454	521	427	1,370	2,750	695	200	187	230	1,230
27	307	339	464	521	409	1,300	3,280	695	194	174	230	1,300
28	307	339	464	502	391	1,300	3,850	640	187	161	238	1,300
29	299	339	464	483	-------	1,230	4,250	590	187	148	230	1,370
30	291	331	474	464	-------	1,160	4,650	560	187	135	245	1,370
31	291	-------	474	445	-------	1,100	-------	540	-------	129	260	-------

Monthly discharge of Fox River at Algonquin, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,340 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	315	260	286	0.214	0.25
November	483	299	393	.293	.33
December	474	323	420	.313	.36
January	521	355	461	.344	.40
February	464	391	438	.327	.34
March	1,510	373	1,040	.776	.89
April	4,650	640	1,440	1.07	1.19
May	4,850	540	1,980	1.48	1.71
June	521	187	314	.234	.26
July	230	129	192	.143	.16
August	260	117	173	.129	.15
September	1,370	275	724	.540	.60
The year	4,850	117	657	.491	6.64

FOX RIVER AT WEDRON, ILL.

LOCATION.—In sec. 9, T. 34 N., R. 4 E., at highway bridge in Wedron, LaSalle County, 1,000 feet above Buck Creek.

DRAINAGE AREA.—2,500 square miles.

RECORDS AVAILABLE.—November 5, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by O. E. Kirby and Charles Davis.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Bed at measuring section is soft and probably shifts. Control about 1,000 feet downstream, composed of coarse gravel and large boulders; practically permanent except as affected at times by growth of aquatic plants.

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EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.3 feet at 6 a. m. April 27 (discharge, 6,740 second-feet); minimum stage, 5.52 feet at 6 a. m. August 10 (discharge, 166 second-feet).

1915–1921: Maximum stage recorded, 17.22 feet[6] January 22, 1916 (discharge not determined because of backwater from ice); maximum open-water discharge, 17,900 second-feet March 26, 1920 (gage height, 14.2 feet); minimum discharge recorded, 105 second-feet November 20,1914 (measured by current meter).

REGULATION.—Slight diurnal fluctuation is caused by operation of power plants at and above Aurora.

ICE.—Stage-discharge relation affected by ice during most winters.

ACCURACY.—Stage-discharge relation changed following the high water of April and May; affected by ice December 22 to January 2, January 10–22, 27–31, and February 1–3. Rating curve used October 1 to May 16, well defined between 200 and 10,000 second-feet; curve used May 17 to September 30, well defined between 250 and 10,000 second-feet. Gage read to hundredths twice daily; diurnal fluctuation only slight. Daily discharge ascertained by applying mean daily gage height to rating table except for periods during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, two discharge measurements, observer's notes, and weather records. Open-water records good; winter records poor.

Discharge measurements of Fox River at Wedron, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 22	L. G. Williams	[a] 6.65	735	Mar. 18	Grosbach and Williams	8.15	2,630
22	do	[a] 6.70	770				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Fox River at Wedron, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	409	356	641	1,500	700	774	1,690	6,510	750	340	209	340
2	409	356	521			672	1,460	6,280	648	315	365	315
3	382	521	409	1,570		672	1,300	6,050	900	268	365	268
4	382	492	436	1,150	738	610	1,240	5,830	750	214	290	340
5	257	436	550	1,060	738	641	1,300	5,390	648	191	390	315
6	436	382	550	932	672	738	1,150	4,760	555	218	290	290
7	382	356	409	932	641	850	1,100	4,550	555	290	268	528
8	409	521	610	890	774	2,070	1,100	4,150	615	365	218	615
9	409	774	641	890	738	2,750	1,060	3,750	528	315	196	528
10	356	705	464		705	2,070	975	3,380	500	245	204	585
11	331	672	464		705	1,690	975	3,050	585	245	227	680
12	307	521	521		705	1,690	975	2,750	615	240	227	785
13	409	492	641		641	1,940	975	2,600	500	315	236	680
14	409	492	850		550	2,600	932	2,200	445	340	290	820
15	464	492	932		738	3,950	1,060	1,940	500	315	218	715
16	436	492	810	750	641	3,050	1,150	1,820	390	315	227	820
17	382	641	774		672	4,350	2,070	1,690	365	268	268	860
18	274	492	641		436	2,330	1,940	1,460	340	268	236	785
19	409	436	580		492	2,330	1,940	1,460	390	245	268	750
20	464	464	464		521	2,070	1,940	1,360	315	315	390	820
21	492	521	560		610	1,940	1,940	1,260	268	365	365	1,020
22	409	521			810	1,820	2,460	1,070	390	290	365	1,160
23	382	521		810	705	1,940	3,950	1,020	340	245	340	1,160
24	356	641		810	774	1,940	3,950	1,070	290	222	390	1,070
25	409	550		774	705	2,070	3,560	1,020	340	232	340	1,260
26	356	464	600	610	705	2,330	5,180	1,260	340	209	365	1,260
27	492	409			610	2,600	6,740	1,160	268	232	340	1,460
28	436	550			580	2,200	6,280	1,070	209	240	365	1,360
29	521	464		650		2,070	6,280	940	290	204	290	1,460
30	464	436				1,820	6,510	785	365	232	290	1,810
31	409					1,690		750		204	290	

NOTE.—Braced figures show estimated mean discharge for periods included.

[6] Published incorrectly in previous reports.

Monthly discharge of Fox River at Wedron, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 2,500 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	521	257	401	0.160	0.18
November	774	356	506	.202	.23
December	932	----------	596	.238	.27
January	----------	----------	853	.341	.39
February	810	436	668	.267	.28
March	4,350	610	1,940	.776	.89
April	6,740	932	2,440	.976	1.09
May	6,510	750	2,660	1.06	1.22
June	900	209	466	.186	.21
July	365	191	268	.107	.12
August	390	196	294	.118	.14
September	1,810	268	829	.332	.37
The year	6,740	191	995	.398	5.39

VERMILION RIVER NEAR STREATOR, ILL.

LOCATION.—In sec. 1, T. 30 N., R. 3 E, third principal meridian, at highway bridge known as bridge No. 3, 1½ miles south of Streator, La Salle County, and 100 feet below Santa Fe Railway bridge.

DRAINAGE AREA.—1,080 square miles.

RECORDS AVAILABLE.—July 27, 1914, to September 30, 1921.

GAGE.—Chain gage attached to highway bridge; read by Floyd Leslie and Andrew Gall.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and rocks. Brush and timber on banks above low-water stage. Control for low stages composed of loose rocks; shifts.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.5 feet September 17 (discharge, 1,850 second-feet); minimum discharge, 0.3 second-foot July 7.

1914–1921: Maximum stage recorded, 22.9 feet April 20, 1920 (discharge, 16,500 second-feet); minimum discharge, no flow, August 25–28 and September 16–30, 1920.

ICE.—Stage-discharge relation seriously affected by ice.

ACCURACY.—Stage-discharge relation not permanent owing to shifting of loose rocks below gage; seriously affected by ice December 17 to January 3 and January 10–19. Three rating curves used, all fairly well defined below 12,000 second-feet; applicable December 10 to April 30, June 29 to July 11, and July 12 to September 30. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice for which it was ascertained by means of gage heights, one discharge measurement, and weather records. Records fair except for periods of ice effect for which they are poor.

Discharge measurements of Vermilion River near Streator, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21	L. G. Williams [a]	[b] 0.71	0.5	Aug. 1	H. E. Grosbach	0.55	0.6
Mar. 17	Williams and Grosbach	1.66	76	Sept. 15	do	.72	2.0
June 29	H. E. Grosbach	2.13	97	17	do	6.18	1,650

[a] Engineer, U. S. Public Health Service. [b] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1921.

Day.	Dec.	Jan.	Apr.	July.	Aug.	Sept.	Day.	Dec.	Jan.	Apr.	July.	Aug.	Sept.
1				38	0.4	1.6	16	1.2			2.7	2.2	1,150
2		0.8		29	.4	1.1	17				.8	2.7	1,850
3				20	.8	.6	18		7.0		2.9	1.7	1,220
4		1.6		12.0	6.8	.8	19				2.7	1.2	595
5		3.8		3.9	6.0	.6	20		14.2		2.7	.4	525
6		8.5		3.0	1.7	1.1	21		15.6		2.5	1.2	490
7		10.0		.3	1.0	2.1	22		17.0		2.2	1.5	490
8		10.7		7.2	.6	1.1	23		15.6		2.7	1.7	370
9		10.7		2.6	.4	2.4	24	.5	14.2	1,090	2.5	2.7	208
10	0.9			3.0	.6	1.1	25		16.3	1,090	2.2	3.4	182
11	1.0			2.6	.8	2.4	26		17.8	1,170	1.7	2.2	170
12	.9	7.0		2.0	.6	.8	27		19.4	1,130	1.2	1.7	235
13	1.7			.4	.8	1.6	28		18.6	1,130	1.2	2.2	182
14	1.6			.9	1.7	2.1	29		17.8	1,090	.8	.4	114
15	1.6			3.0	1.5	3.0	30		17.0	1,090	.6	.8	195
							31		17.0		.6	1.2	

NOTE.—Discharge interpolated on account of missing gage readings, Jan. 9, 23, 30, 31, July 3, and Sept. 18. Braced figures show mean discharge for periods indicated.

