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

WATER-SUPPLY PAPER 284

SURFACE WATER SUPPLY OF THE UNITED STATES

1910

PART IV. ST. LAWRENCE RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

C. C. COVERT, A. H. HORTON
AND R. H. BOLSTER

WASHINGTON
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SURFACE WATER SUPPLY OF ST. LAWRENCE RIVER BASIN, 1910.

By C. C. COVERT, A. H. HORTON, and R. H. BOLSTER.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of measurements of the flow of certain streams in the United States. The work was performed by the United States Geological Survey, either independently or in cooperation with private or State organizations. The organic law of the Geological Survey (Stat. L., vol. 20, p. 394) contains the following paragraph:

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

As water is the most abundant and most valuable of the minerals the investigation of water resources is authorized under the provision for examining mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

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.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

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

SCOPE OF INVESTIGATIONS.

These investigations are not complete nor are they inclusive of all the streams that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins; but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience has shown that the records for some streams should cover 5 to 10 years, and those for other streams 20 years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to stream-flow measurements. It is confidently believed that the stream-flow data presented in the publications of the survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at nearly 2,000 different points in the United States. The surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, and in Hawaii has also been investigated. During 1910 regular gaging stations were maintained by the survey and cooperating organizations at about 1,100 points in the United States, and many discharge measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country, and will be made available in the regular surface water-supply papers and in special papers from time to time.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements the character of the work and the territory covered by these different publications have varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into 12 parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface water supply for 1910. The dividing line between the north Atlantic and south Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1910.

Part.	No.	Title.
I	281	North Atlantic coast.
II	282	South Atlantic coast and eastern Gulf of Mexico.
III	283	Ohio River basin.
IV	284	St. Lawrence River basin.
V	285	Upper Mississippi River and Hudson Bay basins
VI	286	Missouri River basin.
VII	287	Lower Mississippi River basin.
VIII	288	Western Gulf of Mexico.
IX	289	Colorado River basin.
X	290	Great Basin.
XI	291	Pacific coast in California.
XII	292	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey, exclusive of special papers:

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

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

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge	1884 to Sept. 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
WS 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
WS 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.

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

Report.	Character of data.	Year.
WS 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
WS 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
WS 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
WS 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
WS 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
WS 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
WS 75	Monthly discharge	1901.
WS 82 to 85	Complete data	1902.
WS 97 to 100	.....do	1903.
WS 124 to 135	.....do	1904.
WS 165 to 178	.....do	1905.
WS 201 to 214	Complete data, except descriptions	1906.
WS 241 to 252	Complete data	1907-8.
WS 261 to 272	.....do	1909.
WS 281 to 292	.....do	1910.

NOTE.—No data regarding stream flow are given in the fifteenth and seventeenth annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119.

The first table which follows gives, by years and drainage basins, the number of the papers on surface water supply published from 1899 to 1910. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas Rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1910.

	1899 [a]	1900 [b]	1901	1902	1903
Atlantic coast and eastern Gulf of Mexico:					
New England rivers	35	47	65, 75	82	97
Hudson River to Delaware River, inclusive	35	47, (48)	65, 75	82	97
Susquehanna River to York River, inclusive	35	48	65, 75	82	97
James River to Yadkin River, inclusive	(35), 36	48	65, 75	(82), 83	(97), 98
Santee River to Pearl River, inclusive	36	48	65, 75	83	98
St. Lawrence River	36	49	65, 75	(82), 83	97
Hudson Bay	....	....	66, 75	85	100
Mississippi River:					
Ohio River	36	48, (49)	65, 75	83	98
Upper Mississippi River	36	49	65, 75	83	98, (99)
Missouri River	(36), 37	49, (50)	66, 75	84	99
Lower Mississippi River	37	50	(65), 66, 75	(83), 84	(98), 99
Western Gulf of Mexico	37	50	66, 75	84	99
Pacific coast and Great Basin:					
Colorado River	(37), 38	50	66, 75	85	100
Great Basin	38, (39)	51	66, 75	85	100
South Pacific coast to Klamath River, inclusive	(38), 39	51	66, 75	85	100
North Pacific coast	38	51	66, 75	85	100

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing results of stream measurements, 1899–1910—Continued.

