DEPARTMENT OF THE INTERIOR
JOHN BARTON PAYNE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

WATER-SUPPLY PAPER 474

SURFACE WATER SUPPLY OF THE UNITED STATES

1918

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 the
STATES OF WISCONSIN, NEW YORK, AND VERMONT

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SURFACE WATER SUPPLY OF ST. LAWRENCE RIVER BASIN, 1918.

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, 1918.

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 1886 in connection with special studies relating to irrigation in the arid west. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

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

Annual appropriations for the fiscal years ended June 30, 1895-1919.

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
1918	175,000
1919	148,244.10

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

Measurements of stream flow have been made at about 4,500 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1918, 1,180 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, miners' inches, and discharge in second-feet per square mile, and (2) those that represent the actual quantity of water, as run-off in depth in inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

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

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

"Run-off (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 in inches.

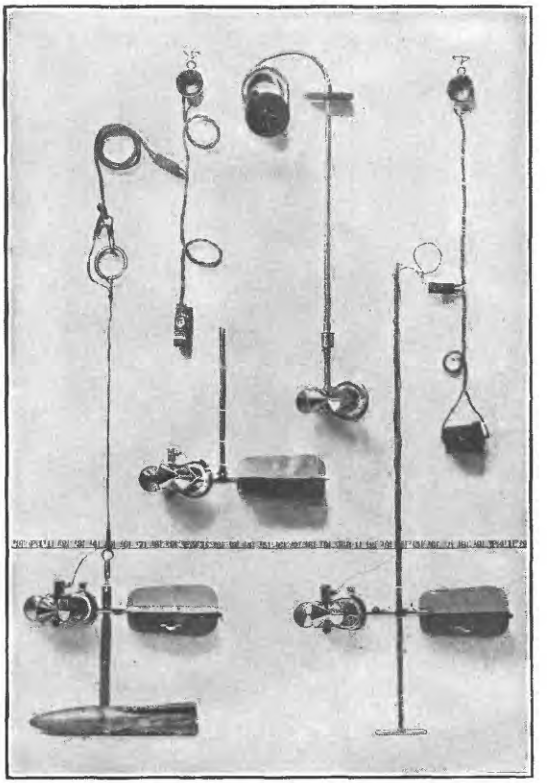
An "acre-foot," equivalent to 43,560 cubic feet, is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation.

The following terms not in common use are here defined:

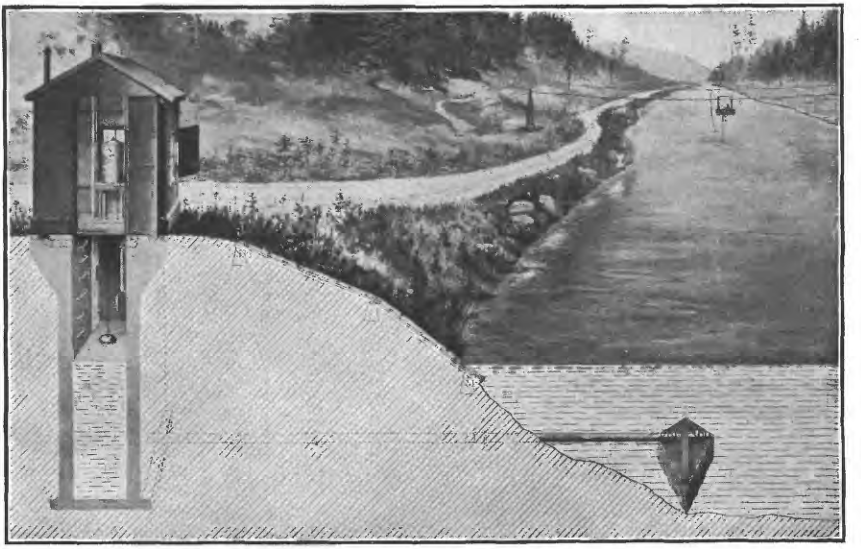
"Stage-discharge relation," an abbreviation for the term "relation of gage height to discharge."

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

The "point of zero flow" for a given 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.



A. PRICE CURRENT METERS.



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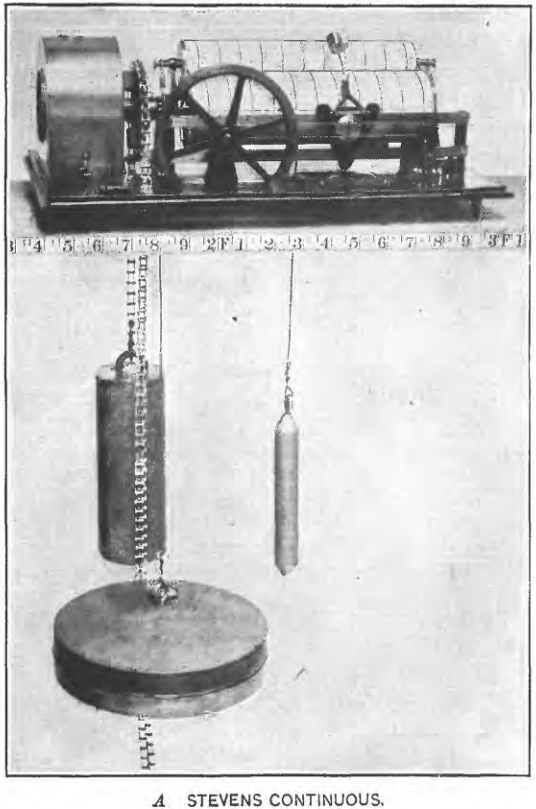

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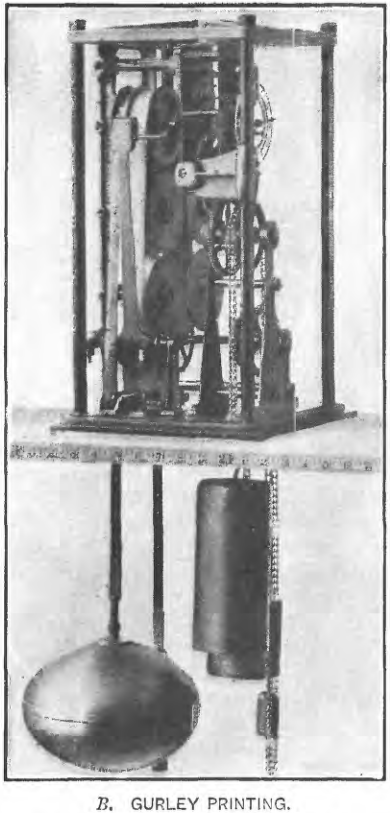
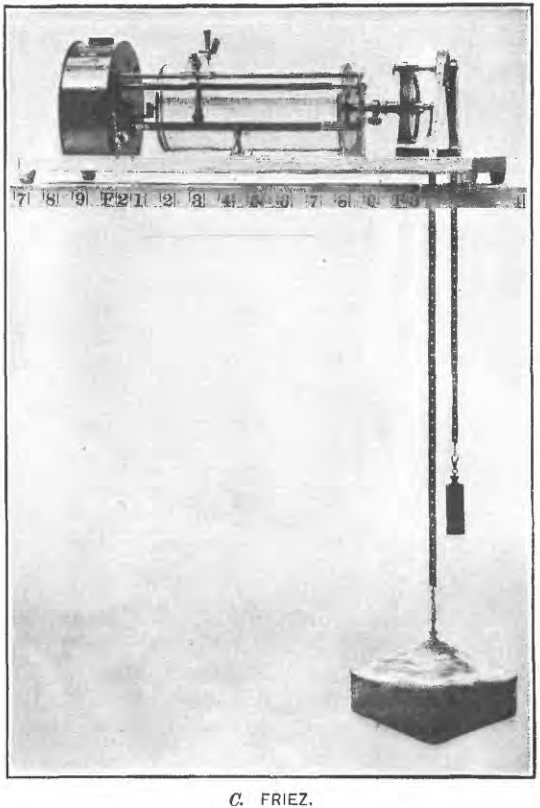


B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1917, and ending September 30, 1918. At the beginning of January in most parts of the United States much of the precipitation in the preceding three months is stored as ground water in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

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

From the discharge measurements rating tables are prepared that give the discharge for any stage, and these rating tables, when applied to gage heights, give the discharge from which the daily, monthly, and yearly mean discharge is determined.

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

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

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

The table of daily discharge gives, in general, the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage height may not be the true mean discharge for the

day. If such stations are equipped with water-stage recorders the mean daily discharge may be obtained by averaging discharge at regular intervals during the day, or by using the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column headed "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet 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 permanence of the discharge relation and (2) on the accuracy of observation of stage, measurements of flow and interpretation of records.

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

For the rating tables "well defined" indicates, in general, that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

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

[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.

streams drainage 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 Wisconsin during the year ending September 30, 1918, 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 Daniel, general manager (Menominee River below Koss, Mich.); Corps of Engineers, United States Army (Wolf River at New London, Fox River at Berlin, and Fox River at Rapide Croche dam); United States Indian Office (Wolf River at Keshena).

The station on Little Calumet River at Harvey, Ill., was maintained in cooperation with division of waterways of the Illinois Department of Public Works and Buildings, W. L. Sackett, director.

The gage reader for Huron River at Flat Rock, Mich., was paid by Gardner S. Williams.

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.

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

The water-stage recorder on Raquette River at Piercefield, N. Y., was inspected by an employee of the International Paper Co.

The work in Vermont has been carried on in cooperation with the State of Vermont, Horace F. Graham, governor, and Herbert M. McIntosh, State engineer, and at certain stations in cooperation with the following organizations and individuals: Vermont Marble Co. (Otter Creek at Middlebury); the department of civil engineering of Norwich University (Dog River at Northfield); Newport Electric Light Co. (Clyde River at West Derby).

DIVISION OF WORK.

The data for stations in the Lake Superior and Lake Michigan drainage basins in Wisconsin and Illinois were collected and prepared for publication under the direction of W. G. Hoyt, district engineer, assisted by S. B. Soulé, H. C. Beckman, L. L. Smith, T. G. Bedford, A. M. Wahl, and H. S. Wahl.

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, J. W. Moulton, Max H. Carson, and W. A. James.

Data for stations in Vermont were collected and prepared for publication under the direction of C. H. Pierce, district engineer, assisted by O. W. Hartwell, H. W. Fear, M. R. Stackpole, J. W. Moulton, and Hope Hearn.

The manuscript was assembled by B. J. Peterson.

GAGING-STATION RECORDS.

STREAMS TRIBUTARY TO LAKE SUPERIOR.

BAD RIVER NEAR ODANAH, WIS.

LOCATION.—In sec. 25, T. 47 N., R. 3 W., 8 miles upstream from Odanah, Ashland County, 12 miles above mouth. 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, 1918.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.61 feet at 9 p. m. June 1 (discharge 8,590 second-feet); minimum open-water stage 0.82 foot, afternoon of August 27, (discharge about 88 second-feet). Discharge during January and February may have been slightly less than 88 second-feet.

1914-1918: Maximum stage recorded 6.66 feet at 1 a. m., April 22, 1916 (discharge 12,200 second-feet); minimum stage recorded that of August 27, 1918.

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

REGULATION.—A number of small reservoirs are operated during the early spring and summer as an aid to log driving. During such periods the stage may fluctuate rapidly.

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 extended and may be subject to considerable error. Operation of water-stage

recorder satisfactory except during winter period. Daily discharge ascertained as follows: October 1–15, by use of discharge integrator; October 16 to December 2, and March 22 to September 30 by applying to rating table mean daily gage height obtained by planimeter from recorder graph, except April 18–20, which was interpolated; December 2 to March 21, determined, because of ice, from discharge measurements, and comparisons with records of flow in adjacent drainage basins. Open-water records good; winter records roughly approximate.

Discharge measurements of Bad River near Odanah, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20[a]	T. G. Bedford	1.60	123	Apr. 27[c]	T. G. Bedford	1.40	376
Jan. 21[b]	do	1.82	106	Aug. 34[d]	S. B. Soule	.88	116

[a] Made through complete ice cover at the gage section. Measured discharge probably too low because of low velocity in measuring section.
[b] Complete ice cover at control and measuring section.
[c] Made at cable section; a few logs lodged on control.
[d] Made by wading.

Daily discharge, in second-feet, of Bad River near Odanah, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	280	649	305				1590	1250	6960	183	139	209
2	260	601	294				1460	1200	6340	177	129	188
3	250	568	275				1180	950	3730	172	116	167
4	240	542					1050	930	2520	188	120	153
5	230	518					990	750	1780	236	120	139
						100						
6	230	510					1010	800	1530	188	158	112
7	245	494					1120	750	1120	167	258	112
8	255	486					1150	840	930	144	264	100
9	270	470					970	820	1250	139	253	108
10	270	463					910	1470	1340	139	253	112
11	270	442					770	1850	990	134	253	129
12	270	421	190				712	1530	910	129	219	153
13	280	407					780	1430	658	125	264	193
14	320	407					730	1130	577	129	299	183
15	350	400			100		780	1050	394	134	253	167
16	435	380		110		440	810	980	368	134	214	153
17	526	380					900	990	342	144	183	158
18	940	368					900	850	269	139	158	158
19	1590	368					900	1160	247	134	139	177
20	1660	329					900	1780	247	134	129	247
21	1590	361					900	1780	203	129	125	374
22	1370	348				1850	1050	1780	193	129	125	361
23	1160	348				1850	910	1920	183	129	116	305
24	1030	348				1850	890	1640	177	129	116	264
25	930	342				1660	790	1590	158	129	100	219
26	860	329	140			1400	685	2860	153	129	96	193
27	830	323				1240	435	3420	158	116	96	183
28	830	317				1250	486	2860	158	139	108	172
29	800	311			.....	1260	830	2360	148	172	153	153
30	760	311			.....	1140	1300	1780	153	158	158	139
31	694	.....			.....	1370	.....	2200	.....	153	198	.....

NOTE.—Stage-discharge relation affected by ice Dec. 3 to Mar. 21; discharge Apr. 18–20 interpolated. Braced figures show mean discharge for period included.

Monthly discharge of Bad River near Odanah, Wis., for the year ending Sept. 30, 1918.

[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	1,660	230	646	1.06	1.22
November	649	311	418	.689	.77
December			182	.300	.35
January			110	.181	.21
February			100	.165	.17
March			668	1.10	1.27
April	1,590	435	950	1.53	1.71
May	3,420	750	1,510	2.49	2.87
June	6,960	148	1,140	1.88	2.10
July	236	116	148	.244	.28
August	299	96	171	.282	.33
September	374	100	183	.301	.34
The year	6,960		519	.855	11.62

MONTREAL RIVER AT IRONWOOD, MICH.

LOCATION.—At main highway bridge on State line between Hurley, Wis., and Ironwood, Mich., about 8 miles upstream from junction of West Branch, and 22 miles above mouth of river.

DRAINAGE AREA.—About 73 square miles (measured on Hixon's County Atlas; scale, 1 inch = 6 miles).

RECORDS AVAILABLE.—April 24 to September 30, 1918.

GAGE.—Chain gage fastened to downstream side of highway bridge, read by W. A. Markert.

DISCHARGE MEASUREMENTS.—Made from wooden bridge at lumber mill, one-fourth mile above gage, or by wading.

CHANNEL AND CONTROL.—Bed at and downstream from gage fairly heavy gravel; fairly permanent. Concrete retaining walls on both sides of the river below the gage prevent overflow at flood stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 3.1 feet, June 2 (discharge, about 455 second-feet); minimum stage recorded, 0.71 foot July 23 (discharge, about 2.9 second-feet).

REGULATION.—Water stored in Pine Lake, in secs. 28, 29, 32, and 33, T. 44 N., R. 3 E., is used to increase the water supply for Ironwood and Hurley during periods of low flow; effect of this regulation on flow at station probably slight.

ACCURACY.—Stage-discharge relation assumed fairly permanent except as affected by ice during winter months. Rating curve poorly defined below 275 second-feet, and extended above. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table. Records probably fair.

Discharge measurements of Montreal River at Ironwood, Mich., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 24	W. G. Hoyt	1.68	74
June 8	T. G. Bedford	2.04	150
Aug. 23	S. B. Soulé	.94	6.4

Daily discharge, in second-feet, of Montreal River at Ironwood, Mich., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	106	425	152	6.1	14	16	.....	82	40	8.3	13	20
2	.....	115	455	14	7.8	14	17	.....	96	16	12	13	23
3	.....	100	335	13	6.6	13	18	.....	65	48	16	12	22
4	.....	89	191	15	6.1	13	19	.....	111	6.4	14	6.1	29
5	.....	89	204	19	6.6	3.9	20	.....	232	12	14	5.4	64
6	.....	78	133	13	8.3	7.5	21	.....	152	10	9.9	8.0	59
7	.....	204	65	14	7.8	8.3	22	.....	165	10	11	8.6	24
8	.....	204	152	11	14	7.8	23	.....	152	5.8	3.2	8.0	42
9	.....	204	96	9.9	16	7.8	24	76	122	7.5	4.4	8.3	14
0	.....	218	91	9.5	18	14	25	70	191	4.0	4.0	8.0	19
11	.....	275	113	8.3	14	2.9	26	62	365	6.1	4.4	8.3	16
12	.....	165	41	7.2	13	19	27	56	365	7.2	4.5	7.5	13
3	.....	85	59	6.6	18	35	28	58	350	7.5	4.4	9.9	13
14	.....	65	64	6.6	30	26	29	191	410	16	4.5	7.5	9.5
15	.....	94	43	8.6	13	26	30	178	335	16	4.4	24	9.0
							31	.....	260	.....	4.7	17	.....

NOTE.—Gage not read May 30 and Sept. 12; discharge interpolated.

Monthly discharge of Montreal River at Ironwood, Mich., for the year ending Sept. 30, 1918.

[Drainage area, 73 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
April 24–30	191	56	98.7	1.35	0.35
May	410	65	179.	2.45	2.82
June	455	4.0	89.3	1.22	1.36
July	152	3.2	13.9	.190	.22
August	30	5.4	11.3	.155	.18
September	64	2.9	19.6	.268	.30

WEST BRANCH OF MONTREAL RIVER AT GILE, WIS.

LOCATION.—In sec. 27, T. 46 N., R. 2 E., 800 feet upstream from highway bridge at Gile, Iron County, 2½ miles southwest of Hurley, Wis., and 4 miles upstream from junction of East and West branches.

DRAINAGE AREA.—About 70 square miles (measured on Hixon's County Atlas; scale, 1 inch=2 miles).

RECORDS AVAILABLE.—April 26 to September 30, 1918.

GAGE.—Standard sloping gage bolted to rock ledge on left bank of river, a few hundred feet upstream from pump house of Ottawa mine; read by Lyle Slender.

DISCHARGE MEASUREMENTS.—Made from downstream side of highway bridge 800 feet below gage or by wading.

CHANNEL AND CONTROL.—Control formed by permanent rock ledge across narrow section of stream about 15 feet below gage; fall at control about 4 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 5.65 feet, June 28 (discharge, about 377 second-feet); minimum stage recorded, 1.32 feet July 23 (discharge, 2.4 second-feet).

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined below 200 second-feet; extended above 200 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table. Records good for days when gage was read; records of discharge obtained by interpolation subject to error.

Discharge measurements of West Branch of Montreal River at Gile, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 25..	W. G. Hoyt	3.46	87	Aug. 23..	S. B. Soulé	1.57	5.3
June 8...	T. G. Bedford	4.25	161	23..	....do	1.57	5.4

Daily discharge, in second-feet, of West Branch of Montreal River at Gile, Wis., for the year ending Sept. 30, 1918.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	184	368	24	2.4	11	16	.....	131	46	3.7	11	19
2	.....	158	359	21	2.5	11	17	.....	112	38	3.7	9.4	18
3	.....	136	350	21	2.5	11	18	.....	104	54	3.3	8.8	36
4	.....	122	334	22	2.5	14	19	.....	144	48	3.1	8.3	19
5	.....	115	270	22	2.5	14	20	.....	184	41	3.0	5.0	36
6	.....	108	240	20	4.0	14	21	.....	198	32	2.8	4.0	54
7	.....	117	212	16	7.0	15	22	.....	198	30	2.6	4.8	48
8	.....	117	158	11	12	13	23	.....	226	31	2.4	4.8	41
9	.....	150	147	9.9	14	11	24	.....	198	31	2.8	5.1	34
10	.....	184	136	8.3	14	11	25	.....	198	32	2.6	4.2	28
11	.....	212	122	5.9	14	12	26	72	274	32	2.6	3.3	30
12	.....	191	104	5.6	14	18	27	65	350	29	2.5	3.6	26
13	.....	170	82	4.8	13	23	28	100	368	25	2.9	3.7	22
14	.....	136	65	4.4	14	22	29	146	334	21	3.3	5.9	20
15	.....	122	54	4.0	14	20	30	184	302	22	3.3	11	19
							31	.....	270	.....	3.4	11	.....

NOTE.—Gage not read Apr. 28, May 5, 9, 12, 19, 26, June 2, 9, 16, 23, 24, 30, July 3, 7, 14, 21, 28, Aug. 4, 11, 18, 25, 31, Sept. 1, 2, 8, 12, 15, 22, and 29; discharge interpolated.

Monthly discharge of West Branch of Montreal River at Gile, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 70 square miles].

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area.)
	Maximum.	Minimum.	Mean.	Per square mile.	
April 26-30	184	65	113	1 61	0.30
May	368	104	188	2.69	3.10
June	368	21	117	1.67	1.86
July	24	2.4	8.0	.114	.13
August	14	2.4	7.6	.109	.13
September	54	11	22.3	.319	.36

STREAMS TRIBUTARY TO LAKE MICHIGAN.

MENOMINEE RIVER BELOW KOSS, MICH.

LOCATION.—In sec. 5, T. 33 N., R. 23 E., at "Grand Rapids," about 4 miles below Koss, Menominee County, 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, 1918.

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 determined from computed tables. The sum of the hourly discharge 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, 15,000 second-feet May 30; minimum daily discharge, 1,160 second-feet February 3.

1913–1918: Maximum daily discharge recorded, 23,200 second-feet, April 23 and 25, 1916; minimum daily discharge recorded, 1,000 second-feet, June 14, 1914.

REGULATION.—Above the station are the following power plants: Sturgeon Falls, owned by Pennsylvania Iron Mining Co., 50 miles; Little Quinnesec, owned by Kimberly Clark Co., 57 miles; Upper Quinnesec, owned by Oliver Iron Mining Co., 62 miles; Twin Falls, owned by Peninsular Power Co. With the exception of the Kimberly Clark dam at Little Quinnesec, the dams furnish power for utility and mining uses so that the flow past the dams is comparatively uniform. The Kimberly Clark dam is used for paper mills and regulates the flow on Sundays and holidays. The effect of this regulation is noticeable at the station generally on Tuesdays. The monthly flow probably represents the natural flow.

ACCURACY.—No measurements have been made by the Survey engineers at this plant, but measurements made at Koss, Mich., in 1914, show a close comparison 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, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,430	4,100	2,140	1,420	1,520	1,680	6,300	5,260	11,600	1,970	1,900	2,340
2	2,280	3,540	2,200	1,590	1,420	1,700	6,470	5,340	11,600	2,270	2,010	3,140
3	2,270	3,330	2,220	1,480	1,160	1,540	5,560	5,370	10,500	2,580	1,960	2,220
4	2,230	3,140	2,120	1,550	1,480	1,630	5,200	4,730	10,500	3,040	1,850	2,790
5	2,270	3,300	1,880	1,600	1,460	1,720	4,830	4,250	10,000	3,040	1,840	3,260
6	2,370	3,090	1,840	1,420	1,420	1,840	4,680	3,900	8,940	2,850	2,000	3,340
7	2,550	3,220	2,030	1,620	1,470	1,910	4,280	4,740	7,860	2,660	2,270	3,360
8	2,620	3,210	2,110	1,470	1,500	1,910	3,840	4,720	7,490	2,760	2,840	2,960
9	2,160	3,120	1,920	1,400	1,420	1,630	4,100	4,660	6,480	2,660	3,560	3,100
10	2,360	3,320	1,720	1,600	1,310	1,750	4,080	5,540	5,940	2,210	4,650	2,180
11	2,510	2,900	1,280	1,680	1,520	1,710	4,060	6,190	5,130	2,110	5,460	2,290
12	2,440	2,780	1,780	1,420	1,400	1,500	3,880	6,810	4,970	2,110	5,430	2,410
13	2,570	2,520	1,630	1,720	1,550	1,610	3,210	6,360	4,640	1,980	4,000	2,780
14	2,900	2,840	1,170	1,560	1,540	1,700	3,580	5,970	3,970	1,970	3,840	2,770
15	2,560	2,880	1,380	1,680	1,310	1,670	2,940	5,520	3,820	1,700	3,310	3,030
16	2,500	2,990	1,160	1,640	1,440	1,670	3,210	5,090	3,500	1,850	3,220	2,870
17	2,680	2,810	1,370	1,640	1,310	1,750	3,610	4,970	3,210	2,070	3,260	2,440
18	3,110	2,380	1,320	1,420	1,440	1,840	3,840	4,970	3,430	2,020	2,600	2,590
19	3,210	2,680	1,380	1,540	1,380	2,060	4,050	4,920	3,400	1,850	2,720	2,870
20	4,070	2,710	1,460	1,600	1,460	2,820	4,050	5,570	2,210	1,770	2,350	3,550
21	5,270	2,960	1,710	1,450	1,320	3,380	4,140	6,760	2,550	1,750	1,880	4,050
22	5,220	3,020	1,690	1,590	1,350	4,490	3,870	6,740	2,340	1,810	1,970	4,220
23	4,280	2,900	1,590	1,440	1,370	5,940	4,350	6,830	2,360	1,710	2,400	4,560
24	4,170	2,890	1,740	1,720	1,330	6,230	4,120	6,020	2,130	2,070	2,570	3,890
25	4,270	2,950	1,810	1,550	1,640	7,180	3,990	6,010	1,820	2,000	2,640	3,970
26	4,100	2,040	1,760	1,550	1,590	7,850	3,580	7,130	1,960	2,460	1,790	3,830
27	3,990	1,660	1,270	1,330	1,600	7,740	3,430	7,850	1,980	2,260	1,830	3,390
28	4,000	2,500	1,460	1,520	1,660	7,500	3,320	10,800	2,110	1,960	1,700	3,300
29	3,890	2,340	1,500	1,390	.....	8,030	3,240	11,600	2,050	2,420	2,190	2,950
30	4,220	2,050	1,460	1,520	.....	8,620	4,480	15,000	2,080	1,970	2,300	2,680
31	4,050	.....	1,440	1,600	.....	7,300	.....	11,700	.....	1,900	2,420	.....

Monthly discharge of Menominee River below Koss, Mich., for the year ending Sept. 30, 1918.

[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	5,270	2,160	3,210	0.847	0.98
November	4,100	1,660	2,870	.757	.84
December	2,220	1,160	1,660	.438	.50
January	1,720	1,330	1,540	.406	.47
February	1,660	1,160	1,440	.380	.40
March	8,620	1,500	3,550	.937	1.08
April	6,470	2,940	4,140	1.09	1.22
May	15,000	3,900	6,490	1.71	1.97
June	11,600	1,820	5,020	1.32	1.47
July	3,040	1,710	2,190	.578	.67
August	5,460	1,700	2,730	.720	.83
September	4,560	2,180	3,100	.818	.91
The year	15,000	1,160	3,170	.836	11.34

NOTE.—Monthly and yearly discharge computed by U. S. Geological Survey from daily discharge records furnished by the Menominee & Marinette Light & Traction Co.

PINE RIVER NEAR FLORENCE, WIS.

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

DRAINAGE AREA.—488 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, 1918.

GAGE.—Chain gage fastened to guardrail 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 subjcet to overflow; extremely high water may overflow right bank around approach to bridge.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.80 feet May 30, 31, and June 1 (discharge, 1,720 second-feet; minimum recorded stage 1.50 feet July 18–20 (discharge, about 160 second-feet).

1914–1918: Maximum recorded stage, 9.25 feet at noon, April 23, 1916, (discharge approximately 4,520 second-feet); minimum recorded stage 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 250 and 1,840 second-feet; extension of curve below 250 and above 1,840 second-feet may be subject to considerable error. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage height 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. Records fair.

Discharge measurements of Pine River near Florence, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Dec. 17[a]	L. L. Smith	2.59	171
Jan. 16[a]	do	2.91	174
Apr. 22	T. G. Bedford	2.48	400

[a] Complete ice cover at control and measuring section.

Monthly discharge, in second-feet, of Pine River near Florence, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	352	552					930	541	1720	292	198	575
2	319	518					890	507	1620	266	198	575
3	319	451			180		575	490	1570	266	198	541
4	319	385					507	507	1520	266	198	507
5	287	352					473	541	1340	266	198	439
6	287	352					439	575	1250	242	242	405
7	319	354					439	575	1090	220	318	374
8	319	336	195			300	422	610	930	220	610	346
9	319	319					405	680	890	220	890	346
10	352	319					405	750	820	209	1,090	318
11	352	287					405	820	758	198	970	305
12	368	287					405	785	750	198	930	292
13	368	287					405	785	715	188	855	292
14	385	287					374	785	680	178	715	292
15	385	287					374	750	680	178	575	292
16	418	287		175			374	715	575	178	507	292
17	484	272			195		405	715	541	169	374	318
18	552	256					405	785	507	160	374	346
19	905	256					422	785	473	160	374	405
20	905						439	820	439	160	346	473
21	905						439	855	374	178	318	541
22	869						439	890	292	198	292	507
23	833						439	930	292	220	266	473
24	833		170			760	473	1010	266	220	266	439
25	833	230					473	1210	266	242	266	439
26	797						473	1250	242	242	266	405
27	797						490	1250	242	242	292	374
28	725						507	1340	242	220	374	374
29	690				.....		507	1470	266	220	645	374
30	655				.....		541	1720	292	220	645	346
31	620	.....			.....	.....	.....	1720	.....	209	610	.....

NOTE.—Stage-discharge relation affected by ice Nov. 20 to Mar. 31. Braced figures show mean discharge for period included.

Monthly discharge of Pine River near Florence, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 488 square miles.[a]]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	905	287	544	1.11	1.28
November	552	.....	299	.613	.68
December	.....	.....	182	.373	.43
January	.....	.....	175	.359	.41
February	.....	.....	192	.393	.41
March	.....	.....	537	1.10	1.27
April	930	374	476	.975	1.09
May	1,720	490	876	1.80	2.08
June	1,720	242	722	1.48	1.65
July	292	160	214	.439	.51
August	1090	198	465	.953	1.10
September	575	292	400	.820	.91
The year	1720	.....	425	.871	11.82

[a] Revised since publication of 1916 report, on the assumption that Kentuck Lake discharges into Brule River instead of into Pine River.

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 two branches of 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, 1918.

GAGE.—Chain gage fastened to guardrail on upstream side of bridge; 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, 3.85 feet at 7.10 a. m., May 28 (discharge 841 second-feet); minimum discharge estimated 70 second-feet December 9–11, 30 and 31.

1914–1918: Maximum stage recorded, 4.65 feet at 8.10 p. m., July 14, 1914 (discharge, 1,200 second-feet); minimum open-water stage recorded, 1.55 feet September 7, 1915 (discharge 109 second-feet). Minimum discharge for winter periods estimated 70 second-feet December 9–11, 30, and 31, 1917.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except when affected by ice. Rating curve well defined between 180 and 1,120 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table or for periods in which stage-discharge relation was affected by ice, from discharge measurements, observer's notes, and weather records. Open-water records good, except for extremely low stages, for which they are fair. Winter records fair.

Discharge measurements of Pike River at Amberg, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 18[a]	L. L. Smith	1.73	112	Feb. 20[a]	L. L. Smith	2.14	101
Jan. 15[a]	do	1.97	117	Apr. 20	T. G. Bedford	2.36	294

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Pike River at Amberg, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	158	258	140	80	80	150	364	510	738	204	154	199
2	158	244	120	100	80	160	364	476	738	217	148	185
3	158	348	110	140	90	170	348	412	658	204	142	230
4	158	204	100	160	90	170	333	348	620	204	138	244
5	158	204	90	160	100	160	310	348	546	204	138	230
6	162	204	80	150	110	150	288	318	428	185	204	217
7	169	204	80	150	110	140	303	348	396	169	288	204
8	162	204	80	140	120	140	318	348	348	158	364	192
9	158	185	70	140	120	140	310	396	318	148	510	180
10	169	180	70	130	120	150	303	582	318	142	698	158
11	169	185	70	130	120	160	296	658	288	138	582	192
12	180	192	80	120	110	160	288	658	273	134	476	258
13	185	185	80	120	110	170	266	582	244	128	364	273
14	185	185	80	120	110	170	244	476	230	122	303	258
15	192	185	90	120	110	170	244	396	230	128	258	230
16	180	185	100	120	100	180	244	364	217	154	230	217
17	192	180	100	110	100	205	303	333	204	154	199	192
18	244	180	110	110	100	230	333	333	204	142	192	244
19	230	180	110	110	100	290	318	364	192	138	169	288
20	244	180	120	110	100	350	318	380	180	128	158	333
21	230	185	120	100	110	410	318	348	180	118	142	318
22	230	192	110	100	120	550	318	364	169	118	230	318
23	230	185	110	100	130	700	318	364	169	154	230	303
24	230	180	100	100	140	780	318	348	169	169	288	258
25	204	169	100	100	160	698	303	396	162	192	258	230
26	204	158	90	90	160	604	288	658	158	192	230	217
27	258	155	90	90	160	510	258	738	169	180	204	204
28	288	150	80	90	160	453	288	820	176	176	192	180
29	288	145	80	80	.....	396	412	820	162	204	217	169
30	273	140	70	80	.....	380	546	820	158	192	230	169
31	258	.....	70	80	.....	364	.....	738	.....	176	204	.....

NOTE.—Stage-discharge relation affected by ice Nov. 27 to Mar. 24. Gage not read on every alternate day, Mar. 26 to Apr. 15; discharge interpolated.

Monthly discharge of Pike River at Amberg, Wis., for the year ending Sept. 30, 1918.

[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	288	158	203	0.846	0.98
November	348	140	191	.796	.89
December	140	70	93.5	.390	.45
January	160	80	114	.475	.55
February	160	80	115	.479	.50
March	780	140	305	1.27	1.46
April	546	244	315	1.31	1.46
May	820	318	485	2.02	2.33
June	738	158	301	1.25	1.40
July	217	118	164	.683	.79
August	698	138	263	1.10	1.27
September	333	158	230	.958	1.07
The year	820	70	232	.967	13.15

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 right), and 15 miles by road northwest of Crivitz.

DRAINAGE AREA.—520 [1] 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, 1918.

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. About 2 second-feet of seepage water enters the river below the gage but above the cable and is included in the determined discharge as published.

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

EXTREMES OF DISCHARGE.—Maximum mean daily discharge during the year, May 31, 2,140 second-feet. Minimum mean discharge 110 second-feet February 10.