Monthly discharge of Vermilion River near Streator, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,080 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
December 10–31	1.7	0.5	0.75	0.001	0.001
January	19.4	.8	10.3	.010	.01
April 24–30	1,170	1,090	1,100	1.03	.27
July	38.0	.3	5.09	.005	.006
August	6.8	.4	1.66	.002	.002
September	1,850	.6	267	.247	.28

MACKINAW RIVER NEAR GREEN VALLEY, ILL.

LOCATION.—In sec. 15, T. 23 N., R. 5 W., at Chicago & Northwestern Railway bridge 200 feet east of crossing of Green Valley-Pekin road, 3 miles north of Green Valley, Tazewell County, and 8 miles south of Pekin.

DRAINAGE AREA.—1,100 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—March 9 to September 30, 1921.

GAGE.—Chain gage attached to downstream guardrail of railway bridge; installed March 28; read by John Eggena. Prior to March 28, temporary staff gage on old crib near left bank, 40 feet above bridge, was used.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand; free from vegetation; shifting. One channel at all stages; curves under bridge. Banks wooded; subject to overflow at high stages. No well-defined control. Backwater from Illinois River will occur during extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 8.32 feet June 3 (discharge, 4,570 second-feet); minimum stage, 1.34 feet July 27 and 28 (discharge, 73 second-feet).

High water of 1920 reached a stage of 12.5 feet according to W. A. McCully, foreman of highway bridge construction.

ICE.—No record.

ACCURACY.—Stage-discharge relation changed during high water of June. Rating curve used prior to June 3 well defined between 100 and 600 second-feet; extended beyond those limits on basis of succeeding curve. Curve used June 3 to September 30 well defined between 50 and 4,500 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for low and medium stages; fair for high stages.

Discharge measurements of Mackinaw River near Green Valley, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 15	Williams [a] and Steinhagen.	1.97	127	Mar. 28	Williams and Bell	2.76	308
				May 30	L. G. Williams	3.25	465
15	do	1.94	133	Aug. 8	do	1.35	70
Mar. 9	Williams and Grosbach	3.31	470	12	do	2.64	307

[a] Engineer, United States Public Health Service.

Daily discharge, in second-feet, of Mackinaw River near Green Valley, Ill., for the year ending Sept. 30, 1921.

Day.	Mar.	Apr.	May.	June.	July.	Aug	Sept.
1	-------	210	860	285	172	83	100
2	-------	210	800	3,560	155	88	88
3	-------	170	605	4,550	155	118	515
4	-------	170	520	2,100	125	88	515
5	-------	160	480	1,070	125	78	3,560
6	-------	150	480	685	118	78	4,440
7	-------	150	405	555	112	78	2,060
8	-------	134	370	515	112	78	890
9	520	134	340	405	112	78	640
10	340	134	370	370	100	74	475
11	210	134	340	475	100	235	475
12	210	126	310	325	94	370	830
13	150	126	285	285	88	112	595
14	150	134	272	248	88	355	405
15	134	160	222	190	88	172	325
16	134	272	210	172	88	139	298
17	134	745	190	172	83	125	475
18	134	860	190	310	94	112	780
19	119	800	170	235	83	100	515
20	119	560	170	210	88	88	640
21	260	520	160	190	88	83	555
22	260	605	150	355	88	78	1,070
23	210	1,050	210	405	88	78	640
24	235	1,050	134	310	83	2,350	515
25	405	920	134	260	78	595	440
26	440	1,400	340	310	78	405	405
27	440	2,350	1,550	260	74	285	370
28	310	1,860	1,120	555	74	190	355
29	285	1,260	560	370	112	155	340
30	260	1,050	440	210	100	125	310
31	248	-------	370	-------	100	112	-------

NOTE.—No gage reading Sept. 7; discharge interpolated.

Monthly discharge of Mackinaw River near Green Valley, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
March 9–31	520	119	248	0.225	0.19
April	2,350	126	587	.534	.60
May	1,120	134	395	.359	.41
June	4,550	172	665	.605	.68
July	172	74	101	.092	.11
August	2,350	74	229	.208	.24
September	4,440	88	807	.734	.82

SPOON RIVER AT SEVILLE, ILL.

LOCATION.—In sec. 24, T. 6 N., R. 1 E. fourth principal meridian, at Toledo, Peoria & Western Railway bridge a quarter of a mile east of railway station at Seville, Fulton County.

DRAINAGE AREA.—1,600 square miles.

RECORDS AVAILABLE.—July 24, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by R. M. Boales.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading above dam at railroad station. Measurements made during rapidly-changing stages are corrected for change in stage by method described in Water-Supply Paper 375.

CHANNEL AND CONTROL.—A loose rock and timber dam 1½ miles downstream from gage, used to create a reservoir for the pumping station of the Toledo Peoria & Western Railway, forms control for medium stages; at other stages control is composed of clay and sand and is somewhat shifting. Dam was removed August, 1918, and replaced August, 1919.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.4 feet March 9 (discharge, 4,530 second-feet); minimum stage, 2.35 feet October 14 (discharge, 26 second-feet).

1914–1921: Maximum stage recorded, 26.0 feet January 23, 1916 (discharge not determined because of backwater from ice); maximum open-water stage recorded, 23.0 feet January 24, 1916 (discharge, 17,800 second-feet); minimum stage, 1.35 feet July 31 and August 27–29, 1914 (discharge, 3.8 second-feet).

ICE.—Stage-discharge relation seriously affected by ice at times.

ACCURACY.—Stage-discharge relation practically permanent during year; slightly affected by ice for short periods. Rating curve fairly well defined throughout. Gage read to hundredths once daily except during winter when it was read three or four times weekly. Daily discharge ascertained by applying daily gage height to rating table except for periods during which stage-discharge relation was affected by ice and for days on which no gage reading was made, for which it was ascertained as indicated in footnote to table of daily discharge. Open-water records fair; winter records poor.

Discharge measurements of Spoon River at Seville, Ill., during the year ending September 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20	Williams [a] and Steinhagen.	[b] 2.89	76	Aug. 5	L. G. Williams	4.88	722
				10 [c]	H. E. Grosbach	3.18	81
20	do	[b] 2.91	75	26	L. G. Williams	5.21	843
Mar. 15	Williams and Grosbach.	8.50	2,640				

[a] Engineer, United States Public Health Service.
[b] Stage-discharge relation slightly affected by ice.
[c] Measurement of doubtful accuracy.

Daily discharge, in second-feet, of Spoon River at Seville, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July.	Aug.	Sept.
1	30	70	59		120	42	225	1,500	315	188	150	130
2	53	54	58		120	46	188	1,380	382	160	470	110
3	55	76	56		120	35	172	1,330	1,660	210	1,230	150
4	46	73	55	250	103	39	160	1,080	740	120	1,600	97
5	40	65	56		86	54	150	930	700	87	880	930
6	38	63	56		86	76	140	830	365	70	382	418
7	36	64	56	330	86	94	140	780	285	69	240	400
8	34	65	58	330	86	1,940	140	700	225	68	185	255
9	32	68	56	265	78	4,530	140	620	225	240	150	185
10	30	70	57	200	71	2,220	188	660	210	365	140	435
11	29	68	56	140	68	980	160	830	400	140	120	225
12	29	73	58	102	65	540	140	580	255	81	188	700
13	27	60	58	63	64	400	120	540	188	64	210	1,550
14	26	58	100		64	660	120	470	172	53	140	830
15	27	60	74		63	2,760	172	418	185	60	120	400
16	34	43	89		61	1,380	1,550	382	505	400	210	300
17	34	42	61		59	1,330	3,760	365	185	110	172	700
18	29	53	56		54	580	1,990	330	185	48	225	1,080
19	29	57	53	50	49	435	1,440	330	930	110	470	1,660
20	48	58			46	400	1,080	315	270	830	285	1,130
21	50	57			42	365	930	300	285	505	185	1,180
22	53	60			39	348	1,330	270	505	188	140	1,660
23	58	60			36	300	1,500	255	400	104	116	1,330
24	48	53		74	33	240	1,030	240	185	68	130	780
25	64	54		74	34	255	830	225	185	43	418	505
26	53	58	50	82	35	270	1,230	740	435	38	1,030	435
27	58	57		89	39	315	3,240	330	348	34	365	505
28	48	56		93	42	300	3,830	270	365	32	270	382
29	56	63		97	-------	300	2,700	1,030	1,130	300	188	300
30	64	60		105	-------	240	1,940	830	300	270	160	400
31	64	-------		113	-------	210	-------	418	-------	210	140	-------

NOTE.—Stage-discharge relation affected by ice Dec. 20 to Jan. 6, and Jan. 14-23; discharge ascertained by means of gage heights, observer's notes, two discharge measurements, and weather records. Discharge interpolated on account of missing gage readings, Dec. 19, Jan. 7, 9, 10, 12, 24, 26, 28, 30, 31, Feb. 2, 4, 6, 7, 9, 11, 13, 14, 16, 18, 20, 21, 23, and 25. Braced figures show mean discharge for periods indicated.

