DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 434

RFACE WATER SUPPLY OF THE UNITED STATES

1916

PART IV. ST. LAWRENCE RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer
W. G. HOYT, A. H. HORTON, C. C. COVERT, and C. H. PIERCE, District Engineers

Prepared in cooperation with
STATES OF MINNESOTA, WISCONSIN, NEW YORK, AND VERMONT

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SURFACE WATER SUPPLY OF ST. LAWRENCE RIVER BASIN, 1916.

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, 1916.

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 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, 1895–1917.

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911 to 1917, inclusive	150,000

In the execution of the work many private and State organizations have cooperated either by furnishing data or by assisting in collecting data. Acknowledgements 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 11.

Measurements of stream flow have been made at about 4,100 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1916, 1,290 gaging stations were being maintained by the Survey and the cooperating organizations. Many

miscellaneous discharge measurements are made at other points. In connection with this work data were also collected in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country and will be made available in water-supply papers from time to time. Information in regard to publications relating to water resources is presented in the appendix to this report.

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 depth of 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, run-off in inches, acre-feet, and millions of cubic 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 by the use of the factors given in the tables of convenient equivalents (pp. 7–9).

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

"Run-off (depth in inches)" is the depth to which 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 of inches.

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

"Millions of cubic feet" is applied to quantities of water stored in reservoirs, most frequently in connection with studies of flood control.

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 determines 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.

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

CONVENIENT EQUIVALENTS.

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

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

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

NOTE.—For part of a month multiply the run-off for one day by the number of days.

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

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

NOTE.—For part of a month multiply the run-off for one day by the number of days.

Table for converting discharge in second-feet into run-off in millions of cubic feet.

Discharge (second-feet).	Run-off in millions of cubic feet.				
	1 day.	28 days.	29 days.	30 days.	31 days.
1	0.0864	2.419	2.506	2.592	2.678
2	.1728	4.838	5.012	5.184	5.356
3	.2592	7.257	7.518	7.776	8.034
4	.3456	9.676	10.02	10.37	10.71
5	.4320	12.10	12.53	12.96	13.39
6	.5184	14.51	15.04	15.55	16.07
7	.6048	16.93	17.54	18.14	18.75
8	.6912	19.35	20.05	20.74	21.42
9	.7776	21.77	22.55	23.33	24.10

NOTE.—For part of a month multiply the run-off for one day by the number of days.

Table for converting discharge in second-feet into run-off in millions of gallons.

Discharge (second-feet).	Run-off in millions of gallons.				
	1 day.	28 days.	29 days.	30 days.	31 days.
1	0.6463	18.10	18.74	19.39	20.04
2	1.293	36.20	37.48	38.78	40.08
3	1.939	54.30	56.22	58.17	60.12
4	2.585	72.40	74.96	77.56	80.16
5	3.232	90.50	93.70	96.95	100.2
6	3.878	108.6	112.4	116.3	120.2
7	4.524	126.7	131.2	135.7	140.3
8	5.171	144.8	149.9	155.1	160.3
9	5.817	162.9	168.7	174.5	180.4

NOTE.—For part of a month multiply the run-off for one day by the number of days.

Table for converting velocity in feet per second into velocity in miles per hour.

[1 foot per second=0.681818 mile per hour, or two-thirds mile per hour, very nearly; 1 mile per hour=1.4666 feet per second. In computing the table the figures 0.68182 and 1.4667 were used.]

Feet per second (units).	Miles per hour for tenths of foot per second.									
	0	1	2	3	4	5	6	7	8	9
0	0.000	0.068	0.136	0.205	0.273	0.341	0.409	0.477	0.545	0.614
1	.682	.750	.818	.886	.995	1.02	1.09	1.16	1.23	1.30
2	1.36	1.43	1.50	1.57	1.64	1.70	1.77	1.84	1.91	1.98
3	2.05	2.11	2.18	2.25	2.32	2.39	2.45	2.52	2.59	2.66
4	2.73	2.80	2.86	2.93	3.00	3.07	3.14	3.20	3.27	3.34
5	3.41	3.48	3.55	3.61	3.68	3.75	3.82	3.89	3.95	4.02
6	4.09	4.16	4.23	4.30	4.36	4.43	4.50	4.57	4.64	4.70
7	4.77	4.84	4.91	4.98	5.05	5.11	5.18	5.25	5.32	5.39
8	5.45	5.52	5.59	5.66	5.73	5.80	5.86	5.93	6.00	6.07
9	6.14	6.20	6.27	6.34	6.41	6.48	6.55	6.61	6.68	6.75

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

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

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

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

1 second-foot for one year (365 days) covers 1 square mile 1.131 feet of 13.572 inches deep.

1 second-foot for one year (365 days) equals 31,536,000 cubic feet.

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

1 second-foot for one year (365 days) equals 724 acre-feet.

1 second-foot for one day covers 1 square mile 0.03719 inch deep.

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

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

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

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

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

1,000,000,000 cubic feet equals 373 second-feet for one 31-day month.

100 California miner's inches equals 18.7 United States gallons per second.

100 California miner's inches for one day equals 4.96 acre-feet.

100 Colorado miner's inches equals 2.60 second-feet.

100 Colorado miner's inches equals 19.5 United States gallons per second.

100 Colorado miner's inches for one day equals 5.17 acre-feet.

100 United States gallons per minute equals 0.223 second-foot.

100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-feet.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1½ horsepower equals about 1 kilowatt.

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

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1915, and ending September 30, 1916. At the first 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 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 a year beginning October 1 is practically all derived from precipitation in that year.

The base data collected at gaging stations (Pl. I, *B*) 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 from a water-stage recorder (Pl. II) that gives a continuous record of the fluctuations. Measurements of discharge are made with a current meter by the general methods 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, and these rating tables, when applied to the gage heights, give the daily 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 comprises 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 channel, 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.

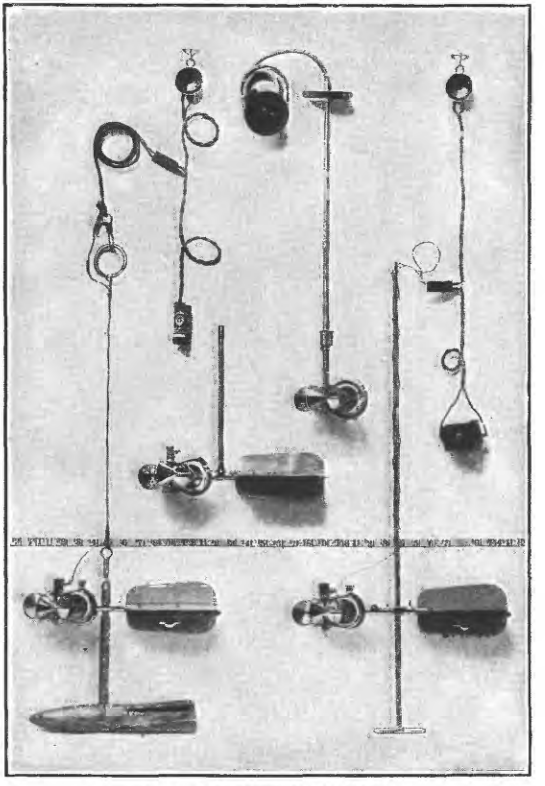
The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging the discharge at regular intervals during the day or by use of 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 for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 6, are based.

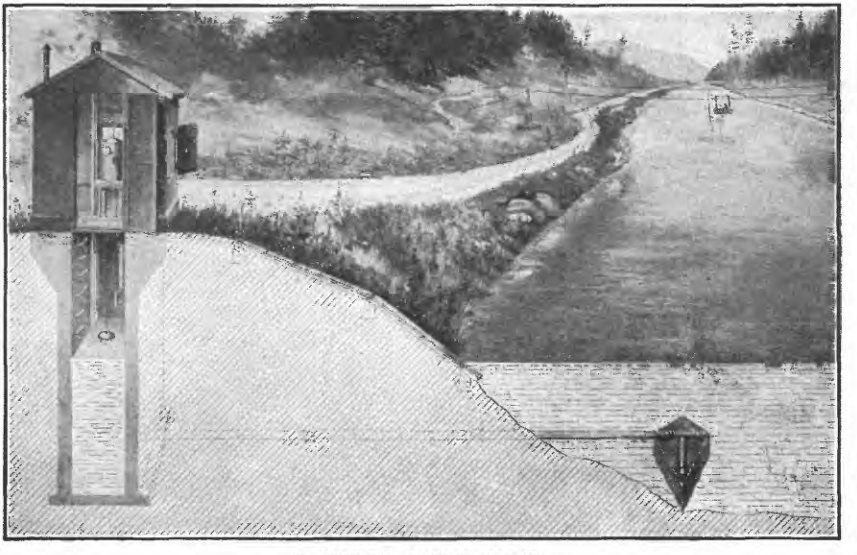
ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

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

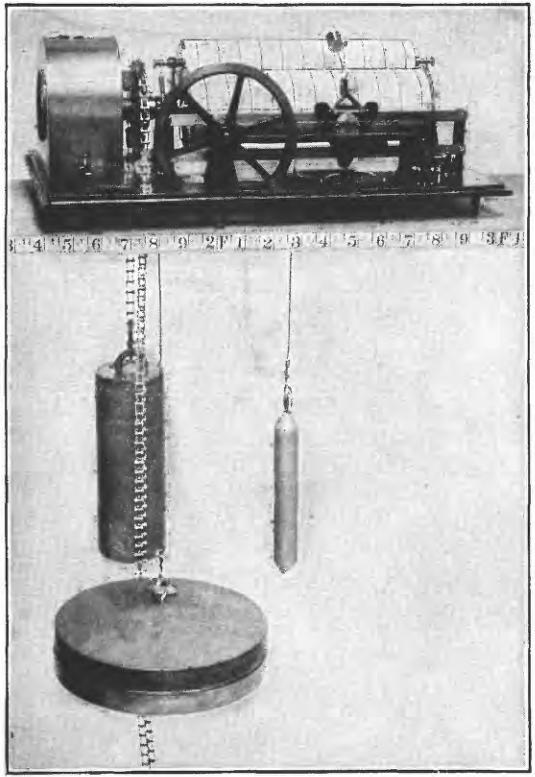
A paragraph in the description of the station or footnotes added to the tables gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating



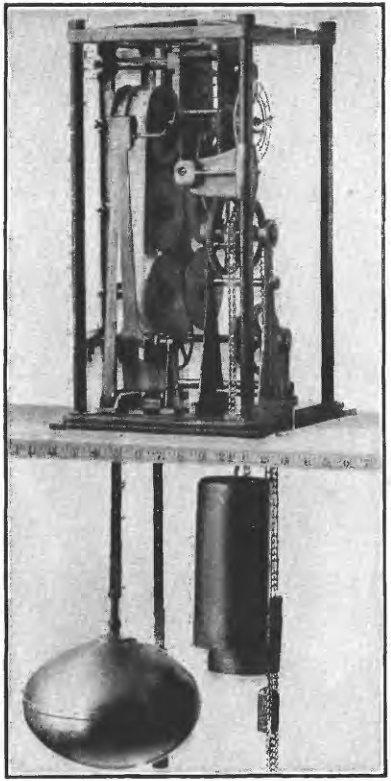
A. PRICE CURRENT METERS.



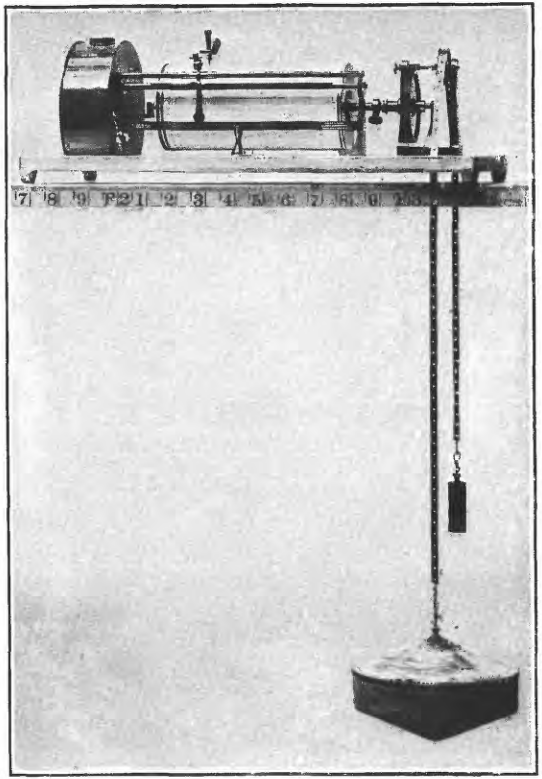
B. TYPICAL GAGING STATION.



A. STEVENS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

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 depth of run-off in inches may be subject to gross errors caused by the inclusion of large non-contributing 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 above the station. "Second-feet per square mile" and "run-off (depth 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 (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

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.

COOPERATION.

The work in Minnesota during the year ending September 30, 1916, was done with State cooperation under terms of an act of the legislature of 1909 as embodied in joint resolution 19, which reads as follows:

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

The work was carried on in conjunction with the State Drainage Commission, E. V. Willard, acting State drainage engineer.

[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.

The work in Wisconsin during the year ending September 30, 1916, was done in cooperation with the Railroad Commission of Wisconsin, C. M. Larson, chief engineer, and at certain stations with the following organizations: Menominee & Marinette Light & Traction Co., Edward Daniell, general manager (Menominee River below Koss, Mich.); United States Army Engineer Corps (Wolf River at New London); United States Indian Office (Wolf River at Keshena, West Branch of Wolf River at Neopit, and Bad River near Odanah).

The gaging station on Escanaba River near Escanaba, Mich., has been maintained in cooperation with the Geological Survey of the State of Michigan.

The station on Manistee River near Sherman, Mich., was maintained in cooperation with William G. Fargo, Jackson, Mich.

Work in the State of New York has been conducted under cooperative agreements with the State engineer and surveyor, and since July 1, 1911, with the division of inland waters of the State Conservation Commission as provided by an act of the State legislature.

Observations of stage on Orwell Brook near Altmar, N. Y., were made by an employee of the Niagara, Lockport & Ontario Power Co., Niagara Falls, N. Y.

The water-stage recorder on Genesee River at Rochester, N. Y., was inspected by an employee of the Rochester Railway & Light Co.

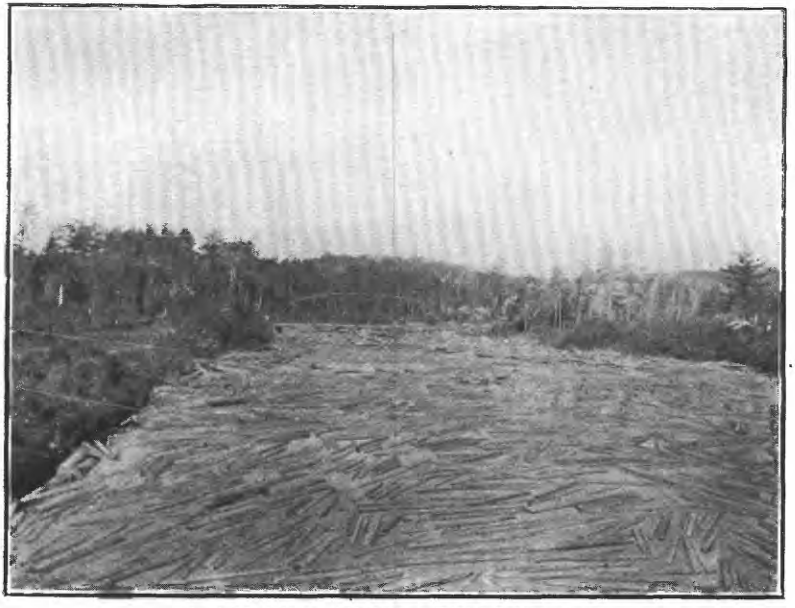
The work in Vermont has been carried on in cooperation with the State of Vermont, Charles W. Gates, governor, and at certain stations in cooperation with the following oganizations and individuals: Vermont Marble Co. (Otter Creek at Middlebury); the department of civil engineering of Norwich University (Dog River at Northfield); Charles T. Middlebrook, consulting engineer, Albany, N. Y. (Green River at Garfield): Newport Electric Light Co. (Clyde River at West Derby).

DIVISION OF WORK.

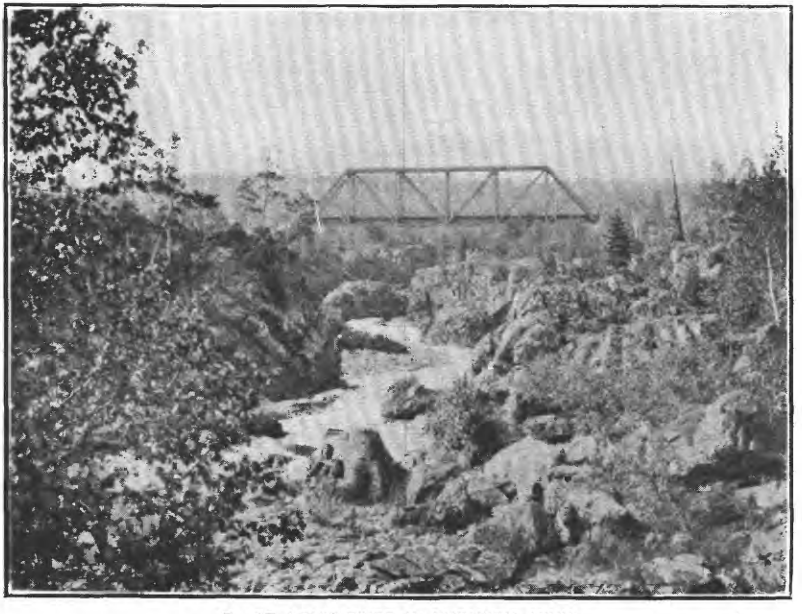
The data for stations in the Lake Superior drainage basin in Minnesota were collected and prepared for publication under the general direction of W. G. Hoyt, district engineer and under the immediate supervision of S. B. Soulé, assisted by E. L. Williams and R. B. Kilgore.

Data for stations in the Lake Superior and Lake Michigan drainage basins in Wisconsin were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by H. C. Beckman, E. L. Williams, and J. O. Entringer.

For stations in the Lake Huron, the Lake Michigan, and the Lake Erie drainage basins in Michigan, data were collected and prepared for publication under the direction of A. H. Horton, district engineer, assisted by B. J. Peterson.



A. LOG JAM ON BIG FORK AT BIG FALLS, MINN.



B. ST. LOUIS RIVER AT THOMSON, MINN.

Data for stations in the St. Lawrence drainage basin in New York were collected and prepared for publication under the direction of C. C. Covert, district engineer, assisted by O. W. Hartwell, E. D. Burchard, A. H. Davison, W. A. James, and Helen Kimmey.

Data for stations in Vermont were collected and prepared for publication under the direction of C. H. Pierce, district engineer, assisted by H. W. Fear, Hardin Thweatt, R. S. Barnes, G. F. Adams, and Hope Hearn.

The manuscript was assembled by B. J. Peterson.

GAGING-STATION RECORDS.

STREAMS TRIBUTARY TO LAKE SUPERIOR.

POPLAR RIVER AT LUTSEN, MINN.

LOCATION.—In sec. 34, T. 60 N., R. 3 W., near the post office of Lutsen, Cook County, about 750 feet above the mouth of the river and the same distance below the State highway bridge.

DRAINAGE AREA.—144 square miles.

RECORDS AVAILABLE.—At present site, August 22, 1912, to September 30, 1916. At former site, about 350 feet downstream from present site, May 6, 1911, to November 4, 1911; gage heights only at the former site.

GAGE.—Vertical staff bolted to rock wall of right bank of stream, in a pool between two distinct falls; read by C. A. A. Nelson. Gage used prior to August 22, 1912, was a vertical staff attached to a stump on right bank about 350 feet below site of present gage and opposite lower point of easterly of the two islands that divide the flow into three channels. No determined relation between the two gages.

DISCHARGE MEASUREMENTS.—Made by wading or from boat, about 500 feet below gage.

CHANNEL AND CONTROL.—Crest of falls below pool in which gage is located constitutes control; channel at this point solid rock; banks not subject to overflow. Point of zero flow, gage height −0.35 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.7 feet at 6 p. m., April 25 (discharge, 1,390 second-feet); minimum stage recorded, 1.02 feet March 7 to 19 (discharge, 25 second-feet).

1912–1916: Maximum stage recorded, April 25, 1916; minimum, 0.80 foot, January 4 and February 8 and 13, 1913 (discharge, 18 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice; open-channel rating curve assumed applicable.

REGULATION.—The flow of the river has in former years been controlled to some extent by two dams above the station, the nearest being that of the National Paper & Pulp Co., 2½ miles above the mouth of the river, but it is believed that the flow for the past two years was entirely natural.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 18 and 1,040 second-feet. Gage read to quarter-tenths twice daily. Discharge ascertained by applying mean daily gage heights to rating table. Results excellent.

Discharge measurements of Poplar River at Lutsen, Minn., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 11	S. B. Soulé	1.89	133	May 16	S. B. Soulé	3.7	742
May 1	E. L. Williams	4.05	966				

Daily discharge, in second-feet, of Poplar River at Lutsen, Minn., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	61	38	75	58	38	29	48	980	228	139	35	34
2	58	36	72	54	38	29	58	800	240	129	34	33
3	61	36	71	54	37	27	65	695	240	114	43	228
4	130	37	70	54	36	27	66	645	240	106	43	325
5	179	37	66	50	36	27	60	600	215	100	37	395
6	159	36	66	50	36	27	54	600	202	100	35	342
7	202	43	71	49	36	26	49	578	179	97	62	215
8	240	310	72	48	36	25	47	578	168	89	70	168
9	215	395	71	48	36	25	54	578	159	83	53	136
10	150	280	70	48	36	25	60	555	148	79	44	106
11	129	395	70	48	36	25	97	490	139	78	38	116
12	113	378	70	48	35	25	106	430	130	72	33	116
13	99	310	70	48	34	25	134	395	143	66	31	146
14	89	252	66	46	34	25	159	342	202	58	28	139
15	80	215	70	46	34	25	202	510	202	71	26	118
16	73	179	70	43	34	25	228	745	190	83	25	108
17	71	143	72	43	34	25	265	695	215	70	25	92
18	72	124	72	43	32	25	342	645	202	65	27	85
19	67	114	72	43	32	25	412	532	179	58	25	73
20	61	106	72	40	32	27	555	430	150	49	25	67
21	59	100	70	40	32	27	860	395	136	47	36	66
22	53	99	70	40	32	27	1,040	378	126	54	190	62
23	49	97	66	46	32	27	1,110	395	190	53	202	60
24	48	93	66	43	32	27	1,110	360	240	47	141	55
25	46	93	62	43	32	28	1,250	325	215	40	110	53
26	44	89	65	43	30	29	1,180	310	190	44	83	49
27	43	86	62	43	30	30	1,110	310	168	48	73	48
28	40	83	62	40	30	30	1,040	280	150	47	62	46
29	40	79	62	40	29	32	1,110	265	150	43	54	42
30	38	75	60	40	.....	35	1,110	240	148	43	46	37
31	38	.....	60	39	.....	37	.....	215	.....	39	40	.....

Monthly discharge of Poplar River at Lutsen, Minn., for the year ending Sept. 30, 1916.

[Drainage area, 144 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	240	38	90.5	0.628	0.72
November	395	36	145	1.01	1.13
December	75	60	68.2	.474	.55
January	58	39	45.7	.317	.37
February	38	29	33.8	.235	.25
March	37	25	27.4	.190	.22
April	1,250	47	466	3.24	3.62
May	980	215	493	3.42	3.94
June	240	130	183	1.27	1.42
July	139	39	71.3	.495	.57
August	202	25	57.3	.398	.46
September	395	33	119	.826	.92
The year	1,250	25	150	1.04	14.17

WHITEFACE RIVER BELOW MEADOWLANDS, MINN.

LOCATION.—In sec. 26, T. 53 N., R. 19 W., in St. Louis County, about half a mile below the beginning of a decided rapids, 1½ miles below the Duluth, Missabe & Northern Railway bridge; 2½ miles below the highway bridge on line between secs. 14 and 23, T. 53 N., R. 19 W., at which station on Whiteface at Meadowlands was located; 4 miles below mouth of the Little Whiteface, which enters from the left, and 8 miles above confluence of Whiteface and St. Louis rivers.

DRAINAGE AREA.—446 square miles.

RECORDS AVAILABLE.—April 28, 1912, to September 30, 1916. Records June 7, 1909, to November 9, 1912, collected at the station at Meadowlands, 2½ miles upstream.

GAGE.—Chain gage attached to a horizontal timber fastened to two trees on left bank of river, near the residence of A. A. Jochim, used for all readings since November 8, 1914; read by A. A. Jochim; a chain gage attached to a horizontal timber fastened to two trees on the same bank, but 300 feet upstream from the present gage, was used from April 28, 1912, to November 7, 1914. Present gage was set so as to read the same as the former one at a stage of 2.85 feet.

DISCHARGE MEASUREMENTS.—Made from the Duluth, Missabe & Northern Railway bridge or by wading in the vicinity of the gage.

CHANNEL AND CONTROL.—Bed of stream consists of heavy gravel and rock; practically permanent. Right bank is rather low and is overflowed at extremely high stages; left bank high and not subject to overflow. A decided rapids a short distance below the gage constitute the control. Another rapid, above the gage, is frequently obstructed by logs, but when there is sufficient water to carry them over this rapid they are generally carried also over the lower rapids, so that the control is seldom obstructed.

EXTREMES OF DISCHARGE.—1909–1916: Maximum stage recorded, 12.0 feet April 21, 1916 (discharge, 5,880 second-feet); minimum stage recorded, 1.6 feet at 8.20 a. m. August 31, 1916 (discharge 15 second-feet). Open water periods only; minimum flow is probably much lower at times during the winter.

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

REGULATION.—Flow controlled to a large extent by logging dams above station. Operation of gates to these dams causes a fluctuation in stage of several feet at the gaging station.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 92 and 3,580 second-feet. Gage read to quarter-tenths twice daily. Discharge ascertained by applying mean daily gage heights to rating table. Mean daily gage heights, as determined from two readings daily, are subject to some error on account of rather rapid fluctuations in stage occasioned by regulation of the flow in the interests of log driving; results which would otherwise be excellent are on this account only fair or good.

Discharge measurements of Whiteface River below Meadowlands, Minn., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	S. B. Soulé	4.39	757	Apr. 29	E. L. Williams	8.33	3,110
14	do	4.38	747	May 14	S. B. Soulé	5.60	1,470
Nov. 11	do	4.92	973	Aug. 29	do	2.57	103

Daily discharge, in second-feet, of Whiteface River below Meadowlands, Minn., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	183	210	320	.....	2,950	520	2,620	78	66
2	183	196	.....	.....	2,380	476	2,260	78	66
3	210	183	.....	.....	2,080	434	1,660	78	72
4	394	170	.....	.....	2,020	434	2,020	78	56
5	710	183	.....	.....	1,900	394	1,480	78	56
6	860	146	.....	.....	1,660	356	1,060	85	66
7	1,060	146	.....	.....	1,420	338	810	78	100
8	1,120	286	.....	.....	1,660	320	566	78	170
9	1,120	710	.....	.....	1,300	320	476	66	196
10	1,060	810	.....	.....	760	303	338	72	196
11	1,010	1,010	.....	.....	910	286	356	78	210
12	960	1,120	.....	1,840	960	270	338	72	224
13	860	1,060	.....	2,320	1,780	270	394	61	224
14	760	960	.....	2,500	1,360	356	394	66	224
15	660	910	.....	2,740	1,060	476	356	56	286
16	612	810	.....	3,230	1,120	566	286	47	303
17	566	710	.....	3,370	1,060	434	239	52	303
18	566	660	.....	4,070	1,060	286	210	52	254
19	566	476	.....	4,520	1,060	710	196	52	239
20	566	476	.....	5,160	960	1,240	158	47	224
21	476	434	.....	5,880	860	760	136	66	224
22	476	394	.....	5,320	960	520	117	85	170
23	394	394	.....	4,760	1,010	760	108	100	158
24	394	356	.....	5,400	960	1,420	100	117	170
25	356	320	.....	5,080	910	1,780	85	136	183
26	320	356	.....	4,760	810	2,200	100	136	183
27	286	394	.....	4,140	760	2,260	108	126	170
28	270	394	.....	3,300	760	2,140	100	108	146
29	270	394	.....	3,160	660	2,740	100	108	126
30	239	356	.....	3,300	660	2,880	92	117	117
31	239	.....	.....	.....	566	.....	92	35	.....

Monthly discharge of Whiteface River below Meadowlands, Minn., for the year ending Sept. 30, 1916.

[Drainage area, 446 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,120	183	572	1.28	1.48
November	1,120	146	501	1.12	1.25
April 12-30	5,880	1,840	3,940	8.83	6.24
May	2,950	566	1,240	2.78	3.20
June	2,880	270	875	1.96	2.19
July	2,620	85	560	1.26	1.45
August	136	35	80	.179	.21
September	303	56	173	.388	.43

CLOQUET RIVER AT INDEPENDENCE, MINN.

LOCATION.—In sec. 26, T. 52 N., R. 17 W., at the highway bridge at Independence, St. Louis County, just below a small tributary entering from the right.

DRAINAGE AREA.—698 square miles.

RECORDS AVAILABLE.—June 28, 1909, to September 30, 1916.

GAGE.—Chain gage attached to upstream handrail of bridge, near left bank of stream; read by Theodore Haakensen. Gage used prior to October 13, 1915, was a vertical staff attached to upstream end of an old log bulkhead, immediately under the bridge, and at the left bank.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading about one-fourth mile below gage.

CHANNEL AND CONTROL.—Heavy gravel and rock; practically permanent. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.3 feet April 30 (discharge, 5,260 second-feet); minimum open-water stage recorded, 4.1 feet November 6, 1915 (discharge, 80 second-feet). The Great Northern Power Co. reported there was no discharge from Fish Lake and Island Lake reservoirs April 6–20 and December 1, 1915; discharge at Independence estimated at 10 second-feet.

1909–1916: Maximum stage recorded, 9.58 feet June 1, 1911 (discharge, 6,010 second-feet); minimum stage recorded, 3.90 feet, July 20, 21, and 22, 1911 (discharge 54 second-feet). See also preceding paragraph.

ICE.—Stage-discharge relation seriously affected by ice; observations discontinued during the winter. Since January, 1913, the determination of monthly mean discharge during winter periods has been based on the discharge at the outlet of Fish Lake reservoir on Cloquet River, in sec. 15, T. 52 N., R. 15 W., and from Island Lake reservoir on Beaver River, in sec. 29, T. 52 N., R. 15 W.

REGULATION.—Cloquet River is used extensively for log driving, and the run-off from by far the greater part of the drainage area above Independence is controlled by logging dams. The operation of these dams causes rapid fluctuations in stage, which may amount to several feet in 24 hours.

ACCURACY.—Stage-discharge relation permanent except as affected by ice. Rating curve well defined between 128 and 4,690 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Mean daily gage height as determined from two readings daily subject to considerable error on account of rapid fluctuation in stage due to operation of logging dams; results are therefore subject to error.

COOPERATION.—Records of flow from logging reservoirs November 28, 1915 to April 2, 1916, furnished by Great Northern Power Co., of Duluth.

Discharge measurements of Cloquet River at Independence, Minn., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Oct. 13	S. B. Soulé	4.87	248	May 13	S. B. Soulé	7.00	1,850
Nov. 10	do	4.67	171	Aug. 28	do	4.42	130
Apr. 28	E. L. Williams	8.93	4,570				

Daily discharge, in second-feet, of Cloquet River at Independence, Minn., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	272	86	10	193	366	357	350	3,650	1,400	2,910	139	254
2	272	93	33	195	440	358	350	3,650	1,600	3,050	150	422
3	272	93	116	180	507	359	352	3,810	1,600	2,910	150	472
4	254	93	111	120	534	364	331	3,810	1,300	2,400	150	584
5	254	93	65	160	489	382	352	3,340	1,600	1,930	961	3,650
6	254	80	65	244	437	383	221	3,190	1,710	1,820	4,510	2,400
7	237	101	65	302	440	384	139	3,050	1,600	1,820	1,400	3,810
8	205	176	65	364	437	394	109	2,650	1,040	1,600	1,500	2,160
9	205	254	65	385	435	432	101	2,520	1,040	1,600	1,400	742
10	205	205	65	411	455	457	101	2,520	1,400	885	1,500	498
11	150	272	65	435	485	488	139	2,400	1,210	352	1,400	446
12	1,120	310	64	432	467	436	254	2,040	526	526	1,300	554
13	310	310	89	434	435		310	1,820	676	2,160	961	237
14	310	291	165	436	433		446	1,820	848	3,340	584	176
15	3,190	237	203	434	435		498	1,930	886	1,500	526	176
16	310	221	321	434	426		613	2,040	961	310	397	176
17	2,280	176	317	406	386		812	2,040	961	237	310	221
18	644	128	326	473	384		848	2,160	885	190	1,600	176
19	310	128	291	558	343		848	2,280	885	190	709	150
20	310	128	272	558	300		1,210	2,160	1,040	163	446	150
21	310	128	201	555	301	370	1,120	1,930	1,210	139	5,070	150
22	310	128	156	555	300		1,040	2,280	1,040	150	3,490	139
23	310	128	91	556	328		1,040	2,280	1,040	2,280	498	128
24	310	128	97	477	356		2,910	2,780	1,210	2,780	237	139
25	310	128	103	421	360		3,050	2,520	1,600	3,980	163	128
26	310	128	103	388	362		3,340	2,520	2,160	1,120	128	272
27	221	163	133	390	360		3,810	2,280	2,400	1,600	128	554
28	109	128	193	370	357		4,510	1,600	2,650	2,040	118	422
29	109	128	193	315	357		4,690	1,300	2,650	1,040	118	526
30	101	128	193	260	.....		5,260	1,400	2,910	472	128	554
31	93	.....	193	259	.....		.....	1,500	.....	139	150	.....

NOTE.—Stage-discharge relation affected by ice Nov. 28, to Apr. 2; gage readings discontinued; discharge estimated from records of discharge from Fish Lake and Island Lake reservoirs.

Monthly discharge of Cloquet River at Independence, Minn., for the year ending Sept. 30, 1916.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,190	93	447	0.640	0.74
November	310	80	160	.229	.26
December	326	10	143	.205	.24
January	558	160	377	.540	.62
February	534	300	404	.579	.62
March	488	357	381	.546	.63
April	5,260	101	1,310	1.88	2.10
May	3,810	1,300	2,430	3.48	4.01
June	2,910	526	1,400	2.01	2.24
July	3,980	139	1,470	2.11	2.43
August	5,070	118	978	1.40	1.61
September	3,650	128	682	.977	1.09
The year	5,260	10	850	1.22	16.59

AMINICON RIVER NEAR AMINICON FALLS, WIS.

LOCATION.—In sec. 29, T. 48 N., R. 12 W., at highway bridge about 500 feet above the Northern Pacific Railway bridge, three-fourths mile east of the settlement of Aminicon Falls, Douglas County, and 7 miles above mouth of river.

DRAINAGE AREA.—102 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—March 17, 1914, to July 8, 1916, when station was discontinued.

GAGE.—Chain gage fastened to upstream side of highway bridge; read by T. J. St. Onge.

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

CHANNEL AND CONTROL.—Heavy gravel and small rock; water confined to one channel at all stages. Stage zero flow approximately 0.20 foot on gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period October 1, 1915, to July 8, 1916, 5.0 feet April 21 (discharge, about 1,650 second-feet); minimum stage recorded, 0.7 foot March 16, 17, 20, and 21 (discharge 15 second-feet).

1914–1916: Maximum stage recorded April 21, 1916; minimum stage, 0.3 foot September 7, 1915 (discharge, about 1 second-foot).

ICE.—Stage-discharge relation seriously affected by ice; gage not read during winter period.

ACCURACY.—Stage-discharge relation permanent, except in winter. Rating curve well defined between 10 and 550 second-feet; extension of curve above 550 second-feet may be subject to error. Gage read once daily to quarter-tenths. Discharge ascertained by applying daily gage heights to rating table. Results good for open water, except during flood stages, for which they are subject to error. No discharge measurements were made at this station during the year.

Daily discharge, in second-feet, of Aminicon River near Aminicon Falls, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.
1	67	60	205	.....	775	422	157	205
2	107	54	205	.....	990	390	136	205
3	157	48	233	.....	775	358	116	180
4	146	42	233	.....	620	310	116	180
5	157	37	205	.....	550	264	107	136
6	157	32	205	.....	550	219	98	136
7	180	23	192	.....	422	205	82	116
8	192	233	180	.....	422	180	82	98
9	295	219	180	.....	620	180	67	.....
10	295	219	192	.....	775	157	67	.....
11	342	585	192	.....	690	136	54	.....
12	390	550	205	.....	730	116	42	.....
13	374	422	248	.....	775	98	67	.....
14	358	342	264	.....	730	136	98	.....
15	326	295	264	.....	690	205	136	.....
16	295	280	280	15	775	233	264	.....
17	264	264	280	15	825	326	233	.....
18	233	264	180	19	775	326	205	.....
19	205	233	116	19	775	358	180	.....
20	192	180	98	15	1,110	390	157	.....
21	180	168	90	15	1,650	422	146	.....
22	168	157	67	23	1,440	454	136	.....
23	157	157	67	32	1,170	422	180	.....
24	157	146	60	32	990	358	205	.....
25	136	136	54	32	825	358	264	.....
26	116	126	60	42	690	295	326	.....
27	98	126	54	157	550	295	326	.....
28	90	146	.....	264	518	264	295	.....
29	82	180	.....	422	518	233	264	.....
30	74	205	.....	550	454	205	233	.....
31	67	.....	.....	550	.....	180	.....	.....

NOTE.—Stage-discharge relation affected by ice Dec. 28 to Mar. 15; gage not read.

Monthly discharge of Aminicon River near Aminicon Falls, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 102 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	390	67	195	1.91	2.20
November	585	23	198	1.94	2.16
December 1–27	280	54	171	1.67	1.68
March 16–31	550	15	138	1.35	.80
April	1,650	422	773	7.57	8.45
May	454	98	274	2.69	3.10
June	326	42	161	1.58	1.76
July 1–8	205	98	157	1.54	.46

BRULE RIVER NEAR BRULE, WIS.

LOCATION.—In about sec. 26 T. 48 N., R. 10 W., about 4½ miles downstream from Brule, Douglas County, and 9 miles above mouth of river.

DRAINAGE AREA.—162 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, 1916.

GAGE.—Vertical staff; low-water section, reading from 0 to 7.9 feet, fastened to downstream side of Brule Outing Club boat landing; high-water section, reading from 8 to 9.9 feet, fastened to tree on shore end of landing; read during different periods by H. A. Wilcox, Charles Leppanen, and Otto Keinanen.

DISCHARGE MEASUREMENTS.—Made about 200 feet below gage from a boat held in place by a wire across the river or by wading.

CHANNEL AND CONTROL.—Channel gravel; control formed by head of rapids below gage; river occupies one channel at all stages; banks wooded and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.2 feet at 7.20 a. m. April 21 (discharge 1,490 second-feet); minimum discharge January 18 to 24 (discharge estimated at 125 second-feet).

1914–1916: Maximum stage recorded, 6.2 feet April 21, 1916; minimum stage recorded, 2.75 feet at 7 a. m., March 20, 1914 (discharge 115 second-feet).

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

REGULATION.—None except by natural storage in Lakes Minnesuing and Nebagamin.

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 145 and 1,370 second-feet. Gage read once daily, to quarter-tenths. Discharge ascertained by applying daily gage heights to rating table, except for periods in which stage-discharge relation was affected by ice, for which periods it was ascertained from discharge measurements, observer's notes, and weather records. Open-water records good; records for winter period fair.

Discharge measurements of Brule River near Brule, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec-ft.*
Jan. 3[a]	E. L. Williams	5.10	183	Apr. 22	S. B. Soulé	5.61	1,160
31	do	4.38	160	Aug. 26	E. L. Williams	2.98	172
Mar. 7[b]	do	4.54	160				

[a] Complete ice cover. [b] Incomplete ice cover.

Daily discharge, in second-feet, of Brule River near Brule, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	182	195	220	195	158	158	235	510	310	440	158	158
2	182	195	220	195	158	158	280	475	280	388	158	158
3	195	195	220	183	160	158	295	440	280	340	165	158
4	340	195	220	182	160	158	295	405	280	325	165	220
5	310	195	208	170	160	158	325	388	265	310	165	208
6	280	182	208	170	160	160	280	370	220	280	158	220
7	388	195	195	170	160	162	295	340	235	265	208	220
8	370	405	195	170	160	164	280	340	325	250	170	208
9	355	280	182	158	160	167	325	310	310	235	170	208
10	340	280	182	158	160	170	370	310	280	220	170	195
11	340	615	195	145	158	170	615	295	265	220	170	195
12	325	440	170	145	164	170	820	280	250	208	170	220
13	310	370	170	145	170	174	775	265	265	195	165	220
14	295	340	170	145	170	178	820	265	310	195	170	220
15	280	310	172	145	170	182	960	355	310	208	165	208
16	265	310	172	135	170	188	1,010	388	370	195	165	195
17	250	280	174	135	170	195	960	370	325	195	170	195
18	280	280	174	125	170	198	865	340	295	182	208	195
19	280	280	176	125	170	201	775	340	280	182	170	182
20	265	280	176	125	170	204	1,160	310	250	170	165	182
21	250	265	182	125	170	208	1,490	295	235	170	195	170
22	250	265	195	125	170	208	1,160	405	265	170	195	195
23	23[illegible]	250	195	125	170	202	1,260	475	650	170	170	195
24	220	235	208	125	164	195	1,010	388	440	170	170	195
25	220	235	208	135	158	195	820	370	340	165	170	182
26	208	250	220	145	158	182	775	580	355	170	165	182
27	208	250	220	170	158	182	690	440	325	182	165	182
28	208	235	220	170	158	182	615	405	295	170	158	182
29	195	220	220	170	158	195	235	370	580	170	158	170
30	195	220	208	170	.....	208	545	340	580	165	150	170
31	195	.....	208	160	.....	220	.....	325	.....	165	150	.....

NOTE.—Stage-discharge relation affected by ice Nov. 21 to Mar. 25.

Monthly discharge of Brule River near Brule, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 162 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	388	182	265	1.64	1.89
November	615	182	275	1.70	1.90
December	220	170	196	1.21	1.40
January	195	125	153	.944	1.09
February	170	158	164	1.01	1.09
March	220	158	182	1.12	1.29
April	1,490	235	678	4.19	4.68
May	580	265	371	2.29	2.64
June	650	220	326	2.01	2.24
July	440	165	222	1.37	1.58
August	208	150	169	1.04	1.20
September	220	158	193	1.19	1.33
The year	1,490	125	266	1.64	22.33

BAD RIVER NEAR ODANAH, WIS.

LOCATION.—In sec. 25, T. 47 N., R. 3 W., about 8 miles upstream from Odanah, Ashland County, 12 miles above mouth of river. Potato River enters from right about 8 miles above station.

DRAINAGE AREA.—607 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—July 31, 1914, to September 30, 1916.

GAGE.—Stevens continuous water-stage recorder installed March 31, 1915, over a wooden well, just above the first falls above the mouth of the river. A Gurley water-stage recorder at same site was used from July 31, 1914, to March 31, 1915.

DISCHARGE MEASUREMENTS.—Made from cable about 700 feet upstream from gage.

CHANNEL AND CONTROL.—Channel is in sand and gravel. Rock outcrops at beginning of rapids about 200 feet below gage form a permanent control. During log-driving period logs may collect on the outcrop and cause backwater at the gage. Right bank high and not subject to overflow; left bank of medium height and may be overflowed by extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.66 feet at 1 a. m. April 22 (discharge, 12,200 second-feet); minimum stage, 0.90 foot, September 1 to 3 (discharge, 120 second-feet).

1914–1916: Maximum stage recorded April 22, 1916; minimum discharge 105 second-feet estimated for period January 21 to February 10, 1915.

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

REGULATION.—The operation of a number of small reservoirs during the early spring and summer as an aid to log driving may cause rapid fluctuations in stage.

ACCURACY.—Stage-discharge relation fairly permanent except when affected by ice. Rating curve well defined between 80 and 7,270 second-feet; above 7,270 second-feet the curve was extended and may be subject to considerable error. Recording gage gave only fair satisfaction throughout the year. Discharge ascertained by applying to rating table the mean daily gage heights as obtained by planimeter from recording-gage record, except for the periods when gage was not in operation, and the period when stage-discharge relation was affected by ice, for which flow was determined from discharge measurements and comparison with records of flow for streams in adjacent drainage basins. See footnote to table of daily discharge. Open-water records good except for extremely high stages and periods for which records are estimated, for which they are fair. Winter records roughly approximate.

Discharge measurements of Bad River near Odanah, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 4[a]	E. L. Williams	1.50	212	Apr. 17	H. C. Beckman	4.88	6,170
Mar. 29[a]	W. G. Hoyt	2.80	479	Aug. 25[b]	E. L. Williams	1.12	106
Apr. 16	H. C. Beckman	4.59	5,580	Sept. 15	....do	1.74	677

[a] Incomplete ice cover at control.
[b] Results subject to error because of extremely low velocity at measuring section.

Daily discharge, in second-feet, of Bad River near Odanah, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	335	260	400				1,740	2,280	500	1,980	139	120
2	329	260	414				2,520	1,980	442	1,500	134	120
3	275	275	348				2,770	1,640	515	1,160	129	120
4		241	374				2,200	1,440	530	838	125	172
5		253	335				2,060	1,240	538	668	120	354
6		253	335				1,840	1,110	449	449	144	905
7		374	335				1,700	1,040	428	470	167	1,030
8	1,100	1,100	323				1,570	945	470	299	335	1,120
9		782	387				1,700	782	593	287	253	886
10		791	435				2,360	719	810	264	198	719
11		1,500	387				3,730	773	569	329	193	553
12		1,280	421				4,800	848	414	323	214	463
13		870	485				5,200	650	435	311	198	532
14	1,300	870					4,540	515	609	299	188	600
15	1,140	870					4,540	782	485	287	177	668
16	1,160	870		230	220	250	5,200	1,430	782	275	167	601
17	975	500					6,340	1,510	1,210	264	158	515
18	838	530					6,190	1,160	1,310	253	148	442
19	773	538					5,340	1,200	764	241	198	394
20	755	828					7,120	791	609	230	323	348
21	538	659					10,600	719	545	219	323	311
22	435	485	310				11,300	876	642	209	421	387
23	428	545					7,910	676	2,600	198	380	545
24	305	577					5,060	650	2,700	188	317	593
25	335	693					3,520	609	1,650	177	241	530
26		693					3,220	857	1,420	167	269	449
27		323					2,770	1,190	1,230	162	209	421
28	250	300					2,440	857	1,100	158	172	380
29		300					2,200	728	1,580	153	148	380
30		300					2,360	650	2,720	148	129	355
31		.....					.....	569	.....	144	125	.....

NOTE.—Gage not in operation Oct. 4–13, Oct. 26 to Nov. 2, Nov. 13–16, and Nov. 28 to Dec. 1; discharge estimated from records of flow for streams in adjacent drainage basins. Stage-discharge relation affected by ice Dec. 14 to Mar. 31. Discharge interpolated Sept. 13 and 14.

Monthly discharge of Bad River near Odanah, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 607 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	.....	.....	723	1.19	1.37
November	.....	.....	604	.995	1.11
December	.....	.....	341	.562	.65
January	.....	.....	230	.379	.44
February	.....	.....	220	.362	.39
March	.....	.....	250	.412	.48
April	11,300	1,570	4,160	6.85	7.64
May	2,280	515	1,010	1.66	1.91
June	2,720	414	955	1.57	1.75
July	1,980	144	408	.672	.77
August	421	120	208	.343	.40
September	1,120	120	500	.824	.92
The year	11,300	120	796	1.31	17.83

STREAMS TRIBUTARY TO LAKE MICHIGAN.

ESCANABA RIVER NEAR ESCANABA, MICH.

LOCATION.—At quarter-section corner between secs. 24 and 25, T. 40 N., R. 23 W., at highway bridge between Escanaba and Gladstone, about 9 miles north of Escanaba and 4 miles above mouth of river.

DRAINAGE AREA.—800 square miles.

RECORDS AVAILABLE.—August 25, 1903, to March 31, 1909; June 1, 1909, to November 6, 1915, when station was discontinued. April, May, and July, 1903, discharge measurements only.

GAGE.—Standard chain gage attached to bridge; read daily, in the morning, to tenths. Gage reader, Regis Beauchamp.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Probably permanent.

ICE.—Stage-discharge relation affected by ice, which sometimes remains for nearly four months.

ACCURACY.—The station has not been visited since July 16, 1908, and gage heights as given in the following table may therefore be in error because of elongation of the gage chain or changes in the position of the gage.

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

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for the period Oct. 1 to Nov. 6, 1915.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	3.0	4.6	11	3.0	.....	21	3.7	.....
2	3.0	4.8	12	3.1	.....	22	3.7	.....
3	3.1	5.1	13	3.1	.....	23	3.7	.....
4	3.1	5.2	14	3.4	.....	24	3.8	.....
5	3.1	5.5	15	3.5	.....	25	3.8	.....
6	3.1	6.0	16	3.7	.....	26	3.9	.....
7	3.1	.....	17	3.7	.....	27	3.9	.....
8	3.0	.....	18	3.7	.....	28	3.9	.....
9	3.0	.....	19	3.8	.....	29	3.9	.....
10	3.0	.....	20	3.8	.....	30	3.9	.....
						31	4.0	.....

MENOMINEE RIVER BELOW KOSS, MICH.

LOCATION.—In sec. 5, T. 33 N., R. 23 E., Marinette County, Wis., at "Grand Rapids," about 4 miles below Koss, Mich., and 3 miles west of Ingalls, Mich. Little Cedar River, draining an area entirely in Michigan, enters from the left about half a mile below the station.

DRAINAGE AREA.—3,790 square miles.

RECORDS AVAILABLE.—July 1, 1913, to September 30, 1916.

DISCHARGE.—The flow is computed by the Menominee & Marinette Light & Traction Co., of Menominee, Mich., as follows: Each hour the load on the generators is noted and gage heights are read of the head and tail water to determine the head on the spillway of the dam and the acting head on the turbines. The flow through the turbines for each hour is taken from a table giving the discharge corresponding to load and head. The flow over the spillway is taken from a table computed from a weir formula. When water is wasted through the gates the magnitude and duration of the gate openings are noted and the quantity wasted is determined from computed tables. The sum of the hourly flow through the turbines and over the spillway, plus the quantity wasted through the gates, divided by the number of seconds in 24 hours, gives the average discharge in second-feet for the day. No account is taken of the water passing through the exciter turbine nor waste over the "trash gate" at the power house. This amount is, however, relatively small.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 23,200 second-feet April 23 and 25, minimum daily discharge, 1,390 second-feet August 29.

1913–1916: Maximum daily discharge April 23 and 25, 1916; minimum daily discharge, 1,000 second-feet, June 14, 1914.

ACCURACY.—No measurements have been made by the Survey engineers at this plant, but measurements made at Koss, Mich., in 1914 compare closely with the discharge as determined at the power house.

COOPERATION.—Daily-discharge records furnished monthly by Edward Daniell, general manager of the Menominee & Marinette Light & Traction Co.