	1904	1905	1906	1907–8	1909	1910
Atlantic coast and eastern Gulf of Mexico:						
New England rivers	124	165	201	241	261	281
Hudson River to Delaware River, inclusive	125	166	202	241	261	281
Susquehanna River to York River, inclusive	126	167	203	241	261	281
James River to Yadkin River, inclusive	126	167	203	242	262	282
Santee River to Pearl River, inclusive	127	168	204	242	262	282
St. Lawrence River	129	170	206	244	264	284
Hudson Bay	130	171	207	245	265	285
Mississippi River:						
Ohio River	128	169	205	243	263	283
Upper Mississippi River	128, (130)	171	207	245	265	285
Missouri River	130, (131)	172	208	246	266	286
Lower Mississippi River	(128), 131	(169), 173	(205), 209	247	267	287
Western Gulf of Mexico	132	174	210	248	268	288
Pacific coast and Great Basin:						
Colorado River	133, (134)	175, (177)	211, (213)	249, (251)	269, (271)	289
Great Basin	133, (134)	176, (177)	212, (213)	250, (251)	270 (271	290
South Pacific coast to Klamath River, inclusive	134	177	213	251	271	291
North Pacific coast	135	(177), 178	214	252	272	292

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kans.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	Yuma and Salton Sea stations repeated.
271	Great Basin	Owens River Basin.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined by measuring or estimating the 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. Records for all stations from the source to the mouth of the main stem of the river are presented first, and records for the tributaries in regular order from source to mouth follow, all records in each tributary basin being given 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 above, and in the records for large lakes, where it is simpler to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

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

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

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

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

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

CONVENIENT EQUIVALENTS.

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

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

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

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

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

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equals 18.7 United States gallons per second.
100 California miner's inches equals 96.0 Colorado miner's inches.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 104 California miner's inches.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-feet.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equals about 1 kilowatt.

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

EXPLANATION OF DATA.

For each drainage basin there is given a brief general description covering such items as area, source, tributaries, topography, geology, forestation, rainfall, irrigation, storage, power, and other interesting or important facts.

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

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

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights records the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights affected by the presence of ice in the streams or by backwater from obstructions are published as recorded, with suitable footnotes. The rating table is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