Monthly discharge of Spoon River at Seville, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,600 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	64	26	42.6	0.027	0.03
November	76	42	60.6	.038	.04
December	100	-------	57.2	.036	.04
January	-------	-------	134	.084	.10
February	120	33	66.0	.041	.04
March	4,530	35	699	.437	.50
April	3,830	120	1,020	.638	.71
May	1,500	225	622	.389	.45
June	1,660	172	417	.261	.29
July	830	32	170	.106	.12
August	1,600	120	345	.216	.25
September	1,660	97	639	.399	.45
This year	4,530	26	357	.223	3.02

SANGAMON RIVER AT MONTICELLO, ILL.

LOCATION.—In sec. 12, T. 18 N., R. 5 E. third principal meridian, at Illinois Central Railroad bridge half a mile west of Monticello, Piatt County.

DRAINAGE AREA.—550 square miles.

RECORDS AVAILABLE.—February 4, 1908, to December 31, 1912; June 23, 1914, to September 30, 1921.

GAGE.—Chain gage attached to downstream side of bridge; read by David Coay.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge and wooden trestle approach during medium and high stages or by wading during low stages.

CHANNEL AND CONTROL.—Control composed of fine gravel; likely to shift. Measuring section is at a pool.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.5 feet September 4 (discharge, 1,980 second-feet); minimum stage, 1.78 feet October 16–23 (discharge, 6 second-feet).

1908–1912 and 1914–1921: Maximum stage recorded, 15.2 feet May 14, 1908 (discharge, 9,280 second-feet); minimum stage recorded, 1.5 feet July 31 to August 3, 1914 (discharge, 1 second-foot).

Maximum stage during flood of March to April, 1913, 17.7 feet; March 25 (discharge not known).

ACCURACY.—Stage-discharge relation permanent since March 1, 1920, except as slightly affected by ice March 1, 6, and 7, 1920. Rating curve well defined between 2 and 1,000 second-feet; fairly well defined above 1,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table except as indicated in footnote to table of daily discharge. Records good for low and medium stages; fair for high stages.

Discharge measurements of Sangamon River at Monticello, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Feb. 10	4.49	210
Apr. 22	7.38	589
Aug. 19	2.58	53.0

Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the period Mar. 1, 1920, to Sept. 30, 1921.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1920.							
1	45	720	860	323	49	11	7
2	43	680	915	275	49	11	7
3	37	426	970	275	89	11	7
4	126	413	970	263	80	11	7
5	478	400	640	263	70	13	7
6	290	374	530	269	52	13	7
7	200	348	452	275	49	13	7
8	165	745	400	251	49	14	7
9	227	895	374	215	49	15	7
10	452	1,250	348	195	46	15	7
11	800	1,150	323	185	46	15	13
12	1,720	1,050	2,080	165	46	11	13
13	2,080	895	2,080	155	46	11	13
14	2,290	770	1,580	145	145	11	15
15	2,500	720	1,460	117	66	11	20
16	1,980	593	1,870	117	49	11	22
17	1,580	895	2,280	109	43	9	31
18	1,350	1,870	5,150	101	42	9	15
19	1,050	2,850	3,750	93	40	9	13
20	970	3,360	2,180	87	31	9	11
21	900	6,970	1,880	81	28	9	9
22	830	7,960	1,250	85	22	8	7
23	660	5,900	1,010	85	22	7	7
24	560	2,080	770	77	22	7	7
25	640	1,660	640	70	21	7	7
26	1,720	1,250	530	66	20	7	11
27	2,080	970	478	64	15	7	15
28	2,080	895	400	63	15	7	11
29	2,080	895	348	49	11	7	7
30	1,720	860	339	49	11	7	7
31	1,150	------	331	------	11	7	------

Daily discharge, in second-feet, of Sangamon River at Monticello, Ill., for the period Mar. 1, 1920, to Sept. 30, 1921—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1920–21.												
1	7	13	13	15	126	63	830	885	413	56	40	31
2	7	15	13	62	145	66	770	720	413	56	40	28
3	7	15	13	109	145	63	682	560	426	44	34	28
4	7	13	15	109	135	60	593	491	413	31	25	1,980
5	7	11	20	97	126	60	465	452	382	31	20	930
6	7	11	25	43	146	68	400	400	251	31	15	387
7	7	12	28	37	165	77	374	361	227	31	13	311
8	7	13	25	37	165	117	374	336	185	46	11	251
9	7	11	25	32	205	185	374	311	165	22	11	205
10	7	11	22	28	215	348	342	275	145	21	11	145
11	7	11	20	40	205	374	311	275	135	20	89	186
12	7	11	21	37	185	348	287	275	122	18	126	227
13	7	11	22	37	165	387	275	251	109	15	239	299
14	7	11	20	37	145	426	275	227	97	15	174	275
15	7	11	20	37	126	374	275	206	85	15	109	205
16	6	13	20	34	126	323	413	185	77	11	117	126
17	6	13	15	31	101	299	672	165	374	11	77	165
18	6	13	15	25	97	263	930	158	251	11	63	175
19	6	13	15	25	93	227	970	151	188	11	52	185
20	6	13	15	31	91	239	720	145	126	11	49	165
21	6	13	15	34	89	251	680	126	165	11	49	165
22	6	13	15	49	85	275	640	118	117	9	49	165
23	6	13	15	63	85	299	720	109	117	9	227	155
24	8	13	15	77	77	413	790	109	93	8	77	145
25	9	13	15	109	70	575	860	101	77	7	60	198
26	9	13	15	77	63	745	895	895	81	7	145	251
27	11	13	15	52	63	1,310	830	1,880	85	7	89	227
28	13	13	15	63	63	1,880	830	1,650	109	77	83	185
29	13	13	15	63	-------	1,880	970	1,280	60	66	77	155
30	11	13	15	70	-------	1,720	1,050	913	56	28	56	145
31	12	-------	15	77	-------	1,250	-------	545	-------	34	37	-------

NOTE.—Discharge records in the above table for the period Mar. 1 to Sept. 30, 1920, supersede those published in Water-Supply Paper 505, p. 266. Stage-discharge relation slightly affected by ice Mar. 1, 6, and 7, 1920; discharge estimated. Gage not read and discharge interpolated May 31, Nov. 25, 1920, Apr. 1, May 18, 19, and 30, 1921. Gage not read on Sundays except Oct. 3, 1920, July 17, 1921, and Sept. 4, 1921; discharge interpolated.

Monthly discharge of Sangamon River at Monticello, Ill., for the years ending Sept. 30, 1920 and 1921.

[Drainage area, 550 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
1919–20.					
October	482	8	74.1	0.135	0.16
November	805	119	240	.436	.49
December	1,200	----------	309	.562	.65
January	----------	----------	57.3	.104	.12
February	278	----------	118	.215	.23
March	2,500	37	1,060	1.93	2.22
April	7,960	348	1,660	3.02	3.37
May	5,150	323	1,200	2.18	2.51
June	323	49	152	.276	.31
July	145	11	43.0	.078	.09
August	15	7	10.1	.018	.02
September	31	7	10.8	.020	.02
The year	7,960	7	412	.749	10.19

Monthly discharge of Sangamon River at Monticello, Ill., for the years ending Sept. 30, 1920 and 1921—Continued.

Month.	Discharge is second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
1920–21.					
October	13	6	7.71	0.014	0.02
November	15	11	12.5	.023	.03
December	28	13	17.6	.032	.04
January	109	15	52.8	.096	.11
February	215	63	125	.227	.24
March	1,880	60	483	.878	1.01
April	1,050	275	620	1.13	1.26
May	1,880	101	470	.855	.99
June	426	56	183	.333	.37
July	77	7	24.8	.045	.05
August	239	11	73.0	.133	.15
September	1,980	28	270	.491	.55
The year	1,980	6	195	.355	4.82

NOTE.—Monthly discharge and run-off, as shown in the above table, for the period March to September, 1920, and discharge and run-off for the climatic year 1920, supersede the determinations published in Water-Supply Paper 505, p. 266.

SANGAMON RIVER AT RIVERTON, ILL.

LOCATION.—In southeast corner of SW. ¼ sec. 9, T. 16 N., R. 4 W. third principal meridian, at Wabash Railroad bridge a quarter of a mile west of Riverton, Sangamon County, and 2½ miles below mouth of South Fork.