1912–1918: 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 reservior, ice does not form on the river in the vicinity of the gage. Open-water rating curve used throughout year.

REGULATION.—Flow controlled by operation of the power plant. Considerable diurnal fluctuation caused by the operation of the power plant and during log-driving season by the manipulation of the gates. The mean monthly flow does not represent the natural flow because of storage in the service reservoir.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined between 145 and 3,980 second-feet. Daily discharge for periods when recording gage was in operation ascertained by averaging the results obtained by applying gage height for hourly or other regular interval to the rating table; discharge for periods when gage was not in operation (see footnote to table of daily discharge) obtained by adding 10 per cent to discharge indicated by records of power plant. Correction determined by study of records available from water-stage recorder. Records fair.

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

[1] Revised since publication of Water-Supply Paper 434.

Daily discharge, in second-feet, of Peshtigo River at High Falls, near Crivitz, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	456	399	464	116	292	236	622	708	1,800	660	456	440
2	462	418	179	288	274	288	657	583	1,360	615	485	335
3	455	496	410	316	170	216	670	569	2,060	475	435	720
4	380	236	424	342	252	262	573	590	1,630	169	310	735
5	355	484	460	338	346	287	656	381	1,310	347	565	700
6	330	428	399	127	402	445	667	580	988	373	650	590
7	124	451	388	309	282	318	410	697	1,210	230	680	600
8	380	418	527	344	236	375	650	685	956	477	620	290
9	354	399	292	339	245	388	680	711	613	455	525	575
10	370	407	415	348	110	174	678	661	940	422	445	775
11	327	202	435	322	214	348	667	727	782	370	208	700
12	337	448	467	258	292	373	670	283	770	389	500	722
13	347	425	428	124	266	438	662	1,490	765	395	564	670
14	172	436	461	276	374	460	393	1,210	790	162	550	530
15	364	444	410	265	271	520	595	1,140	720	376	535	187
16	406	450	174	241	330	537	695	922	380	482	500	506
17	435	428	382	228	177	344	700	860	722	479	329	600
18	407	240	424	295	243	444	697	766	824	544	215	570
19	430	462	423	228	253	457	720	380	770	535	400	531
20	364	455	384	116	253	522	705	1,180	800	433	365	540
21	186	480	368	211	270	607	355	785	865	256	413	533
22	448	464	321	224	288	660	685	784	800	529	395	202
23	415	460	139	330	202	752	674	905	415	562	400	535
24	343	462	171	295	137	423	731	1,160	690	535	410	690
25	322	173	119	314	212	650	683	1,040	760	413	318	710
26	375	407	413	299	248	685	666	320	760	470	537	620
27	346	467	378	184	208	694	694	1,270	760	436	650	660
28	181	419	417	240	231	677	394	1,300	780	196	716	512
29	430	185	410	338	.....	680	634	2,060	680	512	776	207
30	406	428	120	298	.....	669	692	1,790	390	476	749	513
31	415	.....	234	268	.....	375	.....	2,140	.....	449	773	.....

NOTE.—Records for following periods obtained from water-stage recorder: Oct. 5–7, 12, 13, 19, 20, 26, Nov. 2–7, Apr. 15–22, May 2–10, 26, June 2, 9–15, 19–22, 24–30, July 1–3, 7–12, Aug. 1–9, 12–23, Sept. 1–13 and 24–27. Daily discharge for other periods determined from records of power plant, as noted in paragraph under "Accuracy."

Monthly discharge of Peshtigo River at High Falls, near Crivitz, Wis., for the year ending Sept. 30, 1918.

[Drainage are, 520 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	462	124	359	0.690	0.80
November	496	173	402	.773	.86
December	527	119	356	.685	.79
January	348	116	265	.510	.59
February	402	110	253	.487	.51
March	752	174	461	.887	1.02
April	731	355	632	1.22	1.36
May	2,140	283	925	1.78	2.05
June	2,060	380	903	1.74	1.94
July	660	162	427	.821	.95
August	776	208	499	.960	1.11
September	775	187	550	1.06	1.18
The year	2,140	110	503	.967	13.16

OCONTO RIVER NEAR GILLETT, WIS.

LOCATION.—In sec. 34, T. 28 N., R. 18 E., at 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, 1918.

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, 1918, is 4 feet above that of gage used June 7, 1906, to March 31, 1909.

DISCHARGE MEASUREMENTS.—Made from upstream side of bridge to which gage is fastened.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.45 feet at 3.30 p. m., May 30 (discharge, 2,510 second-feet); minimum discharge 230 second-feet, February 6–9.

1906–1918: Maximum stage recorded, 5.3 feet at 3.30 p. m., April 25, 1916 (discharge, 3,220 second-feet); 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 as affected by ice. Rating curve well defined between 239 and 1,790 second-feet. Gage read to quarter-tenths once daily. Daily discharge obtained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good except at highest flood stages, for which they are only fair; winter records fair.

Discharge measurements of Oconto River near Gillett, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 19[a]	L. L. Smith	2.33	339	Feb. 21[a]	L. L. Smith	3.10	295
Jan. 17[a]	do	2.64	342	Apr. 19	T. G. Bedford	2.16	845

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	446	670	340	295	270	305	992	1,020	2,320	468	515	468
2	446	670	330	300	260	305	960	960	2,090	468	515	492
3	446	670	320	300	250	305	1,020	1,020	1,940	540	468	468
4	468	670	310	300	240	305	992	1,160	1,720	565	382	424
5	446	642	305	305	240	305	1,020	930	1,570	590	424	424
6	424	615	300	305	230	310	780	930	1,640	615	424	446
7	424	565	290	310	230	325	1,290	1,090	1,430	590	424	446
8	424	565	290	310	230	320	780	1,290	1,290	590	424	424
9	446	565	280	315	230	320	870	1,430	1,020	468	446	446
10	468	565	270	320	235	320	810	1,290	992	515	468	492
11	468	565	270	320	240	330	752	1,360	1,290	492	565	492
12	468	565	270	325	240	340	698	1,860	960	515	565	515
13	468	540	270	325	260	350	698	2,020	960	492	565	540
14	468	540	270	335	270	360	698	1,860	780	468	540	565
15	468	515	270	340	280	370	725	1,720	725	424	515	515
16	468	515	280	340	280	390	698	1,640	615	424	468	468
17	468	565	290	340	260	410	780	1,430	615	424	468	492
18	468	492	320	330	240	440	840	1,720	615	492	590	515
19	468	515	340	320	260	460	900	1,790	590	515	515	540
20	515	492	330	310	270	470	810	1,640	565	515	468	540
21	515	492	325	305	290	615	780	1,500	382	492	446	515
22	515	515	325	305	290	1,020	810	1,430	382	492	424	515
23	515	515	320	305	300	2,020	870	1,430	342	468	446	540
24	515	492	310	305	300	2,390	870	1,290	424	446	403	565
25	515	424	305	305	305	2,090	900	1,500	468	468	403	540
26	540	403	305	305	310	2,020	960	1,860	492	492	446	565
27	565	390	305	305	320	1,870	1,360	2,090	492	515	446	515
29	615	380	305	300	325	1,720	840	2,160	468	540	492	492
29	565	360	300	290	.....	1,720	870	2,470	468	515	565	492
30	590	340	290	290	.....	1,290	810	2,470	615	515	540	492
31	590	.....	290	290	.....	1,020	.....	2,320	.....	515	515	.....

NOTE.—Stage-discharge relation affected by ice Nov. 27 to Mar. 25. Gage not read Mar. 27; discharge interpolated.

Monthly discharge of Oconto River near Gillett, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 678 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	615	424	490	0.723	0.83
November	670	340	527	.777	.87
December	340	270	301	.444	.51
January	340	290	311	.459	.53
February	325	230	266	.392	.41
March	2,390	305	800	1.18	1.36
April	1,360	698	873	1.29	1.44
May	2,470	930	1,570	2.32	2.68
June	2,320	342	942	1.39	1 55
July	615	424	504	.743	.86
August	590	382	480	.708	.82
September	565	424	498	.735	.82
The year	2,470	230	632	.932	12.68

FOX RIVER AT BERLIN, WIS.

LOCATION.—In sec. 16, T. 17 N., R. 13 E., at government lock and dam about 2⅓ mile upstream from Berlin, Green Lake County.

DRAINAGE AREA.—1,430 square miles (measured on map issued by the Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—1898 to September 30, 1918 (publication of records prior to Sept. 30, 1917, is held up pending collection of data relative to effect of ice on stage-discharge relation).

GAGE.—Staff gage located in pool immediately below the dam. Read by United States Army Engineer.

CHANNEL AND CONTROL.—Sand and gravel, one channel at all stages. Both banks low and subject to overflow.

DISCHARGE MEASUREMENTS.—Made from downstream side of Huron Street highway bridge in city of Berlin about 2⅓ miles downstream from gage. Rating curves for gage corrected for small inflow between the gage and measuring section.

EXTREMES OF DISCHARGE.—Maximum mean daily discharge recorded during year, 6,050 second-feet, March 21–23; minimum mean daily discharge 480 second-feet January 1–3.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation practically permanent except for effect of ice. Rating curve well defined between 800 and 6,000 second-feet. Gage read three times daily, but generally noon reading alone is used in determination of daily discharge. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained from results of one discharge measurement and observer's notes. Open-water records good; winter records roughly approximate.

COOPERATION.—Records have been collected and computations of daily discharge made by United States Army Engineers. Open-water records obtained from rating curves based on discharge measurements made by United States Geological Survey.

Discharge measurements of Fox River at Berlin, Wis., during the period June 1, 1917, to Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1917.		*Feet.*	*Sec.-ft.*	1917.		*Feet.*	*Sec.-ft.*
June 7	R. B. Kilgore	10.37	1,950	Nov. 7	R. B. Kilgore	10.17	1,780
14	Kilgore and Kane	11.27	2,460	1918.			
July 25	....do	9.83	1,600	Jan. 18	Hoyt and Grover	[a] 8.75	609
Aug. 1	Hoyt and Kane	8.97	1,210	Mar. 28	W. G. Hoyt	13.92	5,080
28	Kilgore and Welsch	8.10	824	Apr. 5	T. G. Bedford	11.86	2,940

[a] Stage-discharge relation affected by ice; ice cover, 13 inches thick.

NOTE.—Discharge measured at Huron Street highway bridge. Discharge at gage obtained by applying a correction factor of 0.993 to the figures shown in the above table.

Daily discharge, in second-feet, of Fox River at Berlin, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	940	1,460	940	480	700	940	3,920	1,800	3,080	940	735	675
2	905	1,460	905	480	700	980	3,620	1,740	3,000	975	765	675
3	905	1,520	865	480	700	1,060	3,350	1,740	2,910	905	735	675
4	905	1,570	865	510	740	1,200	3,170	1,680	2,830	905	735	615
5	905	1,680	765	510	700	1,350	3,000	1,570	2,670	975	765	615
6	905	1,850	800	540	660	1,600	2,830	1,460	2,600	940	735	615
7	905	1,800	700	540	660	1,800	2,750	1,420	2,520	940	675	645
8	830	1,740	700	540	700	2,000	2,670	1,320	2,380	905	735	590
9	865	1,680	800	540	700	2,200	2,520	1,270	2,310	865	735	590
10	865	1,620	800	540	740	2,200	2,450	1,740	2,240	800	765	590
11	865	1,570	800	570	740	2,200	2,310	1,910	2,170	800	735	645
12	865	1,460	800	570	740	2,300	2,170	2,040	2,040	800	765	645
13	865	1,420	750	600	740	2,500	2,100	2,100	1,910	800	735	645
14	865	1,360	800	600	780	2,700	1,980	2,100	1,850	765	705	645
15	865	1,320	800	600	780	2,900	1,850	2,040	1,680	800	765	645
16	865	1,270	800	600	780	3,100	1,740	1,910	1,520	800	705	645
17	865	1,220	800	600	780	3,340	1,620	1,850	1,420	765	735	645
18	865	1,180	800	600	780	3,700	1,570	2,040	1,320	765	735	675
19	905	1,140	840	630	780	4,420	1,520	2,240	1,220	765	735	645
20	940	1,140	840	630	820	5,790	1,420	2,830	1,180	765	675	645
21	905	1,140	840	630	820	6,050	1,460	2,450	1,140	735	645	645
22	905	1,100	840	630	820	6,050	1,680	3,530	1,100	735	645	645
23	975	1,060	880	630	820	6,050	1,740	4,120	1,020	735	675	675
24	975	1,020	880	630	820	5,920	1,740	4,020	975	675	675	675
25	1,020	1,020	880	630	860	5,920	1,800	3,820	940	765	645	645
26	1,100	1,020	750	660	900	5,520	1,800	3,530	905	800	675	645
27	1,220	975	750	660	900	5,270	1,740	3,440	865	765	645	615
28	1,270	975	700	660	940	5,030	1,680	3,350	905	735	645	645
29	1,360	975	750	660	.....	4,790	1,740	3,260	865	800	645	615
30	1,360	940	750	660	.....	4,560	1,800	3,170	905	800	675	615
31	1,420	.....	750	700	.....	4,230	.....	3,080	.....	735	675	.....

Monthly discharge of Fox River at Berlin, Wis., for the year ending Sept. 30, 1918.

[Drainage area 1,430 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,420	830	974	0.681	0.79
November	1,850	940	1,320	.923	1.03
December	940	700	805	.563	.65
January	700	480	591	.413	.48
February	940	660	771	.539	.56
March	6,050	940	3,470	2.43	2.80
April	3,920	1,420	2,190	1.53	1.71
May	4,120	1,270	2,410	1.69	1.95
June	3,080	865	1,750	1.22	1.36
July	975	675	815	.570	.66
August	765	645	707	.494	.57
September	675	590	640	.448	.50
The year	6,050	480	1,370	.958	13.06

FOX RIVER AT RAPIDE CROCHE DAM, NEAR WRIGHTSTOWN, WIS.

LOCATION.—At Rapide Croche dam, in sec. 4, T. 21 N., R. 19 E., about 2 miles upstream from Wrightstown, Brown County, 19 miles downstream from Lake Winnebago and 20 miles upstream from mouth of river at Green Bay.

RECORDS AVAILABLE.—March 3, 1896 to September 30, 1918. Daily-discharge records for this station, 1896–1914, were published by the Wisconsin Railroad Commission in "Water Power Report to the Legislature, 1915." The records published in this report have since been found to be considerably in error and should not be used. See "Determination of flow."

DRAINAGE AREA.—6,150 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

DETERMINATION OF DISCHARGE.—This dam is owned and operated by the United States Army Engineers to aid navigation and the flow is computed by the United States Army Engineers as follows: The dam is made of timber and is equipped with four needle sluice gates which are used only in times of high water. A vertical staff gage at the lower end of the canal leading to the lock and about a quarter of a mile below the dam is read five times daily—at 7 a. m., 9 a. m., noon, 3 p. m., and 6 p. m. The mean flow for the day is computed from a formula using the five gage heights for the day, assuming gradual changes in gage height between the readings, and weighting the different gage heights by elapsed time. Prior to 1917 determinations of daily discharge were based on tables derived from theoretical formulas for flow over a sharp-crested weir and through the sluice gates. During 1917 discharge measurements were made by engineers of the United States Geological Survey from a cable a short distance downstream from the dam. Seven measurements were made with the four sluices closed and eight with all sluices open. The measured discharge varied from 1,000 to 13,000 second-feet. Curves based on the discharge measurements show that the theoretical formulas previously used gave results ranging from about 850 second-feet too small at low stages, with the sluices closed, to 250 second-feet too large at high stages, with all sluices open. The deficiency of amounts in the old records as published is due to the fact that no allowance was made for leakage through the dam, which is now determined to be about 1,000 second-feet when water is at the crest of the dam and all gates are closed. Discharge measurements made by the United States Geological Survey in 1902 and 1903 at Wrightstown, about 2 miles below the dam, indicate that the leakage at the dam was apparently the same during 1902 and 1903 as in 1917. As Rapide Croche dam was built in 1878 and existed in 1902 as in 1917, it is considered necessary and proper to correct the old records for 1896–1917 to agree with the results of the current-meter measurements made in 1917. The recomputed records published in Water Supply Paper 454, are the old records corrected by means of the curves for 1917, each recomputation taking into consideration the relation between the old and new curves according to the number of sluices open. Corrections were applied to the semimonthly and monthly mean discharge.

EXTREMES OF DISCHARGE.—Information relative to daily maximum and minimum, 1896–1917 may be obtained from the United States Army Engineer office, Milwaukee, Wis. During 1918, the maximum mean daily discharge was 16,300 second-feet May 25; minimum mean daily discharge, 1,330 second-feet October 22.

REGULATION.—Flow regulated by Lake Winnebago, which has an area of 215 square miles, and also by dams between the outlet of Lake Winnebago and the station, the dams being operated for power development and to some extent in the interests of navigation. Under existing conditions, which, as regards storage, have been the same throughout the period covered by the records, the flow past the station is natural.

ACCURACY.—Records good.

COOPERATION.—Records collected and daily discharge computed by United States Army Engineers from curves developed by current-meter measurements made by engineers of the United States Geological Survey.

Daily discharge, in second-feet, of Fox River at Rapide Croche dam, near Wrightstown, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,870	3,380	2,880	4,740	5,530	4,340	7,820	6,480	16,100	3,830	3,670	1,640
2	3,090	3,440	2,070	4,580	5,570	4,440	9,220	6,630	14,800	4,600	3,360	2,040
3	2,830	3,440	2,740	4,770	4,690	4,300	9,740	6,500	14,700	4,460	3,190	2,100
4	2,940	2,330	3,260	4,830	4,470	4,850	11,600	6,300	15,300	3,060	1,930	2,150
5	2,780	1,970	3,360	4,730	4,980	4,740	11,600	4,970	15,100	3,350	2,480	2,260
6	2,920	3,960	4,080	3,860	5,380	4,440	11,500	4,680	15,000	3,680	3,140	2,380
7	1,750	4,270	4,050	4,750	5,470	4,420	10,800	6,100	14,300	2,960	2,170	2,200
8	1,510	4,280	4,140	5,000	5,330	4,420	10,700	6,360	14,500	4,170	2,410	1,670
9	3,260	4,230	5,400	4,700	5,340	4,200	11,200	6,700	13,700	4,670	2,430	2,070
10	3,310	4,070	3,820	4,680	4,530	3,740	11,300	8,130	13,900	4,690	2,460	1,980
11	3,370	2,610	4,480	4,810	5,080	4,530	11,100	7,510	14,100	4,550	1,650	2,180
12	3,290	2,390	4,760	4,570	5,090	4,730	11,100	5,700	13,100	4,600	2,180	2,050
13	3,150	4,270	4,720	3,600	4,920	4,680	10,800	5,380	13,400	4,550	2,800	2,010
14	2,070	4,380	4,730	4,580	4,760	4,800	9,780	9,070	12,800	3,410	2,640	2,100
15	1,700	4,420	4,730	5,080	4,450	4,860	9,000	9,480	12,400	3,630	2,720	1,570
16	2,950	4,050	4,020	5,130	4,620	4,760	9,040	10,700	11,700	4,440	2,750	1,810
17	2,920	3,740	4,190	5,060	3,860	4,230	8,460	10,900	11,500	4,470	2,660	1,940
18	2,930	2,280	5,050	4,080	4,690	6,230	6,420	11,500	11,800	4,460	1,780	1,830
19	2,570	2,450	5,070	3,880	4,540	7,300	6,390	11,800	11,400	4,390	2,350	1,920
20	2,600	3,860	4,680	4,020	4,440	7,120	6,200	12,200	10,200	4,440	2,800	1,960
21	1,920	4,050	4,590	4,090	4,420	6,080	4,750	13,300	7,960	3,160	2,760	1,940
22	1,330	3,910	4,610	4,070	4,570	5,510	5,420	15,700	5,630	3,670	2,360	1,620
23	2,780	4,000	3,400	4,700	4,500	5,370	6,510	13,800	3,690	4,340	2,430	1,740
24	3,320	4,060	3,510	5,670	3,900	4,120	6,500	14,200	3,920	4,440	2,630	1,980
25	3,290	2,330	3,700	5,700	4,460	4,830	6,590	16,300	4,700	4,460	1,900	1,980
26	3,430	2,650	4,510	5,470	4,280	5,280	6,350	14,800	4,890	4,580	2,040	1,940
27	3,540	4,180	4,370	4,390	4,350	5,450	6,170	14,800	4,940	4,510	2,420	2,100
28	2,100	3,770	4,170	4,160	4,360	5,700	4,790	15,200	4,780	3,110	2,480	1,990
29	2,070	3,730	4,510	4,990	.....	6,000	5,170	15,000	4,630	2,570	2,430	1,530
30	3,220	3,270	3,930	5,440	.....	6,510	6,210	15,400	3,700	3,430	2,270	1,760
31	3,420	.....	4,400	5,520	.....	6,820	.....	15,600	.....	3,540	2,090	.....

Monthly discharge of Fox River at Rapide Croche dam, near Wrightstown, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 6,150 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,540	1,330	2,720	0.442	0.51
November	4,420	1,970	3,530	.574	.64
December	5,400	2,070	4,130	.672	.77
January	5,700	3,600	4,700	.764	.88
February	5,570	3,860	4,740	.771	.80
March	7,300	3,740	5,120	.833	.96
April	11,600	4,750	8,410	1.37	1.53
May	16,300	4,680	10,400	1.69	1.95
June	16,100	3,690	10,600	1.72	1.92
July	4,690	2,570	4,010	.652	.75
August	3,670	1,650	2,500	.407	.47
September	2,380	1,530	1,950	.317	.35
The year	16,300	1,330	5,220	.849	11.53

WOLF RIVER AT KESHENA, WIS.

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

DRAINAGE AREA.—840 [a] square miles.

RECORDS AVAILABLE.—May 9, 1907, to March 31, 1909; February 10, 1911, to September 30, 1918.

GAGE.—Chain gage fastened to downstream side of new bridge December 9, 1914; May 9, 1907, to November 29, 1914, vertical staff gage fastened to downstream end of left 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.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 4.88 feet at 4 p. m. May 28 (discharge, 2,530 second-feet); minimum discharge, about 315 second-feet, February 20.

1907–1909 and 1911–1918: 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 380 and 2,000 second-feet; above and below these limits curve is extended and subject to error. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was ascertained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Open-water records good, except those for extremely high and low stages, which are fair; winter records fair.

Discharge measurements of Wolf River at Keshena, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20[a]	L. L. Smith	2.26	461	Feb. 22[b]	L. L. Smith	2.89	389
Jan. 18[a]	do	2.70	390	Apr. 29	T. G. Bedford	2.98	1,290

[a] Revised since publication of Water-Supply Paper 454.
[b] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Wolf River at Keshena, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	630	715	490	430	350	475	1,110	1,160	2,190	806	672	853
2	590	715	480	415	360	480	950	1,050	2,190	760	760	1,000
3	552	715	475	435	350	490	760	1,000	1,850	901	630	901
4	590	672	460	430	360	495	950	950	1,530	760	552	672
5	630	672	430	395	325	505	950	853	1,530	760	515	760
6	552	715	430	400	350	510	950	853	1,460	715	515	853
7	515	715	435	435	350	510	1,050	853	1,460	853	552	950
8	497	715	435	390	330	510	1,050	901	1,400	760	672	853
9	590	672	435	385	330	510	1,000	950	1,400	715	950	760
10	672	672	440	375	335	510	806	1,790	1,280	760	1,220	760
11	672	760	440	410	335	510	806	1,920	1,160	672	1,160	672
12	715	672	445	385	325	510	760	1,850	1,110	630	760	590
13	630	590	445	340	325	565	853	1,400	1,050	672	1,050	672
14	552	590	430	365	330	605	760	1,220	950	515	1,050	760
15	552	672	445	350	330	625	760	1,280	950	672	1,000	590
16	590	715	475	360	320	670	806	1,000	950	672	950	672
17	590	590	475	365	320	810	806	950	1,050	672	1,050	715
18	672	590	470	390	330	860	853	1,160	1,050	552	760	901
19	672	552	465	375	325	910	901	1,280	901	590	1,000	672
20	760	552	460	375	315	960	853	1,340	760	590	806	715
21	715	715	460	335	355	1,020	901	1,000	715	630	715	672
22	672	760	430	350	390	1,380	901	1,050	806	590	715	760
23	672	590	430	325	400	1,310	853	1,110	760	672	760	806
24	715	590	420	345	415	1,250	806	1,220	672	715	1,000	853
25	760	540	450	375	445	1,190	853	1,160	672	715	1,050	853
26	760	535	445	365	455	1,130	715	1,460	806	672	1,000	853
27	901	530	445	365	460	1,100	806	2,120	672	672	901	590
28	1,000	515	390	365	470	1,070	853	2,330	853	715	1,000	590
29	1,220	505	390	350	.....	1,190	1,280	1,590	901	760	1,050	590
30	1,000	495	395	365	.....	1,400	1,220	2,060	806	715	950	590
31	760	.....	400	365	.....	1,110	.....	2,060	.....	715	1,000	.....

NOTE.—Stage-discharge relation affected by ice Nov. 25 to Mar. 29.

Monthly discharge of Wolf River at Keshena, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 840 square miles.[a]]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,220	497	690	0.821	0.95
November	760	495	635	.756	.84
December	490	390	442	.526	.61
January	435	325	378	.450	.52
February	470	315	360	.429	.45
March	1,400	475	812	.967	1.11
April	1,280	715	897	1.07	1.19
May	2,330	853	1,320	1.57	1.81
June	2,190	672	1,130	1.35	1.51
July	901	515	697	.830	.96
August	1,220	515	863	1.03	1.19
September	1,000	590	749	.892	1.00
The year	2,330	315	750	.893	12.14

[a] Revised since publication of Water-Supply Paper 454.

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, 1918; daily discharge determinations October 1, 1913, to September 30, 1918.

GAGE.—Enameled steel gage, graduated from 1.0 to 13.0 feet, fastened to right hand downstream pier of Pearl Street Bridge. Datum of the gage raised 0.641 foot on 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 the Shawano Street Bridge, two blocks below the gage.

CHANNEL AND CONTROL.—Sand, hardpan, and mud; not permanent; control not well defined. Both banks at the gage fairly high and not subject to overflow. During extreme flood stages it is reported that the water from the Embarrass River will flow across the city of New London and empty into channel of the Wolf River below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.5 May 30 and 31 (discharge, 7,270 second-feet); minimum discharge, about 700 second-feet February 6–9.

1914–1918: Maximum discharge recorded, 9.7 feet April 4, 1916 (discharge, 8,960 second-feet); minimum discharge, that of February 6–9, 1918. The United States Army Engineers report a stage of 11.6 feet on April 16, 1888.

ICE.—Stage-discharge relation affected by ice.

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

ACCURACY.—Stage-discharge relation not permanent. Two rating curves used during 1918, one, applicable October 1 to November 25 and March 12 to September 30, fairly well defined between 20 and 2,750 second-feet; the other, applicable November 26 to March 11, fairly well defined between 810 and 9,280 second-feet; both curves poorly defined outside these limits. Gage read to tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. Records fair.

Discharge measurements of Wolf River at New London, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21[a]	Hoyt and Smith	2.02	814	Apr. 30	T. G. Bedford	5.41	2,440
Jan. 19[a]	L. L. Smith	2.40	725	July 19	W. G. Hoyt	1.90	1,090
Feb. 23[a]	do	2.97	704				

[a] Complete ice cover at control and measuring section.

Daily discharge, in second-feet, of Wolf River at New London, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	953	1,810	910	795	740	795	4,050	2,450	7,000	1,420	1,310	1,310
2	888	1,770	875	780	725	810	3,760	2,550	6,490	1,500	1,230	1,350
3	888	1,650	875	780	725	890	3,500	2,600	6,020	1,500	1,160	1,310
4	920	1,540	840	780	710	945	3,420	2,600	5,610	1,420	1,160	1,230
5	920	1,540	810	780	710	1,020	3,190	2,650	5,250	1,540	1,160	1,160
6	920	1,500	780	795	700	1,140	2,500	2,600	4,940	1,610	1,120	1,060
7	920	1,460	750	795	700	1,280	2,920	2,550	4,650	1,500	1,020	1,060
8	920	1,540	750	780	700	1,420	2,860	2,500	4,390	1,350	1,020	1,060
9	888	1,460	750	780	700	1,610	2,700	2,400	4,160	1,350	1,160	1,060
10	920	1,460	750	765	710	1,810	2,650	2,500	3,850	1,350	1,230	1,090
11	986	1,380	750	750	710	2,060	2,500	2,800	3,670	1,270	1,380	1,060
12	1,060	1,350	765	750	725	2,090	2,450	2,920	3,340	1,200	1,540	1,090
13	1,120	1,310	780	750	740	2,130	2,350	3,050	3,120	1,200	1,690	1,120
14	1,120	1,350	765	750	750	2,220	2,130	3,120	2,980	1,120	1,650	1,120
15	1,120	1,270	765	740	750	2,220	2,050	3,190	2,750	1,090	1,500	1,120
16	1,090	1,160	780	740	750	2,260	1,970	3,340	2,600	1,090	1,460	1,090
17	986	1,120	780	740	740	2,300	1,890	3,420	2,400	1,120	1,420	1,090
18	1,060	1,160	795	725	740	2,450	2,010	3,850	2,220	1,120	1,380	1,090
19	1,090	1,200	795	725	740	3,120	1,970	4,160	2,050	1,060	1,270	1,090
20	1,060	1,200	810	725	725	3,950	1,930	5,420	1,890	1,020	1,200	1,090
21	1,160	1,160	815	740	725	5,420	2,010	6,250	1,730	1,020	1,160	1,120
22	1,230	1,160	810	750	710	6,740	2,090	6,250	1,570	986	1,120	1,120
23	1,270	1,160	810	765	705	6,490	2,170	6,020	1,460	953	1,120	1,200
24	1,270	1,200	810	780	725	6,740	2,220	5,810	1,380	953	1,120	1,200
25	1,270	1,090	825	795	740	6,490	2,220	6,020	1,310	1,090	1,120	1,230
26	1,380	980	825	795	750	6,020	2,130	6,250	1,310	1,060	1,160	1,230
27	1,540	980	810	795	780	6,020	2,090	6,490	1,350	1,020	1,230	1,200
28	1,570	960	810	780	780	5,610	2,090	6,740	1,350	1,090	1,270	1,120
29	1,690	945	795	765	.....	5,090	2,130	7,000	1,310	1,120	1,270	1,060
30	1,730	945	795	750	.....	4,650	2,300	7,270	1,350	1,160	1,310	1,020
31	1,770	.....	795	740	.....	4,390	.....	7,270	.....	1,200	1,310	.....

NOTE.—Stage-discharge relation affected by ice Nov. 26 to Mar. 11.

Monthly discharge of Wolf River at New London, Wis., for the year ending Sept. 30, 1918.

[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	1,770	888	1,150	0.513	0.59
November	1,810	945	1,290	.576	.64
December	910	750	799	.357	.41
January	795	725	764	.341	.39
February	780	700	729	.325	.34
March	6,740	795	3,230	1.44	1.66
April	4,050	1,890	2,480	1.11	1.24
May	7,270	2,400	4,260	1.90	2.19
June	7,000	1,310	3,120	1.39	1.55
July	1,610	953	1,210	.540	.62
August	1,690	1,020	1,270	.567	.65
September	1,350	1,020	1,140	.509	.57
The year	7,270	700	1,790	.799	10.85

LITTLE WOLF RIVER AT ROYALTON, WIS.

LOCATION.—In sec. 1, T. 22 N., R. 13 E., at highway bridge in 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, 1918.

GAGE.—Sloping gage located on left bank of river, about 150 feet upstream from highway bridge, used since August 21, 1915. Chain gage fastened to upstream side of highway bridge was used until August 20, 1915. Datum of the sloping gage is 0.75 foot higher than that of the chain gage. Owing to change in slope, however, difference between the readings from the two gages is not constant.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.69 feet at 5.30 p. m. May 19 (discharge about 2,850 second-feet); minimum discharge about 132 second-feet February 2.

1914–1918: Maximum stage recorded, 7.5 feet at 7.15 p. m. June 7, 1914 (discharge, 5,350 second-feet); minimum discharge about 130 second-feet March 5 and 6, 1916, and January 23, 1917.

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 fairly permanent throughout the year. Rating curve well defined between 209 and 1,570 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for effect of ice by means of discharge measurements, observer's notes, and weather records. During winter period chain gage was read. Open-water records good, except those for high stages, which are fair; winter records fair.

Discharge measurements of Little Wolf River at Royalton, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 21[a]	Hoyt and Smith	[b] 1.18	178	Apr. 30	T. G. Bedford	[c] 2.96	998
Jan. 19[a]	L. L. Smith	[b] 1.91	17	July 19	W. G. Hoyt	1.45	230
Feb. 25[a]	do	[b] 2.40	194				

[a] Complete ice cover at control and measuring section.
[b] Referred to chain gage.
[c] Referred to sloping gage; some uncertainty as to correct gage height as it was determined from reading of chain gage, correction being deduced from previous simultaneous reading of the two gages.

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Daily discharge, in second-feet, of Little Wolf River at Royalton, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	245	402	245	162	148	200	800	970	1,210	314	560	267
2	227	417	223	162	132	203	770	865	1,050	301	276	245
3	230	450	238	170	148	205	800	590	970	314	284	251
4	223	472	232	178	155	207	740	680	830	347	243	254
5	238	439	227	203	148	209	710	590	770	417	223	236
6	207	356	215	186	155	211	650	501	770	361	243	236
7	223	356	207	203	155	213	800	560	770	310	219	211
8	211	402	200	194	162	215	680	620	650	273	301	203
9	219	347	194	203	162	219	650	620	650	267	501	196
10	225	356	189	178	162	223	590	1,130	650	264	620	201
11	245	366	186	194	155	234	590	1,390	650	264	650	257
12	254	371	186	178	162	245	530	1,480	501	236	710	337
13	248	352	183	178	170	266	461	1,390	461	257	530	264
14	227	328	180	178	178	530	407	1,130	450	264	386	251
15	264	301	178	178	178	710	456	830	407	270	301	241
16	251	318	173	194	186	830	417	770	501	238	264	257
17	264	289	170	170	178	1,050	450	970	347	230	273	236
18	332	270	170	155	186	1,210	620	2,400	407	238	257	254
19	366	293	170	177	217	1,390	590	2,740	386	238	254	264
20	356	305	170	149	178	1,570	472	2,070	347	254	270	245
21	328	328	178	155	170	1,870	501	1,870	347	238	270	236
22	323	305	164	140	178	2,070	650	1,670	332	232	251	211
23	276	310	162	148	203	2,290	590	1,300	305	241	257	219
24	318	284	161	162	186	2,400	710	1,300	310	310	251	236
25	318	267	160	170	194	1,210	650	1,870	276	530	243	276
26	386	245	160	162	194	1,130	434	2,070	251	397	236	276
27	456	245	162	170	194	1,050	472	2,740	386	264	254	264
28	472	254	167	162	196	800	590	2,620	347	243	257	241
29	472	248	164	155	.....	770	830	2,400	289	461	301	203
30	501	227	168	162	.....	770	1,090	2,070	314	318	276	217
31	530	.....	173	148	.....	770	.....	1,570	.....	590	264	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 24.