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

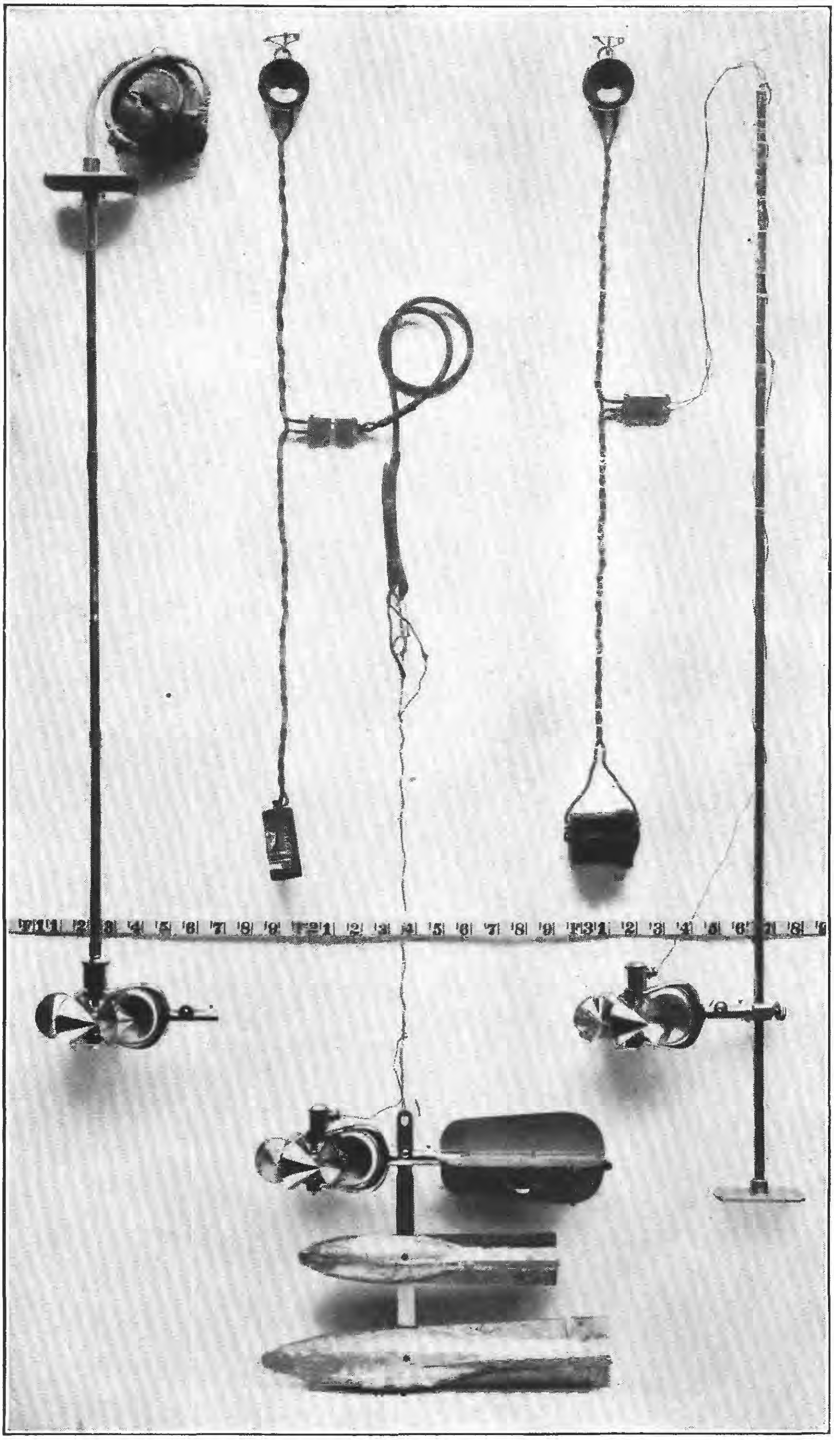
The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report, but can be determined from the daily gage heights and daily discharges for the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

First plot the discharge measurements for the current and earlier years on cross-section paper, with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage-height table for the complete range of stage given and the corresponding discharges for the days selected from the daily discharge table and plot the values on

A. FOR BRIDGE MEASUREMENT.

B. FOR WADING MEASUREMENT.

TYPICAL GAGING STATIONS.



SMALL PRICE CURRENT METERS.

cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant, except for known backwater periods.

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

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than given in the maximum column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 12, are based.

The field methods used in the collection of the data presented in this series of reports are described in the introductory sections of Water-Supply Papers 261 to 272, inclusive, "Surface water supply of the United States, 1909." Plate I shows typical gaging stations, indicating the method of suspending the current meter; Plate II shows the various types of current meters[1] used in the work.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

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

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

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous experi-

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

ments made to test the accuracy of current-meter work show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where the coefficient may be uncertain and conditions of flow are complicated.

The work is, of course, dependent on the reliability of the gage observers. With relatively few exceptions, the observers perform their work honestly. The records are, however, closely watched, and the cause of any discrepancy is investigated. It is obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

An effort is made to visit every station at least once each year for the purpose of making a measurement to determine the constancy of conditions of flow since the last measurement made in the preceding year, and also to check the elevation of the gage. On account of lack of funds or for other causes some stations were not visited during the current year. If conditions of flow have been reasonably permanent up to the time of the last preceding measurements, it is considered best to publish estimates of discharge based on the latest verified rating curve rather than to omit them altogether, although it should be distinctly understood that such records are at times subject to considerable error. This is also true, although to a less degree, of the period of records since the date of the last measurement of the current year. As a rule, the accuracy notes are based on the assumption that the rating curve used is strictly applicable to the current year.