Daily discharge, in second-feet, of Menominee River below Koss, Mich., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,610	3,290	5,830	2,770	2,230	1,970	3,870	15,600	5,320	8,530	2,880	1,890
2	3,210	2,890	4,760	2,890	2,040	1,800	4,430	14,500	6,120	9,270	2,360	1,980
3	3,000	2,940	3,750	2,790	1,940	1,720	5,050	13,400	8,830	9,400	2,330	1,990
4	2,840	3,160	3,960	2,740	1,890	1,780	6,370	12,800	13,100	8,590	2,330	1,570
5	2,990	3,040	4,350	2,730	1,890	1,850	7,180	12,000	16,900	7,140	2,760	1,960
6	2,900	2,840	3,690	2,270	2,000	1,570	7,430	11,300	19,000	6,030	2,860	2,180
7	2,950	2,930	3,390	1,980	1,960	1,690	7,490	10,100	19,300	5,000	3,030	4,550
8	3,560	3,240	3,340	2,060	1,920	1,880	7,740	9,040	16,400	4,440	2,350	5,270
9	3,480	3,410	3,780	1,890	1,880	1,690	7,500	7,630	14,000	4,180	3,640	7,140
10	3,180	3,880	3,290	2,110	1,670	1,620	7,010	8,820	14,900	3,700	4,410	7,670
11	2,900	4,380	3,090	2,210	1,710	1,620	7,920	7,930	15,800	5,610	3,520	7,810
12	3,060	5,970	2,930	2,100	1,750	1,720	10,800	9,210	14,100	4,910	3,600	6,800
13	3,330	7,660	2,970	2,040	1,710	1,640	13,200	8,220	11,600	3,400	3,380	6,020
14	3,600	9,120	2,790	1,780	1,930	1,760	14,500	7,990	10,400	3,450	3,020	5,790
15	4,820	9,190	2,730	1,830	1,850	1,910	14,200	8,290	10,100	3,320	3,460	5,950
16	5,300	8,520	2,750	1,820	1,990	1,880	14,700	8,400	9,990	3,000	2,620	5,560
17	5,090	6,920	2,790	1,740	2,010	1,770	15,000	9,110	10,300	2,280	2,540	5,050
18	4,470	5,660	2,930	1,770	1,900	1,750	15,700	8,740	10,500	3,140	2,540	5,060
19	5,100	5,880	3,120	1,820	2,010	1,860	16,000	8,630	10,500	3,100	2,820	4,210
20	6,010	6,240	3,030	1,840	2,080	1,690	16,300	8,430	10,500	2,780	2,870	3,780
21	7,350	5,840	2,920	1,860	1,910	1,780	18,200	8,310	9,510	3,060	2,650	3,890
22	7,540	4,910	2,710	2,130	2,000	1,900	20,700	7,400	8,550	2,300	2,820	3,800
23	6,860	4,620	2,870	2,370	2,040	1,790	23,200	6,930	7,990	2,640	2,740	3,870
24	6,200	4,200	2,950	2,280	1,990	1,720	22,500	5,080	6,850	2,720	2,730	3,640
25	4,990	4,260	3,060	2,300	1,970	1,780	23,200	5,310	7,130	2,350	2,460	4,110
26	4,430	4,900	3,080	2,300	2,050	2,000	22,900	4,740	7,680	2,570	2,070	3,660
27	4,390	5,070	3,090	2,260	2,050	1,890	20,500	5,810	7,510	2,940	1,940	3,940
28	3,960	5,730	2,790	2,200	1,780	1,960	18,800	6,200	7,010	3,340	1,990	5,540
29	3,670	6,900	2,410	2,140	1,910	2,320	19,400	6,740	6,680	3,750	1,390	6,490
30	3,340	6,780	2,760	2,220	.....	2,730	17,700	6,990	6,760	3,480	2,060	7,070
31	3,390	.....	2,630	2,280	.....	3,380	.....	4,840	.....	3,340	1,890	.....

Monthly discharge of Menominee River below Koss, Mich., for the year ending Sept. 30, 1916.

[Drainage area, 3,790 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	7,540	2,840	4,240	1.12	1.29
November	9,190	2,840	5,150	1.36	1.52
December	5,830	2,410	3,240	.855	.99
January	2,890	1,740	2,180	.575	.66
February	2,230	1,670	1,930	.509	.55
March	3,380	1,570	1,880	.496	.57
April	23,200	3,870	13,600	3.59	4.00
May	15,600	4,740	8,660	2.28	2.63
June	19,300	5,320	10,800	2.85	3.18
July	9,400	2,280	4,310	1.14	1.31
August	4,410	1,390	2,710	.715	.82
September	7,810	1,570	4,610	1.22	1.36
The year	23,200	1,390	5,260	1.39	18.88

NOTE.—Computed by engineers of the United States Geological Survey from records of daily flow furnished by the Menominee & Marinette Light & Traction Co.

BRULE (MENOMINEE) RIVER NEAR FLORENCE, WIS.

LOCATION.—In sec. 10, T. 40 N., R. 18 E., at highway bridge near Washburn Farm, 3½ miles north of Florence, Florence County, 1 mile above mouth of Paint Creek, and 6 miles above mouth of Michigamme River, both of which enter from the left.

DRAINAGE AREA.—344 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 24, 1914, to February 20, 1916, when station was discontinued.

GAGE.—Chain gage fastened to upstream side of highway bridge; read by R. N. Washburn.

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

CHANNEL AND CONTROL.—Firm gravel; smooth. Left bank high; right bank of medium height and may be overflowed during extremely high stages.

EXTREMES OF DISCHARGE.—1914–1916: Maximum stage recorded, 4.6 feet at 1 p. m. May 1 and 3, 1914 (discharge, 1,730 second-feet); minimum discharge recorded by current-meter measurement made February 4, 1915, (discharge, 185 second-feet).

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

REGULATION.—Logging dams above the gage are so operated that during the spring large volumes of water are released to facilitate log driving; the flow during such periods fluctuates rapidly; flow during remainder of the year probably natural. The natural flow may be increased somewhat throughout the year by discharge from mine pumpage.

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 262 and 968 second-feet; gage read once daily, to quarter-tenths. Discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained from discharge measurements, observer's notes, and weather records. Owing to uncertainty in accuracy of gage readings, and diurnal fluctuation, open-water records only fair; winter records roughly approximate.

Discharge measurements of Brule River near Florence, Wis., during the year ending Sept. 30, 1916.

Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 6	2.27	350	Feb. 5[b]	3.70	278
Jan. 8[a]	3.23	281			

[a] Incomplete ice cover.

[b] Complete ice cover.

Daily discharge, in second-feet, of Brule River near Florence, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Day.	Oct.	Nov.	Dec.	Jan.	Feb.
1	401	376	561	305	305	16	561	788	305	351	305
2	401	427	572	305	305	17	561	673	305	376	305
3	351	453	506	305	305	18	730	561	305	401	305
4	351	561	506	351	290	19	1,150	534	284	427	305
5	376	453	427	305	284	20	1,340	534	262	453	305
6	351	351	401	272	296	21	1,090	534	262	453	.....
7	351	401	401	272	305	22	673	453	284	453	.....
8	351	561	376	284	305	23	480	453	305	453	.....
9	376	506	328	328	305	24	480	453	305	453	.....
10	351	506	284	328	305	25	453	453	284	453	.....
11	376	968	328	351	305	26	453	480	284	427	.....
12	351	1,030	351	351	305	27	480	506	284	401	.....
13	376	1,090	351	351	305	28	506	673	305	376	.....
14	534	1,090	351	351	305	29	561	617	305	351	.....
15	589	968	328	351	305	30	453	561	305	328	.....
						31	376	.....	305	305	.....

NOTE.—Stage-discharge relation affected by ice, Dec. 1 to Feb. 20.

Monthly discharge of Brule River near Florence, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 344 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,340	351	524	1.52	1.75
November	1,090	351	600	1.74	1.94
December	572	262	347	1.01	1.16
January	453	272	364	1.06	1.22
February 1-20	305	284	303	.881	.66

PINE RIVER NEAR FLORENCE, WIS.

LOCATION.—In sec. 23, and 26, T. 39 N., R. 17 E., at highway bridge, 8 miles southwest of Florence, Florence County, and 12 miles above mouth of river. Popple River enters from the right about 200 feet above the station.

DRAINAGE AREA.—518 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—January 22, 1914, to September 30, 1916.

GAGE.—Standard chain gage fastened to guard rail on upstream side of bridge; read by William Taft.

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

CHANNEL AND CONTROL.—Coarse gravel and stones; left bank high and not subject to overflow; extremely high water may overflow right bank around approach to bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 9.25 feet at noon, April 23 (discharge about 4,520 second-feet); minimum estimated discharge 118 second-feet, February 13 to 15.

1914–1916: Maximum recorded stage April 23, 1916; minimum stage recorded, 1.6 feet, September 6 and 7, 1915 (discharge, about 118 second-feet).

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

REGULATION.—River not used for log driving during year. Gates of a dam below station remained open throughout the year.

ACCURACY.—Stage-discharge relation practically permanent; rating curve fairly well defined between 200 and 418 second-feet and well defined between 418 and 1,540 second-feet; extension of curve below 200 and above 1,540 second-feet may be subject to considerable error. Gage read once daily to half-tenths. Discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained from results of discharge measurements, observer's notes, and weather records. Open-water records good except during extremely high and low stages; winter records fair.

Discharge measurements of Pine River near Florence, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 5	H. C. Beckman	2.24	293	Feb. 5[a]	H. C. Beckman	3.60	204
6	do	2.12	249	Mar. 11[a]	do	4.00	220
Jan. 8[a]	do	3.70	245	June 16	W. G. Hoyt	5.22	1,430

[a] Ice cover at control.

Daily discharge, in second-feet, of Pine River near Florence, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	352	352	655	319	210	210	552	1,540	869	1,170	434	225
2	352	336	638	319	240	210	620	1,430	3,100	1,210	418	225
3	352	319	638	287	256	210	690	1,290	2,860	1,170	418	225
4	319	319	638	266	196	210	761	1,210	2,780	1,130	402	256
5	319	303	620	256	204	212	833	1,190	2,540	1,050	385	352
6	319	303	620	240	196	214	869	1,090	2,460	905	385	552
7	303	319	603	240	196	216	941	1,010	2,310	833	385	690
8	287	319	586	245	183	218	977	1,010	2,240	690	385	833
9	287	336	552	240	169	218	1,010	1,050	2,100	552	368	941
10	287	352	501	225	169	220	1,080	1,050	2,100	518	352	941
11	287	385	484	210	143	220	1,120	1,050	1,840	484	352	941
12	303	620	451	168	143	225	1,190	977	1,720	468	385	941
13	319	905	451	156	118	225	1,220	905	1,480	418	385	977
14	352	941	484	143	118	225	1,260	869	1,480	385	368	977
15	385	977	518	130	118	225	1,430	797	1,430	352	352	1,290
16	418	1,010	518	130	143	240	1,430	725	1,380	352	352	941
17	620	1,050	501	130	169	240	1,480	690	1,380	352	319	905
18	586	1,050	468	143	169	256	1,540	690	1,380	368	287	869
19	552	1,010	451	143	169	256	1,600	690	1,290	368	287	797
20	552	977	451	143	180	256	2,030	655	1,210	385	385	725
21	518	941	451	156	185	270	3,180	655	1,050	402	368	655
22	518	905	432	168	185	270	3,360	690	941	385	352	552
23	484	905	432	168	190	287	4,370	725	977	385	352	518
24	518	833	418	168	190	287	3,180	833	977	385	336	552
25	484	833	418	156	196	303	2,860	833	977	368	319	586
26	451	797	418	156	200	319	2,540	869	941	352	287	620
27	418	761	418	156	205	352	2,310	1,050	905	352	256	655
28	385	761	385	156	205	368	2,100	1,010	905	385	256	690
29	385	725	385	156	210	385	1,840	977	977	418	256	725
30	352	690	352	180	.....	451	1,660	977	1,050	451	225	725
31	352	.....	330	210	.....	484	.....	905	.....	451	225	.....

NOTE.—Stage-discharge relation affected by ice Nov. 29 to Apr. 14.

Monthly discharge of Pine River near Florence, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 518 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	620	287	401	0.774	0.89
November	1,050	303	678	1.31	1.46
December	655	330	492	.950	1.10
January	319	130	192	.371	.43
February	256	118	181	.349	.38
March	484	210	267	.515	.59
April	4,370	552	1,670	3.22	3.59
May	1,540	655	950	1.83	2.11
June	3,100	869	1,590	3.07	3.42
July	1,210	352	564	1.09	1.26
August	434	225	343	.662	.76
September	1,290	225	696	1.34	1.50
The year	4,370	118	666	1.29	17.49

PIKE RIVER AT AMBERG, WIS.

LOCATION.—In sec. 15, T. 35 N., R. 21 E., at Chicago, Milwaukee & St. Paul Railway bridge half a mile south of Amberg, Marinette County, immediately below the junction of the two branches of the Pike River, and about 11 miles above mouth.

DRAINAGE AREA.—240 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—February 26, 1914, to September 30, 1916.

GAGE.—Chain gage fastened to guard rail on upstream side of ridge; read by Frank Bunce.

DISCHARGE MEASUREMENTS.—Made from a highway bridge a quarter of a mile downstream from the bridge to which the gage is attached or by wading.

CHANNEL AND CONTROL.—Solid rock and some loose granite boulders; channel permanent but very rough at gage. Banks medium high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.6 feet at 8.30 a. m. June 4 (discharge 1,160 second-feet); estimated minimum discharge, 128 second-feet, February 2.

1914–1916: Maximum stage recorded, 4.65 feet at 8.10 p. m. July 14, 1914 (discharge 1,200 second-feet); minimum stage recorded, 1.55 feet September 7, 1915 (discharge 109 second-feet).

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

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 180 and 1,120 second-feet. Gage read once daily, to quarter-tenths. Discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained from discharge measurements, observer's notes, and weather records. Open-water records excellent, except for extremely high stages, for which they are good; winter records fair.

Discharge measurements of Pike River at Amberg, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 8	H. C. Beckman	2.00	198	Mar. 10[a]	H. C. Beckman	1.95	151
Jan. 10[a]	do	1.92	170	June 17	W. G. Hoyt	3.55	701
Feb. 7[a]	do	2.18	142	17	do	3.55	714

[a] Ice at control.

Daily discharge, in second-feet, of Pike River at Amberg, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	128	169	396	204	138	180	476	444	412	820	258	192
2	148	169	412	204	128	169	582	510	444	820	230	199
3	176	162	380	204	138	158	620	412	1,080	738	244	180
4	128	169	333	192	138	158	620	444	1,160	582	348	185
5	138	162	318	192	138	156	582	364	1,080	476	333	217
6	138	162	185	192	138	154	546	428	904	396	273	258
7	134	176	318	180	142	152	510	364	820	348	230	318
8	142	217	258	180	148	150	510	348	778	318	217	348
9	130	230	258	169	148	150	510	348	862	318	204	348
10	134	204	176	170	158	151	620	546	990	288	204	318
11	134	348	288	158	158	148	738	364	947	288	273	303
12	154	510	364	148	162	150	904	460	904	244	230	303
13	169	620	318	162	169	148	904	348	820	244	230	412
14	273	582	230	158	158	142	862	318	738	230	217	412
15	303	476	230	169	154	138	820	380	698	230	204	396
16	283	380	230	158	158	142	738	476	698	303	204	348
17	217	303	244	169	158	148	698	620	698	303	192	333
18	288	258	258	192	162	148	658	444	698	288	333	318
19	348	333	273	192	169	158	582	582	582	244	364	288
20	348	412	288	192	169	169	738	510	510	230	348	273
21	333	396	303	192	169	169	947	582	510	230	318	230
22	288	582	318	230	180	169	1,080	444	658	217	273	230
23	244	460	318	204	192	158	1,120	428	582	217	258	244
24	230	412	318	180	192	169	990	380	476	217	230	230
25	217	318	303	169	180	169	862	364	510	204	244	333
26	204	318	273	169	169	192	778	333	493	303	217	288
27	204	428	230	162	169	230	738	364	428	348	204	546
28	192	546	217	154	158	258	658	396	380	412	199	990
29	192	510	204	158	158	288	546	318	364	396	192	990
30	180	510	204	158	.....	318	476	303	738	476	180	820
31	169	.....	204	165	.....	412	.....	288	.....	288	180	.....

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Apr. 8.

Monthly discharge of Pike River at Amberg, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	348	128	206	0.858	0.99
November	620	162	351	1.46	1.63
December	412	176	279	1.16	1.34
January	230	148	178	.742	.86
February	192	128	159	.662	.71
March	412	138	181	.754	.87
April	1,120	476	714	2.98	3.32
May	620	288	416	1.73	1.99
June	1,160	364	699	2.91	3.25
July	820	204	355	1.48	1.71
August	364	180	246	1.02	1.18
September	990	180	362	1.51	1.68
The year	1,160	128	344	1.43	19.53

PESHTIGO RIVER AT HIGH FALLS, NEAR CRIVITZ, WIS.

LOCATION.—In sec. 1, T. 32 N., R. 18 E., at High Falls, near Crivitz, Marinette County, about a quarter of a mile downstream from power house of Wisconsin Public Service Co., 1 mile upstream from Thunder River (coming in from the right), and 15 miles by road northwest of Crivitz.

DRAINAGE AREA.—585 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale 1 inch=6 miles).

RECORDS AVAILABLE.—October 1, 1912, to September 30, 1916.

GAGE.—Barrett and Lawrence water-stage recorder, set over a wooden well about 15 feet from the left bank and quarter of a mile downstream from power house; well is protected from floating logs by a large boulder.

DISCHARGE MEASUREMENTS.—Made from cable half a mile below gage.

CHANNEL AND CONTROL.—Banks at control amd measuring section are high and not subject to overflow. Control at low stages is a small gravel riffle about 50 feet downstream from gage; at medium and high stages this control is apparently drowned out and control probably formed by some point farther downstream.

EXTREMES OF DISCHARGE.—1912–1916: Maximum stage from water-stage recorder, 7.2 feet May 13, 1916 (discharge, 3,480 second-feet); minimum stage, 1.1 feet at 5 p. m. March 21, 1915 (discharge, 54 second-feet). Owing to artificial regulation extremes given do not represent the natural flow.

ICE.—Because of the relatively warm water in the large service reservoir, ice does not form on the river in the vicinity of the gage; open-water rating curve used throughout year.

DIVERSIONS.—About 2 second-feet of seepage water enters the river below the gage but above the cable and is included in the published estimates.

REGULATION.—Flow controlled by operation of power plant. During log-driving seasons large and sudden fluctuations are caused by the operation of logging and sluice gates. Fluctuations due to changes in load are relatively small. The mean monthly flow does not represent the natural flow because of storage.

ACCURACY.—Stage-discharge relation permanent; not affected by ice; rating curve well defined between 145 and 3,980 second-feet. Discharge ascertained by averaging the results obtained by applying gage heights for hourly or other regular intervals to rating tables. Records good, except for brief periods for which discharge was partly estimated.

Discharge measurements of Peshtigo River at High Falls, near Crivitz, Wis., during the year ending Sept. 30, 1916.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 12	3.85	1,440	May 15	1.80	200
13	7.20	3,480	15	3.00	847
13	5.20	2,240			

Daily discharge, in second-feet, of Peshtigo River at High Falls, near Crivitz, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	570	461	625	207	229	318	580	1,480	980	1,530	803	562
2	555	523	498	185	216	353	317	1,620	1,230	1,530	687	576
3	339	533	515	363	208	499	453	1,680	1,350	1,560	746	389
4	436	521	522	400	211	496	518	1,810	2,410	1,350	605	370
5	394	547	355	422	217	277	520	1,660	2,850	1,340	606	470
6	330	537	537	436	94	412	520	1,820	2,820	1,110	456	502
7	316	320	504	405	184	497	521	1,890	2,660	827	534	555
8	308	458	507	381	229	514	530	2,010	2,470	680	538	584
9	312	505	517	224	215	545	300	1,760	2,470	723	489	636
10	127	499	445	291	222	540	422	1,000	2,660	675	528	457
11	246	506	398	339	236	534	481	1,010	1,960	491	566	824
12	315	511	222	339	248	297	485	1,200	2,380	490	561	960
13	304	507	354	381	97	476	497	1,690	2,170	524	388	985
14	311	282	405	416	196	556	1,000	628	2,030	562	498	763
15	314	418	395	422	238	534	1,760	639	1,650	556	546	732
16	310	476	560	228	250	520	1,610	1,370	1,580	689	528	798
17	120	451	506	364	248	538	1,680	1,620	1,580	593	531	594
18	280	408	478	369	246	524	1,670	1,290	1,410	535	546	736
19	414	408	272	247	240	274	1,730	1,090	1,400	520	556	621
20	404	402	418	220	102	443	2,020	1,120	1,350	583	387	576
21	407	252	469	226	206	496	2,330	990	783	549	488	585
22	429	359	408	204	229	532	2,680	1,050	1,040	436	533	599
23	401	412	413	72	240	417	2,670	1,050	1,180	613	538	604
24	224	460	395	187	250	409	2,810	1,060	1,210	534	551	476
25	446	475	178	229	268	432	2,700	1,080	1,080	480	560	578
26	504	672	180	215	270	286	2,370	940	1,030	480	573	646
27	521	674	354	122	100	442	2,150	940	767	727	404	843
28	515	590	390	90	206	509	1,980	702	799	866	497	1,180
29	534	747	390	198	273	508	1,820	1,080	914	984	530	1,130
30	541	693	393	89	.....	525	1,550	989	1,030	994	570	1,060
31	309	.....	421	116	.....	604	.....	1,040	.....	1,070	560	.....

NOTE.—Gage not in perfect operation Nov. 18–25, Dec. 10–16, 22, 23, 29, 30, Jan. 4–7, 16, 22, 27, Feb. 2–14, Mar. 23–25, May 19, 20, 27, July 26, 27, Sept. 4–7, 12–14; discharge for these days estimated from power-house records.

Monthly discharge of Peshtigo River at High Falls, near Crivitz, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 585 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	570	120	372	0.636	0.73
November	747	252	487	.832	.93
December	625	178	420	.718	.83
January	436	72	271	.463	.53
February	273	94	213	.364	.39
March	604	274	462	.790	.91
April	2,810	300	1,360	2.32	2.59
May	2,010	628	1,270	2.17	2.50
June	2,850	767	1,640	2.80	3.12
July	1,560	436	794	1.36	1.57
August	803	387	545	.932	1.07
September	1,180	370	680	1.16	1.29
The year	2,850	72	708	1.21	16.46

OCONTO RIVER NEAR GILLETT, WIS.

LOCATION.—In sec. 34, T. 28 N., R. 18 E., at steel highway bridge 2½ miles southeast of Gillett, Oconto County, and about 27 miles above mouth of river.

DRAINAGE AREA.—678 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 7, 1906, to March 30, 1909; January 6, 1914, to September 30, 1916.

GAGE.—Chain gage attached to iron railing on upstream side of bridge; read by Miss Nettie Gilbertson. Zero of gage used from January 6, 1914, to September 30, 1916, is 4 feet above that of gage used June 7, 1906, to March 31, 1909.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge.

CHANNEL AND CONTROL.—Gravel; fairly permanent. Left bank of medium height and not subject to overflow; during extremely high stages water may overflow right bank around end of bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.3 feet, at 3.30 p. m. April 25 (discharge, 3,220 second-feet); minimum discharge estimated, 305 second-feet during February.

1906–1915: Maximum stage recorded April 25, 1916; minimum open-water discharge, 95 second-feet January 3 and 6, 1907.

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

REGULATION.—A dam above the station stores water to float logs during the spring; except when dam is in operation flow at the gage is natural.

ACCURACY.—Stage-discharge relation practically permanent, except for the effect of ice. Rating curve well defined, between 239 and 1,790 second-feet. Gage read once daily to quarter-tenths. Discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained from discharge measurements, observer's notes, and weather records. Open-water records good, except at extremely high stages, for which they are only fair; winter records fair.

Discharge measurements of Oconto River near Gillett, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 9	H. C. Beckman	1.42	481	Mar. 9[a]	H. C. Beckman	2.71	345
Jan. 7[a]	do	3.34	384	Apr. 4[b]	W. G. Hoyt	7.40	2,220
Feb. 4[a]	do	2.70	305	June 26	H. C. Beckman	2.51	1,080

[a] Ice at control.

[b] Ice jam below gage.

Daily discharge, in second-feet, of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	468	446	1,060	403	324	342	1,500	1,640	1,860	930	642	446
2	468	492	1,060	400	324	342	1,860	1,570	1,570	1,020	642	424
3	468	468	1,020	396	324	342	2,090	1,430	1,860	960	642	424
4	468	403	840	394	305	342	2,220	1,430	2,160	930	670	492
5	403	468	810	388	305	342	1,790	1,360	2,160	930	698	468
6	362	446	810	384	305	342	1,860	1,290	1,720	840	670	515
7	403	446	840	384	305	342	1,860	1,160	1,860	642	670	565
8	382	492	670	380	305	342	1,720	1,090	2,020	725	642	590
9	362	515	670	378	305	345	1,290	1,060	2,710	698	642	642
10	382	590	670	374	305	362	1,160	1,090	2,160	642	670	615
11	403	960	670	370	305	382	1,160	1,020	2,390	615	670	698
12	446	960	424	365	305	382	1,360	1,090	2,550	565	615	752
13	468	1,020	424	362	305	403	1,430	1,160	2,550	565	565	870
14	468	1,020	466	360	305	403	1,570	1,260	2,390	1,360	515	870
15	515	992	424	360	324	403	1,570	1,570	2,320	565	492	930
16	492	960	424	354	324	424	1,640	1,360	1,860	565	468	900
17	565	960	424	352	324	424	1,570	1,430	1,860	642	468	840
18	698	900	424	348	324	468	1,720	1,790	1,860	604	446	752
19	840	1,020	424	345	324	468	1,790	1,570	1,640	565	446	725
20	780	960	424	342	324	515	2,020	1,570	1,720	615	468	698
21	698	992	420	340	324	515	2,390	1,500	1,290	780	468	698
22	725	960	415	338	324	515	2,950	1,430	1,290	725	403	670
23	698	960	410	336	324	515	3,130	1,290	1,160	725	403	615
24	615	960	405	334	324	565	2,950	1,160	1,160	468	424	590
25	565	960	405	332	342	565	3,220	1,220	1,090	515	424	565
26	492	992	405	332	342	670	2,950	1,360	1,160	642	424	615
27	468	1,020	405	330	342	725	2,320	1,060	1,090	615	403	840
28	468	1,160	405	328	342	840	2,090	960	960	698	403	900
29	515	1,090	405	326	342	960	2,020	780	960	698	403	900
30	515	1,090	405	324	.....	1,090	2,020	725	930	670	424	1,020
31	468	.....	403	324	.....	1,290	.....	1,720	.....	670	424	.....

NOTE.—Stage-discharge relation affected by ice Dec. 15 to Apr. 5. Discharge July 18 interpolated; gage apparently read in error.

Monthly discharge of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 678 square miles.]

Month.	Discharge in second-feet.				Run-off (depth inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	840	362	518	0.764	0.88
November	1,160	403	823	1.21	1.35
December	1,060	403	563	.830	.96
January	403	324	358	.528	.61
February	342	305	320	.472	.51
March	1,290	342	515	.760	.88
April	3,220	1,160	1,970	2.91	3.25
May	1,790	725	1,290	1.90	2.19
June	2,710	930	1,740	2.57	2.87
July	1,360	468	716	1.06	1.22
August	698	403	527	.777	.90
September	1,020	424	688	1.01	1.13
The year	3,220	305	834	1.23	16.75

WOLF RIVER AT KESHENA, WIS.

LOCATION.—In sec. 26, T. 28 N., R. 15 E., at the highway bridge at Keshena, Shawano County, 3 miles below junction with West Branch of Wolf River, coming in from the right.

DRAINAGE AREA.—797 square miles.

RECORDS AVAILABLE.—May 9, 1907, to March 31, 1909; February 10, 1911, to September 30, 1916.

GAGE.—Chain gage fastened to downstream side of new bridge on December 9, 1914. May 9, 1907, to November 29, 1914, vertical staff gage fastened to downstream abutment. Both gages at same datum; gage read by Jerome M. Beauprey.

DISCHARGE MEASUREMENTS.—Made from the bridge.

CHANNEL AND CONTROL.—Gravel; smooth and practically permanent. Banks of medium height; overflow improbable. During the last part of November and the first part of December, 1914, a new bridge was erected at site of old gage. The construction of the new piers apparently changed conditions of channel as shown by plotting of current-meter measurements made since the bridge was built.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.0 feet at 4 p. m. April 22 (discharge, 3,370 second-feet); minimum discharge about 414 second-feet January 15 to 17.

1907–1909 and 1911–1916: Maximum discharge recorded, 3,910 second-feet September 2, 1912; minimum discharge during open-water periods, 275 second-feet September 26, 1908.

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

REGULATION.—The river and its main tributaries above Keshena are controlled to some extent by logging dams.

ACCURACY.—Stage-discharge relation permanent, except for effect of ice. Rating curve well defined between 510 and 2,260 second-feet; above and below these limits curve is extended and subject to error. Gage read twice daily to quarter-tenths. Discharge ascertained by applying mean daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained from discharge measurements, observer's notes, and weather records. Open-water records excellent, except for extremely high and low stages, for which they are fair; winter records fair.

Discharge measurements of Wolf River at Keshena, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 11	H. C. Beckman	2.26	834	Mar. 8[a]	H. C. Beckman	2.93	469
11	do	2.39	909	Apr. 5[b]	W. G. Hoyt	3.95	1,310
Jan. 6[a]	do	3.80	462	June 22	H. C. Beckman	3.14	1,360
Feb. 3[a]	do	3.28	490	Sept. 11	E. L. Williams	2.09	756

[a] Ice at control. [b] Ice jam below gage.

Daily discharge, in second-feet, of Wolf River at Keshena, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	510	586	648	586	475	475	1,120	1,910	810	1,190	909	627
2	547	547	670	510	482	475	1,180	1,840	1,770	1,380	1,020	586
3	547	459	692	510	490	475	859	1,640	2,470	1,250	909	670
4	510	459	670	492	492	475	1,300	1,640	2,400	1,130	909	627
5	547	459	670	475	503	475	1,310	1,570	1,980	1,070	1,020	627
6	510	459	715	462	510	475	1,300	1,500	1,910	960	909	627
7	510	510	786	460	510	472	1,300	1,500	2,120	960	762	810
8	475	547	715	460	510	469	1,300	1,380	2,920	909	715	909
9	443	547	627	460	510	472	1,240	1,440	2,920	810	715	715
10	459	566	627	459	510	475	1,300	1,310	2,770	715	762	762
11	586	859	627	443	510	472	1,440	1,500	2,690	762	762	762
12	627	960	627	436	510	468	1,640	1,440	2,400	960	762	1,020
13	627	1,380	627	428	510	465	1,640	1,250	2,050	1,130	810	1,440
14	670	1,070	627	421	510	462	1,770	1,250	1,910	1,070	810	1,500
15	670	1,020	606	414	510	459	1,840	1,640	1,840	1,070	715	1,020
16	670	810	606	414	510	464	1,910	1,910	1,840	1,020	670	859
17	670	810	606	414	501	470	1,910	1,910	1,770	1,070	670	1,130
18	810	909	586	428	492	475	1,910	1,640	1,700	909	670	1,070
19	909	1,020	586	428	492	500	1,980	1,190	1,640	810	670	1,070
20	859	1,020	586	459	490	528	2,770	1,380	1,570	762	627	1,070
21	715	950	586	475	490	510	3,370	1,440	1,380	715	627	1,020
22	715	757	586	510	490	547	3,220	1,250	1,380	960	627	715
23	715	666	586	510	490	586	2,920	1,500	1,310	762	627	762
24	715	692	586	510	490	627	2,920	1,380	1,310	627	586	909
25	670	762	586	547	490	648	2,690	1,250	1,310	627	627	810
26	670	786	586	547	490	692	2,550	1,250	1,250	762	627	810
27	627	859	566	528	490	762	2,400	1,190	1,250	909	627	1,020
28	627	834	547	528	490	834	2,260	1,380	1,130	1,020	547	1,310
29	627	672	547	510	490	909	2,120	1,190	1,070	909	627	1,250
30	586	627	547	510	.....	986	2,050	1,130	1,020	810	586	1,250
31	627	.....	566	492	.....	1,070	.....	960	.....	859	627	.....

NOTE.—Stage-discharge relation affected by ice Nov. 21 to Apr. 10.

Monthly discharge of Wolf River at Keshena, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 797 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	909	443	627	0.787	0.91
November	1,380	459	753	.945	1.05
December	786	547	619	.777	.90
January	586	414	478	.600	.69
February	510	475	498	.625	.67
March	1,070	459	570	.715	.82
April	3,370	859	1,920	2.41	2.69
May	1,910	960	1,440	1.81	2.09
June	2,920	810	1,800	2.26	2.52
July	1,380	627	932	1.17	1.35
August	1,020	547	727	.912	1.05
September	1,500	586	925	1.16	1.29
The year	3,370	414	939	1.18	16.03

WOLF RIVER AT NEW LONDON, WIS.

LOCATION.—In sec. 12, T. 22 N., R. 14 E., at Pearl Street highway bridge, New London, Waupaca County. Embarrass River enters from the right three-fourths of a mile above and Little Wolf River, also from the right, 5 miles below the station.

DRAINAGE AREA.—2,240 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles.)

RECORDS AVAILABLE.—Gage heights March 1, 1899, to September 30, 1916; daily discharge determinations October 1, 1913, to September 30, 1916.

GAGE.—Enameled steel gage, reading from 1.0 to 13.0 feet, fastened to pile under downstream side of Pearl Street bridge. Datum of the gage raised 0.641 foot March 1, 1911, according to United States Army engineers; zero of gage is at an elevation of 748.874 feet above mean sea level, New York City datum.

DISCHARGE MEASUREMENTS.—Made from Shawano Street bridge, two blocks below gage.

CHANNEL AND CONTROL.—Sand and hardpan; not permanent; no well-defined control. Banks at the gage fairly high and not subject to overflow. It is reported that during extremely high stages water from Embarrass River flows across the city of New London into the channel of Wolf River below the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.7 feet April 4 (discharge, 8,960 second-feet); minimum discharge, about 815 second-feet, March 7 to 10.

1914–1916: Maximum stage, 9.7 feet April 4, 1916; minimum discharge, 755 second-feet January 1 to 10, 1915. The United States Army Engineers report a stage of 11.6 feet April 16, 1888.

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

REGULATION.—Little if any diurnal fluctuation due to operation of power plants on river above station observable at the gage; monthly flow natural.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used October 1 to April 4, well defined between 1,480 and 4,660 second-feet; curve used April 5 to September 30, fairly well defined between 910 and 9,280 second-feet. Gage read at noon each day to nearest tenth. Discharge ascertained by applying daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was based on discharge measurements, observer's notes, and weather records. Results fair.

Discharge measurements of Wolf River at New London, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 13	H. C. Beckman	4.68	2,260	Apr. 6	W. G. Hoyt	9.45	8,220
Jan. 5[a]	.....do	3.40	1,180	May 18	F. A. Potts	7.05	4,090
Feb. 2[a]	.....do	3.13	991	June 27	H. C. Beckman	6.73	3,630
Mar. 7[a]	.....do	2.89	819	Sept. 7	E. L. Williams	2.00	1,020

[a] Ice at control.

Daily discharge, in second-feet, of Wolf River at New London, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,480	1,450	2,640	1,260	1,020	845	4,920	5,900	3,040	3,100	1,280	880
2	1,450	1,330	2,590	1,240	1,000	845	6,230	5,360	3,100	3,040	1,280	840
3	1,450	1,370	2,590	1,220	1,000	830	8,650	5,060	3,420	2,980	1,240	840
4	1,410	1,330	2,590	1,200	1,000	830	8,960	4,780	3,670	2,860	1,370	840
5	1,300	1,260	2,420	1,180	1,000	830	8,650	4,390	3,850	2,800	1,370	840
6	1,300	1,180	2,220	1,160	980	830	8,060	4,160	4,160	2,680	1,460	875
7	1,330	1,260	2,040	1,160	980	815	7,510	4,050	4,640	2,560	1,460	1,020
8	1,300	1,260	1,910	1,140	980	815	7,000	3,850	5,900	2,390	1,460	1,100
9	1,300	1,220	1,790	1,140	980	815	6,310	3,580	7,250	2,280	1,370	1,140
10	1,300	1,220	1,640	1,140	980	815	5,530	3,500	8,350	2,120	1,320	1,280
11	1,300	1,560	1,520	1,140	960	830	5,200	3,420	8,650	2,010	1,320	1,280
12	1,300	2,130	1,450	1,120	960	830	4,780	3,350	8,960	1,810	1,320	1,420
13	1,300	2,350	1,390	1,100	940	830	4,390	3,220	8,960	1,660	1,280	1,660
14	1,410	2,540	1,370	1,040	940	830	4,050	3,280	8,650	1,510	1,280	1,810
15	1,410	2,690	1,330	1,020	940	830	3,850	3,420	8,350	1,460	1,240	1,960
16	1,410	2,640	1,330	1,020	920	830	3,850	3,670	7,780	1,560	1,240	2,010
17	1,450	2,640	1,320	1,020	920	830	3,850	3,760	7,250	1,610	1,190	2,010
18	1,480	2,590	1,320	1,000	900	830	3,850	3,850	6,760	1,610	1,140	2,060
19	1,640	2,690	1,300	1,000	880	830	3,950	3,950	6,100	1,710	1,100	2,010
20	1,670	2,920	1,300	1,000	860	830	4,160	3,950	5,530	1,760	1,060	1,860
21	1,790	2,890	1,320	1,000	860	845	4,510	3,950	5,200	1,760	1,020	1,710
22	1,870	2,860	1,370	1,000	860	845	4,920	4,050	4,920	1,760	1,020	1,660
23	1,950	2,860	1,370	1,000	860	845	5,530	3,950	4,640	1,610	980	1,560
24	1,870	2,810	1,370	1,000	860	845	6,310	3,850	4,390	1,460	910	1,560
25	1,790	2,860	1,370	1,000	860	860	7,000	3,760	4,050	1,370	875	1,460
26	1,750	2,860	1,370	1,000	860	1,370	7,510	3,670	3,670	1,280	875	1,420
28	1,790	2,840	1,370	1,020	860	1,870	7,250	3,580	3,580	1,240	840	1,510
28	1,670	2,810	1,350	1,020	860	2,440	7,000	3,420	3,420	1,240	840	1,860
29	1,560	2,780	1,330	1,020	860	3,100	6,530	3,350	3,220	1,280	840	2,060
30	1,480	2,750	1,300	1,020	.....	3,560	6,100	3,220	3,220	1,320	840	2,220
31	1,450	.....	1,300	1,020	.....	3,700	.....	3,160	.....	1,320	840	.....

NOTE.—Stage-discharge relation affected by ice Nov. 21 to Apr. 3.

Monthly discharge of Wolf River at New London, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 2,240 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,950	1,300	1,510	0.674	0.78
November	2,920	1,180	2,200	.982	1.10
December	2,640	1,300	1,640	.732	.84
January	1,260	1,000	1,080	.482	.56
February	1,020	860	927	.414	.45
March	3,700	815	1,190	.531	.61
April	8,960	3,850	5,880	2.62	2.92
May	5,900	3,160	3,890	1.74	2.01
June	8,960	3,040	5,490	2.45	2.73
July	3,100	1,240	1,910	.853	.98
August	1,460	840	1,150	.513	.59
September	2,220	840	1,490	.665	.74
The year	8,960	815	2,360	1.05	14.31

WEST BRANCH OF WOLF RIVER AT NEOPIT, WIS.

LOCATION.—In sec. 20, T. 29 N., R. 14 E., at dam and power plant at Neopit, Shawano County, a station on the Wisconsin & Northern Railroad, 20 miles north of Shawano; about 11 miles above confluence of Wolf River and West Branch.

DRAINAGE AREA.—108 square miles.

RECORDS AVAILABLE.—January 25, 1911, to September 30, 1916.

GAGE.—Vertical staff, head and tail race gages.

DETERMINATION OF FLOW.—Observations of the head of water flowing over the spillway, the head on the wheels, and the kilowatt output as measured at the switchboard, are taken at 6, 7, and 10 a. m., and at 3, 6, and 10 p. m. The flow at

these times is determined by means of a curve developed by current-meter measurements, and the computed discharge is then weighted in accordance with the elapsed interval.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during year, 471 second-feet, April 20; minimum mean daily discharge, 46 second-feet October 4.

1911–1916: Maximum mean daily discharge, 999 second-feet, July 24, 1912; minimum mean daily discharge, 17 second-feet, August 30, 1914. These extremes are due to regulation.

ACCURACY.—Rating tables used in the determination of daily discharge is based on 5 discharge measurements. Conditions relative to leakage and plant equipment are becoming more unsatisfactory; records as published for year are only fair.

Daily discharge, in second-feet, of West Branch of Wolf River at Neopit, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	95	88	84	82	86	98	161	189	148	196	329	109
2	197	87	84	70	82	100	155	178	370	164	167	129
3	70	85	84	88	82	96	167	154	372	141	137	102
4	108	74	81	90	85	97	156	178	179	113	133	105
5	86	67	67	89	83	72	141	130	218	167	126	124
6	62	68	74	89	58	99	119	185	138	117	108	124
7	84	56	78	81	77	98	137	129	272	129	122	138
8	64	67	73	85	86	93	162	189	408	132	123	143
9	66	64	79	55	84	99	107	151	308	102	99	135
10	76	76	75	68	85	97	131	194	288	129	114	124
11	150	97	78	67	87	98	146	188	236	230	132	96
12	72	217	57	74	87	55	162	141	187	57	108	121
13	125	96	71	80	57	86	177	192	210	213	84	162
14	88	72	70	74	77	91	168	181	202	55	150	164
15	77	87	72	85	81	91	172	270	211	197	113	160
16	66	83	72	60	79	90	169	258	172	97	110	155
17	55	84	79	82	81	89	183	187	227	156	106	139
18	106	96	77	83	79	85	173	187	181	129	104	184
19	89	99	51	84	82	61	209	180	149	118	104	199
20	95	103	74	88	60	80	471	171	162	171	88	100
21	70	82	73	91	84	98	359	137	162	239	138	90
22	67	93	77	85	89	102	257	217	159	118	119	100
23	72	89	77	59	83	98	238	195	140	55	88	65
24	72	95	77	80	91	97	198	170	182	101	106	46
25	84	88	62	88	86	108	196	191	140	151	95	109
26	90	92	64	91	88	80	190	150	133	121	105	131
27	86	100	80	86	66	102	179	183	156	164	73	169
28	87	92	73	84	86	132	171	121	156	115	136	202
29	86	98	75	90	85	103	162	179	152	123	93	181
30	85	90	75	60	.....	131	168	128	160	150	115	161
31	72	.....	77	82	.....	122	.....	149	.....	146	113	.....

Monthly discharge of West Branch of Wolf River at Neopit, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 108 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	197	55	87.2	0.807	0.93
November	217	56	89.5	.829	.92
December	84	51	73.9	.684	.79
January	91	55	79.7	.738	.85
February	91	57	80.6	.746	.80
March	132	55	95.1	.881	1.02
April	471	107	186	1.72	1.92
May	270	121	176	1.63	1.88
June	408	133	206	1.91	2.13
July	239	55	139	1.29	1.49
August	329	73	121	1.12	1.29
September	202	46	132	1.22	1.36
The year	471	46	122	1.13	15.38

LITTLE WOLF RIVER AT ROYALTON, WIS.

LOCATION.—In sec. 1, T. 22 N., R. 13 E., at highway bridge in the town of Royalton, Waupaca County, about 4 miles above mouth of river.

DRAINAGE AREA.—485 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale: 1 inch=6 miles).

RECORDS AVAILABLE.—January 13, 1914, to September 30, 1916.

GAGE.—January 13, 1914, to August 20, 1915, standard chain gage fastened to upstream side of highway bridge; read by J. C. Jenson. August 21, 1915, to September 30, 1916, standard sloping gage on left bank of river, about 150 feet upstream from highway bridge. Datum of sloping gage is 0.75 of a foot higher than that of chain gage; owing to change in slope, however, difference between the readings on the slope and chain gage is not constant.

DISCHARGE MEASUREMENTS.—Made from a cable about 500 feet upstream from chain gage.

CHANNEL AND CONTROL.—Channel at the gage consists of heavy gravel and rock and is permanent; at the measuring section, fine, smooth gravel. Neither bank is overflowed to any extent at flood stages.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, about 3,690 second-feet March 31; minimum discharge recorded, about 130 second-feet March 5 and 6.

1914–1916: Maximum stage recorded, 7.5 feet at 7.15 p. m., June 7, 1914 (discharge, 5,350 second-feet); minimum discharge recorded, about 130 second-feet March 5 and 6, 1916.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—The few power plants above the station have little storage, and no diurnal fluctuation has been observed at the gage.

ACCURACY.—Stage-discharge relation not permanent. Discharge ascertained as follows: October 1 to December 10, 1914, from a fairly well defined rating curve; March 28 to August 20, 1915, from a rating curve fairly well defined between 206 and 730 second-feet; August 21 to December 14, 1915, from a rating curve fairly well defined between 220 and 730 second-feet; curve used December 15 to September 30, 1916, fairly well defined between 209 and 2,070 second-feet. Gage read twice daily to quarter-tenths. Discharge ascertained by applying mean daily gage heights to rating table, except for periods when stage-discharge relation was affected by ice, for which it was ascertained from discharge measurements, observer's notes, and weather records. Open-water records not better than fair for 1914 and 1915, good for 1916 except for high stages for which they are fair. Winter records subject to error.

Discharge measurements of Little Wolf at Royalton, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 12[a]	H. C. Beckman	2.65	706	Apr. 6[d]	W. G. Hoyt	3.24	1,430
Jan. 5[b]	do	[c]1.72	283	May 18	F. A. Potts	2.60	811
Feb. 2[b]	do	[c]1.70	206	June 27	H. C. Beckman	2.05	499
Mar. 7[b]	do	[c]1.92	185	Sept. 8	E. L. Williams	1.65	296

[a] Driftwood at control. [b] Ice at control. [c] Reading on chain gage. [d] Strong downstream wind.

Daily discharge, in second-feet, of Little Wolf River at Royalton, Wis., for the years ending Sept. 30, 1915 and 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914-15.												
1	292	242	284				496	397	337	261	242	192
2	211	211	301				519	354	228	272	292	220
3	242	230	315				566	366	288	228	272	199
4	204	230	315				615	442	250	272	292	210
5	183	242	284	210	190	280	720	542	265	288	272	194
6	230	219	258				1,010	487	304	272	231	194
7	219	219	271				1,080	442	296	300	308	181
8	271	204	250				1,220	478	345	312	288	190
9	398	242	250				1,080	566	460	388	276	199
10	599	219	258				1,050	519	371	312	250	199
11	430	230					1,080	469	371	280	250	215
12	440	219					1,080	424	358	250	261	293
13	492	258					1,150	366	371	250	238	344
14	440						944	354	380	235	181	586
15	440			265	320	450	846	354	371	206	238	441
16	492					500	666	354	358	261	190	632
17	388	265					615	496	288	250	250	632
18	258						615	474	345	250	238	521
19	398						566	487	460	242	269	521
20	338						542	487	424	228	231	460
21	250						542	640	478	253	226	355
22	194						519	944	380	253	153	330
23	176						464	878	371	242	243	355
24	348						496	813	328	253	215	274
25	230					790	478	749	316	354	176	298
26	348	280	220	235	535		433	640	304	280	226	330
27	250						464	542	296	272	226	261
28	258					692	442	456	261	253	176	226
29	219					590	406	380	261	265	207	252
30	219					640	433	354	261	280	215	249
31	204					566	.....	354	.....	272	190	.....
1915-16.												
1	234	215	542	300	242	190	3,290	800	439	530	225	220
2	226	207	500	300	224	175	2,790	770	1,670	590	232	215
3	215	223	542	300	224	190	2,160	590	1,970	560	245	210
4	215	204	422	300	224	175	1,840	590	1,870	530	310	216
5	215	199	287	280	206	130	1,680	590	1,770	530	323	215
6	217	199	320	206	224	130	1,220	560	1,570	501	328	276
7	234	237	287	224	280	185	944	501	2,290	366	314	366
8	252	274	255	242	261	206	900	461	2,740	314	301	297
9	246	283	341	175	384	206	800	428	2,980	318	284	314
10	237	310	400	190	406	206	770	444	3,100	284	280	328
11	232	632	330	224	384	190	680	407	2,740	284	310	328
12	226	705	392	224	341	175	710	472	2,070	245	323	620
13	274	730	320	224	280	362	770	461	1,670	245	276	830
14	261	656	320	224	320	320	770	590	1,090	284	310	935
15	246	586	362	190	320	341	770	900	830	314	284	935
16	274	415	362	190	362	362	740	1,130	800	284	293	770
17	268	418	362	206	341	341	800	1,130	830	284	284	530
18	320	381	362	206	300	320	800	900	770	270	251	501
19	280	680	362	242	341	242	800	770	770	251	241	501
20	296	730	362	242	300	341	1,480	650	740	257	225	428
21	300	441	341	280	320	382	1,870	560	680	248	236	356
22	293	415	341	280	280	341	2,400	650	590	270	227	323
23	293	542	341	300	261	320	2,400	620	560	260	208	323
24	287	500	341	341	280	362	2,400	710	530	241	216	284
25	261	480	341	384	320	519	2,290	770	472	248	217	260
26	246	521	320	341	300	749	2,180	710	466	236	212	270
27	243	586	320	341	190	1,450	1,300	590	560	248	208	740
28	237	609	320	300	224	1,760	900	590	530	251	210	900
29	232	542	320	341	242	2,700	770	444	472	243	209	865
30	237	542	320	406	.....	3,690	830	428	472	236	216	830
31	223	.....	320	320	.....	3,290	.....	461	.....	227	217	.....

NOTE.—Stage-discharge relation affected by ice Dec. 15, Nov. 14–30, Dec. 11–31, 1914, Jan. 1 to Mar. 27 and Dec. 15–31, 1915, and Jan. 1 to Mar. 31, 1916. Braced figures show mean discharge for periods included.

Monthly discharge of Little Wolf River at Royalton, Wis., for the years ending Sept. 30, 1915 and 1916.

[Drainage area, 485 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914–15.					
October	599	176	312	0.643	0.74
November	.....	204	254	.524	.58
December	.....	.....	253	.522	.60
January	.....	.....	254	.524	.60
February	.....	.....	381	.786	.82
March	.....	.....	510	1.05	1.21
April	1,220	406	705	1.45	1.62
May	944	354	503	1.04	1.20
June	478	228	338	.697	.78
July	388	206	269	.555	.64
August	308	153	236	.487	.56
September	632	181	318	.656	.73
The year	1,220	.....	361	.744	10.08
1915–16.					
October	320	215	252	.520	.60
November	730	199	449	.926	1.03
December	542	255	357	.736	.85
January	406	175	268	.553	.64
February	406	190	289	.596	.64
March	3,690	130	656	1.35	1.56
April	3,290	680	1,400	2.89	3.22
May	1,130	407	635	1.31	1.51
June	3,100	439	1,270	2.62	2.92
July	590	227	321	.662	.76
August	328	208	259	.534	.62
September	935	210	473	.975	1.09
The year	3,690	130	550	1.13	15.44

WAUPACA RIVER NEAR WEYAUWEGA, WIS.

LOCATION.—On line between sec. 1, T. 21 N., R. 12 E., and sec. 6, T. 21 N., R. 13 E., at highway bridge about 2½ miles west of Weyauwega, Waupaca County.

DRAINAGE AREA.—308 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 28 to September 30, 1916.

GAGE.—Standard chain gage, bolted to top chord, downstream truss, across left channel; read daily, to hundredths, by Otto Reek.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge or by wading about 300 feet above bridge.

CHANNEL AND CONTROL.—Bed of stream consists of coarse gravel. Control is fairly well-defined riffle about 30 feet downstream from gage. Right bank high, wooded, and will be overflowed only occasionally; left bank low and subject to overflow; road is high, so that during ordinary flood stages all the water will pass under the bridge.

EXTREMES OF STAGE.—Maximum stage recorded during period of records, 2.36 feet, at 12 noon, September 29; minimum stage recorded 1.08 feet, at 12.30 p. m., August 28.