Monthly discharge of Little Wolf River at Royalton, Wis., for the year ending Sept. 30, 1918.

[Drainage area, 485 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	530	207	304	0.627	0.72
November	472	227	330	.680	.76
December	245	160	186	.384	.44
January	203	140	172	.355	.41
February	217	132	172	.355	.37
March	2,400	200	815	1.68	1.94
April	1,090	407	623	1.28	1.43
May	2,740	501	1,410	2.91	3.36
June	1,210	251	531	1.09	1.22
July	590	230	306	.631	.73
August	710	219	330	.680	.78
September	337	196	243	.501	.56
The year	2,740	132	455	.938	12.72

WAUPACA RIVER NEAR WAUPACA, WIS.

LOCATION.—In sec. 34, T. 22 N., R. 12 E., at Waupaca County highway bridge, about 4 miles downstream from Waupaca, Wis.

DRAINAGE AREA.—305 square miles (measured on map issued by Wisconsin Geological and Natural History Survey, edition of 1911; scale, 1 inch=6 miles).

RECORDS AVAILABLE.—October 18, 1917, to September 30, 1918; June 28, 1916, to October 18, 1917, records were obtained at a station near Weyauwega, about a mile downstream from present site.

GAGE.—Chain gage bolted to upstream handrail of bridge; read by Harry Radtke.

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

CHANNEL AND CONTROL.—Bed consists of fine gravel and clay, clean and free from vegetation. Control not well defined; may shift slightly. Right bank is high and will rarely be overflowed; left bank of medium height and will be overflowed in time of flood stage.

ICE.—Stage-discharge relation affected by ice.

EXTREMES OF STAGE.—Maximum stage recorded during year 6.0 feet, March 19 (stage discharge relation affected by ice); minimum open-water stage recorded 1.57 feet September 30 (minimum discharge occurred probably during winter period).

REGULATION.—The operation of power plants at and above Waupaca on the main stream and also several on the Crystal River may cause slight fluctuation during low stages. The pondage at the various plants is small and mean monthly discharge is believed to represent nearly the natural flow.

Data inadequate for determination of discharge.

Discharge measurements of Waupaca River near Waupaca, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 19[a]	R. B. Kilgore	1.92	238	Feb. 26[b]	L. L. Smith	3.60	168
26[a]	do	2.06	289	Mar. 28	T. G. Bedford	2.19	327
Dec. 22[b]	L. L. Smith	2.66	179	June 6	do	2.05	299
Jan. 21[b]	do	3.07	138	July 19[a]	W. G. Hoyt	1.70	182

[a] Measurement made by wading. [b] Complete ice cover at control and measuring section.

Daily gage height, in feet, of Waupaca River near Waupaca, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.86	1.69	2.75	3.4	3.6	2.1	2.1	2.35	1.92	1.68	1.75
2	.....	1.78	1.76	2.75	3.3	3.7	2.05	1.95	2.25	1.93	1.76	1.69
3	.....	1.85	1.68	3.0	3.4	4.0	2.0	1.99	2.15	1.89	1.80	1.72
4	.....	1.86	1.78	2.85	3.4	4.5	1.99	1.84	2.1	1.81	1.78	1.68
5	.....	1.84	1.90	2.8	3.3	4.7	1.98	1.82	2.05	1.93	1.71	1.58
6	.....	1.96	3.6	2.95	3.4	4.4	1.92	1.81	2.1	1.91	1.71	1.62
7	.....	1.83	2.85	2.85	3.4	4.2	2.0	1.88	2.1	1.88	1.71	1.65
8	.....	1.80	2.7	3.0	3.4	4.0	2.0	1.81	2.0	1.88	1.92	1.68
9	.....	1.83	2.65	3.0	3.5	3.0	1.95	1.90	2.1	1.75	1.98	1.62
10	.....	1.84	2.1	2.85	3.5	2.45	1.88	2.45	2.1	1.83	1.96	1.72
11	.....	1.78	1.97	3.0	3.5	3.5	1.83	2.6	2.05	1.83	1.88	1.89
12	.....	1.75	1.98	2.9	3.5	3.9	1.86	2.45	1.99	1.82	2.2	1.85
13	.....	1.79	2.1	3.1	3.5	4.3	1.86	2.25	1.92	1.80	2.2	1.81
14	.....	1.74	2.05	3.0	3.5	4.4	1.87	2.1	1.91	1.85	1.99	1.76
15	.....	1.76	2.0	3.1	3.4	4.2	1.98	2.0	1.91	1.76	1.90	1.77
16	.....	1.69	2.05	3.1	3.5	4.2	1.84	1.99	1.84	1.89	1.80	1.73
17	.....	1.72	2.05	3.1	3.5	4.0	1.77	1.94	1.86	1.84	1.86	1.79
18	.....	1.75	2.0	3.1	3.5	4.5	1.90	3.2	1.87	1.75	1.79	1.82
19	1.78	1.69	2.0	3.1	3.5	6.0	1.87	2.8	1.85	1.75	1.76	1.73
20	1.80	1.77	1.99	3.0	3.6	5.6	1.91	2.8	1.85	1.67	1.76	1.70
21	1.79	1.72	2.05	3.1	3.5	4.7	1.93	2.4	1.86	1.75	1.73	1.80
22	1.80	1.76	2.65	3.2	3.5	3.6	1.96	2.55	1.81	1.71	1.70	1.75
23	1.83	1.74	2.65	2.95	3.4	2.9	2.0	2.5	1.84	1.75	1.71	1.69
24	1.84	2.0	2.7	3.2	3.5	2.6	1.89	2.3	1.81	1.78	1.72	1.78
25	1.81	1.76	2.5	3.3	3.6	2.4	1.87	3.6	1.86	1.83	1.74	1.69
26	1.82	1.68	2.55	3.3	3.5	2.3	1.79	3.4	1.83	1.87	1.75	1.62
27	1.96	1.78	2.6	3.2	3.6	2.25	1.86	3.5	1.87	1.80	1.69	1.62
28	2.1	1.75	2.7	3.3	3.6	2.1	1.90	3.0	1.87	1.75	1.57	1.64
29	2.0	1.74	2.65	3.2	.....	2.15	2.3	2.65	1.85	1.85	2.05	1.66
30	1.96	1.66	2.7	3.4	.....	2.15	2.2	2.55	1.81	1.88	1.87	1.57
31	2.1	.....	2.75	3.3	.....	2.1	.....	2.35	.....	1.78	1.84	.....

NOTE.—Stage-discharge relation affected by ice Nov. 24, 25 and Dec. 4 to Mar. 22.

SHEBOYGAN RIVER NEAR SHEBOYGAN, WIS.

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

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

RECORDS AVAILABLE.—June 30, 1916, to September 30, 1918.

GAGE.—Chain gage fastened to upstream side of bridge; read by Hattie Opgenorth.

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

CHANNEL AND CONTROL.—Control is a well-defined riffle about 200 feet below bridge. Bed of stream is heavy gravel; clear and free from aquatic grass. Banks are of medium height and are rarely overflowed.

EXTREMES OF STAGE.—1916–1918: Maximum stage recorded, 8.85 feet at 8.15 a .m., March 20, 1918. The stage on March 18 and 19, 1918 was somewhat higher, as the observer reports inability to read the gage due to overflow around approach. Minimum stage 1.68 feet at 7.15 p. m., September 13, 1918.

ICE.—Stage-discharge relation affected by ice.

REGULATION.—At low stages there is a small amount of diurnal fluctuation due to operation of small power plants above.

Stage-discharge relation apparently not permanent. Determination of daily discharge during year held up pending the making of additional discharge measurements.

Discharge measurements of Sheboygan River near Sheboygan, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20[a]	W. G. Hoyt	2.66	63	Mar. 27	T. G. Bedford	5.16	1,630
Jan. 17[a]	do	2.79	22	July 18	W. G. Hoyt	2.33	51

[a] Complete ice cover at control and measuring section.

Daily gage height, in feet, of Sheboygan River near Sheboygan, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.18	2.94	2.44	2.34	3.22	5.95	4.02	2.78	3.31	2.35	2.29	1.88
2	2.21	2.79	2.32	2.60	3.45	5.95	3.95	2.77	3.26	2.51	2.45	2.13
3	2.22	2.84	2.46	2.26	3.35	6.25	3.68	2.79	3.18	2.44	2.37	1.99
4	2.21	2.85	2.42	2.34	.....	7.35	3.30	2.81	3.06	2.54	2.46	2.08
5	2.44	2.80	2.42	2.98	3.02	7.75	3.35	2.73	3.00	2.38	2.20	2.09
6	2.28	2.77	.....	3.02	3.80	7.35	2.86	2.59	2.94	2.43	2.48	2.01
7	2.15	2.77	2.42	2.38	3.40	7.30	2.75	2.99	2.81	2.49	2.33	1.91
8	2.06	2.74	2.40	2.36	3.50	7.30	3.05	3.02	2.74	2.33	2.32	2.30
9	2.02	2.68	2.46	2.46	3.60	.....	2.89	2.77	2.87	2.29	2.45	2.08
10	2.17	2.74	2.42	2.66	3.45	5.45	2.90	3.16	2.78	2.25	2.25	2.10
11	2.26	2.57	2.32	2.56	3.45	.....	3.04	3.11	2.84	2.39	2.27	2.16
12	2.33	2.48	2.36	2.66	3.55	5.30	2.80	3.01	2.64	2.42	2.30	1.99
13	2.20	2.53	2.34	.....	3.65	6.60	2.69	2.95	2.59	2.52	2.31	1.92
14	2.24	2.53	2.50	2.64	3.80	7.70	2.59	2.94	2.49	2.32	2.33	2.12
15	2.22	2.51	2.50	2.76	3.70	8.00	2.61	2.86	2.55	2.25	2.26	2.08
16	2.16	2.45	2.56	2.70	3.60	8.80	2.58	2.85	2.74	2.29	2.36	2.08
17	2.28	2.42	2.56	2.78	3.50	8.84	2.61	2.77	2.49	2.33	2.85	1.94
18	2.37	2.46	2.38	3.14	3.75	.....	2.73	3.06	2.59	2.32	2.41	1.99
19	2.29	2.40	2.86	3.28	.....	.....	2.77	3.16	2.44	2.32	2.31	2.02
20	2.26	2.43	2.68	3.10	4.10	8.78	2.71	3.32	2.39	2.33	2.10	2.09
21	2.22	3.20	2.84	3.40	3.20	7.65	3.00	2.97	2.45	2.26	2.19	1.94
22	2.29	2.64	2.80	2.90	3.75	7.05	3.46	3.28	2.14	2.35	2.12	1.95
23	2.29	2.61	2.56	2.96	3.80	6.32	3.02	3.26	2.26	2.37	2.62	1.94
24	2.57	2.78	2.68	3.10	4.15	5.50	2.91	3.00	2.33	2.32	2.29	1.95
25	2.73	2.62	2.46	3.14	4.50	5.60	3.02	3.02	2.32	2.49	2.22	1.96
26	2.64	2.28	2.02	3.10	.....	5.40	3.11	3.23	2.34	2.46	1.95	2.06
27	3.48	2.60	2.34	3.02	5.05	5.15	2.57	3.30	2.31	2.32	2.09	2.05
28	3.45	2.28	2.46	3.06	5.70	4.78	2.84	3.80	2.51	2.30	2.16	2.00
29	3.10	2.40	2.40	2.96	.....	4.65	3.38	3.68	2.34	2.49	2.20	1.91
30	2.95	2.36	2.34	3.60	.....	4.43	3.28	3.50	2.55	2.28	2.26	2.06
31	2.72	.....	2.36	3.32	.....	4.28	.....	3.34	.....	2.47	2.56	.....

NOTE.—Stage-discharge relation affected by ice Nov. 24 to Mar. 20.

MILWAUKEE RIVER NEAR MILWAUKEE, WIS.

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

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

RECORDS AVAILABLE.—April 30, 1914, to September 30, 1918.

GAGE.—Inclined gage on concrete foundations on left bank of river; prior to April 18, 1918, chain gage fastened to cantilever arm supported by posts set in concrete foundations. Both gages at same datum. Gage read by Miss Bertha Kuehl.

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 fairly permanent, changing only during exceptionally heavy floods. 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; at medium and high stages from a concrete highway bridge about a mile upstream from the gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, determined by levels to high-water mark, 9.00 feet, early in morning of March 20 (discharge, about 12,100 second-feet); minimum discharge about 45 second-feet, January 20 to February 2.

1914–1918: Maximum stage recorded, that of March 20, 1918; minimum stage recorded, 0.50 foot at 8.31 p. m., August 2, 1916 (discharge, about 26 second-feet).

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 changed somewhat during the flood of March. Two rating curves used during year, both well defined between 88 and 3,710 second-feet. Gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, except for period when stage-discharge relation was affected by ice, for which it was obtained by applying to rating table mean daily gage height corrected for ice effect by means of discharge measurements, observer's notes, and weather records. Open-water records excellent, except those for extremely high and low stages, which are only good; winter records fair.

Discharge measurements of Milwaukee River near Milwaukee, Wis., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 20[a]	W. G. Hoyt	1.50	141	Apr. 17[c]	T. G. Bedford	1.31	349
Jan. 17[a]	do	2.05	58	July 18	W. G. Hoyt	.65	91
Mar. 25[b]	Hoyt and Potts	8.25	10,400				

[a] Complete ice cover at control and measuring section.
[b] Velocity determined by timing movement of ice cakes and débris over a measured course 200 feet long at old bridge section 1,000 feet downstream from gage.
[c] Made at second highway bridge 1 mile upstream from gage.

Daily discharge, in second-feet, of Milwaukee River near Milwaukee, Wis., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.
1	150	777	230	130	45	1,270	860	860	770	117	95	66
2	117	734	294	120	45	1,310	860	728	495	120	91	51
3	127	650	307	115	50	1,360	770	568	389	127	86	78
4	127	610	247	110	55	1,360	685	460	347	117	93	82
5	127	532	195	95	60	1,180	645	389	330	127	66	70
6	146	494	115	90	65	1,270	605	365	305	136	80	58
7	130	532	110	85	70	1,680	605	371	285	125	91	66
8	127	494	105	80	75	1,790	770	447	244	107	78	70
9	117	460	100	70	80	1,360	815	495	258	102	62	64
10	154	394	90	65	90	1,270	645	568	240	100	60	91
11	210	373	90	60	100	1,180	568	728	240	78	60	104
12	247	367	95	60	110	1,790	495	605	215	104	91	93
13	288	360	100	60	115	2,260	434	495	206	100	125	117
14	247	360	100	60	130	2,380	402	447	180	95	117	117
15	215	353	105	60	145	2,630	383	383	159	107	95	100
16	205	327	110	60	150	2,760	389	335	146	120	102	91
17	225	327	115	55	160	3,150	347	276	136	93	117	109
18	353	301	120	50	170	4,410	421	335	102	93	109	91
19	294	270	125	50	185	8,260	568	860	82	95	84	91
20	264	282	130	45	210	12,100	645	1,040	93	130	86	78
21	205	288	145	45	240	10,300	860	950	109	117	84	80
22	210	288	165	45	270	7,450	1,130	1,220	117	58	51	91
23	394	294	185	45	290	4,860	1,130	1,130	136	72	48	86
24	820	320	190	45	360	3,430	950	995	133	58	84	95
25	952	294	205	45	425	2,400	685	770	117	55	72	78
26	1,270	360	190	45	735	1,920	530	530	93	55	48	62
27	1,360	347	185	45	1,090	1,500	460	728	95	51	53	78
28	1,360	294	170	45	1,180	1,310	530	995	80	82	60	70
29	1,360	294	160	45	.....	1,080	728	1,040	86	95	55	80
30	1,180	301	150	45	.....	995	905	995	86	93	66	72
31	908	.....	145	45	.....	905	.....	905	.....	91	80	.....

NOTE.—Stage-discharge relation affected by ice Dec. 6 to Mar. 10. Gage washed out Mar. 19; discharge interpolated.

Monthly discharge of Milwaukee River near Milwaukee, Wis., for the year ending Sept. 30, 1918.

[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	1,360	117	448	0.678	0.78
November	777	270	403	.610	.68
December	307	90	154	.233	.27
January	130	45	65.0	.098	.11
February	1,180	45	239	.362	.38
March	12,100	905	2,930	4.43	5.11
April	1,130	347	661	1.00	1.12
May	1,220	276	678	1.03	1.19
June	770	80	209	.316	.35
July	136	51	97.4	.147	.17
August	125	48	80.3	.121	.14
September	117	51	82.6	.125	.14
The year	12,100	45	508	.769	10.43

LITTLE CALUMET RIVER AT HARVEY, ILL.

LOCATION.—In NW. ¼ sec. 9, T. 36 N., R. 14 E., at Illinois Central Railroad bridge 800 feet north of railroad station at One Hundred and Forty-seventh Street, Harvey, Cook County, 11 miles above mouth of river.

DRAINAGE AREA.—570 square miles (measured on map issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—Daily discharge, October 1, 1916, to September 30, 1918; daily gage heights, collected by Sanitary District of Chicago, June 10, 1907, to September 30, 1916.

GAGE.—Vertical staff gage attached to bridge pier; read by Mrs. H. Wurtman.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge during medium and high stages, or by wading during low stages.

CHANNEL AND CONTROL.—Bed of river composed of clay and gravel. Low-water control is at "The Rocks," about a mile below gage; bed of river, heavy gravel; somewhat shifting. Banks not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.8 feet at 8 a. m. and 4 p. m. February 15 (discharge not determined because of backwater from ice). Maximum open-water stage recorded, 7.1 feet at 8 a. m. and 4 p. m. March 1 (discharge, 1,680 second-feet); minimum discharge, probably somewhat less than 25 second-feet, occurred in January.

1910–1918: Maximum stage recorded, 13.4 feet March 6, 1908 (discharge not determined); minimum discharge, that in January, 1918.

ACCURACY.—Stage-discharge relation probably permanent throughout the year; seriously affected by ice during the winter. Rating curve well defined above and fairly well defined below 125 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for open-water periods; poor for winter.

Discharge measurements of Little Calumet River at Harvey, Ill., during the year ending Sept. 30, 1918.

[Made by H. C. Beckman.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 1	3.67	188	Sept. 18	3.10	68
Mar. 2	6.98	1,600	18	3.10	76
May 27	4.30	395			

Daily discharge, in second-feet, of Little Calumet River at Harvey, Ill., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	70	182	109			1,680	472	378	530	361	147	70
2	68	195	109			1,620	433	344	452	311	119	65
3	68	182	111			1,510	414	311	414	280	113	71
4	74	182	109			1,400	378	280	396	280	96	73
5	72	182	109			1,290	344	280	396	280	85	94
				85	30							
6	77	170				1,290	328	265	378	296	77	91
7	74	170				1,190	311	265	378	311	68	87
8	71	158				1,090	280	280	361	328	65	85
9	70	147				1,090	265	265	344	311	65	84
10	71	138				1,090	250	280	328	311	65	77
11	71	134				995	236	344	296	296	62	84
12	74	127				905	208	311	265	280	62	91
13	74	119	80			905	195	361	236	250	59	91
14	77	115				1,340	170	361	222	236	56	94
15	77	113				1,340	158	328	195	208	56	91
				40	1,130							
16	77	113				1,090	145	296	170	208	53	84
17	113	125				995	136	280	136	182	65	77
18	147	129				905	236	250	123	158	125	73
19	158	127				905	222	236	105	136	81	74
20	170	117				860	195	650	98	125	71	74
21	170	113				816	236	414	91	113	65	74
22	170	117				773	311	361	87	98	62	73
23	170	119				731	296	344	84	87	58	70
24	182	109				731	265	328	82	81	98	68
25	170	111				690	265	414	79	76	84	66
26	182	107	130	25	1,520	650	265	396	77	101	74	65
27	182	109				610	265	378	77	115	71	65
28	182	109				570	280	361	98	147	64	65
29	182	111				530	452	452	91	182	58	65
30	170	109				510	378	690	101	182	62	68
31	182	.....				472	.....	650	.....	170	65	.....

NOTE.—Discharge Dec. 6 to Feb. 28 estimated, because of ice, from gage heights, observer's notes, and weather records. Braced figures show mean discharge for periods included.

Monthly discharge of Little Calumet River at Harvey, Ill., for the year ending Sept. 30, 1918.

[Drainage area, 570 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	182	68	119	0.209	0.24
November	195	107	135	.237	.26
December	.....	.....	102	.179	.21
January	.....	.....	49.2	.086	.10
February	.....	.....	849	1.49	1.55
March	1,680	472	986	1.73	1.99
April	472	136	280	.491	.55
May	690	236	360	.632	.73
June	530	77	223	.391	.44
July	361	76	210	.368	.42
August	147	53	75.8	.133	.15
September	94	65	77.0	.135	.15
The year	.....	.....	285	.500	6.79

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, 1918.

GAGE.—Staff, attached to bridge; read to tenths; occasionally, October 1, 1917, to February 10, and July 1 to August 5, 1918; twice daily, February 11 to June 30, except on Sundays. Gage read by Charles Darling and J. M. Knoll.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

EXTREMES OF STAGE.—Maximum stage recorded during year 16.2 feet at 8 a. m. and 5 p. m. March 18; minimum stage recorded, −1.8 feet several days in June, July and August.

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

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

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, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	−1.0	1.6	−0.8	.....	0.3	12.05	3.75	0.85	0.8	−1.8	.....
2	.....	1.4	.....	0.4	.4	12.0	3.45	1.0	.....	.....	.....
3	.....	.....	− .8	.3	.....	.....	3.45	.85	.3	−1.5	−1.8
4	−1.0	.....	− .7	.4	.3	11.35	3.6	.8	.35	.....	.....
5	−1.0	.6	− .7	.4	.4	11.0	3.5	.....	.3	.....	−1.8
6	.....	.4	− .6	.....	.3	10.95	3.4	.4	.....	−1.6	.....
7	.....	.....	− .7	.3	.3	11.15	.....	.45	− .4	.....	.....
8	.....	− .2	− .6	.3	.4	10.6	2.45	.4	− .4	−1.8	.....
9	−1.0	− .4	.....	.3	.4	10.55	1.95	.3	.....	.....	.....
10	.....	.....	− .6	.4	.....	.....	1.75	.1	− .4	−1.6	.....
11	.....	.....	− .6	.3	.4	9.4	1.55	.2	− .3	.....	.....
12	.....	− .4	− .6	.3	.45	9.35	1.4	.....	− .4	.....	.....
13	−1.0	.....	− .6	.....	2.35	10.5	1.4	.6	− .38	−1.7	.....
14	.....	− .4	− .6	.2	4.85	11.75	.....	.95	− .35	.....	.....
15	.....	.....	− .6	.3	7.65	13.0	.55	1.2	− .4	−1.8	.....
16	.....	− .6	.....	.3	8.95	14.35	.5	1.2	.....	.....	.....
17	.....	− .8	− .7	.3	9.65	15.9	.4	.9	− .5	−1.6	.....
18	−1.0	.....	.....	.3	11.75	16.2	.55	.55	− .9	−1.8	.....
18	.....	− .8	− .5	.4	12.75	15.6	1.4	.....	− .85	.....	.....
20	.....	− .9	.2	.....	14.3	14.6	.8	−.1	−1.0	−1.8	.....
21	.....	−1.0	.....	.4	14.5	13.7	.....	.1	−1.0	.....	.....
22	− .6	−1.0	.4	.4	14.5	12.8	1.55	−.1	−1.2	−1.7	.....
23	.....	−1.0	.....	.3	14.3	11.92	1.35	.3	.....	.....	.....
24	.....	−1.0	.4	.3	13.45	.....	1.0	.3	−1.25	−1.8	.....
25	.2	.....	.....	.3	12.55	10.15	.9	.2	−1.65	.....	.....
26	.....	−1.0	.4	.3	12.35	9.2	.9	.....	−1.8	−1.8	.....
27	.8	.....	.4	.....	12.05	8.3	.8	.85	−1.8	.....	.....
28	.....	− .9	.....	.3	12.05	7.1	.....	1.85	−1.6	.....	.....
29	1.2	.....	.4	.4	.....	5.8	.55	1.35	−1.7	−1.8	.....
30	.....	.....	.....	.3	.....	4.8	.95	.....	.....	−1.8	.....
31	1.4	.....	.4	.3	.....	.....	.....	.8	.....	−1.8	.....

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, 1918

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, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	620	1,110	1,244	828	967	4,500	5,275	2,270	4,800	930	675	700
2	636	1,110	2,025	821	967	4,700	5,060	2,246	3,285	1,140	646	730
3	646	1,098	1,985	838	967	4,700	4,800	2,230	2,875	1,080	620	760
4	646	1,080	1,905	838	967	4,205	4,250	2,230	2,400	1,050	566	786
5	675	1,038	1,921	821	967	3,905	3,520	2,230	1,785	1,020	566	786
6	700	990	1,921	787	967	3,800	3,285	2,105	1,705	1,002	566	815
7	700	960	1,905	770	967	3,620	3,285	2,065	1,600	990	582	930
8	700	930	1,985	770	948	3,330	3,031	2,025	2,270	930	566	990
9	690	882	1,093	762	928	3,255	2,700	2,025	1,235	930	566	930
10	675	870	1,020	758	928	3,225	2,400	1,985	1,221	845	582	900
11	690	870	928	758	948	3,480	2,270	1,945	1,200	815	592	845
12	700	882	1,000	750	983	3,620	2,025	1,905	1,182	786	603	815
13	712	918	1,032	750	1,112	3,905	1,865	1,865	1,170	760	592	815
14	700	930	1,130	770	1,244	4,825	1,825	1,825	1,170	730	592	821
15	706	930	1,300	794	1,308	5,790	1,825	1,825	1,166	700	603	845
16	712	900	1,390	814	1,855	5,520	1,865	1,865	1,140	700	620	815
17	730	918	1,410	821	2,330	5,490	1,865	1,865	1,020	690	646	786
18	730	930	1,300	828	2,300	5,790	1,825	1,825	930	675	646	760
19	748	900	1,244	838	2,275	6,180	1,825	1,801	900	658	658	748
20	748	900	1,112	838	2,250	7,650	2,400	1,785	845	658	675	700
21	760	942	967	866	2,100	10,000	4,100	1,745	815	646	700	663
22	786	930	948	928	2,125	9,600	4,250	1,785	786	646	700	646
23	815	930	928	928	2,250	8,200	4,400	1,825	760	690	700	636
24	900	1,300	928	928	2,430	7,400	4,250	1,985	760	815	700	620
25	930	1,441	910	928	2,670	5,870	3,475	2,875	748	845	700	620
26	930	1,432	891	948	3,055	5,790	2,610	4,050	730	930	690	592
27	942	1,423	871	967	3,855	5,600	2,315	7,109	730	990	680	582
28	990	1,390	861	983	4,390	5,500	2,306	9,075	700	990	685	582
29	1,020	1,365	858	967	.....	5,450	2,270	8,700	730	900	690	566
30	1,050	1,300	838	948	.....	5,400	2,270	7,735	730	845	690	566
31	1,098	.....	838	967	.....	5,300	.....	6,930	.....	760	700	.....

Monthly discharge of Tittabawassee River at Freeland, Mich., for the year ending Sept. 30, 1918.

[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	1,098	620	777	0.307	0.35
November	1,441	870	1,050	.415	.46
December	2,025	838	1,250	.494	.57
January	983	750	849	.336	.39
February	4,390	928	1,750	.692	.72
March	10,000	3,225	5,340	2.11	2.43
April	5,275	1,825	2,980	1.18	1.32
May	9,075	1,745	3,020	1.19	1.37
June	4,800	700	1,380	.545	.61
July	1,140	646	843	.333	.38
August	700	566	639	.253	.29
September	990	566	745	.294	.33
The year	10,000	566	1,720	.680	9.22

NOTE.—Monthly and yearly discharge computed by United States Geological Survey.

STREAMS TRIBUTARY TO LAKE ERIE.

HURON RIVER AT BARTON, MICH.

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

DRAINAGE AREA.—723 square miles.

RECORDS AVAILABLE.—January 1 to September 30, 1918.

DETERMINATION OF DISCHARGE.—Flow computed from records of operation of power plant, the flow through under-sluice 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.—Daily-discharge record 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, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	164	478	222	196	150	2,499	914	518	255	177	91	70
2	155	420	205	189	155	2,602	922	523	245	106	88	85
3	162	406	280	192	136	2,686	941	442	256	98	83	69
4	166	385	203	217	145	2,568	899	516	211	68	18	133
5	158	419	228	156	153	2,370	857	442	214	111	92	160
6	182	376	231	168	150	2,185	786	433	207	117	79	112
7	163	331	221	175	164	1,939	778	459	186	70	89	134
8	215	317	211	186	160	1,811	812	403	180	108	84	119
9	143	346	152	188	165	1,729	733	393	198	99	85	168
10	134	326	220	179	202	1,720	660	412	194	101	49	113
11	170	313	179	177	242	1,487	532	411	178	102	40	177
12	171	314	206	167	575	1,765	608	418	174	97	87	142
13	146	314	191	103	862	2,459	564	508	166	112	92	111
14	161	278	219	183	1,338	5,841	521	581	163	59	97	131
15	185	340	160	163	2,424	4,138	538	502	160	98	97	139
16	169	264	210	156	1,642	3,603	426	441	143	153	90	175
17	194	313	190	158	1,378	3,497	505	452	149	77	74	147
18	217	305	217	159	1,326	3,382	545	458	162	108	48	151
19	235	290	194	149	1,928	3,286	594	415	145	104	87	152
20	266	298	189	145	2,197	2,822	551	426	158	109	96	141
21	262	272	261	146	2,249	2,555	567	346	136	48	126	160
22	285	289	277	140	1,914	2,197	576	346	135	100	92	102
23	297	273	315	144	1,668	2,142	891	309	44	105	81	146
24	364	273	326	143	1,661	1,759	464	294	135	95	68	175
25	368	250	246	146	2,467	1,577	501	331	129	97	18	130
26	364	273	312	151	3,806	1,346	482	226	107	109	72	137
27	373	255	243	117	3,194	1,335	503	264	119	94	35	142
28	413	221	213	167	2,776	1,205	426	284	100	22	61	151
29	458	254	218	187	.....	1,145	504	222	98	96	54	108
30	515	266	220	151	.....	981	489	272	65	120	68	129
31	476	.....	232	146	.....	917	.....	281	.....	94	68	.....

Monthly discharge of Huron River at Barton, Mich., for the year ending Sept. 30, 1918.

[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	515	134	249	0.344	0.40
November	478	221	315	.436	.49
December	326	152	226	.313	.36
January	217	103	163	.225	.26
February	3,806	136	1,260	1.74	2.01
March	5,841	917	2,310	3.20	3.69
April	941	426	636	.880	.98
May	581	222	398	.550	.63
June	256	44	160	.221	.25
July	177	22	98.5	.136	.16
August	126	18	74.5	.103	.12
September	177	69	134	.185	.21
The year	5,841	18	498	.689	9.56

NOTE.—Monthly and yearly discharge computed by United States Geological Survey.

HURON RIVER AT FLAT ROCK, MICH.

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

DRAINAGE AREA.—1,000 square miles.

RECORDS AVAILABLE.—August 6, 1904, to September 30, 1918.

GAGE.—Staff; read daily to tenths, occasionally to half tenths twice daily, by John Vincent.

DISCHARGE MEASUREMENTS.—Made from downstream side of bridge.

CHANNEL AND CONTROL.—Probably permanent.

EXTREMES OF STAGE.—Maximum stage during year above 11 feet (water over gage) March 15; minimum stage recorded, 0.9 foot, several days in July and August.

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.

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

Daily gage height, in feet, Huron River at Flat Rock, Mich., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.6	2.8	1.75	2.6	2.8	9.62	4.62	3.1	1.65	1.45	1.6	.....
2	1.4	2.65	1.6	2.45	3.0	9.1	4.6	2.7	.....	1.45	1.35	1.55
3	1.65	2.55	1.5	2.35	2.8	9.8	4.65	2.7	1.7	1.4	1.5	1.3
4	1.5	2.2	1.8	2.55	2.8	9.78	4.5	2.5	1.8	.....	.....	1.4
5	1.55	1.95	1.8	2.5	2.8	9.4	4.4	.....	1.85	1.4	1.15	1.55
6	1.65	2.45	1.75	2.4	2.8	8.88	4.25	2.35	1.7	1.05	.95	1.6
7	1.5	2.1	1.6	2.2	2.8	8.7	4.0	2.35	2.0	.....	1.2	1.65
8	1.35	2.1	1.6	2.35	2.8	8.38	3.7	2.6	1.55	1.2	1.35	.....
9	1.6	1.9	1.8	2.6	2.9	7.78	3.6	2.1	.....	1.2	1.35	1.5
10	1.4	1.9	1.75	2.45	2.8	7.7	3.5	2.2	1.55	1.5	1.25	1.6
11	1.4	1.9	1.65	2.55	2.75	7.4	3.4	2.5	1.6	1.4	.....	1.6
12	1.55	1.75	2.15	2.8	3.7	7.05	2.9	2.5	1.45	1.35	1.4	1.6
13	1.4	2.0	1.9	2.8	5.15	7.1	3.0	2.6	1.45	1.3	1.4	1.5
14	1.6	1.9	2.0	2.3	7.0	8.12	2.8	2.8	1.4	.....	1.2	1.45
15	1.35	1.85	1.95	2.2	8.4	.....	2.75	2.9	1.45	1.0	1.3	.....
16	1.6	1.9	1.8	3.0	8.75	9.3	2.85	2.35	.....	1.05	1.4	1.4
17	1.6	1.8	1.7	2.8	9.3	8.8	2.19	2.5	.....	1.25	1.45	1.45
18	1.7	1.8	2.2	2.6	8.8	8.52	2.9	2.3	.....	1.3	.....	1.7
19	1.65	1.75	2.3	2.7	8.25	8.4	3.1	.....	.....	1.35	1.45	1.6
20	2.0	2.2	2.25	2.6	8.55	8.28	2.95	2.1	.....	1.35	1.0	1.6
21	1.6	1.9	2.5	2.4	9.25	8.08	2.9	2.1	.....	.....	1.05	1.6
22	1.65	2.0	2.7	2.5	9.75	7.8	3.05	1.9	.....	1.5	1.45	.....
23	2.0	1.9	2.6	2.5	8.95	7.5	3.1	1.7	.....	1.35	1.35	1.3
24	1.95	1.65	2.1	2.4	8.62	7.1	2.25	1.75	1.4	1.53	1.6	1.45
25	2.05	1.5	2.8	2.7	8.3	6.72	2.5	2.25	1.4	1.5	.....	1.6
26	2.0	1.6	2.65	2.6	8.52	6.25	2.1	.....	1.35	1.5	1.45	1.45
27	2.2	1.7	2.55	2.6	9.58	6.02	2.0	1.9	1.3	1.45	1.05	1.55
28	2.2	1.8	2.5	2.4	10.4	5.6	2.0	1.6	1.5	.....	1.2	1.55
29	2.7	1.8	2.5	2.5	.....	4.25	2.6	2.05	1.35	1.2	1.45	.....
30	3.05	1.85	2.2	2.7	.....	5.1	3.25	.....	1.4	1.05	1.5	1.45
31	3.0	.....	2.05	2.85	.....	4.7	.....	1.8	.....	1.5	1.4	.....