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

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

In general, the base data which are collected in the field each year by the Survey engineers are published, not only to comply with the law but also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables are computed monthly, discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the figures presented in these papers will verify all ratings and make such adjustments for earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for 5 or 10 year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The estimates in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

The daily discharges are published to allow a more detailed study of the variation in flow and to determine the periods of deficient flow.

COOPERATIVE DATA.

Cooperative data of various kinds and data regarding the run-off at many stations maintained wholly by private funds are incorporated in the surface water-supply reports of the United States Geological Survey.

Many stations throughout the country are maintained for specific purposes by private parties who supply the records gratuitously to the United States Geological Survey for publication. When such records are furnished by responsible parties and appear to be reasonably accurate, they are verified, so far as possible, and estimated values of accuracy are given. Records clearly worthless or misleading are not published. As it is, however, impossible to completely verify all such records furnished—because of lack of funds or for other causes—they are published for what they are worth, as they are of value as a matter of record and afford at least approximate information regarding stream flow at the particular localities. The Survey does not, however, assume any responsibility for inaccuracies found in such records, although most of them are believed to be reasonably good.

COOPERATION AND ACKNOWLEDGMENTS.

MINNESOTA.

The work in Minnesota during 1910 has been carried on in conjunction with the State Drainage Commission, George A. Ralph, chief engineer, under the terms of an act of the legislature of 1909, as embodied in joint resolution 19:

Whereas the water supplies, water powers, navigation of our rivers, drainage of our lands, and the sanitary condition of our streams and their watersheds generally form one great asset and present one great problem: Therefore be it

Resolved by the House of Representatives (*the Senate concurring*), That the State Drainage Commission be and is hereby directed to investigate progress in other States toward the solution of said problem in such States, to investigate and determine the nature of said problem in this State. * * *

Special acknowledgment is due to the Great Northern Power Co. for cooperation in maintenance of the gaging station on the St. Louis River near Thomson, Minn., and winter records of discharge of Cloquet River.

MICHIGAN.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: State Geological Survey of Michigan; Penn Iron Mining Co.; Oliver Iron Mining Co.; Mr. L. W. Anderson, city engineer, Grand Rapids, Mich.; the Eastern Michigan Edison Co., Ann Arbor, Mich.; Mr. D. W. Mead, Madison, Wis.; Mr. Gardner S. Williams, Ann Arbor, Mich.; and Mr. William G. Fargo, Jackson, Mich.

NEW YORK.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: United States Engineer Corps; Hon. Frank M. Williams, State engineer and surveyor, William B. Landreth, special deputy State engineer, representing New York State cooperation; State Water-Supply Commission of New York, Hon. Henry M. Persons, president; E. A. Fisher, city engineer, and board of park commissioners, Rochester; George Beebe, chief engineer and superintendent bureau of water, Syracuse; Plattsburg Gas & Electric Co., Plattsburg.

New York State cooperation, under the direction of the State engineer and surveyor, has been carried on by cooperative agreements authorized by an act of the State legislature, being paragraph 11 of chapter 420, laws of 1900.

Cooperation with the State water-supply commission was made possible by the provisions of the "Fuller bill," chapter 569, laws of 1907, and carried on under agreements between the State water-supply commission and the United States Geological Survey.

VERMONT.

The work in Vermont during 1910 has been done in cooperation with the State of Vermont, George H. Prouty, governor, under the provisions of the following act of the general assembly:

AN ACT To provide for investigation of the water resources of the State of Vermont and to make the records of such investigation available to the authorities of the State, and to all the people thereof.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. That, as the Director of the United States Geological Survey is authorized to cooperate with the properly constituted authorities in the several States in making investigation of and reports upon the water resources of these States, the governor of the State of Vermont is hereby empowered to enter into contract with the Director of the United States Geological Survey for the purpose of making such investigation and report for this State, provided that such work shall include, first, the completion of the surveys of river basins already partially investigated; and provided further, that the director shall agree to expend for this purpose, and from funds placed at his disposal by the Government of the United States, sums equal to those hereinafter appropriated.