REGULATION.—Several power plants at Waupaca and above cause slight fluctuations during low stages. The pondage at the various plants is small; mean monthly discharge is believed to represent nearly the natural flow.

Data inadequate for determination of discharge.

Discharge measurements of Waupaca River near Weyauwega, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 19	F. A. Potts	1.63	312	Sept. 9	E. L. Williams	1.46	241
June 28	H. C. Beckman	1.47	249				

Daily gage height, in feet, of Waupaca River near Weyauwega, Wis., for the year ending Sept. 30, 1916.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		1.71	1.14	1.20	16		1.46	1.30	1.76
2		1.86	1.14	1.20	17		1.60	1.30	1.52
3		1.63	1.20	1.30	18		1.66	1.22	1.68
4		1.54	1.46	1.10	19		1.44	1.32	1.54
5		1.42	1.58	1.46	20		1.54	1.26	1.50
6		1.43	1.46	1.28	21		1.48	1.60	1.54
7		1.40	1.54	1.24	22		1.34	1.12	1.50
8		1.33	1.38	1.30	23		1.34	1.12	1.46
9		1.36	1.50	1.58	24		1.22	1.12	1.38
10		1.27	1.44	1.28	25		1.28	1.10	1.30
11		1.35	1.54	1.52	26		1.28	1.16	1.54
12		1.34	1.54	2.30	27		1.30	1.12	2.15
13		1.31	1.30	2.30	28	1.42	1.18	1.08	2.35
14		1.19	1.40	1.94	29	1.48	1.34	1.12	1.80
15		1.27	1.30	1.72	30	1.74	1.12	1.22	1.64
					31		1.20	1.18	

SHEBOYGAN RIVER NEAR SHEBOYGAN, WIS.

LOCATION.—In sec. 28, T. 15 N., R. 23 E., about 2 miles west of the city of Sheboygan, Sheboygan County, and 2½ miles above mouth of river.

DRAINAGE AREA.—403 square miles (measured on Wisconsin Geological and Natural History Survey map, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—June 30 to September 30, 1916.

GAGE.—Standard chain gage, fastened to upstream side of bridge; read twice daily, to hundredths, by Anton E. Opgenorth.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading. At extreme flood stages measurements are made from Chicago & North Western Railway bridge, one-third mile downstream.

CHANNEL AND CONTROL.—Control, well-defined riffle about 200 feet below bridge. Channel of heavy gravel, clear, and free from aquatic grass. Both banks are of medium height and are rarely overflowed.

EXTREMES OF STAGE.—Maximum stage recorded during period of records, 2.52 feet, at 6 p. m., September 29; minimum stage recorded, 1.84 feet, at 6.30 p. m., September 2.

Data inadequate for determination of discharge.

Discharge measurements of Sheboygan River near Sheboygan, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 21	H. C. Beckman	2.97	350	Sept. 6	E. L. Williams	2.17	73
30	....do	2.44	139				

Daily gage height, in feet, of Sheboygan River near Sheboygan, Wis., for the year ending Sept. 30, 1916.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	2.45	2.12	2.07	16	.....	2.34	2.10	2.12
2	.....	2.27	2.08	1.89	17	.....	2.33	2.10	2.07
3	.....	2.31	2.07	2.02	18	.....	2.10	2.12	2.08
4	.....	2.25	2.09	1.91	19	.....	2.22	2.12	2.14
5	.....	2.22	2.54	1.98	20	.....	2.08	2.09	2.16
6	.....	2.20	2.40	2.13	21	.....	2.14	2.06	2.04
7	.....	2.22	2.22	2.14	22	.....	2.16	2.08	2.03
8	.....	2.22	2.22	2.21	23	.....	2.12	2.09	2.11
9	.....	2.07	2.16	2.12	24	.....	2.07	2.06	2.18
10	.....	2.08	2.10	2.14	25	.....	2.12	2.08	1.96
11	.....	2.14	2.28	2.08	26	.....	2.14	2.10	2.12
12	.....	2.12	2.22	2.12	27	.....	2.12	2.16	2.12
13	.....	2.10	2.28	2.08	28	.....	2.05	2.04	2.20
14	.....	2.13	2.19	2.10	29	.....	2.04	2.05	2.41
15	.....	2.06	2.12	2.06	30	2.48	1.95	2.02	2.34
					31	.....	2.05	2.06	.....

MILWAUKEE RIVER NEAR MILWAUKEE, WIS.

LOCATION.—In the NW. ¼ sec. 5, T. 7 N., R. 22 E., immediately above an old quarry near the north limits of Milwaukee, Milwaukee County, about half a mile below the concrete highway bridge and 1 mile above Mineral Spring road; about 5½ miles above the confluence of Milwaukee and Menominee rivers.

DRAINAGE AREA.—661 square miles (measured on map issued by the Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—April 30, 1914, to September 30, 1916.

GAGE.—Chain gage fastened to cantilever arm supported by two trees on the left bank of the river; read by Johanna Liebl October to March, by William Ploetz April to September.

CHANNEL AND CONTROL.—Bed of channel at gage heavy gravel; about 200 feet below the gage is a rock outcrop with a 4-foot fall which forms the control and is probably permanent. Below the control the river flows in an artificial channel which at one time was a quarry. Left bank above and below the control high and not subject to overflow; right bank above control of medium height; below the control the right bank is artificial and of such height that overflow will rarely occur.

DISCHARGE MEASUREMENTS.—Made by wading immediately above the gage section or from the lower members of a wooden railroad bridge about 700 feet below the gage. Bridge crosses an abandoned quarry, and the channel, being artificial, affords an excellent measuring section.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.8 feet, at 3 p. m., March 29 (discharge, about 4,130 second-feet); minimum stage recorded, 0.50 foot, at 8.31 a. m., August 2 (discharge, about 26 second-feet).

1914–1916: Maximum stage recorded, 5.58 feet, February 24, 1915 (discharge, 5,280 second-feet); minimum stage recorded, August 2, 1916.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—No diurnal fluctuation at the gage resulting from operation of small plants above.

ACCURACY.—Stage-discharge relation practically permanent, except for effect of ice. Rating curve well defined between 88 and 3,710 second-feet; poorly defined outside these limits. Gage read twice daily, to quarter-tenths. Discharge ascertained by applying mean daily gage heights to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained from results of discharge measurements, observer's notes, and weather records. Open-water records excellent, except for extremely high and low stages, for which they are only fair; winter records fair.

Discharge measurements of Milwaukee River near Milwaukee, Wis., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 4[a]	H. C. Beckman	2.47	509	May 11	F. A. Potts	2.32	1,190
Feb. 16[a]	W. G. Hoyt	2.06	216	June 20	H. C. Beckman	1.97	811
Mar. 30	do	4.15	3,230	Sept. 16	E. L. Williams	0.89	110

[a] Ice at control.

Daily discharge, in second-feet, of Milwaukee River near Milwaukee, Wis., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	340	176	1,220	367	3,020	92	2,260	1,270	210	301	48	93
2	302	184	820	532	2,890	89	2,140	1,790	235	294	37	86
3	263	184	734	569	2,760	83	1,680	1,460	264	259	54	93
4	254	184	734	509	1.790	83	1,460	1,220	327	185	93	86
5	227	176	569	427	1,360	83	1,130	908	327	162	494	88
6	218	168	569	367	997	92	997	692	235	88	908	86
7	210	122	532	263	734	100	864	569	1,180	140	777	185
8	197	138	494	218	569	117	692	532	2,260	120	532	150
9	184	112	427	197	494	138	610	569	2,500	120	320	195
10	184	122	427	176	427	176	532	569	2,500	86	294	247
11	184	131	415	168	367	218	532	1,040	2,020	111	820	143
12	184	157	415	138	312	367	460	1,090	1,680	83	692	146
13	210	168	397	138	263	569	385	908	1,270	93	460	120
14	227	240	356	146	263	650	460	820	1,090	88	420	140
15	302	263	312	157	218	692	460	952	1,270	83	247	120
16	302	146	254	161	216	650	460	1,220	1,180	69	181	104
17	397	146	227	176	187	610	494	1,090	1,360	83	154	114
18	367	288	218	218	187	569	532	908	1,040	76	143	93
19	356	569	218	240	187	494	997	650	864	91	146	117
20	302	734	218	263	187	864	2,500	494	777	140	140	109
21	302	997	218	312	176	777	1,680	427	569	101	140	93
22	302	820	210	427	176	777	1,460	494	427	93	120	93
23	254	734	206	569	176	952	1,220	692	460	205	109	109
24	210	777	201	997	157	1,570	952	734	427	114	101	93
25	254	734	197	1,360	138	1,790	777	569	367	111	93	93
26	227	734	184	1,900	138	2,380	692	427	373	86	83	120
27	197	908	184	3,150	122	2,890	569	360	288	76	69	120
28	197	1,180	197	3,570	105	3,710	494	360	241	64	109	241
29	184	1,460	210	2,890	92	4,130	460	294	210	66	114	282
30	184	1,460	240	3,150	.....	3,570	427	294	190	69	91	307
31	138	.....	263	3,020	.....	2,760	.....	294	.....	69	93	.....

NOTE.—Stage-discharge relation affected by ice Dec. 17 to Mar. 19.

Monthly discharge of Milwaukee River near Milwaukee, Wis., for the year ending Sept. 30, 1916.

[Drainage area, 661 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	397	138	247	0.374	0.43
November	1,460	112	474	.717	.80
December	1,220	184	383	.579	.67
January	3,570	138	864	1.31	1.51
February	3,020	92	645	.976	1.05
March	4,130	83	1,030	1.56	1.80
April	2,500	385	946	1.43	1.60
May	1,790	294	764	1.16	1.34
June	2,500	190	871	1.32	1.47
July	301	64	120	.182	.21
August	908	37	261	.395	.46
September	307	86	136	.206	.23
The year	**4,130**	**37**	**561**	**.849**	**11.57**

GRAND RIVER AT GRAND RAPIDS, MICH.

LOCATION.—At Fulton Street Bridge, Grand Rapids.

DRAINAGE AREA.—4,900 square miles.

RECORDS AVAILABLE.—March 12, 1901, to September 30, 1915.

GAGE.—Staff, attached to bridge; read daily, morning and evening, to tenths by C. A. Brink from October 1 to June 30 and by D. C. McIntyre from July 1 to September 30.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

EXTREMES OF STAGE.—Maximum stage recorded during year 15.8 feet at 4.45 p. m. March 30; minimum stage recorded, −1.2 feet, during most of August and September.

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

REGULATION.—Operation of power plants above station may modify low-water flow.

ACCURACY.—The two or three measurements made since 1905 indicate that the rating curve used in 1905 was not applicable after that year.

COOPERATION.—Records furnished by city engineer of Grand Rapids.

No discharge measurements made during the year.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.8	1.0	0.25	.....	6.55	4.65	14.45	1.45	3.5	3.4	−1.1	−1.2
2	2.2	1.02	.3	.....	6.5	4.2	.....	1.25	3.5	.....	−1.1	−1.2
3	.....	1.1	.2	0.45	6.5	3.45	11.9	1.35	3.4	3.35	−1.1	.....
4	1.5	1.0	.5	.3	.....	3.3	11.0	1.85	.....	.....	−1.08	.....
5	1.02	1.0	.....	3.35	.....	.....	10.1	1.55	2.0	1.8	−1.1	−1.1
6	.9	1.1	.9	3.0	.....	3.0	9.4	1.5	.....	1.05	.....	−1.18
7	.9	.....	1.2	2.0	11.1	3.0	8.6	.....	.....	.35	−1.1	−1.2
8	.55	1.08	1.15	3.5	11.05	2.5	7.6	1.5	.....	− .2	−1.1	−1.2
9	.32	1.0	.9	.....	10.9	2.5	.....	1.6	.....	.....	−1.1	−1.2
10	.....	1.0	.9	4.1	10.4	2.5	5.6	1.5	3.15	− .75	−1.1	.....
11	.1	1.12	.85	5.3	10.0	2.5	4.55	1.75	.....	− .85	−1.05	−1.2
12	.2	1.02	.....	7.0	9.65	.....	3.7	1.8	2.4	−1.0	−1.1	−1.2
13	.6	1.0	1.0	8.75	.....	3.0	3.15	1.9	2.15	−1.0	.....	−1.2
14	.48	.....	1.2	8.1	9.3	3.9	2.9	.....	2.1	−.98	−1.2	−1.2
15	.4	.98	1.2	7.85	9.35	4.4	2.7	1.75	2.05	−1.0	−1.2	−1.2
16	.5	1.0	1.2	.....	9.35	4.5	.....	2.6	2.1	.....	−1.2	−1.2
17	.....	.98	1.0	7.5	9.1	4.2	2.7	4.6	2.2	− .95	−1.2	.....
18	.5	1.05	1.0	7.25	9.05	4.0	2.7	5.6	.....	−1.0	−1.2	−1.2
19	.5	1.05	.....	6.75	8.65	.....	2.65	6.2	1.75	−1.0	−1.2	−1.2
20	.4	1.05	1.0	6.4	.....	3.0	2.55	6.5	1.6	−1.0	.....	−1.2
21	.2	.....	1.0	7.9	7.6	2.5	3.5	.....	1.4	−0.9	−1.2	−1.2
22	.38	1.0	1.0	10.65	.....	2.0	3.6	4.8	1.1	−1.0	.....	−1.2
23	.6	.45	1.2	.....	5.65	2.0	.....	3.45	.7	.....	−1.2	−1.2
24	.....	.55	1.1	12.55	5.65	2.0	3.6	3.0	.6	−1.05	−1.2	.....
25	.7	.....	.....	11.3	5.75	2.75	3.4	2.8	.....	−1.0	−1.2	−1.2
26	.75	.85	.....	9.75	5.95	.....	2.85	2.6	.8	−1.0	−1.2	−.95
27	1.0	.70	1.0	9.0	.....	8.85	2.6	2.4	1.65	−1.0	.....	− .9
28	.98	.....	1.0	8.05	5.65	11.35	2.4	.....	1.9	−1.0	−1.2	−1.1
29	.85	.....	1.0	7.0	5.25	14.25	1.65	1.5	1.5	−1.1	−1.2	−1.1
30	1.0	.50	1.0	.....	.....	15.7	.....	.....	1.9	.....	−1.2	−1.1
31	.....	.....	1.2	6.45	.....	15.4	.....	3.3	.....	−1.1	−1.2	.....

MANISTEE RIVER NEAR SHERMAN, MICH.

LOCATION.—At North Bridge, 1 mile from Sherman, immediately above mouth of Wheeler Creek.

DRAINAGE AREA.—900 square miles.

RECORDS AVAILABLE.—July 10, 1903, to May 31, 1916, when station was discontinued.

GAGE.—Chain gage; read by Eunice Munn.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year: 6.4 feet at 3.45 p. m., April 2 (discharge, 3,130 second-feet); minimum stage recorded, 1.00 foot at 8.45 a. m., January 17 (discharge, about 580 second-feet; flow held back by an ice jam above gage).

WINTER FLOW.—Stream freezes over and special studies are necessary to determine the winter flow. The constancy of flow is remarkable and is due to the fact that the water is derived from springs and ground water. A fairly close estimate of the discharge for the periods during which ice is present can be made by using climatic data and the general records.

ACCURACY.—No current-meter measurements were made at this station during the year and the accuracy of discharge estimates published in the following tables depends upon the constancy of the stage discharge relation subsequent to August 28, 1913, when the last current-meter measurement was made and upon the constancy of the length of the gage chain and of the position of the gage. Rating curve well defined between 885 and 2,880 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table.

Daily discharge, in second-feet, of Manistee River near Sherman, Mich., for the period Oct. 1, 1915, to May 31, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
1	1,030	993	1,200	955	1,280	955	3,070	1,510
2	993	993	1,200	1,110	1,280	919	3,130	1,510
3	993	993	1,160	1,110	1,200	955	3,010	1,560
4	993	955	1,110	1,070	919	955	2,950	1,560
5	993	955	1,030	1,070	955	993	2,880	1,600
6	955	955	1,030	1,030	993	957	2,760	1,600
7	993	955	1,030	1,030	993	921	2,640	1,650
8	955	955	1,070	1,030	1,030	885	2,340	1,600
9	993	955	1,030	993	1,070	885	2,170	1,600
10	993	955	1,030	1,030	1,110	955	2,120	1,600
11	993	993	1,030	1,070	1,110	955	2,060	1,650
12	955	993	1,030	955	1,160	993	1,950	1,700
13	955	993	1,030	955	1,160	993	1,850	1,650
14	955	993	993	955	1,110	1,030	1,850	1,600
15	955	1,030	955	919	1,070	1,070	1,900	1,560
16	955	1,030	919	919	1,110	1,070	1,900	1,510
17	955	1,030	1,030	608	1,160	1,070	1,950	1,460
18	1,110	1,030	1,030	697	1,200	1,030	1,950	1,460
19	1,330	1,110	1,030	758	1,200	955	2,010	1,420
20	1,370	1,280	993	885	1,110	955	2,010	1,420
21	1,330	1,370	885	1,200	1,070	955	2,060	1,370
22	1,280	1,370	919	1,700	1,110	955	2,120	1,420
23	1,240	1,280	955	1,750	1,110	919	2,340	1,460
24	1,160	1,200	993	1,800	1,160	955	2,290	1,510
25	1,110	1,200	993	1,850	1,160	1,070	2,120	1,460
26	1,070	1,200	993	1,850	1,110	1,330	1,900	1,420
27	1,070	1,240	993	1,900	1,070	1,560	1,800	1,420
28	1,030	1,280	955	1,900	1,030	1,800	1,650	1,370
29	993	1,240	955	1,800	993	2,120	1,600	1,330
30	993	1,240	919	1,600	.....	2,520	1,560	1,280
31	993	.....	955	1,460	.....	2,950	.....	1,240

Monthly discharge of Manistee River near Sherman, Mich., for the period Oct. 1, 1915, to May 31, 1916.

[Drainage area, 900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,370	955	1,050	1.17	1.35
November	1,370	955	1,090	1.21	1.35
December	1,200	885	1,010	1.12	1.29
January	1,900	608	1,220	1.36	1.57
February	1,280	919	1,100	1.22	1.32
March	2,950	885	1,180	1.31	1.51
April	3,130	1,560	2,200	2.44	2.72
May	1,700	1,240	1,500	1.67	1.92

STREAMS TRIBUTARY TO LAKE HURON.

TITTABAWASSEE RIVER AT FREELAND, MICH.

LOCATION.—At Highway bridge at Freeland.

DRAINAGE AREA.—2,530 square miles.

RECORDS AVAILABLE.—August 22, 1903, to August 3, 1906; October 28, 1906, to December 31, 1909; January 1, 1912, to September 30, 1916.

COOPERATION.—Estimates of daily discharge were made and furnished by G. S. Williams, consulting engineer, Ann Arbor, Mich.

Daily discharge, in second-feet, of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,993	1,635	4,000	1,365	3,420	1,469	20,000	3,475	3,810	2,000	1,040	1,020
2	1,905	1,670	3,195	1,687	3,390	1,365	16,000	4,250	3,520	1,865	1,020	1,010
3	1,905	1,635	3,055	1,760	3,330	1,320	15,000	5,475	3,910	1,670	1,020	1,000
4	1,865	1,600	2,480	2,060	3,285	1,264	13,600	5,275	3,590	1,480	1,020	1,020
5	1,833	1,560	2,600	2,725	2,775	1,267	9,980	4,770	3,520	1,385	1,000	1,020
6	1,825	1,600	2,896	3,402	2,645	1,264	9,010	4,250	3,475	1,300	990	1,000
7	1,809	1,600	2,430	3,170	2,620	1,244	8,400	3,590	3,570	1,270	1,000	1,020
8	1,745	1,635	2,527	2,470	2,525	1,224	6,650	3,475	3,810	1,335	1,020	1,010
9	1,713	1,600	2,430	2,060	2,430	1,215	6,090	3,493	6,750	1,235	1,040	990
10	1,670	1,560	2,250	1,880	2,340	1,191	4,800	4,600	8,244	1,235	1,020	912
11	1,635	1,560	2,075	1,855	2,275	1,185	4,200	9,010	8,220	1,170	1,050	900
12	1,600	1,520	1,880	1,830	2,250	1,191	3,665	8,575	7,500	1,140	1,055	930
13	1,584	1,520	1,673	1,760	2,250	1,244	3,665	6,360	6,480	1,140	1,050	930
14	1,560	1,520	1,545	1,626	2,250	1,300	3,683	5,375	5,829	1,600	1,050	960
15	1,020	1,340	1,545	1,522	2,222	1,410	3,710	4,970	5,125	2,245	1,060	990
16	990	1,270	1,535	1,410	2,200	1,522	3,900	5,325	4,570	1,995	1,080	990
17	1,635	1,249	1,522	1,300	2,182	1,478	4,200	4,950	4,550	1,785	1,060	998
18	1,833	1,520	1,522	1,365	2,162	1,455	3,973	4,070	4,570	1,600	1,050	990
19	2,150	1,600	1,483	1,342	2,125	1,432	3,910	3,570	4,550	1,480	1,060	960
20	2,270	2,400	1,442	1,365	2,110	1,390	3,810	3,330	3,955	1,340	1,080	930
21	2,440	3,380	1,365	3,010	2,100	1,410	5,275	3,760	3,620	1,315	1,080	900
22	2,570	3,100	1,342	3,500	2,040	1,432	8,575	4,460	3,015	1,325	1,060	930
23	2,520	2,965	1,365	3,500	1,880	1,464	8,364	4,250	2,875	1,300	1,050	930
24	2,400	2,745	1,390	3,500	1,760	1,478	6,930	3,810	2,655	1,200	1,040	960
25	2,246	2,400	1,410	3,500	1,760	1,491	6,035	3,240	2,675	1,120	1,020	990
26	2,025	2,230	1,432	3,500	1,687	1,855	5,086	3,195	2,655	1,110	1,020	1,020
27	1,841	2,270	1,455	3,500	1,627	8,000	4,500	3,177	2,400	1,100	1,020	1,020
28	1,785	2,315	1,442	3,500	1,545	12,000	4,100	3,150	2,315	1,080	990	1,050
29	1,705	2,610	1,432	3,500	1,522	20,000	3,620	3,082	2,245	1,050	990	1,140
30	1,670	4,756	1,410	3,420	.....	25,000	3,240	3,055	2,155	1,050	1,000	1,200
31	1,600	.....	1,300	3,237	.....	25,000	.....	4,070	.....	1,050	1,020	.....

Monthly discharge of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1916.

[Drainage area, 2,530 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,570	990	1,850	0.731	0.84
November	4,750	1,249	2,010	.794	.89
December	4,000	1,300	1,920	.759	.88
January	3,500	1,300	2,440	.964	1.11
February	3,420	1,522	2,300	.909	.98
March	25,000	1,185	4,050	1.60	1.84
April	20,000	3,240	6,800	2.69	3.00
May	9,010	3,055	4,430	1.75	2.02
June	8,244	2,155	4,210	1.66	1.85
July	2,245	1,050	1,390	.549	.63
August	1,080	990	1,030	.407	.47
September	1,200	900	991	.392	.44
The year	25,000	900	2,780	1.10	14.95

NOTE.—Monthly and yearly discharge computed by engineers of the U. S. Geological Survey.

STREAMS TRIBUTARY TO LAKE ERIE.

HURON RIVER AT DEXTER, MICH.

LOCATION.—At the highway bridge at Dexter, one-fourth mile below mouth of Mill Creek.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 1, 1904, to April 1, 1916, when station was discontinued.

GAGE.—Standard chain attached to bridge; read daily, morning and evening by D. M. Litchfield.

DISCHARGE MEASUREMENTS.—Made from a boat several hundred feet below gage or from bridge.

CHANNEL AND CONTROL.—The high water that carried out the gage on March 12, 1908, caused permanent change in bed of river; a small headrace runs to an abandoned mill on left bank; at ordinary stages little or no water flows into this headrace, but at high stages a small quantity of water may pass through it around the gage.

EXTREMES OF STAGE.—Maximum stage recorded during year: 4.95 feet, at 5 p. m., March 31; minimum stage recorded, 0.0 foot, November 11.

ICE.—Little ice forms at this section; current swift.

COOPERATION.—Gage-height record furnished by Eastern Michigan Edison Co., Washtenaw division, Ann Arbor.

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

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Daily gage height, in feet, of Huron River at Dexter, Mich., for the period Oct. 1, 1915, to Apr. 1, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1	1.12	0.15	0.50	0.28	2.50	0.75	4.80
2	1.28	.12	.52	1.25	2.55	.75	.....
3	1.18	.10	.48	1.40	1.98	.58	.....
4	1.08	.10	.40	1.40	1.88	.48	.....
5	.90	.10	.38	1.42	1.65	.38	.....
6	.88	.12	.32	1.38	1.55	.35	.....
7	.78	.12	.30	1.32	1.50	.40	.....
8	.68	.10	.30	1.20	1.58	.72	.....
9	.60	.10	.28	1.05	1.70	.80	.....
10	.60	.05	.22	.90	1.48	.80	.....
11	.60	.00	.20	.88	1.25	.78	.....
12	.52	.20	.20	.92	1.08	.78	.....
13	.50	.18	.20	1.05	.88	1.08	.....
14	.48	.15	.18	.80	.80	1.18	.....
15	.45	.20	.18	.80	.72	1.18	.....
16	.48	.20	.18	.82	.58	.98	.....
17	.45	.20	.15	1.25	.60	.90	.....
18	.50	.22	.20	2.55	.52	1.00	.....
19	.48	.45	.15	3.10	.58	.80	.....
20	.45	.55	.10	3.05	.50	.70	.....
21	.38	.60	.10	2.70	.48	.68	.....
22	.38	.55	.10	2.20	.45	.78	.....
23	.40	.52	.12	1.50	.62	.70	.....
24	.32	.52	.18	1.45	.78	.60	.....
25	.30	.60	.22	1.42	.90	.85	.....
26	.28	.60	.22	1.48	.82	3.02	.....
27	.28	.62	.18	1.78	.80	4.55	.....
28	.28	.70	.18	1.90	.78	4.45	.....
29	.22	.60	.18	1.85	.68	4.35	.....
30	.20	.58	.15	1.95	.....	4.50	.....
31	.18	.....	.20	2.88	.....	4.92	.....

HURON RIVER AT BARTON, MICH.

LOCATION.—At dam and power plant of the Eastern Michigan Edison Co. at Barton, near Ann Arbor, 4 miles above the station at Geddes.

DRAINAGE AREA.—723 square miles.

RECORDS AVAILABLE.—January 1 to September 30, 1916.

DETERMINATION OF DISCHARGE.—Flow computed from records of operation of power plant, the flow through under-sluices during floods, and the depth of flow over dam. The flow through the power house is determined from a calibration of the turbines by means of a specially constructed weir, the crest of which was formed by a ¼-inch by 5-inch milled plate, the discharge over the weir being computed by Bazin's formula for free overflow. The greater part of the flood water passes through under-sluices in the power-house foundations, and this flow is determined from a weir calibration of the sluices. Water flows over crest of dam only a few days during the year.

COOPERATION.—Estimates of daily discharge made and furnished by G. S. Williams, consulting engineer, Ann Arbor, Mich.

Daily discharge, in second-feet, of Huron River at Barton, Mich., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	754	339	508	406	1,671	601	3,506	824	1,080	757	243	177
2	776	308	516	1,055	1,467	516	3,350	791	1,021	745	218	146
3	774	299	478	952	1,265	573	2,973	797	1,019	555	204	130
4	756	314	515	909	1,068	495	2,531	840	1,007	496	192	22
5	711	292	406	1,040	1,416	475	2,293	809	978	424	177	163
6	688	297	478	958	1,222	463	2,116	744	875	406	161	164
7	653	276	444	750	1,005	624	1,905	762	952	339	172	180
8	605	302	425	763	847	749	1,765	752	973	342	188	149
9	549	289	395	757	906	631	1,632	680	971	343	153	154
10	559	285	410	695	816	615	1,486	742	887	293	174	101
11	535	307	375	735	764	634	1,385	719	839	266	175	129
12	548	306	324	775	725	810	1,287	783	824	253	183	124
13	480	353	340	801	591	895	1,215	613	808	291	146	120
14	539	238	329	588	563	896	1,225	677	782	243	161	126
15	481	421	267	571	645	777	1,133	1,349	828	249	118	129
16	502	455	336	553	637	788	1,164	1,766	808	264	119	118
17	435	332	335	447	557	689	1,175	1,522	688	203	115	126
18	593	354	344	404	616	747	1,172	1,386	699	213	123	159
19	417	428	308	449	482	694	1,215	1,349	682	206	185	159
20	474	567	304	455	494	662	1,338	1,281	548	259	46	110
21	476	344	532	756	529	693	1,242	1,261	604	192	151	135
22	463	533	304	1,176	538	743	1,123	1,234	559	244	143	109
23	425	524	634	1,102	717	572	1,186	1,301	526	275	174	97
24	425	549	296	1,008	746	600	1,144	1,256	646	352	189	38
25	420	540	288	981	745	899	1,087	1,113	619	259	184	136
26	418	561	350	1,072	763	2,658	1,053	1,022	525	306	189	133
27	386	560	368	1,157	639	3,951	1,021	1,019	535	230	107	148
28	399	550	319	1,273	611	3,500	1,005	917	508	267	141	192
29	379	545	293	1,298	629	3,226	1,045	884	502	282	144	195
30	366	529	332	1,291	.....	3,378	840	1,062	566	321	134	171
31	325	.....	339	2,346	.....	3,664	.....	1,121	.....	390	132	.....

Monthly discharge of Huron River at Barton, Mich., for the year ending Sept. 30, 1916.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	776	325	526	0.728	0.84
November	567	238	400	.553	.62
December	634	267	384	.531	.61
January	2,346	404	888	1.23	1.42
February	1,671	482	816	1.13	1.22
March	3,951	463	1,200	1.66	1.91
April	3,506	840	1,550	2.14	2.39
May	1,766	613	1,010	1.40	1.61
June	1,080	502	762	1.05	1.17
July	757	192	331	.458	.53
August	243	46	159	.220	.25
September	195	22	135	.187	.21
The year	3,951	22	680	.941	12.78

NOTE.—Monthly and yearly discharge computed by engineers of the U. S. Geological Survey.

HURON RIVER AT FLAT ROCK, MICH.

LOCATION.—At the highway bridge at Flat Rock, 2,000 feet below the crossing of Detroit, Toledo & Ironton Railway.

DRAINAGE AREA.—1,000 square miles.

RECORDS AVAILABLE.—August 6, 1904, to September 30, 1916.

GAGE.—Staff; read daily, morning and evening, to tenths, by C. L. Metler.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Probably permanent.

EXTREMES OF STAGE.—Maximum stage recorded during year, 10.4 feet, at 7 a. m., March 28; minimum stage recorded, 1.0 foot, September 5, 11, 12, 14, and 26.

ICE.—Ice jams form below the station and cause backwater at the gage; in general the section above the station is kept open by the power plant.

REGULATION.—At ordinary stages flow of the river is controlled by a dam and power plant immediately above station, but operation of this plant is assumed to have little effect on diurnal fluctuations of stage.

COOPERATION.—Gage-height record furnished by Eastern Michigan Edison Co., Washtenaw division, Ann Arbor, Mich.

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

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.3	2.2	2.9	2.0	7.85	4.65	8.65	4.0	5.05	2.85	2.2	1.25
2	4.3	2.2	2.9	3.6	8.3	4.35	8.7	3.95	4.8	3.6	1.9	1.2
3	4.3	2.15	2.8	6.1	6.7	4.7	8.6	4.0	4.5	3.6	1.65	1.3
4	3.85	2.15	2.8	6.4	8.5	4.5	8.4	4.0	4.3	3.6	1.55	1.25
5	4.15	1.85	2.8	5.5	8.15	4.2	8.05	4.0	4.3	2.75	1.55	1.0
6	3.7	1.65	2.65	5.65	8.2	4.05	7.75	3.95	4.3	2.55	1.5	1.15
7	3.7	1.7	2.7	5.2	8.0	3.9	7.3	4.0	4.7	2.45	1.5	1.15
8	3.6	1.6	2.65	4.75	7.2	4.85	7.1	3.65	5.05	2.4	1.8	1.5
9	3.3	2.2	2.75	4.6	6.8	6.2	6.7	3.8	4.95	1.6	1.5	1.5
10	.....	2.0	2.35	4.4	6.85	4.85	6.45	3.45	4.9	1.7	1.45	1.3
11	2.85	2.0	2.3	4.1	7.15	4.85	6.0	3.55	4.6	1.55	1.45	1.0
12	3.05	2.0	2.3	3.9	6.6	4.9	5.65	3.8	4.3	2.2	1.35	1.0
13	2.9	2.05	2.3	4.65	6.2	5.7	5.5	3.7	4.05	1.75	1.5	1.1
14	2.9	2.0	2.3	4.9	6.0	6.4	5.3	3.4	3.9	1.75	1.5	1.0
15	2.95	1.85	2.3	3.6	5.6	5.8	5.2	4.4	4.0	1.75	2.0	1.2
16	2.8	2.5	2.35	3.0	5.65	5.2	5.0	5.9	4.2	1.8	1.8	1.55
17	2.8	2.8	2.2	3.0	5.95	5.2	4.9	6.9	3.9	1.6	1.55	1.4
18	2.65	2.3	2.05	3.95	5.75	4.7	5.0	6.55	3.5	1.9	1.4	1.3
19	3.0	2.25	2.0	4.15	5.45	4.6	5.1	5.85	3.45	1.6	1.45	1.2
20	2.8	3.0	2.0	4.0	4.4	4.55	5.35	5.6	3.3	1.5	1.4	1.65
21	2.7	2.7	2.5	3.9	4.85	4.4	5.55	5.3	3.55	1.55	1.3	1.6
22	2.7	2.35	2.5	4.65	4.7	4.75	5.55	5.25	3.1	1.75	1.1	1.35
23	2.95	3.15	1.95	6.0	4.9	5.15	5.05	5.35	3.0	1.6	1.1	1.45
24	2.6	3.05	2.1	6.45	6.0	4.65	4.95	5.35	2.9	1.5	1.2	1.4
25	2.15	3.0	.....	5.55	6.25	4.4	5.1	5.4	3.3	2.15	1.2	1.3
26	2.7	3.0	.....	5.05	5.5	6.9	4.8	5.0	3.1	1.85	1.35	1.0
27	2.65	3.0	2.0	5.3	4.9	9.45	4.7	4.6	3.0	1.75	1.2	1.4
28	2.45	3.0	2.7	5.95	4.6	10.25	4.45	4.6	2.7	1.8	1.1	1.5
29	2.4	2.85	2.8	6.05	4.8	9.2	4.35	4.45	2.6	1.8	1.05	1.4
30	2.35	3.3	2.15	5.7	.....	8.6	4.2	5.4	2.6	1.7	1.35	1.35
31	2.4	.....	2.05	7.15	.....	8.5	.....	5.0	.....	1.55	1.2	.....

CATTARAUGUS CREEK AT VERSAILLES, N. Y.

LOCATION.—At the three-span highway bridge in the village of Versailles, Cattaraugus County, 2¼ miles above mouth of Clear Creek, about 6 miles below Gowanda, and about 8 miles above mouth of stream.

DRAINAGE AREA.—467 square miles (measured on Post-Route map).

RECORDS AVAILABLE.—September 23, 1910, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and the State of New York conservation commission.

GAGE.—Chain, on upstream side of right span of bridge; read by James Palmer.

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

CHANNEL AND CONTROL.—Rock and gravel, shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.7 feet at 2 p. m., March 28 (discharge, about 14,000 second-feet); minimum stage recorded, 4.45 feet, several times during September (discharge, 64 second-feet).

1910–1916: Maximum stage recorded, 11.6 feet at 5.40 p. m. March 25, 1913 (discharge, about 30,000 second-feet); minimum stage recorded, 4.65 feet August 21, September 6 and 7, 1913 (discharge, 55 second-feet).

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

ACCURACY.—Stage-discharge relation not permanent; affected by ice for a considerable portion of February and March. A shift in the control occurred during the high water of March 27 to 29, and again during the high water on May 17. Rating curve used October 1 to March 27 well defined between 200 and 2,000 second-feet; other rating curves not well defined. Indirect method for shifting control used from May 17 to June 10. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results fair except for periods when the stage-discharge relation was affected by ice, and possibly when shift occurred in control.

Discharge measurements of Cattaraugus River at Versailles, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec.-ft.*
Feb. 29[a]	A. H. Davison	6.91	419	June 15	E. D. Burchard	5.28	549
Mar. 29	C. S. DeGolyer	7.72	6,220	July 23	do	4.86	221
29	do	7.61	5,670	23	do	4.86	222
May 19	E. D. Burchard	5.95	1,610	Sept. 9	do	4.84	204
19	do	5.87	1,480	9	do	4.82	201
June 15	do	5.25	522				

[a] Complete ice cover.

Daily discharge, in second-feet, of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	222	253	702	948	1,610	515	4,310	725	625	310	143	81
2	1,270	253	790	13,300	790	515	3,670	648	522	474	143	81
3	675	253	702	3,260	402	515	1,890	670	551	985	135	81
4	468	286	702	1,610	568	422	1,890	900	680	522	124	72
5	2,600	268	675	2,020	760	422	1,330	692	738	456	124	75
6	1,270	268	675	5,210	760	422	1,200	582	625	386	124	90
7	1,810	253	594	1,810	702	422	965	510	680	310	113	75
8	1,200	268	568	850	286	422	926	480	1,270	297	113	105
9	1,020	253	568	702	268	515	876	460	985	245	124	200
10	1,120	268	468	915	238	2,980	840	416	703	245	113	152
11	675	253	541	1,270	222	2,980	804	373	1,050	245	113	113
12	541	268	541	820	194	2,240	1,330	335	1,020	245	135	105
13	445	253	648	1,430	182	1,610	2,570	312	680	234	234	81
14	360	253	541	790	170	1,080	9,600	312	522	1,320	234	81
15	2,360	286	402	541	157	948	2,960	460	493	430	166	105
16	980	445	568	675	157	760	1,420	4,310	1,710	297	113	99
17	594	340	675	445	157	648	1,200	8,860	1,050	245	105	75
18	492	340	3,870	381	157	568	1,060	2,600	946	245	124	81
19	2,980	702	1,120	882	157	541	840	1,520	946	217	124	81
20	1,080	1,430	1,120	1,120	157	492	840	1,220	1,380	200	113	75
21	730	1,430	790	1,810	157	445	2,830	1,020	985	189	105	81
22	541	1,120	820	5,210	157	445	7,610	895	895	189	113	81
23	402	882	790	1,710	157	422	2,570	3,880	703	200	113	90
24	360	948	1,050	1,020	182	402	1,690	1,380	592	200	81	90
25	360	1,200	1,610	1,020	340	381	1,300	1,190	456	189	81	90
26	304	1,430	2,850	1,050	360	1,520	1,890	1,160	404	180	99	81
27	286	1,610	1,430	1,120	381	11,100	1,690	1,080	386	180	124	75
28	286	1,350	1,080	1,430	422	13,600	1,600	1,160	348	189	99	61
29	286	948	850	1,020	468	7,220	1,140	858	325	189	81	61
30	304	850	594	1,050	.....	4,310	804	795	325	152	81	81
31	268	.....	760	1,120	.....	4,650	.....	738	.....	143	81	.....

NOTE.—Discharge Feb. 9 to Mar. 9 estimated, because of ice, from one discharge measurement, weather records, study of gage-height graph and comparison with records for adjacent streams.

Monthly discharge of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 467 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,980	222	848	1.82	2.10
November	1,610	253	632	1.35	1.51
December	3,870	402	939	2.01	2.32
January	13,300	381	1,820	3.90	4.50
February	1,610	157	370	.792	.85
March	13,600	381	2,050	4.39	5.06
April	9,600	804	2,120	4.54	5.06
May	8,860	312	1,310	2.81	3.24
June	1,710	325	753	1.61	1.80
July	1,320	143	320	.685	.79
August	234	81	122	.261	.30
September	200	61	90	.193	.22
The year	13,600	61	952	2.04	27.75

STREAMS TRIBUTARY TO LAKE ONTARIO.

LITTLE TONAWANDA CREEK AT LINDEN, N. Y.

LOCATION.—At the stone-arch highway bridge in the village of Linden, Genesee County, about 3 miles above the junction with Tonawanda Creek.

DRAINAGE AREA.—22 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 8, 1912, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Vertical staff on right upstream abutment of bridge; lower 2 feet of enameled iron, graduated to hundredths of foot; upper 4 feet of bronze, graduated to half-tenths. Gage read by C. L. Schenck.

DISCHARGE MEASUREMENTS.—Made from a cable 1,000 feet above gage or by wading near gage.

CHANNEL AND CONTROL.—A standard Francis weir 2.01 feet long and 8 inches high has been constructed under the upstream side of the bridge. When the water overtops this weir it flows over a 2-inch plank about 13 feet long, including the 2 feet of weir.

EXTREMES OF DISCHARGE.—1912–1916: Maximum stage 14.6 feet during the flood of April 22, 1916, determined by leveling from flood marks (discharge about 2,400 second-feet); minimum stage recorded during year, 0.21 foot at 8.30 a. m., September 23, 1916 (discharge, 0.55 second-foot); minimum stage recorded, 1912–1916: 0.18 foot August 20 and 21, September 14 to 16 and October 8, 1913 (discharge, 0.43 second-foot).

ACCURACY.—Stage-discharge relation permanent; not affected by ice or back water. Rating curve well defined below 800 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results good for all except extremely high stages, for which they are fair.

Discharge measurements of Little Tonawanda Creek at Linden, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 30	C. S. De Golyer	4.56	354	June 16	E. D. Burchard	1.92	79.8
Apr. 27	E. D. Burchard	3.24	206	June 16	do	1.90	74.5
27	do	3.28	214				

Daily discharge, in second-feet, of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.62	3.7	11	51	43	7.8	316	26	12	5.1	2.25	0.91
2	14	3.36	12	770	20	7.5	164	24	187	4.9	2.12	1.07
3	9.0	3.00	11	95	13	7.2	99	28	274	71	2.12	.91
4	5.6	3.07	10	63	10	6.9	79	32	79	26	2.12	.96
5	18	4.1	9.7	261	9.7	6.6	71	21	71	11	1.99	.87
6	12	4.2	8.7	117	10	6.4	59	16	37	7.2	1.99	.91
7	7.8	3.6	8.7	51	6.9	9.7	41	14	25	5.9	1.74	.96
8	6.4	3.36	8.4	27	9.0	14	37	20	43	4.9	1.81	1.39
9	5.6	3.21	8.1	21	8.4	14	38	15	31	4.2	1.74	1.07
10	6.6	2.93	8.4	26	7.8	9.7	41	12	20	3.9	1.74	.96
11	5.6	2.93	9.0	32	7.8	16	47	10.4	135	4.2	1.74	.96
12	4.2	2.93	9.0	22	7.8	15	75	7.8	59	3.5	1.68	.82
13	3.36	3.00	9.0	55	7.8	16	122	6.9	29	29	2.65	.77
14	3.07	2.93	7.5	21	7.8	20	390	6.6	18	55	1.62	.77
15	15	4.1	8.4	16	7.2	16	95	19	25	13	1.51	.91
16	9.0	6.1	8.4	14	7.5	16	55	810	37	7.8	1.51	.87
17	7.2	4.9	9.4	12	7.8	13	51	274	104	5.6	1.51	.87
18	5.6	4.6	108	9.7	7.5	13	34	112	39	3.9	1.45	.87
19	17	7.2	51	9.7	6.9	13	24	59	47	3.6	1.45	.77
20	11	15	25	9.7	6.6	12	24	43	51	3.36	1.34	.72
21	7.8	21	24	91	6.1	12	71	26	35	3.07	1.28	.68
22	6.1	16	20	223	6.6	11	484	87	24	3.14	1.17	.68
23	5.1	14	20	51	6.6	11	164	126	16	2.93	1.12	.68
24	4.6	13	23	38	6.1	10	99	47	13	2.79	1.17	.77
25	4.4	13	104	22	7.8	13	91	25	13	2.72	1.12	.77
26	4.2	37	83	35	7.2	33	108	17	9.7	2.72	1.07	.72
27	3.6	32	47	63	6.6	484	175	26	8.1	3.36	1.23	.77
28	3.5	25	34	59	6.1	1,090	75	26	6.9	3.07	1.28	.59
29	3.36	17	26	21	7.8	516	43	15	6.6	2.12	1.12	.68
30	4.1	13	40	21	.....	390	33	30	6.4	2.51	.96	.68
31	4.2	.....	24	63	.....	330	.....	19	.....	2.51	.96	.....

Monthly discharge of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 22.0 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	18	1.62	7.04	0.320	0.37
November	37	2.93	9.64	.438	.49
December	108	7.5	25.4	1.15	1.33
January	770	9.7	76.5	3.48	4.01
February	43	6.1	9.43	.429	.46
March	1,090	6.4	101	4.59	5.29
April	484	24	107	4.87	5.43
May	810	6.6	64.5	2.93	3.38
June	274	6.4	48.7	2.21	2.47
July	71	2.12	9.8	.445	.51
August	2.65	.96	1.57	.071	.08
September	1.39	.59	.85	.039	.04
The year	1,090	.59	38.6	1.75	23.86

GENESEE RIVER AT SCIO, N. Y.

LOCATION.—At the steel highway bridge, one-fourth mile above Vandermark Creek, half a mile above the village of Scio, Allegany County, and 1 mile above Knight Creek.

DRAINAGE AREA.—297 square miles (measured on United States Geological Survey map of scale 1:500,000).

RECORDS AVAILABLE.—June 12 to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Vertical staff attached to downstream face of left bridge abutment; read by Raymond Sisson.

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

CHANNEL AND CONTROL.—Coarse gravel; probably permanent.

EXTREMES OF STAGE.—Maximum stage recorded, 8.7 feet at 8 a. m. June 17; minimum stage recorded, 0.60 foot August 25 and 26.

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

Discharge measurements of Genesee River at Scio, N. Y., during the year ending Sept. 30, 1916.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec-ft.*		*Feet.*	*Sec.-ft.*
June 12	2.31	953	June 20	3.27	1,560
14	2.00	595	July 24	.80	67.2
14	1.93	562	Sept. 11	.70	43.1
20	3.62	1,900	11	.68	36.5
20	3.43	1,700	11	.68	37.3

Daily discharge, in second-feet, of Genesee River, at Scio, N. Y., for the year ending Sept. 30, 1916.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		336	61	43	16	1,070	114	41	61
2		298	61	41	17	8,850	111	51	53
3		361	61	41	18	3,050	104	41	59
4		298	61	45	19	2,100	88	41	57
5		242	61	41	20	1,680	80	43	55
6		194	57	43	21	1,400	80	41	53
7		170	51	41	22	1,310	104	41	57
8		154	47	43	23	815	83	38	55
9		136	45	41	24	720	72	28	57
10		132	41	41	25	920	69	25	41
11		166	45	45	26	572	66	25	41
12	850	128	55	41	27	490	66	28	41
13	720	154	53	41	28	920	61	57	43
14	572	242	41	49	29	490	61	45	53
15	600	143	41	88	30	438	61	41	45
					31		64	41	

Monthly discharge of Genesee River at Scio, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 297 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
June, 12–30	8,850	438	1,450	4.88	2.04
July	361	61	143	.481	.55
August	61	25	45.4	.153	.18
September	88	41	48.5	.163	.18

GENESEE RIVER AT ST. HELENA, N. Y.

LOCATION.—At the steel highway bridge in the hamlet of St. Helena, Wyoming County, about 5½ miles below the village of Portageville and the site of the proposed storage dam of the State of New York Conservation Commission, and 9½ miles above the mouth of Canaseraga Creek.

DRAINAGE AREA.—1,030 square miles.

RECORDS AVAILABLE.—August 14, 1908, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Gurley seven-day water-stage recorder, installed July 22, 1916. Prior to this date a chain fastened to the upstream side of the bridge, middle span, installed August 14, 1908, and a Gurley printing water-stage recorder, installed August 24, 1911. Water-stage recorder inspected and chain gage read by Herman Piper.

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

CHANNEL AND CONTROL.—Gravel and rocks; shifting occasionally.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 12.81 feet at 8 a. m. May 17 (discharge 43,500 second-feet); minimum stage, from water-stage recorder, 1.83 feet at 11 p. m. September 3 (discharge, 52 second-feet).

1908–1916: Maximum stage, from water-stage recorder, May 17, 1916; minimum stage recorded, 1.70 feet at 5 p. m. October 5 and 8 a. m. October 17, 1913 (discharge, about 18 second-feet).

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

ACCURACY.—Stage-discharge relation probably permanent between dates of shifting, except as affected by ice. Rating curve used October 1 to March 28 and January 18 to September 30 well defined between 75 and 2,000 second-feet and fairly well defined between 2,000 and 30,000 second-feet. Rating curve used March 29 to June 17 fairly well defined between 600 and 3,500 second-feet and well defined between 3,500 and 27,000 second-feet. Operation of water-stage recorder satisfactory throughout year. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by averaging hourly gage heights from the printed record or by inspecting gage-height graph from the seven-day recorder.

Discharge measurements of Genesee River at St. Helena, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 21[a]	O. W. Hartwell	3.38	728	Apr. 22	C. S. De Golyer	10.29	24,400
Feb. 15[b]	C. S. De Golyer	4.00	455	28	E. D. Burchard	6.08	4,940
26[a]	A. H. Davison	5.13	571	28	do	5.98	4,670
Mar. 16[a]	C. S. De Golyer	5.48	326	May 11	do	3.62	797
28	do	10.17	28,100	11	do	3.61	763
Apr. 1	do	8.65	14,600	July 23	do	2.77	330
13	do	7.11	8,170	Sept. 8	do	2.62	244

[a] Complete ice cover. [b] Incomplete ice cover.

Daily discharge, in second-feet, of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.
1	219	443	932	1,420	3,440	568	17,700	2,000	970	976	177	128
2	1,820	402	820	8,360	2,150	530	14,500	1,640	815	900	166	115
3	1,230	389	774	10,000	1,240	485	7,750	1,460	2,160	1,390	150	77
4	729	429	729	8,680	672	471	6,410	2,000	4,330	1,240	150	108
5	5,020	422	672	9,680	712	443	4,580	1,580	2,560	910	144	110
6	3,330	450	600	12,800	900	436	4,090	1,300	1,930	720	130	106
7	1,820	429	552	5,420	712	436	3,110	1,150	1,510	608	157	104
8	1,360	396	538	3,000	415	680	2,830	1,020	3,740	530	150	184
9	1,010	376	522	2,160	350	1,020	2,560	970	2,740	478	141	215
10	954	376	429	1,970	334	1,020	2,230	870	2,560	471	135	166
11	774	350	443	2,020	300	860	2,560	779	3,420	457	132	180
12	608	382	370	1,570	295	720	4,700	676	3,420	443	135	138
13	508	443	492	2,060	295	624	7,400	602	2,310	600	154	128
14	443	492	443	1,210	344	584	13,500	560	1,780	1,540	206	115
15	3,440	396	328	720	478	568	10,800	655	1,720	890	184	90
16	2,690	640	356	508	640	600	4,830	11,300	5,950	592	160	138
17	1,580	648	500	450	616	624	3,420	29,000	8,100	471	160	173
18	1,200	632	2,790	429	552	640	3,020	7,400	10,600	402	130	166
19	2,020	870	3,560	429	485	624	2,310	4,090	6,160	363	130	157
20	2,020	2,590	1,920	471	457	624	2,000	3,020	7,270	322	90	138
21	1,880	2,350	1,210	910	443	632	5,230	2,230	4,520	295	138	130
22	1,420	2,590	1,080	3,560	450	640	20,600	1,790	4,400	306	122	130
23	1,100	1,820	1,050	3,440	464	640	10,800	5,660	3,040	312	110	112
24	880	1,500	954	1,720	485	1,020	6,260	3,020	2,460	295	98	100
25	738	1,260	1,330	1,350	552	1,250	4,330	2,080	2,460	245	122	150
26	672	1,660	5,280	1,240	568	1,390	5,370	1,930	2,090	224	112	115
27	608	3,110	2,690	1,900	584	9,000	5,950	1,560	1,580	215	85	115
28	552	2,690	2,000	3,560	545	21,700	4,960	1,790	1,440	211	135	110
29	492	1,560	1,290	2,490	608	21,800	3,210	1,570	1,700	195	118	115
30	471	1,150	860	1,510	.....	18,800	2,480	1,280	1,170	166	87	115
31	464	.....	1,190	1,820	.....	20,000	.....	1,170	.....	195	118	.....