CATTARAUGUS CREEK AT VERSAILLES, N. Y.

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

DRAINAGE AREA.—467 square miles (measured on post-route map).

RECORDS AVAILABLE.—September 23, 1910, to September 30, 1918.

GAGE.—Chain, on upstream side of right span of bridge; read by Charles Wilson.

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, 12.0 feet at 8 a. m. February 23 (stage-discharge relation affected by ice, discharge not computed); minimum stage recorded during year, 4.35 feet several times in August (discharge about 49 second-feet).

1910–1918: Maximum open-water stage recorded, 11.6 feet at 5.40 p. m., March 25, 1913 (discharge, about 30,000 second-feet); minimum stage recorded 4.35 feet several times in August, 1918 (discharge, about 49 second-feet).

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

ACCURACY.—Stage-discharge relation not permanent; affected by ice during much of the period from December to March. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily effective gage height to rating table. Records fair.

Discharge measurements of Cattaraugus Creek at Versailles, N. Y., during the year ending Sept. 30, 1918.

[Made by E. D. Burchard.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1911.	*Feet.*	*Sec.-ft.*	1912.	*Feet.*	*Sec.-ft.*
Jan. 22[a]	6.43	232	Aug. 22	4.45	78.1
Mar. 1	6.18	1,950	22	4.50	78.4
May 29	4.99	333	22	4.60	117
29	4.99	347			

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Cattaraugus Creek at Versailles, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	190	1,900	1,400	380	220	1,800	480	300	280	240	180	120
2	170	1,500	1,000	340	220	1,100	650	280	240	220	150	85
3	190	1,300	650	340	220	1,500	550	240	200	180	140	85
4	1,600	1,100	600	360	220	950	500	240	200	150	140	100
5	1,200	1,000	500	360	220	2,400	460	240	200	150	160	160
6	1,000	900	480	340	220	4,000	400	240	220	120	130	300
7	800	900	420	320	220	1,800	380	280	200	130	85	170
8	380	750	280	320	220	1,000	380	380	200	110	100	110
9	380	700	280	320	380	1,200	420	280	170	140	130	110
10	340	700	320	320	1,500	2,000	340	320	200	220	150	65
11	280	650	380	320	3,200	1,400	380	500	180	280	140	100
12	300	600	400	320	1,700	1,400	420	380	500	200	180	85
13	500	550	480	320	2,000	3,400	420	460	440	160	140	140
14	850	500	550	300	2,200	16,000	900	700	320	150	120	180
15	900	500	550	300	2,600	4,000	800	400	260	100	80	150
16	1,100	550	600	260	1,500	1,400	600	300	200	120	55	170
17	650	550	650	260	1,000	1,200	480	300	200	140	65	440
18	420	500	750	240	800	1,200	800	280	200	120	80	360
19	1,100	550	850	240	900	1,100	600	240	170	110	65	320
20	2,100	500	1,200	240	2,600	1,400	460	1,000	160	100	80	550
21	900	480	2,400	240	1,500	1,400	400	550	160	100	75	420
22	700	550	2,200	240	2,200	1,200	550	340	340	85	80	380
23	650	750	1,500	240	4,400	950	600	900	420	95	110	360
24	1,600	650	1,500	240	4,400	750	550	440	300	95	80	340
25	3,600	500	3,400	240	3,900	700	500	340	240	340	65	440
26	2,800	500	1,700	240	7,000	600	400	950	180	160	80	300
27	5,500	380	1,000	240	2,000	600	380	650	180	130	65	440
28	6,000	550	800	220	1,800	600	320	420	160	220	65	500
29	8,500	500	550	220	.....	550	300	300	170	160	95	320
30	10,000	550	500	220	.....	550	300	300	180	800	160	260
31	3,400	.....	440	220	.....	500	.....	280	.....	280	85	.....

NOTE.—Stage-discharge relation affected by ice Dec. 10, to Feb 25.

Monthly discharge of Cattaraugus Creek at Versailles, N. Y., for year ending Sept. 30, 1918.

[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	10,000	170	1,870	4.00	4.61
November	1,900	380	720	1.54	1.72
December	3,400	280	914	1.96	2.26
January	380	220	282	.631	.73
February	4,400	220	1,760	3.78	3.94
March	16,000	500	1,890	4.05	4.67
April	900	300	491	1.05	1.17
May	1,000	240	414	.877	1.01
June	500	160	236	.505	.56
July	800	85	181	.388	.45
August	180	55	107	.229	.26
September	550	65	252	.540	.60
The year	16,000	55	756	1.62	21.98

STREAMS TRIBUTARY TO LAKE ONTARIO.

LITTLE TONAWANDA CREEK AT LINDEN, N. Y.

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

DRAINAGE AREA.—22.0 square miles (measured on topographic maps).

RECORDS AVAILABLE.—July 8, 1912, to September 30, 1918.

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

DISCHARGE MEASUREMENTS.—Made from 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, constructed under the upstream side of the bridge, formed the control until February 20, 1918, when it was entirely destroyed by ice and has not since been replaced. When the water overtopped this weir it flowed over a 2-inch plank about 13 feet long, including the 2 feet of weir. The section of the channel that forms the control since the destruction of the weir is of coarse gravel and boulders and is probably permanent between dates of shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.45 feet at 8 p. m. February 19 (stage-discharge relation affected by ice; discharge not determined); minimum stage recorded, −0.46 foot at 8 p. m. August 20 (discharge, 0.5 second-foot).

1912–1918: Maximum stage determined by leveling from flood marks, 14.6 feet during the flood of April 22, 1916 (discharge about 2,400 second-feet); minimum stage recorded, 0.18 foot August 20 and 21, September 14–16, and October 8, 1913 (discharge, 0.43 second-foot).

ACCURACY.—Stage-discharge relation changed when weir was destroyed on February 20. Rating curve for weir in good condition, well defined up to 250 second-feet and fairly well defined between 250 and 750 feet; rating curve for period after the weir was destroyed fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for period when weir was in good condition and fairly good for remainder of year.

Discharge measurements of Little Tonawanda Creek near Linden, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Mar. 4	E. D. Burchard	0.26	41	Mar. 19	E. D. Burchard	1.18	147
19	do	.86	106	May 31	do	— .24	6.8
19	do	.94	116	31	do	— .24	6.8
19	do	1.02	128	July 23	C. C. Covert	— .39	.70
19	do	1.12	140	Aug. 21	E. D. Burchard	— .47	.60

Daily discharge, in second-feet, of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.
1	1.51	51	43	9.0	4.2	33	25	9.2	5.9	5.9	1.2	0.9
2	1.45	41	21	8.4	4.6	105	43	8.7	4.7	4.3	1.0	.8
3	1.51	34	12	7.8	3.6	52	25	8.2	4.0	3.2	1.0	.6
4	2.25	27	11	7.2	3.6	38	18	7.8	3.8	3.0	1.2	.6
5	2.86	24	10	6.6	3.48	79	15	7.4	3.8	2.7	1.3	1.3
6	3.28	21	9.7	6.6	3.6	203	14	6.6	5.9	2.1	1.0	1.2
7	2.38	19	8.4	7.2	4.6	50	13	7.4	7.4	2.1	.9	.8
8	2.12	16	8.7	6.6	5.1	56	16	8.2	5.1	2.1	.9	.8
9	2.25	16	6.1	6.6	6.1	32	14	7.0	4.3	2.7	1.9	.6
10	2.18	15	7.2	6.6	9.7	158	13	22	5.1	3.2	1.3	.6
11	2.12	13	9.0	7.2	25	77	14	17	4.3	2.7	3.2	.6
12	2.32	13	9.0	7.8	.....	585	15	14	75	2.7	.9	.8
13	3.36	12	9.0	6.6	.....	203	38	15	21	2.1	.8	1.5
14	7.8	11	9.0	6.4	.....	740	44	12	16	1.9	.8	.9
15	8.4	12	9.0	6.1	.....	97	25	9.2	11	1.9	.8	.9
16	9.7	13	8.1	6.1	.....	63	15	8.2	7.4	1.9	.6	1.6
17	6.1	13	8.1	5.9	.....	73	22	7.4	5.9	1.9	.6	2.1
18	5.6	13	8.1	5.6	.....	65	80	6.6	5.1	1.6	.6	1.3
19	12	13	8.4	5.3	.....	110	32	6.2	4.0	1.6	.6	1.6
20	19	12	13	5.6	.....	108	21	5.9	3.8	1.6	.5	3.8
21	11	12	35	5.6	.....	71	21	5.1	4.3	1.3	.6	3.0
22	7.2	17	39	5.1	.....	60	25	5.1	8.2	1.3	1.3	2.1
23	7.8	18	23	5.1	.....	42	19	6.6	7.4	1.3	.8	1.6
24	154	13	37	5.1	.....	32	19	5.1	5.9	1.3	.8	2.7
25	164	12	59	4.6	.....	30	17	5.9	4.3	1.3	.8	3.2
26	154	11	24	4.9	115	25	14	22	3.8	1.3	.6	3.2
27	135	10	18	4.9	88	21	13	15	3.5	1.2	.6	3.2
28	135	10	13	4.9	46	26	11	10	3.2	1.0	.6	3.2
29	144	10	12	4.6	.....	25	10	7.8	3.0	2.1	.9	2.7
30	288	14	11	4.2	.....	26	9.2	8.2	3.0	2.1	.8	2.4
31	83	.....	9.7	4.4	.....	25	.....	6.6	.....	1.5	1.0	.....

NOTE.—Discharge Feb. 12–25 estimated at 141 second-feet because of ice.

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Monthly discharge of Little Tonawanda Creek at Linden, N. Y., for the year ending Sept. 30, 1918.

[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	288	1.45	44.6	2.03	2.34
November	51	10	17.2	.782	.87
December	59	6.1	16.9	.768	.86
January	9.0	4.2	6.1	.277	.32
February	----------	3.48	82	3.73	3.88
March	740	21	107	4.86	5.60
April	80	9.2	22	1.00	1.12
May	22	5.1	9.39	.427	.49
June	75	3.0	8.34	.379	.42
July	5.9	1.0	2.16	.098	.11
August	3.2	.5	.964	.044	.05
September	3.8	.6	1.69	.077	.09
The year	740	.5	26.2	1.19	16.15

GENESEE RIVER AT SCIO, N. Y.

LOCATION.—At steel highway bridge half a mile above Vandermark Creek, half a mile above Scio, Allegheny County, and a mile above Knight Creek.

DRAINAGE AREA.—297 square miles (measured on maps issued by United States Geological Survey; scale, 1:500,000.)

RECORDS AVAILABLE.—June 12, 1916, to September 30, 1918.

GAGE.—Vertical staff attached to downstream face of left bridge abutment; read by Raymond Sisson until November 3, and by Miss Retta B. Potter, after that date.

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

CHANNEL AND CONTROL.—Coarse gravel; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 9.0 feet at 8 a. m. March 14 (discharge, 10,400 second-feet); minimum discharge 34 second-feet, January 20.

1916–1918: Maximum stage recorded, that of March 14, 1918; minimum discharge recorded, 25 second-feet, August 25 and 26, 1916.

ICE.—Stage-discharge relation affected by ice.

ACCURACY.—Stage-discharge relation practically permanent, except as affected by ice December 7 to February 13. Rating curve well defined between 25 and 5,500 second-feet. Gage read to hundredths twice daily; gage-height record unreliable, April 27 to May 22, and June 14–20. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except those for period of ice effect and for periods in which gage-height record was unreliable, which are fair.

Discharge measurements of Genesee River at Scio, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 22[a]	E. D. Burchard	1.83	186	June 21	E. D. Burchard	0.74	74
Jan. 19[a]	do	2.05	55	21	do	.74	73
Mar. 5	do	2.02	609	Aug. 23	do	.69	56.7
May. 27	J. W. Moulton	1.61	346	23	do	.69	58.2

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at Scio, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	61	1,150	361	120	46	6,300	572	460	465	345	61	178
2	74	2,680	312	100	46	1,360	545	440	279	322	41	74
3	64	1,310	265	120	46	1,150	920	360	218	300	41	71
4	91	690	198	95	46	780	850	340	200	279	41	66
5	265	545	178	85	46	660	660	340	238	258	440	74
6	121	386	158	75	46	1,680	600	360	322	238	147	264
7	98	438	180	75	46	780	572	400	518	218	87	147
8	88	438	120	75	46	690	600	360	415	200	87	116
9	118	386	140	70	60	750	720	320	518	200	147	113
10	101	336	140	70	160	815	750	320	518	132	102	113
11	88	336	160	65	380	750	850	320	415	74	218	116
12	202	288	120	70	1,300	1,150	815	500	415	61	147	116
13	312	242	120	65	1,800	1,490	780	650	279	41	147	147
14	190	265	140	65	1,310	10,000	690	550	200	61	147	164
15	361	242	160	60	2,800	2,300	780	440	150	41	147	147
16	490	220	140	65	1,310	1,070	1,490	340	120	41	147	141
17	312	242	160	60	1,150	885	1,490	300	85	41	116	300
18	251	198	160	150	990	750	1,880	260	60	61	116	258
19	1,580	265	140	55	750	720	1,880	340	60	41	116	218
20	2,680	158	140	34	8,070	720	1,990	600	60	41	87	2,540
21	1,150	178	100	38	990	720	1,780	550	77	41	87	750
22	850	220	180	42	850	750	1,580	500	322	41	87	518
23	990	242	240	46	780	750	1,230	1,310	279	41	61	440
24	2,100	265	500	48	815	750	750	780	258	41	61	390
25	2,100	312	440	46	720	720	720	440	200	61	61	345
26	1,880	312	220	46	4,560	630	600	518	200	61	41	300
27	3,570	336	150	46	1,150	600	550	440	200	41	41	300
28	4,130	312	140	46	815	630	500	390	181	41	39	238
29	3,440	336	110	46	.....	600	460	465	181	41	43	238
30	2,920	312	130	16	.....	572	440	465	238	61	74	218
31	1,680	.....	120	46	.....	572	.....	390	.....	61	119	.....

NOTE.—Discharge, Dec. 7 to Feb. 13 estimated, because of ice, from discharge measurements, weather records, study of gage-height graph, and comparison with records for stations downstream. Discharge Apr. 27 to May 22, and June 14–20, estimated by comparison with records of flow at St. Helena.

Monthly discharge of Genesee Rivver at Scio, N. Y., for year ending Sept. 30, 1918.

[Drainage area, 297 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	4,130	61	1,040	3.50	4.04
November	2,680	158	455	1.53	1.71
December	500	100	188	.633	.73
January	150	34	67	.226	.26
February	8,070	46	1,110	3.74	3.90
March	10,000	572	1,360	4.58	5.28
April	1,990	440	935	3.15	3.51
May	1,310	260	460	1.55	1.79
June	518	60	256	.862	.96
July	345	41	114	.384	.44
August	440	39	106	.357	.41
September	2,540	66	303	1.02	1.14
The year	10,000	34	529	1.78	24.17

GENESEE RIVER AT ST. HELENA, N. Y.

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

DRAINAGE AREA.—1,030 square miles.

RECORDS AVAILABLE.—August 14, 1908, to September 30, 1918.

GAGE.—Stevens continuous water-stage recorder on left bank just below bridge and a chain gage fastened to the upstream side of the bridge; middle-span chain gage installed August 14, 1908; water-stage recorder installed August 24, 1911. Water-stage recorder inspected by C. S. De Golyer. Chain gage read by Herman Piper.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.4 feet at 5 p. m. March 14 (discharge about 29,500 second-feet); minimum stage recorded, 2.00 feet at 7 a. m. July 26 and 6 p. m. August 30 (discharge, 40 second-feet).

1908–1918: Maximum stage, from water-stage recorder, 12.81 feet at 8 a. m. May 17, 1916 (discharge, 43,500 second-feet); minimum stage recorded, 1.70 feet at 5 p. m. October 5 and 8 a. m. October 17, 1913 (discharge, approximately 18 second-feet).

ICE.—Stage discharge relation somewhat affected by ice.

ACCURACY.—Stage-discharge relation not permanent. Rating curve well defined between 75 and 2,000 second-feet and fairly well defined between 2,000 and 30,000 second-feet. Chain gage read to quarter-tenths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table, except for days of great range in stage, when it was determined by averaging the results obtained by applying gage heights for two-hour periods to rating table. Records fair.

Discharge measurements of Genesee River at St. Helena, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 29	C. S. De Golyer	7.68	10,800	Apr. 27	D. S. De Golyer	3.55	880
Nov. 2	E. D. Burchard	4.97	2,950	May 25	J. W. Moulton	3.44	774
14	D. S. De Golyer	3.24	690	30	C. S. De Golyer	3.16	588
Dec. 12[a]	do	3.52	379	June 27	do	2.76	319
Jan. 8[b]	do	3.87	238	July 13	E. D. Burchard	2.51	194
25[b]	do	3.84	146	13	do	2.50	191
Feb. 8[b]	do	3.68	153	25	C. S. De Golyer	2.15	71
13	do	7.53	9,860	Aug. 21	E. D. Burchard	2.40	144
Mar. 9	do	4.56	2,200	28	C. S. De Golyer	2.10	57.6
13	do	6.15	5,750	Sept. 20	do	3.23	579
15	do	9.78	19,300				

[a] Measurement made through partial ice cover. [b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	245	3,980	760	220	150	5,320	790	555	520	257	132	109
2	268	2,950	1,040	200	190	5,320	882	628	425	262	140	103
3	261	2,420	670	190	170	4,100	882	555	401	199	126	182
4	511	1,980	590	200	160	2,100	980	488	346	182	115	136
5	895	1,640	590	200	140	2,260	930	455	329	186	225	182
6	805	1,440	475	260	240	5,850	745	443	351	154	451	214
7	630	1,290	392	240	190	3,660	665	488	384	154	293	335
8	510	1,120	309	240	170	1,960	665	555	431	91	209	282
9	573	1,000	221	280	170	2,180	790	443	384	170	190	214
10	622	940	240	190	180	10,400	980	520	346	150	186	209
11	489	868	320	240	240	3,050	790	590	329	190	178	166
12	447	760	360	260	850	3,050	745	590	745	182	281	228
13	820	670	240	220	15,400	6,420	882	665	835	174	257	218
14	931	670	240	220	4,810	26,000	2,480	930	530	147	204	346
15	796	630	300	260	10,400	14,800	5,530	705	407	149	182	329
16	1,540	805	220	220	3,450	3,840	4,060	555	335	134	278	329
17	1,150	590	320	240	1,680	2,830	2,830	443	329	126	228	373
18	823	510	280	220	1,140	2,830	5,010	395	292	123	190	1,130
19	1,090	590	280	280	1,300	3,020	2,650	384	247	122	166	1,080
20	9,170	550	240	150	9,000	2,830	1,930	455	232	111	154	835
21	3,830	630	380	240	4,810	2,830	1,590	882	228	112	140	2,100
22	2,180	630	650	300	1,810	2,830	1,860	745	419	106	143	1,080
23	1,690	760	750	220	1,360	2,150	1,590	1,240	1,030	109	129	808
24	4,470	670	750	190	1,540	1,590	1,470	1,180	628	103	122	650
25	8,820	380	1,200	130	1,420	1,350	1,300	745	455	100	115	628
26	7,040	447	1,100	190	11,500	1,180	1,030	745	362	97	110	605
27	10,700	332	650	170	4,100	1,030	882	1,130	308	143	104	808
28	12,000	440	440	170	3,050	930	745	835	247	122	98	781
29	10,800	428	360	160	.....	882	665	590	257	109	103	628
30	12,300	496	320	170	.....	835	628	555	242	122	115	507
31	6,500	.....	260	180	.....	835	.....	665	.....	136	103	.....

NOTE.—Discharge Nov. 11 to July 13 and Aug. 31 to Sept. 20 determined from chain-gage heights. Discharge Dec. 10 to Feb. 12 estimated, because of ice, from discharge measurements, weather records, study of gage-height graph and comparison with records for stations at Scio and Jones Bridge. Discharge Feb. 20 estimated by comparison with station at Jones Bridge.

Monthly discharge of Genesee River at St. Helena, N. Y., for the year ending Sept. 30, 1918.

[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	12,300	245	3,320	3.22	3.71
November	3,980	332	1,020	.990	1.10
December	1,200	220	482	.468	.54
January	300	130	215	.209	.24
February	15,400	140	2,840	2.76	2.87
March	26,000	835	4,140	4.02	4.64
April	5,530	628	1,570	1.52	1.70
May	1,240	384	650	.631	.73
June	1,030	228	412	.400	.45
July	262	91	146	.142	.16
August	451	98	176	.171	.20
September	2,100	103	520	.505	.56
The year	26,000	91	1,280	1.24	16.90

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

LOCATION.—At highway bridge known as Jones Bridge, 1½ miles below Canaseraga Creek, 1¾ miles above mouth of Beads Creek, 5 miles below Mount Morris, Livingston County, and 6 miles by river above 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, 1918.

GAGE.—Gurley seven-day water-stage recorder installed September 11, 1915, on the right bank about 60 feet downstream from the bridge. Prior to 1915, a chain gage fastened to upstream side of highway bridge was used. Datum of water-stage recorder is 2.73 feet higher than that for the former chain gage (540.00 feet Conservation Commission datum). Water-stage recorder inspected by Theron S. Trewer.

DISCHARGE MEASUREMENTS.—Made from footbridge erected on the lower chord of the truss at the upstream side of the 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 estimated from record 25.5 feet at 3.30 a. m. February 21 (stage-discharge relation affected by ice; discharge not determined); minimum stage, 0.45 foot at 1 a. m. July 25 (discharge 63 second-feet).

1903–1918 (not including periods of no record; see "Records available"): Maximum stage recorded 25.44 feet at noon May 17, 1916 (discharge, 54,500 second-feet); minimum stage recorded, 2.7 feet at 6 p. m. August 29, 1909 (discharge about 18 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—During extreme low water there is some diurnal fluctuation in flow caused by mills at Mount Morris.

ACCURACY.—Stage-discharge relation practically permanent during the year except as affected by ice December 8 to March 22. Rating curve well-defined between 150 and 7,000 second-feet and fairly well defined between 7,000 and 60,000 second-feet. Operation of the water-stage recorder satisfactory throughout the year. Daily discharge ascertained by applying to the rating table mean daily gage height determined by inspecting the recorder graph, or for days of considerable fluctuation by use of discharge integrator. Records good.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 1	E. D. Burchard	11.12	6,040	Feb. 26[b]	E. D. Burchard	22.0	11,700
1	J. W. Moulton	10.12	5,320	27[b]	do	21.5	8,400
2	do	7.40	3,900	Mar. 2[b]	do	19.21	6,970
Dec. 19[a]	E. D. Burchard	2.98	530	4[b]	do	15.0	4,120
Jan. 16[a]	do	2.59	318	15	do	24.2	[c]28,300
Feb. 11[b]	do	2.96	313	18	do	8.90	4,890
13[b]	do	12.4	3,700	19	do	7.08	3,770
14[b]	do	21.42	6,860	May 23	do	3.21	1,190
15[b]	do	21.60	8,450	July 12	do	1.36	292
16[b]	do	21.9	7,920	Aug. 21	do	.91	159

[a] Measurement made through complete ice cover.
[b] Ice jam on control.
[c] Includes overflow of 6,300 second-feet on left bank

Daily discharge, in second-feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	305	7,050	892	440	280	5,000	1,200	892	840	365	165	140
2	353	4,200	1,330	440	280	7,000	1,200	892	690	357	162	204
3	365	3,240	1,030	420	280	6,000	1,300	865	615	327	155	213
4	502	2,750	865	420	280	4,200	1,360	815	565	278	126	226
5	1,080	2,280	815	380	260	3,600	1,420	790	515	305	162	210
6	1,030	2,020	690	360	240	4,800	1,140	765	506	238	413	238
7	740	1,840	590	320	260	5,500	1,000	740	535	155	425	258
8	640	1,660	650	320	260	3,000	1,030	1,000	540	273	295	319
9	690	1,480	600	300	300	4,570	1,140	840	590	258	285	302
10	740	1,300	600	300	320	8,310	1,420	865	515	275	298	278
11	615	1,220	600	300	440	10,700	1,170	1,140	492	269	229	271
12	560	1,140	600	320	1,600	9,700	1,170	1,030	740	255	281	258
13	857	1,080	600	320	5,800	12,500	1,220	1,000	1,250	235	353	229
14	1,060	975	600	320	7,500	21,600	2,790	1,280	840	190	281	264
15	840	948	550	320	8,000	22,200	6,790	1,200	665	236	248	369
16	1,540	920	550	320	7,500	12,100	4,970	948	535	223	241	369
17	1,320	920	550	320	5,500	7,980	3,760	815	466	216	316	425
18	920	865	550	320	3,800	4,500	5,740	740	466	188	245	1,470
19	1,120	840	500	320	3,200	3,500	4,270	665	399	167	248	892
20	10,500	815	500	320	8,500	3,800	2,820	690	341	164	238	867
21	5,080	790	650	400	9,000	3,700	2,280	1,220	349	135	213	2,570
22	2,680	815	900	420	6,500	3,600	2,410	1,250	461	136	181	1,420
23	1,960	920	1,000	380	4,800	3,170	2,410	1,250	1,120	133	168	1,030
24	4,740	920	1,100	340	3,600	2,380	2,020	1,720	920	130	133	865
25	13,700	740	1,500	340	3,400	2,000	1,840	1,140	690	216	140	765
26	10,800	665	2,000	340	6,500	1,700	1,600	1,440	535	145	.....	715
27	13,200	615	1,500	300	7,500	1,600	1,300	1,840	448	131	.....	892
28	16,500	615	1,000	300	6,000	1,400	1,110	1,480	399	153	.....	1,000
29	15,100	690	750	320	.....	1,400	1,080	1,030	365	181	.....	790
30	17,300	715	550	320	.....	1,300	920	948	323	163	.....	640
31	14,100	.....	500	320	.....	1,300	.....	948	.....	164	140	.....

NOTE.—Discharge Dec. 8 to Mar. 22 estimated, because of ice, from discharge measurements, weather records, study of gage height graph and comparison with records for St. Helena and Rochester. Discharge Aug. 26–30 estimated 140 second-feet.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for year ending Sept. 30, 1918.

[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.	
October	17,300	305	4,550	3.23	3.72
November	7,050	615	1,500	1.06	1.18
December	2,000	500	810	.575	.66
January	440	300	344	.244	.28
February	9,000	240	3,640	2.58	2.69
March	22,200	1,300	5,940	4.21	4.85
April	6,790	920	2,130	1.51	1.69
May	1,840	665	1,040	.738	.85
June	1,250	323	590	.418	.47
July	365	130	215	.152	.18
August	425	126	221	.157	.18
September	2,570	140	616	.437	.49
The year	22,200	126	1,790	1.27	17.74

GENESEE RIVER AT ROCHESTER, N. Y.

LOCATION.—At Elmwood Avenue Bridge, at north end of South Park, 3¼ miles below mouth of Black Creek, 3½ miles above center of 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, 1918. 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 the pump house immediately below the bridge on the right bank. Recorder inspected by Geo. A. Bailey. Prior to December, 1910, a staff gage bolted to the downstream end of the first pier from the right abutment. Elevation of zero of gage 506.848 feet, barge canal datum, and 245.591 feet, Rochester city datum.

DISCHARGE MEASUREMENTS.—Made from downstream side of the bridge. Prior to 1904, measurements and elevation of water surface taken in conjunction with the city of Rochester.

CHANNEL AND CONTROL.—Smooth gravel; practically permanent until May, 1918, when dredging operations for the barge canal were begun near the control. These operations were continued through the summer, causing a gradual change in the stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 10.97 feet at 9.15 p. m., March 16 (discharge, 27,900 second-feet); minimum discharge about 110 second-feet during afternoons of July 21 and 22.

1904–1918: Maximum stage, from water-stage recorder, 12.3 feet at midnight March 30, 1916 (discharge, 48,300 second-feet); minimum discharge, July 21 and 22, 1918.

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 until May 1 except as affected by ice December 10 to February 13; May 1 to September 30, a gradual change in stage-discharge relation was caused by dredging operations. Rating curve well defined between 2,000 and 44,000 second-feet. Operation of water-stage recorder satisfactory throughout the year. Mean daily gage height ascertained by averaging hourly gage heights. Daily discharge prior to May ascertained by applying mean daily gage height to rating table; May to September, by the shifting-control method. Records good except those for periods when the stage discharge relation was affected by ice or dredging on the control, which are fair.

COOPERATION.—Water-stage recorder inspected by an employee of the Rochester Railway & Light Co.

Discharge measurements of Genesee River at Rochester, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 3	J. W. Moulton	4.05	4,970	July 12	E. D. Burchard	1.14	764
Dec. 19[a]	E. D. Burchard	1.99	865	20	do	1.20	675
Jan. 16[b]	do	2.18	517	27	do	.76	664
Feb. 11[b]	do	1.63	400	31	do	.60	666
13[a]	do	8.36	7,720	Aug. 19	do	.49	597
Mar. 22	do	4.59	6,440	26	do	.40	512
May 22	do	2.36	1,680	Sept. 24	do	1.21	1,580
June 20	do	1.12	742				

[a] Measurement made through partial ice cover.
[b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Genesee River at Rochester, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	531	14,900	1,480	850	360	8,060	2,340	1,500	900	750	460	550
2	510	8,330	1,980	750	360	7,540	2,500	1,500	1,100	850	480	550
3	553	5,130	2,010	750	400	9,430	2,500	1,400	950	850	480	550
4	619	3,880	1,620	700	340	8,330	2,340	1,400	850	850	480	550
5	776	3,300	1,480	700	420	5,930	2,340	1,300	850	850	480	550
6	1,380	2,850	1,280	600	420	6,050	2,040	1,200	900	900	500	550
7	1,340	2,590	1,150	550	420	8,330	1,860	1,100	950	800	900	550
8	1,070	2,340	1,320	600	400	7,800	1,840	1,100	950	700	1,100	550
9	956	2,180	1,340	650	440	5,700	1,900	1,300	850	750	1,000	550
10	920	2,000	1,300	650	440	5,130	2,040	1,100	850	800	650	550
11	980	1,890	1,100	650	420	8,870	2,000	1,200	900	800	500	550
12	896	1,760	1,000	600	1,200	8,060	1,980	1,500	850	750	500	550
13	812	1,680	1,000	600	7,500	15,600	2,060	1,500	1,100	800	500	550
14	1,110	1,580	1,000	600	11,200	19,200	3,490	1,200	1,400	700	500	550
15	1,370	1,510	1,000	550	13,600	23,000	6,900	850	1,400	750	750	550
16	1,250	1,450	1,000	550	14,000	27,200	5,930	1,200	1,100	800	700	550
17	1,920	1,440	950	550	12,100	25,100	5,240	1,700	950	700	650	550
18	1,620	1,400	900	550	8,060	14,900	7,930	1,200	950	700	650	700
19	1,240	1,340	850	500	5,020	7,800	7,030	1,000	900	650	600	1,600
20	3,680	1,330	800	500	8,870	6,530	4,700	800	800	550	600	1,300
21	8,870	1,270	900	500	12,400	6,290	3,680	1,000	800	550	550	1,600
22	4,600	1,300	1,200	500	13,600	6,050	3,400	1,400	950	300	550	2,800
23	2,760	1,410	1,700	500	11,200	5,130	3,490	1,800	800	480	500	2,200
24	2,500	1,550	1,800	480	6,290	4,080	3,120	1,700	1,400	750	500	1,800
25	10,600	1,450	2,200	480	4,600	3,490	2,850	1,700	1,400	800	500	1,400
26	14,900	1,200	3,000	460	7,800	3,120	2,500	1,100	1,200	800	500	1,400
27	13,300	1,040	3,200	440	11,200	2,850	2,180	1,500	900	650	550	1,300
28	14,300	1,060	2,200	420	11,800	2,680	1,960	2,200	800	650	550	1,500
29	15,300	1,070	1,800	420	.....	2,500	1,800	1,600	900	950	550	1,800
30	16,000	1,190	1,200	420	.....	2,420	1,650	1,500	800	600	550	1,500
31	17,000	.....	950	420	.....	2,340	.....	1,400	.....	650	550	.....

NOTE.—Discharge Dec. 10 to February 13 estimated, because of ice, from discharge measurements, weather records, study of gage-height graph, and comparison with records for station upstream.

Monthly discharge of Genesee River at Rochester, N. Y., for year ending Sept. 30, 1918.

[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	17,000	510	4,630	1.96	2.26
November	14,900	1,040	2,510	1.06	1.18
December	3,200	800	1,440	.610	.70
January	850	420	560	.239	.28
February	14,000	340	5,890	2.50	2.60
March	27,200	2,340	8,700	3.69	4.25
April	7,930	1,650	3,190	1.35	1.51
May	2,200	850	1,350	.572	.66
June	1,400	800	982	.416	.46
July	950	300	725	.307	.35
August	1,100	460	591	.250	.29
September	2,800	550	1,010	.428	.48
The year	27,200	300	2,610	1.11	15.02

CANASERAGA CREEK AT CUMMINSVILLE, N. Y.

LOCATION.—At bridge on State road in Cumminsville, Livingston County, about a mile downstream from station formerly maintained near Dansville, 1½ miles below mouth of Mill Brook and 21 miles above mouth of creek.

DRAINAGE AREA.—171 square miles (measured by State conservation commission).

RECORDS AVAILABLE.—October 23, 1917, to September 30, 1918; July 21, 1910, to December 31, 1912, and July 10, 1915, to December 29, 1917, at station near Dansville.

GAGE.—Vertical staff gage in three sections on downstream face of bridge pier; read to tenths daily by George Freed.

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

CHANNEL AND CONTROL.—Fairly well compacted gravel and small boulders may shift during severe floods, otherwise practically permanent.

EXTREMES OF STAGE.—Maximum stage recorded during year, 5.2 feet at 3.30 p. m. February 12 (stage discharge relation affected by ice); minimum stage recorded during year, 0.7 foot several times in August and September.

ICE.—Stage-discharge relation affected by ice.

Data inadequate for determination of daily discharge.