SEC. 2. That, for the purpose set forth in section 1 of this act, the sum of $1,000 for the year 1909, and a like sum for the year 1910, is hereby appropriated to be expended by the State, in accordance with the laws relating to, and the regulations of, the United States Geological Survey in such case provided, payment to be made on vouchers audited and approved by the director of said survey, when presented to the auditor of accounts.

Assistance has been rendered or records furnished by the following, to whom special acknowledgment is due: Newport Electric Light Co.; Prof. C. S. Carleton, of Norwich University; Lane Manufacturing Co.; Morrisville water and light commissioners; Colton Manufacturing Co.; Corry, Deavitt & Frost Electric Co.; Sweat-Comings Manufacturing Co.

DIVISION OF WORK.

The field data in the Lake Superior drainage basin were collected under the direction of Robert Follansbee, district engineer, assisted by G. A. Gray and C. R. Adams.

The field data in the Lake Michigan, Lake Huron, and Lake Erie drainage basins were collected under the direction of A. H. Horton, district engineer, by private parties.

The field data for New York were collected under the direction of C. C. Covert, district engineer, assisted by W. G. Hoyt and F. J. Shuttleworth.

The field data in the St. Lawrence River drainage basin in Vermont prior to August 1, 1910, were collected under the direction of T. W. Norcross by D. M. Wood, G. M. Brett, and A. D. Butterfield. After August 1, 1910, the work in Vermont was under the direction of C. C. Covert.

The ratings, special estimates, and studies of the completed data were made by A. H. Horton, C. C. Covert, R. H. Bolster, and J. G.

Mathers. The computations and the preparation of the data for publication were made under the direction of R. H. Bolster, assistant engineer, by W. G. Hoyt, J. G. Mathers, F. J. Shuttleworth, Alexander McMillan, and M. I. Walters.

The entire manuscript has been edited by Mrs. B. D. Wood.

GENERAL FEATURES OF THE ST. LAWRENCE RIVER BASIN.[1]

The surface waters of an area 565,000 square miles [2] in extent pass to the ocean by way of St. Lawrence River. In form this area is an irregular parallelogram extending southwestward for about 900 miles with a fairly uniform breadth of 250 miles. The Great Lakes, into which the river expands, have a water surface of 95,600 square miles, leaving for the land surface drained by the river about 470,000 square miles. More than eight-tenths of this area belongs to Canada. The remainder constitutes a part of the United States. With the exception of about 50,000 square miles (including the whole of the Gaspe Peninsula) in the eastern part of the Province, the Canadian portion lies wholly on the north side of the river. The only part of the United States lying north of the river is at the west end of Lake Superior.

At its mouth the river and its tributaries are drowned, so that the salt water of the ocean enters to form the broad bay of St. Lawrence, with its irregular margin, and even beyond the bay there is indication of a river valley carved in the continental shelf completely covered by the ocean waters. Upstream from the bay of St. Lawrence the water area narrows and the water freshens, though the tide rises nearly as far as Montreal, where the St. Lawrence is a very broad river with gentle current. Just above Montreal the river becomes a series of violent rapids, and from this point upstream it consists of stretches of quiet water separated by rapids. At the outlet of Lake Ontario the river passes through a maze of islands beyond which is Lake Ontario—the lowest of the five Great Lakes.

The lakes are connected by broad rivers and straits, which in places are navigable, are elsewhere interrupted by rapids, and in one place are broken by one of the great falls of the world—Niagara. To the entire area above the mouth of Lake Ontario no large river is tributary. In places the divide runs close to the lakes and it is nowhere far from them.

The water surface of Lake Superior nearly equals the combined areas of New Hampshire, Vermont, Massachusetts, and Connecticut; the combined area of the lakes exceeds the area of England, Wales, and Scotland; the length of shore line of the lakes and their connecting

[1] Abstracted from Tarr, R. S., Physical geography of New York State, Macmillan Co., 1902, pp. 220-223.