NOTE.—Stage-discharge relation affected by ice Jan. 15–21 and Feb. 9 to Mar. 27; discharge estimated from current-meter measurements, weather records, and study of gage-height graph.

Monthly discharge of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,020	219	1,360	1.32	1.52
November	3,110	350	1,040	1.01	1.13
December	5,280	328	1,180	1.15	1.33
January	12,800	429	3,120	3.03	3.49
February	3,440	295	693	.673	.73
March	21,800	436	3,530	3.43	3.95
April	20,600	2,000	6,320	6.14	6.85
May	29,000	560	3,100	3.01	3.47
June	10,600	815	3,300	3.20	3.57
July	1,540	166	547	.531	.61
August	206	87	136	.132	.15
September	215	77	131	.127	.14
The year	29,000	77	2,040	1.98	26.94

GENESEE RIVER AT JONES BRIDGE, NEAR MOUNT MORRIS, N. Y.

LOCATION.—At highway bridge known as Jones Bridge, 1½ miles below Canaseraga Creek, about 1¼ miles above mouth of Beads Creek, 5 miles below village of Mount Morris, Livingston County, and 6 miles, by river, above village of Geneseo.

DRAINAGE AREA.—1,410 square miles.

RECORDS AVAILABLE.—May 22, 1903, to April 30, 1906; August 12, 1908, to December 31, 1913; July 12, 1915, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Gurley seven-day water-stage recorder installed September 11, 1915, on right bank about 60 feet downstream from the bridge. Gage used prior to 1915 was a chain gage fastened to upstream side of highway bridge. Datum of water-stage recorder 2.73 feet higher than that of chain gage. Water-stage recorder inspected by Theron S. Trewer.

DISCHARGE MEASUREMENTS.—Made from footbridge erected on the lower chord of the upstream truss of bridge.

CHANNEL AND CONTROL.—Sandy clay; likely to shift but, as shown by current-meter measurements, fairly permanent in recent years.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 25.44 feet at noon May 17 (discharge 55,100 second-feet); minimum stage from water-stage recorder, 0.60 foot at 1 a. m. September 1 (discharge, 86 second-feet).

1903–1916 (not including periods of no record; see "Records available"): Maximum stage recorded May 17, 1916; minimum stage recorded, 2.7 feet at 6 p. m. August 29, 1909 (discharge about 18 second-feet).

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

REGULATION.—During extremely low water there is some diurnal fluctuation in flow from mills at Mount Morris.

ACCURACY.—Stage-discharge relation practically permanent between dates of shift, except as affected by ice in January, February and March and by back water from an ice jam at Geneseo and flooding of flats during short periods in April. Rating curve well defined between 150 and 1,000 second-feet and fairly well defined between 1,000 and 60,000 second-feet. Operation of the water-stage recorder satisfactory throughout the year except when intake was clogged with mud. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting gage-height graph.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 13	C. C. Covert	4.66	2,030	Apr. 17	E. D. Burchard	9.47	5,110
19[a]	O. W. Hartwell	4.73	500	19	do	6.54	3,440
Feb. 17[a]	C. C. Covert	5.02	577	22	do	23.25	21,000
25[a]	A. H. Davison	4.68	561	23	do	22.39	16,100
Mar. 18[a]	C. C. Covert	4.20	710	24	do	19.00	11,700
Apr. 3	do	20.90	13,200	24	do	18.64	11,200
5	do	12.75	7,040	25	do	13.16	7,420
12	E. D. Burchard	10.20	6,110	May 14	do	2.62	840
13	do	10.12	5,740	17	do	25.32	53,400
14	do	19.96	16,600	Sept. 7	do	1.04	188
15	do	21.85	15,900	7	do	1.02	183

[a] Ice at control.

Daily discharge, in second-feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the years ending Sept. 30, 1915 and 1916.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1915.				1915.			
1		2,030	755	16	1,030	474	336
2		2,400	657	17	4,810	540	311
3		1,850	531	18	3,750	495	311
4		2,270	478	19	1,610	433	343
5		2,830	437	20	1,360	394	482
6		1,500	437	21	1,000	375	508
7		1,000	437	22	850	3,070	409
8		825	405	23	850	3,400	386
9		2,480	453	24	750	1,940	353
10		1,420	413	25	608	2,420	332
11		900	353	26	508	2,060	287
12	5,600	725	314	27	2,800	1,220	478
13	3,110	608	371	28	1,470	900	536
14	1,820	562	386	29	900	825	409
15	1,280	495	394	30	875	1,280	357
				31	2,450	960	

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	332	608	1,110	2,740	3,000	675	22,500	2,860	1,380	990	341	162
2	1,110	558	975	7,010	2,360	675	18,000	2,410	1,240	908	312	165
3	1,880	522	950	16,100	1,420	572	13,000	2,040	1,980	855	278	154
4	1,060	531	875	6,920	1,000	518	9,800	2,670	5,160	1,560	271	142
5	3,260	531	825	5,480	850	478	6,290	2,410	3,000	1,240	245	168
6	5,240	531	775	17,300	1,080	540	5,480	2,150	2,280	880	213	165
7	2,240	504	725	8,900	1,030	652	3,960	1,900	1,920	780	254	170
8	1,520	495	675	3,190	875	1,030	3,470	1,700	3,400	730	245	229
9	1,200	470	608	2,240	775	1,300	2,120	1,520	3,120	635	271	278
10	1,060	453	558	2,000	675	1,300	2,930	1,350	2,860	590	222	261
11	950	445	504	2,180	585	1,220	3,060	1,200	3,060	590	213	268
12	775	437	453	2,000	508	1,170	5,000	1,040	3,890	590	278	261
13	675	429	429	2,060	495	1,200	7,730	935	2,540	545	204	238
14	608	413	421	1,760	495	1,250	14,300	830	2,040	1,260	288	222
15	3,190	461	445	1,420	518	1,030	15,300	990	1,920	1,040	288	226
16	3,470	675	562	1,080	585	900	10,300	11,200	5,880	730	291	170
17	1,700	725	1,080	825	576	875	5,720	45,700	9,100	612	264	175
18	1,300	652	2,480	675	522	750	4,030	24,400	14,100	541	226	254
19	4,850	700	4,480	608	429	775	3,120	13,500	11,000	498	232	248
20	3,400	2,600	2,480	540	425	750	2,540	7,010	8,800	456	201	213
21	2,000	2,240	1,580	775	413	750	5,800	3,820	7,000	705	248	192
22	1,470	2,480	1,360	3,960	413	725	17,000	2,600	5,200	935	235	207
23	1,170	1,940	1,360	4,700	449	675	16,100	6,830	4,000	612	195	195
24	975	1,580	1,250	2,360	425	630	12,100	4,620	3,100	532	187	138
25	900	1,420	1,200	1,700	491	700	8,300	2,740	2,480	464	170	173
26	825	1,640	4,920	1,520	675	2,240	8,400	2,410	1,860	407	145	198
27	750	2,600	3,470	2,000	725	7,010	9,300	2,160	1,620	391	145	190
28	700	2,740	2,240	3,470	675	28,000	8,200	2,340	1,380	407	192	157
29	652	1,760	1,760	2,740	652	29,000	5,080	2,160	1,740	379	213	157
30	630	1,360	1,420	1,760	.....	24,500	3,540	1,800	1,240	288	165	178
31	608	.....	2,120	1,820	.....	25,500	.....	1,620	.....	341	152	.....

NOTE.—Discharge Dec. 8–17, Jan. 16–21, Feb. 8 to Mar. 31, Apr. 1–5, 15, 16, 23, 24, and 25, estimated because of ice or backwater from dam at Geneseo, from discharge measurements, weather records, and study of gage height graph. No gage-height record Feb. 20–22, Mar. 10–12, May 6–11, and June 19–24; discharge estimated.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the years ending Sept. 30, 1915 and 1916.

[Drainage area, 1,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915.					
July 12–31	5,600	508	1,870	1.33	0.99
August	3,400	375	1,380	.978	1.13
September	755	287	422	.299	.33
1915–16.					
October	5,240	332	1,630	1.16	1.34
November	2,740	413	1,080	.766	.85
December	4,920	421	1,420	1.01	1.16
January	17,300	540	3,610	2.57	2.96
February	3,000	413	797	.565	.60
March	29,000	478	4,430	3.14	3.62
April	22,500	2,540	8,450	6.00	6.69
May	45,700	*830	5,190	3.68	4.24
June	14,100	1,240	3,940	2.79	3.11
July	1,560	288	693	.491	.57
August	341	145	232	.165	.19
September	278	138	198	.140	.16
The year	45,700	138	2,640	1.87	25.49

GENESEE RIVER NEAR ROCHESTER, N. Y.

LOCATION.—At the Elmwood Avenue Bridge, at the north end of South Park, 3¼ miles below the mouth of Black Creek, 3½ miles above center of the city of Rochester, Monroe County, and 7½ miles above mouth of river.

DRAINAGE AREA.—2,360 square miles.

RECORDS AVAILABLE.—February 9, 1904, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission. Fragmentary records prior to this period published in Water-Supply Papers 24, 65, and 97.

GAGE.—Gurley water-stage recorder installed in December, 1910, in pump house immediately below bridge on right bank. Gage inspected by Geo. A. Bailey. Gage used prior to December, 1910, was a staff bolted to downstream end of first pier from right abutment. Elevation of zero of gage, 506.848 feet, Barge Canal datum, 245.591 feet, Rochester city datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge. Prior to 1904 measurements and elevation of water surface were taken in conjunction with measurement of water flowing over and around Johnson and Seymour dam in Rochester.

CHANNEL AND CONTROL.—Smooth gravel; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 15.30 feet at midnight March 30 (discharge 48,300 second-feet); minimum stage from water-stage recorder, 0.88 foot from 12.30 to 4 a. m. November 16 (discharge 238 second-feet).

1904–1916: Maximum stage recorded March 30, 1916; minimum stage, 0.71 foot, from 10 p. m. September 30 to 4 a. m. October 1, 1913 (discharge 154 second-feet).

ICE.—Stage-discharge relation affected by ice during a large part of the period from December to March, inclusive.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curves fairly well defined between 2,000 and 12,000 second-feet, well defined between 12,000 and 44,000 second-feet. Operation of water-stage recorder satisfactory throughout the year. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by averaging hourly gage heights. Results fairly good for periods when the stage-discharge relation was affected by ice and good for other periods.

Discharge measurements of Genesee River near Rochester, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 14	C. S. De Golyer	1.53	826	Apr. 5	C. C. Covert	9.14	20,300
14	do	1.53	839	15	E. D. Burchard	7.91	16,000
Jan. 18[a]	O. W. Hartwell	3.86	1,130	15	do	8.01	16,300
Feb. 17[a]	C. C. Covert	1.99	1,020	25	C. C. Covert	9.11	19,700
24[b]	A. H. Davison	1.91	837	July 12	E. D. Burchard	1.76	1,050
Mar. 17	C. C. Covert	2.56	1,840	12	do	1.75	1,050
Apr. 1	do	12.94	[c]41,300	Sept. 5	do	1.07	303
2	do	13.11	37,700				

[a] Nearly complete ice cover.
[b] Measurement made under complete ice cover.
[c] Velocity determined at 0.2 depth and reduced to mean velocity by using coefficient, 0.89.

Daily discharge, in second-feet, of Genesee River near Rochester, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	554	692	1,840	1,650	3,480	1,380	41,300	4,700	2,500	1,180	630	330
2	598	768	1,530	3,380	4,390	1,380	37,500	3,880	2,260	884	630	306
3	2,280	680	1,380	14,600	3,100	1,430	32,900	3,300	9,430	1,740	586	314
4	2,140	622	1,270	16,200	2,050	1,350	27,600	3,210	11,800	2,500	553	314
5	1,530	598	1,180	9,820	1,760	1,240	20,700	3,680	8,870	2,340	520	306
6	5,310	587	768	12,800	1,790	1,170	13,300	3,210	5,930	1,840	500	306
7	5,310	587	656	16,200	1,730	1,150	8,330	2,680	4,180	1,480	480	322
8	2,910	554	610	11,000	1,550	1,180	6,050	2,420	3,880	1,290	480	339
9	2,030	500	500	5,920	1,380	1,500	5,460	2,260	7,030	1,160	490	357
10	1,600	432	414	4,390	1,230	2,100	5,240	2,100	5,580	1,100	470	393
11	1,440	362	336	3,380	1,240	2,240	4,700	1,920	4,700	1,070	470	393
12	1,300	320	306	3,970	1,360	2,070	5,240	1,710	5,580	1,030	440	384
13	1,070	313	278	3,280	1,430	1,880	7,800	1,520	5,130	1,010	460	.....
14	900	285	299	3,380	1,320	1,840	11,800	1,400	3,780	1,200	440	.....
15	846	264	285	2,460	1,410	2,150	15,600	1,370	3,030	1,950	450	.....
16	4,720	320	278	1,760	1,100	2,150	17,000	4,080	3,880	1,550	490	.....
17	3,770	780	278	1,360	1,030	1,930	13,600	22,600	9,710	1,190	460	330
18	2,210	1,000	587	1,130	956	1,810	7,540	35,200	14,000	968	430	314
19	2,550	887	3,190	1,100	1,030	1,660	5,350	34,700	14,000	.....	420	339
20	5,790	1,350	5,070	1,140	970	1,620	4,180	25,500	10,900	.....	384	375
21	4,080	3,380	3,380	1,760	820	1,600	4,600	15,300	9,150	.....	348	339
22	2,550	3,380	2,210	3,770	860	1,580	11,500	7,540	6,290	.....	384	322
23	1,930	3,380	1,930	7,320	794	1,580	19,200	8,060	5,460	1,470	393	322
24	1,520	2,730	2,000	5,670	833	1,490	21,400	10,600	4,180	1,160	357	298
25	1,300	2,240	2,070	3,570	1,000	1,410	19,900	7,030	4,600	993	348	306
26	1,180	1,980	2,890	2,910	1,140	1,440	15,300	4,600	4,380	872	322	282
27	1,060	2,460	5,920	2,910	1,340	2,800	12,100	3,980	3,120	788	306	306
28	942	3,670	4,390	4,080	1,490	12,400	11,800	3,780	2,340	752	322	330
29	874	3,280	2,910	5,070	1,460	27,200	9,430	3,880	1,830	740	330	314
30	833	2,350	2,170	3,670	.....	44,800	6,290	3,210	1,650	696	348	282
31	794	.....	2,020	2,910	.....	46,300	.....	2,760	.....	674	348	.....

NOTE.—Discharge Dec. 9–16, Jan. 15–21, and Feb. 8 to Mar. 27, estimated, because of ice, from current-meter measurements, weather records, and study of gage-height graph. Gage-height not recorded, discharge estimated as follows: July 19–22, 900 second-feet; Sept. 13–16, 360 second-feet.

Monthly discharge of Genesee River near Rochester, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 2,360 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	5,790	554	2,130	0.903	1.04
November	3,670	264	1,360	.576	.64
December	5,920	278	1,710	.725	.84
January	16,200	1,100	5,240	2.22	2.56
February	4,390	794	1,520	.644	.69
March	46,300	1,150	5,670	2.40	2.77
April	41,300	4,180	13,100	5.55	6.19
May	35,200	1,370	7,490	3.17	3.66
June	14,000	1,650	5,970	2.53	2.82
July	2,500	674	1,200	.508	.59
August	630	306	438	.186	.21
September	393	282	332	.141	.16
The year	46,300	264	3,930	1.67	22.17

CANASERAGA CREEK NEAR DANSVILLE, N. Y.

LOCATION.—At highway bridge 1 mile west of village of Dansville, Livingston County, about 2,200 feet below mouth of Mill Brook and 22 miles above mouth of creek.

DRAINAGE AREA.—167 square miles (measured by engineers of State of New York Conservation Commission).

RECORDS AVAILABLE.—July 21, 1910, to December 31, 1912; July 10, 1915, to September 30, 1916. Data pubblished also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Vertical staff at downstream side of left abutment; datum lowered 4.77 feet on July 10, 1915. Gage read by Floyd Harter.

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

CHANNEL AND CONTROL.—Sand and gravel; frequently shifting.

EXTREMES OF DISCHARGE.—1910–1912 and 1915–1916: Maximum stage recorded, 13.0 feet at 9.30 p. m. May 16, 1916 (discharge, about 6,600 second-feet); minimum stage recorded, 5.45 feet several times in September, 1916 (discharge, 30 second-feet).

ICE.—Stage-discharge relation affected by ice. Gage observations suspended.

ACCURACY.—Stage-discharge relation changed several times during year; probably during high water. Rating curves used October 1 to March 27 well defined between 30 and 350 second-feet; those used March 28 to April 14 well defined between 600 and 3,200 second-feet; curves for remainder of year not well defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Results fair.

Discharge measurements of Canaseraga Creek near Dansville, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 30	H. Johnson	8.26	1,590	Apr. 19	E. D. Burchard	6.55	259
30	F. H. Macy	9.11	2,370	21	do	7.15	581
30	C. C. Covert	9.69	2,960	21	do	7.15	594
31	do	8.34	1,700	May 26	do	6.70	256
Apr. 4	do	7.19	727	26	do	6.70	259
14	F. H. Macy	9.35	2,670	July 21	C. C. Covert	5.76	64.6
17	do	6.80	379	Sept. 7	E. D. Burchard	5.51	34.6
19	E. D. Burchard	6.55	258	7	do	5.51	36.1

Daily discharge, in second-feet, of Canaseraga Creek near Dansville, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	65	50	129	220	.....	1,920	280	132	136	50	34
2	315	53	109	1,580	.....	1,650	280	109	142	44	39
3	162	53	88	670	.....	800	330	495	295	46	34
4	104	50	67	420	.....	730	380	212	305	44	34
5	1,140	58	64	900	.....	525	330	235	248	46	34
6	505	53	53	980	.....	465	235	145	206	54	36
7	220	50	50	635	.....	410	226	258	158	54	32
8	138	50	53	365	.....	355	201	410	109	56	90
9	129	50	53	200	.....	382	185	620	95	56	42
10	120	48	50	114	.....	114	162	438	114	46	34
11	88	44	48	67	.....	202	185	355	114	59	34
12	64	44	45	188	.....	800	162	212	95	71	34
13	58	44	43	180	.....	1,040	139	124	102	68	36
14	53	44	42	114	.....	1,920	129	132	95	59	34
15	820	78	42	88	.....	880	258	173	86	59	64
16	340	67	44	67	.....	435	2,850	805	86	54	42
17	129	58	58	53	.....	330	2,600	2,780	102	54	34
18	84	58	420	48	.....	355	1,080	1,120	80	44	39
19	315	162	315	50	.....	258	805	1,040	68	44	36
20	180	392	212	88	.....	226	495	800	68	44	32
21	129	315	138	315	.....	690	305	800	695	46	32
22	109	212	120	475	.....	2,150	330	525	1,040	42	75
23	93	180	109	220	.....	1,430	585	382	438	44	42
24	88	144	93	212	.....	840	495	355	136	42	34
25	78	151	120	151	.....	555	382	281	102	39	32
26	84	162	290	173	635	760	258	248	86	36	32
27	71	212	265	265	2,500	1,080	330	214	136	44	34
28	67	220	220	365	3,880	690	355	206	120	44	34
29	58	188	151	220	2,680	465	258	175	80	44	42
30	58	151	114	151	2,280	330	235	142	68	36	36
31	50	.....	114	188	2,100	.....	145	.....	59	34	.....

NOTE.—Discharge Dec. 11–17, 30, 31, and Jan. 14–20, estimated, because of ice, from weather records, study of gage-height graph, and comparison with records of streams in adjacent areas.

Monthly discharge of Canaseraga Creek near Dansville, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 167 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,140	50	191	1.14	1.31
November	392	44	115	.689	.77
December	420	42	120	.719	.83
January	1,580	48	315	1.89	2.18
April	2,150	114	760	4.55	5.08
May	2,850	129	484	2.90	3.34
June	2,780	109	464	2.78	3.10
July	1,040	59	183	1.10	1.27
August	71	34	48.5	.290	.33
September	90	32	39.6	.237	.26

CANASERAGA CREEK AT GROVELAND STATION, N. Y.

LOCATION.—At highway bridge at Groveland Station, Livingston County.

DRAINAGE AREA.—195 square miles (measured by engineers of New York State Conservation Commission).

RECORDS AVAILABLE.—August 5, 1915, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Chain near center of downstream side of bridge. Prior to March 30, 1916, inclined staff gage on right bank about 400 feet above bridge, at practically the same datum (560.00 feet Conservation Commission datum). Gage read by E. R. Stoner.

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

CHANNEL AND CONTROL.—Creek flows through improved channel, which is in gravel and is likely to shift.

ICE.—Stage-discharge relation affected by ice. Gage observations suspended.

For a considerable distance upstream from the station the improved channel is above the lowest part of the valley. During low stages there may be loss by seepage and during high stages some of the water overflows into the lower part of the valley and is diverted past the gage.

Data inadequate for determination of discharge.

Discharge measurements of Canaseraga Creek at Groveland Station, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 29	F. H. Macy	13.65	2,110	May 18	E. D. Burchard	12.47	1,050
30	C. C. Covert	13.16	1,570	18	do	12.42	1,000
Apr. 4	do	10.64	692	23	do	11.13	788
18	E. D. Burchard	8.80	366	23	do	11.02	745
21	do	10.18	636	26	do	8.61	320
22	do	14.64	2,560	June 17	do	13.33	1,610
26	do	11.10	847	July 20	do	6.99	70.2
26	do	10.80	766	Sept. 6	do	6.54	38.8
May 15	do	7.65	169				

Daily gage height, in feet, of Canaseraga Creek at Groveland Station, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	6.65	6.9	7.5	13.6	9.0	8.0	7.7	7.05	6.65
2	7.9	6.9	7.45	12.9	8.8	7.8	7.7	7.0	6.6
3	7.45	6.9	7.35	11.0	8.7	9.0	8.2	7.0	6.6
4	7.15	6.95	7.2	10.8	9.4	8.8	8.3	7.0	6.6
5	11.3	7.0	7.0	9.5	8.7	8.2	7.8	6.9	6.6
6	8.2	6.9	7.1	9.4	8.5	8.1	7.7	6.9	6.6
7	7.9	6.85	7.0	8.9	8.4	7.9	7.6	6.9	6.6
8	7.6	6.9	7.0	8.8	8.5	8.6	7.5	6.85	7.1
9	7.3	6.9	7.1	8.0	8.3	8.4	7.4	6.8	6.9
10	7.2	6.85	.....	8.8	8.0	8.3	7.4	6.8	6.8
11	7.1	6.8	.....	8.7	8.0	8.3	7.35	6.9	6.7
12	7.0	6.75	.....	10.0	7.7	8.4	7.3	7.0	6.7
13	6.9	6.7	.....	10.2	7.6	8.0	7.4	7.0	6.6
14	6.9	6.75	.....	12.7	7.6	7.8	7.4	6.95	6.6
15	8.5	7.2	.....	12.3	8.4	8.0	7.3	6.9	6.8
16	8.1	7.1	.....	9.8	15.2	9.4	7.2	6.9	6.8
17	7.7	7.05	.....	9.2	15.4	14.5	7.2	6.85	6.7
18	7.7	6.9	.....	8.9	12.4	11.3	7.15	6.85	6.7
19	8.1	7.2	.....	8.4	10.9	10.5	7.1	6.8	6.65
20	7.7	8.0	.....	8.4	10.1	10.3	7.1	6.8	6.6
21	7.6	8.0	.....	11.2	9.5	9.8	11.4	6.75	6.55
22	7.4	7.8	.....	14.6	9.2	9.5	8.3	6.7	6.5
23	7.35	7.7	.....	13.5	11.6	8.8	7.6	6.7	6.6
24	7.1	7.6	.....	11.7	9.8	8.6	7.45	6.75	6.6
25	7.1	7.5	.....	10.8	9.0	8.5	7.4	6.7	6.55
26	7.1	7.4	.....	11.6	8.6	8.2	7.3	6.7	6.55
27	7.05	7.35	.....	13.0	8.8	8.1	7.3	6.7	6.6
28	7.0	7.8	.....	11.4	8.7	8.0	7.3	6.7	6.6
29	6.95	7.6	.....	10.1	8.5	7.9	7.2	6.75	6.6
30	6.9	7.6	.....	9.5	8.2	7.8	7.15	6.7	6.6
31	6.9	.....	.....	.....	8.1	.....	7.05	6.7	.....

CANASERAGA CREEK AT SHAKERS CROSSING, N. Y.

LOCATION.—At highway bridge at Shakers Crossing, about a mile above mouth and 1½ miles northeast of Mount Morris, Livingston County.

DRAINAGE AREA.—347 square miles (measured by engineers of the New York State Conservation Commission).

RECORDS AVAILABLE.—Current-meter measurements 1904–1915; continuous record of gage height and occasional current-meter measurements July 13, 1915, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Gurley seven-day water-stage recorder on left bank, just below bridge. Datum of gage same as that for gage established on Genesee River at Jones Bridge near Mount Morris July 12, 1915 (540.00 feet Conservation Commission datum). Recorder inspected by Mrs. William Russell.

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

CHANNEL AND CONTROL.—Firm gravel; not likely to shift; subject to backwater from Genesee River.

ICE.—Stage-discharge relation affected by ice.

EXTREMES OF STAGE.—Maximum stage during year, from water-stage recorder, 28.92 feet at 1 p. m. May 17; miminum stage from water-stage recorder, 8.02 feet at midnight September 28.

Data on extent and duration of backwater from Genesee River insufficient to permit correct determination of discharge.

Discharge measurements of Canaseraga Creek at Shakers Crossing, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	C. S. De Golyer	9.48	349	Apr. 17	E. D. Burchard	14.70	1,650
12	do	9.37	327	17	do	14.52	1,540
Jan. 13	C. C. Covert	10.50	595	17	do	13.65	1,310
20	O. W. Hartwell	[a] 10.62	322	17	do	13.50	1,270
Feb. 17	C. C. Covert	[a] 9.45	349	18	do	12.50	896
25	A. H. Davison	9.55	345	19	do	11.19	655
Mar. 29	C. C. Covert	28.25	6,790	20	do	10.81	596
31	do	26.95	4,970	24	do	22.38	4,070
Apr. 3	do	22.68	5,160	24	do	22.14	4,080
4	do	19.56	3,510	26	do	17.08	2,770
16	E. D. Burchard	19.03	3,040	27	do	18.00	2,550
16	do	18.80	3,000	May 17	do	28.62	7,020
16	do	17.70	2,640	Sept. 6	do	8.45	114
16	do	17.52	2,610	6	do	8.43	109

[a] Stage-discharge relation affected by ice.

Daily gage height, in feet, of Canaseraga Creek at Shakers Crossing, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9.28	9.06	9.58	9.86	11.28	9.90	26.41	11.23	9.89	9.5	8.78	8.18
2	10.06	9.04	9.48	15.54	10.37	9.82	25.93	10.85	9.88	9.31	8.74	8.56
3	9.96	9.08	9.40	21.65	9.60	9.73	23.40	10.62	10.59	10.36	8.61	8.34
4	9.58	9.08	9.39	15.05	.....	9.68	20.10	11.20	12.80	10.12	8.60	8.22
5	11.62	9.08	9.10	15.25	9.47	9.43	16.00	10.82	10.78	9.7	8.58	8.26
6	13.56	9.14	9.24	22.96	9.31	9.59	13.97	10.38	10.39	9.78	8.55	8.28
7	.....	8.82	9.32	16.57	9.42	9.72	12.38	9.75	9.75	9.46	8.58	8.34
8	.....	9.00	9.28	11.68	9.34	10.38	11.80	9.93	11.4	9.25	8.60	8.63
9	.....	9.04	9.28	10.56	9.40	10.70	11.52	9.87	10.99	9.21	8.56	8.91
10	9.26	8.96	9.19	10.46	9.51	10.56	11.38	9.75	10.7	9.3	8.60	8.60
11	9.39	8.98	9.28	10.49	9.52	10.32	11.45	9.63	10.25	9.18	8.56	8.57
12	9.38	9.08	.....	10.23	9.67	9.98	13.29	9.43	11.73	9.26	8.62	8.54
13	9.30	.....	.....	10.48	.....	10.08	15.76	9.35	10.45	9.25	8.48	8.44
14	9.26	8.84	.....	9.97	.....	10.42	20.83	.....	9.88	9.44	8.68	8.45
15	11.59	9.10	.....	9.99	.....	10.10	23.30	.....	9.75	9.15	8.65	8.50
16	11.50	9.28	.....	9.93	.....	10.12	18.70	.....	14.03	8.85	8.58	8.29
17	9.71	9.24	.....	10.13	.....	10.13	14.30	28.05	17.25	8.92	8.60	8.50
18	9.77	9.16	.....	10.38	.....	.....	12.40	25.50	20.50	8.91	8.60	8.50
19	12.88	9.30	.....	10.42	.....	.....	11.38	21.20	15.39	8.90	8.64	8.48
20	11.36	10.94	10.37	10.47	9.18	9.99	10.85	16.55	15.56	8.84	8.44	8.41
21	10.13	10.46	9.83	10.28	9.41	9.93	14.69	13.20	12.59	9.60	8.52	8.39
22	9.70	10.80	9.63	11.54	9.36	9.91	23.28	11.32	12.25	10.65	8.42	8.41
23	9.58	10.18	9.58	12.44	9.34	9.88	24.40	15.49	11.00	9.28	8.38	8.39
24	9.20	9.94	9.60	10.51	9.38	9.81	21.55	12.85	10.76	9.20	8.32	8.35
25	9.30	9.69	9.58	10.04	9.51	9.93	18.04	11.15	10.9	9.08	8.32	8.31
26	9.26	9.88	12.48	9.96	9.77	10.89	16.99	10.65	10.38	9.01	8.43	8.44
27	9.20	10.82	11.08	10.58	9.81	16.93	17.53	10.9	9.95	8.98	8.31	8.32
28	9.16	10.82	10.27	11.90	9.80	27.42	16.42	10.89	9.78	.....	8.58	8.24
29	9.16	10.00	9.41	11.02	9.86	28.05	13.92	10.52	9.75	.....	8.50	8.24
30	9.16	9.81	9.26	9.90	.....	27.02	11.90	10.2	9.55	8.85	8.49	8.24
31	8.94	.....	9.91	10.28	.....	26.82	.....	10.05	.....	8.86	8.15	.....

KESHEQUA CREEK NEAR SONYEA, N. Y.

LOCATION.—About 400 feet above the Delaware, Lackawanna & Western Railroad bridge and half a mile below gaging station formerly maintained at Sonyea, Livingston County.

DRAINAGE AREA.—74 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 22, 1910, to December 31, 1912, at station at Sonyea; August 29, 1915, to September 30, 1916, at present site. Data published also in annual reports of New York State engineer and surveyor and State of New York conservation commission.

GAGE.—Staff, in two sections; inclined section graduated from 3.0 to 6.0 feet; vertical section graduated from 6.0 to 17.0 feet. Gage read by Fred Mott.

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

CHANNEL AND CONTROL.—Gravel; probably fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.15 feet at 7 a. m. March 28 (discharge not determined); minimum stage recorded, 4.0 feet several times during December, August, and September (discharge 1.5 second-feet).

ICE.—Stage-discharge relation affected by ice. Gage observations suspended.

ACCURACY.—Stage-discharge relation probably permanent, except as affected by ice or backwater from Canaseraga Creek, during a large part of the period from December to April 4. Rating curve well defined between 1 and 350 second-feet and fairly well defined between 350 and 1,300 second-feet. Gage read to half-tenths twice daily. Daily discharge, except for periods of backwater, ascertained by applying mean daily gage heights to rating table. Results fairly good.

Discharge measurements of Keshequa Creek near Sonyea, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 29	C. C. Covert	9.84	1,020	May 18	E. D. Burchard	7.65	247
31	do	8.52	672	23	do	6.21	296
Apr. 4	do	5.79	190	23	do	6.10	279
18	E. D. Burchard	5.03	84.6	26	do	4.86	69.0
21	do	6.28	278	June 17	do	6.20	305
21	do	6.20	274	July 20	do	4.20	8.6
22	do	9.95	1,120	20	do	4.20	8.8
23	do	7.38	476	Sept. 6	do	4.01	1.5
May 14	do	4.40	23.8	6	do	4.01	1.8
14	do	4.39	20.4				

Daily discharge, in second-feet, of Keshequa Creek near Sonyea, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.0	8.7	78	.....	759	81	51	22	10	1.5
2	30	8.7	49	.....	759	74	44	24	8.7	1.5
3	26	8.7	30	.....	369	65	41	21	10	1.5
4	15	8.7	15	.....	207	54	39	16	8.7	1.5
5	107	8.7	6.6	.....	123	51	44	24	8.7	1.5
6	84	8.7	3.0	.....	131	59	37	24	6.6	1.5
7	30	8.7	3.0	.....	92	54	32	24	4.5	2.1
8	22	3.0	3.0	.....	99	51	32	15	5.3	7.9
9	18	6.6	4.5	.....	92	51	37	22	3.9	24
10	15	3.0	3.0	.....	99	47	30	16	2.1	21
11	22	6.6	1.5	.....	115	41	32	15	3.0	16
12	6.6	6.6	1.5	.....	271	41	57	15	3.0	15
13	4.5	6.6	1.5	.....	369	54	51	15	5.3	14
14	4.5	6.6	1.5	.....	1,160	34	47	8.7	5.3	10
15	411	6.6	1.5	.....	329	37	41	10	4.5	7.9
16	131	6.6	1.5	.....	216	1,090	59	8.7	5.3	5.3
17	12	6.6	3.0	.....	131	349	309	12	4.5	4.5
18	4.5	3.0	411	.....	131	290	198	8.7	3.0	5.3
19	290	4.5	181	.....	99	560	181	10	3.0	3.0
20	92	147	92	.....	61	432	164	8.7	1.5	1.5
21	131	181	49	.....	349	349	156	10	2.1	2.1
22	115	65	22	.....	1,310	369	107	8.7	1.5	3.9
23	22	54	12	.....	626	369	99	16	1.5	4.5
24	4.5	39	8.7	.....	329	198	92	8.7	1.5	4.5
25	3.0	26	12	.....	290	81	57	8.7	1.5	2.1
26	1.5	84	107	.....	252	69	49	8.7	1.5	2.1
27	8.7	99	225	1,660	252	69	30	8.7	1.5	1.5
28	4.5	131	252	1,380	432	74	24	10	1.5	1.5
29	8.7	123	198	828	234	65	24	8.7	1.5	1.5
30	8.7	49	139	828	115	61	21	8.7	1.5	1.5
31	8.7	.....	123	828	.....	49	.....	12	1.5	.....

NOTE.—Discharge, Dec. 3–5, 11–16, and 20–25, Mar. 28–31, Apr. 1–4, and 23 estimated, because of ice or backwater from Canaseraga Creek, from weather records, study of gage-height graph, and comparison with records of adjacent streams.

Monthly discharge of Keshequa Creek near Sonyea, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 74 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	290	1.5	53.0	0.716	0.83
November	181	3.0	37.5	.507	.57
December	411	1.5	65.8	.889	1.02
April	1,310	61	327	4.42	4.93
May	1,090	34	170	2.30	2.65
June	309	21	72.8	.984	1.10
July	24	8.7	13.8	.186	.21
August	10	1.5	4.0	.054	.06
September	24	1.5	5.7	.077	.09

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

LOCATION.—In outlet at foot of Canadice Lake, 4½ miles southeast of Hemlock, Livingston County. The outlet flows into Genesee River through Hemlock Outlet and Honeoye Creek.

DRAINAGE AREA.—12.6 square miles, of which 1.0 square mile is lake surface.

RECORDS AVAILABLE.—April, 1903, to September 30, 1916. Data published also in annual reports of New York State engineer and snrveyor and State of New York Conservation Commission.

GAGE.—Hook gage in channel above weir.

CHANNEL AND CONTROL.—Outflow is measured over a standard thin-edged weir with a 5-foot crest and two end contractions so arranged with needle timbers at the ends that the length may be increased to 14.96 feet. No end contractions during high water. The weir crest stands 3.14 feet above the stream channel, which is artificial, with plank bottom and vertical sides, and the crest is never submerged by backwater. Two additional rectangular gates, each a foot square, with three complete contractions and a fourth incomplete contraction at the bottom afford by-passes during low water.

ICE.—Stage-discharge relation not affected by ice as pool above weir is free from ice throughout winter.

DIVERSIONS.—No water is diverted from Canadice Lake above the station.

REGULATION.—Outflow of lake is regulated by bulkhead and gates at dam above weir.

ACCURACY.—Stage-discharge relation permanent. Rating curve used is expressed by the Francis formula. Corrections are made for velocity of approach for the high stages. Gage read to hundredths once daily. Results good.

COOPERATION.—Data collected, computed, and furnished for publication by the city engineer of Rochester.

Monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for the year ending Sept. 30, 1916.

Month.	Mean discharge in second-feet.	Mean elevation of lake above low-water mark, in feet.	Month.	Mean discharge in second-feet.	Mean elevation of lake above low-water mark, in feet.
October	7.543	1.616	May	46.228	3.245
November	[a] 1.105	1.770	June	37.640	2.967
December	11.101	2.040	July	6.692	2.475
January	32.419	2.336	August	5.340	2.030
February	10.196	1.329	September	920	1.481
March	24.279	1.502			
April	53.597	3.059	The year	19.755	2.154

[a] In November, 1915, the old plank weir and channel was replaced by a concrete structure. The head gates were closed during construction, and an estimate of the leakage is included in above table.

NOTE.—Water surface 0.16 foot higher Sept. 30, 1916, than on Oct. 1, 1915. Gain in storage, 4,876,601 cubic feet, corresponding to 0.154 second-feet for year.

OWASCO LAKE OUTLET NEAR AUBURN, N. Y.

LOCATION.—On the farm of Charles H. Pearce, 2 miles below center of Auburn, Cayuga County, and 3¾ miles below the State dam at outlet of Owasco Lake.

DRAINAGE AREA.—206 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 17, 1912, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Gurley water-stage recorder in a concrete shelter on the left bank on the farm of Charles H. Pearce. Recorder inspected by Charles H. Pearce.

DISCHARGE MEASUREMENTS.—Made by wading directly opposite gage or a cable at same section.

CHANNEL AND CONTROL.—A low concrete control has been constructed about 15 feet below the gage. Crest of control is 1 foot wide and the slopes of both upstream and downstream faces are ½:1. A small horizontal apron built on a level with

the bed of the stream extends downstreams 2½ feet from toe of dam. Mean elevation of the left-hand end of the dam for a distance of 50 feet is gage height 1.28 feet; the remaining 50 feet of the crest of the dam is at gage height 2.12 feet.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 4.21 feet at 7.30 p. m. April 3 (discharge, 2,050 second-feet); minimum stage not recorded.

1912–1916: Maximum stage, 6.4 feet during period March 25 to 30, 1913, determined by leveling from flood marks (discharge, 2,750 second-feet); minimum stage from water-stage recorder, 1.41 feet at 1 a. m. October 15, 1915 (discharge, 5.6 second-feet).

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

DIVERSIONS.—An average flow of about 10 second-feet is pumped from Owasco Lake for the municipal water supply of Auburn; proportion returning to stream above gaging station not known.

REGULATION.—Large diurnal fluctuation in low-water flow due to operation of mills in Auburn; seasonal flow regulated at the State dam.

ACCURACY.—Stage-discharge relation permanent; not affected by ice during year. Rating curve well defined between 1 and 1,700 second-feet. Operation of the water-stage recorder satisfactory throughout year except when it was not in operation. Daily discharge ascertained by averaging the hourly discharge. Records excellent except for periods for which gage heights are lacking. See note to table of daily discharge.

The following discharge measurement was made by C. C. Covert: April 24, 1916: Gage height, 3.14 feet; discharge, 734 second-feet.

Daily discharge, in second-feet, of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	430	393	291	428	342	.....	1,530	690	483	288	136	120
2	510	370	292	542	387	.....	1,780	658	463	270	130	113
3	485	355	286	581	414	.....	1,820	593	469	258	.....	74
4	475	363	279	619	331	.....	1,780	528	486	260	.....	105
5	548	355	271	663	397	.....	1,690	508	522	258	.....	132
6	575	337	266	.....	384	.....	1,600	488	507	257	.....	141
7	579	331	273	.....	377	.....	1,510	461	499	246	.....	138
8	592	337	266	.....	342	.....	1,380	404	491	226	.....	133
9	587	322	248	.....	384	.....	1,250	320	487	196	.....	140
10	555	311	241	.....	380	.....	1,070	323	452	221	84	53
11	540	250	236	.....	382	.....	926	310	404	219	137	107
12	516	258	237	690	371	.....	863	308	409	213	124	124
13	501	314	238	652	383	.....	827	270	404	204	83	117
14	481	273	238	648	462	.....	821	234	397	199	132	120
15	514	315	231	633	484	.....	826	244	396	208	131	132
16	500	307	231	595	391	.....	792	254	402	174	128	108
17	502	311	240	649	334	.....	772	494	398	214	135	65
18	493	310	273	632	327	.....	736	699	376	212	131	112
19	525	324	283	591	336	.....	708	740	432	208	151	113
20	538	323	293	519	344	.....	679	743	422	206	54	107
21	529	331	308	404	361	283	642	699	403	185	107	108
22	524	330	301	182	352	288	642	678	396	187	131	113
23	505	331	326	166	263	293	612	717	393	138	133	113
24	486	326	328	180	262	294	674	766	388	194	125	48
25	484	330	354	175	273	298	784	795	353	184	130	107
26	472	323	379	173	254	329	794	716	302	172	127	105
27	449	318	403	165	264	383	800	689	300	174	55	111
28	439	310	414	237	.....	479	816	649	290	173	104	111
29	423	308	422	314	.....	646	756	594	303	171	120	116
30	400	297	424	323	.....	875	687	566	297	148	125	103
31	389	.....	419	336	.....	1,190	.....	513	.....	140	121	.....

NOTE.—Mean discharge for periods for which gage record is lacking estimated by interpolation as follows: Jan. 6–11, 700 second-feet; Feb. 28 to Mar. 10, 290 second-feet; Mar. 11–20, 275 second-feet; Aug. 3–9, 120 second-feet. In November, 1916, it was discovered that from 20 to 25 second-feet was leaking under control. No data as to time of beginning of leak, but study of the record seems to show that it occurred in October, 1916.

Monthly discharge of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 206 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	592	a 389	.502	2.44	2.81
November	393	250	322	1.56	1.74
December	424	231	300	1.46	1.68
January	.....	165	493	2.39	2.76
February	484	254	350	1.70	1.83
March	1,190	.....	355	1.72	1.98
April	1,820	a 612	1,020	4.95	5.52
May	795	a 234	537	2.61	3.01
June	522	290	411	2.00	2.23
July	288	a 138	207	1.00	1.15
August	137	a 55	119	.578	.67
September	141	a 48	110	.534	.60
The year	1,190	a 48	393	1.91	25.98

a Sunday.

NOTE.—No correction for storage in Owasco Lake or for diversion for municipal water supply.

WEST BRANCH OF ONONDAGA CREEK AT SOUTH ONONDAGA, N. Y.

LOCATION.—At highway bridge in village of South Onondaga, Onondaga County, about 1¾ miles above mouth of creek and about 10 miles above Syracuse.

DRAINAGE AREA.—20.8 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 22 to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Staff on downstream side of right abutment of bridge.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Fine and coarse gravel; probably shifting.

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

Data inadequate for determination of discharge.

Discharge measurements of West Branch of Onondaga Creek at South Onondaga, N. Y., during the year ending Sept. 30, 1916.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Aug. 23	1.07	8.0
23	1.07	7.8

Daily gage height, in feet, of West Branch of Onondaga Creek at South Onondaga, N. Y., for the year ending Sept. 30, 1916.

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1	.....	1.03	11	.....	1.00	21	.....	1.00
2	.....	1.05	12	.....	.99	22	1.00	1.03
3	.....	1.02	13	.....	1.00	23	1.08	1.07
4	.....	1.01	14	.....	.99	24	1.03	1.04
5	.....	1.00	15	.....	1.35	25	1.00	1.08
6	.....	1.00	16	.....	1.16	26	1.00	1.07
7	.....	.99	17	.....	1.04	27	1.01	1.06
8	.....	1.00	18	.....	1.07	28	1.04	1.03
9	.....	1.00	19	.....	1.07	29	1.02	1.37
10	.....	1.00	20	.....	1.06	30	1.01	1.31
						31	1.02	.....

ORWELL BROOK NEAR ALTMAR, N. Y.

LOCATION.—At highway bridge one-eighth mile above mouth and 1½ miles by road northwest of Altmar, Oswego County.

DRAINAGE AREA.—22.1 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 23, 1911, to June 30, 1916, when station was discontinued. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Chain at downstream side of bridge; read by Mrs. A. G. White.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Small stone and gravel; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.00 feet at 5.30 p. m. May 17 (discharge, 497 second-feet); minimum stage recorded, 1.85 feet at 8 a. m. and 5 p. m. October 1 (discharge, 11 second-feet).

1911–1916: Maximum stage recorded, 5.5 feet at 6 p. m. April 7, 1912 (discharge, 610 second-feet); minimum stage recorded, 1.65 feet August 6, 7, 14, 22, 23, and 24 and September 5, 1911 (discharge, 5 second-feet).

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice during a large part of the period from December to March, inclusive. Rating curve well defined between 10 and 350 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results good.

Discharge measurements of Orwell Brook near Altmar, N. Y., during the year ending Sept. 30, 1916.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Nov. 3	1.99	16.3
3	1.99	16.4

Daily discharge, in second-feet, of Orwell Brook near Altmar, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	Day.	Oct.	Nov.	Dec.	Apr.	May.	June.
1	11	20	61	368	42	34	16	15	34	18	149	52	56
2	23	20	54	347	42	30	17	13	30	20	181	475	76
3	20	16	49	241	47	102	18	13	29	30	181	288	56
4	17	15	58	198	72	91	19	45	52	165	142	232	52
5	29	18	47	149	64	56	20	42	165	165	91	126	66
6	61	15	42	126	45	47	21	38	91	149	108	94	61
7	38	15	36	91	45	32	22	30	56	142	149	66	49
8	24	15	40	84	38	30	23	26	61	119	149	84	34
9	24	15	36	91	42	47	24	23	61	105	108	88	34
10	23	15	32	98	34	52	25	20	56	116	91	66	49
							26	17	54	134	91	49	42
11	20	15	29	91	32	45	27	17	105	181	84	42	34
12	15	15	26	165	24	112	28	15	134	142	66	38	32
13	15	15	23	134	23	64	29	15	112	105	56	38	26
14	15	15	21	126	23	40	30	24	81	91	49	42	22
15	17	18	19	142	29	32	31	23	.....	84	.....	45	.....

NOTE.—Discharge Dec. 10–18 and 28–31 estimated, because of ice, from weather records and study gage-height graph.

Monthly discharge of Orwell Brook near Altmar, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 22.1 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	61	11	23.5	1.06	1.22
November	165	15	45.4	2.05	2.29
December	181	18	75.5	3.42	3.94
April	368	49	138	6.24	6.96
May	475	23	78.3	3.54	4.08
June	112	22	50.1	2.27	2.53

BLACK RIVER NEAR BOONVILLE, N. Y.

LOCATION.—At highway bridge about 1 mile above mouth of Sugar River, 2 miles northeast of Boonville, Oneida County, and 2 miles, by river, downstream from Hawkinsville.

DRAINAGE AREA.—303 square miles (measured on topographic maps).

RECORDS AVAILABLE.—February 16, 1911, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Chain gage near center of left span, downstream side of bridge; staff gage, graduated from 6.0 to 13.0 feet, on downstream side of right abutment, for high-water readings. Gage read by W. D. Charbonneau.

DISCHARGE MEASUREMENTS.—Made from a cable about one-half mile above gage or by wading near cable.

CHANNEL AND CONTROL.—Rough and full of boulders; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 9.45 feet at 8 a. m. May 18 (discharge, 4,750 second-feet); minimum stage recorded, 3.10 feet at 4 p. m. August 21 (discharge, 34 second-feet).

1911-1916: Maximum stage approximately 12.5 feet during night of March 28, 1913, determined by leveling from flood mark (discharge, about 10,000 second-feet); minimum stage recorded, 3.0 feet at 8 a. m. September 29 and November 8, 1913, and October 8, 1914 (discharge, 27 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION AND DIVERSION.—The State dam at Forestport, about 8 miles upstream, provides a reservoir with a capacity of about 2 billion cubic feet. Water is diverted from this reservoir during the navigation season through the Forestport Feeder to a basin in Boonville. The Black River canal flows north from this basin and enters Black River at foot of Lyons falls. A spillway from the basin overflows into Mill Creek, a tributary of Black River. Water flowing through these two canals returns to the river below the gaging station, thus passing around it. The Black River canal also flows south from Boonville, passing out of the Black River basin and entering the summit level of the Erie Canal (or Barge Canal) at Rome. Occasional discharge measurements have been made at three points to indicate the distribution of the diverted water. The water entering Boonville through the Forestport Feeder has been measured at the highway bridge about a mile northeast of Boonville. During October, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of the flow. This record is published as a separate station, Forestport Feeder near Boonville, N. Y. The water flowing north from the basin through the Black River canal has been measured at the highway bridge just below the lock into this canal near the railroad station. The water flowing south from the basin has been

measured at a private farm bridge about a mile southeast of Boonville. During September, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of the flow, which is published as a separate station, called Black River canal (flowing south) near Boonville, N. Y.

ACCURACY.—Stage-discharge relation permanent, but affected by ice during a large part of the period December to March. Rating curve well defined between 35 and 2,800 second-feet and fairly well defined between 2,800 and 4,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results good, except for periods when the stage-discharge relation was affected by ice, for which they are fair.

Discharge measurements of Black River near Boonville, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*			*Feet.*	*Sec-ft.*
Dec. 29	A. H. Davison	[a] 5.19	441	Mar. 4	C. C. Covert	[a] 5.64	561
Jan. 8	do	[a] 6.42	850	16	A. H. Davison	[a] 5.22	412
20	do	[a] 5.77	466	27	do	5.18	484
Feb. 2	do	[a] 6.98	1,750	May 8	do	5.77	810
10	do	[a] 5.58	660	27	do	5.52	685
17	do	[a] 5.57	527	July 26	do	3.54	72.5
23	do	[a] 5.45	388				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Black River near Boonville, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	184	470	630	795	1,940	990	2,620	1,740	390	174	72	119
2	127	470	680	1,210	1,740	735	3,110	1,840	275	250	68	111
3	104	410	558	1,460	1,640	630	2,860	2,050	194	490	71	97
4	111	430	410	1,210	1,370	558	2,620	2,160	227	430	84	78
5	262	470	410	1,060	1,060	535	2,160	2,270	154	410	84	119
6	1,140	490	352	1,060	990	558	1,640	1,940	184	450	63	97
7	1,940	450	335	920	795	535	1,540	1,210	164	305	68	59
8	855	335	352	855	680	535	1,290	795	205	227	84	49
9	735	262	320	735	630	470	1,140	735	305	145	90	97
10	512	227	290	680	680	450	1,060	680	290	70	78	97
11	352	205	275	630	605	430	990	630	238	46	84	97
12	250	194	305	855	535	470	1,060	605	275	57	111	78
13	184	164	352	1,060	470	450	1,290	580	250	55	90	56
14	194	119	370	795	430	390	1,640	535	216	44	78	49
15	184	104	630	735	410	410	1,840	605	194	53	78	97
16	205	154	855	512	430	410	2,160	2,500	305	55	63	275
17	205	184	1,140	512	512	352	2,620	4,140	735	56	56	275
18	194	216	920	450	512	320	2,500	4,540	1,140	72	53	250
19	262	227	735	512	535	352	2,380	3,620	1,460	84	46	216
20	410	275	630	490	490	352	2,270	2,380	1,210	63	42	205
21	512	430	605	558	450	335	2,500	1,540	1,370	68	38	205
22	490	580	512	795	410	430	2,980	1,290	1,216	66	44	238
23	490	535	512	920	390	390	3,360	1,210	990	78	216	305
24	470	490	490	920	410	352	3,110	1,370	735	97	250	238
25	450	430	680	795	430	370	2,620	1,370	580	90	194	184
26	430	370	990	795	1,370	470	2,500	990	490	84	145	174
27	490	370	1,290	1,060	1,540	630	2,500	580	430	84	111	97
28	512	352	990	1,540	1,460	1,210	2,160	558	335	66	205	55
29	450	335	450	2,050	1,210	1,370	1,940	535	305	72	184	119
30	450	352	227	2,270	.....	1,640	1,840	450	227	78	145	250
31	490	.....	320	2,160	.....	2,160	.....	450	.....	84	136	.....