DRAINAGE AREA.—2,560 square miles.

RECORDS AVAILABLE.—February 13, 1908, to December 31, 1912; August 7, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by J. J. Washburn.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Control composed of fine gravel; shifting. Measuring section is at a pool.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 22.5 feet March 30 (discharge, 10,100 second-feet); minimum stage, 7.25 feet January 25 (discharge, 22 second-feet).

1908–1912; 1914–1921: Maximum stage recorded, 27.8 feet February 3, 1916 (discharge, 20,800 second-feet); minimum stage, 6.9 feet October 3–15, 1915 (discharge, 3 second-feet).

Flood of 1883 reached a stage of about 32 feet on present gage, and that of 1875 is said to have been one-half foot lower (discharge not determined).

ACCURACY.—Stage-discharge relation changed following the high water of latter part of March; not affected by ice during period of record. Two rating curves used, both well defined between 500 and 4,000 second-feet and fairly well defined outside those limits; applicable October 1 to March 31 and April 1 to September 30. Gage read to hundredths once daily except during periods December 23 to January 24 and August 10–14, when observations were discontinued. Daily discharge ascertained by applying daily gage height to rating table except for periods during which gage was not read for which discharge was not determined except for August 10–14, for which it was estimated. Records good except for low stages, for which they are fair.

Discharge measurements of Sangamon River at Riverton, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 6	9.26	374
Apr. 18	16.36	3,400

Daily discharge, in second-feet, of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	80	133	32	-------	295	317	9,620	7,000	1,300	435	1,420	181
2	87	55	33	-------	317	295	8,980	6,620	1,260	364	2,220	181
3	76	58	34	-------	385	295	8,520	5,600	976	321	2,370	172
4	68	64	36	-------	409	295	6,620	4,830	910	280	1,500	163
5	45	61	40	-------	385	317	5,500	4,010	717	250	910	280
6	40	60	45	-------	385	317	3,800	3,300	656	230	656	540
7	35	57	48	-------	409	339	2,950	3,000	597	220	717	812
8	32	60	50	-------	485	511	2,220	2,620	540	210	386	1,040
9	31	58	57	-------	565	565	2,020	1,970	513	321	321	1,120
10	31	52	68	-------	595	715	2,020	1,700	460	300		1,180
11	32	48	90	-------	655	845	1,660	1,660	460	260		1,180
12	31	42	90	-------	715	1,080	1,380	1,500	435	230	1,200	910
13	35	40	275	-------	715	1,120	1,340	1,420	410	154		686
14	38	38	339	-------	685	1,270	1,620	1,340	486	138		435
15	42	39	385	-------	655	1,510	1,620	1,150	910	120	943	410
16	40	39	409	-------	595	2,080	1,700	1,080	1,920	105	717	386
17	40	38	409	-------	565	1,390	2,220	976	1,260	97	540	342
18	39	38	385	-------	459	1,270	3,420	943	780	154	910	364
19	37	37	385	-------	433	1,120	3,540	910	597	1,660	1,040	410
20	36	37	409	-------	433	1,020	3,540	844	540	3,540	877	410
21	34	37	409	-------	409	1,310	3,540	780	540	2,420	748	410
22	31	37	409	-------	385	1,350	3,660	717	597	2,320	626	386
23	31	36	-------	-------	361	1,230	4,360	717	1,660	1,180	300	386
24	32	36	-------	-------	361	1,470	4,430	656	1,260	686	513	364
25	37	35	-------	48	361	2,280	3,870	626	943	342	460	597
26	52	35	-------	115	339	2,940	5,600	597	910	280	435	844
27	60	34	-------	196	339	3,800	8,980	568	1,010	220	386	1,180
28	74	33	-------	206	339	8,080	9,460	626	1,120	210	342	1,660
29	275	33	-------	235	-------	9,780	8,980	780	812	200	260	1,820
30	275	32	-------	275	-------	10,100	8,080	844	656	172	240	1,970
31	275	-------	-------	275	-------	9,950	-------	1,040	-------	230	200	-------

NOTE.—Braced figure shows mean discharge for period included.

Monthly discharge of Sangamon River at Riverton, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 2,560 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	275	31	66.8	0.026	0.03
November	133	32	46.7	.018	.02
December 1-22	409	32	202	.079	.06
February	715	295	466	.182	.19
March	10,100	295	2,220	.867	1.00
April	9,620	1,340	4,510	1.76	1.96
May	7,000	568	1,950	.762	.88
June	1,920	410	841	.329	.37
July	3,540	97	569	.222	.26
August	2,370	200	840	.328	.38
September	1,970	163	694	.271	.30

SANGAMON RIVER NEAR OAKFORD ILL.

LOCATION.—In sec. 6, T. 19 N., R. 7 W. third principal meridian, at highway bridge 3 miles northeast of Oakford, Menard County, 2½ miles above Chicago, Peoria & St. Louis Railway bridge, and 1¼ miles above mouth of Crane Creek.

DRAINAGE AREA.—5,000 square miles.

RECORDS AVAILABLE.—October 26, 1909, to June 30, 1911; December 10, 1911, to March 31, 1912; August 25, 1914, to June 11, 1919; and March 18 to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by Harm Otto and J. E. Moss.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of sand and fine gravel; shifting. Banks low and subject to overflow. The river for some distance above and below station has been dredged and straightened, thus increasing the slope and disturbing the regimen of flow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.75 feet April 30 (discharge, 12,000 second-feet); minimum stage, 1.95 feet September 4 and 5 (discharge, 545 second-feet).

1909–1912; 1914–1919; 1921: Maximum discharge recorded, 33,300 second-feet June 8 and 9, 1917 (determined from extension of rating curve); minimum discharge recorded, 85 second-feet August 30 and 31, November 28, and December 2, 1914.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 400 and 8,000 second-feet; fairly well defined beyond these limits. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Sangamon River near Oakford, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 16	L. G. Williams	1.95	571	Apr. 20	L. G. Williams	7.84	5,330
16	do	1.95	573	May 5	do	9.72	7,390
Mar. 10	H. E. Grosbach	3.54	1,560	Aug. 9	H. E. Grosbach	2.31	702

Daily discharge, in second-feet, of Sangamon River near Oakford, Ill., for the year ending Sept. 30, 1921.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		10,400	11,700	2,380	1,250		645
2		10,100	11,100	4,140	1,180		595
3		10,200	9,500	4,500	1,040		545
4		9,500	8,500	5,480	1,390		545
5		9,200	7,540	3,240	1,180		1,460
6		8,780	6,450	2,620	620		4,320
7		5,900	5,280	2,060	645		4,680
8		4,780	4,680	1,900	570		4,140
9		4,140	4,320	1,740	570		3,600
10		3,690	3,870	1,600			3,060
11		3,420	3,600	1,460			2,540
12		3,150	3,420	1,320			1,900
13		2,970	3,240	1,180			1,740
14		3,060	2,880	1,180		1,040	1,180
15		2,970	2,700	1,320		790	1,460
16		3,240	2,540	2,300		1,740	1,320
17		3,960	2,460	1,900		1,180	1,180
18	2,380	4,780	2,220	1,740		1,180	1,180
19	2,220	5,280	2,060	1,740		1,320	1,180
20	2,060	5,280	2,060	1,320		1,600	1,600
21	1,980	5,380	1,900	1,180		1,180	1,320
22	1,900	5,380	1,900	1,180		1,180	1,320
23	2,060	6,450	1,740	1,820		1,040	1,320
24	2,380	6,680	1,740	2,060		790	1,180
25	3,330	6,680	1,600	2,220		2,060	1,740
26	4,410	6,920	1,530	2,060		2,700	1,180
27	5,080	8,220	2,060	1,740		1,600	1,600
28	5,900	10,100	2,790	1,600		1,320	1,900
29	6,560	11,400	2,540	1,390		1,040	2,460
30	9,200	12,000	2,140	1,320		910	2,460
31	10,400		2,220			700	

NOTE.—No record July 10 to Aug. 13, discharge not determined.

Monthly discharge of Sangamon River near Oakford, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 5,000 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
March 18-31	10,400	1,900	4,280	0.856	0.45
April	12,000	2,970	6,470	1.29	1.44
May	11,700	1,530	3,940	.788	.91
June	5,480	1,180	2,060	.412	.46
July 1-9	1,390	570	938	.188	.06
August 14-31	2,700	700	1,300	.260	.17
September	4,680	545	1,840	.368	.41

SOUTH FORK OF SANGAMON RIVER AT POWER PLANT NEAR TAYLORVILLE, ILL.

LOCATION.—In sec. 14, T. 13 N., R. 3 W., at Chicago & Illinois Midland Railroad bridge 6 miles northwest of Taylorville, Christian County, 500 feet east of power plant of Central Illinois Public Service Co., 5 miles below mouth of Bear Creek, and 8 miles below station formerly maintained at Wabash Railroad bridge.