Discharge measurements of Canaseraga Creek at Cumminsville, N. Y., during year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 20	E. D. Burchard	2.06	478	Feb. 15	E. D. Burchard	3.00	1,130
20	do	1.98	425	Mar. 18	do	1.63	289
23	do	1.38	135	21	do	1.70	326
25	do	3.05	1,140	May 26	do	1.45	183
25	do	2.92	1,020	31	J. W. Moulton	1.21	88
Dec. 20[a]	do	1.44	120	July 15	E. D. Burchard	.89	38.2
Jan. 17[a]	do	1.66	49	Aug. 23	do	.77	24.7
Feb. 12[b]	do	4.60	782				

[a] Measurement made through complete ice cover.
[b] Measurement made through partial ice cover.

Daily gage height, in feet, of Canaseraga Creek at Cumminsville, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.78	1.18	1.95	1.50	2.10	1.38	1.12	1.28	0.90	0.90	0.70
2	.....	1.71	1.18	1.95	1.45	2.05	1.38	1.11	1.20	.90	.90	.70
3	.....	1.57	1.18	2.10	1.45	2.00	1.38	1.10	1.10	.85	.90	.70
4	.....	1.51	1.20	1.95	1.50	1.85	1.36	1.10	1.10	.80	.80	.70
5	.....	1.52	1.19	1.90	1.50	1.90	1.30	1.10	1.10	.80	.85	.75
6	.....	1.51	1.18	1.90	1.45	2.30	1.30	1.10	1.10	.80	.80	.80
7	.....	1.48	1.18	1.80	1.54	1.95	1.34	1.08	1.10	.80	.80	.80
8	.....	1.37	1.17	1.60	1.50	2.05	1.39	1.30	1.10	.80	.80	.80
9	.....	1.37	1.31	1.60	1.50	1.90	1.39	1.20	1.10	.85	.80	.80
10	.....	1.34	1.34	1.67	1.50	2.90	1.32	1.28	1.10	1.00	.80	.80
11	.....	1.33	1.40	1.60	2.56	1.95	1.28	1.35	1.05	1.00	1.00	.80
12	.....	1.32	1.46	1.85	4.43	2.70	1.29	1.30	1.40	.90	.95	.80
13	.....	1.30	1.50	1.80	2.85	2.55	1.35	1.30	1.25	.90	.80	.90
14	.....	1.28	1.70	1.60	2.20	4.00	1.80	1.30	1.20	.90	.80	.80
15	.....	1.29	1.71	1.60	3.05	2.55	2.05	1.23	1.10	.90	.80	.80
16	.....	1.26	1.70	1.60	2.00	1.90	1.90	1.20	1.00	.90	.80	.90
17	.....	1.26	1.70	1.55	1.70	1.85	1.70	1.14	1.00	.85	.80	1.00
18	.....	1.26	1.70	1.40	1.70	1.60	1.95	1.14	1.00	.90	.80	.90
19	.....	1.27	1.71	1.45	2.90	1.60	1.72	1.13	.90	.90	.80	.80
20	.....	1.23	1.50	1.50	3.90	1.64	1.55	1.24	.90	.90	.80	1.40
21	.....	1.21	1.30	1.48	1.80	1.67	1.69	1.30	.90	.80	.70	1.10
22	.....	1.27	1.30	1.50	1.70	1.83	1.59	1.30	1.00	.80	.70	.95
23	.....	1.28	1.28	1.50	1.70	1.67	1.43	1.30	1.00	.80	.70	.90
24	.....	1.25	1.33	1.50	1.70	1.55	1.38	1.40	1.00	.80	.70	.90
25	.....	1.22	1.45	1.60	1.75	1.41	1.38	1.34	1.00	1.00	.70	.90
26	.....	1.20	1.50	1.55	2.95	1.32	1.30	1.30	.95	.95	.70	.90
27	.....	1.20	1.69	1.50	2.35	1.31	1.26	1.30	.90	.90	.70	.90
28	2.66	1.20	1.68	1.43	1.80	1.30	1.20	1.27	.90	.90	.70	.90
29	2.95	1.18	1.82	1.40	.....	1.36	1.20	1.30	.90	.90	.70	.90
30	2.94	1.18	2.00	1.45	.....	1.36	1.16	1.34	.90	1.00	.70	.90
31	2.35	.....	2.00	1.50	.....	1.38	.....	1.30	.....	.90	.80	.....

NOTE.—Stage-discharge relation affected by ice during large part of period from December to February.

CANASERAGA CREEK AT GROVELAND STATION, N. Y.

LOCATION.—At highway bridge at Groveland Station, Livingston County. The creek is flowing through the improved channel at this point.

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

RECORDS AVAILABLE.—August 5, 1915, to September 30, 1916, and March 1, 1917, to September 30, 1918.

GAGE.—Chain, near center of downstream side of bridge. Prior to March 30, 1916, inclined staff gage on right bank about 400 feet above the bridge, at practically the same datum (560.00 feet conservation commission datum); read by Thomas Maimone.

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

CHANNEL AND CONTROL.—Gravel; likely to shift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 19.01 feet at 7 a. m. February 13 (stage-discharge relation affected by ice, discharge not determined); minimum stage recorded, 6.3 feet at 6 p. m. August 20 and 30 (discharge about 22 second-feet).

1915–1918: Maximum open-water stage recorded 16.5 feet from 2 to 3 p. m. July 29, 1917 (discharge, 4,170 second-feet); minimum stage recorded, 6.3 feet at 6 p. m. August 20 and 30, 1918.

ICE.—Stage-discharge relation affected by ice; gage observations suspended during winter.

ACCURACY.—Stage-discharge relation not permanent; affected by ice December to March and by shifting control during the rest of the year. Rating curve well defined between 35 and 3,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table, for the period previous to winter, and for the remainder of the year by the shifting-control method. Records fair.

Discharge measurements of Canaseraga Creek at Groveland Station, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 25	E. D. Burchard	12.59	1,200	Mar. 18	E. D. Burchard	8.91	314
25	do	12.50	1,190	21	do	9.30	394
31	do	10.42	678	May 24	do	7.61	118
31	do	10.30	637	June 23	do	7.30	88
Nov. 1	do	9.08	418	July 15	do	6.64	36
Mar. 16[a]	do	11.11	400	Aug. 24	do	6.52	29

[a] Slush ice in the current and flats below flooded, causing backwater.

Daily discharge, in second-feet, of Canaseraga Creek at Groveland Station, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	54	474	179	.....	200	95	85	42	32	24
2	54	365	187	.....	200	100	70	40	32	26
3	47	328	155	.....	190	85	60	38	32	26
4	116	292	155	.....	180	75	55	38	34	28
5	109	274	124	.....	130	70	60	36	32	36
6	102	256	124	.....	120	65	60	36	30	36
7	139	238	109	.....	110	70	60	36	28	.....
8	124	204	179	.....	120	170	55	36	28	.....
9	124	196	.....	.....	200	95	50	48	60	.....
10	95	196	.....	.....	140	120	55	70	32	.....
11	139	184	.....	.....	200	110	60	50	32	.....
12	109	171	.....	.....	140	120	200	42	32	.....
13	139	171	.....	.....	180	130	120	38	32	.....
14	95	155	.....	.....	650	140	90	36	28	.....
15	95	155	.....	.....	650	100	65	36	28	.....
16	139	163	.....	400	420	95	60	34	28	.....
17	102	155	.....	320	300	75	55	40	26	.....
18	83	147	.....	300	550	65	44	42	26	36
19	460	155	.....	300	320	65	44	36	28	80
20	536	139	.....	360	260	100	44	32	22	150
21	256	155	.....	380	240	190	48	32	28	65
22	204	155	.....	400	220	170	95	32	28	46
23	171	163	.....	300	200	170	75	32	28	40
24	975	139	.....	240	190	110	65	40	28	40
25	1,610	139	.....	220	190	85	60	65	28	36
26	1,090	155	.....	200	150	260	48	42	26	38
27	1,320	139	.....	170	110	300	50	36	28	40
28	1,000	139	.....	190	100	160	44	34	24	38
29	1,130	124	.....	170	90	150	44	34	24	36
30	1,490	139	.....	200	90	120	42	40	22	36
31	675	.....	.....	200	.....	110	.....	36	24	.....

NOTE.—Discharge Dec. 9 to Mar. 15 not determined because of ice. Discharge Sept. 7–17 estimated at 36 second-feet.

Monthly discharge of Canaseraga Creek at Groveland Station, N. Y., for the year ending Sept. 30, 1918.

[Drainage area, 195 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,610	47	412	2.11	2.43
November	479	124	196	1.00	1.12
April	650	90	228	1.17	1.30
May	300	65	122	.626	.72
June	200	42	65.4	.335	.37
July	70	32	39.6	.203	.23
August	60	22	29.4	.151	.17
September	150	24	41.8	.214	.24

CANASERAGA CREEK AT SHAKERS CROSSING, N. Y.

LOCATION.—At highway bridge at Shakers Crossing, about a mile above mouth and 1¼ 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, 1918.

GAGE.—Gurley seven-day water-stage recorder on the left bank, just below the bridge. Datum of gage same as that established on Genesee River at Jones Bridge near Mount Morris July 12, 1916 (540 feet conservation commission datum). Recorder inspected by Mrs. Wm. 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, 27.9 feet at 4 a. m. February 21; minimum stage from water-stage recorder, 7.86 at 6 p. m. August 31.

1915–1918: Maximum stage from water-stage recorder, 28.92 feet at 1 p. m. May 17, 1916; minimum stage from water-stage recorder 7.86 feet at 6 p. m. August 31, 1918.

Stage-discharge relation is affected by backwater from the Genesee River to such an extent that daily discharge has not been determined.

Discharge measurements of Canaseraga Creek at Shakers Crossing, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 1	E. D. Burchard	15.44	1,910	Feb. 14	E. D. Burchard	24.75	1,650
1	J. W. Moulton	14.74	1,623	Mar. 16	....do	22.82	5,620
2	.....do	12.62	980	May 23	.....do	9.79	421
Feb. 13[a]	E. D. Burchard	24.97	−1,640	July 15	.....do	8.70	157

[a] Measurement shows flow upstream due to backwater flow from Genesee River caused by ice jam near Jones Bridge.

Daily gage height, in feet, of Canaseraga Creek at Shakers Crossing, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	8.63	14.90	9.98	9.48	.....	20.15	9.71	9.46	9.10	8.63	8.22	8.29
2	8.65	12.32	9.88	9.46	.....	22.61	9.77	9.33	8.94	8.61	8.18	8.29
3	8.68	11.26	9.52	9.52	.....	21.15	9.75	9.26	8.85	8.54	8.16	8.23
4	8.96	10.71	9.48	9.42	.....	17.98	9.66	9.24	8.75	8.40	8.00	8.26
5	9.31	10.29	9.41	9.42	.....	16.48	9.53	9.20	8.75	8.52	8.20	8.18
6	9.17	10.11	9.42	9.31	9.29	18.95	9.40	9.18	8.75	8.41	8.32	8.35
7	8.98	10.01	9.32	9.41	9.35	18.16	9.31	9.13	8.79	8.42	8.26	8.36
8	8.95	9.88	9.45	9.40	9.39	14.30	9.32	9.77	8.74	8.46	8.20	8.49
9	9.14	9.74	9.48	9.35	9.50	11.64	9.67	9.42	8.65	8.37	8.36	8.48
10	9.02	9.56	8.88	9.48	9.83	16.28	9.51	9.63	8.69	8.59	8.36	8.45
11	8.90	9.42	9.72	9.74	10.81	18.39	.....	10.10	8.70	8.61	8.39	8.45
12	8.93	9.52	9.78	9.52	15.94	18.36	.....	9.68	9.49	8.54	8.41	8.37
13	9.39	9.46	9.85	9.51	20.97	19.90	9.70	9.68	9.38	8.50	8.50	8.25
14	9.25	9.42	9.89	9.52	24.19	24.02	11.94	9.82	9.01	8.49	8.46	8.49
15	9.16	9.42	9.88	9.55	24.53	26.68	15.01	9.53	8.90	8.49	8.41	8.61
16	9.66	9.58	9.72	9.56	24.03	22.14	12.99	9.33	8.76	8.37	8.40	8.51
17	9.32	9.70	9.68	9.70	20.97	16.76	11.78	9.22	8.79	8.32	8.44	8.95
18	9.03	9.54	9.68	9.82	17.65	13.47	14.04	9.08	8.74	8.27	8.42	9.02
19	9.96	9.58	9.62	9.60	15.81	11.96	12.35	9.02	8.70	8.21	8.41	8.56
20	17.43	9.55	9.62	9.53	25.23	12.20	10.89	9.17	8.63	8.16	8.30	8.96
21	13.01	9.62	10.02	9.58	26.88	12.19	10.38	9.90	8.62	8.16	8.20	9.95
22	10.45	9.56	10.45	9.55	23.56	12.02	10.70	9.47	8.98	8.05	8.15	8.64
23	9.79	9.52	9.90	9.50	21.94	11.45	10.50	9.70	9.09	8.07	8.14	8.75
24	13.20	9.50	10.17	9.47	17.59	.....	10.14	9.57	8.97	8.05	8.16	8.91
25	20.48	9.42	10.94	9.49	16.75	.....	9.92	9.20	8.80	8.53	8.20	8.71
26	18.38	9.46	10.87	9.51	23.40	10.08	9.68	10.53	8.72	8.22	8.22	8.70
27	19.96	9.49	10.10	9.55	23.90	9.86	9.49	10.79	8.64	8.16	8.15	8.74
28	22.26	9.52	9.80	9.50	21.54	9.82	9.32	9.78	8.64	8.14	8.09	8.78
29	21.12	9.65	9.50	9.58	.....	9.84	9.20	9.38	8.63	8.20	8.07	8.70
30	22.69	9.72	9.32	9.58	.....	9.74	9.28	9.50	8.64	8.17	8.15	8.66
31	20.01	.....	9.48	.....	.....	9.72	.....	9.31	.....	8.20	8.09	.....

NOTE.—Gage heights Oct. 20 and 21 estimated by comparison with records on Genesee River at Jones Bridge. Gage heights Nov. 10 to Dec. 18, and Dec. 29 to Jan. 16 from observations on staff gage.

KESHEQUA CREEK AT CRAIG COLONY, SONYEA, N. Y.

LOCATION.—About 200 feet downstream from private highway bridge on grounds of Craig Colony at Sonyea, Livingston County.

DRAINAGE AREA.—69 square miles (measured by engineers of the State conservation commission).

RECORDS AVAILABLE.—October 31, 1917, to September 30, 1918, at present site; July 22, 1910, to December 31, 1912, at a site about 200 feet upstream, and from August 29, 1915, to October 31, 1917, at a station about 1 mile downstream near the Delaware, Lackawanna & Western Railroad bridge.

GAGE.—Vertical staff gage in three sections on retaining wall on left bank just above the concrete weir; read by A. J. Porter.

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

CHANNEL AND CONTROL.—Double-crested concrete weir built by Craig Colony for maintaining water level for their pumping plant; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period of record at present station, 5.9 feet at 6.30 a. m. March 14 (discharge, about 3,700 second-feet); minimum stage recorded, 0.13 foot at 8 a. m. August 20 (discharge 0.7 second-foot).

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

ACCURACY.—Stage-discharge relation permanent, except when slightly affected by ice from December 10 to February 12 and by use of flashboards on downstream crest of dam, August 17–22. Rating curve well defined below 450 second-feet. Gage read to hundredths twice daily. Daily discharge, except for periods of backwater, determined by applying mean daily gage height to rating table. Records good.

Discharge measurements of Keshequa Creek at Craig Colony, Sonyea, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 26	E. D. Burchard	1.60	245	Feb. 15	E. D. Burchard	1.70	210
31	do	1.33	151	Mar. 16	do	1.30	156
Nov. 3	do	1.00	68	May 24	J. W. Moulton	.64	21
Dec. 20[a]	do	.87	22	June 23	E. D. Burchard	.52	14
Jan. 17[b]	do	.66	11	July 15	do	.30	3.4
Feb. 12[a]	do	3.15	1,450	Aug. 21	do	.19	1.3

[a] Measurement made through partial ice cover.
[b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Keshequa Creek at Craig Colony, Sonyea, N. Y., for the year ending Sept. 30, 1918.

Day.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	105	75	8	6	56	37	26	20	7.0	5.6	1.8
2	83	54	8	6	197	47	25	17	7.5	3.8	2.6
3	66	38	7	5	75	40	23	14	9.3	3.2	3.0
4	56	36	6	5	368	38	20	12	5.6	2.6	2.2
5	50	34	6	5	115	31	20	12	4.8	4.1	3.0
6	47	33	6	5	368	26	18	14	5.6	6.3	6.3
7	44	33	6	6	77	26	17	17	3.8	5.2	3.0
8	36	15	8	6	61	26	79	12	4.1	2.3	2.2
9	34	26	9	10	75	40	33	11	3.8	15	3.0
10	33	40	12	28	620	28	90	13	6.3	7.5	2.5
11	31	60	11	190	95	26	81	29	7.5	6.3	2.0
12	31	55	15	900	395	32	48	45	4.8	2.4	1.4
13	28	48	36	455	395	34	65	20	3.4	7.0	3.0
14	26	26	36	154	1,590	226	70	14	4.1	3.0	4.8
15	26	17	17	595	226	190	38	11	3.4	2.0	3.8
16	29	14	12	61	245	110	29	8.8	4.5	2.2	3.4
17	28	18	11	50	75	72	23	9.8	4.1	1.6	14
18	25	22	11	35	72	245	19	7.5	4.8	3.0	9.3
19	17	20	10	245	79	102	18	7.0	3.0	2.0	13
20	22	24	9	545	105	68	45	7.0	2.4	.8	21
21	23	110	9	35	112	60	44	7.9	2.2	1.3	15
22	28	90	9	29	112	128	23	28	2.6	1.4	5.2
23	28	32	8	33	75	72	40	12	2.6	1.4	6.3
24	22	46	8	43	51	61	23	12	3.0	1.1	4.8
25	21	110	8	68	51	50	21	7.9	15	1.0	7.5
26	24	26	8	425	47	41	207	7.5	5.9	.9	7.0
27	22	26	8	66	35	36	118	7.0	3.4	1.0	8.8
28	32	24	8	68	38	31	44	8.8	1.8	1.4	7.0
29	30	14	8	.....	40	26	29	5.6	9.3	1.2	6.3
30	51	11	8	.....	37	26	48	4.1	9.8	1.0	5.6
31	.....	10	6	.....	40	.....	31	.....	9.8	2.4	.....

NOTE.—Discharge Dec. 10 to Feb. 12 estimated, because of ice, from discharge measurements, weather records, study of gage-height graph, and comparison with records for near-by streams.

Monthly discharge of Keshequa Creek at Craig Colony, Sonyea, N. Y., for the year ending Sept. 30, 1918.

[Drainage area, 69 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
November	105	17	36.6	0.534	0.60
December	110	10	38.3	.555	.64
January	36	6	10.7	.155	.16
February	900	5	146	2.12	2.21
March	1,590	35	191	2.77	3.19
April	245	26	65.8	.954	1.06
May	207	17	45.6	.661	.76
June	45	4.1	13.4	.194	.22
July	15	1.8	5.32	.077	.09
August	15	.8	3.23	.047	.05
September	21	1.4	5.96	.086	.10

OWASCO LAKE OUTLET NEAR AUBURN, N. Y.

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

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

RECORDS AVAILABLE.—November 17, 1912, to September 30, 1918.

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 the gage in low water and from a cable at the same section in high water.

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 downstream 2½ feet from toe of dam. Mean elevation of the left end of the dam for a distance of 50 feet is at a gage height 1.28 feet; the remaining 50 feet of the crest of the dam is at a gage height 2.13 feet

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 3.5 feet at 3 a. m. March 17 (discharge 1,100 second-feet); minimum stage during year, from water-stage recorder, 1.48 feet at 10 and 11 p. m. October 7 (discharge 12 second-feet).

1912-1918: Maximum stage, 6.4 feet during period March 25–30, 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 the gaging station is not known.

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

ACCURACY.—Stage-discharge relation permanent except when affected by ice December 30 to January 10. Rating curve well defined between 1 and 1,700 second-feet. Operation of the water-stage recorder satisfactory throughout year, except as indicated in footnote to daily discharge table. Daily discharge ascertained by averaging the hourly discharge. Records good.

The following discharge measurement was made by E. D. Burchard July 11, 1918: Gage height, 2.43 feet; discharge, 254 second-feet.

Daily discharge, in second-feet, of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	181	534	271	.....	a 175	434	484	439	414	.....	194	134
2	184	509	267	.....	a 170	420	471	407	393	.....	205	149
3	176	522	261	.....	125	353	468	394	401	.....	195	157
4	181	525	274	.....	154	317	458	389	402	.....	166	156
5	188	507	263	.....	167	340	422	332	369	.....	191	159
6	158	499	267	.....	174	352	434	284	337	.....	205	147
7	48	474	261	.....	139	427	361	298	332	.....	204	141
8	155	458	256	.....	139	506	237	284	286	.....	209	132
9	209	a 455	254	.....	130	526	239	269	205	.....	196	149
10	212	a 445	245	.....	114	558	202	214	190	.....	a 190	150
11	212	a 435	251	145	135	795	301	265	181	188	a 185	145
12	273	a 425	263	172	160	937	335	265	192	166	a 180	155
13	213	a 420	250	124	157	923	336	276	171	168	a 180	177
14	205	a 412	196	203	156	921	429	203	179	160	a 180	183
15	219	a 404	249	150	169	931	524	203	161	168	176	96
16	211	a 395	244	163	160	946	539	267	160	171	194	137
17	211	388	a 225	156	162	921	560	203	184	162	168	181
18	211	330	a 220	161	181	876	596	205	147	161	185	167
19	244	322	214	158	184	784	643	196	171	a 165	175	159
20	206	324	205	195	199	748	640	194	175	171	177	188
21	64	315	205	193	175	718	612	174	242	181	175	169
22	232	303	194	176	189	689	622	194	315	191	183	77
23	359	309	202	171	170	591	628	348	258	178	179	124
24	376	298	202	178	173	a 578	626	396	235	184	163	80
25	428	296	193	153	214	a 580	580	390	226	a 185	174	137
26	457	285	202	181	262	a 570	522	373	.....	a 190	a 175	134
27	468	289	202	175	304	a 560	495	398	.....	a 190	173	126
28	452	287	149	152	351	a 550	526	402	.....	a 190	167	116
29	492	278	202	140	.....	a 530	516	407	.....	a 190	167	92
30	537	264	a 202	146	.....	515	480	402	.....	a 195	162	138
31	545	.....	a 200	131	.....	504	.....	414	.....	a 195	172	.....

a Estimated; no gage height record.

NOTE.—Discharge, Jan. 1–10, estimated 198 second-feet; June 26–30, 216 second-feet; July 1–10, 206 second feet.

Monthly discharge of Owasco Lake outlet near Auburn, N. Y., for the year ending Sept. 30, 1918.

[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	545	48	268	1.30	1.50
November	534	264	390	1.89	2.11
December	274	149	229	1.11	1.28
January	203	124	174	.845	.97
February	351	114	178	.864	.90
March	946	317	626	3.04	3.51
April	643	202	476	2.31	2.58
May	439	174	306	1.49	1.72
June	414	147	247	1.20	1.34
July	.....	160	187	.908	1.05
August	209	162	182	.883	1.02
September	188	77	142	.689	.77
The year	946	48	284	1.38	18.75

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

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

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

RECORDS AVAILABLE.—August 22, 1916, to June 30, 1918, when station was discontinued.

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.

EXTREMES OF STAGE.—Maximum stage recorded, 3.34 feet at 7.20 a. m., February 20; minimum stage recorded, 1 foot at 7.15 a. m. October 30.

1916–1918: Maximum stage recorded, 3.34 feet at 7.20 a. m. February 20, 1918; minimum stage recorded, 0.90 foot at 6.45 p. m. September 24 and 6.35 a. m. September 25, 1917.

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

Data inadequate for determination of discharge.

The following discharge measurement was made by E. D. Burchard.

April 5, 1918: Gage height, 1.76 feet; discharge, 19 second-feet.

Daily gage height, in feet, of West Branch of Onondaga Creek at South Onondaga, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.
1	1.18	1.62	1.60	.....	1.84	1.88	1.73	1.37
2	1.70	1.52	1.47	.....	1.86	1.89	1.67	1.33
3	1.40	1.45	1.38	.....	1.88	1.86	1.61	1.30
4	1.48	1.39	1.35	.....	1.79	1.80	1.65	1.31
5	1.41	1.37	1.34	.....	2.11	1.79	1.59	1.31
6	1.38	1.33	1.27	.....	2.63	1.75	1.58	1.38
7	1.14	1.36	1.36	.....	2.06	1.74	1.55	1.69
8	1.59	1.28	1.16	.....	1.95	1.81	1.53	1.41
9	1.29	1.28	1.22	.....	1.83	2.45	1.52	1.34
10	1.15	1.27	.....	.....	2.53	1.93	1.59	1.44
11	1.11	1.27	.....	.....	2.11	1.96	1.60	1.34
12	1.16	1.27	.....	2.34	2.24	1.95	1.57	1.86
13	1.20	1.24	.....	2.49	2.43	2.39	1.79	1.65
14	1.13	1.18	.....	2.26	3.03	2.15	1.78	1.51
15	1.24	1.19	.....	3.47	2.75	1.93	1.58	1.44
16	1.15	1.25	.....	2.72	2.46	1.85	1.51	1.35
17	1.09	1.26	.....	.....	2.49	1.84	1.47	1.33
18	1.60	1.21	.....	.....	2.21	2.34	1.43	1.32
19	1.68	1.27	.....	2.04	2.19	2.04	1.40	1.29
20	1.82	1.30	.....	3.15	2.21	1.89	1.57	1.28
21	1.31	1.26	.....	2.17	2.22	1.92	1.78	1.28
22	1.24	1.39	.....	2.41	2.17	2.60	1.54	1.51
23	1.25	1.38	.....	2.06	2.27	1.96	1.61	1.67
24	1.50	1.30	.....	1.76	1.97	1.93	1.45	1.45
25	2.17	1.20	.....	2.01	1.97	1.83	1.45	1.37
26	1.77	1.24	.....	3.14	1.94	1.78	1.54	1.33
27	1.51	1.20	.....	2.35	1.92	1.73	1.50	1.28
28	1.65	1.23	.....	2.05	1.85	1.69	1.45	1.29
29	1.59	1.24	.....	.....	1.89	1.63	1.46	1.49
30	1.96	1.32	.....	.....	1.88	1.64	1.44	1.80
31	1.79	.....	.....	.....	1.88	.....	1.39	.....

BLACK RIVER NEAR BOONVILLE, N. Y.

LOCATION.—At highway bridge 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 June 30, 1918.

GAGE.—Chain, near center of left span, downstream side of bridge. Staff gage, graduated from 6 to 13 feet, on downstream side of right abutment, used for high water readings. Gage read by W. D. Charbonneau.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.6 feet at 5 p. m. October 31 (discharge, 4,960 second-feet); minimum stage recorded, 2.40 feet at 5 p. m. August 26 (discharge about 5 second-feet).

1911–1918: Maximum stage about 12.5 feet during night of March 28, 1913 (determined by leveling from flood mark), discharge about 10,000 second-feet. Minimum stage recorded, that of August 26, 1918.

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. During the navigation season water is diverted westward from this reservoir through the Forestport feeder to a storage basin in Boonville. The Black River canal flows north from this basin, entering Black River at the foot of Lyons Falls. A spillway from the basin overflows into Mill Creek, a tributary of Black River. Water flowing through this spillway and through Black River canal 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 drainage 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 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 1 mile southeast of Boonville. During September, 1915, two water-stage recorders were installed on this canal to obtain a continuous record of the flow. This is published as a separate station under the heading "Black River Canal, flowing south, near Boonville, N. Y."

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice December 10 to March 24. 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 height to rating table. Records good, except those for period of ice effect which are fair.

Discharge measurements of Black River near Boonville, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 19[a]	J. W. Moulton	5.67	318	Mar. 19[a]	J. W. Moulton	6.85	574
Jan. 11[a]	E. D. Burchard	4.69	170	Apr. 13	E. D. Burchard	6.70	1,400
Feb. 9[b]	J. W. Moulton	4.85	173	June 6	M. H. Carson	3.65	92
Mar. 14[a]	do	7.08	586				

[a] Measurement made through partial ice cover. [b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Black River near Boonville, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	90	4,140	680	220	120	1,200	2,500	1,290	145	194	28	119
2	78	1,940	630	220	110	850	2,385	1,210	154	250	42	90
3	127	1,370	558	220	120	800	2,500	1,135	136	216	46	66
4	250	1,210	450	220	120	850	2,385	1,210	111	205	49	72
5	305	1,060	335	200	100	900	2,160	1,210	97	154	49	90
6	490	920	227	190	90	800	2.160	1,060	97	63	44	70
7	735	795	227	190	130	650	2,160	920	430	66	36	174
8	680	855	238	190	160	550	2,270	855	920	154	24	227
9	605	680	250	180	180	600	2,270	795	630	558	28	194
10	580	535	260	170	200	700	2,620	735	305	855	56	184
11	580	335	280	220	240	600	2,385	795	194	795	84	227
12	558	275	300	440	300	500	1,740	795	164	535	70	275
13	795	250	300	280	460	480	1,455	1,060	154	174	56	305
14	1,140	194	320	300	480	600	1,740	1,545	97	145	61	410
15	1,140	512	320	340	550	600	1,945	1,370	90	535	46	535
16	1,140	1,540	320	280	550	850	2,050	1,210	63	430	44	450
17	1,060	1,540	320	240	460	1,200	1,945	855	56	262	49	410
18	855	1,210	320	200	440	1,200	1,740	920	40	205	59	680
19	795	1,140	320	190	550	1,000	1,545	795	36	154	70	795
20	795	855	320	200	650	800	1,840	680	38	127	59	990
21	795	735	300	180	900	1,600	1,945	735	35	104	46	1,140
22	795	735	280	200	1,100	2,400	1,740	855	205	111	33	855
23	735	630	280	200	1,100	2,400	1,545	795	470	63	27	795
24	795	512	260	180	1,200	2,200	1,545	680	370	66	21	795
25	795	450	260	150	1,200	2,160	1,370	680	290	49	11	735
26	795	430	240	140	1,400	2,050	1,370	680	262	30	7	795
27	855	450	220	140	1,700	2,160	1,210	795	227	40	10	795
28	920	450	220	120	1,900	2,380	990	1,060	164	44	26	735
29	1,940	512	220	95	.....	2,270	1,060	855	84	49	53	680
30	3,750	535	220	100	.....	2,160	1,210	680	275	30	70	605
31	4,820	.....	200	110	.....	2,380	.....	227	.....	36	84	.....

NOTE.—Discharge Dec. 10 to Mar. 24 estimated, because of ice, from discharge measurements, weather records and study of gage-height graph.

Monthly discharge of Black River near Boonville, N. Y., for the year ending Sept. 30, 1918.

[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	4,820	78	961	3.17	3.66
November	4,140	194	893	2.94	3.28
December	680	200	312	1.03	1.19
January	440	95	203	.670	.77
February	1,900	90	590	1.95	2.03
March	2,400	480	1,290	4.26	4.91
April	2,620	990	1,860	6.14	6.85
May	1,540	227	919	3.03	3.47
June	920	35	211	.696	.78
July	855	30	216	.713	.82
August	84	7	44.8	.148	.17
September	1,140	66	476	1.57	1.75
The year	4,820	7	663	2.19	29.68

NOTE.—Water diverted past this station by the Forestport feeder not included in the above table.

BLACK RIVER AT BLACK RIVER, N. Y.

LOCATION.—About one-fourth mile below concrete-arch highway bridge and the power plant of Northern New York Utilities Co., and three-fourths mile below village of Black River, Jefferson County.

DRAINAGE AREA.—1,870 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 24, 1917, to September 30, 1918.

GAGE.—Vertical staff, in two sections, spiked to large cedar tree on the left bank one-fourth mile below highway bridge; a low-water section fastened to rocks 10 feet upstream; read by Erwin W. Hart.

DISCHARGE MEASUREMENTS.—Made from a cable 100 yards above the gage.

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF DISCHARGE.—Maximum stage recorded, 12.3 feet at 8.40 a. m. April 4 (discharge, 16,300 second-feet); minimum discharge, 440 second-feet, January 20. 1917–1918: Maximum stage recorded 13.4 feet from 6 p. m., April 4, to 7 a. m., April 5, 1917 (discharge, 19,300 second-feet); minimum stage recorded, 1.05 feet at 2.45 p. m. Sunday, July 29, 1917, during a current-meter measurement (discharge about 16 second-feet).

ICE.—Stage-discharge relation affected by ice.

REGULATION.—Seasonal distribution of flow is regulated by Beaver River flow, Fulton Chain Lakes, Forestport reservoir, and other storage reservoirs in the upper part of the drainage basin. Some diurnal fluctuation at low stages due to mills and power plants above the station.

DIVERSIONS.—Water is diverted from Black River into the Forestport feeder at Forestport. A part of this water returns to the river through various spillways and through the Black River canal (flowing north); the rest passes out of the drainage basin through the Black River canal (flowing south), the record at the station on Black River canal (flowing south) at Boonville indicates the amount of this diversion. See also "Regulation and diversion" in description of station on Black River near Boonville.

ACCURACY.—Stage-discharge relation permanent except as affected by ice December 7 to February 19. Rating curve well defined between 500 and 18,000 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for days of low discharge when they may be poor.

Discharge measurements of Black River at Black River, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 14[a]	E. D. Burchard	5.78	1,340	Mar. 18	J. W. Moulton	6.20	3,930
Feb. 13[a]	J. W. Moulton	5.28	1,370	Apr. 6	E. D. Burchard	11.32	14,300
Mar. 14	do	6.20	3,760				

[a] Measurement made through partial ice cover.