NOTE.—Discharge Dec. 29 to Jan. 30 and Feb. 10 to Mar. 25, estimated, because of ice, from numerous current-meter measurements, weather records, and study of gage-height graph.

Monthly discharge of Black River near Boonville, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 303 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,940	104	440	1.45	1.67
November	580	104	337	1.11	1.24
December	1,290	227	568	1.87	2.16
January	2,270	450	981	3.24	3.74
February	1,940	390	832	2.74	2.96
March	2,160	320	622	2.05	2.36
April	3,360	990	2,140	7.06	7.88
May	4,540	450	1,480	4.88	5.63
June	1,460	154	503	1.66	1.85
July	490	44	142	.469	.54
August	250	38	101	.333	.38
September	305	49	146	.482	.54
The year	4,540	38	689	2.27	30.95

NOTE.—Figures do not indicate total run-off from drainage area above the station; water being diverted is measured by station on the Forestport Feeder near Boonville.

FORESTPORT FEEDER NEAR BOONVILLE, N. Y.

LOCATION.—Slope station at lower end of feeder, above point where it enters the basin at Boonville, Oneida County.

RECORDS.—Occasional discharge measurements 1900 and 1905 to 1915, continuous record October 30, 1915, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGES.—Two Gurley seven-day water-stage recorders, with natural scale for gage heights. Gage No. 1 is at downstream end of left abutment of steel highway bridge in village of Hawkinsville; gage No. 2 located on left bank, just below a farm bridge about a mile above the basin at Boonville; they are 2.53 miles apart. The float wells are 1½ by 2 feet, inside dimensions, and the bottoms are about 1½ feet below normal elevation of water surface in canal. These gages and the two in the Black River canal (flowing south) near Boonville are all set at the same datum; recorder at gage No. 1 inspected by Mrs. Anna Zwahlen; that at gage No. 2 inspected by Charles Nugent.

DISCHARGE MEASUREMENTS.—Made from the steel highway bridge at gage No. 1 in Hawkinsville.

DIVERSIONS.—One spillway takes water from the Forestport Feeder just below gage No. 2 and a second spillway takes water from the basin in Boonville. Both discharge into Mill Creek, which enters Black River below the Boonville gaging station. No spillway between gage No. 1 and gage No. 2. Other spillways in the feeder above gage No. 1 discharge into Black River above the gaging station. Therefore, this station indicates the total amount of water diverted past the gaging station on Black River near Boonville, and the sum of this record and the record for the Black River near Boonville indicates the total run-off of the Black River basin above these gaging stations.

REGULATION.—Flow in the feeder is regulated at the outlet of Forestport reservoir.

ICE.—No flow in the canal during the winter season.

ACCURACY.—Stage-discharge relation affected by variations in the slope of the water surface and by vegetable growth in channel. Slope of water surface determined from gage-height graphs by the two gages. Seasonal changes in the coefficient C in Chezy formula, caused by vegetable growth, determined by discharge measurements and are fairly consistent. Results fair.

Discharge measurements of Forestport Feeder near Boonville, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height in feet.		Discharge.
		Gage No. 1.	Gage No. 2.	
				Sec.-ft.
Oct. 3	O. W. Hartwell			291
21	A. H. Davison			307
Nov. 1	E. D. Burchard	3.567	2.068	295
1	do	3.586	2.081	295
2	do	3.610	2.078	298
2	do	3.607	2.055	296
19	do	3.611	2.123	332
19	do	3.614	2.170	327
30	do	3.312	1.920	287
30	do	3.298	1.909	282
30	do	3.290	1.899	280
June 9	O. W. Hartwell	3.348	1.817	295
23	do	3.048	1.619	252
23	M. J. Maguire	3.042	1.614	252
24	do	2.998	1.701	246
24	do	3.008	1.719	249
July 6	A. H. Davison	3.392	1.955	304
6	do	3.381	1.948	303
6	do	3.346	1.898	290
6	do	3.334	1.894	293
26	do	3.288	1.893	281
Sept. 7	do	3.450	2.180	260
26	do	3.374	2.132	238

Daily discharge, in second-feet, of Forestport Feeder near Boonville, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1	.....	296	293	244	273	269	16	.....	332	305	267	248	259
2	.....	305	325	243	271	262	17	.....	329	272	259	237	256
3	.....	298	315	269	278	260	18	.....	327	262	300	232	245
4	.....	297	326	273	286	260	19	.....	330	288	307	222	242
5	.....	307	321	274	285	261	20	.....	346	296	297	217	259
6	.....	303	311	293	280	260	21	.....	304	290	275	216	259
7	.....	306	300	281	269	261	22	.....	289	282	240	222	255
8	.....	305	301	290	262	255	23	.....	275	263	270	262	259
9	.....	309	302	283	269	249	24	.....	322	253	304	274	255
10	.....	310	297	271	265	245	25	.....	332	253	304	272	251
11	.....	317	290	276	260	244	26	.....	333	249	286	270	248
12	.....	316	295	267	262	238	27	.....	292	254	272	269	236
13	.....	320	303	266	258	237	28	.....	279	257	299	271	228
14	.....	314	305	284	256	223	29	.....	340	255	283	267	259
15	.....	328	297	280	253	246	30	280	302	248	278	263	245
							31	294	.....	.....	275	263	.....

Monthly discharge of Forestport Feeder near Boonville, N. Y., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
November	346	275	312
June	326	248	287
July	307	240	278
August	286	216	259
September	269	223	251

BLACK RIVER CANAL (FLOWING SOUTH) NEAR BOONVILLE, N. Y.

LOCATION.—Slope station in summit level of Black River canal near Boonville, Oneida County.

RECORDS AVAILABLE.—Occasional discharge measurements 1900, 1905 to 1915; continuous record September 16, 1915, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGES.—Two Gurley seven-day water-stage recorders with natural scale for gage heights; they are 1.81 miles apart. Gage No. 1 is on right bank (opposite towpath) about 50 feet downstream from collector's office in Boonville; gage No. 2 is on right bank (opposite towpath) about 300 yards above Lock 70 and 50 yards above spillway from the canal into Lansing Kill. These gages and the two gages in the Forestport feeder near Boonville are all set at the same datum. Recorders inspected by Philip Joynt.

DISCHARGE MEASUREMENTS.—Made from the steel and concrete highway bridge in the village of Boonville, a short distance below gage No. 1.

DIVERSIONS.—No diversions between gage No. 1 and gage No. 2. This station indicates the amount of water diverted for canal purposes from the Black River basin into the Mohawk River basin.

REGULATION.—Flow in canal is regulated by operation of spillway and sluice gates at Lock 70 and also by discharge of Forestport feeder into the basin at Boonville.

ICE.—No flow in the canal during winter season.

ACCURACY.—Stage-discharge relation affected by variations in the slope of the water surface and by vegetable growth in channel. Slope of water surface determined from gage-height graphs by the two gages. Seasonal changes in the coefficient C in Chezy formula, caused by vegetable growth, determined by discharge measurements and are fairly consistent. Results fair.

Discharge measurements of Black River canal (flowing south), near Boonville, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height in feet.		Discharge.
		Gage No. 1.	Gage No. 2.	
				Sec.-ft.
Oct. 3	O. W. Hartwell	1.705	1.095	250
3	do	1.696	1.079	247
21	A. H. Davison	1.55	.....	239
22	O. W. Hartwell	1.48	1.00	212
22	E. D. Burchard	1.48	1.00	224
27	do	1.68	1.20	262
27	A. H. Davison	1.68	1.20	270
27	E. D. Burchard	1.655	1.16	260
27	A. H. Davison	1.655	1.15	267
Nov. 18	E. D. Burchard	1.626	1.236	248
29	do	1.670	1.199	295
29	do	1.653	1.190	293
29	do	1.653	1.188	295
June 9	O. W. Hartwell	1.453	1.100	233
23	do	1.232	.957	183
23	M. J. Maguire	1.272	1.120	178
24	do	1.252	.932	195
24	do	1.245	.932	193
July 7	A. H. Davison	1.225	.885	201
7	do	1.150	.835	197
26	do	1.510	1.140	216
27	do	1.491	1.131	208
Sept. 8	do	1.580	1.040	193
27	do	1.650	1.090	193

Daily discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the years ending Sept. 30, 1915 and 1916.

Day.	Sept.	Day.	Sept.	Day.	Sept.	Day.	Sept.
1915.		1915.		1915.		1915.	
18	200	22	184	25	169	28	186
19	198	23	183	26	176	29	192
20	195	24	178	27	186	30	196
21	187						

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1915–16.							1915–16.						
1	.....	235	.....	186	215	207	16	240	258	247	182	201	205
2	.....	243	220	191	213	204	17	241	252	215	211	205	200
3	239	252	259	218	211	212	18	231	248	186	229	195	194
4	234	242	265	214	215	214	19	249	275	222	230	192	190
5	236	237	258	201	213	206	20	241	266	242	225	194	203
6	231	249	268	212	212	203	21	236	237	224	202	196	201
7	231	242	264	199	209	210	22	229	226	195	187	196	202
8	226	241	230	208	208	201	23	222	241	196	201	214	207
9	218	236	226	203	208	200	24	223	264	203	227	213	201
10	219	248	216	192	212	195	25	224	254	196	228	215	201
11	219	246	216	194	220	202	26	227	258	195	215	215	195
12	215	244	220	189	217	191	27	239	267	217	210	219	197
13	227	245	208	184	210	184	28	234	254	200	228	220	181
14	233	252	199	192	213	189	29	220	296	194	215	216	211
15	233	289	213	184	211	202	30	226	323	193	211	215	202
							31	232	.....	.....	211	207	.....

Monthly discharge of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
October 3–31	249	215	230
November	323	226	254
June 2–30	268	186	220
July	230	182	206
August	220	192	210
September	214	181	200

MOOSE RIVER AT MOOSE RIVER, N. Y.

LOCATION.—In the village of Moose River, Lewis County, about 3 miles downstream from McKeever, 5 miles below mouth of South Branch of Moose River and nearly 20 miles above junction of Black and Moose rivers at Lyons Falls.

DRAINAGE AREA.—370 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 5, 1900, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Staff in two sections, on the left bank a short distance above cable. Read by Mrs. Martha Hannan. Gage datum was lowered 0.17 foot February 28, 1903, and again 5.00 feet on January 1, 1913.

DISCHARGE MEASUREMENTS.—Made from a cable a short distance below the gage.

CHANNEL AND CONTROL.—Cobblestone and boulders; fairly permanent. Current smooth; depth comparatively uniform. Ice and logs occasionally jam on a small island just above the station.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.0 feet at 8 a. m. May 18 (discharge 9,250 second-feet); minimum stage recorded, 5.1 feet at 8 a. m. and 6 p. m. Sunday August 20 and 27 (discharge about 65 second-feet).

1900–1916: Maximum stage recorded, 16.3 feet during the afternoon of March 27, 1913, determined by leveling from flood marks (discharge about 16,500 second-feet); minimum stage recorded, 4.94 feet, July 21, 23, 25, 26, and 27, 1913 (discharge 42 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—A timber dam at McKeever, 3 miles upstream, is used for power and for the regulation of flow during log driving. Seasonal distribution of flow affected by operation of the State dam at Old Forge. This regulation is indicated by a record from station Middle Branch of Moose River at Old Forge.

ACCURACY.—Stage-discharge relation practically permanent, but affected by ice for a large portion of the period from December to March. Rating curve fairly well defined between 100 and 5,500 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Results fairly good except for periods when the discharge is low or the stage-discharge relation is affected by ice; winter results fair.

Discharge measurements of Moose River at Moose River, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 28[a]	A. H. Davison	8.31	1,230	Feb. 22[a]	A. H. Davison	7.19	435
Jan. 10[a]	do	7.66	875	Mar. 1[a]	C. C. Covert	7.25	472
11[a]	do	7.42	739	17[a]	A. H. Davison	7.51	389
22[a]	do	7.27	558	28[a]	do	7.89	680
Feb. 1[a]	do	9.81	2,630	May 6	do	8.84	1,760
15[a]	do	7.42	690	26	do	8.44	1,460
16[a]	do	7.34	546	July 25	do	7.40	880

[a] Complete ice cover.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	426	545	805	545	2,860	510	2,660	2,480	665	316	286	114
2	409	545	710	393	2,860	585	3,170	2,480	625	189	257	229
3	316	442	710	625	2,570	545	3,060	2,480	625	710	272	85
4	426	426	625	625	1,940	545	2,660	2,300	625	1,150	176	216
5	476	409	510	625	1,590	377	2,120	2,210	665	1,020	176	257
6	1,430	426	710	665	1,220	331	1,940	1,760	545	585	176	216
7	1,220	164	805	1,020	1,220	442	1,760	1,510	476	442	377	189
8	710	346	710	1,020	1,020	409	1,590	1,590	442	409	377	176
9	625	331	625	625	965	426	1,020	1,590	442	257	377	176
10	346	316	625	875	855	426	1,290	1,430	377	362	476	105
11	710	316	625	739	755	442	1,220	1,290	316	316	426	216
12	510	316	229	625	710	362	1,290	1,150	476	301	393	176
13	409	426	545	710	442	476	1,510	910	476	301	316	103
14	476	202	510	625	585	476	1,760	805	476	1,670	316	164
15	409	625	476	710	585	426	2,030	665	545	1,430	346	377
16	409	476	442	409	545	426	1,760	1,150	476	805	346	625
17	202	625	409	585	545	409	3,280	4,750	585	710	286	442
18	426	585	377	476	510	393	2,860	7,060	855	625	164	476
19	476	442	229	476	510	331	2,480	3,390	855	545	189	176
20	545	625	710	442	316	393	2,300	3,060	1,150	393	79	202
21	585	805	476	476	426	393	2,300	2,480	1,020	346	257	346
22	585	710	625	510	442	393	3,280	2,390	710	229	243	257
23	545	665	442	1,590	476	362	3,060	2,120	625	476	176	202
24	229	585	442	2,120	409	362	2,860	1,940	545	910	69	286
25	362	545	176	1,760	426	409	2,860	1,590	316	710	103	476
26	476	476	910	1,590	510	442	3,060	1,430	409	585	121	362
27	409	476	1,290	1,590	476	545	3,280	1,220	409	442	164	362
28	476	755	1,150	2,860	805	665	2,860	710	409	426	202	346
29	476	1,020	805	3,280	710	965	2,860	855	346	272	79	377
30	442	965	625	2,480	.....	1,430	2,480	625	346	117	117	855
31	331	.....	625	2,210	.....	1,940	.....	910	.....	346	103	.....

NOTE.—Discharge Dec. 15 to Jan. 22 and Feb. 9 to Mar. 30, estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph.

Monthly discharge of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 370 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,430	202	512	1.38	1.59
November	1,020	164	520	1.41	1.57
December	1,290	176	611	1.65	1.90
January	3,280	393	1,070	2.89	3.33
February	2,860	316	941	2.54	2.74
March	1,940	331	536	1.45	1.67
April	3,280	1,020	2,360	6.38	7.12
May	7,060	625	1,950	5.27	6.08
June	1,150	316	561	1.52	1.70
July	1,670	117	561	1.52	1.75
August	476	69	240	.649	.75
September	855	85	286	.773	.86
The year	7,060	69	844	2.28	31.06

NOTE.—No correction made for storage at Old Forge.

MIDDLE BRANCH OF MOOSE RIVER AT OLD FORGE, N. Y.

LOCATION.—About 300 feet below highway bridge and 400 feet below the State dam at Old Forge, Herkimer County.

DRAINAGE AREA.—51.5 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 9, 1911, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Vertical staff on left bank, 300 feet below highway bridge; read by Jacob Edick.

DISCHARGE MEASUREMENTS.—Made by wading near the gage at low and medium stages and from highway bridge at high stages.

CHANNEL AND CONTROL.—Channel, stone and gravel near the gage. Control is rock ledge about 200 feet below gage, practically permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.8 feet at 8 a. m. and 5 p. m. May 19 (stage-discharge relation affected by backwater from Moose River); maximum discharge computed from records at Old Forge dam, 387 second-feet May 18. Minimum stage occurs when gates at dam are closed, discharge being due to leakage and discharge through the fish hatchery; minimum gage height during the year 0.50 foot (discharge 5.0 second-feet).

1911–1916: Maximum stage recorded 6.3 feet (stage-discharge relation affected by backwater from Moose River) March 28, 1913; discharge computed from records at dam, 760 second-feet.

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

REGULATION.—Flow controlled at dam.

ACCURACY.—Stage-discharge relation practically permanent between dates of shift; not affected by ice. A change in the rating was caused by the high water in May. Rating curve used October 1 to May 16 well defined from 2 to 300 second-feet. Rating curve used May 26 to September 30 well defined from 20 to 400 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to the rating table mean daily gage heights weighted on days of changing gates, from records of gate opening at dam. Results good, except for period May 17 to 25, when Moose River caused backwater at gage, for which they are fair.

Discharge measurements of Middle Branch of Moose River at Old Forge, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 26	A. H. Davison	3.10	339	June 10	O. W. Hartwell	1.35	55.6
26	do	3.10	330	July 24	A. H. Davison	.86	22.4
June 9	O. W. Hartwell	1.13	36.2	24	do	2.18	153
10	do	1.57	74.0	24	do	2.61	228
10	do	1.80	104				

Daily discharge, in second-feet, of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	158	150	75	5.6	260	60	250	181	86	30	37	75
2	158	150	75	5.6	260	60	260	181	86	30	37	75
3	158	150	75	5.6	250	60	310	181	56	165	37	75
4	158	150	75	5.6	241	60	310	189	43	260	37	75
5	150	116	75	5.6	223	60	310	189	43	92	37	75
6	158	86	75	6.2	214	60	310	197	43	40	37	75
7	158	86	75	6.5	206	60	310	197	45	40	60	75
8	158	80	75	7.4	197	60	290	197	40	40	143	75
9	158	80	75	9.2	197	60	290	250	39	40	143	75
10	158	80	75	11	189	62	290	241	37	40	143	80
11	158	110	75	13	189	65	290	241	36	40	143	75
12	150	136	75	15	143	65	280	33	36	40	143	116
13	150	136	75	18	123	64	280	33	36	86	136	165
14	150	136	36	20	116	64	270	33	36	232	136	165
15	158	165	5.0	24	116	65	270	30	36	232	136	165
16	150	197	5.0	24	104	80	280	63	128	206	75	165
17	150	197	5.0	27	104	110	270	304	216	181	54	165
18	150	197	5.0	29	104	110	270	387	135	98	54	165
19	150	75	5.0	29	104	110	197	378	103	35	70	165
20	158	75	5.0	31	104	104	104	360	103	35	75	165
21	150	75	5.3	37	104	104	104	342	103	35	75	165
22	150	75	5.0	44	86	104	110	327	86	35	75	165
23	150	75	5.0	54	56	104	123	320	56	35	75	165
24	150	75	5.0	60	58	104	123	330	56	37	75	165
25	150	75	5.0	70	60	104	123	330	39	39	75	165
26	150	75	5.0	98	60	104	130	307	32	38	75	165
27	150	75	5.3	130	60	104	158	234	32	38	75	165
28	150	75	5.6	173	60	104	173	142	32	37	75	165
29	150	75	5.6	223	59	104	181	86	32	37	75	165
30	150	75	5.6	223	.....	130	181	86	32	37	75	165
31	150	.....	5.6	232	.....	165	.....	86	.....	37	75	.....

NOTE.—No gage-height record May 12 and 13; discharge estimated. Discharge May 17-25 computed because of backwater from Moose River, from records of elevation of lake and gate opening at Old Forge dam. Comparison with records at the dam indicates that stage-discharge relation was not affected by ice.

Monthly discharge of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 51.5 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	158	150	153	2.97	3.42
November	197	75	110	2.14	2.39
December	75	5.0	35.4	.687	.79
January	232	5.6	53.0	1.03	1.19
February	260	56	140	2.72	2.93
March	165	60	86.1	1.67	1.92
April	310	104	228	4.43	4.94
May	387	30	208	4.04	4.66
June	216	32	62.8	1.22	1.36
July	260	30	76.4	1.48	1.71
August	143	37	82.5	1.60	1.84
September	165	75	131	2.54	2.83
The year	387	5.0	113	2.19	29.98

NOTE.—Table indicates the flow as regulated at the Old Forge dam.

BEAVER RIVER AT STATE DAM NEAR BEAVER RIVER, N. Y.

LOCATION.—At the concrete storage dam at the outlet of Beaver River flow, about 7½ miles west of Beaver River postoffice, Herkimer County, and 7 miles above Beaver Lake at Number Four.

DRAINAGE AREA.—176 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 11, 1908, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGES.—Elevation of water surface in reservoir is determined by staff gage in two sections on west corner of gate house. Mean elevation of crest of spillway, gage height 16.96 feet. Prior to September 28, 1916, elevation of water surface was determined by measuring the distance from the water surface to a reference point set at the elevation of the crest of the spillway. Widths of sluice-gate openings determined by measuring on the gate stems the distance they have been raised. Gage heights and sluice-gate openings recorded by James Dunbar, tender at the dam.

DISCHARGE RATINGS.—Records include the discharge through one or more of four 4-foot circular sluice gates when open, discharge over the spillway, and the discharge through the logway at the west end of the spillway. The sluice gates have been rated by current-meter measurements made at different elevations of the lake, but no measurements have been made of the discharge over the spillway or through the logway. Theoretical coefficients based on the experiments [1] at the hydraulic laboratory of Cornell University have been used to compute rating tables for the spillway and the logway.

EXTREMES OF STAGE.—Maximum elevation of water surface in reservoir during year, 19.0 feet at 10 a. m. May 19; minimum elevation recorded, 7.7 feet at 1.30 p. m. September 28.

1908–1916: Maximum elevation of water surface in reservoir, 19.46 feet on March 29, 1913; minimum stage, 2.9 feet September 29 and October 1, 1913.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 2,210 second-feet May 19; minimum discharge, zero during periods when gates were closed and there was no flow over the spillway.

1908–1916: Maximum daily discharge recorded, 3,300 second-feet on May 2, 1911.

REGULATION.—At ordinary stages the discharge of Beaver River is completely regulated by the operation of the sluice gates.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curves for sluice gates fairly well defined. Rating curves for spillway and logway based on theoretical coefficients; probably fairly good. Reservoir gage read to half-tenths once daily. Sluice-gate openings set to even inches; probably correct within one-half inch. Results good when flow is confined to one or two sluice gates; fairly good when water is flowing over the spillway or through the logway.

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[1] See U. S. Geol. Survey Water-Supply Paper 200.

Discharge measurements of Beaver River at State dam near Beaver River, N. Y., during the year ending Sept. 30, 1916.

[Made by O. W. Hartwell.]

Date.	Gate.		Lake gage height.	Discharge.	Date.	Gate.		Lake gage height.	Discharge.
	No.	Opening.				No.	Opening.		
		Inches.	*Feet.*	*Sec.-ft.*			*Inches.*	*Feet.*	*Sec.-ft..*
Aug. 11	1	12	15.15	74.4	Aug. 12	4	48	15.05	234
11	1	24	15.15	149	12	4	36	15.05	199
11	1	36	15.15	205	12	3	24	15.05	142
11	1	44½	15.15	236	12	3	12	15.05	73.6
11	4	12	15.15	77.1	12	4	12	15.10	75.5
11	4	24	15.15	136	12	4	24	15.10	144

Monthly discharge of Beaver River at State dam near Beaver River, N. Y., for the years ending Sept. 30, 1908–1916.

[Drainage area, 176 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1908.					
May 11-31	1,010	315	599	3.41	2.66
June	330	193	270	1.53	1.71
July	250	134	177	1.01	1.16
August	169	0	102	.580	.67
September	245	0	109	.619	.69
1908–9.					
October	397	212	301	1.71	1.97
November	243	106	184	1.04	1.16
December	120	112	118	.670	.77
January	364	120	140	.795	.92
February	750	147	339	1.93	2.01
March	500	0	219	1.24	1.42
April	2,680	2	1,220	6.93	7.73
May	1,740	466	1,050	5.97	6.88
June	466	153	307	1.74	1.94
July	159	76	148	.841	.97
August	473	76	256	1.45	1.67
September	194	112	152	.864	.96
The year	2,680	0	369	2.10	28.40
1909–10.					
October	126	107	113	.642	.74
November	190	117	144	.818	.91
December	200	129	180	1.02	1.18
January	184	0	132	.750	.86
February	426	71	259	1.47	1.53
March	1,580	359	560	3.18	3.67
April	2,020	530	862	4.90	5.47
May	730	395	548	3.11	3.58
June	630	270	430	2.44	2.72
July	251	88	159	.903	1.04
August	240	152	157	.892	1.03
September	250	150	206	1.17	1.30
The year	2,020	0	312	1.77	24.03
1910–11.					
October	225	0	123	.699	.81
November	152	0	42.9	.244	.27
December	240	0	166	.943	1.09
January	180	0	106	.602	.69
February	403	154	258	1.47	1.53
March	390	249	355	2.02	2.33
April	2,040	141	926	5.26	5.87
May	3,300	542	982	5.58	6.43
June	726	395	568	3.23	3.60
July	350	154	198	1.12	1.29
August	243	185	216	1.23	1.42
September	184	106	128	.727	.81
The year	3,300	0	339	1.93	26.14

Monthly discharge of Beaver River at State dam near Beaver River, N. Y., for the years ending Sept. 30, 1908–1916—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1911–12.					
October	142	120	136	0.773	0.89
November	315	0	140	.795	.89
December	640	210	392	2.23	2.57
January	410	251	298	1.69	1.95
February	487	247	367	2.09	2.25
March	205	100	124	.704	.81
April	2,670	0	1,040	5.91	6.59
May	1,480	133	574	3.26	3.76
June	1,200	60	351	1.99	2.22
July	163	150	154	.875	1.01
August	232	147	177	1.01	1.16
September	217	128	181	1.03	1.15
The year	2,670	0	326	1.85	25.25
1912–13.					
October	224	70	144	0.818	0.94
November	368	22	217	1.23	1.37
December	675	193	373	2.12	2.44
January	1,560	193	906	5.15	5.94
February	630	133	309	1.76	1.83
March	3,060	193	923	5.24	6.04
April	1,900	22	888	5.04	5.62
May	623	154	271	1.54	1.78
June	552	156	258	1.46	1.63
July	250	154	220	1.25	1.44
August	237	173	208	1.18	1.36
September	168	60	96.8	.550	.61
The year	3,060	22	402	2.28	31.00
1913–14.					
October	196	0	96.2	0.547	0.63
November	1,240	22	387	2.20	2.46
December	650	207	327	1.86	2.14
January	496	164	248	1.41	1.63
February	374	233	289	1.64	1.71
March	302	0	146	.820	.95
April	3,160	0	1,090	6.19	6.91
May	1,660	139	518	2.94	3.39
June	217	117	162	.920	1.03
July	161	153	156	.887	1.02
August	242	144	206	1.17	1.35
September	234	146	182	1.03	1.15
The year	3,160	0	316	1.80	24.37
1914–15.					
October	221	134	181	1.03	1.19
November	146	0	97.7	.555	.62
December	552	0	267	1.52	1.75
January	709	207	419	2.38	2.74
February	893	207	390	2.22	2.31
March	650	139	266	1.51	1.74
April	1,750	83	705	4.01	4.47
May	519	11	216	1.23	1.42
June	280	39	163	.926	1.03
July	280	139	181	1.03	1.19
August	457	83	223	1.27	1.46
September	261	83	176	1.00	1.12
The year	1,750	0	273	1.55	21.04
1915–16.					
October	224	216	220	1.25	1.44
November	226	215	217	1.23	1.37
December	430	223	259	1.47	1.70
January	1,240	305	511	2.90	3.34
February	1,360	229	514	2.92	3.15
March	305	217	234	1.33	1.53
April	1,530	333	962	5.47	6.10
May	2,210	322	886	5.03	5.80
June	457	207	328	1.86	2.08
July	324	111	212	1.21	1.40
August	251	225	241	1.37	1.58
September	223	163	195	1.11	1.24
The year	2,210	111	397	2.26	30.73

STREAMS TRIBUTARY TO ST. LAWRENCE RIVER.

EAST BRANCH OF OSWEGATCHIE RIVER AT NEWTON FALLS, N. Y.

LOCATION.—600 feet below lower dam of the Newton Falls Paper Co. in the village of Newton Falls, St. Lawrence County, 4 miles above mouth of Little River and 10 miles below outlet of Cranberry Lake.

DRAINAGE AREA.—166 square miles (measured by engineers of State of New York Conservation Commission).

RECORDS AVAILABLE.—October 6, 1912, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Vertical staff on left bank about 600 feet below lower dam; read by C. H. Corp and Alfred Renaud.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 30 feet above gage.

CHANNEL AND CONTROL.—Small boulders and rock; covered with waste from the pulp mill.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.6 feet at 5.30 p. m. May 18 (discharge, 1,860 second-feet); minimum stage is reached nearly every Sunday during low-water period when paper mill is shut down, gage height 0.0 (discharge, 22 second-feet, represents leakage).

1912–1916: Maximum stage recorded 6.1 feet at 5.15 p. m. March 28, 1913 (discharge, 2,200 second-feet).[1]

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

REGULATION.—Some diurnal fluctuation in flow is caused by operation of the paper mills. Seasonal flow largely controlled by storage at Cranberry Lake.

ACCURACY.—Stage-discharge relation practically permanent. Not affected by ice during year. Rating curve well defined between 20 and 1,200 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying to rating table weighted mean gage heights based on observer's notes concerning operation of paper mills. Results good.

Discharge measurements of East Branch of Oswegatchie River at Newton Falls, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 9	A. H. Davison	1.98	308	July 4	A. H. Davison	0.26	76
Apr. 28	O. W. Hartwell	3.96	960	Sept. 24	do	.26	35.8
28	do	3.92	945				

[1] Supersedes figures previously published.

Daily discharge, in second-feet, of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	304	205	304	376	588	402	554	982	350	223	350	262
2	350	262	304	a 188	622	376	a 430	894	304	a 196	304	262
3	a 119	262	350	350	490	350	522	894	304	106	304	a 140
4	242	262	376	376	430	376	326	938	a 402	81	326	223
5	304	282	a 171	350	402	a 163	262	894	732	304	350	304
6	304	350	282	350	a 304	304	242	810	490	304	a 196	262
7	304	a 155	402	350	402	326	242	a 694	304	223	262	282
8	326	223	350	402	402	304	242	732	304	223	350	282
9	304	282	304	a 402	376	304	a 140	658	304	a 112	304	282
10	a 112	282	326	460	376	304	196	588	304	171	304	a 140
11	242	262	376	430	376	304	223	554	a 126	205	304	205
12	304	242	a 163	402	376	a 242	205	506	282	282	326	282
13	304	242	242	460	a 350	304	223	475	350	376	a 133	223
14	304	a 140	304	430	430	304	262	a 282	376	402	282	205
15	304	180	304	402	402	350	350	282	376	350	350	196
16	304	223	304	a 430	402	376	a 376	282	430	a 282	262	223
17	a 81	223	304	430	350	376	554	694	402	402	223	a 133
18	188	205	304	402	350	376	522	1,680	a 326	350	262	196
19	304	262	a 148	402	402	a 196	522	1,680	402	326	223	242
20	304	282	242	402	a 180	402	522	1,740	402	304	a 119	262
21	304	a 140	282	402	282	490	622	a 1,560	402	304	223	262
22	304	223	282	522	304	588	694	1,500	402	304	223	242
23	304	242	304	a 588	304	622	a 732	1,440	a 30	a 140	242	304
24	a 70	205	223	522	304	588	894	1,270	402	402	262	a 87
25	188	205	99	522	304	554	982	1,070	a 262	460	304	350
26	262	262	a 112	522	304	a 554	982	982	350	460	262	282
27	262	304	326	522	a 188	658	982	894	326	376	a 112	223
28	262	a 106	350	554	402	622	982	a 732	326	376	205	262
29	262	242	304	622	402	694	938	588	282	490	242	304
30	262	304	350	a 490	.....	732	a 938	658	262	a 148	223	326
31	a 140	.....	376	522	.....	554	.....	554	.....	402	262	.....

a Sundays.

NOTE.—No gage-height record May 11–15; discharge interpolated.

Monthly discharge of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 166 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	350	a 70	256	1.54	1.78
November	350	a 106	235	1.42	1.58
December	402	b 99	286	1.72	1.98
January	622	a 188	438	2.64	3.04
February	622	a 180	372	2.24	2.42
March	732	a 163	422	2.54	2.93
April	982	a 140	522	3.14	3.50
May	1,740	a 282	887	5.34	6.16
June	732	a 126	357	2.15	2.40
July	490	b 81	293	1.77	2.04
August	350	a 112	261	1.57	1.81
September	350	a 87	242	1.46	1.63
The year	1,740	70	382	2.30	31.27

a Sunday. b Holiday.

NOTE.—Table shows run-off as regulated at Cranberry Lake and by paper mills at Newton Falls.

OSWEGATCHIE RIVER NEAR HEUVELTON, N. Y.

LOCATION.—2½ miles above Heuvelton, St. Lawrence County, 3 miles below Rensselaer Falls and 7 miles above mouth of Indian River (outlet to Black Lake).

DRAINAGE AREA.—961 square miles (all except 187 square miles measured on topographic maps).

RECORDS AVAILABLE.—June 23 to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Gurley seven-day water-stage recorder on the right bank, about 2½ miles above Heuvelton, installed September 16, 1916; prior to this date stage was determined by measuring the distance from a reference point to the water surface. Recorder inspected by George Todd.

CHANNEL AND CONTROL.—Some fluctuations due to operation of mills at Rensselaer Falls; seasonal flow regulated by storage in Cranberry Lake.

Data inadequate for determination of discharge.

Discharge measurements of Oswegatchie River near Heuvelton, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 26	E. D. Burchard	1.95	1,190	Sept. 10	A. H. Davison	0.99	340
Aug. 24	do	1.17	418	17	do	.89	326

Daily gage height, in feet, of Oswegatchie River near Heuvelton, N. Y., for the year ending Sept. 30, 1916.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		1.69	1.44	1.20	16		1.39	1.29	1.05
2		1.64	1.39	1.16	17		1.44	1.24	.95
3		1.69	1.39	1.19	18		1.54	1.29	1.06
4		1.64	1.29	1.13	19		1.64	1.29	.92
5		1.54	1.04	.49	20		1.74	1.24	.95
6		1.54	1.04	.59	21		1.69	1.29	1.02
7		1.54	1.14	1.19	22		1.69	1.19	
8		1.49	1.14	1.22	23	2.32	1.64	1.14	
9		1.44	1.19	1.19	24	2.22	1.64	1.18	1.02
10		1.39	1.19	1.14	25	2.14	1.64	1.09	1.02
11		1.39	1.19	1.19	26	1.98	1.59	1.09	1.08
12		1.44	1.29	.99	27	1.94	1.49	1.07	1.15
13		1.39	1.39	1.09	28	1.89	1.54	1.08	1.13
14		1.39	1.44	1.09	29	1.89	1.49	.95	1.17
15		1.34	1.39	1.14	30	1.84	1.44	1.12	1.13
					31		1.54	1.17	

NOTE.—Gage height June 23 to Sept. 15 is mean of two observations per day; gage height Sept. 16–30 is the mean from water-stage recorder.

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

LOCATION.—At the steel highway bridge locally known as Eel Weir Bridge, about a mile below mouth of Black Lake and 5½ miles above Ogdensburg, St. Lawrence County, and mouth of river.

DRAINAGE AREA.—1,580 square miles.

RECORDS AVAILABLE.—April 22, 1903, to December 1, 1916, when station was discontinued. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Chain near center of right span upstream side of bridge; read by J. H. La Rue.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Channel under bridge solid rock and partly artificial, the ledge underneath bridge having been removed by blasting to increase the bridge opening.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.9 feet at 5 p. m., April 4 and 8 a. m. April 5 (discharge not determined). Minimum stage recorded, 4.3 feet several times in September (discharge 390 second feet).

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

REGULATION.—There may be some diurnal fluctuation caused by operation of two dams in the vicinity of the gage—one at Heuvelton about 5 miles above, and one at Rensselaer Falls, 10 miles above. Seasonal distribution of flow affected by artificial storage in Cranberry Lake reservoir and natural storage in Black Lake.

ACCURACY.—Stage-discharge relation assumed to be permanent between dates of shifting; not affected by ice. Change in rating curve caused by high water in April. Rating curves poorly defined. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean gage heights to rating table. Results poor.

Discharge measurements of Oswegatchie River near Ogdensburg, N. Y., during the year ending Sept. 30, 1916.

[Made by A. H. Davison.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 28	7.09	5,720	Sept. 18	4.35	446
Sept. 18	4.34	441			

Daily discharge, in second-feet, of Oswegatchie River near Ogdensburg, N. Y., for the period Oct. 1, 1915, to Dec 1, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915-16.												
1	596	750	1,200	3,700	6,360	2,100	10,600	4,980	4,980	2,100	1,010	500
2	724	750	1,200	3,460	6,360	1,900	12,500	4,980	4,460	1,900	965	412
3	750	646	1,280	2 980	6,360	2,000	13,700	4,980	3,850	1,900	890	412
4	890	620	1,280	2,980	6,360	2,100	14,700	4,460	3,950	1,710	890	445
5	1,040	596	1,280	2,980	5,800	2,000	14,700	4,720	3,340	1,710	820	412
6	1,040	646	1,360	3,700	5,250	2,100	14,000	4,980	3,340	1,620	724	390
7	965	750	1,360	4,720	4,720	2,100	13,400	4,720	3,220	1,530	685	390
8	1,120	750	1,360	4,720	4,200	1,900	12,200	4,720	3,340	1,360	724	390
9	1,040	750	1,360	4,980	3,460	1,800	10,600	4,200	3,220	1,280	724	390
10	1,040	724	1,360	4,720	3,220	1,710	9,390	3,950	3,220	1,360	750	390
11	1,040	685	1,200	4,720	3,220	1,530	9,080	3,460	3,100	1,440	685	390
12	1,040	685	1,040	4,200	2,640	1,530	8,460	2,980	2,980	1,440	685	412
13	1,200	750	1,040	4,460	2,310	1,440	8,150	2,860	2,980	1,440	685	390
14	1,040	646	1,040	4,720	2,310	1,360	6,650	2,530	2,750	1,200	820	390
15	1,040	620	890	4,720	2,200	1,360	6,650	2,530	2,640	1,200	750	390
16	1,040	685	890	4,200	1,800	1,360	7,240	2,310	2,640	1,440	646	390
17	1,040	620	890	4,460	1,530	1,280	7,540	2,420	3,220	1,200	685	478
18	1,040	620	890	4,200	1,440	1,200	7,240	4,200	3,100	1,200	620	390
19	1,040	620	965	3,700	1,360	1,200	6,650	5,520	2,980	1,280	620	445
20	1,040	1,440	1,040	3,700	1,530	1,200	6,080	8,460	3,460	1,360	620	390
21	1,040	965	1,040	3,220	1,360	1,200	5,520	9,080	3,100	1,360	620	445
22	1,040	820	1,040	3,220	1,360	1,120	5,520	10,000	2,980	1,280	620	390
23	1,040	890	1,120	4,460	1,440	1,120	5,250	10,300	2,980	1,200	620	390
24	1,040	890	1,360	5,250	1,360	1,200	5,250	10,300	2,980	1,170	646	390
25	890	965	1,440	4,200	1,360	1,200	5,520	9,080	3,220	1,170	620	390
26	890	1,200	1,800	4,200	1,360	1,200	5,520	8,150	2,860	1,010	524	390
27	862	1,200	2,310	5,250	1,440	1,280	5,250	7,240	2,420	965	500	390
28	750	1,040	2,640	5,520	1,360	1,530	4,980	6,650	2,310	1,040	478	390
29	750	1,040	3,700	5,800	2,100	2,750	4,980	5,800	2,100	965	445	390
30	750	1,200	4,200	5,800	.....	4,720	4,980	5,520	2,100	1,040	412	412
31	750	.....	4,700	6,080	.....	8,150	.....	5,250	.....	1,040	478	.....

Daily discharge, in second-feet, of Oswegatchie River near Ogdensburg, N. Y., for the period Oct. 1, 1915, to Dec. 1, 1916—Continued.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1916				1916				1916			
1	390	750	1,120	11	560	778	.....	21	820	890	.....
2	390	820	.....	12	596	724	.....	22	724	890	.....
3	445	750	.....	13	620	750	.....	23	620	890	.....
4	500	724	.....	14	566	778	.....	24	596	1,360	.....
5	524	646	.....	15	560	820	.....	25	620	890	.....
6	524	685	.....	16	620	778	.....	26	862	920	.....
7	500	750	.....	17	724	750	.....	27	750	965	.....
8	685	750	.....	18	620	778	.....	28	750	965	.....
9	620	965	.....	19	596	750	.....	29	750	1,040	.....
10	560	890	.....	20	620	862	.....	30	750	1,040	.....
								31	724	.....	.....

NOTE.—Stage-discharge relation probably not affected by ice; open-water rating curve applicable throughout year.

Monthly discharge of Oswegatchie River near Ogdensburg, N. Y., for the period Oct. 1, 1915, to Nov. 30, 1916.

[Drainage area, 1,580 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915-16.					
October	1,200	596	954	0.604	0.70
November	1,440	596	819	.518	.58
December	4,200	890	1,530	.968	1.12
January	6,080	2,980	4,360	2.76	3.18
February	6,360	1,360	2,950	1.87	2.02
March	8,150	1,120	1,890	1.20	1.38
April	14,700	4,980	8,410	5.32	5.94
May	10,300	2,310	5,530	3.50	4.04
June	4,980	2,100	3,130	1.98	2.21
July	2,100	965	1,350	.854	.98
August	1,010	412	676	.428	.49
September	500	390	406	.257	.29
The year	14,700	390	2,660	1.68	22.93
1916.					
October	862	390	619	.392	.45
November	1,360	646	845	.535	.60

WEST BRANCH OF OSWEGATCHIE RIVER NEAR HARRISVILLE, N. Y.

LOCATION.—At highway bridge near Geers Corners, about 2½ miles downstream from Harrisville, Lewis County.

DRAINAGE AREA.—245 square miles (measured on topographic maps and United States Geological Survey map; scale, 1 to 500,000).

RECORDS AVAILABLE.—July 1 to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Vertical staff in three sections on the right bank; section reading from 0.0 to 3.3 feet, about 25 feet below bridge, 2 sections graduated from 3.3 to 10.1 feet on downstream side of bridge abutment. Gage read by Frank Osborne.

DISCHARGE MEASUREMENTS.—Made from a cable about 200 feet above bridge or by wading.

CHANNEL AND CONTROL.—Rocky and rough; probably permanent.

ICE.—Stage-discharge relation not effected by ice.

REGULATION.—The pulp mill at Harrisville causes some diurnal fluctuation.

Discharge measurements of West Branch of Oswegatchie River at Harrisville, N. Y., during the year ending Sept. 30, 1916.

[Made by A. H. Davison.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
July 3	2.15	212	Sept. 21	1.63	95.3
27	1.97	162	22	1.31	59.1

Daily discharge, in second-feet, of West Branch of Oswegatchie River at Harrisville, N. Y., for the year ending Sept. 30, 1916.

Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.	Day.	July.	Aug.	Sept.
1	208	63	63	11	146	115	74	21	170	68	79
2	195	74	63	12	115	77	63	22	146	68	68
3	220	98	70	13	135	135	51	23	146	85	91
4	245	74	79	14	195	115	53	24	135	74	91
5	290	74	79	15	260	124	62	25	170	63	91
6	245	85	85	16	195	106	68	26	170	63	124
7	195	68	79	17	195	91	91	27	146	79	98
8	220	63	68	18	232	70	91	28	135	58	74
9	170	115	65	19	220	91	106	29	135	51	85
10	146	146	64	20	195	58	91	30	124	51	220
								31	77	44	.....

Monthly discharge of West Branch of Oswegatchie River at Harrisville, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 245 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
July	290	77	180	0.735	0.85
August	146	44	82.1	.335	.39
September	220	51	82.9	.338	.38

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

LOCATION.—One-half mile below the dam of the International Paper Co. at Piercefield, St. Lawrence County and about three-fourths mile above head of Black Rapids.

DRAINAGE AREA.—723 square miles (all but 16 square miles measured on topographic maps).

RECORDS AVAILABLE.—August 20, 1908, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Stevens water-stage recorder in a galvanized sheet iron house over a concrete well, on the right bank about one-half mile below dam. Prior to January 1, 1913, the following gages were used: August 20, 1908, to September 3, 1910, vertical staff fastened to an old pine stump; September 4 to December 31, 1910, chain gage fastened to same stump and at same datum; June 1, 1911, datum of the chain gage was lowered 2 feet; water-stage recorder was set at this datum. Recorder inspected by F. Bedard.

DISCHARGE MEASUREMENTS.—Made from a cable three-fourths mile below gage, just above Black rapids.

CHANNEL AND CONTROL.—Channel opposite gage is a deep pond with no perceptible velocity. Control is at head of Black rapids.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 9.63 feet at 9 a. m. May 22 (discharge 4,780 second-feet); minimum stage, estimated 1.80 feet on September 17 and September 24 (discharge 56 second-feet).

1908–1916: Maximum stage from water-stage recorder, 11.68 feet at 3 a. m. April 1, 1913 (discharge 7,100 second-feet); minimum stage from water-stage recorder, 0.85 foot at 11 a. m. September 2, 1913 (discharge about 10 second-feet).

ICE.—Rapids that form control rarely freeze and measurements when the pond was covered with ice indicate that the stage-discharge relation was not affected.

REGULATION.—Large diurnal fluctuation in flow caused by dam during low and medium stages. Numerous lakes in the upper part of the drainage afford considerable storage, most of which is so controlled that the effect on the seasonal distribution of flow is large.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 1,500 second-feet and fairly well defined between 1,500 and 6,000 second-feet. Operation of the water-stage recorder satisfactory throughout the year, except from November 12 to March 5. Daily discharge ascertained by applying to the rating table mean daily gage heights determined by inspecting the gage-height graph or, for days of considerable fluctuation, by averaging the hourly discharge. Results good except for period November 5 to March 5, for which estimated discharge is probably fair.

Discharge measurements of Raquette River at Piercefield, N. Y., during the year ending Sept. 30, 1916.

[Made by A. H. Davison.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Jan. 13	5.74	1,230	Jan. 23	3.10	239	May 5	9.41	4,610
13	5.72	1,250	May 4	9.38	4,610	25	9.43	4,560
23	3.22	263	4	9.38	4,450	Sept. 28	3.05	256

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug	Sept.
1	530	355	686	.....	.....	.....	1,320	4,540	3,440	908	598	365
2	652	562	702	.....	.....	.....	1,290	4,540	3,340	653	615	365
3	308	562	718	.....	.....	.....	2,020	4,540	3,240	818	580	217
4	335	545	700	.....	.....	.....	2,110	4,540	2,840	507	580	107
5	562	575	138	.....	.....	.....	2,380	4,540	3,140	492	580	249
6	562	575	425	.....	.....	.....	2,470	4,540	2,910	747	318	274
7	580	130	715	.....	.....	1,630	2,560	4,240	2,750	750	492	218
8	580	339	729	.....	.....	1,600	2,650	4,340	2,630	754	562	185
9	485	545	718	.....	.....	1,630	2,640	4,140	2,550	347	580	104
10	223	545	720	1,180	.....	1,600	2,740	4,040	2,430	670	580	82
11	368	530	715	1,190	.....	1,600	2,840	3,840	1,780	779	580	145
12	580	540	245	1,200	.....	761	2,840	3,640	2,110	741	580	203
13	598	545	575	1,190	.....	1,430	2,840	3,540	2,020	737	294	190
14	580	119	725	1,160	.....	1,600	2,740	3,340	1,820	892	471	194
15	562	309	740	1,130	.....	1,460	2,840	3,340	1,780	933	545	203
16	440	515	730	.....	.....	1,350	2,730	3,340	1,740	517	545	119
17	227	525	740	.....	.....	1,380	3,240	3,540	1,600	873	562	60
18	367	500	700	.....	.....	1,380	3,140	3,840	739	1,010	562	118
19	562	515	355	.....	.....	644	3,040	4,040	1,370	759	545	218
20	580	330	761	.....	.....	1,120	3,140	4,240	1,660	769	304	234
21	562	232	674	.....	.....	1,160	3,140	4,340	1,420	726	363	224
22	562	304	679	.....	.....	1,290	3,340	4,640	1,190	725	545	214
23	485	545	704	.....	.....	1,190	3,440	4,750	1,190	397	545	124
24	235	530	815	1,160	.....	1,160	3,840	4,640	1,320	738	500	59
25	376	545	453	1,250	.....	1,160	4,340	4,540	651	615	485	156
26	562	575	471	1,280	.....	542	4,340	4,440	1,120	632	455	220
27	562	550	.....	1,280	.....	1,010	4,340	4,340	1,060	632	276	232
28	562	285	.....	1,630	.....	1,070	4,440	3,940	781	632	328	230
29	580	696	.....	1,860	.....	874	4,440	3,940	779	650	410	222
30	435	661	.....	1,780	.....	1,050	4,340	3,740	775	460	395	122
31	293	.....	.....	1,950	.....	1,280	.....	3,640	.....	650	380	.....

NOTE.—Daily discharge estimated for following days: Nov. 5, 6, 11–13, 17–19, 25–27, Dec. 4, 10–19, Jan. 12, 31, and June 6–10. Discharge estimated by comparison with records of flow of streams in adjacent drainage basins, as follows: Dec. 27–31, 975 second-feet; Jan. 1–9, 978 second-feet; Jan. 16–23, 1,040 second-feet; Feb. 1–10, 1,910 second-feet; Feb. 11–20, 1,570 second-feet; Feb. 21–29, 1,600 second-feet; Mar. 1–6, 1,600 second-feet.

Monthly discharge of Raquette River at Piercefield, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	652	[a] 223	480	0.664	0.77
November	696	[a] 119	469	.649	.72
December	.....	[a] 138	684	.946	1.09
January	1,950	.....	1,170	1.62	1.87
February	.....	.....	1,700	2.35	2.53
March	.....	[a] 542	1,310	1.81	2.09
April	4,440	[a] 1,290	3,050	4.22	4.71
May	4,750	3,340	4,120	5.70	6.57
June	3,440	[a] 651	1,870	2.59	2.89
July	1,010	[a] 347	694	.960	1.11
August	615	[a] 276	489	.677	.78
September	365	[a] 59	188	.260	.29
The year	4,750	[a] 59	1,350	1.87	25.42

[a] Sunday.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

LOCATION.—At the concrete highway bridge at Massena Springs, St. Lawrence County, 8 miles below Raymondville and 10 miles above the mouth of stream.