DRAINAGE AREA.—510 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—May 18, 1917, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by H. Hendricks.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of soft mud; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.85 feet March 30 (discharge, 2,720 second-feet); minimum stage, 3.13 feet October 15–17 and 19–22 (discharge, 0.01 second-foot).

1917–1921: Maximum stage recorded, 26.6 feet June 6, 1917 (discharge, 10,400 second-feet); minimum stage same as for 1921.

A stage of about 27.3 feet in the present gage is said to have been reached January 31, 1916 (discharge, 11,300 second-feet).

DIVERSIONS.—On an average, about half a second-foot of water is used for boiler feed and other purposes at the power plant.

ACCURACY.—Stage-discharge relation practically permanent during year; not affected by ice. Rating curve well defined between 50 and 1,500 second-feet; fairly well defined below 50 and between 1,500 and 6,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except as noted in footnote to daily-discharge table. Records good for medium stages; otherwise fair.

Discharge measurements of South Fork of Sangamon River at power plant near Taylorville, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 7	4.87	59.8
Apr. 19	12.78	1,100

Daily discharge, in second-feet, of South Fork of Sangamon River at power plant near Taylorville, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	7.0	5.9	2.0	67	67	36	1,730	1,440	61	34	242	36
2	4.9	4.9	2.6	93	70	36	1,310	975	49	34	214	32
3	4.9	3.2	3.2	96	73	34	1,250	875	46	28	697	27
4	3.2	4.9	4.0	100	67	34	680	680	44	22	680	51
5	2.4	4.0	16	84	64	33	415	439	39	17	418	75
6	1.5	4.0	44	68	61	32	300	427	34	11	156	100
7	1.5	4.0	34	52	58	34	300	415	32	9.7	76	90
8	.6	3.2	29	49	82	142	300	300	29	300	58	58
9	.6	3.2	21	39	128	333	344	280	29	114	42	42
10	3.2	2.4	14	34	180	403	415	223	29	55	76	36
11	2.4	1.7	11	32	164	300	300	214	32	34	708	29
12	1.5	1.0	16	29	149	232	250	172	34	11	1,340	27
13	.15	.6	29	27	128	463	223	128	29	9.7	875	23
14	.03	1.0	34	29	114	487	260	172	216	8.4	697	20
15	.01	1.5	29	29	86	415	260	156	403	7.2	573	18
16	.01	2.0	34	21	79	367	488	135	573	5.9	300	18
17	.01	1.8	34	15	73	223	715	121	280	10	172	21
18	.03	1.5	36	13	67	188	975	121	121	14	616	18
19	.01	2.0	36	13	61	156	1,080	121	79	1,690	462	16
20	.01	1.6	38	17	58	156	1,020	114	78	1,970	309	25
21	.01	1.3	39	19	55	142	771	100	76	1,580	156	34
22	.01	1.0	36	21	54	205	535	93	93	680	124	67
23	.02	.6	34	25	52	250	715	90	121	205	93	44
24	.02	1.3	32	34	49	501	791	86	196	138	100	34
25	.03	2.0	39	32	46	752	616	76	142	70	214	433
26	.03	2.3	44	25	42	975	811	76	110	76	142	832
27	25	2.6	39	23	39	1,310	1,620	114	79	58	106	900
28	20	3.0	34	21	36	1,850	1,890	128	70	39	70	1,160
29	7.0	3.2	16	46	-------	2,540	1,850	121	55	156	58	1,370
30	5.9	2.6	8.2	70	-------	2,720	1,650	101	58	300	42	1,280
31	7.2	-------	8.2	73	-------	2,260	-------	81	-------	271	44	-------

NOTE.—Discharge interpolated, because of missing gage heights Oct. 5, 11, 23, 24, Nov. 10, 11, 15, 17, 20, 21, 22, 24, 26, Dec. 20, 22, Jan. 3, 5, 6, 29, Feb. 5, 23, Mar. 5, 24, Apr. 16, May 6, 30, 31, June 7, 14, 20, 26, July 3, 4, 5, 14, 15, 17, 24, 31, Aug. 1, 5, 11, 19, 20, 27, Sept. 4, 5, 20, and 25.

Monthly discharge of South Fork of Sangamon River at power plant near Taylorville, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	25	0.01	3.20	0.0063	0.01
November	5.9	.6	2.48	.0049	.01
December	44	2.0	25.7	.050	.06
January	100	13	41.8	.082	.09
February	180	36	78.6	.154	.16
March	2,720	32	568	1.11	1.28
April	1,890	223	795	1.56	1.74
May	1,440	76	277	.543	.63
June	573	29	108	.212	.24
July	1,970	5.9	257	.504	.58
August	1,340	42	318	.624	.72
September	1,370	16	231	.453	.51
The year	2,720	.01	226	.443	6.03

CROOKED CREEK AT RIPLEY, ILL.

LOCATION.—In sec. 33, T. 1 N., R. 2 W., at highway bridge a quarter of a mile east of Ripley, Brown County.

DRAINAGE AREA.—1,310 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—March 12 to September 30, 1921.

GAGE.—Chain gage attached to downstream handrail of bridge; read by Mrs. Darius Seckman.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Bed composed of soft mud and clay; likely to shift. Control not well defined. Banks high and are overflowed only in extreme high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record, 17.39 feet September 5 (discharge, 5,890 second-feet); minimum stage, 1.88 feet September 1 (discharge, 15 second-feet).

On an unknown date a stage of about 26 feet was reached as evidenced by old high-water marks near gage.

ICE.—No information.

ACCURACY.—Stage-discharge relation permanent during period of record. Rating curve well defined between 30 and 5,000 second-feet; fairly well defined beyond these limits. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Crooked Creek at Ripley, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 18	Williams and Steinhagen.	2.10	31.1	Apr. 18	L. G. Williams	11.64	2,820
18	do	2.10	30.3	29	do	13.25	3,660
Mar. 12	L. G. Williams[a]	4.52	407	Aug. 4	do	9.92	2,100

[a] Engineer, U. S. Public Health Service.

Daily discharge, in second-feet, of Crooked Creek at Ripley, Ill., for the year ending Sept. 30, 1921.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	-------	108	1,640	135	685	1,540	15
2	-------	102	1,330	128	460	3,970	35
3	-------	95	1,760	610	195	3,370	150
4	-------	89	1,150	510	150	2,200	195
5	-------	89	790	510	121	1,180	5,890
6	-------	83	710	485	95	165	5,110
7	-------	83	585	340	83	142	4,690
8	-------	83	535	225	71	108	3,770
9	-------	83	440	128	59	78	400
10	-------	128	225	83	52	48	400
11	-------	114	460	89	49	560	710
12	400	77	880	95	47	280	1,120
13	300	77	440	95	42	135	440
14	320	77	340	89	38	1,240	280
15	1,120	83	260	89	36	610	1,360
16	1,180	1,150	210	71	35	340	1,800
17	585	2,280	210	57	35	150	2,910
18	320	2,860	195	44	34	128	2,040
19	240	1,760	180	142	40	102	3,000
20	195	1,150	165	195	158	89	940
21	485	535	158	1,210	320	77	710
22	485	2,640	150	790	260	68	1,920
23	280	2,780	135	735	59	53	1,840
24	225	1,720	128	685	48	42	1,430
25	180	1,000	121	820	34	27	880
26	195	2,120	114	1,030	31	21	440
27	225	4,750	1,760	2,460	31	20	300
28	300	4,420	1,500	3,090	180	19	300
29	280	4,270	1,150	1,800	685	17	225
30	158	2,200	635	1,210	735	17	210
31	165	-------	142	-------	850	15	-------

Monthly discharge of Crooked Creek at Ripley, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,310 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
March 12-31	1,180	158	382	0.292	0.22
April	4,750	77	1,230	.939	1.05
May	1,760	114	597	.456	.53
June	3,090	44	598	.456	.51
July	850	31	184	.140	.16
August	3,970	15	542	.414	.48
September	5,890	15	1,450	1.11	1.24

MACOUPIN CREEK NEAR KANE, ILL.

LOCATION.—In sec. 7, T. 9 N., R. 11 W., at Chicago & Alton Railway bridge 3 miles northwest of Kane, Greene County.

DRAINAGE AREA.—865 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

RECORDS AVAILABLE.—March 11 to September 30, 1921.

GAGE.—Vertical staff; lower section on old piling between piers, intermediate section on left pier, high-water section on transmission line pole on left bank 20 feet above bridge; read by Claude Linn.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading; at high water also from bridges over flood channels a quarter of a mile south and an eighth of a mile north of main channel.

CHANNEL AND CONTROL.—Control at low and medium stages, rock fill under bridge; affected by drift on piers and old piling. Channel below bridge composed of clay and heavy mud; likely to shift. At high stages water overflows above gage into two high-water channels; affected by drift and vegetation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record, 18.1 feetMarch 29 and April 28 (discharge, 8,320 second-feet); minimum stage, 0.50 foot July 31 (discharge, 13 second-feet).