Daily discharge, in second-feet, of Black River at Black River, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,570	10,400	2,360	1,400	1,800	7,420	12,600	5,840	2,730	1,470	1,100	680
2	2,010	12,600	2,240	2,400	1,700	7,240	13,100	6,520	2,600	1,680	1,100	745
3	2,010	11,100	2,480	2,200	1,200	6,700	14,600	7,060	2,730	3,390	1,100	620
4	2,010	9,570	2,360	1,800	1,400	6,010	16,000	6,880	1,900	3,250	1,100	950
5	2,480	8,370	2,240	2,400	1,600	5,510	15,300	6,350	1,900	2,120	1,020	1270
6	2,990	6,520	1,900	1,700	1,200	4,870	13,800	5,840	1,570	1,900	950	950
7	3,120	5,030	1,790	1,200	1,200	4,550	13,100	4,870	2,360	2,120	1,100	810
8	3,250	4,550	1,500	1,400	1,500	4,100	10,800	5,840	4,710	1,680	845	712
9	2,860	3,950	1,300	2,000	950	3,670	10,400	6,180	5,670	2,240	1,100	1,020
10	2,990	3,670	1,500	2,200	750	3,530	10,800	6,180	4,710	3,390	950	1,100
11	2,600	3,530	1,700	1,700	1,100	3,120	11,100	7,240	3,950	2,120	1,900	950
12	2,360	3,390	2,500	850	1,400	2,990	11,100	7,240	4,870	1,680	1,370	1,100
13	3,120	3,120	2,400	850	1,700	3,250	9,990	7,610	5,510	1,900	950	1,100
14	4,550	2,860	2,000	1,500	2,200	3,950	9,570	7,610	5,840	2,360	1,100	1,790
15	5,190	2,600	2,000	1,300	3,400	4,100	9,170	7,610	5,350	3,120	950	810
16	5,510	2,360	1,600	1,400	3,600	3,950	8,570	8,370	4,870	3,670	880	650
17	4,870	2,730	2,200	1,800	4,200	3,670	8,770	7,610	4,250	2,990	1,180	560
18	4,400	2,600	2,200	1,300	4,400	3,810	8,570	6,700	2,730	2,480	1,570	1,470
19	3,670	2,860	2,000	650	4,600	4,550	9,370	5,840	2,360	2,600	1,370	3,120
20	6,180	3,120	1,500	440	6,500	6,010	9,780	4,870	2,360	2,480	950	3,390
21	7,240	2,990	1,300	1,200	6,880	8,180	9,780	3,810	2,240	1,900	1,470	4,250
22	6,520	3,250	1,200	850	6,880	9,570	9,570	4,870	2,120	1,790	1,100	4,710
23	5,840	3,250	1,000	1,700	5,840	10,800	9,780	5,030	1,790	1,680	1,370	4,400
24	4,710	3,390	1,000	1,700	5,510	11,100	9,990	5,030	1,900	1,370	1,680	4,870
25	5,840	2,600	1,300	1,400	5,190	11,100	9,570	4,400	2,240	1,370	1,270	3,670
26	6,180	2,360	2,200	1,700	7,240	10,800	8,770	3,670	2,120	1,470	1,180	2,730
27	6,180	2,360	1,800	750	7,420	10,600	7,800	4,550	1,900	1,270	880	2,480
28	5,840	1,900	1,800	480	7,990	9,570	6,180	4,870	1,680	810	1,100	3,120
29	5,840	2,010	2,000	850	.....	8,770	5,840	4,710	1,900	1,100	1,100	3,530
30	6,880	2,010	1,600	1,000	.....	8,770	5,510	4,250	1,680	1,270	1,370	3,390
31	9,170	.....	2,200	1,500	.....	9,990	.....	4,250	.....	1,020	950	.....

NOTE.—Discharge Dec. 7 to Feb. 19, estimated because of ice from discharge measurements, weather records study of gage-height graph, and comparison with records for Black River near Boonville.

Monthly discharge, of Black River at Black River, N. Y., for the year ending Sept. 30, 1918.

[Drainage area, 1,870 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	9,170	1,570	4,450	2.38	2.74
November	12,600	1,900	4,370	2.34	2.61
December	2,600	1,000	1,850	.989	1.14
January	2,400	440	1,410	.754	.87
February	7,990	750	3,550	1.90	1.98
March	11,100	2,990	6,520	3.49	4.02
April	16,000	5,510	10,300	5.51	6.15
May	8,370	3,670	5,860	3.13	3.61
June	5,840	1,570	3,080	1.65	1.84
July	3,670	810	2,050	1.10	1.27
August	1,900	845	1,160	.620	.71
September	4,870	560	2,030	1.09	1.22
The year	16,000	440	3,880	2.07	28.16

FORESTPORT FEEDER NEAR BOONVILLE, N. Y.

LOCATION.—At lower end of feeder, above point at which it enters basin at Boonville.

RECORDS AVAILABLE.—Occasional current-meter measurements 1900 and 1905–1915; continuous record October 30, 1915, to September 30, 1918.

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

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

DETERMINATION OF DISCHARGE.—Daily discharge determined by Chezy formula. The coefficient, c, computed from each current-meter measurement, is plotted with reference to the date of measurement. A smooth curve drawn through the plotted points shows the variation of c through the season, and the coefficient for each day is taken off the curve. The other factors in the Chezy formula are obtained from gage-height records and the cross section of the canal.

DIVERSIONS.—A spillway takes water from the feeder just below gage No. 2, discharging it into Mill Creek, which enters Black River below the gaging station at Boonville. Other spillways above Hawkinsville discharge into Black River above the gaging station. There are no spillways between gage No. 1 and gage No. 2. The sum of the flow at this station and that of Black River near Boonville indicates the total run-off of Black River above the station near Boonville. The way in which water is diverted from Black River is briefly described under "Black River near Boonville" (pp. 66–67).

ICE.—There is usually no water in the canal during the winter, but water was observed in the canal several times during the winter of 1917–18, and occasional current-meter measurements of the discharge were made. See table of discharge measurements.

ACCURACY.—Records good except for days on which the discharge varies widely from the mean, for which they are fair.

Discharge measurements of Forestport feeder near Boonville, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height (feet).		Discharge (second-feet).	Date.	Made by—	Gage height (feet).		Discharge (second-feet).
		Gage No. 1.	Gage No. 2.				Gage No. 1.	Gage No. 2.	
Oct. 25	O. W. Hartwell..	3.254	1.934	239	June 27	J. W. Moulton..	3.002	1.592	241
Nov. 13	E. D. Burchard..	3.240	1.877	262	27	.....do.....	3.026	1.625	246
13	.....do.....	3.239	1.876	262	July 18	.....do.....	3.122	1.776	237
Feb. 9[a]	J. W. Moulton...	.....	.....	60	18	.....do.....	3.124	1.779	243
Mar. 14[a]	.....do.....	.....	.....	21	Aug. 15	C. C. Covert....	3.044	1.724	201
19[a]	.....do.....	.....	.....	23	Sept. 7	.....do.....	3.526	2.005	254
Apr. 13	M. H. Carson....	.....	.....	40	20	O. W. Hartwell.	3.627	2.057	291
June 6	.....do.....	3.222	1.858	281					

[a] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Forestport feeder near Boonville, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1	266	235	134	246	238	215	16	.....	.....	238	243	197	247
2	255	227	194	292	221	240	17	.....	.....	236	236	195	243
3	250	246	238	307	216	229	18	.....	.....	235	238	179	240
4	246	239	226	255	207	221	19	.....	.....	255	234	220	219
5	248	271	237	254	212	228	20	261	.....	240	224	217	260
6	246	284	259	245	221	239	21	255	.....	226	215	227	252
7	238	288	261	240	222	251	22	252	.....	212	230	227	246
8	230	300	251	238	224	237	23	235	.....	254	239	229	243
9	214	262	228	252	225	200	24	273	.....	265	226	230	214
10	257	263	230	265	233	193	25	246	.....	256	217	222	206
11	.....	264	224	264	220	206	26	230	.....	244	206	218	206
12	.....	261	230	240	219	242	27	217	.....	240	223	215	251
13	.....	261	248	226	220	214	28	238	.....	240	198	209	240
14	.....	257	259	249	213	209	29	238	.....	228	205	221	213
15	.....	.....	248	257	203	238	30	258	.....	212	208	231	196
							31	250	.....	.....	235	238	.....

NOTE.—Discharge, Oct. 11–19, estimated at 240 second-feet; Nov. 15–30, 250 second-feet.

Monthly discharge, in second-feet, of Forestport feeder near Boonville, N. Y., for the year ending Sept. 30, 1918.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	273	214	244	July	307	198	239
November	300	227	255	August	238	179	218
June	265	134	235	September	260	193	228

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, 1918.

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

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

DETERMINATION OF DISCHARGE.—Daily discharge determined by use of Chezy formula. The coefficient, c, computed from each current measurement is plotted with reference to date of measurement. A smooth curve, then drawn through the plotted points, shows the variation of c through the season and the coefficient for each day is taken off the curves. The other factors in Chezy formula are obtained from gage-height records and cross section of canal.

DIVERSIONS.—There are no diversions between gage No. 1 and gage No. 2. This station indicates the amount of water diverted from the Black River drainage into the Mohawk River drainage for canal purposes. For brief description of way in which water is diverted from Black River, see "Black River near Boonville."

REGULATION.—Flow in the canal is regulated by the operation of the 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 the frozen season.

ACCURACY.—Records good.

Discharge measurements of Black River canal (flowing south) near Boonville, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height (feet).		Discharge. (sec.-ft.)	Date.	Made by—	Gage height (feet).		Discharge (sec.-ft).
		Gage No. 1.	Gage No. 2.				Gage No. 1.	Gage No. 2.	
Oct. 26	O. W. Hartwell.	1.465	1.200	151	June 27	J. W. Moulton...	1.457	1.345	126
Nov. 13	E. D. Burchard.	1.550	1.286	175	27	.....do.....	1.395	1.328	111
13	.....do.....	1.526	1.279	168	27	.....do.....	1.285	1.085	163
13	.....do.....	1.500	1.278	168	July 18	.....do.....	1.462	1.262	156
14	.....do.....	1.506	1.291	170	18	.....do.....	1.456	1.255	153
14	.....do.....	1.502	1.285	165	Aug. 16	C. C. Covert.....	1.486	1.196	164
June 7	M. H. Carson....	1.415	1.258	146	Sept. 20	O. W. Hartwell..	1.62	1.29	168

Daily discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	June.	July.	Aug.	Sept.	Day.	Oct.	Nov.	June.	July.	Aug.	Sept.
1.....	182	173	100	165	159	167	16.....	.....	.....	177	150	155	144
2.....	184	182	217	177	163	173	17.....	.....	.....	173	149	158	160
3.....	179	175	202	181	153	167	18.....	.....	.....	173	145	143	173
4.....	179	177	205	154	166	159	19.....	.....	.....	173	143	162	158
5.....	173	197	195	155	165	173	20.....	.....	.....	176	136	162	166
6.....	179	199	227	140	150	155	21.....	148	.....	178	133	162	159
7.....	186	184	182	157	153	160	22.....	157	.....	159	151	162	154
8.....	179	199	194	153	160	161	23.....	166	.....	170	167	169	144
9.....	178	192	180	157	169	166	24.....	176	.....	171	162	166	136
10.....	183	184	179	160	168	156	25.....	171	.....	165	162	169	142
11.....	194	180	184	168	162	153	26.....	170	.....	163	151	161	132
12.....	173	180	188	140	158	183	27.....	171	.....	151	165	157	166
13.....	171	185	184	138	164	166	28.....	176	.....	161	158	160	165
14.....	.....	181	195	153	157	158	29.....	186	.....	157	156	164	143
15.....	.....	.....	182	156	157	153	30.....	198	.....	146	149	165	139
							31.....	182	.....	.....	152	172	.....

NOTE.—Discharge estimated as follows: Oct. 14–20, 175 second-feet; Nov. 15–30, 180 second-feet.

Monthly discharge, in second-feet, of Black River canal (flowing south) near Boonville, N. Y., for the year ending Sept. 30, 1918.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October.....	198	148	176	July.....	181	133	154
November.....	199	173	182	August.....	172	143	161
June.....	227	100	177	September.....	183	132	158

MOOSE RIVER AT MOOSE RIVER, N. Y.

LOCATION.—In 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, 1918.

GAGE.—Staff in two sections on the left bank; read by H. W. Hoch. The gage datum was lowered 0.17 foot on 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.—Cobblestones and boulders; fairly permanent. Current smooth, depth comparatively uniform.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.8 feet at 8 a. m. October 31 (discharge, 6,680 second-feet); minimum discharge 65 second-feet January 31.

1900–1918: 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 about 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 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 except as affected by ice December 8 to April 16. 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. Records fairly good except for periods of ice effect or low discharge, for which they are fair.

Discharge measurements of Moose River at Moose River, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 5	E. D. Burchard	6.61	488	Mar. 13[b]	J. W. Moulton	8.63	568
Dec. 18[a]	J. W. Moulton	6.50	277	Apr. 12	E. D. Burchard	9.08	1,910
Jan. 10[b]	E. D. Burchard	6.70	151	12	M. H. Carson	8.99	1,820
Feb. 8[b]	J. W. Moulton	8.0	284				

[a] Measurement made through partial ice cover.
[b] Measurement made through complete ice cover.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	460	2,660	441	360	170	1,100	800	2,760	625	369	202	540
2	369	2,000	441	280	240	950	1,500	2,860	670	1,320	216	500
3	274	1,830	404	240	180	650	2,600	2,180	540	810	230	422
4	441	1,590	386	300	110	950	2,600	1,910	422	715	230	189
5	580	1,320	336	280	200	700	2,400	1,590	369	625	176	352
6	810	1,200	352	260	220	600	2,000	1,590	369	404	151	259
7	715	1,140	220	260	75	550	1,800	1,520	670	386	151	230
8	580	1,020	340	200	280	600	2,200	2,180	1,080	386	151	422
9	500	965	380	190	110	550	2,600	2,270	760	422	126	422
10	500	965	400	150	170	750	2,400	2,270	860	441	189	259
11	460	910	440	220	160	600	2,200	2,180	860	715	230	176
12	386	860	400	220	180	600	1,900	1,830	860	760	176	336
13	965	860	550	220	200	550	1,500	2,180	1,200	810	202	386
14	1,080	760	340	170	360	600	1,200	3,170	1,020	860	164	460
15	860	715	360	240	360	550	1,500	2,460	860	810	151	441
16	1,260	625	440	260	400	600	1,900	1,910	760	670	259	352
17	1,140	670	420	240	380	500	3,060	1,670	670	580	336	860
18	860	670	280	360	400	600	3,170	1,260	625	670	320	1,260
19	715	670	440	260	340	600	3,060	1,260	500	625	202	1,260
20	1,830	670	340	180	550	550	2,560	1,020	404	540	151	1,140
21	1,380	540	280	280	700	750	2,360	1,260	404	386	164	1,200
22	1,200	500	280	440	1,110	850	2,860	1,140	500	336	189	1,380
23	1,080	500	280	240	950	1,200	2,860	1,080	670	289	289	1,140
24	965	500	240	100	750	1,200	2,460	810	810	274	274	1,140
25	860	500	240	220	850	1,100	2,180	860	580	259	230	1,080
26	1,140	460	180	150	850	1,000	1,910	860	580	230	259	1,020
27	1,080	500	420	180	1,100	900	1,830	860	369	216	259	1,080
28	1,200	441	400	170	1,100	750	1,910	1,080	320	244	259	1,200
29	1,590	404	320	360	.....	700	2,090	910	336	230	230	1,140
30	2,660	500	300	70	.....	700	2,360	810	176	244	259	910
31	5,170	.....	280	65	.....	700	.....	715	.....	274	230	.....

NOTE.—Discharge Dec. 8 to Apr. 16 estimated, because of ice, from discharge measurements, weather records, study of gage-height graph, and comparison with records for Black River near Boonville.

Monthly discharge of Moose River at Moose River, N. Y., for the year ending Sept. 30, 1918.

[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	5,170	274	1,070	2.89	3.33
November	2,660	404	900	2.43	2.71
December	550	180	353	.954	1.10
January	440	65	231	.624	.72
February	1,100	75	446	1.21	1.26
March	1,200	500	742	2.01	2.32
April	3,170	800	2,190	5.92	6.61
May	3,170	715	1,630	4.41	5.08
June	1,200	176	629	1.70	1.90
July	1,320	216	513	1.39	1.60
August	336	126	215	.581	.67
September	1,380	176	719	1.94	2.16
The year	5,170	65	802	2.17	29.46

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

LOCATION.—About 300 feet below highway bridge and 400 feet below 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, 1918.

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

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.0 feet at 8 a. m. and 3.30 p. m. May 13 (discharge, 530 second-feet); minimum discharge, 16 second-feet June 23.

1911–1918: Maximum stage recorded, 6.3 feet on March 28, 1913 (stage-discharge relation affected by backwater from Moose River); discharge computed from records at dam, 760 second-feet.

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

REGULATION.—Flow controlled by dam.

ACCURACY.—Stage-discharge relation practically permanent between dates of shift; not affected by ice. Rating curve 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 height weighted on days of changing gates, from records of gate opening at dam. Records good except those computed from gate openings at dam which are fair.

Discharge measurements of Middle Branch of Moose River at Old Forge, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 4	E. D. Burchard	1.81	97	May 11	J. W. Moulton	3.68	451
4	do	2.20	149	11	E. D. Burchard	3.79	493
5	do	2.42	182	11	J. W. Moulton	2.58	177
5	do	1.39	36	June 24	do	1.20	28
5	do	1.32	36	24	do	1.77	83
Apr. 11	M. H. Carson	2.40	137	24	do	2.33	163
11	E. D. Burchard	1.86	35	July 16	do	2.76	212
May 11	do	3.39	382				

Daily discharge, in second-feet, of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	98	280	49	58	143	130	130	232	63	34	34	104
2	98	311	51	56	136	130	136	232	53	25	34	104
3	98	290	52	58	136	130	106	232	35	31	28	104
4	98	290	52	57	136	130	115	232	27	32	27	104
5	98	290	52	57	136	130	115	232	38	33	27	104
6	98	280	54	57	136	130	125	223	126	34	27	104
7	98	280	57	57	136	130	115	214	36	40	28	104
8	98	280	57	57	136	130	115	214	58	42	28	98
9	98	280	56	58	136	130	125	290	63	36	29	98
10	98	280	56	58	136	130	135	378	220	36	31	98
11	98	280	58	56	136	130	135	378	311	43	33	98
12	98	280	58	56	136	130	135	378	241	74	32	98
13	98	270	58	56	130	130	135	451	36	200	31	98
14	98	260	59	56	130	130	150	530	63	223	31	98
15	104	250	63	60	130	130	150	503	74	298	32	110
16	104	270	63	60	130	130	150	402	74	324	30	98
17	104	250	63	59	130	123	165	280	53	272	29	98
18	104	250	63	59	130	123	165	184	41	200	29	104
19	98	165	63	59	130	123	135	141	35	36	27	104
20	98	58	63	59	130	123	167	141	50	42	75	104
21	98	54	61	57	130	123	178	111	126	44	173	104
22	98	51	61	57	130	123	324	86	74	58	173	104
23	98	54	60	57	130	123	324	86	16	63	173	104
24	98	55	60	57	130	130	324	74	53	63	173	104
25	104	56	60	57	130	130	324	63	311	58	165	98
26	104	55	60	57	130	130	298	74	241	58	165	98
27	104	50	60	57	130	130	298	63	24	58	165	104
28	143	48	60	56	130	130	248	46	21	58	116	98
29	165	48	58	56	.....	130	232	175	21	58	98	98
30	181	48	58	104	.....	130	232	53	28	58	98	98
31	214	.....	58	143	.....	130	.....	63	.....	86	98	.....

NOTE.—Discharge Apr. 3–13, 19–28 and May 18 to July 12 determined from special rating curves based on discharge measurements made when logs were lodged on the control. Discharge Sept. 21–23 estimated because of logs on the control.

Monthly discharge of Middle Branch of Moose River at Old Forge, N. Y., for the year ending Sept. 30, 1918.

[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	214	98	109	2.12	2.44
November	311	48	190	3.69	4.12
December	63	49	58	1.13	1.30
January	143	56	61.6	1.20	1.38
February	143	130	133	2.58	2.69
March	130	123	128	2.49	2.87
April	324	106	183	3.56	3.97
May	530	46	218	4.24	4.89
June	311	16	87.1	1.69	1.89
July	324	25	87.6	1.70	1.96
August	173	27	72.2	1.40	1.61
September	110	98	101	1.96	2.19
The year	530	16	119	2.31	31.31

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

LOCATION.—At concrete storage dam at outlet of Beaver River flow, 7½ miles west of Beaver River post office, 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, 1918.

GAGES.—Elevation of water surface in the reservoir is determined by a staff gage in two sections, on the west corner of the gage house; read by James Dunbar, gate tender. The mean elevation of the crest of the spillway is at gage height 16.96 feet. Prior to September 28, 1913, 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 distances they have been raised.

DISCHARGE MEASUREMENTS.—Made from a temporary footbridge at the mouth of the outlet tunnel, below the gates.

DETERMINATION OF DISCHARGE.—Records include the discharge through one or more of four 4-foot circular sluice gates, when opened, the 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. Theoretic coefficients based on the experiments [1] in the hydraulic laboratory at Cornell University have been used to compute ratings for the spillway and logway.

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

EXTREMES OF STAGE.—Maximum elevation of water surface in reservoir recorded during year, 18.5 feet on April 4 and 5; minimum stage recorded 7.85 feet at 8:35 a. m. February 13.

1908–1918: Maximum elevation of water surface in reservoir, 19.46 feet on March 29, 1913; minimum stage, 2.9 feet on September 29 and October 1, 1913.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 1,900 second-feet on April 5; minimum discharge, zero, during periods when gates were closed and there was no flow over spillway.

1908–1918: Maximum discharge, 3,300 second feet on May 2, 1911.

ACCURACY.—Stage-discharge relation permanent. Probably not affected by ice. Rating curves for sluice gates well defined. Lake gage read to half-tenths once daily. The accuracy of these computations depends to a large extent on the care with which the gates were set to the recorded openings Records fairly good.

Monthly discharge of Beaver River at State dam near Beaver River, N. Y., for the year ending Sept. 30, 1918.

[Drainage area, 176 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	259	200	228	1.30	1.50
November	536	253	328	1.86	2.08
December	252	238	246	1.40	1.61
January	237	199	219	1.24	1.43
February	224	166	188	1.07	1.11
March	338	227	245	1.39	1.60
April	1,900	536	1,100	6.22	6.94
May	1,260	552	846	4.80	5.53
June	835	173	475	2.70	3.01
July	363	160	237	1.35	1.56
August	253	218	237	1.35	1.56
September	221	194	208	1.18	1.32
The year	1,900	160	380	2.16	29.25

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

STREAMS TRIBUTARY TO ST. LAWRENCE RIVER.

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

LOCATION.—600 feet below lower dam of Newton Falls Paper Co., in 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 the State of New York Conservation Commission).

RECORDS AVAILABLE.—October 6, 1912, to September 30, 1918.

GAGE.—Vertical staff on left bank about 600 feet above the lower dam; read by Henry Van Waldick.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.53 feet at 5.10 p. m. May 16 (discharge, 1,240 second-feet); minimum stage is reached nearly every Sunday during low-water period when paper mills shut down.

1912–1918: Maximum stage recorded, 6.1 feet at 5.15 p. m. March 28, 1913 (discharge, 2,200 second-feet).

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

REGULATION.—Some diurnal fluctuation in flow caused by 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 the rating table weighted mean gage heights based on observer's notes concerning operation of paper mills. Records good.

Discharge measurements of East Branch of Oswegatchie River at Newton Falls, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 12[a]	J. W. Moulton	2.63	399	June 25	J. W. Moulton	2.42	412
Apr. 7	E. D. Burchard	1.31	168	July 17	do	2.09	318
7	do	.85	94	17	do	1.99	296
7	do	1.05	117	17	do	1.98	295
June 25	J. W. Moulton	2.78	508	17	do	1.93	301
25	do	2.66	473				

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	148	350	363	22	363	430	460	622	416	326	304	20
2	363	315	180	363	363	430	588	810	242	293	304	338
3	338	223	214	376	22	22	460	1,030	416	20	350	376
4	338	22	272	326	416	460	506	1,030	402	20	326	338
5	315	338	272	338	416	430	522	538	445	326	326	338
6	350	338	232	22	402	460	416	852	326	20	326	338
7	22	252	252	338	45	445	152	506	389	20	293	338
8	430	188	232	350	402	326	522	506	416	376	350	130
9	402	293	232	338	416	293	490	506	304	262	326	338
10	389	163	658	338	22	22	460	571	588	475	350	376
11	376	180	852	315	430	430	416	694	894	293	137	293
12	350	223	214	315	416	460	430	554	852	376	326	350
13	376	205	223	22	430	445	402	894	1,120	350	460	430
14	171	223	196	326	193	430	144	938	1,120	20	389	363
15	376	252	445	338	460	416	460	1,220	1,070	304	363	242
16	350	252	22	315	445	430	506	1,220	588	304	350	350
17	338	242	554	326	22	22	554	1,070	810	315	376	363
18	282	232	363	315	460	338	554	938	554	282	137	363
19	315	350	283	326	445	445	389	770	430	272	304	445
20	338	304	389	350	460	350	363	770	402	262	326	402
21	326	293	338	338	430	445	20	588	293	20	326	389
22	293	272	363	338	460	490	522	522	242	232	338	326
23	363	293	87	350	460	430	445	522	202	282	304	363
24	272	304	350	363	22	152	402	490	350	282	363	363
25	262	205	363	350	475	430	506	490	326	304	130	282
26	262	223	376	350	430	338	389	282	304	272	416	350
27	272	223	522	22	445	445	376	588	326	262	376	376
28	22	376	363	350	460	460	20	460	315	242	326	338
29	75	283	338	304	.....	445	152	490	304	252	363	293
30	272	363	99	252	.....	460	350	522	293	326	376	522
31	262	.....	163	252	.....	202	.....	475	.....	293	338	.....

Monthly discharge, of East Branch of Oswegatchie River at Newton Falls, N. Y., for the year ending Sept. 30, 1918.

[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	430	22	292	1.76	2.03
November	376	22	259	1.56	1.74
December	852	22	316	1.90	2.19
January	376	22	291	1.75	2.02
February	475	22	350	2.11	2.20
March	490	22	367	2.21	2.55
April	554	20	399	2.40	2.68
May	1,220	282	692	4.17	4.81
June	1,120	202	491	2.96	3.30
July	475	20	248	1.49	1.72
August	460	130	325	1.96	2.26
September	522	20	338	2.04	2.28
The year	1,220	20	364	2.19	29.78

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 (measured on topographic maps and map of State of New York, issued by United States Geological Survey).

RECORDS AVAILABLE.—June 23, 1916, to September 30, 1918.

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

CHANNEL AND CONTROL.—Solid rock.

EXTREMES OF DISCHARGE.—Maximum stage, from water-stage recorder, 6.6 feet from midnight to 8 p. m. April 4 (discharge, 9,220 second-feet); minimum stage from water-stage recorder 0.95 foot at 5 a. m. August 24 (discharge 340 second-feet).

1916–1918: Maximum stage from water-stage recorder, 7.6 feet from 9 to 12 a. m. March 30, 1917 (discharge, 11,700 second-feet); minimum stage from water-stage recorder, 0.91 foot at 11 p. m. October 16, 1916 (discharge 320 second-feet).

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

REGULATION.—Some diurnal fluctuation due to operation of mills at Rensselaer Falls and above. Seasonal flow regulated by storage in Cranberry Lake.

ACCURACY.—Stage-discharge relation permanent, except as affected by ice December 28 to March 7. Rating curve well defined between 400 and 15,000 second-feet. Operation of water-stage recorder satisfactory during the year. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records fair.

Discharge measurements of Oswegatchie River at Heuvelton, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec. ft.*			*Feet.*	*Sec. ft.*
Dec. 20[a]	J. W. Moulton	1.47	675	Mar. 16[a]	J. W. Moulton	2.60	1,780
Jan. 12[a]	E. D. Burchard	1.50	656	Apr. 9	E. D. Burchard	4.46	4,830
Feb. 14[b]	J. W. Moulton	2.02	735	June 7	M. H. Carson	1.95	1,180

[a] Measurement made through incomplete ice cover.
[b] Measurement made through complete ice cover.

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Daily discharge, in second-feet, of Oswegatchie River at Heuvelton, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	513	3,700	1,060	650	500	4,800	6,450	1,480	1,600	800	446	452
2	560	3,780	1,530	600	600	4,000	7,890	1,520	1,590	791	426	440
3	620	3,700	1,410	500	500	3,400	8,990	1,700	1,490	800	520	404
4	690	3,210	1,190	500	500	3,000	9,220	2,180	1,290	966	510	459
5	770	2,750	1,040	550	460	2,600	8,990	2,320	1,230	863	495	513
6	870	2,320	956	550	700	2,600	8,100	2,180	1,140	686	480	499
7	938	2,040	872	550	600	2,200	6,850	1,910	1,110	600	490	492
8	881	1,700	755	500	380	1,910	5,480	1,720	1,470	555	400	485
9	909	1,470	600	550	420	1,780	4,830	1,630	2,320	562	440	492
10	966	1,360	592	550	550	1,650	4,560	1,780	2,530	728	541	472
11	1,020	1,240	694	480	550	1,650	4,380	2,040	2,530	881	719	520
12	1,080	1,100	654	650	500	1,650	4,040	2,390	2,460	947	863	492
13	1,060	1,080	615	650	600	1,650	3,870	3,780	2,460	938	800	446
14	1,100	985	678	600	700	1,590	3,870	4,650	2,750	854	622	446
15	1,240	881	800	600	1,000	1,650	3,960	6,050	2,980	800	555	420
16	1,410	809	764	650	1,800	1,910	3,620	5,860	2,900	719	555	459
17	1,410	809	719	650	2,000	1,840	3,370	5,480	2,390	615	541	472
18	1,400	800	702	650	2,200	2,040	3,370	4,040	1,970	615	520	534
19	1,360	881	686	600	2,600	2,600	3,370	3,530	1,660	600	485	555
20	1,540	1,000	662	550	4,000	3,450	2,820	2,900	1,330	622	466	938
21	2,020	985	670	480	4,400	5,100	2,750	2,530	1,130	593	492	1,170
22	2,180	1,080	881	550	4,200	6,650	2,980	2,460	1,040	555	459	1,420
23	2,180	1,310	995	650	4,000	7,680	2,980	2,460	966	513	398	1,840
24	1,980	1,410	1,040	650	3,800	7,890	2,820	2,250	918	506	355	1,730
25	2,320	1,360	1,040	600	3,200	7,890	2,600	2,040	1,000	459	398	1,740
26	2,530	1,210	938	600	4,000	7,470	2,390	1,840	1,100	433	420	1,780
27	2,600	1,060	976	600	5,000	6,850	2,180	1,780	1,040	440	392	1,980
28	2,600	956	918	460	5,000	6,250	1,910	1,720	928	420	420	1,840
29	2,460	881	900	420	.....	5,670	1,730	1,840	863	446	446	1,590
30	2,530	809	800	420	.....	5,480	1,570	1,840	800	459	446	1,510
31	3,290	.....	750	480	.....	5,480	.....	1,730	.....	485	472	.....

NOTE.—Discharge Dec. 28 to Mar. 7 estimated, because of ice, from discharge measurements, weather records and study of gage-height graph. Discharge Aug. 4–9 estimated by study of gage-height graph.

Monthly discharge of Oswegatchie River near Heuvelton, N. Y., for the year ending Sept. 30, 1918.

[Drainage area, 961 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,290	513	1,520	1.58	1.82
November	3,780	800	1,560	1.62	1.81
December	1,530	592	867	.902	1.04
January	650	420	564	.588	.68
February	5,000	380	1,960	2.04	2.12
March	7,890	1,590	3,890	4.04	4.66
April	9,220	1,570	4,400	4.58	5.11
May	6,050	1,480	2,630	2.74	3.16
June	2,980	800	1,630	1.70	1.90
July	966	420	653	.679	.78
August	863	355	502	.522	.60
September	1,980	404	886	.922	1.03
The year	9,220	355	1,750	1.82	24.71

WEST BRANCH OF OSWEGATCHIE RIVER NEAR HARRISVILLE, N. Y.

LOCATION.—At highway bridge near Geers Corners, 2½ miles downstream from Harrisville, Lewis County.

DRAINAGE AREA.—245 square miles (measured on topographic maps and map of New York, issued by United States Geological Survey; scale, 1:500,000).

RECORDS AVAILABLE.—July 1, 1916, to September 30, 1918.

GAGE.—Vertical staff in three sections on the right bank. One section graduated from 0.0 to 3.3 feet about 25 feet below bridge, and two sections graduated from 3.3 to 10.1 feet on downstream side of bridge abutment; read by Frank Osborne.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet above the bridge, or by wading.

CHANNEL AND CONTROL.—Rocky and rough; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.4 feet at 6 p. m. April 3 (discharge, 3,980 second-feet); minimum stage recorded, 1.1 feet at 7 a. m. August 28 and 29 (discharge 42 second-feet).

1916–1918: Maximum stage recorded 8.1 feet at 6.30 a. m. and 6 p. m. March 28, 1917 (discharge, 4,880 second-feet); minimum stage recorded 1.10 feet at 6 p. m. August 11, 1917, and 7 a. m. August 28 and 29, 1918 (discharge 42 second-feet).

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

REGULATION.—The pulp mill at Harrisville causes some diurnal fluctuation.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve well defined between 50 and 4,000 second-feet. Gage read to half-tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of West Branch of Oswegatchie River near Harrisville, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Feb. 12	J. W. Moulton	1.99	165
Apr. 8	E. D. Burchard	4.88	1,580
June 26	J. W. Moulton	2.63	339

Daily discharge, in second-feet, of West Branch of Oswegatchie River near Harrisville, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	158	1,960	305	106	106	1,560	1,800	560	480	220	195	54
2	245	1,640	335	115	91	1,210	2,890	650	422	440	170	70
3	220	1,350	305	106	106	1,090	3,980	650	405	370	124	58
4	275	1,090	245	106	106	970	3,300	600	352	245	106	58
5	335	850	232	91	98	800	2,690	600	320	275	106	79
6	405	650	220	68	91	750	2,130	560	275	245	124	91
7	388	560	245	77	106	650	1,640	520	520	245	77	74
8	460	422	170	85	91	560	1,560	600	1,090	220	106	77
9	480	405	158	77	85	480	1,640	600	1,210	245	195	54
10	480	370	170	79	77	480	1,800	560	1,030	370	320	63
11	405	352	170	91	115	440	1,640	650	910	335	245	66
12	305	370	170	124	124	370	1,420	800	850	305	158	56
13	370	335	158	98	146	405	1,280	1,150	970	320	124	70
14	520	275	170	79	220	370	1,210	1,720	1,090	275	135	70
15	560	220	170	158	440	370	1,210	1,800	970	275	91	68
16	560	220	195	115	480	370	1,210	1,490	750	220	66	91
17	480	260	182	106	480	370	1,350	1,210	650	195	63	106
18	520	275	207	106	560	405	1,350	1,030	520	209	68	275
19	520	305	158	115	650	440	1,350	850	440	195	79	320
20	750	405	170	106	1,210	600	1,210	750	352	170	70	460
21	970	370	195	124	1,490	850	1,090	700	320	146	68	750
22	1,030	405	207	98	1,350	1,350	1,090	650	388	124	68	850
23	850	460	195	124	1,350	1,800	1,150	560	422	106	51	650
24	750	440	195	146	1,210	1,960	1,090	480	480	124	60	700
25	850	370	195	124	1,210	1,960	970	440	422	115	58	800
26	1,090	335	207	124	1,800	1,960	910	460	335	146	63	800
27	1,090	335	260	124	1,800	1,640	800	560	305	146	56	600
28	910	305	195	98	1,720	1,350	700	650	245	106	56	560
29	700	275	170	79	.....	1,280	650	700	275	98	54	560
30	850	290	170	98	.....	1,280	600	650	245	195	58	520
31	1,420	.....	115	106	.....	1,420	.....	560	.....	245	56	.....