DRAINAGE AREA.—1,200 square miles (measured by engineers of the State of New York Conservation Commission).

RECORDS AVAILABLE.—September 21 to October 17, 1903; April 9, 1904, to November 30, 1916, when station was discontinued. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Chain gage near center of left span upstream side of bridge; installed February 2, 1912. Original gage was a vertical staff fastened to the stonework on left bank, about 50 feet upstream from present bridge. On August 16, 1906, it was replaced by the present chain gage fastened to the old highway bridge just above the present bridge. Zero of the present gage was set 1 foot lower than that of the staff gage to avoid negative readings. The present chain gage was reset at such a datum that readings would be comparable with those at the former location. Gage read by Vivian McDonald.

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

CHANNEL AND CONTROL.—Coarse gravel and boulders; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.83 feet at 3.30 p. m., April 1 (discharge about 14,200 second-feet); minimum stage recorded 1.13 feet at 8.30 a. m., October 4 (discharge 212 second-feet).

1903–1916: Maximum stage recorded, 14.2 feet between 9 and 11 a. m., March 31, 1913 (discharge 16,500 second-feet); minimum stage recorded, 0.8 foot at 8.30 a. m., September 21, 1913 (discharge, about 50 second-feet).

ICE.—Stage-discharge relation affected by ice. Gage observations suspended during winter.

REGULATION.—The operation of a number of power plants above the station has marked effect on the low-water flow of the stream. These plants are usually run for 24-hour power but are closed on Sundays. The effect of this closing is noticeable for several days.

ACCURACY.—Stage-discharge relation practically permanent between dates of shifting. Rating curve used October 1 to March 29, 1916, well defined between 200 and 8,000 second-feet; that used after March 29 fairly well defined between 200 and 8,000 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying the mean daily gage heights to rating table. Results fair.

Discharge measurements of Raquette River at Massena Springs, N. Y., during the year ending Sept. 30, 1916.

[Made by A. H. Davison.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 2	7.00	5,380	May 22	7.44	6,180	Sept. 19	1.20	272
2	6.98	5,360	July 28	2.07	850	19	1.17	226
22	7.42	6,120	28	2.21	884			

Daily discharge, in second-feet, of Raquette River at Massena Springs, N. Y., for the period Oct. 1, 1915, to Nov. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.										
1	1,060	1,140	990	.....	14,400	5,450	4,680	1,260	695	370
2	1,680	1,600	990	.....	12,900	5,970	4,200	1,260	792	310
3	325	850	1,060	.....	10,500	5,840	3,980	1,180	1,030	370
4	230	690	1,360	.....	8,440	5,710	3,760	465	960	330
5	405	600	1,440	.....	6,670	5,970	3,760	665	925	350
6	545	850	1,680	.....	5,710	5,710	3,870	1,030	890	296
7	630	1,140	1,680	.....	4,440	5,190	3,650	1,500	370	392
8	920	1,210	1,680	.....	4,680	4,680	3,320	960	728	415
9	920	990	1,280	.....	5,190	4,930	3,220	695	520	415
10	785	850	.....	.....	3,650	4,680	3,320	825	665	492
11	920	850	.....	.....	3,650	4,800	3,120	1,030	1,100	415
12	1,140	850	.....	.....	3,650	4,930	2,920	1,180	1,030	465
13	1,210	1,060	.....	.....	4,200	4,200	3,120	1,340	858	465
14	990	1,600	.....	.....	4,800	4,440	3,760	1,340	695	575
15	1,060	1,210	.....	.....	3,540	4,090	2,920	1,100	485	575
16	1,360	1,520	.....	.....	5,580	3,650	2,720	1,100	415	520
17	720	1,680	.....	.....	4,680	4,440	2,720	415	392	440
18	990	1,850	.....	.....	5,190	4,930	3,650	1,500	290	330
19	1,210	1,140	.....	.....	4,800	6,250	3,320	1,500	290	330
20	1,520	1,210	.....	.....	5,060	5,450	2,440	1,500	370	290
21	1,850	990	.....	.....	4,090	5,190	2,350	1,500	370	310
22	1,850	920	.....	.....	4,930	5,970	2,170	1,340	290	290
23	1,940	1,060	.....	.....	5,190	6,530	2,260	605	575	415
24	1,680	1,360	.....	.....	5,450	6,250	1,900	792	760	370
25	1,680	1,210	.....	.....	5,970	5,710	1,740	1,030	825	330
26	1,360	1,600	.....	.....	5,450	5,190	1,580	1,030	760	392
27	1,680	1,210	.....	.....	5,190	5,320	1,820	925	890	330
28	1,360	1,060	.....	.....	6,110	4,930	1,740	728	890	330
29	1,600	1,360	.....	.....	6,390	4,930	1,660	925	760	310
30	1,210	920	.....	13,900	5,710	5,190	1,660	415	792	392
31	1,360	.....	.....	13,700	.....	4,930	.....	575	605	.....

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1916.			1916.			1916.		
1	310	492	11	370	520	21	1,180	465
2	150	465	12	440	728	22	1,500	605
3	330	392	13	465	575	23	1,260	760
4	370	575	14	792	415	24	1,100	960
5	168	520	15	1,030	350	25	1,030	1,030
6	290	415	16	728	465	26	960	1,000
7	290	465	17	825	415	27	858	960
8	520	440	18	825	415	28	890	1,100
9	415	370	19	890	310	29	1,030	960
10	350	330	20	1,100	370	30	635	960
						31	350	.....

NOTE.—Discharge estimated, because of ice, as follows: Dec. 10–31, 1,160 second-feet; Jan. 1–31, 2,610 second-feet; Feb. 1–29, 2,510 second-feet; Mar. 1–29, 1,830 second-feet. These estimates were based on the assumption that the run-off per square mile below Piercefield was the same as that for St. Regis River at Brasher Center. A study of the data for months for which records are available indicates that results based on this assumption are fairly good.

Monthly discharge of Raquette River at Massena Springs, N. Y., for the period Oct. 1, 1915, to Nov. 30, 1916.

[Drainage area, 1,200 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1915–16.					
October	1,940	230	1,170	0.975	1.12
November	1,850	600	1,150	.958	1.07
December	.....	.....	1,220	1.02	1.18
January	.....	.....	2,610	2.18	2.51
February	.....	.....	2,510	2.09	2.25
March	.....	.....	2,600	2.17	2.50
April	14,400	3,540	5,870	4.89	5.46
May	6,530	3,650	5,210	4.34	5.00
June	4,680	1,580	2,910	2.42	2.70
July	1,500	415	1,020	.850	.98
August	1,100	290	678	.565	.65
September	575	290	387	.322	.36
The year	14,400	230	2,270	1.89	25.78
1916.					
October	1,500	150	692	.577	.67
November	1,030	310	594	.495	.55

NOTE.—See footnote to table of daily discharge.

ST. REGIS RIVER AT BRASHER CENTER, N. Y.

LOCATION.—Near the steel highway bridge in the village of Brasher Center, St. Lawrence County, 5 miles downstream from Brasher Falls, 6¼ miles below junction of East and West branches of St. Regis River, and about 12 miles above the mouth.

DRAINAGE AREA.—621 square miles (measured on post route map).

RECORDS AVAILABLE.—August 22, 1910, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGES.—Staff, with inclined and vertical sections, on right bank about 600 feet above bridge; installed June 24, 1916. Prior to this date, chain on downstream side of bridge. Gages not at same datum; subject to different controls. Gage read by Joseph Vanier.

DISCHARGE MEASUREMENTS.—Made from a cable at staff gage installed in June, 1916; previously made from highway bridge or by wading.

CHANNEL AND CONTROL.—Small boulders and coarse gravel at cable; large boulders and gravel, very rough, at bridge; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.2 feet (chain gage) at 8 a. m., March 31 and April 2; stage-discharge relation affected by ice (discharge about 13,800 second-feet); minimum stage recorded, 5.75 feet (staff gage) at 7 a. m., August 21 (discharge, 162 second-feet).

1910–1916: Maximum stage recorded, 9.1 feet at 7 a. m., March 27, 1914 (discharge, 16,200 second-feet); minimum stage recorded, 3.75 feet at 5 p. m., August 9, 7 a. m. and 5 p. m., August 10, and 7 a. m., August 12, 1914 (discharge, 105 second-feet).

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

ACCURACY.—Stage-discharge relation practically permanent between dates of shifting. Affected by ice for a large portion of the period from December to March, inclusive. Rating curve used October 1 to June 23 well defined between 200 and 3,000 second-feet; that used June 24 to September 30 well defined between 200

and 1,000 second-feet. Gages read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results for periods when the stage-discharge relation was affected by ice fair, those for other periods good.

Discharge measurements of St. Regis River at Brasher Center, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 30	A. H. Davison	[a] 5.03	832	Mar. 29	A. H. Davison	[a] 7.26	3,240
Jan. 14	do	[a] 7.06	1,170	May 3	do	4.96	1,290
26	do	[a] 5.65	1,960	3	do	4.88	1,190
29	do	[a] 6.02	3,480	23	do	5.51	2,470
Feb. 12	do	[a] 6.79	722	24	do	5.36	2,270
18	do	[a] 5.23	748	June 24	do	[b] 4.61	812
19	do	[a] 5.79	624	July 29	do	[c] 4.08	298
Mar. 3	C. C. Covert	[a] 6.40	838	Sept. 20	do	[d] 4.00	244
15	A. H. Davison	[a] 5.71	610				

[a] Stage-discharge relation affected by ice.
[b] Staff gage read 6.60 feet.
[c] Staff gage read 6.02 feet.
[d] Staff gage read 5.98 feet.

Daily discharge, in second-feet, of St. Regis River at Brasher Center, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	475	592	494	820	2,480	1,550	7,950	1,570	1,390	695	296	179
2	407	625	475	765	2,260	1,140	11,700	1,480	1,220	590	259	183
3	432	551	432	765	2,040	1,000	9,250	1,660	1,220	533	237	183
4	494	475	407	710	1,840	880	7,500	1,860	1,220	461	237	195
5	680	494	458	655	1,640	655	3,360	1,480	1,220	514	220	264
6	1,220	494	432	2,150	1,380	500	2,810	1,760	930	571	215	259
7	1,070	407	424	2,590	1,070	410	2,560	1,570	800	410	220	220
8	1,000	432	407	2,480	880	372	2,190	1,390	680	452	237	215
9	740	458	407	1,940	820	335	2,080	1,140	930	495	237	207
10	551	390	350	1,640	765	335	1,760	1,140	930	402	237	175
11	475	458	358	1,460	765	335	1,970	1,220	680	365	283	199
12	458	458	365	1,300	710	335	2,190	930	1,140	418	342	199
13	407	407	372	1,220	710	410	2,190	930	1,070	402	302	191
14	330	458	380	1,170	710	500	2,430	740	930	350	220	199
15	390	375	395	1,070	710	550	2,680	800	1,140	365	248	179
16	390	625	410	1,000	655	455	3,220	865	930	335	237	195
17	330	680	419	1,000	655	500	2,810	1,970	1,000	365	220	179
18	330	740	428	940	655	335	2,940	6,650	1,070	372	191	195
19	330	592	446	940	655	372	2,680	6,650	1,220	380	179	276
20	315	592	473	940	655	500	2,810	4,770	1,390	365	171	237
21	282	865	491	940	655	335	2,560	3,810	1,570	335	175	220
22	263	865	510	1,940	655	302	2,190	3,220	1,220	302	195	220
23	407	800	540	3,360	655	270	2,940	2,560	1,000	402	175	226
24	390	680	580	2,830	710	335	2,810	2,190	810	427	179	248
25	390	522	600	2,360	765	335	2,810	1,760	695	410	179	215
26	375	475	1,070	1,940	820	302	3,080	1,570	695	365	175	276
27	302	475	1,000	4,270	1,070	455	2,080	1,390	611	335	179	296
28	330	475	940	4,600	1,380	820	2,430	1,140	495	322	171	350
29	302	494	940	3,480	1,550	4,600	1,860	1,220	810	283	183	264
30	282	522	880	3,650	.....	6,450	1,570	1,390	875	264	195	302
31	475	.....	880	3,220	.....	13,800	.....	1,570	.....	237	183	.....

NOTE.—Discharge Dec. 10 to Apr. 4 estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph. Observations on new inclined staff gage begun June 24.

Monthly discharge of St. Regis River at Brasher Center, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 621 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,220	263	472	0.760	0.88
November	865	375	549	.884	.99
December	1,070	350	541	.871	1.00
January	4,600	655	1,880	3.03	3.49
February	2,480	655	1,050	1.69	1.82
March	13,800	270	1,270	2.05	2.36
April	11,700	1,570	3,380	5.45	6.08
May	6,650	740	2,010	3.24	3.74
June	1,570	495	996	1.60	1.78
July	695	237	404	.650	.75
August	342	171	219	.353	.41
September	350	175	225	.362	.40
The year	13,800	171	1,080	1.74	23.70

DEER RIVER AT BRASHER IRON WORKS, N. Y.

LOCATION.—In the village of Brasher Iron Works, St. Lawrence County, about 1,000 feet below the steel highway bridge, and 2 miles above confluence of Deer River with St. Regis River in Helena. No important tributaries enter between gage and mouth of river.

DRAINAGE AREA.—206 square miles (measured on Post Route map).

RECORDS AVAILABLE.—July 25, 1912, to September 30, 1916, when station was discontinued. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Inclined staff 32 feet long, graduated from 0.5 to 11.0 feet, about 1,000 feet below the steel highway bridge. Gage read by Alex. Barlow.

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

CHANNEL AND CONTROL.—Gravel and rocks; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.8 feet at 5 p. m. April 1 (discharge about 4,220 second-feet); minimum stage recorded, 0.85 foot at 6 p. m. September 12 (discharge 21 second-feet).

1912–1916: Maximum stage recorded, 9.3 feet at 4 p. m. January 17, 1913 (discharge, about 9,700 second-feet); minimum stage recorded, 0.80 foot at 6 a. m. August 20 and 7 a. m. September 14, 1913 (discharge, 17 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Gage observations suspended during such periods.

ACCURACY.—Stage-discharge relation practically permanent between dates of shifting; affected by ice for large portion of period from December to March. Rating curve used October 1 to December 9 well defined between 35 and 600 second-feet and fairly well defined between 600 and 3,200 second-feet; that used April 1 to September 30 well defined between 40 and 600 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results good, except for periods after April 1, when the discharge was above 600 second-feet, for which they are fair.

Discharge measurements of Deer River at Brasher Iron Works, N. Y., during the year ending Sept. 30, 1916.

[Made by A. H. Davison.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 1	2.18	273	June 17	2.34	309
1	2.17	262	July 29	1.17	56.6
23	2.68	435			

Daily discharge, in second-feet, of Deer River at Brasher Iron Works, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	71	99	82	3,760	274	290	116	60	46
2	64	99	99	1,980	274	218	107	41	34
3	99	88	88	1,120	260	192	116	40	48
4	99	88	93	710	372	205	157	48	50
5	143	82	78	660	305	168	136	47	66
6	251	74	71	660	274	168	146	45	52
7	175	70	59	570	245	146	107	42	71
8	133	66	59	485	218	157	98	71	63
9	115	82	58	660	218	180	88	88	48
10	92	77	58	525	192	192	74	93	57
11	82	71	58	570	180	146	92	88	41
12	85	66	59	660	168	168	93	71	25
13	71	71	61	570	146	180	157	60	46
14	74	58	63	570	136	157	116	47	41
15	85	63	66	660	126	245	98	37	27
16	88	143	70	1,190	126	232	76	35	50
17	79	133	74	810	660	338	146	24	50
18	61	133	81	660	1,980	274	136	40	52
19	64	143	86	615	1,590	570	126	46	66
20	85	133	92	485	1,050	760	98	52	47
21	85	175	99	426	660	660	74	37	45
22	78	153	107	407	485	465	67	27	47
23	70	133	124	760	445	322	73	40	52
24	56	115	133	760	407	245	90	37	71
25	46	107	153	615	305	218	76	41	54
26	45	99	199	525	245	180	68	34	57
27	56	99	704	407	218	168	61	40	63
28	74	88	610	390	192	157	61	40	54
29	72	96	484	338	168	126	55	31	48
30	74	93	446	305	232	126	54	42	80
31	78	.....	392	.....	426	.....	50	42	.....

NOTE.—Discharge Dec. 9–24 estimated, because of ice, from weather records, study of gage-height graph, and comparison with records of flow of streams in adjacent drainage areas.

Monthly discharge of Deer River at Brasher Iron Works, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 206 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	251	45	88.7	0.431	0.50
November	175	58	99.9	.485	.54
December	704	.....	158	.718	.83
April	3,760	305	762	3.70	4.13
May	1,980	126	406	1.97	2.27
June	760	126	255	1.24	1.38
July	157	50	97.2	.472	.54
August	93	24	47.9	.232	.27
September	80	25	51.7	.251	.28

RICHELIEU RIVER AT FORT MONTGOMERY, ROUSES POINT, N. Y.

LOCATION.—Inside the fort, three-eighths mile south of the international boundary, about one-half mile above mouth of Richelieu River, the outlet of Lake Champlain, and 1 mile northeast of the village of Rouses Point, Clinton County.

DRAINAGE AREA.—7,870 square miles, including 436 square miles of water surface (from annual report of New York State Engineer and Surveyor).

RECORDS AVAILABLE.—1875 to 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Staff inside the fort. Elevation of gage zero, 92.50 feet above mean sea level.

EXTREMES OF STAGE.—Maximum elevation recorded during year, 98.00 feet at 10 a. m. April 26 and 27; minimum elevation recorded, 92.7 feet at 10 a. m. November 5.

1869–1916: Maximum elevation recorded 103.28 feet, April, 1869,[1] Minimum elevation recorded, 91.9 feet, November 13, 1908.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, Rouses Point, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.5	0.6	0.7	1.45	2.7	2.85	3.4	5.35	4.2	3.55	2.25	1.5
2	.5	.4	.7	1.5	2.8	2.9	3.7	5.3	4.3	3.55	2.3	1.4
3	.45	.3	.65	1.5	2.9	2.9	3.95	5.25	4.2	3.3	2.4	1.35
4	.6	.35	.65	1.5	2.95	2.9	4.25	5.2	4.05	3.2	2.25	1.4
5	.4	.2	.6	1.6	3.0	2.9	4.5	5.15	4.0	3.3	2.25	1.3
6	.4	.3	.6	1.5	3.0	2.9	4.6	5.1	3.5	3.35	2.1	1.45
7	.55	.3	.65	1.55	3.05	2.95	4.7	5.05	3.75	3.3	2.15	1.35
8	.6	.4	.8	1.6	3.0	2.9	4.8	5.0	4.0	3.3	2.05	1.3
9	.5	.35	.7	1.65	3.05	2.85	4.8	4.85	4.0	3.25	2.05	1.15
10	.5	.4	.55	1.65	3.05	2.85	4.9	4.95	4.0	3.25	2.05	1.2
11	.6	.4	.65	1.65	3.0	2.85	5.0	4.75	3.75	3.25	2.1	1.25
12	.65	.6	.65	1.65	2.95	2.8	4.95	4.55	3.4	3.25	2.05	1.35
13	.65	.5	.7	1.6	2.95	2.8	4.95	4.45	3.3	3.2	2.0	1.25
14	.7	.45	.65	1.6	2.9	2.8	4.95	4.45	3.3	3.1	1.95	1.15
15	.4	.35	.65	1.75	2.9	2.75	5.0	4.35	3.3	3.1	2.0	1.2
16	.5	.4	.65	1.75	2.9	2.75	5.1	4.4	3.3	3.15	1.95	1.15
17	.6	.3	.7	1.7	2.85	2.75	5.15	4.3	3.5	2.95	1.9	1.3
18	.7	.45	.7	1.7	2.85	2.7	5.1	4.5	3.5	2.95	1.9	1.1
19	.7	.5	.75	1.65	2.85	2.7	5.15	4.5	3.8	2.95	1.85	1.05
20	.55	.75	.75	1.75	2.8	2.65	5.25	4.6	3.9	2.85	1.8	1.05
21	.6	.55	.75	1.65	2.7	2.6	5.25	4.65	3.9	2.8	1.8	1.2
22	.5	.55	.85	1.75	2.7	2.6	5.25	4.65	3.85	2.75	1.75	1.1
23	.3	.55	.95	1.75	2.65	2.55	5.2	4.95	3.6	2.7	1.7	1.1
24	.4	.55	.85	1.8	2.6	2.5	5.35	4.65	3.6	2.7	1.65	1.15
25	.5	.65	.9	1.95	2.6	2.5	5.45	4.5	3.9	2.7	1.65	1.1
26	.6	.65	.95	1.95	2.9	2.5	5.5	4.4	3.7	2.65	1.65	1.1
27	.45	.75	1.2	2.05	2.85	2.65	5.5	4.4	3.65	2.55	1.6	1.25
28	.5	.6	1.25	2.2	2.85	2.85	5.45	4.6	3.5	2.5	1.55	1.3
29	.6	.6	1.25	2.35	2.85	2.9	5.45	4.25	3.5	2.6	1.55	1.25
30	.3	.7	1.35	2.5	.....	3.15	5.35	4.2	3.55	2.55	1.6	1.1
31	.3	.....	1.45	2.65	.....	3.3	.....	4.1	.....	2.4	1.5	.....

SARANAC RIVER NEAR PLATTSBURG, N. Y.

LOCATION.—At Indian Rapids power plant (formerly known as Lozier dam) of Plattsburg Gas & Electric Co., about 6 miles above mouth of river at Plattsburg, Clinton County.

DRAINAGE AREA.—607 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 27, 1903, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGES.—Crest gage a vertical staff on angle of wing wall at end of tailrace; datum raised 0.76 foot August 20, 1906. Tailrace gage a vertical staff spiked to timberwork dike between tailrace and river and about 50 feet below power house. Datum has changed slightly owing to settling of crib work. Records of kilowatt output are obtained by a wattmeter on switchboard at half-hour intervals. An inclined staff gage at the cable station, about one-fourth mile below the dam, has been used to obtain a discharge rating at that point.

[1] U. S. Geol. Survey Water-Supply Paper 97, p. 340, 1904.

DISCHARGE MEASUREMENTS.—Made from cable one-fourth mile below dam. Low-water measurements made by wading under cable or in tailrace. Gages and watt meters read by power-house operators.

DISCHARGE RATING.—Records include flow over concrete spillway 171.25 feet in crest length, a rating for which has been prepared by use of coefficients [1] derived from experiments made in the hydraulic laboratory of Cornell University on a model section of the dam; the discharge through two power units equipped with 300-kilowatt generators which have been rated by current-meter measurements, and the discharge through two 5-foot waste gates when open. Occasional observations are made on inclined staff gage at the cable to check ratings of spillway and turbines.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 4,100 second feet, April 2; minimum daily discharge, 165 second-feet, September 17.

1908–1916: Maximum daily discharge, 6,410 second-feet April 20, 1914; minimum daily discharge, 90 second-feet, September 28, 1914.

SPECIAL STUDY.—A portable water-stage recorder was operated at the cable for a short period in July, 1914. Determinations of mean daily discharge based on its record agree very closely with those based on power-plant ratings.

ICE.—Crest of spillway is kept free from ice so that stage-discharge relation is not affected.

REGULATION.—The lakes and ponds on the main stream and tributaries above the station comprise a water surface of about 25.5 square miles. The actual storage afforded by these reservoirs has been largely increased by the State dam at Lower Saranac Lake, the operation of which affects the distribution of flow throughout the year.

ACCURACY.—Discharge measurements made during the year indicate that the ratings of spillway and turbines have not changed. Discharge over the spillway ascertained by applying to the rating table mean gage heights for 6-hour periods; discharge through the turbines ascertained by applying to their ratings the mean kilowatt output and head for 12-hour periods. Results fair.

COOPERATION.—Gage-height records and wattmeter readings furnished by Plattsburg Gas & Electric Co., Herbert A. Stutchbury, superintendent.

Discharge measurements of Saranac River near Plattsburg, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 12	E. D. Burchard	2.02	460	May 27	O. W. Hartwell	2.94	1,440
Apr. 29	A. H. Davison	3.20	1,860	Aug. 7	A. H. Davison	2.32	716
29	do	3.24	1,980				

[1] Horton, R. E., Weir experiments, coefficients and formulas: U. S. Geol. Survey Water-Supply Paper 200, pp. 98–100, 1907.

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	390	560	410	430	2,150	920	3,000	1,600	1,220	740	460	370
2	490	580	350	440	1,850	900	4,100	1,350	1,160	510	540	310
3	310	410	400	540	1,550	780	3,300	1,400	1,000	800	410	215
4	420	410	400	400	1,140	740	2,600	1,800	1,080	680	450	390
5	400	420	260	460	1,350	640	2,150	1,650	1,100	1,100	500	370
6	410	430	450	520	1,240	600	2,200	1,600	1,450	880	580	300
7	440	300	300	700	1,220	680	1,800	1,500	1,030	760	540	245
8	360	420	340	660	980	760	1,600	1,400	780	720	450	380
9	410	370	370	520	920	700	1,450	1,400	880	500	490	310
10	290	460	360	740	880	740	1,450	1,300	860	720	560	220
11	470	370	270	700	700	760	1,450	1,350	880	580	470	380
12	350	300	260	700	700	640	1,600	1,300	1,040	600	430	270
13	235	360	390	760	540	780	1,650	1,120	940	620	230	320
14	320	280	310	760	580	640	1,750	960	940	540	460	280
15	380	500	300	660	460	600	1,650	1,020	1,000	560	460	330
16	420	560	320	600	560	540	1,800	980	1,120	370	300	290
17	245	450	330	700	600	520	2,150	1,550	1,550	660	340	165
18	490	450	470	600	720	520	2,200	3,000	1,600	800	310	280
19	380	500	380	560	600	500	2,100	2,700	1,700	620	360	250
20	390	540	490	560	520	620	2,000	2,700	1,400	460	215	240
21	380	470	260	620	500	540	1,900	2,350	1,240	580	390	270
22	390	600	320	640	620	540	1,650	2,000	960	540	300	280
23	420	400	290	960	720	560	1,600	2,000	840	600	300	480
24	250	410	320	1,080	640	560	2,800	1,900	780	960	310	320
25	340	420	270	1,220	640	520	2,500	1,650	640	780	310	480
26	250	400	410	1,250	1,300	440	2,250	1,600	680	760	330	400
27	290	410	520	1,500	1,400	760	2,050	1,450	700	660	230	360
28	330	340	540	2,250	1,100	1,400	1,600	1,200	900	740	320	260
29	480	470	540	2,200	980	2,000	1,850	1,300	880	500	360	300
30	500	390	540	2,100	.....	2,500	1,650	1,300	840	360	370	280
31	440	.....	490	2,000	.....	2,800	.....	1,400	.....	640	440	.....

Monthly discharge of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 607 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	500	235	376	0.619	0.71
November	600	a 280	433	.713	.80
December	540	a 260	376	.619	.71
January	2,250	400	898	1.48	1.71
February	2,150	460	937	1.54	1.66
March	2,800	a 440	845	1.39	1.60
April	4,100	a 1,450	2,060	3.39	3.78
May	3,000	a 960	1,610	2.65	3.06
June	1,700	a 640	1,040	1.71	1.91
July	1,100	a 360	657	1.08	1.24
August	580	a 215	394	.649	.75
September	480	a 165	312	.514	.57
The year	4,100	a 165	826	1.36	18.50

a Sunday.

AUSABLE RIVER AT AUSABLE FORKS, N. Y.

LOCATION.—In the village of Ausable Forks, Clinton County, immediately below junction of east and west branches and about 15 miles above mouth of river.

DRAINAGE AREA.—444 square miles (measured on topographic maps.)

RECORDS AVAILABLE.—August 17, 1910, to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Chain gage on left bank about 1,000 feet below junction of East and West branches; read by A. S. Baker.

DISCHARGE MEASUREMENTS.—Made from cable about 1½ miles below gage, or by wading near the cable or a short distance above the gage.

CHANNEL AND CONTROL.—Stone and gravel; occasionally shifting. Channel divided by an island opposite gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.35 feet at 6 p. m., May 17 (discharge about 8,570 second-feet); minimum stage recorded 3.54 feet at 8 a. m. November 14 (discharge 135 second-feet).

1910–1916: Maximum stage recorded, 10.2 feet in evening of March 27, 1913 (discharge about 25,000 second-feet); minimum stage recorded 3.0 feet at 7 a. m., July 21, 1912 (discharge practically zero).

SPECIAL STUDY.—A portable water-stage recorder was installed at this station and a continuous gage-height record obtained July 11 to September 30, 1914, which showed a continual small fluctuation in stage. It was shown that the determination of monthly mean discharge based on semidaily gage heights is in error as follows: July 11–31, 3.5 per cent; August 4.1 per cent; September 0.5 per cent. Some of the determinations of daily discharge showed greater errors, but these were largely compensating.

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

ACCURACY.—Stage-discharge relation changed probably during the high water on February 26; affected by ice for short periods from December to March. Rating curve used before the shift in control fairly well defined between 170 and 5,900 second-feet. Rating curve used after the shift, fairly well defined between 175 and 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Results fair.

Discharge measurements of Ausable River at Ausable Forks, N. Y., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 11	E. D. Burchard	3.75	273	Mar. 14[b]	A. H. Davison	4.00	405
Dec. 4	A. H. Davison	3.83	328	Apr. 28	do	4.92	2,050
4	do	3.77	286	28	do	4.87	2,020
Jan. 1[a]	do	3.85	317	28	do	4.85	1,940
1[a]	do	3.88	334	May 26	O. W. Hartwell	4.35	1,020
1[a]	do	3.91	347	26	do	4.35	1,040
16[b]	do	3.82	306	Aug. 7	A. H. Davison	3.54	182

[a] Complete ice cover. [b] Incomplete ice cover.

Daily discharge, in second-feet, of Ausable River at Ausable Forks, N. Y., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	172	238	504	356	3,440	851	2,840	2,490	1,070	515	272	157
2	179	192	412	374	1,490	825	3,950	3,070	825	446	257	148
3	179	238	338	384	940	702	1,940	2,160	955	417	257	221
4	262	238	278	374	716	536	1,260	3,690	1,350	1,030	242	202
5	254	238	238	347	597	446	1,100	2,380	1,100	1,730	242	208
6	982	224	278	338	504	407	970	1,940	1,130	1,070	242	202
7	585	185	246	328	453	371	955	1,830	727	1,070	214	202
8	484	230	224	319	422	311	851	1,730	764	567	208	189
9	347	185	217	347	402	336	825	1,620	984	484	319	196
10	310	238	166	374	374	336	702	1,350	691	426	336	189
11	374	238	179	374	347	455	825	1,350	1,730	465	272	196
12	246	198	192	384	270	336	1,230	1,230	1,230	851	250	189
13	172	224	192	393	192	272	1,210	1,180	955	1,030	242	189
14	254	151	204	818	166	242	1,200	788	903	825	227	189
15	278	211	204	384	166	287	1,160	890	800	825	214	280
16	262	338	179	294	328	272	1,260	1,350	739	436	196	851
17	230	238	204	286	504	250	2,050	5,600	1,440	634	202	354
18	254	204	262	286	597	227	2,270	5,030	1,620	679	189	257
19	211	230	310	278	433	214	1,440	2,950	1,260	567	214	234
20	374	692	356	328	402	214	1,350	1,620	1,130	505	189	214
21	374	550	310	294	365	214	1,200	1,150	929	388	177	189
22	302	504	356	844	328	208	1,350	1,230	691	354	164	202
23	262	412	294	2,380	310	177	4,210	1,620	955	1,030	157	465
24	224	319	217	1,240	302	196	4,750	1,440	567	751	177	567
25	230	238	262	996	310	214	3,440	1,260	526	955	196	371
26	238	302	740	982	6,190	302	3,190	1,010	505	890	170	302
27	270	286	844	1,860	2,160	484	2,600	851	465	505	137	242
28	224	644	574	6,490	998	955	2,050	776	2,490	426	157	202
29	224	805	504	2,490	929	1,830	2,380	751	1,130	388	183	196
30	230	940	433	1,580	.....	2,380	2,270	955	702	302	153	727
31	270	.....	402	1,490	.....	2,270	.....	1,620	.....	272	177	.....

NOTE.—Discharge Dec. 30 to Jan. 19 and Feb. 3 to Mar. 28 estimated, because of ice, from discharge measurements, weather records, and study of gage-height graph.

Monthly discharge of Ausable River at Ausable Forks, N. Y., for the year ending Sept. 30, 1916.

[Drainage area, 444 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	982	172	299	0.673	0.78
November	940	151	331	.745	.83
December	844	166	326	.734	.85
January	6,490	278	904	2.04	2.35
February	6,190	166	849	1.91	2.06
March	2,380	177	552	1.24	1.43
April	4,750	702	1,890	4.26	4.75
May	5,600	731	1,830	4.12	4.75
June	2,490	465	1,010	2.28	2.54
July	1,730	272	672	1.51	1.74
August	336	137	214	.482	.56
September	851	148	278	.626	.70
The year	6,490	137	762	1.72	23.34

WEST BRANCH OF AUSABLE RIVER NEAR NEWMAN, N. Y.

LOCATION.—On farm of James Dudley, about 4 miles northeast of Newman, Essex County, and about 4 miles below confluence at Lake Placid.

DRAINAGE AREA.—116 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 7 to September 30, 1916. Data published also in annual reports of New York State engineer and surveyor and State of New York Conservation Commission.

GAGE.—Staff in two sections, on right bank near residence of the gage reader, Mr. Dudley.

DISCHARGE MEASUREMENT.—Made by wading or from a cable, about 300 feet above gage.

CHANNEL AND CONTROL.—Solid rock.

Data inadequate for determination of discharge.

Discharge measurements of West Branch of Ausable River near Newman, N. Y., during the year ending Sept. 30, 1916.

[Made by A. H. Davison.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 7	3.33	217
Aug. 3	2.64	61.0

Daily gage height, in feet, of West Branch of Ausable River near Newman, N. Y., for the year ending Sept. 30, 1916.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1	.....	3.02	2.72	2.52	16	3.3	3.05	2.62	3.28
2	.....	3.02	2.7	2.7	17	3.8	3.72	2.42	2.8
3	.....	3.1	2.7	2.6	18	3.78	3.7	2.45	2.8
4	.....	3.72	2.6	2.6	19	3.55	3.3	2.5	2.7
5	.....	4.12	2.65	2.55	20	3.52	3.12	2.45	2.58
6	.....	3.8	2.52	2.52	21	3.42	2.95	2.48	2.7
7	3.33	3.28	2.55	2.52	22	3.32	2.9	2.42	2.62
8	3.22	3.15	2.68	2.52	23	3.18	3.58	2.45	3.08
9	3.2	3.05	3.02	2.6	24	3.1	3.78	2.55	3.2
10	3.22	3.12	2.95	2.52	25	3.05	3.55	2.6	2.9
11	3.15	3.48	2.7	2.5	26	3.1	3.3	2.6	2.78
12	3.48	3.48	2.72	2.52	27	3.0	3.35	2.42	2.85
13	3.42	3.32	2.58	2.4	28	3.58	3.15	2.48	2.52
14	3.38	3.78	2.65	2.5	29	3.22	2.98	2.45	2.75
15	3.32	3.28	2.6	3.1	30	3.32	2.88	2.4	3.65
					31	.....	2.88	2.45	.....

LAKE GEORGE AT ROGERS ROCK, N. Y.

LOCATION.—At a boathouse in a small bay on the north side of the steamboat landing at Rogers Rock, Essex County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 10, 1913, to September 30, 1916.

GAGE.—Vertical staff fastened to a pile in the back end of the boathouse. Datum 3.15 feet[1] below crest of dam at outlet of lake. Gage read once daily by George O. Cook.

EXTREMES OF STAGE.—Maximum stage recorded during year, 3.8 feet May 30; minimum stage recorded, 1.4 feet December 11 and 12.

1913–1916: Maximum stage recorded, 4.98 feet May 2, 1914; minimum stage recorded, 1.38 feet December 8, 1914.

REGULATION.—Elevation of lake surface is regulated by the operation of gates and wheels at the dam at outlet at Ticonderoga.

COOPERATION.—Gage height record July 1 to September 30 furnished by International Paper Co.

Daily gage height, in feet, of Lake George at Rogers Rock, N. Y., with direction and force of wind, for the year ending Sept. 30, 1916.

[L, light; H, heavy; M, moderate.]

Day.	October.			November.			December.		
	Gage height.	Wind.		Gage height.	Wind.		Gage height.	Wind.	
		Direction.	Force.		Direction.	Force.		Direction.	Force.
1	2.28	N.	L.	1.92	S.	M.	1.55	SW.	M.
2	2.26	N.	L.	2.00	SW.	H.	1.52	Calm.	.....
3	2.25	N.	L.	1.88	S.	M.	1.5	N.	L.
4	2.28	S.	M.	1.85	S.	H.	1.5	N.	L.
5	2.2	W.	L.	1.78	N.	M.	1.48	N.	M.
6	2.2	N.	M.	1.7	N.	H.	1.45	N.	M.
7	2.25	S.	M.	1.7	NE.	H.	1.45	N.	L.
8	2.2	S.	M.	1.78	S.	L.	1.48	S.	M.
9	2.2	SW.	M.	1.8	SW.	M.	1.5	SW.	H.
10	2.15	N.	M.	1.8	W.	M.	1.42	N.	M.
11	2.22	S.	H.	1.68	SE.	M.	1.4	N.	M.
12	2.2	S.	M.	1.68	S.	M.	1.4	Calm.	.....
13	2.18	S.	M.	1.7	S.	H.	1.42	Calm.	.....
14	2.15	S.	M.	1.65	S.	M.	1.45	SW.	H.
15	2.0	N.	H.	1.75	S.	H.	1.48	SW.	H.
16	2.15	Calm.	.....	1.7	W.	H.	1.48	S.	M.
17	2.18	S.	M.	1.68	N.	L.	1.45	S.	L.
18	2.1	S.	M.	1.58	Calm.	.....	1.48	S.	L.
19	2.1	S.	M.	1.65	SE.	H.	1.52	W.	M.
20	2.08	S.	L.	1.75	S.	H.	1.5	SW.	M.
21	2.02	S.	H.	1.7	S.	L.	1.45	N.	M.
22	2.1	SW.	M.	1.6	N.	L.	1.5	S.	H.
23	2.0	N.	H.	1.62	S.	M.	1.5	S.	M.
24	2.0	N.	M.	1.6	Calm.	.....	1.52	S.	M.
25	2.02	Calm.	.....	1.58	S.	M.	1.55	S.	L.
26	2.05	S.	H.	1.55	S.	M.	1.5	N.	H.
27	2.0	S.	M.	1.58	S.	M.	1.78	S.	M.
28	2.0	S.	L.	1.55	Calm.	.....	1.75	S.	M.
29	1.98	S.	M.	1.6	S.	M.	1.72	N.	M.
30	1.95	N.	M.	1.65	S.	M.	1.75	N.	M.
31	1.92	N.	L.	.....	.....	.....	1.82	Calm.	.....

[1] Determination obtained by leveling; supersedes that previously published, which was based on a comparison of gage heights.

Daily gage height, in feet, of Lake George at Rogers Rock, N. Y., with direction and force of wind, for the year ending Sept. 30, 1916—Continued.

Day.	January.			February.			March.		
	Gage height.	Wind.		Gage height.	Wind.		Gage height.	Wind.	
		Direction.	Force.		Direction.	Force.		Direction.	Force.
1	1.78	N.	H.	2.12	S.	M.	2.45	N.	M.
2	1.88	S.	M.	2.1	N.	M.	2.42	SW.	M.
3	1.85	SW.	M.	2.15	N.	L.	2.45	N.	M.
4	1.9	S.	M.	2.2	S.	H.	2.42	Calm.	.....
5	1.95	S.	M.	2.18	S.	M.	2.45	W.	M.
6	1.9	SW.	H.	2.2	S.	L.	2.48	SW.	M.
7	1.88	N.	M.	2.28	SW.	H.	2.48	SW.	M.
8	1.85	N.	M.	2.2	Calm.	.....	2.5	NW.	M.
9	1.9	Calm.	.....	2.22	SW.	L.	2.58	SW.	M.
10	1.92	S.	H.	2.2	SW.	M.	2.55	SW.	M.
11	1.95	S.	H.	2.15	N.	L.	2.5	SW.	L.
12	1.92	Calm.	.....	2.12	NE	M.	2.5	S.	M.
13	1.9	S.	H.	2.2	N.	M.	2.5	N.	L.
14	1.85	N.	H.	2.18	N.	M.	2.52	W.	H.
15	1.90	Calm.	.....	2.2	S.	L.	2.45	N.	H.
16	1.92	S.	M.	2.2	SW.	M.	2.5	N.	H.
17	1.95	S.	H.	2.2	S.	L.	2.48	NW.	H.
18	1.9	SW.	H.	2.15	SW.	M.	2.48	NW.	L.
19	1.9	S.	M.	2.18	S.	M.	2.45	N.	L.
20	1.88	S.	H.	2.20	N.	H.	2.42	NW.	M.
21	1.85	SW.	M.	2.18	N.	M.	2.42	W.	L.
22	1.88	S.	M.	2.12	S.	M.	2.4	N.	H.
23	1.9	SW.	H.	2.15	N.	H.	2.42	N.	L.
24	1.85	S.	M.	2.12	SW.	L.	2.42	NW.	L.
25	1.8	S.	L.	2.2	S.	M.	2.38	N.	L.
26	1.82	S.	L.	2.4	SW.	H.	2.4	N.	L.
27	1.8	N.	L.	2.45	SW.	M.	2.4	S.	L.
28	1.85	SW.	H.	2.5	W.	H.	2.4	S.	L.
29	2.08	N.	M.	2.45	NW.	M.	2.42	N.	L.
30	2.12	S.	M.	.....	.....	.....	2.48	N.	M.
31	2.15	S.	L.	.....	.....	.....	2.62	S.	M.

Day.	April.			May.			June.		
	Gage height.	Wind.		Gage height.	Wind.		Gage height.	Wind.	
		Direction.	Force.		Direction.	Force.		Direction.	Force.
1	2.75	S.	H.	3.5	S.	L.	3.68	N.	L.
2	2.9	S.	M.	3.55	S.	M.	3.72	S.	M.
3	2.95	N.	M.	3.48	N.	M.	3.75	S.	M.
4	3.0	S.	L.	3.45	S.	M.	3.75	S.	M.
5	3.05	S.	M.	3.42	S.	M.	3.78	S.	M.
6	3.08	SW.	M.	3.42	Calm.	.....	3.68	N.	H.
7	3.1	(a)	M.	3.45	S.	M.	3.7	Calm.	.....
8	3.1	S.	M.	3.48	S.	H.	3.65	S.	L.
9	3.12	N.	H.	3.4	NW.	H.	3.62	S.	M.
10	3.18	SW.	L.	3.45	SW.	H.	3.65	S.	L.
11	3.2	S.	H.	3.52	SW.	H.	3.7	S.	M.
12	3.2	S.	L.	3.4	W.	H.	3.68	N.	M.
13	3.22	S.	M.	3.35	S.	M.	3.68	S.	L.
14	3.2	N.	M.	3.38	S.	M.	3.65	S.	M.
15	3.25	N.	M.	3.35	Calm.	.....	3.7	S.	H.
16	3.3	S.	M.	3.4	Calm.	.....	3.62	Calm.	.....
17	3.32	S.	M.	3.5	SW.	M.	3.65	Calm.	.....
18	3.42	S.	H.	3.7	S.	H.	3.65	S.	H.
19	3.4	N.	H.	3.7	S.	L.	3.62	S.	L.
20	3.3	Calm.	.....	3.65	NW.	M.	3.68	SW.	H.
21	3.32	Calm.	.....	3.62	N.	M.	3.65	S.	L.
22	3.35	E	M.	3.7	S.	H.	3.6	NW.	H.
23	3.4	N.	L.	3.72	S.	H.	3.58	N.	L.
24	3.48	N.	M.	3.75	S.	L.	3.6	S.	M.
25	3.5	Calm.	.....	3.7	N.	M.	3.55	S.	M.
26	3.5	S.	L.	3.68	N.	H.	3.58	S.	H.
27	3.48	Calm.	.....	3.7	Calm.	.....	3.55	S.	M.
28	3.5	S.	L.	3.72	S.	H.	3.5	N.	M.
29	3.48	W.	L.	3.75	S.	L.	3.58	S.	M.
30	3.48	Calm.	.....	3.8	S.	H.	3.52	N.	M.
31	.....	.....	.....	3.7	N.	H.	.....	.....	.....

a Changeable.

Daily gage height, in feet, of Lake George at Rogers Rock, N. Y., with direction and force of wind, for the year ending Sept. 30, 1916—Continued.

Day.	July.			August.			September.		
	Gage height.	Wind.		Gage height.	Wind.		Gage height.	Wind.	
		Direction.	Force.		Direction.	Force.		Direction.	Force.
1	3.5			3.1			2.45		
2	3.48			3.1			2.4		
3	3.5			3.08			2.4		
4	3.48			3.02			2.35		
5	3.5			3.05			2.3		
6	3.5			2.98			2.35		
7	3.52			3.0			2.35		
8	3.48			2.95			2.3		
9	3.42			2.9			2.2		
10	3.5			2.9			2.1		
11	3.48			2.9			2.3		
12	3.48			2.88			2.22		
13	3.45			2.82			2.2		
14	3.45			2.8			2.18		
15	3.5			2.82			2.2		
16	3.48			2.72			2.2		
17	3.4			2.7			2.22		
18	3.42			2.7			2.25		
19	3.4			2.68			2.18		
20	3.38			2.65			2.15		
21	3.35			2.62			2.18		
22	3.4			2.6			2.15		
23	3.35			2.6			2.1		
24	3.32			2.62			2.08		
25	3.35			2.55			2.05		
26	3.3			2.58			2.02		
27	3.25			2.55			2.08		
28	3.22			2.55			2.02		
29	3.25			2.58			2.02		
30	3.27			2.5			2.0		
31	3.15			2.48					

LAKE CHAMPLAIN AT BURLINGTON, VT.

LOCATION.—On south side of roadway leading to dock of Champlain Transportation Co., at foot of King Street, Burlington.

RECORDS AVAILABLE.—May 1, 1907, to September 30, 1916.

GAGE.—Staff. Comparisons of gage readings indicate that zero of gage at Burlington is at practically the same elevation as that of gage at Fort Montgomery—92.50 feet above mean sea level. Gage read by employee of the Champlain Transportation Co.

EXTREMES OF STAGE.—Maximum stage recorded during year, 5.75 feet April 27; minimum stage recorded, 0.65 foot November 10 to 13.

1907–1916: Maximum stage recorded, 8.20 feet on April 7, 1913; minimum stage recorded, −0.25 foot on December 4, 1908.

ICE.—Wider portions of lake not usually frozen over until the last part of January. Occasionally closure does not occur until February and in some years it lasts only for a few days. The northern end of the lake, above the outlet, is usually covered with ice from the middle of December to the middle of April.

ACCURACY.—Gage read to hundredths once a day except on Sundays; readings during winter irregular. Gage readings made when the lake is rough subject to inaccuracies due to wave action.

COOPERATION.—Gage-height record furnished through the courtesy of Mr. D. A. Loomis, general manager of the Champlain Transportation Co.

Daily gage height, in feet, of Lake Champlain at Burlington, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.78	0.68	0.83	.....	3.08	.....	3.85	5.60	4.55	3.75	2.40	1.53
2	.75	.68	.83	.....	3.30	.....	.....	5.52	4.55	.....	2.35	1.50
3	.....	.68	.87	1.62	.....	.....	4.62	5.48	4.52	3.75	2.31	1.47
4	.73	.67	.90	1.68	.....	3.30	4.80	5.42	.....	3.69	2.25	1.44
5	.80	.67	.....	1.71	.....	.....	4.90	5.38	4.43	3.67	2.17	1.41
6	.90	.67	.94	.....	.....	.....	5.00	5.33	4.37	3.62	.....	1.38
7	.90	.....	.94	.....	3.30	.....	5.03	.....	4.30	3.58	2.14	1.35
8	.88	.66	.96	.....	.....	.....	5.10	5.20	4.23	3.55	2.13	1.31
9	.88	.66	.97	.....	.....	.....	.....	5.09	4.20	.....	2.12	1.28
10	.....	.65	.97	1.85	.....	.....	5.15	4.98	4.15	3.47	2.10	1.25
11	.85	.65	1.02	.....	.....	.....	5.15	4.93	.....	3.43	2.10	1.23
12	.85	.65	.....	.....	.....	.....	5.18	4.87	4.08	3.35	2.08	1.20
13	.82	.65	1.08	.....	.....	.....	5.19	4.80	4.08	3.27	.....	1.20
14	.80	.....	1.11	.....	.....	3.18	5.22	.....	4.03	3.18	2.03	1.20
15	.78	.67	1.12	.....	.....	.....	5.32	4.60	3.96	3.13	2.00	1.20
16	.78	.67	1.15	.....	.....	.....	.....	4.50	3.94	.....	1.96	1.20
17	.....	.67	1.15	2.00	.....	.....	5.33	4.55	3.91	3.04	1.96	1.20
18	.75	.68	1.18	.....	.....	3.05	5.40	4.70	.....	2.98	1.93	1.20
19	.75	.68	.....	.....	.....	.....	.....	4.88	3.87	2.94	1.87	1.20
20	.80	.69	1.20	.....	.....	2.93	5.44	4.90	3.85	2.90	.....	1.20
21	.80	.....	1.20	.....	.....	.....	5.45	.....	3.85	2.87	1.82	1.20
22	.78	.71	1.22	.....	.....	.....	5.45	4.83	3.84	2.85	1.80	1.20
23	.77	.73	1.22	.....	.....	.....	.....	4.80	3.83	.....	1.83	1.23
24	.....	.78	1.25	2.05	.....	.....	5.60	4.80	3.83	2.76	1.82	.....
25	.73	.78	.....	2.10	.....	2.80	5.65	4.74	.....	2.73	1.81	1.25
26	.71	.78	.....	2.20	.....	.....	5.68	4.68	3.80	2.71	1.80	1.18
27	.71	.78	1.28	2.30	.....	2.60	5.75	4.62	3.79	2.68	1.75	1.10
28	.70	.....	1.30	2.45	.....	2.65	5.72	.....	3.77	2.63	1.70	1.13
29	.69	.81	1.30	2.60	.....	.....	5.68	4.42	3.76	2.55	1.65	1.18
30	.69	.81	1.45	.....	.....	3.05	.....	4.40	3.75	.....	1.60	1.20
31	.....	.....	1.60	2.95	.....	3.48	.....	4.48	.....	2.43	1.55	.....

NOTE.—Thickness of ice 100 feet from dock: Feb. 14, 4.5 inches; Feb. 21, 7 inches; Feb. 24, 10 inches; Feb. 28, 11 inches; Mar. 6, 13.5 inches; Mar. 13, 15 inches; Mar. 20, 16 inches; Mar. 27, 12 inches.

OTTER CREEK AT MIDDLEBURY, VT.

LOCATION.—At the railroad bridge about half a mile south of the railroad station at Middlebury, 3½ miles below mouth of Middlebury River, and 3½ miles above mouth of New Haven River.

DRAINAGE AREA.—615 square miles.

RECORDS AVAILABLE.—April 1, 1903, to May 1, 1907, and October 5, 1910, to September 30, 1916 (published also in Water Supply Paper 424).

GAGE.—Chain; read by William Jackson and Alexander Hamilton.

DISCHARGE MEASUREMENTS.—Made from a boat just below railroad bridge, or by wading.

CHANNEL AND CONTROL.—Channel deep; current sluggish for several miles above the station. Control for low stages is gravel and bowlder rips about 500 feet below gage, probably somewhat shifting; control at high stages is at dam 800 feet below station.