High water of 1915 reached a stage of approximately 26.5 feet on present gage (discharge not determined).

ICE.—No information.

ACCURACY.—Stage-discharge relation affected by drift and brush on bridge piers and old piling, but the backwater effect was probably practically unchanged throughout the period of record, giving in effect a practically permanent stage-discharge relation. Rating curve well defined between 20 and 1,500 second-feet; fairly well defined beyond these limits. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good to fair for medium and ordinary low stages; fair to poor for high and extremely low stages.

Discharge measurements of Macoupin Creek near Kane, Ill., during the year ending Sept. 30, 1921.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 17	Williams[a] and Steinhagen	2.59	162	Apr. 28	L. G. Williams	18.06	8,240
Mar. 11	Grosbach and Williams	4.56	452	Aug. 3	do	2.45	120
Apr. 19	L. G. Williams	8.21	1,070	25	do	1.00	25.9

[a] Engineer, U. S. Public Health Service.

Daily discharge, in second-feet, of Macoupin Creek near Kane, Ill., for the year ending Sept. 30, 1921.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	------	2,240	1,860	58	192	24	17
2	------	742	1,290	54	58	178	16
3	------	575	1,250	73	51	178	16
4	------	515	950	90	69	90	14
5	------	440	670	62	45	62	17
6	------	395	545	54	36	73	410
7	------	365	470	45	32	1,110	192
8	------	335	380	39	590	622	136
9	------	320	350	136	90	192	118
10	------	276	575	81	39	106	192
11	455	234	1,310	395	26	51	136
12	335	220	1,480	455	26	425	36
13	814	206	622	234	22	192	36
14	670	670	425	220	20	500	45
15	425	1,310	290	206	20	425	90
16	305	2,560	276	365	143	136	395
17	248	3,360	220	220	51	81	136
18	192	2,610	192	365	39	500	100
19	192	1,290	178	130	26	515	51
20	157	670	164	150	164	276	136
21	220	530	143	2,200	276	90	545
22	1,330	560	136	262	164	51	276
23	1,010	3,050	118	276	51	26	100
24	1,250	2,950	106	688	51	26	90
25	3,000	814	90	706	42	26	560
26	3,150	3,250	100	706	26	26	706
27	4,400	6,890	90	290	17	23	410
28	7,060	8,320	136	143	18	42	164
29	8,320	7,420	143	150	16	34	112
30	7,420	6,210	90	220	15	45	832
31	6,210	------	73	------	13	23	------

Monthly discharge of Macoupin Creek near Kane, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 865 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
March 11-31	8,320	157	2,240	2.59	2.02
April	8,320	206	1,980	2.29	2.56
May	1,860	73	475	.549	.63
June	2,200	39	302	.349	.39
July	590	13	78.3	.091	.10
August	1,110	23	198	.229	.26
September	832	14	203	.235	.26

KASKASKIA RIVER AT VANDALIA, ILL.

LOCATION.—In sec. 16, T. 6 N., R. 1 E. third principal meridian, at highway bridge at east end of Main Street, Vandalia, Fayette County, 3½ miles above Hickory Creek.

DRAINAGE AREA.—1,980 square miles.

RECORDS AVAILABLE.—February 26, 1908, to December 31, 1912; August 11, 1914, to September 30, 1921.

GAGE.—Chain gage attached to bridge; read by Wilson Haley. Gage was removed March 13 to May 16 and June 5–24, during construction of new bridge.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; clean; likely to shift. Measuring section in a pool. Control not well defined; shifting.

EXTREMES OF DISCHARGE.—Maximum stage occurred during period of no record; minimum stage recorded, 0.98 foot November 14 (discharge, 42 second-feet).

1908–1912; 1914–1921: Maximum stage recorded, 23.0 feet June 5, 1917 (discharge, 16,400 second-feet); minimum discharge, 3.5 second-feet August 22, 1911.

ACCURACY.—Stage-discharge relation practically permanent during year. Rating curve well defined between 20 and 11,000 second-feet. Gage read to hundredths once daily, except during periods March 13 to May 16 and June 5–24, when new bridge was being built and observations were discontinued. Daily discharge ascertained by applying daily gage height to rating table except for periods during which gage was not read, as indicated in footnote to table of daily discharge. Records good.

Discharge measurements of Kaskaskia River at Vandalia, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 8	3.26	364
May 17	4.25	584
Aug. 20	2.42	222

Daily discharge, in second-feet, of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	May.	June.	July.	Aug.	Sept.
1	96	78	58	152	360	225	------	485	420	50	84
2	72	72	58	990	380	210	------	585	320	102	78
3	67	67	58	1,160	340	210	------	635	260	54	67
4	62	67	58	510	340	195	------	610	240	72	62
5	58	62	102	400	400	180	------	------	195	84	195
6	58	62	166	400	535	280	------	------	173	84	225
7	54	62	180	360	460	380	------	------	195	96	320
8	54	58	138	360	485	810	------	------	900	210	320
9	46	58	108	360	750	585	------	------	610	120	440
10	50	54	102	320	780	610	------	------	240	78	460
11	50	54	96	280	585	840	------	------	173	67	690
12	50	46	108	225	560	1,190	------	------	138	67	560
13	46	46	126	195	535	------	------	------	120	810	510
14	46	43	120	166	510	------	------	------	120	400	400
15	46	46	126	159	460	------	------	------	195	210	320
16	43	46	126	145	420	------	------	------	114	145	225
17	46	46	126	138	400	------	585	------	84	114	195
18	46	46	102	159	360	------	560	------	78	1,300	145
19	50	50	78	195	380	------	535	------	90	360	138
20	43	54	67	173	510	------	485	------	635	180	138
21	43	54	90	166	340	------	460	------	260	152	138
22	46	58	114	195	260	------	440	------	108	96	132
23	46	54	180	195	260	------	420	------	108	78	132
24	43	54	210	195	260	------	400	------	84	485	120
25	54	54	138	180	240	------	360	585	72	1,680	120
26	67	54	132	180	240	------	340	585	72	990	2,000
27	84	54	126	173	240	------	400	460	58	260	2,920
28	84	54	120	166	225	------	460	750	58	195	2,840
29	90	54	114	159	------	------	420	810	58	180	1,640
30	84	46	108	260	------	------	440	720	54	138	1,190
31	84	------	108	340	------	------	440	------	50	108	------

NOTE.—Observations discontinued Mar. 13 to May 16 and June 5–24, owing to removal of gage during construction of new bridge; discharge not determined. Discharge interpolated Dec. 26–28, on account of lack of gage readings.

Monthly discharge of Kaskaskia River at Vandalia, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 1,980 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	96	43	58.3	0.029	0.03
November	78	43	55.1	.028	.03
December	210	58	114	.058	.07
January	1,160	138	292	.147	.17
February	780	225	415	.210	.22
March 1–12	1,190	180	476	.240	.11
May 17–31	585	340	450	.227	.13
July	900	50	203	.103	.12
August	1,300	50	289	.146	.17
September	2,920	62	560	.283	.32

KASKASKIA RIVER AT NEW ATHENS, ILL.

LOCATION.—In W. ½ NE. ¼ sec. 28, T. 2 S., R. 7 W. third principal meridian, at Illinois Central Railroad bridge 600 feet north of railroad station at New Athens, St. Clair County, 1 mile below mouth of Silver Creek, and 3 miles above mouth of Lively Creek.

DRAINAGE AREA.—5,220 square miles.

RECORDS AVAILABLE.—January 23, 1907, to December 31, 1912; June 22, 1914, to September 30, 1921, when station was discontinued. Gage height of river was taken on Wednesday and Thursday mornings from January 23, 1907, to October 28, 1909, by C. J. von Roth Roffy for the New Athens Journal, in which they are published. These heights have been reduced to present datum; maximum error probably not more than 0.4 foot, decreasing with increase of stage. Record is authentic.

GAGE.—Chain gage attached to bridge; installed November 1, 1909; read by Henry Hoffman.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge to which gage is attached or from highway bridge about 500 feet downstream.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifting. Backwater from Mississippi River occurs when a stage of about 15 feet and above is reached on the United States Weather Bureau gage at Chester, Ill.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 22.88 feet, April 4 (discharge, 13,300 second-feet); minimum stage, 2.77 feet November 23 and 24 (discharge, 130 second-feet).

1907–1912; 1914–1921; Maximum stage recorded, 35.7 feet August 26, 1915 (discharge, 63,100 second-feet); minimum stage, 2.08 feet August 10, 1914 (discharge, 102 second-feet).

ICE.—Stage-discharge relation affected by ice at times.