[2] Ann. Rept. Geol. and Nat. Hist. Survey Canada, new ser., vol. 3, pt. 1, 1887-88, p. 18 B.

rivers is about 5,400 miles, or about equal to the coast line from Maine to the Isthmus of Panama, exclusive of minor indentations.

Lake Superior is 602 feet above sea level and Huron and Michigan are 581 feet above, the intervening descent being made chiefly in the rapids of St. Marys River. From Lake Michigan to Lake Erie (altitude, 573 feet) there is a descent of about 8 feet, mostly in Detroit River. Of the descent from Lake Erie to Lake Ontario (246 feet above sea level), 160 feet occurs at the Falls, 110 feet in the rapids of the gorge, 50 feet in the rapids just above the falls, and 6 feet in the upper Niagara above the rapids.

The beds of all the lakes except Erie are below sea level and the area below this level is so large that even if the water surface was lowered to the level of the sea large bodies of water would remain on the sites of Ontario, Michigan, and Superior; Huron would be greatly reduced in size and Erie would disappear.

The rainfall of the lake area averages about 31 inches, being higher in the eastern than in the northwestern end. This rainfall fills the lakes, satisfies percolation and evaporation, and furnishes for discharge 70,000 cubic feet per second from Lake Superior, 208,000 cubic feet per second from Lake Erie through the Niagara, and 250,000 cubic feet per second from Lake Ontario through the St. Lawrence. Nearly one-half of the total bulk of water in the system is in Lake Superior.

The area tributary to Lake Superior in the United States comprises the northeastern part of Minnesota, a small strip in northern Wisconsin, and nearly one-half of the Northern Peninsula of Michigan. Except at the west end the slopes to the lake are very narrow and are drained by short streams of sharp descent. St. Louis River, which enters at the head of the lake, is the largest and most important stream.

Lake Michigan receives the drainage from a comparatively narrow strip of flat or gently rolling land in the northwestern part of Indiana and the northestern part of Illinois on the south shore of the lake and the eastern part of Wisconsin and the eastern part of the Northern Peninsula of Michigan on the western and northern shores; on the eastern shore there is a wide strip of the western part of the Southern Peninsula of Michigan. The principal streams entering the lake from the west are Escanaba, Menominee, Peshtigo, Oconto, and Fox rivers; from the east St. Joseph, Kalamazoo, Grand, Muskegon, and Manistee rivers.

The area tributary to Lake Huron in the United States comprises the eastern part of the Southern Peninsula of Michigan. South of Saginaw Bay the Lake Huron slope is very narrow and the brooks and runnels by which it is drained are only a few miles in length.

The so-called Thumb of the Mitten is drained chiefly by three short northward-flowing streams, known as Willow, Pinnepog, and Pigeon rivers, which lie in a flat, marshy region. The Sagin: w River system is tributary to the bay at its head, while northward from the bay are Rifle, Au Sable, and Thunder Bay rivers, streams having considerable fall, excellent ground storage, and well-sustained flow. Cheboygan River also belongs in the Lake Huron drainage basin.

That portion of the Lake Erie drainage basin that lies within the United States, exclusive of Lakes Superior, Michigan, and Huron, covers the northern third of Ohio, a small corner of northeastern Indiana, and a similar area in southeastern Michigan. South of the lake the drainage area is narrow, the divide lying in places scarcely 50 miles back from the lake shore. To the west the width of the area is greater, and the Maumee, which enters the lake near Toledo, is the largest stream of northern Ohio. The average altitude of the basin above Lake Erie is 500 feet, but the head of the Maumee at Fort Wayne, Ind., is only 170 feet above the lake. The surface is level or gently rolling.

The principal streams are Huron and Raisin rivers, which enter the lake from the Michigan corner, and Maumee, Black, and Cuyahoga rivers, which enter from Ohio. Of these, the Maumee, formed by the junction of St. Marys and St. Joseph rivers at Fort Wayne, Ind., is the most important.