EXTREMES OF STAGE.—Maximum stage recorded during year, 17.55 feet at 8.30 a. m. April 5 (discharge computed from extension of rating curve, about 4,850 second-feet); minimum stage recorded during year, 11.80 feet at 7.50 a. m. October 11 (discharge, 217 second-feet).

1903–1907 and 1910–1916: Maximum stage, 21.07 feet March 30, 1913 (discharge, computed from extension of rating curve, about 8,000 second-feet); minimum open-water stage recorded, 11.45 feet September 15, 1913 (discharge, 138 second-feet). A somewhat lower discharge has probably occurred at various times when the stage-discharge relation has been affected by ice.

ICE.—Ice forms to a considerable thickness at the gage and occasionally at the control, affecting the stage-discharge relation.

REGULATION.—Probably little if any effect from power developments above the station. Very little storage in the basin.

ACCURACY.—Stage-discharge relation not permanent, probably affected by shifts in stream bed. Rating curve for 1916 well defined between 2,000 and 4,000 second-feet; not well defined for low stages. Chain gage read to quarter-tenths once daily. Daily discharge ascertained by applying rating table to daily-gage heights. Results good, except for low stages.

COOPERATION.—Data for 1910 to 1915 furnished by H. K. Barrows, consulting engineer, Boston, Mass.

Discharged measurements of Otter Creek at Middlebury, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Aug. 3	C. H. Pierce	12.27	390	Sept. 30	Hardin Thweatt	12.07	332
Sept. 29	Hardin Thweatt	12.03	299				

NOTE.—Several discharge measurements obtained subsequent to Sept. 30, 1916, used in determining the rating curve.

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1911–1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1903.							1903.						
1....	3,960	566	159	450	360	360	16.....	1,370	360	866	290	403	283
2....	3,840	555	242	599	360	403	17.....	1,390	360	705	290	302	302
3....	3,720	555	248	566	242	369	18.....	1,320	320	599	276	352	320
4....	3,600	491	248	475	313	360	19.....	1,210	360	501	302	340	320
5....	3,480	475	242	360	360	360	20.....	1,070	360	475	202	403	360
6....	3,370	475	217	320	360	403	21.....	992	320	501	328	501	283
7....	3,320	460	242	360	352	302	22.....	866	320	775	450	610	313
8....	3,200	450	159	340	360	320	23.....	845	320	1,240	1,500	528	320
9....	3,100	426	202	320	360	320	24.....	740	328	880	1,210	369	313
10....	2,980	426	255	320	255	320	25.....	726	168	640	775	360	283
11....	2,760	360	382	290	328	320	26.....	670	242	566	566	412	265
12....	2,540	382	441	290	582	290	27.....	610	265	726	528	475	232
13....	2,270	382	1,130	183	824	283	28.....	640	276	622	528	544	175
14....	1,850	360	1,600	217	622	202	29.....	610	265	475	412	441	217
15....	1,460	360	1,320	276	475	232	30.....	582	248	441	412	412	276
							31.....	.....	248	.....	382	320	.....

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1910–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1903–4.												
1	283	403	290	.....	.....	.....	3,960	3,040	582	555	381	283
2	283	360	320	.....	.....	.....	3,480	3,150	555	610	403	301
3	283	394	320	.....	.....	.....	3,150	3,150	501	880	450	301
4	320	369	302	.....	.....	.....	2,600	3,040	475	705	501	450
5	290	360	302	.....	.....	.....	1,950	2,820	475	475	426	320
6	340	475	320	.....	.....	.....	1,550	2,380	450	501	360	360
7	501	544	223	.....	.....	.....	1,645	1,900	955	450	360	381
8	491	555	283	.....	.....	.....	2,050	1,370	705	403	248	360
9	658	412	302	.....	.....	.....	2,380	1,030	1,030	360	283	340
10	1,020	450	283	.....	.....	.....	2,710	955	845	340	320	320
11	1,110	412	.....	.....	.....	.....	2,710	1,030	705	248	301	320
12	845	403	.....	.....	.....	.....	2,820	1,110	582	205	340	248
13	658	403	.....	.....	.....	.....	2,820	992	450	426	381	248
14	491	382	.....	.....	.....	.....	2,710	880	450	426	381	283
15	450	403	.....	.....	.....	.....	2,380	810	403	403	301	501
16	394	290	.....	.....	.....	.....	1,800	880	403	360	320	1,240
17	360	369	.....	.....	.....	.....	1,420	1,750	403	320	360	1,190
18	460	705	.....	.....	.....	.....	1,370	1,900	360	248	340	918
19	670	866	.....	.....	.....	.....	1,460	1,650	320	320	301	775
20	940	705	.....	.....	.....	.....	1,500	1,950	232	320	301	670
21	726	475	.....	.....	.....	.....	1,370	2,160	320	283	501	810
22	599	403	.....	.....	.....	.....	1,370	2,160	360	283	670	705
23	512	369	.....	.....	.....	.....	1,370	1,850	360	248	740	610
24	610	412	.....	.....	.....	.....	1,460	1,370	340	283	670	501
25	610	450	.....	.....	.....	.....	1,700	1,070	320	217	582	810
26	528	328	.....	.....	.....	.....	2,050	1,030	320	232	475	1,070
27	501	283	.....	.....	.....	.....	2,050	1,070	265	320	403	1,280
28	501	320	.....	.....	.....	.....	2,320	918	320	450	403	1,150
29	450	394	.....	.....	.....	.....	2,760	740	320	403	248	1,030
30	450	248	.....	.....	.....	.....	3,040	610	320	450	283	2,050
31	426	.....	.....	.....	.....	.....	.....	582	.....	501	320	.....
1904–5.												
1	2,160	880	450	.....	.....	.....	4,910	1,300	400	1,300	2,730	735
2	2,050	810	450	.....	.....	.....	5,270	1,210	335	1,880	2,670	655
3	1,460	705	403	.....	.....	.....	5,630	1,120	367	2,620	2,400	1,160
4	1,190	670	360	.....	.....	.....	5,570	1,120	470	2,510	1,830	2,130
5	992	640	248	.....	.....	.....	5,150	1,210	400	2,080	1,300	2,340
6	810	610	320	.....	.....	.....	4,670	1,210	615	1,530	902	2,290
7	740	582	.....	.....	.....	.....	4,430	1,210	1,030	1,210	695	2,290
8	670	555	.....	.....	.....	.....	4,070	1,160	1,070	1,030	695	1,880
9	670	501	.....	.....	.....	.....	3,830	1,070	1,070	860	860	1,390
10	610	450	.....	.....	.....	.....	3,560	1,120	860	695	775	987
11	740	450	.....	.....	.....	.....	3,220	1,070	695	615	615	817
12	1,110	450	.....	.....	.....	.....	3,110	902	695	540	615	860
13	1,110	450	.....	.....	.....	.....	3,060	775	817	470	695	987
14	1,030	450	.....	.....	.....	.....	3,060	817	902	695	695	1,030
15	955	450	.....	.....	.....	.....	2,950	775	695	615	695	902
16	845	450	.....	.....	.....	.....	2,840	987	540	470	945	775
17	740	450	.....	.....	.....	.....	2,510	1,070	540	335	1,630	735
18	670	360	.....	.....	.....	.....	1,980	945	1,030	470	1,430	1,210
19	610	403	.....	.....	.....	.....	1,480	860	1,430	540	1,120	2,510
20	610	426	.....	.....	.....	.....	1,210	860	1,780	540	817	2,730
21	705	450	.....	.....	.....	.....	1,250	860	1,480	470	615	2,890
22	2,490	775	.....	.....	.....	.....	2,130	695	2,180	400	615	2,840
23	2,490	775	.....	.....	.....	.....	2,290	615	2,400	400	540	2,780
24	2,320	740	.....	.....	.....	.....	1,980	540	2,340	220	505	2,510
25	1,900	610	.....	.....	.....	.....	1,680	470	1,880	400	470	2,080
26	1,460	610	.....	.....	.....	.....	1,430	470	1,630	505	470	1,530
27	1,500	528	.....	.....	.....	.....	1,300	578	2,400	540	400	1,300
28	1,750	381	.....	.....	.....	.....	1,300	615	2,400	470	305	1,120
29	1,460	340	.....	.....	.....	3,500	1,300	505	2,080	435	400	902
30	1,190	403	.....	.....	.....	4,250	1,300	470	1,630	655	400	860
31	955	.....	.....	.....	.....	4,700	.....	400	.....	2,510	655	.....

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1910–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1905–6.												
1	775	470	1,580				3,610	1,880	3,440	1,830	1,120	615
2	695	470	735				3,500	1,630	3,500	2,080	775	505
3	655	470	1,300				3,120	1,880	3,560	1,680	615	435
4	655	470	2,130				2,680	2,340	3,280	1,300	540	695
5	615	615	1,980				2,340	2,400	2,840	1,480	655	615
6	615	735	1,880				2,510	2,290	2,130	1,300	860	540
7	540	1,030	1,780				2,400	1,980	1,780	1,030	1,080	470
8	470	1,210	1,630				2,080	1,680	1,980	818	945	470
9	400	1,030	1,480				1,780	1,390	2,400	695	735	470
10	400	860	1,210				1,580	2,030	2,400	775	578	275
11	400	775	1,210				1,580	2,290	2,340	945	540	368
12	470	695	1,030				1,780	2,240	2,080	818	615	400
13	775	615	1,030				1,830	2,180	1,580	695	540	400
14	860	615	860				2,130	2,400	1,120	615	540	470
15	735	615					3,280	2,460	902	540	470	470
16	655	540					3,500	2,180	860	470	470	400
17	578	578					3,500	1,930	945	470	470	220
18	540	540					3,720	1,680	1,580	505	470	305
19	540	540					4,010	1,480	1,580	470	368	400
20	578	400					4,430	1,160	1,210	470	220	400
21	695	400					4,550	1,030	945	470	540	335
22	775	400					4,610	902	860	470	540	335
23	695	400					4,490	775	818	860	505	400
24	655	400					4,370	775	1,120	860	540	335
25	615	400					4,250	817	1,390	695	540	400
26	540	470					3,950	1,030	1,300	540	615	435
27	540	505					3,660	1,390	1,030	470	987	400
28	470	540					3,280	2,510	818	470	2,620	335
29	470	540					2,840	2,840	695	695	1,480	335
30	400	1,430					2,400	3,060	860	1,300	1,120	400
31	470							3,280		1,480	775	
1906–7.												
1	335	615					3,610					
2	775	615					3,610					
3	400	540					3,610					
4	400	540					3,500					
5	335	435					3,220					
6	305	470					2,780					
7	275	470					2,290					
8	220	435					1,680					
9	275	400					1,300					
10	335	400					1,120					
11	335	400					1,030					
12	435	400					1,120					
13	470	615					1,480					
14	615	615					1,730					
15	275	578					1,730					
16	400	540					1,780					
17	400	470					1,680					
18	368	505					1,630					
19	305	1,480					1,440					
20	248	2,180					1,340					
21	945	2,080					1,210					
22	945	1,730					1,030					
23	818	1,480					1,030					
24	540	1,210					2,290					
25	540	1,075					2,840					
26	695	860					3,390					
27	860	1,160					3,950					
28	735	1,390				3,280	3,830					
29	615	1,340				3,440	3,950					
30	615	1,030				3,610	4,250					
31	615					3,660						

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1910–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1910–11.												
1	.....	465	415	1,140	830	1,090	1,980	2,190	465	370	370	972
2	.....	415	415	1,230	585	1,020	1,890	2,210	490	370	370	875
3	.....	565	393	2,360	475	860	1,800	2,180	440	393	320	675
4	.....	790	370	2,190	475	600	1,720	2,190	393	335	320	609
5	430	1,040	370	2,110	530	440	1,890	2,070	335	289	320	565
6	406	1,240	370	2,110	585	390	2,060	1,750	393	289	320	550
7	393	1,080	370	2,020	585	390	2,320	1,250	375	345	243	535
8	393	778	370	1,930	530	390	2,980	1,020	384	490	263	525
9	393	702	320	1,920	475	365	3,160	907	355	360	271	475
10	393	620	317	1,720	425	350	3,080	778	388	267	289	440
11	393	620	270	1,140	375	355	3,030	730	360	345	243	440
12	393	620	205	1,030	375	340	2,980	730	227	345	255	430
13	384	565	240	1,060	370	320	2,980	675	370	320	247	415
14	370	515	290	1,030	395	630	2,980	592	375	255	207	415
15	370	565	290	990	420	1,040	2,980	565	430	195	219	415
16	335	555	290	960	420	1,110	2,980	540	465	195	280	440
17	255	515	365	700	395	1,180	2,900	445	440	110	267	415
18	311	465	365	600	370	880	2,850	490	415	110	271	393
19	345	455	365	370	370	630	2,760	465	393	146	384	415
20	345	415	365	450	470	545	2,670	440	370	175	465	440
21	320	415	365	450	525	600	2,500	440	375	183	284	465
22	311	465	290	450	470	685	2,230	465	370	195	302	440
23	335	415	290	450	470	750	2,020	465	360	219	320	440
24	370	384	1,120	440	420	750	1,850	465	350	231	505	402
25	430	393	1,060	370	395	780	1,720	465	345	267	465	384
26	465	455	990	340	370	910	1,800	465	360	275	505	440
27	465	415	930	1,270	695	1,730	1,890	440	379	335	430	440
28	480	415	860	1,910	1,200	2,240	1,980	440	402	345	465	415
29	465	415	790	1,680	.....	2,240	2,060	397	406	370	1,120	415
30	455	415	990	1,460	.....	2,160	2,100	425	406	370	1,170	415
31	440	.....	1,060	1,320	.....	2,130	.....	455	.....	370	1,080	.....
1911–12.												
1	415	637	1,340	760	460	620	3,620	2,320	2,760	195	320	392
2	415	692	1,100	855	510	590	3,620	2,100	2,760	320	320	345
3	415	748	952	778	460	610	3,520	1,600	2,820	320	320	515
4	465	664	760	609	560	390	3,440	1,290	2,870	320	345	540
5	465	609	697	581	440	650	3,390	1,070	2,900	215	255	490
6	465	582	425	770	490	620	3,440	952	2,800	275	392	465
7	515	637	648	770	460	390	3,570	1,050	2,650	297	370	490
8	565	822	680	560	435	390	4,010	1,050	2,410	175	345	675
9	540	842	648	505	480	430	3,960	985	1,980	275	320	505
10	505	742	703	505	590	560	4,640	1,020	1,440	345	320	465
11	465	637	784	560	670	470	4,950	1,050	1,080	297	345	440
12	430	626	868	560	400	530	4,780	1,260	887	297	255	465
13	515	1,050	1,820	560	670	530	4,370	873	790	275	392	465
14	540	939	1,800	560	590	620	4,010	1,180	730	297	392	440
15	565	842	1,480	470	480	820	3,700	1,150	675	255	415	440
16	620	748	1,250	430	540	1,400	3,620	1,020	620	415	370	620
17	675	675	1,470	480	485	2,610	3,480	1,400	565	345	370	1,080
18	842	719	1,580	430	485	2,570	3,390	1,930	565	345	370	1,050
19	2,060	1,520	1,370	455	385	2,650	3,390	2,000	530	297	255	730
20	2,160	1,520	1,040	535	485	2,650	3,480	1,850	490	345	392	730
21	2,150	1,280	742	800	560	2,610	3,520	1,980	465	320	760	1,330
22	2,150	1,080	790	800	600	2,520	3,520	2,280	490	370	370	1,290
23	2,150	875	2,040	740	710	2,610	3,620	2,320	490	540	392	952
24	1,980	790	2,360	675	710	2,970	3,570	2,280	620	440	345	790
25	1,640	822	2,320	620	710	2,970	3,390	2,170	415	392	415	647
26	1,330	875	2,170	560	620	2,880	3,300	1,890	392	370	297	565
27	1,220	778	1,970	535	680	2,610	3,210	1,520	392	345	370	540
28	1,150	790	1,630	535	660	2,430	3,080	1,150	392	345	565	490
29	920	1,180	1,130	480	620	2,500	2,830	952	370	195	465	565
30	790	1,560	1,040	535	.....	2,650	2,580	1,970	320	297	415	515
31	702	.....	920	590	.....	2,750	.....	2,360	.....	345	415	.....

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1910–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1912–13.												
1	702	2,280	702	1,680	1,330	555	6,700	1,050	2,280	345	335	167
2	760	1,930	675	1,560	1,890	540	5,850	1,260	1,980	302	311	235
3	675	1,720	1,350	1,440	1,640	647	5,400	920	1,640	293	307	267
4	565	1,330	1,930	1,890	1,560	620	4,950	822	1,260	297	191	255
5	515	1,050	2,020	1,960	1,180	565	4,460	730	1,080	251	284	255
6	490	887	1,890	1,640	1,150	540	4,050	691	855	275	302	255
7	415	920	1,720	1,590	1,210	592	3,620	637	730	267	275	255
8	465	2,020	1,560	1,890	1,120	530	3,300	620	675	330	280	155
9	440	2,190	1,260	1,800	1,000	465	3,030	592	675	335	284	195
10	440	2,230	1,020	1,980	920	592	2,720	565	650	355	293	235
11	465	2,230	920	2,140	887	1,850	2,410	540	555	397	191	227
12	490	2,060	887	1,680	790	1,930	2,140	515	505	350	267	215
13	702	1,760	760	2,320	790	1,930	1,980	540	490	379	297	235
14	592	1,440	760	2,630	592	1,980	1,760	515	450	288	255	215
15	540	1,520	920	2,540	555	1,560	1,680	515	392	370	235	138
16	490	1,470	760	1,760	581	2,900	1,560	515	430	335	235	175
17	465	1,280	1,020	1,600	540	2,900	1,370	540	530	320	267	247
18	465	1,120	702	2,280	592	2,940	1,220	565	470	302	155	255
19	440	1,020	730	2,630	565	2,900	1,190	565	420	297	215	155
20	392	952	1,180	2,670	465	2,670	1,250	582	392	297	275	247
21	345	920	1,150	2,900	515	2,540	1,150	540	383	215	255	235
22	449	920	760	2,800	620	2,900	1,050	490	334	345	235	175
23	415	887	760	2,800	1,430	2,620	1,020	790	284	355	235	480
24	1,600	842	730	2,850	1,760	2,580	1,190	1,800	374	275	155	540
25	2,460	790	730	2,760	1,400	2,620	1,150	2,060	365	284	195	440
26	2,410	1,020	647	2,760	920	3,480	1,070	2,020	335	302	215	345
27	2,580	985	565	2,500	675	4,100	1,050	1,850	345	293	275	320
28	2,630	920	565	2,230	565	5,640	952	1,400	350	195	275	311
29	2,720	760	540	2,060	.....	7,500	887	2,140	316	311	275	175
30	2,720	730	592	1,210	.....	8,000	1,120	2,390	219	374	275	235
31	2,580	.....	1,050	1,330	.....	7,300	.....	2,360	.....	355	297	.....
1913–14.												
1	275	636	370	460	1,220	475	4,420	3,660	370	370	288	887
2	275	565	465	380	1,150	400	4,680	3,570	430	345	255	702
3	370	465	440	370	1,090	1,470	4,500	3,610	415	320	195	540
4	415	505	505	390	920	2,050	4,280	3,570	440	370	215	555
5	320	465	515	370	810	1,930	4,190	3,480	647	320	311	515
6	370	440	530	370	810	1,710	3,870	3,280	790	297	275	430
7	370	415	540	370	790	1,470	3,660	3,160	675	392	235	370
8	345	392	592	350	680	1,190	3,670	3,030	490	370	247	415
9	345	415	952	370	600	980	3,830	2,890	465	455	275	392
10	297	465	702	400	700	895	3,610	2,760	370	415	195	370
11	320	1,190	702	430	540	765	3,660	2,500	392	415	207	370
12	345	1,120	887	360	580	710	3,790	2,230	370	465	275	345
13	155	855	702	390	430	650	3,610	1,970	392	370	275	275
14	620	647	730	410	370	670	3,830	1,870	345	370	255	235
15	490	620	675	350	410	650	3,750	1,680	235	320	275	320
16	415	592	790	320	320	595	3,660	1,520	370	345	275	360
17	392	515	647	330	460	1,200	3,570	1,480	384	311	255	370
18	370	515	675	340	460	1,890	3,440	1,050	384	515	430	288
19	370	480	920	280	480	1,930	3,440	920	345	415	370	275
20	255	465	565	330	510	1,670	3,700	820	335	297	345	288
21	565	565	530	390	570	1,420	4,140	760	384	320	490	195
22	760	620	515	420	710	1,170	4,320	730	275	320	702	297
23	730	540	540	430	630	990	5,220	719	345	311	675	297
24	490	480	415	380	800	840	5,540	691	345	320	465	255
25	647	465	465	410	740	740	5,450	592	275	320	465	320
26	920	455	440	340	540	960	5,000	565	320	297	383	320
27	1,400	465	465	600	520	1,970	4,490	565	297	255	345	297
28	1,400	470	550	640	480	2,410	4,140	530	215	275	320	207
29	1,190	470	380	670	.....	2,410	3,830	515	215	297	335	297
30	920	470	430	920	.....	2,520	3,790	465	297	320	790	370
31	702	.....	420	1,180	.....	3,120	.....	440	.....	275	1,080	.....

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1911–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	320	345	415	220	340	3,050	403	528	265	248	450	283
2	320	235	465	200	330	3,320	403	880	265	340	320	283
3	298	320	465	220	320	3,410	403	810	265	610	283	265
4	320	345	465	150	320	3,140	450	775	248	640	302	248
5	195	311	415	200	320	2,870	403	670	232	810	320	248
6	275	284	370	300	320	2,510	426	555	232	670	360	202
7	275	298	275	440	420	2,330	450	528	202	582	426	188
8	275	370	298	1,480	600	1,970	555	501	217	475	403	248
9	298	203	255	1,560	550	1,520	740	528	232	1,270	320	283
10	298	311	320	1,260	450	1,110	1,030	501	232	1,880	360	302
11	284	370	298	822	400	880	1,700	450	217	1,790	360	283
12	203	370	255	592	400	810	2,510	403	248	1,270	360	265
13	255	345	275	515	400	880	2,420	403	232	810	320	202
14	298	345	175	490	480	610	2,510	360	188	610	283	232
15	298	370	195	440	580	501	2,600	360	232	501	248	248
16	275	415	255	392	2,060	501	2,690	382	232	450	232	232
17	275	730	227	370	2,060	475	2,510	302	283	340	265	188
18	370	760	235	370	2,140	450	2,240	382	302	320	320	202
19	320	515	235	1,480	2,140	403	1,880	382	320	302	309	202
20	415	415	255	1,800	2,140	382	1,440	360	320	320	302	188
21	392	415	175	1,800	1,980	360	1,190	340	232	340	248	217
22	345	370	170	1,800	1,640	403	1,030	302	283	320	175	265
23	360	284	170	1,640	1,480	501	810	302	302	360	403	360
24	298	320	170	1,260	1,400	555	705	265	265	382	403	360
25	320	345	170	1,180	2,060	705	670	283	232	340	582	302
26	255	345	130	1,050	2,320	810	705	283	248	320	555	283
27	298	298	170	920	2,500	775	610	382	202	320	501	202
28	275	515	100	730	2,670	670	555	360	163	360	426	248
29	298	565	170	560	.....	555	501	320	217	382	360	265
30	298	440	190	480	.....	501	501	302	248	426	283	265
31	345	.....	190	400	.....	426	.....	360	.....	475	302	.....
1915–16.												
1	248	340	501	1,610	2,330	2,510	2,690	2,420	640	450	450	301
2	217	320	450	1,110	2,240	2,330	3,140	2,330	528	403	426	283
3	283	301	381	955	2,150	2,150	3,410	2,150	475	360	381	320
4	232	301	360	955	2,060	1,700	4,400	1,970	528	1,790	360	248
5	283	320	320	1,030	1,790	1,440	4,850	1,700	740	1,790	360	232
6	340	501	320	955	1,440	1,110	4,760	1,440	670	1,610	320	248
7	360	283	320	1,520	1,110	810	4,490	1,190	582	1,270	283	265
8	340	248	283	1,610	1,030	700	4,130	1,110	528	880	320	248
9	302	283	283	1,190	670	640	3,770	1,110	475	670	360	248
10	283	283	263	810	670	610	3,500	955	426	670	555	283
11	217	265	265	705	610	580	3,230	810	475	555	555	248
12	248	283	283	810	580	555	3,050	740	528	555	450	248
13	283	283	232	810	580	530	2,870	640	1,030	528	450	265
14	248	320	248	1,190	610	530	2,690	582	955	450	320	248
15	248	248	265	955	530	500	2,690	501	740	475	360	283
16	360	381	283	640	500	500	2,510	528	582	381	320	360
17	670	450	320	555	475	500	2,510	775	582	360	320	450
18	450	381	320	555	475	475	2,510	1,970	810	381	320	360
19	450	340	610	501	475	475	2,510	2,150	955	381	283	340
20	403	360	880	501	475	475	2,510	2,150	810	340	301	360
21	360	670	810	475	475	475	2,420	1,970	1,110	360	217	283
22	320	640	670	450	475	475	2,330	1,610	955	381	283	265
23	301	555	555	1,440	450	500	2,420	1,190	740	1,110	283	265
24	301	450	501	1,790	450	530	2,510	1,110	610	670	283	320
25	232	403	475	1,790	450	530	2,515	1,110	555	582	283	265
26	283	320	582	1,700	705	530	2,690	955	501	475	283	301
27	283	360	1,790	1,970	2,240	670	2,690	705	501	450	283	320
28	283	340	1,970	2,240	2,420	955	2,690	610	528	955	248	301
29	248	360	1,970	2,240	2,510	1,520	2,690	555	555	955	283	283
30	283	450	1,970	2,240	.....	2,240	2,510	610	555	610	320	301
31	360	.....	1,700	2,330	.....	2,510	.....	640	.....	475	301	.....

NOTE.—Stage-discharge relation affected by ice Dec. 11, 1903, to Mar. 31, 1904; Dec. 7, 1904, to Mar. 28, 1905; Dec. 15, 1905, to Mar. 31, 1906; Dec. 1, 1906, to Mar. 27, 1907; Dec. 10, 1910, to Mar. 31, 1911; Jan. 6 to Mar. 31, 1912; Dec. 28, 1913, to Mar. 30, 1914; Dec. 22, 1914, to Jan. 6, 1915; Jan. 23 to Feb. 15, 1915; Feb. 12–24, and Mar. 8-27, 1916. Daily discharge given for these periods for the years 1910 to 1916 determined from gage heights, observer's notes, and weather records. Several discharge measurements were made during the winter of 1911.

Monthly discharge of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1911–1916.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1903.					
April	3,960	582	1,970	3.20	3.57
May	566	168	370	.602	.69
June	1,600	159	570	.927	1.03
July	1,500	183	446	.725	.84
August	824	242	417	.678	.78
September	403	175	304	.494	.55
1903–4.					
October	1,110	283	541	.880	1.01
November	866	248	431	.701	.78
December	.....	.....	[a] 385	.626	.72
January	.....	.....	[a] 370	.602	.69
February	.....	.....	[a] 400	.650	.70
March	6,200	.....	[a] 1,700	2.76	3.18
April	3,960	1,370	2,200	3.58	3.99
May	3,150	582	1,590	2.59	2.99
June	1,030	232	471	.766	.86
July	880	217	396	.644	.74
August	740	248	398	.647	.75
September	2,050	248	661	1.07	1.19
The year	4,200	.....	796	1.29	17.60
1904–5.					
October	2,490	610	1,230	2.00	2.31
November	880	340	545	.886	.99
December	.....	.....	[a] 300	.488	.56
January	.....	.....	[a] 240	.390	.45
February	.....	.....	[a] 230	.374	.39
March	4,790	.....	[a] 1,070	1.74	2.01
April	5,630	1,210	2,950	4.80	5.36
May	1,300	400	871	1.42	1.64
June	2,400	335	1,210	1.97	2.20
July	2,620	220	904	1.47	1.70
August	2,730	305	951	1.55	1.79
September	2,890	655	1,570	2.55	2.84
The year	5,630	.....	1,010	1.64	22.24
1905–6.					
October	860	400	590	.960	1.11
November	1,430	400	625	1.02	1.14
December	2,130	600	969	1.58	1.82
January	3,550	775	1,400	2.28	2.63
February	.....	.....	[a] 714	1.16	1.21
March	.....	.....	[a] 900	1.46	1.68
April	4,610	1,580	3,130	5.09	5.68
May	3,280	775	1,870	3.04	3.50
June	3,560	695	1,710	2.78	3.10
July	2,080	470	881	1.43	1.65
August	2,620	220	738	1.20	1.38
September	695	220	421	.685	.76
The year	4,610	220	1,160	1.89	25.96
1906–7.					
October	945	220	498	.810	.93
November	2,180	400	869	1.41	1.57
December	815	.....	[a] 487	.795	.92
January	.....	.....	[a] 960	1.56	1.80
February	.....	.....	[a] 350	.569	.59
March	3,660	.....	[a] 1,040	1.69	1.95
April	4,250	1,030	2,320	3.77	4.21
1910–11.					
October 5–31	480	255	387	.629	.63
November	1,240	384	572	.930	1.04
December	1,120	205	500	.813	.94
January	2,360	340	1,200	1.95	2.25
February	1,200	370	500	.813	.85
March	2,240	320	900	1.46	1.68
April	3,160	1,720	2,400	3.90	4.35
May	2,210	397	875	1.42	1.64
June	490	227	387	.629	.70
July	490	110	286	.465	.54
August	1,170	207	405	.659	.76
September	972	384	490	.797	.89
The period [b]	3,160	110	746	1.21	16.27

[a] Estimated from gage heights, observer's notes, and comparison with other streams. [b] 361 days.

Monthly discharge of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1903–1907 and 1911–1916—Continued.

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1911–12.					
October	2,160	415	963	1.56	1.80
November	1,560	582	876	1.42	1.58
December	2,360	425	1,240	2.02	2.33
January	855	430	600	.976	1.13
February	710	385	550	.894	.96
March	2,970	390	1,600	2.60	3.00
April	4,950	2,580	3,630	5.90	6.58
May	2,360	873	1,550	2.52	2.90
June	2,900	320	1,220	1.98	2.21
July	540	175	318	.517	.60
August	760	255	376	.611	.70
September	1,330	345	634	1.03	1.15
The year	4,950	175	1,130	1.84	24.94
1912–13.					
October	2,720	345	1,010	1.65	1.90
November	2,280	730	1,340	2.18	2.43
December	2,020	540	995	1.62	1.87
January	2,900	1,210	2,130	3.46	3.99
February	1,890	465	973	1.58	1.65
March	8,000	465	2,530	4.11	4.74
April	6,700	887	2,380	3.87	4.32
May	2,390	490	1,000	1.63	1.88
June	2,280	219	659	1.07	1.19
July	397	195	312	.507	.58
August	335	155	256	.416	.48
September	540	138	255	.414	.46
The year	8,000	138	1,150	1.87	25.49
1913–14.					
October	1,400	155	543	.883	1.02
November	1,190	392	559	.909	1.01
December	952	370	582	.946	1.09
January	1,180	280	444	.722	.83
February	1,220	320	654	1.06	1.10
March	3,120	400	1,350	2.20	2.54
April	5,540	3,440	4,100	6.67	7.44
May	3,660	440	1,790	2.91	3.36
June	790	215	387	.629	.70
July	515	255	348	.566	.65
August	1,080	195	371	.603	.70
September	887	195	372	.605	.68
The year	5,540	155	957	1.56	21.12
1914–15.					
October	415	195	302	.491	.57
November	760	203	385	.626	.70
December	465	100	257	.418	.48
January	1,800	150	810	1.32	1.52
February	2,670	320	1,170	1.90	1.98
March	3,410	360	1,210	1.97	2.27
April	2,690	403	1,170	1.90	2.12
May	880	265	437	.711	.82
June	320	163	245	.398	.44
July	1,880	248	589	.958	1.10
August	582	175	348	.566	.65
September	360	188	252	.410	.46
The year	3,410	100	594	.966	13.11
1915–16.					
October	670	217	314	0.511	0.59
November	670	248	368	.598	.67
December	1,970	232	651	1.06	1.22
January	2,330	450	1,210	1.97	2.27
February	2,510	450	1,070	1.74	1.88
March	2,510	475	970	1.58	1.82
April	4,850	2,330	3,060	4.98	5.56
May	2,420	501	1,240	2.02	2.33
June	1,110	426	656	1.07	1.19
July	1,790	340	688	1.12	1.29
August	555	217	341	.554	.64
September	450	232	291	.473	.53
The year	4,850	217	901	1.47	19.99

NOTE.—Determinations of discharge for 1903 and 1904 supersede those published in Water-Supply Papers 97 and 129.

Days of deficiency in discharge of Otter Creek at Middlebury, Vt., for the years ending Sept. 30, 1911–1916.

Discharge in second-feet.	Days of deficient discharge.					
	1910–11[a]	1911–12	1912–13	1913–14	1914–15	1915–16
150	3	.....	1	.....	2	.....
200	8	3	14	4	21	.....
250	18	4	32	13	66	23
300	39	19	66	48	119	63
350	66	41	88	86	175	101
400	136	63	103	133	209	127
450	188	84	112	162	239	132
500	225	114	126	193	255	168
550	236	136	145	213	271	194
600	247	158	166	227	284	216
700	260	193	179	249	294	240
800	271	221	200	271	303	249
900	276	235	208	280	313	259
1,000	284	243	220	290	314	271
1,100	296	256	233	293	317	274
1,200	303	263	244	300	320	287
1,400	309	273	257	302	324	288
1,600	310	283	270	309	331	294
1,800	316	286	284	312	335	308
2,000	327	296	301	318	342	315
2,500	347	315	323	322	352	336
3,000	358	338	350	326	361	355
4,000	361	360	354	352	365	361
8,000	.....	366	365	365	.....	366

WINOOSKI RIVER AT MONTPELIER, VT.

LOCATION.—One mile downstream from the Central Vermont Railway station in Montpelier, Washington County, about three-eighths mile above mouth of Dog River, and 1¼ miles below mouth of Worcester Branch.

DRAINAGE AREA.—420 square miles.

RECORDS AVAILABLE.—May 19, 1909, to September 30, 1916.

GAGE.—Gurley seven-day water-stage recorder installed July 4, 1914, on right bank; gage heights referred to datum by means of a hook gage inside the well; an outside staff gage is used for auxiliary readings; records June 16 to July 3, 1914, obtained from the staff gage. Chain gage at highway bridge just above the Central Vermont Railway station, from May 19, 1909, to June 30, 1914.

DISCHARGE MEASUREMENTS.—Made from a cable or by wading.

CHANNEL AND CONTROL.—Channel deep and fairly uniform in section at the gage; control is formed by sharply defined rock outcrop about 500 feet below gage.

EXTREMES OF DISCHARGE.—Maximum open-water stage during year, from water-stage recorder, 10.0 feet at 8 p. m. April 2 (discharge, 6,630 second-feet, determined from extension of rating curve and may be subject to error); somewhat higher stages occurred March 30–31, owing to ice in the river; minimum stage, from water-stage recorder, 2.77 feet at 11 a. m. October 24 (discharge, 19 second-feet).

1909–1916: Maximum stage determined by leveling from flood marks preserved on building near present gage, 17.31 feet, April 7, 1912 (discharge not determined); minimum stage from water-stage recorder 1914–1916, 2.77 feet, August 13, 1914, and October 24, 1915 (discharge, 19 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during the winter months. Discharge ascertained by means of gage heights, current-meter measurements, observer's notes, and climatic records.

REGULATION.—Operation of power plants on main stream and tributaries above station cause large diurnal fluctuations in stage (see fig. 30, p. 139, Water-Supply Paper 375).

ACCURACY.—Stage-discharge relation practically permanent except when ice is present. Rating curve well defined between 30 and 5,000 second-feet. Operation of water-stage recorder was unsatisfactory during the last part of the year owing to frequent stopping of the clock. Daily discharge ascertained as follows: October 1 to August 31 by applying rating table to mean daily gage height, with corrections for ice during the period December to March; September 1 to 30, by discharge integrator. Results good October to June, fair for July to September.

Discharge measurements of Winooski River at Montpelier, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 16	G. F. Adams	4.10	386	Mar. 22	R. S. Barnes	[a] 5.65	385
Dec. 20	R. S. Barnes	[a] 4.23	247	Apr. 6	do	5.58	1,330
Jan. 12	do	[a] 5.08	367	6	do	5.52	1,310
Feb. 13	do	[a] 5.24	408				

[a] Stage-discharge relation affected by ice.

NOTE.—Discharge measurements made subsequent to Sept. 30, 1916, used in determining rating curve.

Daily discharge, in second-feet, of Winooski River at Montpelier, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	113	163	300	1,180	1,730	530	3,830	909	566	350	228	130
2	86	133	210	1,140	1,220	470	4,450	839	370	300	168	145
3	58	136	195	1,140	825	445	2,380	755	430	420	129	105
4	158	115	195	1,040	620	395	1,780	1,070	1,100	470	115	135
5	216	108	110	1,040	420	300	1,420	818	909	602	108	155
6	430	141	178	1,600	560	280	1,500	692	818	380	90	145
7	234	74	148	1,460	530	280	1,550	608	657	256	99	135
8	189	108	145	790	395	280	1,340	626	500	280	108	120
9	153	115	143	530	420	300	1,380	602	790	240	370	115
10	97	104	131	420	445	320	1,220	524	1,380	234	930	100
11	153	120	120	320	370	320	1,420	530	1,380	195	470	135
12	124	108	42	240	345	300	1,680	465	1,460	204	260	125
13	110	165	108	210	370	300	1,550	420	1,000	204	225	105
14	115	51	97	180	345	300	1,600	330	825	186	213	115
15	108	175	108	168	320	300	1,600	375	620	195	160	125
16	195	225	97	143	320	320	1,730	536	590	155	155	225
17	82	228	108	180	300	300	2,030	2,480	811	195	150	150
18	148	148	131	168	300	260	2,430	3,650	755	198	126	145
19	136	150	280	168	300	240	1,880	1,550	584	183	131	140
20	165	440	280	143	240	280	1,460	1,070	1,140	153	76	140
21	168	445	180	155	240	240	1,420	867	776	183	113	135
22	150	365	155	180	210	260	1,600	734	530	204	117	125
23	145	296	131	355	195	225	2,700	818	470	207	110	110
24	52	248	120	500	195	210	2,030	811	430	210	101	70
25	117	138	86	395	225	240	1,640	650	395	186	113	140
26	113	216	168	500	1,140	260	1,420	530	415	160	120	150
27	115	175	860	1,600	1,300	445	1,220	494	460	148	64	125
28	117	158	2,700	5,790	970	970	1,140	415	839	155	120	128
29	124	240	2,430	2,230	650	1,550	1,040	440	554	108	136	155
30	124	360	1,380	1,140		3,110	965	650	430	56	158	1,010
31	82		1,260	1,070		6,070		902		148	129	

NOTE.—No record by water-stage recorder Nov. 7–9; Dec. 28, 29; Jan. 22, 23; July 21–25, 27; Aug. 4, 6, 8, 10, 11; Sept. 4, 17, 18; discharge estimated by comparison with records for streams in near-by drainage basins. Stage-discharge relation affected by ice Dec. 10–27, 1915, and Jan. 8 to Mar. 31, 1916; estimates for these periods based on gage heights corrected for backwater by means of 4 current-meter measurements, observer's notes, and weather records.

Monthly discharge of Winooski River at Montpelier, Vt., for the years ending Sept. 30, 1915, and 1916.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
1914–15.					
October	268	22	134	0.319	0.37
November	590	68	225	.536	.60
December	482	21	126	.300	.35
January	2,530	49	373	.888	1.02
February	1,640	90	359	.885	.89
March	1,000	210	463	1.10	1.27
April	4,190	355	923	2.20	2.46
May	970	192	397	.945	1.09
June	560	86	208	.495	.55
July	2,300	168	382	.910	1.05
August	853	120	296	.705	.81
September	201	54	129	.307	.34
The year	4,190	21	334	.795	10.80
1915–16.					
October	430	52	141	.336	.39
November	445	51	188	.448	.50
December	2,700	42	406	.967	1.11
January	5,790	143	844	2.01	2.32
February	1,730	195	534	1.27	1.37
March	6,070	210	648	1.54	1.78
April	4,450	965	1,780	4.24	4.73
May	3,650	330	844	2.01	2.32
June	1,460	370	733	1.75	1.95
July	602	56	231	.550	.63
August	930	64	180	.429	.49
September	1,010	70	161	.383	.43
The year	6,070	42	556	1.32	18.02

NOTE.—Monthly and yearly discharge for the year ending Sept. 30, 1915, supersedes that published in Water-Supply Paper 404. Rating curve revised above 1,000 second-feet by means of current-meter measurements obtained in 1916 and 1917.

DOG RIVER AT NORTHFIELD, VT.

LOCATION.—At highway bridge near Norwich University campus in Northfield, Washington County. Union Brook joins Dog River a short distance below station.

DRAINAGE AREA.—47 square miles (from surveys made by Norwich University students).

RECORDS AVAILABLE.—May 14, 1909, to September 30, 1916. Records from May 14, 1909, to August 22, 1910, obtained at lower highway bridge; those from August 23, 1910, to date at present location.

GAGES.—Gurley 7-day water-stage recorder; gage heights referenced to gage datum by means of a hook gage inside the well; outside staff gage used for auxiliary readings.

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

CHANNEL AND CONTROL.—Channel composed of gravel and alluvial deposits; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 5.18 feet at 5 a. m. January 28 (discharge, 978 second-feet); minimum stage during year from water-stage recorder, 0.92 foot at 1 a. m. and 2 p. m. September 13 (discharge, 8.6 second-feet).

1910–1916: Maximum stage recorded at present site, 8.5 feet March 25, 1913 (discharge, 3,400 second-feet); minimum stage recorded, 0.60 foot September 10 and 11, 1913 (discharge, 3.0 second-feet). At the lower gage, 1909–10 flow was practically zero at various times when water was held back by dam above gage.

ICE.—River frozen over at various times during the winter.

ACCURACY.—Stage-discharge relation practically permanent except when ice is present. Rating curve well defined below 500 second-feet and poorly defined above. Operation of water-stage recorder satisfactory throughout year except for short periods as shown in footnote to daily discharge table. Daily discharge ascertained by applying rating table to mean daily gage heights, determined by inspection of gage-height graph. Results good.

Discharge measurements of Dog River at Northfield, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	Knowlton and George..	1.40	28.7	Nov. 20	Knowlton and George..	1.91	71
23	.....do.....	1.16	15.9	20	.....do.....	1.86	64
Nov. 6	.....do.....	1.12	17.1	Dec. 4	.....do.....	1.29	22.2
15	G. F. Adams.....	1.20	18.3	Feb. 14	R. S. Barnes.....	[a] 1.75	34.4
15	.....do.....	1.35	21.4	Mar. 21	.....do.....	1.60	38.0
15	R. C. Knowlton.....	1.35	25.3	Apr. 6	.....do.....	3.10	252

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Dog River at Northfield, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	13	19	32	58	308	149	505	125	69	48	26	13
2	16	19	27	54	168	133	505	107	53	43	24	15
3	22	17	27	51	136	125	286	102	56	55	21	15
4	18	16	24	47	102	110	224	107	124	64	21	12
5	23	17	24	53	88	90	206	84	88	65	19	13
6	29	18	25	159	76	78	217	76	92	46	21	14
7	22	17	25	103	56	67	215	71	69	39	19	14
8	21	16	22	72	53	62	183	72	60	37	19	13
9	16	17	18	57	55	58	178	71	116	39	32	12
10	13	17	17	58	48	58	167	60	144	44	30	11
11	13	15	18	47	45	58	190	60	173	37	22	11
12	13	16	14	38	46	53	217	50	133	47	20	10
13	13	16	15	38	44	50	217	48	93	60	20	9
14	14	15	16	33	43	49	208	49	72	50	18	9
15	47	22	18	33	44	38	215	45	62	36	17	27
16	27	29	18	34	44	35	245	73	78	31	15	24
17	20	20	17	31	44	34	276	405	149	29	14	18
18	18	18	23	27	38	32	255	368	138	26	15	14
19	19	20	45	29	33	34	217	195	118	23	15	14
20	20	55	36	33	31	34	194	154	170	22	14	13
21	18	39	30	52	31	37	187	133	119	23	13	12
22	17	33	27	93	30	36	215	127	99	57	13	12
23	16	27	27	190	29	31	355	118	84	93	14	16
24	16	25	27	116	27	33	297	102	75	45	14	16
25	16	22	27	96	45	36	245	83	75	39	13	14
26	16	22	141	217	392	44	211	72	72	34	12	12
27	18	22	115	445	226	76	180	62	74	49	17	12
28	17	25	97	650	190	152	160	57	121	42	18	11
29	14	28	76	265	165	245	144	53	72	32	22	14
30	17	44	60	195	.....	392	141	72	58	30	14	42
31	20	.....	44	197	.....	430	.....	104	.....	28	14	.....

NOTE.—Stage-discharge relation affected by ice Jan. 9–20, Feb. 5–25, Mar. 11–13, and 16–19. No records by water-stage recorder Dec. 7–10, 1915; Jan. 9–11, 18–22; Feb. 20–25; Mar. 2–10; May 14–15, 21–23; May 27 to June 2; June 11–17; July 9–11, and Sept. 2–3, 1916; discharge estimated by comparison with records of Winooski River at Montpelier.

Monthly discharge of Dog River at Northfield, Vt., for the year ending Sept. 30, 1916.

[Drainage area, 47 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	47	13	18.8	0.400	0.46
November	55	15	22.9	.487	.54
December	141	14	36.5	.777	.90
January	650	27	115	2.45	2.82
February	392	27	90.9	1.93	2.08
March	430	31	92.2	1.96	2.26
April	505	141	235	5.00	5.58
May	405	45	107	2.28	2.63
June	173	53	96.9	2.06	2.30
July	93	22	42.4	.902	1.04
August	32	12	18.3	.389	.45
September	42	9	14.7	.313	.35
The year	650	9	73.9	1.57	21.41

LAMOILLE RIVER AT CADYS FALLS, VT.

LOCATION.—About one-fourth mile below power plant of Morrisville Electric Light & Power Co., at what was formerly known as Cadys Falls, 2 miles downstream from village of Morrisville, Lamoille County.

DRAINAGE AREA.—280 square miles.

RECORDS AVAILABLE.—September 4, 1913, to September 30, 1916. A station was maintained at highway bridge near power plant at Cadys Falls from July 28, 1909, to July 13, 1910.

GAGES.—Barrett & Lawrence water-stage recorder in gage house on right bank, one-fourth mile below highway bridge at Cadys Falls. Gage heights are referred to gage datum by means of a hook gage inside the well. An outside staff gage is used for auxiliary readings. From July 28, 1909, to July 13, 1910, chain gage on highway bridge.

DISCHARGE MEASUREMENTS.—Made from a cable or by wading.

CHANNEL AND CONTROL.—Channel smooth gravel; well defined gravel control 500 feet downstream from gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.25 feet at 9 a. m., April 2 (discharge, 3,370 second-feet); minimum stage recorded during year, 1.99 feet on September 5, 10, and 11 (discharge, 83 second-feet).

1913–1916: Maximum stage recorded, 10.53 feet April 20, 1914 (discharge, 7,250 second-feet); minimum stage recorded, 1.82 feet, August 17, 1914 (discharge, 50 second-feet).

ICE.—River freezes over for short periods during extremely cold weather; stage-discharge relation not seriously affected by ice.

ACCURACY.—Stage-discharge relation practically permanent, except when ice is present. Rating curve well defined. Operation of water-stage recorder satisfactory throughout year except for short periods as shown in footnote to daily discharge tables. Daily discharge ascertained by applying rating table to mean daily gage heights, determined by inspection of gage-height graph. Results good.

Discharge measurements of Lamoille River at Cadys Falls, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 20	G. F. Adams	3.26	535	Feb. 10	R. S. Barnes	2.77	336

Daily discharge in second-feet, of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	135	175	420	445	1,350	367	2,430	416	475	248	191	124
2	135	172	272	375	972	351	2,050	493	347	198	150	141
3	132	175	220	309	672	347	1,300	502	290	207	141	135
4	141	169	220	355	533	367	1,350	618	672	328	135	109
5	420	178	191	546	462	302	945	560	745	367	132	132
6	672	188	201	582	395	294	870	467	1,000	276	109	144
7	383	153	172	551	387	283	945	437	610	220	121	141
8	290	147	156	347	351	279	795	428	428	290	138	147
9	230	178	169	272	336	279	845	408	450	347	395	178
10	178	182	135	428	317	276	695	383	641	240	845	115
11	178	169	129	313	302	258	820	383	745	204	445	109
12	169	166	129	294	254	254	1,090	359	672	244	268	115
13	160	178	126	287	217	244	1,060	317	542	276	207	112
14	150	150	150	244	244	328	1,180	269	391	268	185	107
15	175	175	160	359	244	237	1,060	283	309	204	160	204
16	169	263	156	234	230	204	1,180	283	287	147	141	276
17	132	220	153	185	224	237	1,520	493	363	188	141	147
18	124	191	175	211	224	272	2,180	1,590	412	175	135	138
19	163	211	302	237	237	237	1,700	1,060	515	160	129	135
20	204	560	347	178	200	214	1,220	695	795	147	104	144
21	204	582	265	182	224	172	1,090	515	574	141	109	129
22	204	462	237	279	214	227	1,180	428	395	141	129	118
23	166	347	211	745	211	328	1,800	408	317	147	132	129
24	132	279	211	720	207	220	1,760	395	276	172	124	135
25	135	224	201	515	217	220	1,350	328	214	185	126	126
26	153	217	646	533	480	214	1,090	272	262	188	118	118
27	163	194	1,030	945	945	332	895	244	240	175	121	115
28	153	211	672	2,430	506	770	770	230	524	150	132	115
29	147	272	551	1,660	391	1,150	605	244	432	126	147	144
30	166	493	493	895	.....	1,730	560	363	317	115	138	1,000
31	172	.....	462	770	.....	2,340	.....	770	.....	237	135	.....

NOTE.—Stage-discharge relation affected by ice Jan. 8–21; Feb. 11–18; Mar. 1–6 and 16–21; discharge estimated from gage heights, observer's notes, and weather records. No records by water-stage recorder Jan. 1–3, 5; Feb. 26–28; Mar. 17–20, 29–30; and May 3–22; determinations based on readings once daily by observer and comparison with records of flow for streams in adjacent drainage basins.

Monthly discharge of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1916.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	672	124	198	0.707	0.82
November	582	147	243	.868	.97
December	1,030	126	289	1.03	1.19
January	2,430	178	528	1.80	2.18
February	1,350	207	400	1.43	1.54
March	2,340	172	430	1.54	1.78
April	2,950	560	1,260	4.50	5.02
May	1,590	230	473	1.69	1.95
June	1,000	214	475	1.70	1.90
July	367	115	210	.750	.86
August	845	104	183	.654	.75
September	1,000	107	166	.593	.66
The year	2,950	104	403	1.44	19.62

GREEN RIVER AT GARFIELD, VT.

LOCATION.—At site of old dam just above highway bridge at Garfield, Lamoille County. Green River is tributary to Lamoille River about 4 miles east of Morrisville.

DRAINAGE AREA.—20 square miles (roughly approximate).

RECORDS AVAILABLE.—January 3, 1915, to September 30, 1916.

GAGE.—Inclined staff on left bank in pool back of weir; read by P. M. Trescott.

DISCHARGE MEASUREMENTS.—Standard sharp-crested weir of compound section; length of crest at gage height 0.00 is 9.0 feet; at gage height 0.83 foot, length of crest is increased 11.17 feet. Current-meter measurements made at footbridge about one-half mile downstream from weir, and at highway bridge about one-half mile above weir.

CHANNEL AND CONTROL.—A pool of considerable size is formed in the old mill pond back of the weir; at ordinary stages the velocity of approach to the weir is very small. Some water leaks around weir in old tailrace on left bank.