ACCURACY.—Stage-discharge relation changed during high water in April; affected by backwater from Mississippi River during several periods; not affected by ice. Two fairly well defined rating curves used for periods of no backwater from Mississippi River. Gage read to hundredths once daily. Daily discharge, during periods of no backwater, ascertained by applying daily gage height to rating table; during periods of backwater, by applying to rating table daily gage height corrected for backwater effect by amounts determined from results of a number of discharge measurements made during various conditions of backwater; shifting-control method used April 1–16. Records fair except for periods of backwater, for which they are poor.

Discharge measurements of Kaskaskia River at New Athens, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 10	5.43	744
Aug. 22	6.14	1,080

Daily discharge, in second-feet, of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	300	200	140	650	1,220	475	13,200		888		250	505
2	230	200	140	1,820	1,520	450	13,000		832		325	427
3	260	210	140	2,410	1,440	450	13,200		1,440	1,000	288	427
4	325	220	160	3,150	1,160	450	13,300	11,000	1,000		238	401
5	300	210	160	3,300	920	425	12,800		1,360		225	350
6	250	190	180	2,410	775	425	12,100		1,060		375	310
7	240	190	220	1,440	725	500	11,500	6,500	944		427	275
8	220	180	375	1,040	775	920	11,000		860	450	639	300
9	220	170	500	860	1,220	1,400	10,500	3,490			401	350
10	200	160	525	750	1,600	2,410	9,580	2,850			325	2,850
11	200	160	425	700	1,960	2,320	7,950			720	453	1,650
12	200	150	350	675	1,920	2,900	4,990			944	401	916
13	160	150	300	2,100	1,690	5,200	3,790			776	375	693
14	160	150	280	2,500	1,360	5,570	2,650	5,000	950	612	531	666
15	170	150	400	3,000	1,160	5,990	2,550			479	1,150	693
16	170	150	400	1,800	980	6,440	2,450			427	1,030	666
17	160	150	300	750	920	6,360	3,200			375	944	639
18	160	140	300	400	830	4,960	4,210			350	720	585
19	160	140	325	400	775	2,900	4,990	1,200		325	585	505
20	160	140	300	400	700	2,000			916	375	427	776
21	160	140	375	400	650	1,600			1,600	350	720	612
22	150	140	650	425	600	1,600	3,200	1,120	1,700	325	1,000	585
23	150	130	950	400	575	1,820		1,030	2,600	720	720	
24	150	130	920	400	550	3,300		972		748	505	
25	150	140	1,040	425	525	6,440		916		558	1,060	
26	160	140	980	475	500	7,270		888		453	2,350	750
27	160	140	950	550	500	8,600		916	1,500	375	1,650	
28	170	140	775	600	475	10,100	10,000	972		325	1,650	
29	170	140	700	575	-------	12,200		1,060		300	1,650	
30	180	140	650	600	-------	12,700		1,120		288	888	3,500
31	180	-------	600	1,010	-------	13,000	-------	1,060	-------	275	666	-------

NOTE.—Stage-discharge relation affected by backwater from Mississippi River, Apr. 20 to May 8, May 11-21, June 9-19, June 24 to July 10, and Sept. 23-30; discharge ascertained by method described under "Accuracy" in station description. Discharge estimated Jan. 16, Mar. 27, and Sept. 6, on account of lack of gage readings. Braced figures show estimated mean discharge for periods included.

Monthly discharge of Kaskaskia River at New Athens, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 5,220 square miles.]

Month.	Discharge in second-feet.				
	Maximum.	Minimum.	Mean.	Per square mile.	Run-off in inches.
October	325	150	194	0.037	0.04
November	220	130	160	.031	.03
December	1,040	140	468	.090	.10
January	3,300	400	1,170	.224	.26
February	1,960	475	1,000	.192	.20
March	13,000	425	4,230	.810	.93
April	13,300	2,450	7,540	1.44	1.61
May	----------	888	2,300	.441	.51
June	2,600	----------	1,200	.230	.26
July	----------	275	560	.107	.12
August	2,350	225	741	.142	.16
September	3,500	275	798	.153	.17
The year	13,300	130	1,700	.326	4.39

BIG MUDDY RIVER AT PLUMFIELD, ILL.

LOCATION.—In W. ½ sec. 20, T. 7 S., R. 2 E., at highway bridge in Plumfield, Franklin County, 6 miles west of West Frankfort, 1½ miles below mouth of Middle Fork, and 2 miles below station formerly maintained at Chicago, Burlington & Quincy Railroad bridge.

DRAINAGE AREA.—753 square miles.

RECORDS AVAILABLE.—August 18, 1914, to September 30, 1921. From June 16, 1908, to December 31, 1912, records were obtained at Chicago, Burlington & Quincy Railroad bridge, 2 miles upstream.

GAGE.—Chain gage attached to bridge; read by Louis Robertson.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

CHANNEL AND CONTROL.—Control is about a quarter of a mile below gage; somewhat shifting. Point of zero flow is at a stage of about 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.2 feet March 31 (discharge, 4,740 second-feet); minimum stage, 0.69 foot August 1 (discharge, 0.4 second-foot).

1914–1920: Maximum stage recorded, 30.2 feet February 1, 1916 (discharge, 16,300 second-feet); minimum discharge, no flow, August 18–26, 1914.

ACCURACY.—Stage-discharge relation practically permanent during year; not affected by ice. Rating curve well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for days when gage was not read, for which it was ascertained by interpolation. Records good.

Discharge measurements of Big Muddy River at Plumfield, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 12	2.70	94.2
Aug. 23	.81	1.0

Daily discharge, in second-feet, of Big Muddy River at Plumfield, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	20	31	12	161	1,270	85	4,460	1,470	85	126	0.4	36
2	14	48	13	602	1,060	73	3,670	762	62	81	23	25
3	9.5	42	13	1,030	602	62	2,720	392	44	52	36	23
4	7.7	94	15	1,100	296	52	1,820	350	25	34	235	21
5	5.9	55	14	861	497	45	980	270	18	23	94	23
6	4.2	31	14	364	698	39	556	191	10	19	90	21
7	3.6	22	202	181	997	36	131	141	12	18	258	19
8	3.0	18	235	126	1,270	39	108	98	11	14	126	17
9	2.7	16	103	98	1,510	73	282	77	9.5	10	45	58
10	2.7	13	55	94	1,620	336	540	98	8.8	8.0	39	586
11	4.2	10	39	90	1,420	450	540	213	6.2	6.2	25	465
12	4.2	9.0	29	94	1,230	1,010	270	963	6.2	5.2	16	48
13	2.1	8.0	25	77	844	1,350	141	1,130	6.2	4.8	11	42
14	2.1	6.5	23	66	634	1,470	151	844	8.5	4.2	11	27
15	2.0	6.0	20	62	420	1,510	258	336	14	3.8	12	18
16	2.0	8.5	18	62	270	1,550	495	151	18	3.6	23	13
17	1.6	8.2	17	58	191	1,700	602	94	364	10	13	9.0
18	2.4	7.8	17	52	141	1,800	296	62	258	4.2	7.2	7.0
19	2.7	7.8	23	48	108	1,820	218	45	185	5.2	5.5	5.5
20	2.7	7.0	22	48	90	1,290	141	34	112	21	3.2	4.4
21	2.7	8.2	320	45	77	586	103	27	77	45	2.6	9.8
22	2.8	8.5	618	48	85	526	85	23	618	21	2.0	12
23	3.0	10	946	48	191	465	141	19	714	10	1.6	121
24	3.0	10	1,120	55	282	1,030	172	17	778	5.8	5.0	778
25	7.2	9.8	997	131	235	1,410	202	16	282	3.6	17	1,080
26	11	9.5	510	465	161	1,650	602	15	176	2.1	49	963
27	14	9.5	213	586	126	1,880	1,370	14	69	1.3	81	618
28	14	12	171	495	103	2,520	1,620	141	55	1.0	170	258
29	12	13	131	364	-------	3,220	1,800	151	73	1.0	258	126
30	9.5	12	90	810	-------	4,390	1,800	112	103	.8	131	912
31	39	-------	85	1,100	-------	4,740	-------	141	-------	.6	77	-------

Monthly discharge of Big Muddy River at Plumfield, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 753 square miles.]

Month.	Discharge in second-feet.				
	Maximum.	Minimum.	Mean.	Per square mile.	Run-off in inches.
October	39	1.6	7.02	0.009	0.01
November	94	6.0	18.4	.024	.03
December	1,120	12	197	.262	.30
January	1,100	45	304	.404	.47
February	1,620	77	587	.780	.81
March	4,740	36	1,200	1.59	1.83
April	4,460	85	876	1.16	1.29
May	1,470	14	271	.360	.42
June	778	6.2	140	.186	.21
July	126	.6	17.6	.023	.03
August	258	.4	60.2	.080	.09
September	1,080	4.4	212	.282	.31
The year	4,740	.4	332	.428	5.80

BIG MUDDY RIVER AT MURPHYSBORO, ILL.

LOCATION.—In SW. ¼ sec. 8, T. 9 S., R. 2 W., at lower highway bridge on South Twentieth Street, Murphysboro, Jackson County, a quarter of a mile below mouth of Louis Creek and Mobile & Ohio Railway bridge.