Monthly discharge of West Branch of Oswegatchie River near Harrisville, N. Y., for the year ending Sept. 30, 1918.

[Drainage area, 245 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	1,420	158	611	2.50	2.88
November	1,960	220	530	2.16	2.41
December	335	115	201	.82	.95
January	158	68	105	.429	.38
February	1,800	77	618	2.52	2.62
March	1,960	370	953	3.89	4.48
April	3,980	600	1,520	6.22	6.94
May	1,800	440	766	3.13	3.61
June	1,210	245	568	2.32	2.59
July	440	98	223	.910	1.05
August	320	51	105	.429	.49
September	850	54	302	1.23	1.37
The year	3,980	51	540	2.20	29.77

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

LOCATION.—Half a mile below dam of International Paper Co. at Piercefield, St. Lawrence County and 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, 1918.

GAGE.—Stevens water-stage recorder on 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 fastened to same stump and having 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 M. O. Wood.

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, 10.6 feet at 1 p. m. April 2 (discharge, 5,990 second-feet); minimum stage from water-stage recorder, 1.8 feet at 3 p. m. January 20 (discharge, 56 second-feet).

1908–1918: 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 made 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 basin 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 7,000 second-feet. Operation of the water-stage recorder satisfactory throughout the year. Daily discharge ascertained by use of discharge integrator. Records good.

COOPERATION.—Water-stage recorder inspected by an employee of the International Paper Co.

Discharge measurements of Raquette River at Piercefield, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 4	E. D. Burchard	4.05	475	Mar. 12	J. W. Moulton	6.08	1,420
Feb. 7[a]	J. W. Moulton	4.21	387	May 10	do	8.50	3,550

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet of Raquette River at Piercefield, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	318	1,800	1,070	620	300	915	1,900	3,900	1,980	854	865	235
2	480	1,930	676	450	275	950	3,290	3,850	1,750	1,250	765	259
3	485	1,980	1,000	440	140	490	2,980	3,870	1,960	1,200	740	370
4	496	2,020	1,000	470	70	975	3,280	3,900	2,070	782	485	523
5	484	2,310	887	550	450	1,070	3,610	3,840	1,970	962	565	387
6	480	2,240	654	144	550	1,200	3,740	3,880	1,870	1,270	740	328
7	226	2,180	668	210	460	1,110	3,820	3,830	1,970	824	713	204
8	369	2,140	696	254	209	1,100	3,850	3,800	1,990	964	710	117
9	510	2,030	436	315	245	1,180	4,050	3,510	1,690	1,260	746	273
10	480	1,950	778	410	200	620	4,150	3,550	2,090	1,210	677	417
11	484	1,680	914	440	105	1,200	4,180	3,650	2,010	1,260	421	407
12	502	1,870	708	450	338	1,180	4,170	3,500	2,160	1,240	838	408
13	519	1,770	556	204	522	1,170	4,120	3,840	2,200	1,280	830	408
14	238	1,730	538	301	535	1,120	4,010	3,780	2,150	830	867	385
15	425	1,680	734	366	520	1,200	3,910	3,750	2,130	1,330	862	154
16	564	1,630	420	130	450	1,230	3,920	3,740	1,860	1,380	845	278
17	758	1,530	680	254	246	460	3,880	3,630	2,150	1,330	835	458
18	978	1,270	800	448	250	1,000	3,970	3,680	2,060	1,350	523	414
19	959	1,470	620	448	518	1,230	4,020	3,470	1,990	1,290	775	453
20	1,000	1,550	520	180	540	1,140	3,930	3,430	1,950	1,380	845	531
21	387	1,590	510	297	575	1,120	4,170	3,300	1,850	898	785	532
22	810	1,550	650	356	700	1,130	4,180	3,170	1,480	1,400	710	300
23	1,310	1,400	271	196	935	1,140	4,400	3,050	1,330	1,380	695	401
24	1,350	1,330	577	344	365	655	4,300	2,840	1,520	1,110	657	614
25	1,480	812	277	408	638	1,330	4,220	2,900	1,440	1,100	277	780
26	1,440	1,180	464	383	810	1,550	4,290	2,450	1,270	1,110	417	1,070
27	1,460	884	579	190	810	1,540	4,200	2,720	1,170	960	417	1,070
28	1,070	1,220	580	86	920	1,560	4,060	2,440	1,230	640	340	1,110
29	1,570	1,240	580	398	.....	1,350	4,000	2,150	1,340	895	285	950
30	1,630	1,120	320	450	.....	1,640	3,880	2,000	754	983	205	1,290
31	1,730	.....	520	431	.....	1,380	.....	1,970	.....	975	160	.....

NOTE.—Discharge Dec. 16–22, Dec. 29 to Jan. 5, and Jan. 10–12 estimated for lack of gage-height record, from study of record for the periods Dec. 8–15 and Jan. 19–26.

Monthly discharge of Raquette River at Piercefield, N. Y., for the year ending Sept. 30, 1918.

[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	1,730	226	800	1.11	1.28
November	2,310	812	1,640	2.27	2.53
December	1,000	271	635	.878	1.01
January	620	86	343	.475	.55
February	935	70	453	.627	.65
March	1,640	460	1,130	1.56	1.80
April	4,400	1,900	3,880	5.37	5.99
May	3,900	1,970	3,340	4.62	5.33
June	2,200	754	1,780	2.46	2.74
July	1,400	640	1,120	1.55	1.79
August	867	160	632	.874	1.01
September	1,290	117	504	.697	.78
The year	4,400	70	1,360	1.88	25.46

ST. REGIS RIVER AT BRASHER CENTER, N. Y.

LOCATION.—Near steel highway bridge in 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 mouth.

DRAINAGE AREA.—621 square miles (measured on post-route map).

RECORDS AVAILABLE.—August 22, 1910, to November 10, 1917, when the station was discontinued.

GAGES.—Staff gage consisting of inclined and vertical sections, on right bank about 600 feet above bridge; installed June 24, 1916. Prior to this date, chain on right hand downstream side of bridge. Gages not at same datum; subject to different controls. Gage read by George Myers.

DISCHARGE MEASUREMENTS.—Made from a cable at the staff gage installed in June, 1916; previously made from the highway bridge or by wading.

CHANNEL AND CONTROL.—Small boulders and coarse gravel at cable; large boulders and gravel; very rough at bridge; both sections fairly permanent.

EXTREMES OF DISCHARGE.—1910–1917: Maximum stage recorded, 9.1 feet at 7 a. m. March 27, 1914 (discharge, 16,200 second-feet); minimum stage recorded 5.25 feet at 5 p. m. August 8, 1917 (discharge about 34 second-feet).

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

ACCURACY.—Stage-discharge relation practically permanent. Gage read to quarter-tenths twice dialy. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of St. Regis River at Brasher Center, N. Y., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 2	J. W. Moulton	6.20	441	Mar. 17[a]	J. W. Moulton	6.67	545
2	E. D. Burchard	6.21	442	Apr. 10	E. D. Burchard	8.33	3,400

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of St. Regis River at Brasher Center, N. Y., for the period Oct. 1 to Nov. 10, 1917.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	404	1,880	12	625	.....	22	930	.....
2	510	1,520	13	685	.....	23	930	.....
3	529	1,240	14	705	.....	24	810	.....
4	586	1,050	15	930	.....	25	1,120	.....
5	655	930	16	810	.....	26	1,380	.....
6	810	810	17	705	.....	27	1,310	.....
7	930	705	18	605	.....	28	1,180	.....
8	810	625	19	625	.....	29	1,240	.....
9	705	529	20	990	.....	30	1,590	.....
10	685	438	21	990	.....	31	1,960	.....
11	625	.....						

NOTE.—Mean discharge for October is 883 second-feet, or 1.42 second-feet per square mile, equivalent to a run-off of 1.64 inches from drainage area above station.

RICHELIEU RIVER AT FORT MONTGOMERY, ROUSES POINT, N. Y.

LOCATION.—Inside fort three-eighths mile south of international boundary, about one-half mile below outlet of Lake Champlain and 1 mile northeast of 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 1918.

GAGE.—Staff, inside the fort; read by Thomas Bourke. Elevation of gage zero 92.50 feet above mean sea level.

EXTREMES OF STAGE.—Maximum elevation recorded during year, 98.95 feet on April 11, 12, and 15; minimum elevation recorded, 93.65 feet at 10 a. m. September 10. 1869–1918: Maximum elevation recorded, 103.28 feet April, 1869; [1] minimum elevation recorded, 91.9 feet November 13, 1908.

COOPERATION.—Gage heights observed under direction of United States Engineer Corps and reported weekly to the United States Geological Survey.

[1] Hoyt, J. C., U. S. Geol. Survey Water-Supply Paper 97, p. 340. 1904.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.2	2.45	2.15	1.45	1.2	2.25	4.9	5.75	4.25	2.95	1.9	1.4
2	1.2	2.6	2.0	1.45	1.2	2.35	5.25	5.9	4.1	2.9	1.9	1.45
3	1.4	2.7	2.1	1.4	1.2	2.4	5.7	5.75	4.05	2.9	1.75	1.55
4	1.3	2.7	2.05	1.4	1.2	2.45	6.0	5.55	4.0	2.85	1.8	1.3
5	1.2	2.8	2.1	1.4	1.2	2.4	6.15	5.6	3.9	2.8	1.85	1.4
6	1.25	2.9	2.0	1.4	1.2	2.45	6.2	5.6	3.85	2.8	1.65	1.3
7	1.35	2.7	1.95	1.35	1.2	2.45	6.3	5.45	3.9	2.75	1.7	1.3
8	1.4	2.75	1.95	1.35	1.2	2.5	6.3	5.45	3.75	2.7	1.65	1.3
9	1.25	2.75	1.9	1.3	1.2	2.5	6.25	5.25	3.65	2.75	1.7	1.3
10	1.25	2.7	1.95	1.3	1.2	2.45	6.25	6.0	3.65	2.65	1.8	1.15
11	1.35	2.7	1.85	1.3	1.25	2.6	6.45	5.1	3.6	2.65	2.1	1.2
12	1.35	2.6	1.85	1.3	1.25	2.6	6.45	5.05	3.75	2.6	1.85	1.5
13	1.55	2.6	1.85	1.3	1.2	2.55	6.35	5.15	3.55	2.55	1.9	1.25
14	1.45	2.6	1.9	1.3	1.25	2.6	6.4	5.15	3.6	2.5	1.85	1.2
15	1.6	2.6	1.9	1.3	1.6	2.6	6.45	5.1	3.55	2.5	1.8	1.2
16	1.4	2.45	1.85	1.3	1.3	2.65	6.4	5.5	3.6	2.5	1.7	1.2
17	1.35	2.5	1.8	1.3	1.3	2.6	6.4	5.1	3.5	2.45	1.7	1.2
18	1.55	2.6	1.8	1.3	1.3	2.6	6.25	5.1	3.5	2.4	1.7	1.2
19	1.8	2.4	1.8	1.3	1.7	2.6	6.35	5.05	3.4	2.4	1.65	1.3
20	1.45	2.5	1.75	1.25	1.6	2.75	6.35	5.05	3.35	2.35	1.7	1.3
21	1.5	2.3	1.75	1.25	1.6	2.8	6.25	4.75	3.45	2.3	1.65	1.35
22	1.55	2.3	1.65	1.25	1.65	2.95	6.25	4.75	3.3	2.3	1.6	1.4
23	1.6	2.25	1.7	1.25	1.65	3.15	6.25	4.65	3.2	2.3	1.65	1.5
24	1.55	2.3	1.7	1.25	1.7	3.4	6.25	4.6	3.15	2.2	1.55	1.5
25	1.7	2.2	1.6	1.25	1.7	3.6	6.05	4.55	3.15	2.25	1.55	1.65
26	1.65	2.1	1.55	1.25	1.95	3.8	6.15	4.4	3.1	2.25	1.6	1.75
27	1.65	2.2	1.55	1.25	2.05	3.95	6.1	4.4	3.1	2.15	1.45	1.95
28	1.75	2.2	1.6	1.2	2.15	4.05	6.0	4.2	3.2	1.95	1.55	2.35
29	1.8	2.15	1.45	1.2	.....	4.2	6.05	4.25	3.1	2.0	1.8	2.2
30	1.9	2.2	1.5	1.2	.....	4.4	5.85	4.25	3.0	2.0	1.35	2.3
31	2.2	.....	1.45	1.2	.....	4.65	.....	4.3	.....	1.85	1.45	.....

SARANAC RIVER NEAR PLATTSBURG, N. Y.

LOCATION.—At Indian Rapids power plant of Plattsburg Gas & Electric Co., 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, 1918.

GAGES.—Crest gage a vertical staff on the angle of the wing wall at the end of the racks; 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 cribwork. Records of kilowatt output are obtained by a watt meter on switchboard at half-hour intervals. An inclined staff gage at the cable station, about one-fourth mile below the dam. Gages and watt meters read by power-house operators.

DISCHARGE MEASUREMENTS.—Made from a cable at head of Indian Rapids, one-fourth mile below dam, or, at low water, by wading under cable or in tailrace.

DISCHARGE RATING.—Records include flow over concrete spillway 171.25 feet in crest length, a rating for which has been prepared for 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 the inclined staff gage at the cable as a check on the ratings of spillway and turbines.

[1] Horton, R. E., Weir experiments, coefficients, and formulas; U. S. Geol. Survey Water-Supply Paper 200, pp. 98-100, 1907.

EXTREMES OF DISCHARGE.—Maximum daily discharge during year, 5,600 second-feet April 3; minimum daily discharge, 200 second-feet August 4.

1908–1918: Maximum daily discharge recorded, 6,410 second-feet, April 20, 1914; minimum daily discharge recorded, 90 second-feet, September 28, 1914.

ICE.—The crest of the spillway is kept free from ice so that the stage-discharge relation is not affected.

REGULATION.—The lakes and ponds on the main stream and tributaries above the station have a water surface area 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. Records fairly good.

COOPERATION.—Gage-height records and watt meter readings furnished by Plattsburg Gas & Electric Co., Herbert A. Stutchbury, superintendent.

The following discharge measurement was made by J. W. Moulton:
May 9, 1918: Gage height, 2.79 feet; discharge, 1,300 second-feet.

Daily discharge, in second-feet, of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	740	1,040	440	330	450	1,550	3,500	1,750	1,040	700	350	420
2	880	940	440	440	640	2,600	4,900	2,000	1,300	700	290	470
3	1,080	660	520	410	440	1,500	5,600	1,700	920	620	300	390
4	940	820	410	520	860	1,200	4,000	1,650	800	580	200	370
5	880	760	370	450	410	1,100	3,200	1,800	820	700	250	360
6	920	700	360	480	420	920	2,700	1,600	700	620	310	390
7	720	740	300	540	700	900	2,450	1,600	1,240	900	290	620
8	760	760	260	340	840	800	2,600	1,550	1,300	740	220	600
9	520	780	230	520	440	760	2,500	1,500	1,060	540	520	600
10	460	740	420	560	620	620	2,000	1,300	920	840	780	580
11	500	660	310	470	880	780	1,800	1,250	860	780	900	580
12	430	800	280	580	470	820	1,650	1,400	1,000	720	1,180	560
13	560	800	470	540	640	780	1,600	1,300	1,060	740	1,220	620
14	490	800	450	810	580	960	1,800	1,450	1,080	440	1,180	700
15	620	780	470	750	580	820	1,850	1,250	960	700	940	600
16	520	720	410	680	660	840	2,100	1,300	920	580	720	600
17	480	760	560	460	920	620	2,050	1,350	880	400	620	560
18	600	660	430	390	840	900	2,100	1,240	880	480	520	640
19	520	620	300	560	640	860	1,950	1,250	840	580	600	900
20	560	520	370	280	760	900	1,850	960	800	580	390	900
21	640	500	390	520	2,200	1,450	1,800	1 000	800	460	480	1,080
22	660	480	370	310	1,500	2,050	2,200	740	780	540	500	1,220
23	540	410	290	300	1,240	2,900	2,200	820	840	580	490	1,040
24	540	270	370	240	960	2,300	2,050	920	820	520	490	1,020
25	620	225	260	330	1,020	2,300	1,850	820	800	1,140	430	1,200
26	880	290	480	380	1,550	2,300	1,750	1,040	720	840	420	1,300
27	700	260	370	700	2,000	2,000	1,700	1,200	680	600	370	1,600
28	680	320	320	1,050	1,900	1,900	1,500	1,400	700	370	360	1,600
29	880	500	470	410	.....	2,050	1,350	960	720	400	420	1,250
30	900	500	440	320	.....	2,500	1,700	940	680	310	400	1,180
31	1,220	.....	460	460	.....	2,800	.....	900	.....	310	380	.....

Monthly discharge of Saranac River near Plattsburg, N. Y., for the year ending Sept. 30, 1918.

[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	1,220	430	692	1.14	1.31
November	1,040	225	627	1.03	1.15
December	560	230	388	.639	.74
January	1,050	240	488	.804	.93
February	2,200	410	899	1.48	1.54
March	2,900	620	1,440	2.37	2.73
April	5,600	1,350	2,340	3.86	4.31
May	2,000	740	1,290	2.13	2.46
June	1,300	680	897	1.48	1.65
July	1,140	310	613	1.01	1.16
August	1,220	200	533	.878	1.01
September	1,600	360	798	1.31	1.46
The year	5,600	200	915	1.51	20.45

AUSABLE RIVER AT AUSABLE FORKS, N. Y.

LOCATION.—In 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, 1918.

GAGE.—Chain on left bank 1,000 feet below junction of East and West branches; read by A. S. Baker.

DISCHARGE MEASUREMENTS.—Made from a cable about 1½ miles below gage, or by wading, either near the cable or a short distance above the gage.

CHANNEL AND CONTROL.—Stone and gravel, occasionally shifting. Channel divided by an island opposite the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.46 feet at 5.15 p. m., April 1, and 7 a. m., April 22 (discharge, 6,070 second-feet); minimum discharge, 80 second-feet, January 14 and 15 and February 1–3.

1910–1918: Maximum stage recorded, 10.2 feet in the evening of March 27, 1913 (discharge, roughly, 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 determinations of monthly mean discharge based on semidaily gage heights are 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, which were, however, largely compensating.

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

ACCURACY.—Stage-discharge relation probably permanent between dates of shifts; affected by ice December 10 to February 13. Rating curve fairly well defined between 175 and 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Ausable River at Ausable Forks, N. Y., during the year ending Sept. 30, 1918.

[Made by J. W. Moulton.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Jan. 10[a]	3.59	124
May 4	4.78	1,790
6	5.28	2,840

[a] Measurement made through incomplete ice cover.

Daily discharge, in second-feet, of Ausable River at Ausable Forks, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	371	1,440	234	220	80	890	4,210	3,690	656	345	250	1,230
2	417	1,010	221	220	80	668	5,600	3,320	588	998	196	567
3	371	751	189	260	80	1,060	3,950	3,690	679	436	170	436
4	379	599	183	260	85	557	2,490	1,830	557	336	164	221
5	1,090	546	208	220	100	515	1,730	1,440	345	294	142	227
6	739	455	202	160	110	398	1,350	2,160	319	302	121	611
7	597	436	183	130	100	362	1,530	2,720	465	407	121	679
8	455	388	170	120	95	371	1,620	2,950	1,230	484	142	426
9	398	407	157	120	100	407	2,380	1,440	1,940	526	5,310	362
10	345	362	180	120	110	354	1,530	1,260	998	526	2,600	294
11	319	311	180	110	110	319	1,260	2,720	515	505	2,050	234
12	398	328	190	100	140	336	1,120	1,350	1,130	536	1,940	177
13	1,010	302	200	90	200	426	1,010	1,620	1,530	515	1,620	170
14	578	264	220	80	407	417	1,200	3,070	1,180	634	567	929
15	567	280	200	80	864	407	2,270	1,730	813	536	465	436
16	955	264	200	90	800	336	1,620	1,200	567	407	302	354
17	567	227	220	100	505	319	2,600	929	484	336	257	679
18	484	272	220	110	436	526	2,600	851	388	319	227	1,180
19	465	280	200	110	668	788	1,830	764	328	302	189	1,260
20	903	280	160	140	3,190	788	1,440	1,040	257	250	164	702
21	727	280	160	130	942	1,260	1,440	1,030	264	214	196	1,100
22	588	272	160	120	903	2,050	5,030	764	214	214	177	1,210
23	484	311	180	110	890	3,070	2,490	800	328	189	177	1,070
24	515	311	200	110	788	2,160	2,600	702	567	164	177	1,040
25	864	202	220	120	714	1,730	1,440	588	546	153	164	1,180
26	788	208	240	130	3,070	1,350	1,350	825	407	153	183	1,350
27	1,070	221	240	130	2,160	1,040	1,350	825	354	102	177	2,490
28	1,260	208	220	110	1,620	903	1,830	764	311	132	164	1,530
29	1,620	208	220	110	.....	1,040	1,730	1,260	272	110	189	984
30	2,400	208	240	100	.....	1,350	3,690	903	242	234	183	813
31	3,070	.....	220	85	.....	1,830	.....	714	.....	436	183	.....

NOTE.—Discharge Dec. 10 to Feb. 13, 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, 1918.

[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	3,070	319	800	1.80	2.08
November	1,440	202	388	.874	.98
December	240	157	201	.453	.52
January	260	80	132	.298	.34
February	3,190	80	691	1.56	1.62
March	3,070	319	904	2.04	2.35
April	5,600	1,010	2,210	4.98	5.56
May	3,690	588	1,580	3.56	4.10
June	1,940	214	616	1.39	1.55
July	998	102	358	.806	.93
August	5,310	121	612	1.38	1.59
September	2,490	170	798	1.80	2.01
The year	5,600	80	772	1.74	23.63

LAKE GEORGE AT ROGERS ROCK, N. Y.

LOCATION.—At boathouse in small bay on north side of steamboat landing at Rogers Rock, Essex County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 10, 1913, to September 30, 1918.

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; read once daily by George O. Cook.

EXTREMES OF STAGE.—Maximum stage recorded during year, 4.2 feet May 20, 22, 27, 30, and June 3; minimum stage recorded, 1.55 feet February 16.

1913–1918: Maximum stage recorded, 4.98 feet on May 2, 1914; minimum stage recorded, 1.2 feet on November 21 and December 22, 1916.

REGULATION.—The elevation of lake surface is regulated by the operation of gates and wheels at the dam at the outlet of the lake at Ticonderoga.

COOPERATION.—Gage-height record furnished by International Paper Co.

[1] Determined by levels; supersedes the estimated figure previously published.

Daily gage height, in feet, of Lake George at Rogers Rock, N. Y., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.20	2.60	2.25	1.85	1.70	1.82	2.80	3 82	4.10	3.65	3.18	2.58
2	2.30	2.58	2.28	1.90	1.70	1.85	2.92	3.90	4.15	3.50	3.10	2.62
3	2.28	2.55	2.22	1.80	1.72	1.80	3.00	3.80	4.20	3.52	3.00	2.60
4	2.30	2.55	2.22	1.78	1.70	1.82	3.12	3.80	4.05	3.48	3.10	2.52
5	2.25	2.52	2.20	1.75	1.62	1.88	3.20	3.85	4.00	3.50	3.05	2.50
6	2.28	2.58	2.15	1.78	1.65	1.85	3.22	3.85	4.02	3.50	2.98	2.55
7	2.18	2.50	2.10	1.80	1.62	1.82	3.25	3.90	4.10	3.55	3.00	2.50
8	2.20	2.52	2.08	1.82	1.65	1.80	3.30	3.88	4.05	3.55	2.95	2.55
9	2.12	2.50	2.28	1.78	1.70	1.85	3.35	3.80	4.08	3.52	2.90	2.40
10	2.10	2.45	2.20	1.75	1.70	1.88	3.42	3.88	3.98	3.50	2.92	2.38
11	2.12	2.40	2.15	1.78	1.68	1 92	3.48	3.85	4.00	3.50	3.00	2.40
12	2.10	2.35	2.10	1.80	1.65	1.95	3.52	3.92	4.08	3.48	2.95	2.45
13	2.15	2.40	2.05	1.82	1.65	1.95	3.55	4.02	4.00	3.45	2.98	2.48
14	2.12	2.38	2.10	1.80	1.62	1.92	3.58	4.08	4.05	3.42	2.98	2.45
15	2.10	2.35	2.12	1.85	1.60	1.95	3.60	4.05	3.90	3.45	2.95	2.42
16	2.05	2.30	2.10	1.90	1.55	1.98	3.62	4.15	3.98	3.45	2.88	2.40
17	2.02	2.35	2.05	1.88	1.60	2.00	3.65	4.12	3.95	3.40	2.85	2.38
18	2.00	2.32	2.08	1.85	1.65	1.98	3.68	4.15	3.90	3.38	2.80	2.35
19	2.15	2.35	2.05	1.88	1.68	2.00	3.70	4.18	3.78	3.40	2.75	2.40
20	2.10	2.30	2.02	1.85	1.70	1.98	3.72	4.20	3.75	3.40	2.80	2.35
21	2.00	2.22	2.00	1.82	1.68	2.02	3.75	4.15	3.80	3.38	2.70	2.35
22	1.98	2.25	1.98	1.85	1.65	2.15	3.85	4.20	3.78	3.40	2.75	2.40
23	1.95	2.30	2.00	1.82	1.65	2.20	3.82	4.15	3.78	3.35	2.75	2.35
24	1 98	2.30	1.98	1.80	1.68	2.30	3.85	4.12	3.75	3.32	2.72	2.32
25	2.08	2.32	2.00	1.85	1.70	2.35	3.80	4.10	3.70	3.28	2.70	2.40
26	2.05	2.35	1.95	1.80	1.80	2.40	3.82	4.15	3.68	3.30	2.68	2.35
27	2.15	2.22	1.92	1.75	1.80	2.42	3.80	4.20	3.65	3.30	2.65	2.50
28	2.08	2.25	1.95	1.78	1.82	2.45	3.80	4.12	3.68	3.20	2.62	2.50
29	2.10	2.20	1.90	1.80	.....	2.50	3.82	4.12	3.62	3.25	2.60	2.48
30	2.50	2.25	1.88	1.78	.....	2.55	3.80	4.20	3.58	3.30	2.58	2.45
31	2.58	.....	1.88	1.75	.....	2.62	.....	4.18	.....	3.12	2.55	.....

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, 1918.

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—92.5 feet above mean sea level. Gage read by employee of the Champlain Transportation Co.

EXTREMES OF STAGE.—Maximum stage recorded during year, 6.78 feet on April 10 and 11; minimum stage recorded, 1.44 feet on September 14.

1907–1918: Maximum stage recorded, 8.20 feet on April 7, 1913; minimum stage recorded, −0.25 foot on December 4, 1908.

ICE.—Wider parts of Lake Champlain not usually frozen over until 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 Sundays from October 1 to December 21 and from March 25 to April 20; readings at irregular intervals during the rest of the year. 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, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.48	3.10	2.38	.....	.....	2.68	5.30	6.14	4.48	.....	2.18	.....
2	1.50	3.18	.....	.....	.....	2.68	5.65	6.10	.....	3.19	.....	1.52
3	1.52	3.20	2.35	.....	.....	.....	6.14	6.04	.....	.....	.....	.....
4	1.56	.....	2.33	.....	.....	.....	6.49	6.02	4.29	.....	2.08	.....
5	1.56	3.23	2.32	.....	.....	2.84	6.61	.....	4.24	3.04	.....	.....
6	1.58	3.21	2.30	.....	.....	.....	6.63	5.88	.....	.....	1.92	.....
7	.....	3.18	2.25	.....	.....	.....	.....	5.77	4.10	.....	1.92	1.60
8	1.63	3.18	2.23	.....	.....	.....	6.60	5.68	.....	.....	.....	.....
9	1.64	3.15	.....	1.58	.....	.....	6.65	5.58	.....	.....	2.09	.....
10	1.67	3.13	2.15	.....	.....	.....	6.78	.....	3.95	2.93	.....	.....
11	1.67	.....	2.13	1.58	.....	2.98	6.78	5.45	3.90	2.89	.....	1.50
12	1.68	3.05	2.08	.....	.....	.....	6.75	.....	.....	2.84	2.14	.....
13	1.68	2.98	2.06	.....	.....	3.03	6.75	5.35	3.92	.....	.....	.....
14	.....	2.95	2.06	.....	.....	.....	.....	5.40	3.95	.....	.....	1.44
15	1.74	2.90	2.03	.....	.....	.....	6.65	5.48	.....	2.78	2.10	.....
16	1.74	2.83	.....	.....	.....	.....	6.65	5.45	.....	.....	2.08	1.49
17	1.72	2.76	2.01	.....	.....	.....	6.65	5.39	3.83	2.72	.....	.....
18	1.70	.....	2.00	.....	.....	2.99	6.70	.....	3.78	2.71	.....	.....
19	1.70	2.65	2.00	.....	.....	2.99	6.65	.....	3.73	.....	2.02	.....
20	1.73	2.62	1.98	.....	.....	2.99	6.61	.....	.....	.....	1.98	1.67
21	.....	2.58	1.98	.....	.....	.....	.....	5.15	.....	2.60	.....	1.70
22	1.79	2.58	.....	.....	.....	3.35	6.48	5.04	.....	.....	1.92	.....
23	1.83	2.55	.....	.....	.....	.....	6.53	4.96	.....	2.52	1.86	1.76
24	1.87	2.54	.....	.....	.....	.....	.....	4.92	3.43	2.48	.....	1.82
25	1.87	.....	.....	.....	2.03	4.20	.....	4.82	3.45	.....	.....	1.89
26	1.95	2.47	.....	.....	.....	4.42	6.44	.....	3.50	2.30	.....	2.06
27	2.03	2.47	.....	.....	2.34	4.55	6.37	4.70	.....	2.20	1.75	2.16
28	.....	2.47	.....	.....	.....	4.67	.....	4.67	.....	.....	.....	2.46
29	2.35	2.43	.....	.....	.....	4.75	.....	4.60	.....	2.20	.....	.....
30	2.70	2.40	.....	.....	.....	4.87	.....	.....	.....	.....	1.54	2.76
31	3.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

NOTE.—Thickness of ice 50 feet from dock: Jan. 9, 9½ inches; Jan. 18, 11½ inches; Jan. 21, 11½ inches; Jan. 28, 15½ inches; Feb. 4, 18½ inches; Feb. 11 and 18, 22 inches; Feb. 25, 23½ inches; Mar. 4, 22½ inches; Mar. 11, 21 inches; Mar. 18, 22½ inches; Mar. 25, 19 inches; Apr. 1, 13 inches; lake was frozen over Jan. 24 and was clear of ice again on Apr. 10.

OTTER CREEK AT MIDDLEBURY, VT.

LOCATION.—At railroad bridge half a mile south of railroad station at Middlebury, Addison County, 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, October 5, 1910, to September 30, 1918.

GAGE.—Chain; read by Almon Lovett.

DISCHARGE MEASUREMENTS.—Made from a boat just below railroad bridge, at the stone-arch highway bridge just above the dam, or by wading.

CHANNEL AND CONTROL.—Channel deep; current sluggish for several miles above the station. Control for low stages is gravel and boulder rips about 800 feet below gage, probably somewhat shifting; control at high stages is near the dam 800 feet farther downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.1 feet at 7.15 a. m. March 30 (discharge, 3,500 second-feet); minimum stage recorded, 11.75 feet at various times during the year (discharge, 202 second-feet).

1903–1907 and 1910–1918: Maximum stage recorded, 21.07 feet March 30, 1913 (discharge 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 possibly 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. Winter discharge ascertained by means of gage heights, current-meter measurements, observer's notes, and climatic records.

REGULATION.—Probably little if any effect from operation of power plants above the station. Considerable storage has been developed on tributaries near the headwaters.

ACCURACY.—Stage-discharge relation apparently permanent during the year, except when affected by ice. Rating curve well defined between 200 and 4,000 second-feet. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table, with corrections for ice from December 27 to March 23. Records good.

Discharge measurements of Otter Creek at Middlebury, Vt., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 11	M. R. Stackpole.....	12.24	368	Apr. 2	M. R. Stackpole.....	15.82	3,270
Feb. 1	.....do.....	[a]12.42	278	July 27	H. W. Fear.....	12.10	320
Mar. 11	.....do.....	[a]13.25	592				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Otter Creek at Middlebury, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	232	2,510	360	220	280	2,400	3,230	1,440	810	320	283	320
2	283	2,510	501	210	280	2,500	3,320	1,700	670	360	248	360
3	265	2,330	360	210	280	2,400	3,320	1,790	555	403	232	403
4	265	2,060	450	220	280	2,200	3,230	1,610	450	340	232	360
5	360	1,610	426	250	220	1,800	3,140	1,360	426	301	202	320
6	403	1,190	403	220	220	1,350	3,140	1,030	426	320	248	301
7	403	917	320	210	250	1,100	3,050	955	450	340	265	320
8	403	775	403	220	250	880	2,960	917	610	360	248	301
9	403	670	301	210	230	740	2,870	1,030	555	450	381	248
10	381	610	202	280	250	660	2,690	880	528	450	501	265
11	340	610	360	280	250	580	2,600	1,190	610	450	360	301
12	320	450	301	300	230	520	2,510	1,150	670	501	283	301
13	403	501	265	280	250	520	2,420	1,150	955	670	283	301
14	450	475	320	280	320	660	2,060	2,600	1,110	381	320	320
15	426	475	360	220	400	1,200	1,970	2,510	880	810	403	301
16	475	403	381	300	500	1,100	1,970	2,330	670	640	403	248
17	426	450	265	320	1,250	740	1,970	2,150	475	501	360	301
18	426	450	320	320	1,100	740	1,970	1,700	450	501	301	426
19	403	320	360	320	960	1,100	1,970	1,190	403	475	248	528
20	450	403	403	320	960	1,700	1,970	992	403	450	232	555
21	501	426	403	220	2,300	2,100	1,880	1,070	360	381	283	640
22	381	426	381	220	2,200	2,300	1,970	1,110	360	320	248	775
23	403	501	360	230	2,200	2,500	2,060	955	555	320	265	880
24	403	705	283	230	1,950	2,690	2,150	810	1,360	340	248	640
25	501	640	283	260	2,100	2,780	2,060	670	1,440	320	248	1,030
26	740	450	283	300	2,500	2,780	1,970	670	1,030	320	217	775
27	740	340	300	340	2,400	2,960	1,790	640	670	320	202	2,330
28	775	381	280	340	2,400	3,050	1,520	740	528	283	248	2,240
29	670	340	360	280	.....	3,140	1,360	810	450	265	265	1,970
30	955	283	280	250	.....	3,500	1,360	810	450	202	265	1,880
31	2,690	.....	220	280	.....	3,320	.....	810	.....	283	283	.....

NOTE.—Stage-discharge relation affected by ice Dec. 27 to Mar. 23. Determination of discharge for this period based on gage heights corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records.