In the northwestern part of the State of New York, between Niagara and St. Lawrence rivers, is an area aggregating 12,400 square miles drained by streams which flow into Lake Ontario. The divide which controls this drainage is very irregular. Extending to the south and southeast from Fort Niagara, it passes around the headwaters of the Genesee a short distance into Pennsylvania; thence reentering New York it runs southward and eastward from the interior group of lakes, turns to the north, encircles the sources of Black River, turns again to the west, and descends to the lake. The country thus included is level or gently undulating in the counties bordering the lake, but farther south it becomes more rolling, and a series of ridges, gradually increasing in height, stretch down between Cayuga and Seneca and their companion lakes, finally becoming merged with the elevated, broken country forming the principal divide whose abrupt slopes reach altitudes of 2,000 to 2,500 feet about the headwaters of the Genesee.

The easterly or Black River lobe of the drainage basin receives the run-off from the southwestern slope of the Adirondack Mountains—largely a rugged and forest-covered area receiving heavy precipitation, especially in the winter.

The principal streams of the area are Genesee, Oswego (formed by the union of Seneca and Oneida rivers, which drain the chain of lakes in central New York), Salmon, and Black rivers.

St. Lawrence River receives also the flow of a number of New York streams rising on the northerly slopes of the Adirondacks and fed by the innumerable lakes with which the region is dotted. Some of these rivers, as the Grass, Raquette, and St. Regis, lie entirely within the United States; others, notably Salmon, Trout, Chateaugay, and English rivers, cross the international boundary and flow northward into the St. Lawrence in Canada, as does also Richelieu River, the outlet of Lake Champlain. The following table gives a list of the principal tributaries of the St. Lawrence in the United States, with the areas drained by them:

Drainage areas of St. Lawrence River tributaries in the United States.

	Square miles.		Square miles.
Oswegatchie River	1,609	Salmon River[1]	273
Grass River	637	Trout River[2]	129
Raquette River	1,219	Chateaugay River[2]	199
St. Regis River	910	English River[2]	53
Little Salmon River[1]	103	Lake Champlain[2]	8,187

The St. Lawrence drains, through Lake Champlain, an area of about 4,560 square miles in the State of Vermont. This drainage is practically all from Missisquoi, Lamoille, and Winooski rivers and Otter Creek. Clyde, Barton, and Black rivers, in northern Vermont, are tributary to St. Lawrence River through Lake Memphremagog and St. Francis River.

BASINS TRIBUTARY TO LAKE SUPERIOR.

ST. LOUIS RIVER BASIN.

GENERAL FEATURES.

St. Louis River drains an area in the northeastern part of Minnesota, chiefly in southern St. Louis County. The river rises in a small lake on the extreme western edge of Lake County, Minn., in T. 59 N., R. 11 W. It flows southwestward through Seven Beaver Lake, then southward until it reaches a point about 6 miles above the St. Louis-Carlton County line, whence its general course is northeastward to the extreme western end of Lake Superior. Its principal tributaries are Partridge, Embarrass, and Floodwood rivers from the west and Whiteface and Cloquet rivers from the east.

From the crossing of the Duluth & Iron Range Railroad near Skibo to a point nearly at the mouth of Whiteface River, the St. Louis flows between banks ranging in height from 10 to 30 feet and its valley is little wider than the river itself. In the 10 miles below the Whiteface the banks are 15 to 20 feet high, but below that section the valley gradually widens and becomes deeper. At Thompson the

[1] Above junction near international boundary. [2] Above New York State line.

river enters a deep, narrow gorge, in which it continues nearly to Lake Superior, and falls nearly 500 feet.

The following drainage areas have been measured in the basin:

Drainage areas in St. Louis River basin.