RECORDS AVAILABLE.—December 6, 1916, to September 7, 1921.

DRAINAGE AREA.—2,170 square miles (measured on map issued by United States Geological Survey; scale, 1 to 500,000).

GAGE.—Chain gage attached to bridge; read by Clarence Jacobs.

CHANNEL AND CONTROL.—Bed composed of heavy clay; likely to shift. Backwater from Mississippi River occurs whenever the stage at the United States Weather Bureau gage at Chester, Ill., is above about 10.0 feet.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 24.00 feet March 22 (discharge, 8,690 second-feet); minimum stage, 1.42 feet August 1 (discharge, 1.0 second-foot).

1917–1921: Maximum discharge recorded, 15,600 second-feet January 10, 1917; minimum stage recorded in 1921.

The highest known stage of this river occurred about February 2, 1916, when a height of 39.6 feet on the present gage was reached (discharge, from extension of rating curve, 28,000 second-feet).

ICE.—Stage-discharge relation affected by ice during severe winters.

ACCURACY.—Stage-discharge relation practically permanent during year except as affected by backwater from Mississippi River; not affected by ice. Rating curve fairly well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except for periods of backwater from Mississippi River for which it was not determined (see footnote to table of daily discharge). Records good for medium stages; fair for very low and high stages.

Discharge measurements of Big Muddy River at Murphysboro, Ill., during the year ending Sept. 30, 1921.

[Made by H. E. Grosbach.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 11	4.22	293
Aug. 22	[a] 3.04	84.8

[a] Stage-discharge relation affected by backwater from Mississippi River.

Daily gage height, in feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.82	3.10	1.95	9.80	13.90	4.35	11.65	20.60	2.90	11.60	1.42	5.35
2	2.90	3.00	1.92	9.95	13.60	3.90	11.40	20.10	3.10	11.10	1.86	5.60
3	3.10	3.05	1.95	10.00	14.05	3.70	11.15	17.05	3.15	10.30	2.45	5.40
4	3.15	2.90	2.00	10.14	12.35	3.60	10.20	15.20	3.35	10.20	4.45	5.30
5	2.95	2.85	2.10	8.15	12.10	3.25	9.15	14.10	3.30	10.22	4.50	4.95
6	2.70	2.80	2.12	7.10	10.54	3.15	8.65	11.20	3.45	10.20	7.85	5.10
7	2.65	2.75	2.10	6.55	12.05	4.50	8.10	9.50	4.15	9.50	8.15	5.70
8	2.62	2.70	2.15	6.30	10.15	6.20	7.90	8.00	5.80	8.40	8.05	6.40
9	2.65	2.70	2.12	5.30	8.10	7.10	7.85	7.45	6.70	7.10	6.30	8.70
10	2.60	2.75	2.20	4.25	7.20	8.50	7.80	9.30	7.70	6.45	4.75	9.10
11	2.62	2.80	2.20	4.10	6.40	10.80	6.10	12.00	7.75	5.40	3.70	12.54
12	2.50	2.75	2.30	3.90	5.00	12.20	6.05	15.10	7.80	4.50	3.40	12.35
13	2.50	2.70	2.30	3.70	4.50	14.30	5.90	16.00	5.96	3.60	3.10	-------
14	2.40	2.70	2.45	3.80	4.40	14.20	6.70	15.90	5.60	2.90	2.95	8.70
15	2.35	2.65	2.40	3.85	4.45	14.50	7.10	12.95	5 15	2.40	7.30	5.00
16	2.30	2.60	2.50	3.70	4.35	14.90	7.40	11.85	4.90	2.30	8.15	4.15
17	2.10	2.55	2.65	3.50	4.25	15.65	8.35	11.60	5.10	2.10	6.45	4.55
18	1.85	2.50	2.70	3.30	4.25	16.30	7.95	9.40	5.65	2.20	5.35	5.85
19	1.80	2.50	2.90	3.40	4.20	19.60	7.90	8.70	5.20	2.90	5.10	5.60
20	1.70	2.45	3.80	3.00	4.15	23.10	8.10	6.10	5.50	3.50	4.80	4.45
21	1.70	2.42	3.95	3.30	4.20	23.70	8.15	5.90	5.65	4.55	3.70	4.70
22	1.65	2.40	4.60	3.40	4.20	24.00	8.20	5.70	6.50	4.50	3.04	5.15
23	1.80	2.30	4.85	3.60	4.25	23.90	8.55	4.05	6.70	3.60	2.90	5.30
24	2.30	2.20	4.90	5.20	4.25	22.10	8.60	4.20	6.90	3.40	-------	11.40
25	2.35	2.10	5.00	6.00	4.30	22.00	10.10	3.70	7.00	2.82	-------	15.65
26	2.40	2.10	5.40	6.20	4.40	21.60	12.05	3.15	7.65	2.44	-------	16.50
27	2.45	2.05	5.90	7.60	4.60	21.10	14.20	3.10	8.50	2.38	-------	15.40
28	2.55	2.00	6.30	7.70	4.40	19.05	16.80	3.15	8.70	2.16	-------	-------
29	2.60	2.05	6.50	7.65	-------	16.15	20.68	2.80	9.30	1.94	3.15	-------
30	2.90	2.10	7.90	8.10	-------	14.40	20.64	2.75	11.30	1.86	3.45	-------
31	3.50	-------	8.10	10.20	-------	12.90	-------	2.80	-------	1.74	4.35	-------

Daily discharge, in second-feet, of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1921.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	July.	Aug.	Sept
1	90	124	17	1,840	3,400	340	-------	1	565
2	100	112	15	1,900	3,270	243	-------	12	615
3	124	118	17	1,900	3,450	210	-------	56	565
4	130	100	20	1,940	2,760	195	-------	340	540
5	106	95	27	1,360	2,640	144	-------	360	465
6	80	90	29	1,030	2,080	130	-------	1,240	490
7	75	85	27	880	2,600	360	-------	1,360	-------
8	70	80	31	790	1,970	765	-------	1,300	-------
9	75	80	29	540	1,330	1,030	-------	790	-------
10	70	85	35	300	1,060	1,450	-------	420	-------
11	70	90	35	280	820	2,180	-------	210	2,800
12	61	85	43	243	465	2,680	-------	165	2,760
13	61	80	43	210	360	3,600	-------	124	2,140
14	52	80	56	226	340	3,550	-------	106	1,510
15	48	75	52	226	340	3,700	-------	1,090	465
16	43	70	61	210	340	3,900	-------	1,360	-------
17	27	66	75	180	300	4,250	-------	820	-------
18	12	61	80	150	300	4,600	35	565	-------
19	9	61	100	165	300	6,280	100	490	-------
20	5	56	226	112	300	8,200	180	420	-------
21	5	52	260	150	300	8,520	380	-------	-------
22	4	52	380	165	300	8,690	360	-------	-------
23	9	43	420	195	300	8,640	195	-------	-------
24	43	35	440	515	300	7,640	165	-------	-------
25	48	27	465	715	320	-------	90	-------	-------
26	52	27	565	765	340	-------	56	-------	-------
27	56	24	690	1,180	380	-------	50	-------	-------
28	66	20	790	1,210	340	-------	32	-------	-------
29	70	24	850	1,180	-------	-------	16	130	-------
30	100	27	1,270	1,330	-------	-------	12	172	-------
31	180	-------	1,330	1,970	-------	-------	7	340	-------

NOTE.—Stage-discharge relation affected by backwater from Mississippi River Mar. 25 to July 17, Aug. 21-28, Sept. 7-10, and 16-30; discharge not determined. Bridge closed for repairs Aug. 24-28; gage not read. Gage not read Sept. 28-30. Discharge interpolated Sept. 13, on account of missing gage height.

Monthly discharge of Big Muddy River at Murphysboro, Ill., for the year ending Sept. 30, 1921.

[Drainage area, 2,170 square miles.]

Month.	Discharge in second-feet.				Run-off in inches.
	Maximum.	Minimum.	Mean.	Per square mile.	
October	180	4	62.6	0.029	0.03
November	124	20	67.5	.031	.03
December	1,330	15	273	.126	.14
January	1,970	112	770	.355	.41
February	3,450	300	1,110	.512	.53
March 12–24	8,690	130	3,390	1.56	1.39
July 18–31	380	7	120	.055	.03
August 1–20	1,360	1	561	.258	.19

MISCELLANEOUS DISCHARGE MEASUREMENTS.

Miscellaneous discharge measurements in upper Mississippi River drainage basin during the year ending Sept. 30, 1921.

Date.	Stream.	Tributary to—	Locality.	Discharge.
				Sec.-ft.
June 1	Wapsipinicon River	Mississippi River	Quasqueton, Iowa	2,890
Sept. 26	Pine Creek	Iowa River	Eldora, Iowa	6.7

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