EXTREMES OF DISCHARGE.—Maximum stage during year, 2.64 feet at 9 a. m. April 18 (discharge, 236 second-feet); minimum stage during year, 0.37 foot at 5 p. m. September 14 (discharge, 7.8 second-feet).

1915–16: Maximum stage recorded, 3.6 feet at 9 a. m. April 12, 1915 (discharge, 436 second-feet); minimum stage recorded, 0.35 foot at 9 a. m. February 5, 1915 (discharge, 7.2 second-feet).

ICE.—Weir and weir crest kept clear of ice by clear fall below; stage-discharge relation not affected by ice.

REGULATION.—An old timber dam about 2 miles upstream affects flow to some extent. The dam leaks by an amount somewhat greater than the low-water flow. During prolonged low stages the surface of water in pond (103 acres) falls below crest of dam; subsequent increased flow into pond is retained until water again flows over crest, when the increased flow is apparent at gaging station.

ACCURACY.—Stage-discharge relation practically permanent. Discharge computed from weir formula, $Q=3.33\ LH^{3}/^{2}$ with logarithmic extension above gage height 1.90 feet, to which has been added 1.0 second-foot on account of leakage. Gage read twice daily to hundredths. Daily discharge ascertained by applying rating table to mean daily gage heights. Except for some uncertainty in regard to leakage through old tailrace results are good below 120 second-feet; at the higher stages the weir is flooded and results are somewhat uncertain.

COOPERATION.—Gage-height records furnished by C. T. Middlebrook, consulting engineer, Albany, N. Y.

Discharge measurements of Green River at Garfield, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 19[a]	G. F. Adams	0.62	19.0	Apr. 4[a]	R. S. Barnes	1.76	109
19[b]	do	.62	13.6	4[a]	do	1.76	111
19[b]	do	.62	12.2	4[b]	do	1.77	97

[a] Measurement made about one-half mile below weir.
[b] Measurement made at highway bridge about one-half mile above weir.

Daily discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	11	14	45	23	77	21	152	52	38	18	15	10
2	12	13	29	23	70	28	192	43	28	19	14	13
3	11	15	26	22	62	24	160	39	25	19	14	10
4	11	14	23	20	43	21	103	55	51	19	13	10
5	28	14	21	20	34	19	77	52	70	19	13	10
6	23	14	19	25	33	19	66	42	79	17	13	10
7	37	13	17	23	29	17	56	35	55	15	12	10
8	29	13	17	24	24	17	56	30	35	17	13	9.8
9	23	13	17	25	23	17	53	28	32	17	44	9.1
10	19	13	16	23	22	15	53	26	44	17	47	9.1
11	18	13	15	21	20	15	56	29	59	16	54	8.6
12	16	13	17	18	18	14	88	28	55	16	32	8.6
13	15	14	17	18	18	14	103	26	41	16	26	8.3
14	15	13	15	16	18	14	128	23	33	15	23	7.8
15	15	14	15	15	18	14	95	21	28	15	20	12
16	14	16	14	15	17	13	109	22	27	13	18	11
17	14	16	13	15	16	13	170	50	32	13	17	10
18	13	17	15	15	15	13	229	150	36	13	16	9.8
19	15	16	17	15	15	12	165	129	36	13	15	9.8
20	15	27	19	15	15	12	105	65	36	12	14	9.3
21	15	36	21	15	14	11	111	40	32	12	14	9.1
22	15	37	18	18	13	12	138	34	25	12	16	9.8
23	15	28	17	22	13	12	192	34	22	12	15	9.8
24	14	23	18	19	13	12	184	32	20	11	13	9.6
25	13	20	20	21	15	11	155	28	19	11	13	9.6
26	13	19	28	32	25	11	119	25	19	11	11	9.3
27	13	18	31	44	20	17	94	22	23	15	12	9.3
28	13	21	35	97	16	22	81	20	25	15	12	9.1
29	13	29	33	92	18	29	65	19	24	14	12	9.6
30	15	51	31	96	.....	56	51	35	20	13	11	16
31	15	.....	21	77	.....	129	.....	51	.....	23	11	.....

Monthly discharge of Green River at Garfield, Vt., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
October	37	11	16.4	May	150	19	41.5
November	51	13	19.2	June	79	19	35.6
December	45	13	21.3	July	23	11	15.1
January	97	15	29.8	August	54	11	18.5
February	77	13	25.3	September	16	7.8	9.91
March	129	11	21.1				
April	229	51	114	The year	229	7.8	30.5

MISSISQUOI RIVER NEAR RICHFORD, VT.

LOCATION.—About 3 miles downstream from Richford, Franklin County, 3 miles below mouth of North Branch, and 2 miles above mouth of Trout River.

DRAINAGE AREA.—445 square miles.

RECORDS AVAILABLE.—May 22, 1909, to December 3, 1910, and June 26, 1911, to September 30, 1916.

GAGE.—Barrett & Lawrence water-stage recorder in gage house on left bank, about one-fourth mile above highway bridge, installed August 1, 1915. June 26, 1911, to July 31, 1915, chain gage on highway bridge. From May 22, 1909, to December 3, 1910, gage was just below plant of the Sweat-Comings Co., in Richford.

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

CHANNEL AND CONTROL.—Channel deep; banks not subject to overflow; stream bed composed of gravel, boulders, and ledge rock. Control is sharply defined by rock outcrop about 100 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.25 feet at 12 p. m., March 31 (probably backwater from ice); highest open-water stage, 9.8 feet at 6 a. m., April 2 (discharge, 6,710 second-feet); minimum stage recorded, 2.22 feet at 3 p. m., October 3 (discharge, 40 second-feet).

1911–1916: Maximum stage recorded at new site, 16.7 feet by chain gage March 26, 1913 (determination of discharge, 10,200 second-feet, from extension of rating curve may be subject to error); minimum stage recorded, at new site, 4.15 feet by chain gage, July 14, 1911 (discharge, 8 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from gage heights corrected for backwater by means of current-meter measurements, observer's notes, and weather records.

REGULATION.—Considerable daily fluctuation at low stages, caused by operation of power plants at Richford.

ACCURACY.—Stage-discharge relation practically permanent except when ice is present. Rating curve fairly well defined below 4,000 second-feet. Operation of water-stage recorder unsatisfactory during last part of year on account of clock stopping, as indicated in footnote to daily discharge table. Chain gage read to half-tenths once daily from April 21 to July 1. Daily discharge ascertained by applying rating table to mean daily gage heights determined by inspection of recorder sheets; determinations for periods for which no record was obtained based on comparison with records of flow of streams in adjacent drainage basins. Results good for periods when water-stage recorder was in operation.

Discharge measurements of Missisquoi River near Richford, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height, in feet.		Discharge.	Date.	Made by—	Gage height, in feet.		Discharge.
		Chain gage.	Hook gage.				Chain gage.	Hook gage.	
				Sec.-ft.					*Sec.-ft.*
Nov. 17	G. F. Adams	[a] 6.78	[a] 4.36	957	Feb. 12	R. S. Barnes	[a] 9.05	[a] 5.69	1,210
17	do	[a] 6.65	[a] 4.28	915	Mar. 23	do	[a] 7.00	[a] 4.04	182
Dec. 19	R. S. Barnes	[a] 7.90	[a] 5.20	863	Apr. 5	do	8.58	5.81	2,370
Jan. 13	do	[a] 7.25	[a] 4.79	544					

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	223	900	1,110	605	3,330	900	7,460	1,270	1,350	605	179	.....
2	186	726	935	605	2,730	765	6,230	1,270	900	476	118	.....
3	152	700	791	545	2,330	515	5,510	1,190	900	900	98	.....
4	155	758	706	515	1,960	408	4,070	1,430	1,350	2,180	112	.....
5	545	674	599	545	1,780	408	2,380	1,430	2,100	1,740	98	.....
6	1,190	617	545	1,230	1,510	408	1,960	1,110	1,820	1,080	104	.....
7	739	551	488	1,470	1,270	408	2,230	970	1,600	772	96	.....
8	476	498	434	1,150	1,110	408	2,000	900	1,270	732	98	.....
9	341	510	379	830	970	384	2,180	830	1,110	900	1,110	.....
10	250	599	341	668	935	408	1,870	732	1,510	648	1,510	.....
11	230	551	292	575	900	408	1,960	935	1,780	408	713	.....
12	226	504	250	488	830	359	2,430	1,040	1,350	515	587	.....
13	186	587	230	488	732	313	2,430	810	1,190	408	680	.....
14	162	515	212	515	668	292	2,630	700	1,110	635	557	.....
15	179	798	193	408	635	292	2,330	575	830	313	398	.....
16	168	1,230	193	408	515	292	2,230	527	706	254	309	.....
17	145	970	212	384	515	230	2,830	1,270	830	270	250	.....
18	158	765	488	336	460	212	4,070	3,850	1,230	354	200	.....
19	200	687	935	359	434	212	4,620	4,070	2,630	313	186	.....
20	450	1,390	765	359	384	193	3,630	2,530	1,780	292	109	.....
21	569	1,920	545	359	292	193	2,630	1,560	1,350	292	132	.....
22	720	1,560	408	1,040	270	193	2,480	1,230	1,000	322	136	.....
23	493	1,150	336	1,870	250	193	3,430	1,040	804	413	126	.....
24	369	900	336	1,430	250	193	4,070	900	713	557	112	.....
25	296	746	336	1,040	313	193	3,330	778	642	359	106	.....
26	313	642	1,920	1,040	605	212	2,630	668	700	274	112	.....
27	408	648	2,180	1,870	1,230	545	2,100	581	460	246	98	.....
28	460	900	1,820	5,060	1,350	1,870	1,740	527	563	434	86	.....
29	545	1,080	1,270	4,180	1,110	4,180	1,510	504	605	250	126	.....
30	830	1,390	900	2,430	.....	5,870	1,350	970	772	226	126	.....
31	1,190	.....	668	2,230	.....	6,950	.....	1,960	.....	212	101	.....

NOTE.—Stage-discharge relation affected by ice Nov. 12–19; Dec. 1, and Dec. 6, 1915, to Apr. 1, 1916; estimates based on gage heights, current-meter measurements, observer's notes, and weather records. No record by water-stage recorder Jan. 3, 4, 8, 9, 15–21, 29–31; Feb. 1–8, 11, 12, 14, 20–29; Mar. 1–9, 11–13, 17–22; Apr. 8; May 16–25; June 2–4, 25–29; July 1, 2, 5–7, 10–14, 17–21, 28–31; determinations based on reading of chain gage once daily Apr. 21 to July 1, and by study of comparative hydrographs for stations in nearby drainage basins.

Monthly discharge of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1916.

[Drainage area, 445 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,190	145	405	0.910	1.05
November	1,920	498	849	1.91	2.13
December	2,180	193	672	1.51	1.74
January	5,060	336	1,130	2.54	2.93
February	3,330	250	1,020	2.29	2.47
March	6,950	193	916	2.06	2.38
April	7,460	1,350	3,010	6.76	7.54
May	4,070	504	1,230	2.76	3.18
June	2,630	460	1,170	2.63	2.93
July	2,180	212	561	1.26	1.45
August	1,510	86	283	.636	.73
September	.....	.....	[a]220	.494	.55
The year	7,460	.....	951	2.14	29.08

[a] Mean for September estimated by comparison with records of flow for other streams.

CLYDE RIVER AT WEST DERBY, VT.

LOCATION.—Just below plant of Newport Electric Light Co. at West Derby, Orleans County; about 1 mile above mouth of river.

DRAINAGE AREA.—150 square miles.

RECORDS AVAILABLE.—May 25, 1909, to September 30, 1916.

GAGES.—Barrett & Lawrence water-stage recorder on right bank; chain gage fastened to tree is used for auxiliary readings; gage heights referred to chain-gage datum.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from highway bridge one-half mile downstream.

CHANNEL AND CONTROL.—Stream bed rough and irregular; covered with boulders and ledge rock; fall of river rapid for some distance below gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, 3.45 feet at 6.10 p. m. April 24 (discharge, 928 second-feet); minimum stage during year, 1.88 feet at 5.50 p. m. September 27 (discharge, 66 second-feet).

1909–1916: Maximum stage during high water March 25 to 30, 1913, 5.8 feet, as determined by engineers of Geological Survey from high-water marks (discharge about 6,300 second-feet); minimum stage recorded, 1.60 feet at 5.45 p. m. August 25, 1913, 7.30 p. m. July 30, and 4.50 p. m. August 17, 1914 (discharge, 17 second-feet).

ICE.—Ice covers large boulders below gage during greater part of winter and causes some backwater.

REGULATION.—Flow at ordinary stages fully controlled by two dams at West Derby, but power plant is so operated that fluctuations in stage are not great. Distribution of flow affected also by several dams above West Derby. Seymour Lake and several smaller ponds in the basin afford a large amount of natural storage, but at the present time there is little if any artificial regulation at these ponds.

ACCURACY.—Stage-discharge relation practically permanent, except when ice is present; individual current-meter measurements occasionally plot erratically, probably because of rough measuring section. Rating curve fairly well defined. Operation of water-stage recorder unsatisfactory during a part of the year on account of clock stopping, as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying rating table to mean daily gage heights, using observer's reading of chain gage when recorder was not in operation (chain gage readings to quarter-tenths twice daily). Results fair.

Discharge measurements of Clyde River at West Derby, Vt., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 18	G. F. Adams	2.27	158	Feb. 11	R. S. Barnes	2.65	[b] 291
Dec. 17	R. S. Barnes	[a] 2.12	90	Mar. 24	do	[a] 2.18	120
Jan. 14	do	[a] 2.44	178				

[a] Stage-discharge relation affected by ice.

[b] Results doubtful.

Daily discharge, in second-feet, of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	149	110	161	348	470	221	545	630	320	218	132	80
2	140	108	167	375	442	221	725	585	320	218	128	98
3	130	118	173	336	405	207	775	585	320	210	125	108
4	122	122	170	298	387	194	725	585	399	221	122	102
5	115	120	164	251	336	176	630	545	470	224	118	112
6	112	122	149	218	311	176	585	545	491	221	115	110
7	102	122	132	194	288	164	545	505	505	228	115	102
8	115	115	138	207	271	164	498	491	545	243	110	110
9	115	108	130	243	263	152	449	449	545	263	284	102
10	122	105	122	259	243	146	423	387	545	267	442	95
11	120	102	108	228	239	146	429	399	505	271	449	102
12	108	102	102	204	221	140	435	364	470	263	435	115
13	105	102	110	179	210	146	442	331	449	239	375	100
14	100	110	102	152	204	152	463	316	449	200	320	90
15	98	120	98	158	218	135	463	298	423	185	267	95
16	95	130	108	170	204	125	449	275	399	185	224	102
17	98	132	90	185	188	112	505	326	381	179	188	84
18	95	132	88	200	164	112	585	405	375	170	170	88
19	86	140	80	155	155	110	775	463	387	158	155	90
20	92	158	88	135	152	112	875	505	381	164	135	86
21	90	164	90	149	155	120	875	505	387	170	125	82
22	95	182	108	173	152	110	825	491	375	170	115	78
23	120	182	102	200	155	112	825	470	375	170	105	86
24	138	179	118	228	161	105	875	411	364	176	100	80
25	125	170	130	251	170	105	875	364	342	173	92	74
26	118	155	176	271	176	102	875	331	326	164	95	74
27	112	140	200	311	188	115	875	302	302	152	90	70
28	102	140	224	405	200	140	775	275	275	140	86	70
29	98	161	259	545	210	210	775	267	235	135	90	80
30	98	155	320	545	.....	302	675	284	218	135	86	158
31	105	.....	364	463	.....	442	.....	320	.....	135	88	.....

NOTE.—Stage-discharge relation affected by ice Dec. 10-24, 1915; Jan. 7-24, Feb. 2-24, and 27-29; and Mar. 16-28, 1916; discharge estimated from gage heights, four current-meter measurements and observer's notes. Operation of water-stage recorder unsatisfactory and twice-daily readings of chain gage used during the following periods: Dec. 31 to Jan. 2; Jan. 29; Feb. 8, 9; Feb. 11 to June 17; June 29, 30; July 1, 6-9, 20-31; and Aug. 1 to Sept. 30.

Monthly discharge of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1916.

[Drainage area, 150 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	149	86	110	0.733	0.85
November	182	102	134	.893	1.00
December	364	80	147	.980	1.13
January	545	135	259	1.73	1.99
February	470	152	239	1.59	1.72
March	442	102	160	1.07	1.23
April	875	423	652	4.35	4.85
May	630	267	420	2.80	3.23
June	545	218	396	2.64	2.94
July	271	135	195	1.30	1.50
August	449	86	177	1.18	1.36
September	158	70	94.1	.627	.70
The year	875	70	248	1.65	22.50

MISCELLANEOUS MEASUREMENTS.

Measurements of Onondaga Creek near Cardiff, N. Y., about 2 miles above mouth of West Branch, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 12	C. C. Covert	4.99	59.0	Aug. 23	E. D. Burchard	3.50	10.9
Aug. 23	E. D. Burchard	3.50	11.0				

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STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART IV. ST. LAWRENCE RIVER BASIN

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

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 investigations 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, monographs, and annual reports.

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 slope 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).

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

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 list 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., Room 18, Federal Building.
Atlanta, Ga., Post Office Building.
Chicago, Ill., 802 Federal Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
St. Paul, Minn., Old Capitol Building.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Phoenix, Ariz., 417 Fleming Building.
Austin, Tex., Old Post Office Building.
Portland, Oreg., 416 Couch Building.
Tacoma, Wash., 406 Federal Building.
San Francisco, Cal., 328 Customhouse.
Los Angeles, Cal., 619 Federal Building.
Honolulu, Hawaii, Kapiolani Building.

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

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,100 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 September, 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
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.

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

Report.	Character of data.	Year.
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.

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 1916. The data for any particular station will, as a rule, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1916, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, and 431, which contain records for the New England streams from 1903 to 1916. Results of miscellaneous measurements are published by drainage basins.

Numbers of water-supply papers containing results of stream measurements, 1899–1916.

Year.	I North Atlantic slope (St. John River to York River).	II South Atlantic and eastern Gulf of Mexico (James River to the Mississippi).	III Ohio River.	IV St. Lawrence River and Great Lakes.	V Hudson Bay and upper Mississippi River.	VI Missouri River.	VII Lower Mississippi River.	VIII Western Gulf of Mexico.	IX Colorado River.	X Great Basin.	XI Pacific slope in California.	XII North Pacific slope basins.		
												Pacific slope in Washington 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	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	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] 179, 173	174	175, [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	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Estimates for 1899 in Twenty-first Annual Report, Part 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 coast 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. Estimates 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.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated on page III, and in the records for large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

PART IV. ST. LAWRENCE RIVER BASIN.

PRINCIPAL STREAMS.

The St. Lawrence River basin includes streams which drain into the Great Lakes and St. Lawrence River. The principal streams flowing directly or indirectly into Lake Superior from the United States are St. Louis, Ontonagon, Dead, and Carp rivers; streams flowing into Lake Michigan are Escanaba, Menominee, Peshtigo, Oconto, Fox, St. Joseph, and Grand rivers; into Lake Huron flow Thunder Bay, Au Sable, Rifle, and Saginaw rivers; into Lake Erie flow Huron, Maumee, Sandusky, Black, and Cuyahoga rivers. Streams flowing into Lake Ontario are Genesee, Oswego, Salmon, and Black rivers. The St. Lawrence receives Oswegatchie and Raquette rivers, Richelieu River (the outlet of Lake Champlain), and St. Francis River, whose principal tributary, Clyde River, reaches it through Lake Memphremagog. The streams of this basin drain wholly or in part the States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin.

In addition to the list of gaging stations and annotated list of publications relating specifically to the section, this part contains a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations. (See p. xix.)

GAGING STATIONS.

NOTE.—Dash following a date indicates that station was being maintained September 30, 1916. Period after date indicates discontinuance.

Streams tributary to Lake Superior:
- Brule River at mouth, Minn., 1911.
- Devil Track River at mouth, Minn., 1911.
- Cascade River at mouth, Minn., 1911.
- Poplar River at Lutsen, Minn., 1911–
- Beaver Bay River at Beaver Bay, Minn., 1911–1914.
- St. Louis River near Cloquet, Minn., 1903.
- St. Louis River near Thomson, Minn., 1909–1915.
  - Whiteface River at Meadowlands, Minn., 1909–1912.
  - Whiteface River below Meadowlands, Minn., 1912–
  - Cloquet River at Independence, Minn., 1909–
- Aminicon River near Aminicon Falls, Wis., 1914–1916.
- Brule River near Brule, Wis., 1914–
- Bad River near Odanah, Wis., 1914–

Streams tributary to Lake Superior—Continued.
Ontonagon River near Rockland, Mich., 1903.
Sturgeon River near Sidnaw, Mich., 1912–1915.
Perch River near Sidnaw, Mich., 1912–1915.
Dead River near Negaunee, Mich., 1902–3.
Dead River at Forestville, Mich., 1898–1902.
Carp River near Marquette, Mich., 1902–3.
Streams tributary to Lake Michigan:
Escanaba River near Escanaba, Mich., 1903–1915.
Brule River (head of Menominee River) near Florence, Wis., 1914–1916.
Menominee River near Iron Mountain, Mich., 1902–1914.
Menominee River at Lower Quinnesec Falls, Wis., 1898–99.
Menominee River at Koss, Mich., 1902–1909; 1914.
Menominee River below Koss, Mich., 1913–
Iron River near Iron River, Mich., 1900–1905.
Pine River near Florence, Wis., 1914–
Pike River at Amberg, Wis., 1914–
Peshtigo River at High Falls, near Crivitz, Wis., 1912–
Peshtigo River near Crivitz, Wis., 1906–1909.
Peshtigo River at Crivitz, Wis., 1906.
Oconto River near Gillett, Wis., 1906–1909; 1914–
Oconto River at Stiles, Wis., 1906.
Fox River at Omro, Wis., 1902–3.
Fox River at Oshkosh, Wis., 1902.
Fox River at Wrightstown, Wis., 1902–1904.
Wolf River at Keshena, Wis., 1907–1909; 1911–
Wolf River at White House Bridge, near Shawano, Wis., 1906–7.
Wolf River at Darrows Bridge, near Shawano, Wis., 1906.
Wolf River at New London, Wis., 1913–
Wolf River at Northport, Wis., 1905.
Wolf River at Winneconne, Wis., 1902–3.
West Branch of Wolf River at Neopit, Wis., 1911–
Little Wolf River near Royalton, Wis., 1914–
Little Wolf River near Northport, Wis., 1907–1910.
Waupaca River near Weyauwega, Wis., 1916–
Fond du Lac River, West Branch (head of Fond du Lac River) at Fond du Lac, Wis., 1903.
East Branch of Fond du Lac River at Fond du Lac, Wis., 1903.
Sheboygan River near Sheboygan, Wis., 1916–
Milwaukee River near Milwaukee, Wis., 1914–
St. Joseph River at Mendon, Mich., 1902–1905.
St. Joseph River near Buchanan, Mich., 1901–1906.
Fawn River at White Pigeon, Mich., 1903–4.
Kalamazoo River near Allegan, Mich., 1901–1907.
Reeds Springs near Albion, Mich., 1904–1906.
Grand River at North Lansing, Mich., 1901–1906.
Grand River at Grand Rapids, Mich., 1901–
Crockery Creek at Slocums Grove, Mich., 1902–3.
Red Cedar River at Agricultural College, Mich., 1902–3.
Muskegon River at Newaygo, Mich., 1901–1906.
Manistee River near Sherman, Mich., 1903–1916.
Boardman River at Traverse City, Mich., 1904.

Streams tributary to Lake Huron:
- Thunder Bay River near Alpena, Mich., 1901–1908.
- Au Sable River near Lovells, Mich., 1908–1914.
- Au Sable River at Bamfield, Mich., 1902–1913.
- Rifle River near Sterling, Mich., 1905–1908.
- Rifle River at Omer, Mich., 1902–3.
- Shiawassee River (head of Saginaw River):
  - Flint River at Flint, Mich., 1903–4.
  - Cass River at Frankenmuth, Mich., 1908–9.
  - Cass River at Bridgeport, Mich., 1908.
  - Tittabawassee River at Freeland, Mich., 1903–1909; 1912–

Streams tributary to Lake Erie:
- Huron River at Dover, Mich., 1904.
- Huron River at Dexter, Mich., 1904–1916.
- Huron River at Barton, Mich., 1914–
- Huron River at Geddes, Mich., 1904–1914.
- Huron River at French Landing, Mich., 1904–5.
- Huron River at Flat Rock, Mich., 1904–
- Maumee River near Sherwood, Ohio, 1903–1906.
- Maumee River near Waterville, Ohio, 1898–1901.
  - St. Marys River at Fort Wayne, Ind., 1905–6.
  - St. Joseph River at Fort Wayne, Ind., 1905–6.
  - Tiffin River near Defiance, Ohio, 1903–1906.
  - Auglaize River near Defiance, Ohio, 1903.
    - Ottawa River at Lima, Ohio, 1902–3.
      - Blanchard River at Ottawa, Ohio, 1902–3.
- Sandusky River near Mexico, Ohio, 1898–1900.
- Sandusky River at Fremont, Ohio, 1898–1901.
- Black River near Elyria, Ohio, 1903–1906.
- Cuyahoga River at Independence, Ohio, 1903–1906.
- Cuyahoga River at Cleveland, Ohio, 1903.
- Cattaraugus Creek at Versailles, N. Y., 1910–

Streams tributary to Lake Ontario:
- Niagara River:
  - Tonawanda Creek:
    - Little Tonawanda Creek near Linden, N. Y., 1912–
- Genesee River at Scio, N. Y., 1916–
- Genesee River at St. Helena, N. Y., 1908–
- Genesee River at Mount Morris, N. Y., 1905–1909.
- Genesee River at Jones Bridge, near Mount Morris, N. Y., 1903–1906; 1908–
- Genesee River at Rochester, N. Y., 1904–
  - Canaseraga Creek near Dansville, N. Y., 1910–1912; 1915–
  - Canaseraga Creek at Groveland station, N. Y., 1915–
  - Canaseraga Creek at Shakers Crossing, N. Y., 1915–
    - Keshequa Creek at Sonyea, N. Y., 1910–1912.
    - Keshequa Creek near Sonyea, N. Y., 1915–
  - Hemlock Lake at Hemlock, N. Y., 1894–1902.
    - Canadice outlet near Hemlock, N. Y., 1903–
    - Honeoye Creek at East Rush, N. Y., 1903–1906.
- Seneca River (head of Oswego River) at Baldwinsville, N. Y., 1898–1908.
- Oswego River at Fulton, N. Y., 1900; 1902.
- Oswego River at Battle Island, above Minetto, N. Y., 1900–1906.

Streams tributary to Lake Ontario—Continued.
Oswego River at high dam, near Oswego, N. Y., 1897–1901.
Seneca Lake at Geneva, N. Y., 1905–6.
Cayuga Lake at Ithaca, N. Y., 1905–1908.
Fall Creek near Ithaca, N. Y., 1908–9.
Owasco Lake outlet near Auburn, N. Y., 1912–
Shaneateles Lake at Skaneateles, N. Y., 1890–91.
Skeneateles Lake outlet at Willow Glen, N. Y., 1892–1908.
Skeneateles Lake outlet at Jordan, N. Y., 1890–1892.
Onondaga Lake outlet at Long Branch, N. Y., 1904.
West Branch of Onondaga Creek at South Onondaga, N. Y., 1916–.
Fish Creek, East Branch (through Oneida Lake, head of Oneida River), at Point Rock, N. Y., 1898–99.
Oneida River at Brewerton, N. Y., 1899.
Oneida River at Oak Orchard, near Euclid, N. Y., 1902–1909.
Oneida River at Caughdenoy, N. Y., 1910–1913.
Fish Creek:
West Branch of Fish Creek at McConnellsville, N. Y., 1898–1901.
Oneida Creek at Kenwood, N. Y., 1898–1900.
Chittenango Creek at Chittenango, N. Y., 1901–1906.
Chittenango Creek at Bridgeport, N. Y., 1898–1901.
Salmon River at Stillwater Bridge, near Redfield, N. Y., 1911–1913.
Salmon River near Pulaski, N. Y., 1900–1908; 1910–1914.
Orwell Brook near Altmar, N. Y., 1911–1916.
Black River near Boonville, N. Y., 1911–
Black River near Felts Mills, N. Y., 1902–1913.
Black River at Huntingtonville dam, near Watertown, N. Y., 1897–1901.
Forestport feeder near Boonville, N. Y., 1915–
Black River canal flowing south near Boonville, N. Y., 1915–
Moose River at Moose River, N. Y., 1900–
Middle Branch of Moose River at Old Forge, N. Y., 1911–
Beaver River at State dam, near Beaver River, N. Y., 1908–
Beaver River at Croghan, N. Y., 1901–1903.
Streams tributary to the St. Lawrence:
Oswegatchie River, East Branch (head of Oswegatchie River), at Newton Falls, N. Y., 1912–
Oswegatchie River near Heuvelton, N. Y., 1916.
Oswegatchie River near Ogdensburg, N. Y., 1903–1916.
West Branch of Oswegatchie River near Harrisville, N. Y., 1916–
Raquette River at Raquette Falls, near Coreys, N. Y., 1908–1912.
Raquette River at Piercefield, N. Y., 1908–
Raquette River at South Colton, N. Y., 1904.
Raquette River at Massena Springs, N. Y., 1903–1916.
Bog River near Tupper Lake, N. Y., 1908–1912.
St. Regis River at Brasher Center, N. Y., 1910–
Deer River at Brasher Iron Works (railroad station), Ironton, N. Y., 1912–1916.
Chateaugay River near Chateaugay, N. Y., 1908.
Richelieu River at Fort Montgomery, N. Y., 1875–
Lake Champlain at Burlington, Vt., 1907–
Big Chazy River at Moors, N. Y., 1908.
Saranac River at Saranac Lake, N. Y., 1902–3.
Saranac River near Plattsburg, N. Y., 1903–
Ausable River, West Branch, near Newman, N. Y., 1916–

Streams tributary to the St. Lawrence—Continued.
Richelieu River tributaries—Continued.
Lake Champlain tributaries—Continued.
Ausable River at Ausable Forks, N. Y., 1910–
Ausable River at Keeseville, N. Y., 1904 and 1908.
Boquet River at Willsboro, N. Y., 1904 and 1908.
Lake George, N. Y., 1913–
Lake George outlet at Ticonderoga, N. Y., 1904–5.
Poultney River at Fairhaven, Vt., 1908.
Mettawee River at Whitehall, N. Y., 1908.
Otter Creek at Middlebury, Vt., 1903–1907; 1910–
East Creek near Rutland, Vt., 1911–1913.
Winooski River above Stevens Branch, near Montpelier, Vt.,1909–1914.
Winooski River at Montpelier, Vt., 1909–
Winooski River at Richmond, Vt., 1903–1907; 1910.
Winooski River near Winooski, Vt., 1903.
Worcester Branch of Winooski River at Montpelier, Vt., 1909–1914.
Dog River at Northfield, Vt., 1909–
Dog River near Montpelier Junction, Vt., 1910.
Mad River at Moretown, Vt., 1910.
Little River near Waterbury, Vt., 1910.
Huntington River at Jonesville, Vt., 1910.
Lamoille River at Morrisville, Vt., 1909–10.
Lamoille River at Cadys Falls, near Morrisville, Vt., 1913–
Lamoille River at Johnson, Vt., 1910–1913.
Lamoille River at West Milton, Vt., 1903.
Green River at Garfield, Vt., 1915–
Missisquoi River at Richford, Vt., 1909–10.
Missisquoi River near Richford, Vt., 1911–
Missisquoi River at Swanton, Vt., 1903.
St. Francis River (by way of Lake Memphremagog and Magog River):
Clyde River at West Derby, Vt., 1909–

REPORTS ON WATER RESOURCES OF THE ST. LAWRENCE RIVER BASIN.[1]

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Water-supply papers are of octavo size.

*21. Wells of northern Indiana, by Frank Leverett. 1899. 82 pp., 2 pls. (Continued in No. 26.)

Discusses, by counties, the glacial deposits and the sources of well water; gives many well sections.

*24. Water resources of the State of New York, Part I, by G. W. Rafter. 1899. 99 pp., 13 pls. 15c.

*25. Water resources of the State of New York, Part II, by G. W. Rafter. 1899. 100 pp., 12 pls. 15c.

No. 24 contains descriptions of the principal rivers of New York and their more important tributaries and data on temperature, precipitation, evaporation, and stream flow.

No. 25 contains discussion of water storage projects on Genesee and Hudson Rivers, power development at Niagara Falls, descriptions and early history of State canals, and a chapter on the use and value of the water powers of the streams and canals; also brief discussion of the water yield of sand areas of Long Island.

*26. Wells of southern Indiana (continuation of No. 21), by Frank Leverett. 1899. 64 pp. 5c.

Discusses, by counties, the glacial deposits and the sources of well water; contains many well sections.

*30. Water resources of the Lower Peninsula of Michigan, by A. C. Lane. 1899. 97 pp., 7 pls.

Describes lake and river transportation and navigation, water powers and domestic water supplies; discusses climate, topography, geology, and well waters; compares quality and quantity of waters.

31. Lower Michigan mineral waters, by A. C. Lane. 1899. 97 pp., 4 pls. 10c.

Treats of economic value of mineral waters and discussion and classification of analyses; contains analyses of waters of Lake Superior and of smaller lakes and rivers and of well waters from various geologic formations; also sanitary condition of drinking waters.

57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 and 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" give information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.)

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[1] For stream-measurement reports, see tables on pp. IV, V, VI.

91. The natural features and economic development of the Sandusky, Maumee, Muskingum, and Miami drainage areas in Ohio, by B. H. and M. S. Flynn. 1904. 130 pp. 10c.

Describes the topography, geology, and soils of the areas, and discusses stream flow, dams, water powers, and public water supplies.

102. Contributions to the hydrology of eastern United States, 1903; M. L. Fuller, geologist in charge. 1904. 522 pp. 30c.

Contains brief reports on wells and springs of Minnesota and of lower Michigan. The report comprises tabulated well records giving information as to location, owner, depth yield, head, etc., supplemented by notes as to elevation above sea, materials penetrated, temperature, use and quality; many miscellaneous analyses.

114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains brief reports as follows:

Minnesota, by C. W. Hall; Wisconsin district, by Alfred R. Schultz; Lower Michigan; Illinois, by Frank Leverett; Indiana, by Frank Leverett; New York, by F. B. Weeks; Ohio, by Frank Leverett.

Each of these reports describes briefly the topography of the area, the relation of the geology to the water supplies, and gives list of pertinent publications; lists also principal mineral springs.

121. Preliminary report on the pollution of Lake Champlain, by M. O. Leighton. 1905. 119 pp., 13 pls. 20c.

Describes the lake and principal inflowing streams and discusses the characteristics of the water and the wastes resulting from the manufacturing processes by which the waters are polluted. Discusses also the effect of mill waste on algæ, bacteria, and fish.

144. The normal distribution of chlorine in the natural waters of New York and New England, by D. D. Jackson. 1905. 31 pp., 5 pls. 10c.

Discusses common salt in coast and inland waters, salt as an index to pollution of streams and wells, the solutions and methods used in chlorine determinations, and the use of the normal chlorine map; gives charts and tables for chlorine in the New England States and New York.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains three brief reports pertaining chiefly to areas in the St. Lawrence River basin:

Two unusual types of artesian flow, by Myron L. Fuller. Describes (1) artesian flows from uniform, unconfined sand on Long Island, N. Y., and in Michigan; and (2) flow from jointed upper portion of limestone and other rocks in southeastern Michigan.

Water resources of the Catatonk area, New York, by E. M. Kindle. Describes topography and geology of areas southeast of Finger Lake region, New York, including part of city of Ithaca; discusses briefly the artesian wells of Ithaca, the quality of the spring water at several small towns, and of the streams used for municipal supplies and for power.

A ground-water problem in southeastern Michigan, by Myron L. Fuller. Discusses causes of failure of wells in certain areas in southeastern Michigan in 1904 and the application of the conclusions to other regions.

147. Destructive floods in the United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Describes flood on Grand River, Mich. (from report of R. E. Horton), discussing streams precipitation, and temperature, discharge, damage, and prevention of future damage.

149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives, by States (and within the States by counties), the location, depth, diameter, yield, height of water, and other features of wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*156. Water powers of northern Wisconsin, by L. S. Smith. 1906. 145 pp., 5 pls. 25c.

Describes, by river systems, the drainage, geology, topography, rainfall, and run-off, water powers and dams.

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*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Contains brief report entitled Flowing well districts in the eastern part of the northern peninsula of Michigan, by Frank Leverett.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Contains accounts of floods on Sixmile Creek and Cayuga Inlet, N. Y. (in 1857, 1901, and 1905), and on Grand River, Mich., and estimate of flood discharge and frequency for Genesee River; gives index to literature on floods in American streams.

*182. Flowing wells and municipal water supplies in the southern portion of the southern peninsula of Michigan, by Frank Leverett and others. 1906. 292 pp., 5 pls. 50c.

*183. Flowing wells and municipal water supplies in the middle and northern portions of the southern peninsula of Michigan, by Frank Leverett and others. 1907. 393 pp., 5 pls. 50c.

Nos. 182 and 183 describe in general the geographic features, water-bearing formations, drainage, quality of water, and subterranean-water temperature, and give details concerning water supplies by countries. The reports contain many analyses.

*193. The quality of surface waters in Minnesota, by R. B. Dole and F. F. Wesbrook. 1907. 171 pp., 7 pls. 25c.

Describes by river basins the topography, geology, and soils, the industrial and municipal pollution of the streams, and gives notes on the municipalities; contains many analyses.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls. 40c.

Scope indicated by amplification of title.

236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results; gives results of analyses of waters of Lake Superior and Lake Michigan, Kalamazoo and Grand rivers, Lake Huron, Lake Erie, Maumee River, and St. Lawrence and Oswegatchie rivers.

239. The quality of the surface waters of Illinois, by W. D. Collins. 1910. 94 pp., 3 pls. 10c.

Discusses the natural and economic features that determine the character of the streams, describes the larger drainage basins and the methods of collecting and analyzing the samples of water, and discusses each river in detail with reference to its source, course, and quality of water; includes short chapters on municipal supplies and industrial uses.

254. The underground waters of north-central Indiana, by S. R. Capps, with a chapter on the chemical character of the waters, by R. B. Dole. 1910. 279 pp., 7 pls. 40c.

Describes relief, drainage, vegetation, soils and crops, industrial development, geologic formations; sources, movements, occurrence, and volume of ground water; methods of well construction and lifting devices; discusses in detail, for each county, surface features and drainage, geology, and ground water, city, village, and rural supplies, and gives record of wells and analyses of waters. Discusses also, under chemical character, methods of analyses and expression of results, mineral constituents, effects of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification and chemical composition; many analyses and field assays.

417. Profile surveys of rivers in Wisconsin, prepared under the direction of W. H. Herron, acting chief geographer. 1916. 16 pp., 32 pls. 45c.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

Annual reports 1 to 26 are royal octavo; later reports are octavo.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II. Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of eastern United States, by W J McGee, pp. 1 to 47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

Seventeenth Annual Report of the United States Geological Survey, 1895–96, Charles D. Walcott, Director. 1896. 3 parts in 4 vols. *Pt. II. Economic geology and hydrography, xxv, 864 pp., 113 pls. $2.35. Contains:

*The water resources of Illinois, by Frank Leverett, pp. 695–849, pls. 108–113. Describes the physical features of the State, and the drainage basins, including Illinois, Des Plaines, Kankakee, Fox, Illinois-Vermilion, Spoon, Mackinaw, and Sangamon rivers, Macoupin Creek, Rock River, tributaries of the Mississippi in western Illinois, Kaskaskia, Big Muddy, and tributaries of the Wabash; discusses the rainfall and run-off, navigable waters and water powers, the wells supplying water for rural districts, and artesian wells; contains tabulated artesian well data and water analyses.

Eighteenth Annual Report, United States Geological Survey, 1896–97, Charles D. Walcott, Director. 1897. 5 parts in 6 volumes. *Pt. IV. Hydrography, x, 756 pp., 102 pls. $1.75. Contains:

*The water resources of Indiana and Ohio, by Frank Leverett, pp. 419–560, pls. 33–37. Describes Wabash, Whitewater, Great Miami, Little Miami, Scioto, Hocking, Muskingum, and Beaver rivers and lesser tributaries of the Ohio in Indiana and Ohio, the streams discharging into Lake Erie and Lake Michigan, and streams flowing to the Upper Mississippi through the Illinois; discusses shallow and drift wells, the flowing wells from the drift and deeper artesian wells, and gives records of wells at many of the cities; describes the mineral springs and gives analyses of the waters; contains also tabulated lists of cities using surface waters for waterworks, and of cities and villages using shallow and deep well waters; discusses the source and quality of the city and village supplies, and gives precipitation tables for various points.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Pts. II, III, and V, 1899.) 6 parts in 7 volumes and separate case for maps with Pt. V. *Pt. IV. Hydrography. $1.85. Contains:

*The rock waters of Ohio, by Edward Orton, pp. 633–717, pls. 71–73. Describes the principal geologic formations of Ohio and the waters from the different strata; discusses the flowing wells at various points and the artesian wells of the deep preglacial channels in Allen, Auglaize, and Mercer counties; discusses city and village supplies; gives analyses of waters from various formations.

MONOGRAPHS.

Monographs are of quarto size. They are not distributed free, but may be obtained from the Geological Survey or from the Superintendent of Documents at the prices given. An asterisk (*) indicates that the Survey's stock of the paper is exhausted. (See Finding lists, pp. 89, 118.)

XLI. Glacial formations and drainage features of the Erie and Ohio basins, by Frank Leverett. 1902. 802 pp., 26 pls. $1.75.

Treats of an area extending westward from Genesee Valley in New York across northwestern Pennsylvania and Ohio, central and southern Indiana, and southward from Lakes Ontario and Erie to Allegheny and Ohio rivers.

BULLETINS.

An asterisk (*) indicates that the Geological Survey's stock of paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

Discusses the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describes the general methods of work; gives tabulated records of wells in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin, and detailed records of wells in Onondaga County, N. Y., and Hancock and Wood counties, Ohio. These wells were selected because they give definite stratigraphic information.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Gives an account of progress in the collection of well records and samples; contains tabulated records of wells in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin, and detailed records of wells in Cook County, Ill.; Erie County, N. Y.; Ottawa, Sandusky, and Summit counties, Ohio; and Manitowoc County, Wis. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth of underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

Folios 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but 80 or 90 per cent of the folios are usable. They will be sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also to the library edition of Folio 186. The library edition of Folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of Folio 185 and higher numbers sells for 50 cents a copy, except Folio 193, which sells for 75 cents a copy. A discount of 40 per cent is allowed on an order for folios or for folios together with topographic maps amounting to $5 or more at the retail rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection

[1] Index maps showing areas in the St. Lawrence basin covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director U. S. Geological Survey, Washington, D. C.

with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

*81. Chicago, Illinois-Indiana.

Describes an area embracing not only the immediate site of the city but adjacent parts of Cook, Dupage, and Will counties, Ill.; gives an account of the water power, discusses the quality of the waters, and gives analyses of waters from artesian wells; gives also a list of papers relating to the geology and paleontology of the area.

*140. Milwaukee special, Wisconsin. 5c.

Gives analyses of spring waters and of artesian water in Milwaukee; also tabulated data concerning wells.

155. Ann Arbor, Mich. 25c.

Discusses the present lakes, the lakes of the glacial period, and under "Economic geology," the water resources, including the use of the rivers for power and of the underground waters, shallow and artesian, for city and village supplies; discusses the quality of the waters, and gives details by townships.

*169. Watkins Glen-Catatonk, New York.

Includes discussion of water supply at Ithaca.

190. Niagara, N. Y. 50c. either edition.

Gives analyses of mineral water from well at Akron; discusses briefly the municipal supplies of Buffalo, Niagara Falls, Tonawanda, La Salle, and Youngstown, and the use of Niagara River for power development.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of the various sections of the country. Notable among those pertaining to the St. Lawrence River basin are the reports of the Chief of Engineers, United States Army, the State Geological Survey of Illinois, the Illinois Water-Supply Commission, the Rivers and Lakes Commission of Illinois, the New York State Conservation Commission and State Water-Supply Commission, and the water-power report of the Tenth Census (vol. 16). The following reports deserve special mention:

The mineral content of Illinois waters, by Edward Bartow, J. A. Udden, S. W. Parr, and George T. Palmer: Illinois State Geol. Survey Bull. 10, 1909.

Chemical and biological survey of waters of Illinois, by Edward Bartow: Univ. Illinois Pubs. 3, 6, 7, 1906–1909.

Chemical survey of the waters of Illinois, report for the years 1897–1902, by A. W. Palmer, with report on geology of Illinois as related to its water supply, by Charles W. Rolfe: Univ. Illinois Pub.

Diversion of the waters of the Great Lakes by way of the Sanitary and Ship canal of Chicago: A brief of the facts and issues, by Lyman E. Cooley, Chicago, 1913.

The State of Missouri *v.* the State of Illinois and the Sanitary district of Chicago, before Frank S. Bright, commissioner of the Supreme Court of the United States. 1904.

The mineral waters of Indiana, their location, origin, and character, by W. S. Blatchley: Indiana Dept. Geology and Nat. Res. Twenty-sixth Ann. Rept., 1901.

Reports of the water resources investigation of Minnesota, by the State Drainage Commission, 1909–1912.

Water powers of Wisconsin, by L. S. Smith: Wisconsin Geol. and Nat. Hist. Survey Bull. 20, 1908.

Report of the Railroad Commission of Wisconsin to the legislature on water powers. 1915.

Hydrology of the State of New York, by George W. Rafter: New York State Mus. Bull. 85, 1905.

Many of these reports can be obtained from the various commissions, and probably all can be consulted in the public libraries of the larger cities.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports that are not readily classifiable by drainage basins and that cover a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 57 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also, storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl. 10c.

Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, makes comparisons of wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill, its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 15c.

*42. The windmill, its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp., 2 pls. 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurement. 1901. 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901–2. See also Nos. 64, 94, and 95.

57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. (See No. 149.) 5c.

61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 and 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" gives information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.). 5c.

64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of underground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motion of underground water; surface and deep zones of flow and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing well; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

79. Normal and polluted waters in northeastern United States, by M. O. Leighton. 1903. 192 pp. 10c.

Defines essential qualities of water for various uses, the impurities in rain, surface, and underground waters, the meaning and importance of sanitary analyses, and the principal sources of pollution; chiefly, "a review of the more readily available records" of examination of water supplies derived from streams in the Merrimack, Connecticut, Housatonic, Delaware, and Ohio River basins; contains many analyses.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of stream flow; gives rainfall, run-off, and evaporation formulas; discusses effect of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c.

Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey and the reports of the conference, the following papers of more or less general interest:

Limits of an irrigation project, by D. W. Ross.
Relation of Federal and State laws to irrigation, by Morris Bien.
Electrical transmission of power for pumping, by H. A. Storrs.
Correct design and stability of high masonry dams, by Geo. Y. Wisner.
Irrigation surveys and the use of the plane table, by J. B. Lippincott.
The use of alkaline waters for irrigation, by Thomas A. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. See also No. 95.

*95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. See also No. 94.

103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

110. Contributions to the hydrology of eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.

The California or "stovepipe" method of well construction, by Charles S. Slichter.

Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.

Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.

Experiment relating to problems of well contamination at Quitman, Ga., by S. W. McCallie

Notes on the hydrology of Cuba, by M. L. Fuller.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., the contamination of rock wells and of streams by waste oil and brine.

114. Underground waters of eastern United States; M. L. Fuller, geologist in charge 1905. 285 pp., 18 pls. 25c.

Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential conditions of artesian flows, and general conditions affecting underground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c

Scope indicated by title.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.

Scope indicated by title.

*122. Relation of the law to underground waters, by D.W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Cal., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton 1905. 61 pp., 4 pls.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c.

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.
Power engineering applied to irrigation problems, by O. H. Ensign.
Estimates on tunneling in irrigation projects, by A. L. Fellows.
Collection of stream-gaging data, by N. C. Grover.
Diamond-drill methods, by G. A. Hammond.
Mean-velocity and area curves, by F. W. Hanna.
Importance of general hydrographic data concerning basins of streams gaged, by R. E. Horton.
Effect of aquatic vegetation on stream flow, by R. E. Horton.
Sanitary regulations governing construction camps, by M. O. Leighton.
Necessity of draining irrigated land, by Thos. H. Means.
Alkali soils, by Thos. H. Means.
Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in the United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and areas of cross section.

149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 to 61; mentions also principal publications relating to deep borings.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp., 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

*151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls. 10c.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists of publications relating to underground waters, and contains the following brief reports of general interest:

Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation, treatment of slop, sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp. 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, by C.-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and recent tendencies in sewage-disposal practice in England, Germany, and the United States: describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification in intermittent sand filtration and coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls. 5c.

Describes manufacture of strawboard, present and proposed methods of disposal of waste liquors, laboratory investigations of precipitation and sedimentation, and field studies of amount and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of The State of Missouri *v.* The State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls. 40c.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 38 pls. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes the manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States: Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, method of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvement and the French department of agriculture, and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs and their protection; open or dug and deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall, water-bearing rocks, amount of underground water, artesian conditions, and oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties; contamination of well waters and methods of prevention; tests of capacity and measurement of depth; and costs of sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage of wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

259. The underground waters of southwestern Ohio, by M. L. Fuller and F. G. Clapp, with a discussion of the chemical character of the waters, by R. B. Dole. 1912. 228 pp., 9 pls. 35c.

Describes the topography, climate, and geology of the region, the water-bearing formations, the source, mode of occurrence, and head of the waters, and municipal supplies; gives details by counties; discusses in supplement, under chemical character, method of analysis and expression of results, mineral constituents, effect of the constituents on waters for domestic, industrial, and medicinal uses, methods of purification, chemical composition; many analyses and field assays. The matter in the supplement was also published in Water-Supply Paper 254 (The underground waters of north-central Indiana).

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c.

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of waters of the Rio Grande and of Pecos, Gallinas, and Hondo rivers.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of waterworks systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water and municipal water softening.

334. The Ohio Valley flood of March–April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914. N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c.

*(*e*) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53–65.
Scope indicated by title.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri and Oklahoma, Montana, Colorado and Utah, Nevada and Arizona, and California.

371. Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells, shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915. N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls.

(*c*) The relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.
(*e*) A method of correcting river discharge for a changing stage, by B. E. Jones, pp. 117–130.
(*f*) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131–139.
Three papers presented at the conference of engineers of the water-resources branch in December, 1914.

400. Contributions to the hydrology of the United States, 1916. N. C. Grover, chief hydraulic engineer.

(*a*) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.
(*c*) The measurement of silt-laden streams, by Raymond C. Pierce, pp. 39–51.
(*d*) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125–173. Pl. 21. Scope indicated by title.

Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 375–561, pls. 107–146. See Water-Supply Paper 87.

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101–349, pls. 111–145. Discusses the economic aspects of irrigation, alkaline drainage, silt, and sedimentation; gives brief history of legislation; describes perennial canals in Idaho-California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of eastern United States, by W J McGee, pp. 1–47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II, papers chiefly of a theoretic nature, v, 958 pp., 127 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6–16. Discusses the amount of water stored in sandstone, in soil, and in other rocks, the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous media, and through sand, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pls. 17. Scope indicated by title.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate and population, and transportation facilities of the region, the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee river basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Cal., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream slope and discharge and to the degree of comminution of the débris."

A highly technical report.

105. Hydraulic mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Bulletins 264 and 298 discuss the importance of accurate well records to the driller, to owners of oil, gas, and water wells, and to the geologist; describe the general methods of work; give tabulated records of wells by States, and detailed records selected as affording valuable stratigraphic information.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller, 1908. 44 pp. 10c.

Describes underground reservoirs, the sources of underground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

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