Monthly discharge of Otter Creek at Middlebury, Vt., for the year ending Sept. 30, 1918.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	2,690	232	525	0.854	0.98
November	2,510	283	807	1.31	1.46
December	501	202	339	.551	.64
January	340	210	263	.428	.49
February	2,500	220	958	1.56	1.62
March	3,500	520	1,810	2.94	3.39
April	3,320	1,360	2,350	3.82	4.26
May	2,600	640	1,250	2.03	2.34
June	1,440	360	644	1.05	1.17
July	810	202	399	.649	.75
August	501	202	284	.462	.53
September	2,330	248	665	1.08	1.20
The year	3,500	202	854	1.39	18.83

WINOOSKI RIVER AT MONTPELIER, VT.

LOCATION.—1 mile downstream from 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, 1918.

GAGE.—Gurley seven-day water-stage recorder on right bank, installed July 4, 1914; 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 used 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, 11.45 feet at 9 p. m. October 30 (discharge from extension of rating curve, 8,780 second-feet); minimum stage from water-stage recorder, 2.95 feet at 7 a. m. July 26 and 8 a. m. August 29 (discharge, 42 second-feet).

1909–1918: 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 1914–1918, 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; 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.[1]

ACCURACY.—Stage-discharge relation practically permanent except when affected by ice. Rating curve well defined between 30 and 5,000 second-feet. Operation of water-stage recorder satisfactory during the year, except during part of October and November, when it was temporarily removed for cleaning; Sanborn water-stage recorder used November 16 to December 17. Daily discharge determined by discharge integrator, except for high stages and the period November 16 to March 28, when mean daily gage heights were used. Open-water records good; winter records fair.

[1] See fig. 1, p. 41, U. S. Geol. Survey Water-Supply Paper 424.

Discharge measurements of Winooski River at Montpelier, Vt., during the year ending Sept. 30, 1918.

[Made by M. R. Stackpole.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 31	7.57	3,460	Mar. 1	[a] 6.06	668
Dec. 18	[a] 4.80	389	Mar. 26	[a] 7.23	1,650
Jan. 25	[a] 5.06	275	Apr. 12	5.69	1,510

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Winooski River at Montpelier, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	255	1,500	276	150	155	760	4,200	1,360	960	245	130	200
2	270	1,100	284	155	145	620	5,950	1,300	1,020	360	120	144
3	215	860	320	110	98	560	4,600	1,040	530	270	100	180
4	255	680	345	140	110	470	2,600	850	350	194	60	150
5	500	620	325	130	125	440	2,000	700	310	220	106	136
6	620	560	284	65	125	420	1,700	640	270	150	77	160
7	320	520	268	110	130	400	1,900	640	760	172	92	158
8	280	470	272	75	130	370	2,000	600	670	245	100	130
9	390	440	237	75	115	320	2,450	530	395	215	2,900	152
10	320	390	290	88	130	400	1,960	510	395	200	1,160	120
11	210	500	290	105	150	370	1,580	1,040	330	245	500	124
12	320	370	220	120	155	370	1,440	750	760	260	330	118
13	620	260	260	120	185	400	1,480	1,240	1,120	250	240	154
14	370	195	260	180	250	400	1,780	2,350	620	385	530	225
15	340	240	250	165	310	400	1,900	1,320	435	340	925	154
16	440	300	170	185	310	370	1,900	880	350	240	365	164
17	420	284	250	210	310	400	1,700	720	315	185	275	180
18	280	264	240	185	310	600	1,760	620	295	195	184	325
19	210	312	240	210	310	640	1,360	560	265	200	210	640
20	960	268	240	220	400	1,600	1,180	560	235	165	176	320
21	660	316	240	195	700	1,150	1,180	520	220	106	156	1,080
22	370	345	220	185	580	2,000	1,860	440	225	170	136	690
23	240	345	185	250	480	2,400	1,600	455	430	140	142	395
24	320	312	240	230	380	1,800	1,440	400	405	125	134	890
25	900	231	210	195	360	1,800	1,160	335	340	100	93	780
26	820	219	200	195	910	1,800	1,000	340	260	100	140	2,000
27	720	207	175	170	1,200	1,400	930	660	235	91	128	3,000
28	860	183	185	145	1,050	1,700	960	670	200	74	118	1,420
29	720	185	145	190	.....	2,900	1,000	440	156	108	102	900
30	3,700	210	115	140	.....	2,300	1,280	840	205	118	114	670
31	3,450	.....	125	160	.....	2,900	.....	660	.....	130	102	.....

NOTE—Stage-discharge relation affected by ice Dec. 10 to Mar. 28; discharge for this period computed from gage heights corrected for effect of ice by means of four discharge measurements, observer's notes, and weather records. Discharge estimated Oct. 6–29, Nov. 3–16, 29–30.

Monthly discharge of Winooski River at Montpelier, Vt., for the year ending Sept. 30, 1918.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
October	3,700	210	657	1.56	1.80
November	1,500	183	423	1.01	1.13
December	345	115	237	.564	.65
January	250	65	157	.374	.43
February	1,200	98	343	.817	.85
March	2,900	320	1,050	2.50	2.88
April	5,950	930	1,930	4.59	5.12
May	2,350	335	773	1.84	2.12
June	1,120	156	435	1.04	1.16
July	385	74	193	.459	.53
August	2,900	60	321	.764	.88
September	3,000	118	525	1.25	1.40
The year	5,950	60	586	1.40	18.95

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.

RECORDS AVAILABLE.—May 14, 1909, to September 30, 1918. 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.—Water-stage recorder on left bank below highway bridge; gage heights referred to gage datum by means of a hook gage inside the well. Inclined staff on left bank read by Florence C. Doyle from August 30 to September 30, 1918.

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

CHANNEL AND CONTROL.—Bed composed of gravel and alluvial deposits; subject to slight shifts.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, about 5.05 feet on April 2 (discharge, 960 second-feet); minimum stage, from water-stage recorder, 0.85 foot at 11 p. m. August 3 (discharge, 8 second-feet).

1910–1918: 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 during winter; stage-discharge relation affected for short periods.

ACCURACY.—Stage-discharge relation fairly permanent except when affected by ice. Rating curve well defined below 600 second-feet. Operation of water-stage recorder unsatisfactory during a considerable part of the year as shown in footnote to daily discharge table. Daily discharge ascertained by applying to rating table mean daily gage heights determined by inspecting recorder graph, and from observer's readings (staff gage readings to quarter-tenths twice daily). Records fair.

Discharge measurements of Dog River at Northfield, Vt., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 31	M. R. Stackpole	3.10	296	Feb. 28	M. R. Stackpole	a 2.59	162
Nov. 16	do	1.61	49.5	Apr. 12	do	2.75	213
Dec. 18	do	a 1.46	28.6	July 26	H. W. Fear	.92	9.4
Jan. 24	do	a 1.29	21.5	Aug. 29	J. W. Moulton	1.01	11.8

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Dog River at Northfield, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	16	198	.....	570	157	.....	23	10	33
2	12	153	.....	760	135	.....	28	9.6	16
3	12	127	.....	585	119	.....	21	8.6	13
4	18	106	.....	390	104	.....	18	8.4	12
5	30	93	.....	302	95	.....	16	9.0	13
6	39	89	.....	255	90	.....	14	8.8	19
7	25	85	.....	315	89	.....	15	9.0	19
8	19	75	.....	315	85	.....	14	11	14
9	19	74	.....	390	80	.....	.....	196	14
10	17	73	.....	.....	81	.....	.....	66	12
11	16	65	.....	.....	138	.....	.....	43	12
12	20	63	.....	.....	101	.....	.....	33	14
13	63	54	.....	.....	158	68	.....	22	16
14	34	53	.....	.....	249	50	.....	67	19
15	34	49	.....	.....	155	40	.....	.....	14
16	41	51	.....	.....	124	34	.....	.....	16
17	32	48	.....	.....	108	28	.....	.....	19
18	25	48	.....	.....	94	27	.....	.....	32
19	23	50	.....	.....	83	24	.....	.....	47
20	44	.....	.....	.....	75	22	.....	.....	62
21	38	.....	237	227	75	20	.....	.....	107
22	30	.....	304	270	67	37	.....	.....	49
23	27	.....	304	229	.....	43	.....	.....	35
24	33	.....	281	217	.....	37	.....	.....	54
25	128	.....	281	169	.....	30	.....	.....	48
26	61	.....	264	146	.....	23	9.8	.....	268
27	46	.....	225	145	.....	20	9.8	10	257
28	128	.....	235	223	.....	19	9.6	11	190
29	79	.....	281	186	.....	19	10	11	104
30	527	.....	315	207	.....	82	13	12	83
31	327	.....	444	.....	.....	.....	11	12	.....

NOTE.—Stage-discharge relation affected by ice from last part of November to about Mar. 20. Water-stage recorder not operating Nov. 20 to Mar. 20, Apr. 10-20, May 5-6, 23-31, June 1-12, July 9-25 and Aug. 15-26.

Monthly discharge of Dog River at Northfield, Vt., for the year ending Sept. 30, 1918.

[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	527	12	63.3	1.35	1.56
November	198	.....	61.0	1.30	1.45
December	.....	.....	28.0	.596	.69
January	.....	.....	17.5	.372	.43
February	.....	.....	42.5	.904	.94
March	444	.....	138	2.94	3.39
April	760	145	285	6.06	6.76
May	249	.....	99.2	2.11	2.43
June	.....	19	39.5	.840	.94
July	.....	9.6	16.7	.355	.41
August	196	8.4	25.3	.538	.62
September	268	12	53.7	1.14	1.27
The year	760	.....	72.3	1.54	20.89

NOTE.—Discharge estimated by comparison with Winooski River at Montpelier and White River at West Hartford as follows: Nov. 20-30, 25 second-feet; Dec. 1-31, 28 second-feet; Jan. 1-31, 17.5 second-feet; Feb. 1-28, 42.5 second-feet; Mar. 1-20, 55 second-feet; Apr. 10-20, 240 second-feet; May 23-31, 68 second-feet; June 1-12, 51 second-feet; July 9-25, 18 second-feet; Aug. 15-26, 19 second-feet. Use was also made of three discharge measurements obtained during December, January, and February in making estimates of flow during the winter.

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 Morrisville, Lamoille County.

DRAINAGE AREA.—280 square miles.

RECORDS AVAILABLE.—September 4, 1913, to September 30, 1918. A station was maintained at highway bridge near power plant at Cadys Falls from July 28, 1909, to July 13, 1910.

GAGES.—Friez water-stage recorder 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.

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 open-water stage during year, from water-stage recorder, 10.66 feet at 7.45 p. m. October 30 (discharge, from extension of rating curve, about 7,430 second-feet); minimum stage, from water-stage recorder, 1.85 feet at 1 p. m. August 18 (discharge, 52 second-feet).

1913-1918: Maximum stage recorded October 30, 1917; minimum stage recorded, 1.82 feet August 17, 1914 (discharge, 50 second-feet).

ICE.—River freezes over during extremely cold weather; stage-discharge relation slightly affected by ice. Discharge determined from gage heights with corrections for backwater based on current-meter measurements, observer's notes, and climatic records.

ACCURACY.—Stage-discharge relation practically permanent, except when affected by ice. Rating curve well defined. Operation of water-stage recorder satisfactory throughout year except for periods during the winter when clock would not run on account of extreme cold. Daily discharge ascertained by discharge integrator. Records good.

Discharge measurements of Lamoille River at Cadys Falls, Vt., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 15	M. R. Stackpole.....	a2.39	167	Apr. 11	M. R. Stackpole.....	4.42	1,150
Mar. 2	.....do.....	a3.35	397	11	.....do.....	4.28	1,080
27	.....do.....	a3.89	804	July 25	H. W. Fear.....	2.22	147

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	385	1,500	275	240	190	560	3,150	1,080	590	184	110	196
2	330	1,020	250	200	190	430	4,550	990	630	290	104	140
3	260	820	230	220	200	370	3,900	600	380	300	100	112
4	430	680	240	200	200	370	2,100	620	300	220	90	114
5	740	610	235	240	200	290	1,520	495	265	176	98	112
6	950	550	230	220	220	270	1,260	470	240	170	116	118
7	640	520	230	200	220	250	1,520	495	720	184	110	130
8	480	455	200	200	220	240	1,760	440	550	198	132	100
9	660	420	210	200	240	450	2,100	405	350	184	465	120
10	495	425	220	200	200	450	1,520	385	315	172	330	120
11	400	530	220	190	190	490	1,160	800	280	196	235	112
12	355	445	200	190	170	430	1,040	580	820	164	174	112
13	780	305	200	190	140	350	990	820	1,520	198	164	112
14	530	300	200	190	140	270	1,100	2,250	800	255	152	230
15	485	330	200	170	155	270	1,420	1,080	590	275	162	154
16	720	325	200	170	220	220	1,740	700	435	200	178	136
17	510	270	200	170	240	200	1,520	680	290	158	142	215
18	390	240	200	170	250	270	1,380	410	425	174	114	255
19	350	275	200	155	220	350	990	330	480	158	122	330
20	1,000	260	200	155	290	410	820	325	245	122	120	210
21	700	300	200	155	520	600	820	325	140	95	144	490
22	485	330	200	140	600	1,100	1,520	330	215	87	140	335
23	405	345	220	140	540	1,750	1,460	720	390	116	130	285
24	415	430	200	140	390	1,250	1,240	485	410	124	104	740
25	780	345	190	125	290	970	940	340	345	114	96	770
26	640	260	200	125	440	970	740	250	295	104	110	950
27	510	220	200	140	880	840	570	340	255	99	112	2,500
28	980	220	200	155	780	720	700	380	225	85	85	1,560
29	820	225	200	190	.....	900	740	325	220	85	100	540
30	3,800	240	200	170	.....	1,500	1,080	710	230	162	104	520
31	4,100	.....	220	190	.....	1,950	.....	550	.....	140	110	.....

NOTE.—Stage-discharge relation affected by ice from Dec. 10 to Mar. 31; determination of discharge for this period based on gage heights corrected for effect of ice by means of three discharge measurements, observer's notes, and weather records. Discharge estimated Dec. 3, 6–8, and for several short periods during the winter.

Monthly discharge of Lamoille River at Cadys Falls, Vt., for the year ending Sept. 30, 1918.

[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	4,100	260	791	2.82	3.25
November	1,500	220	440	1.57	1.75
December	275	190	212	.757	.87
January	240	125	179	.639	.74
February	880	140	305	1.09	1.14
March	1,950	200	629	2.25	2.59
April	4,550	570	1,510	5.39	6.01
May	2,250	250	604	2.16	2.49
June	1,520	140	432	1.54	1.72
July	300	85	167	.596	.69
August	465	85	144	.514	.59
September	2,500	100	394	1.41	1.57
The year	4,550	85	483	1.72	23.41

GREEN RIVER AT GARFIELD, VT.

LOCATION.—At site of old dam above highway bridge at Garfield village, town of Hyde Park, 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, 1918.

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 length of crest is increased 11.17 feet. Current-meter measurements made at footbridge about one-half mile downstream from weir, and at old 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 the weir in the old tailrace on left bank.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.03 feet at 9 a. m. October 31 and 5 p. m. April 2 (discharge, from extension of rating curve, about 306 second-feet); minimum stage recorded, 0.29 foot August 28, 30, and 31 (discharge, 4.7 second-feet).

1915–1918: Maximum stage recorded, 3.6 feet at 9 a. m. April 12, 1915 (discharge from extension of rating curve, about 436 second-feet); minimum stage recorded, 0.29 foot August 28, 30, and 31, 1918 (discharge, 4.7 second-feet.)

ICE.—Weir and weir crest kept clear of ice during winter; 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. Rating curve based on weir formula, $Q = 3.33 LH^{\frac{3}{2}}$ with corrections determined from current-meter measurements, and with logarithmic extension above gage height 1.90 feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying to rating table mean daily gage height. Records good below 130 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, 1918.

[Made by H. W. Fear.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 25[a]	0.39	6.9
July 25[b]	.39	7.6

[a] Measurement made at old bridge one-half mile above gage.
[b] Measurement made at footbridge one-half mile below gage.

Daily discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	17	126	16	11	9.7	11	163	84	63	20	15	8.4
2	21	81	17	11	9.7	11	271	87	57	20	14	6.3
3	27	62	17	10	9.7	11	286	68	39	19	13	6.0
4	32	47	17	10	9.3	11	207	50	26	18	13	5.7
5	35	43	17	10	8.7	12	163	40	20	17	13	5.7
6	51	38	15	11	8.4	12	138	34	18	16	12	8.7
7	49	34	15	11	8.4	12	149	40	27	19	14	6.6
8	46	32	15	11	8.0	12	170	32	60	18	14	6.3
9	49	29	16	10	8.4	12	172	30	58	19	22	6.0
10	41	28	15	9.7	8.7	13	139	32	32	17	16	6.3
11	37	27	13	9.3	8.7	14	106	62	26	17	14	6.0
12	33	26	13	9.7	9.0	15	91	58	47	17	13	6.0
13	38	25	13	10	9.7	14	79	72	98	17	12	7.1
14	34	24	14	10	10	14	100	210	68	21	12	8.4
15	35	23	14	10	10	14	159	117	51	18	12	7.1
16	49	23	13	10	10	14	197	68	38	15	11	7.1
17	47	22	13	10	9.7	14	181	49	32	13	11	11
18	37	21	13	10	9.7	14	163	39	27	10	10	11
19	31	21	14	10	9.7	15	95	32	25	9.7	10	12
20	46	20	14	9.7	12	17	74	28	23	9.0	9.7	13
21	60	20	14	9.7	12	22	78	30	21	8.4	9.3	25
22	43	21	13	10	11	30	117	28	23	8.0	9.3	21
23	35	22	13	10	11	34	131	33	25	7.7	8.4	22
24	34	21	13	10	10	22	110	32	26	7.4	5.7	39
25	39	22	13	10	10	29	77	28	26	7.4	5.5	64
26	43	18	12	10	13	43	64	26	23	7.1	5.5	68
27	38	17	12	10	12	60	69	35	22	7.1	5.2	188
28	51	17	12	9.7	12	62	70	40	20	6.9	4.9	146
29	56	17	12	9.7	.....	65	71	40	25	6.6	5.2	82
30	130	16	11	9.7	.....	69	74	70	20	23	4.7	51
31	264	.....	11	9.7	.....	90	.....	64	.....	16	4.7	.....

Monthly discharge, in second-feet, of Green River at Garfield, Vt., for the year ending Sept. 30, 1918.

Month.	Maximum.	Minimum.	Mean.	Month.	Maximum.	Minimum.	Mean.
October	264	17	49.9	May	210	26	53.5
November	126	16	31.4	June	98	18	35.5
December	17	11	13.9	July	23	6.6	14.0
January	11	9.3	10.1	August	22	4.7	10.6
February	13	8.0	9.95	September	188	5.7	28.7
March	90	11	25.4				
April	286	64	132	The year	286	4.7	34.6

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, 1918.

GAGE.—Gurley water-stage recorder on left bank, about one-fourth mile above highway bridge; chain gage on highway bridge used from June 26, 1911, to July 31, 1915. 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 during year, 17.64 feet on April 1 determined by levels from high-water mark (stage-discharge relation affected by ice); minimum stage, from water-stage recorder, 2.16 feet at 4 p. m. August 30 discharge, 44 second-feet).

1911–1918: Maximum stage recorded April 1, 1918; minimum stage recorded, 4.15 feet by chain gage, July 14, 1911 (discharge, 8 second-feet).

ICE.—Stage-discharge relation usually affected by ice from December to March; discharge determined 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 affected by ice. Rating curve fairly well defined below 6,000 second-feet. Operation of water-stage recorder satisfactory during the year except as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting recorder sheets; determinations for periods for which no record was obtained are based on comparison with records of flow of streams in adjacent drainage basins. Records good for periods when water-stage recorder was in operation, and fair for other periods and during the winter.

Discharge measurements of Missisquoi River near Richford, Vt., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 11	M. R. Stackpole	4.09	809	Apr. 8	M. R. Stackpole	7.17	3,430
Dec. 12	do	[a] 4.26	315	9	do	7.69	4,090
Jan. 30	do	[a] 4.69	160	July 24	H. W. Fear	2.91	234
Mar. 6	do	[a] 6.48	760	Aug. 31	J. W. Moulton	2.20	51
Apr. 1	do	[a] 13.49	4,730	31	do	2.35	84
1	do	[a] 13.69	4,800				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	770	5,280	380	185	82	1,050	5,800	1,720	438	615	324	456
2	1,140	2,590	600	170	160	1,000	9,000	1,880	510	620	258	300
3	890	1,720	420	145	160	960	8,000	1,720	393	446	248	240
4	1,140	1,360	440	130	130	900	6,720	1,480	282	379	186	179
5	1,520	1,100	420	170	94	820	4,270	1,320	248	318	150	168
6	1,680	995	380	170	72	760	3,280	1,240	215	300	1,240	194
7	1,360	890	320	185	120	700	3,170	1,200	482	268	710	272
8	1,060	830	280	160	145	560	4,050	1,170	995	307	575	227
9	1,200	770	300	82	160	500	3,940	890	590	324	698	203
10	960	740	300	120	160	460	3,170	710	395	314	800	200
11	740	680	300	120	170	420	2,340	890	332	290	500	168
12	750	650	320	120	170	360	1,880	1,440	610	258	363	152
13	770	635	320	130	160	380	1,680	2,100	3,060	339	321	203
14	995	565	320	145	130	300	1,880	2,240	2,840	860	282	307
15	1,140	496	320	160	82	280	2,440	1,640	1,480	668	286	395
16	1,920	510	280	220	72	260	2,850	1,140	995	550	237	343
17	1,360	460	300	200	145	260	2,650	830	680	480	200	1,760
18	960	440	300	185	600	300	2,390	710	545	505	170	1,170
19	830	500	300	185	700	340	1,880	570	456	500	179	1,140
20	2,240	500	300	185	900	380	1,680	500	387	400	145	860
21	1,880	575	260	200	960	560	1,700	510	324	282	132	1,600
22	1,200	585	230	185	1,100	1,500	2,500	407	314	234	122	1,840
23	960	860	200	130	1,100	3,200	2,700	325	590	230	140	1,170
24	830	740	230	170	700	2,800	2,440	363	1,280	212	100	1,560
25	1,640	590	300	120	410	2,400	1,970	325	860	170	108	1,640
26	1,880	400	280	130	700	2,200	1,480	310	536	150	125	1,360
27	1,280	350	170	160	1,150	1,550	1,320	318	420	185	125	4,600
28	1,440	320	170	170	1,100	1,050	1,440	367	339	152	100	5,160
29	1,800	320	120	145	.....	1,150	1,520	363	339	150	92	3,500
30	5,760	350	120	160	.....	1,950	1,600	324	474	209	102	2,200
31	6,720	.....	120	130	.....	4,000	.....	363	.....	541	110	.....

NOTE.—Stage-discharge relation affected by ice from about Nov. 26 to Apr. 2; determination of discharge for this period based on gage heights corrected for effects of ice by means of five discharge measurements, observer's notes, and weather records. Discharge estimated for following periods for lack of gage-height record: Oct. 12, Nov. 9–10, 18–20, Apr. 3, 16–17, 21–23, May 11–15, and July 16–21.

Monthly discharge of Missisquoi River near Richford, Vt., for the year ending Sept. 30, 1918.

[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	6,720	740	1,580	3.55	4.09
November	5,280	320	893	2.00	2.23
December	440	120	287	.645	.74
January	220	82	157	.353	.41
February	1,150	72	415	.933	.97
March	4,000	260	1,080	2.43	2.80
April	9,000	1,320	3,060	6.88	7.68
May	2,240	310	947	2.13	2.46
June	3,060	215	713	1.60	1.78
July	860	150	363	.816	.94
August	1,240	92	294	.661	.76
September	5,160	152	1,120	2.52	2.81
The year	9,000	72	906	2.04	27.67

CLYDE RIVER AT WEST DERBY, VT.

LOCATION.—Just below plant of Newport Electric Light Co. at West Derby (Newport), Orleans County, about a mile above mouth of river.

DRAINAGE AREA.—150 square miles.

RECORDS AVAILABLE.—May 25, 1909, to September 30, 1918.

GAGES.—Water-stage recorder on right bank; referred to gage datum by a hook gage inside the well; chain gage fastened to tree is used for auxiliary readings.

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, from water-stage recorder, 3.70 feet at 11 p. m. April 3 (discharge, 1,280 second-feet); minimum stage recorded 1.87 feet at 5 a. m. September 1 (discharge, 40 second-feet).

1909–1918: High water of March 25–30, 1913, reached maximum stage of 5.8 feet, as determined by engineers of Geological Survey from high-water marks (discharge about 6,300 second-feet); minimum stage, 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. Winter discharge determined from gage heights, current-meter measurements, observer's notes, and climatic records.

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 afforded 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 affected by ice; individual current-meter mesurements 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, as indicated in footnote to daily-discharge table. Daily discharge ascertained by applying mean daily gage height to rating table, using observer's reading of chain gage when recorder was not in operation. Records fair.

Discharge measurements of Clyde River at West Derby, Vt., during the year ending Sept. 30, 1918.

Date.	Made by—	Gage height (feet).		Discharge (sec.-ft.).	Date.	Made by—	Gage height (feet).		Discharge (sec.-ft.).
		Hook gage.	Chain gage.				Hook gage.	Chain gage.	
Oct. 12	M. R. Stackpole..	2.64	2.55	272	Mar. 28	M. R. Stackpole..	.....	2.70	357
Dec. 13	.....do.....	[a] 2.53	[a] 2.49	138	29	.....do.....	.....	2.75	385
Jan. 29	.....do.....	[a] 2.15	[a] 2.08	80	July 23	C. H. Pierce.....	2.32	2.32	157
Mar. 5	.....do.....	2.48	2.42	215	Sept. 1	J. W. Moulton...	2.15	2.15	98

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1918.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	160	950	280	68	74	230	389	655	255	194	204	99
2	230	1,060	260	70	70	250	810	810	288	194	218	96
3	220	1,000	270	80	70	250	1,220	860	278	184	222	102
4	240	850	260	82	70	240	1,120	810	264	198	213	99
5	300	755	210	80	70	217	1,170	702	229	167	187	93
6	360	620	200	80	68	205	1,060	610	209	167	175	102
7	380	500	210	80	76	200	1,010	533	211	164	204	123
8	330	460	175	80	64	195	910	509	213	155	220	99
9	315	411	175	80	52	184	910	478	217	155	245	100
10	330	378	160	80	66	170	810	485	221	146	286	100
11	360	354	120	80	78	160	1,120	471	221	149	292	99
12	310	336	115	82	84	145	1,010	525	304	152	280	99
13	315	310	115	82	100	140	960	493	408	161	259	105
14	290	300	110	82	112	140	702	610	356	264	238	107
15	330	280	90	80	130	140	655	655	304	274	204	113
16	342	264	90	82	167	140	702	702	310	316	182	138
17	354	260	90	82	143	140	810	655	299	304	164	131
18	330	256	84	80	135	140	810	655	274	310	145	152
19	336	248	80	78	138	140	800	610	255	274	128	160
20	397	244	80	76	198	140	860	541	225	245	138	156
21	411	244	80	74	149	150	810	450	200	225	134	200
22	397	244	76	72	140	180	810	415	188	205	105	218
23	384	256	72	70	140	230	702	402	191	191	126	238
24	390	248	68	76	160	275	655	350	209	152	141	286
25	404	236	74	70	177	310	655	288	209	128	191	322
26	378	270	76	68	180	350	610	304	233	119	171	328
27	360	280	76	68	184	363	760	293	217	126	160	422
28	378	290	70	70	205	370	655	264	209	119	145	540
29	372	290	68	80	.....	327	610	255	205	107	138	557
30	620	280	66	74	.....	389	610	274	209	145	128	565
31	800	.....	64	72	.....	344	.....	269	.....	178	76	.....

NOTE.—Stage-discharge relation affected by ice Nov. 26 to Dec. 2, and Dec. 7 to Feb. 13; determination of discharge for these periods based on gage heights corrected for effect of ice by means of two discharge measurements, observer's notes, and weather records. Discharge estimated for following periods owing to lack of gage-height records: Oct. 1–8, Nov. 7, Feb. 22–24, 28, Mar. 1–4, 6–8, 10–12, 14–16, 18–19, 21–26, Apr. 19, June 7, 20–21, Aug. 8–9, 31, and Sept. 9–10.

Monthly discharge of Clyde River at West Derby, Vt., for the year ending Sept. 30, 1918.

[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	800	160	359	2.39	2.76
November	1,060	236	416	2.77	3.09
December	280	64	128	.853	.98
January	82	68	76.7	.512	.59
February	205	52	118	.787	.82
March	389	140	221	1.47	1.70
April	1,220	389	824	5.49	6.12
May	860	255	514	3.43	3.95
June	408	188	247	1.65	1.84
July	316	107	189	1.26	1.45
August	292	76	184	1.23	1.42
September	565	93	198	1.32	1.47
The year	1,220	52	290	1.93	26.19

INDEX.

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:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

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.

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

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

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704 Journal Building.
Atlanta, Ga., Post Office Building.
Chicago, Ill., 1404 Kimball Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Topeka, Kans., Room 23, Federal Building.
Salt Lake City, Utah, 313 Federal Building.
Boise, Idaho, 615 Idaho Building.
Tucson, Ariz., University of Arizona.
Austin, Tex., Capitol Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 602 Federal Building.
Honolulu, Hawaii, 14 Capitol 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 about 4,500 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 discriptive 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	1895.
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.

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

Report.	Character of data.	Year.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	....do	1903.
W 124 to 135	....do	1904.
W 165 to 178	....do	1905.
W 201 to 214	....do	1906.
W 241 to 252	....do	1907–8.
W 261 to 272	....do	1909.
W 281 to 292	....do	1910.
W 301 to 312	....do	1911.
W 321 to 332	....do	1912.
W 351 to 362	....do	1913.
W 381 to 394	....do	1914.
W 401 to 414	....do	1915.
W 431 to 444	....do	1916.
W 451 to 464	....do	1917.
W 471 to 484	....do	1918.

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 1918. 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 1918, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, 451; and 471, which contains records for the New England streams from 1903 to 1918. Results of miscellaneous measurements are published by drainage basins.

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 the 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.

Numbers of water-supply papers containing results of stream measurements, 1899-1918.

Year.	I North Atlantic slope (St. John River to York River).	II South Atlantic slope and eastern Gulf of Mexico (James River to the Mississippi).	III Ohio River basin.	IV St. Lawrence River and Great Lakes basins.	V Hudson Bay and upper Mississippi River 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.		
												Pacific slope basins in Washington and upper Columbia River.	Snake River basin.	Lower Columbia River and Pacific slope basins 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
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464
1918	471	472	473	474	475	476	477	478	479	480	481	482	483	484

[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.

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, Ausable, 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 pp. xvii-xviii.)

GAGING STATIONS.

NOTE.—Dash following a date indicates that station was being maintained September 30, 1918. 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., 1911–1917.
- 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., 1912–1917.
  - Cloquet River at Independence, Minn., 1909–1917.
- Aminicon River near Aminicon Falls, Wis., 1914–1916.
- Brule River near Brule, Wis., 1914–1917.
- Bad River near Odanah, Wis., 1914–
- Montreal River at Ironwood, Mich., 1918–
  - West Branch of Montreal River at Gile, Wis., 1918–
- 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 Berlin, Wis., 1918–
- Fox River at Omro, Wis., 1902–3.
- Fox River at Oshkosh, Wis., 1902.
- Fox River at Wrightstown, Wis., 1902–1904.
- Fox River at Rapide Croche dam, Wis., 1896–
  - 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., 1911–1917.
    - Little Wolf River at Royalton, Wis., 1914–
    - Little Wolf River near Northport, Wis., 1907–1910.
    - Waupaca River near Weyauwega, Wis. 1916–17.
    - Waupaca River near Waupaca, Wis., 1917–
  - 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–
- Little Calumet River at Harvey, Ill., 1916–
- 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.

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, description 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., 7pls.

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. Darten. 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 to 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.).

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.

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[1] For stream-measurement reports, see tables on pp. IV, V, VI.

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.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. Superseded by 152.

Cites statutory restrictions of water pollution.

110. Contributions to the hydrology of Eastern United States, 1904; M. L. Fuller, geologist in charge. 1905. 211 pp., 5 pls. 10c.

Contains:

Water resources of the Watkins Glen quadrangle, New York, by Ralph S. Tarr; pp. 134–140. Discusses the use of the surface and underground waters for municipal supplies and their quality as indicated by examination of Sixmile and Fall creeks, and sanitary analyses of well water at Ithaca.

New artesian water supply at Ithaca, New York, by F. L. Whitney, pp. 55–64.

*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. Weels; 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.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in Michigan and Wisconsin.

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 Unites 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 portions 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 applications 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.

*152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 140 pp. 10c.

Cites statutory restrictions of water pollution in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, and Wisconsin.

*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.

*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 counties. The report contains 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.

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, occurence, 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 water. 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.

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 water from Caledonia Spring, New York, and from the Quincy mine, Mich.

417. Profile surveys of rivers in Wisconsin, prepared under the direction of W. H. Herron, acting chief geographer. 1917. 16 pp., 32 pls. 45c.

Contains brief description of general features of drainage of Wisconsin and of the rivers surveyed, but consists chiefly of maps showing "not only the outlines of the river banks, the islands, the positions of rapids, falls, shoals, and existing dams, and the crossings of all ferries and roads, but the contours of banks to an elevation high enough to indicate the possibility of using the stream."

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 minerals prings 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 water works, 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 prelacial 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.)

41. 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 record of wells in Onondaga County, N. Y., and Hancock and Wood counties, Ohio. These wells were selected because they gave 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

[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.

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 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.

205. Detroit, Mich. 50c. either edition.

Discusses surface and ground waters; gives mineral analyses of water from Lake Huron, from rivers near Detroit, and from salt wells.

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 Engi-

neers, 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 investigation:

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.

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.

*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 1 (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, purpose 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, complied 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 instructions 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 in 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. McCallies.

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, Calif., 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. 5c.

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 tunnelling 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.

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 wastes, by E. B. Phelps. 1906. 29 pp., 2 pls.

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.

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 of costs 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; give details by counties; discusses in supplement, under chemical character, method of analysis and expression of results, mineral constitutents, effect of the constitutents 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.

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 biblography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquires that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

(c) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Biblography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

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 result 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 detail 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, Catawaba, 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 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.

616. The data of geochemistry (third edition), by F. W. Clarke. 1916. 821 pp. 45c.

Earlier editions were published as Bulletins 330 and 491. Contains a discussion of the statement and interpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 179–216). Discusses the definition and classification of mineral waters, changes in the composition of water, deposits of calcareous, ocherous, and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

INDEX BY AREAS AND SUBJECTS.

[A=Annual Report; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper; G F=Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.

[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

INDEX OF STREAMS.