River.	Drainage area above—	Square miles.
St. Louis	Seven Beaver Lake	46
Do	Sec. 4, T. 57 N., R. 14 W	84
Do	Sec. 22, T. 58 N., R. 15 W	109
Do	Sec. 29, T. 58 N., R. 15 W	299
Do	Embarrass River	332
Do	Sec. 2, T. 56 N., R. 17 W	500
Do	Sec. 29, T. 56 N., R. 18 W	881
Do	Whiteface River	1,280
Do	Cloquet River	2,440
Do	Sec. 22, T. 50 N., R. 17 W	3,170
Do	Mouth	3,440
Embarrass	do	165
Whiteface	Meadowlands	442
Do	Mouth	522
Floodwood	do	224
Cloquet	Sec. 20, T. 54 N., R. 13 W	313
Do	Alden Lake outlet	395
Do	Sec. 34, T. 53 N., R. 14 W	438
Do	Sec. 15, T. 52 N., R. 15 W	523
Do	Independence	698
Do	Mouth	742

The area is covered with a thin layer of sand, clay, and gravel. In the upper portion of the basin this drift sheet rests on crystalline rocks of Cambrian age. The lower valley exhibits the oldest rocks in the region—slates and other rocks of Archean age—but such outcrops are not numerous, for the river has cut through the drift sheet in but few places.

The northern boundary of the basin is, in general, the line of hills rising from 300 to 500 feet above the plain and known as the Mesabi Range. Through a break in the hills Embarrass River flows, draining a considerable area north of the range. The greater part of the area above the mouth of Cloquet River is a vast swamp, containing much muskeag, through which the flow of the river is greatly obstructed. The eastern part of the basin is rougher than the western, although it contains areas of muskeag.

Much of the area is densely forested, although it has been burned and cut over extensively, but within the densely timbered areas are other areas where the cover is thin. The trees found in greatest abundance are white, Norway, and jack pine, spruce, balsam, tamarack, and cedar.

The mean annual rainfall ranges from 28 inches in the western to about 31 inches in the eastern part of the basin, 5 inches or more occurring as snow, which remains during the winter months. As winter thaws are unknown, the winter flow of the streams is derived from the few lakes which exist in the area and from ground water.

Logging dams have been erected at the following points for the purpose of storing the waters for log driving during the spring and summer months:

St. Louis River	Sec. 4, T. 57 N., R. 14 W.
Embarrass River	Sec. 6, T. 58 N., R. 15 W.
Partridge River	Sec. 6, T. 58 N., R. 14 W.
Paleface River	Sec. 36, T. 56 N., R. 16 W.
Whiteface River	Sec. 2, T. 54 N., R. 16 W.
Bug Creek	Sec. 21, T. 54 N., R. 16 W.
Ushkabwakka River	Sec. 14, T. 52 N., R. 16 W.
Cloquet River	Sec. 19, T. 53 N., R. 13 W. and Sec. 15, T. 52 N., R. 15 W.
Beaver River	(Which drains Wild Rice Lake.)
West Branch of Cloquet River	Sec. 15, T. 55 N., R. 13 W.
Branch of Cloquet River	Sec. 12, T. 55 N., R. 13 W.
Little Cloquet River	Sec. 18, T. 54 N., R. 12 W. Sec. 25, T. 54 N., R. 13 W., and Sec. 36, T. 54 N., R. 13 W.
Branch of Cloquet River	Sec. 17, T. 53 N., R. 13 W.

The operation of these dams hinders rather than aids the uniform regulation of the stream flow in the basin, as the dams are closed during the winter, the season of minimum flow, to hold back a large part of the flow until the spring and early summer, when the flow is greater than the average for the year, to drive the logs downstream as far as Cloquet. After the driving is completed the dams are usually left open until the late fall or winter. That it is possible to reconcile these conflicting interests has been proved in Maine, where the lumber and power interests have cooperated to increase the storage facilities and improve the channels and thus lessen the waste incidental to log driving.

The swampy areas of the basin afford a large amount of natural storage. Wild Rice Lake, in T. 51 N., R. 15 W., which is used as a reservoir in connection with the development of power on the lower St. Louis, has an area of 5 square miles with a draft of 5 feet, making its storage capacity 139 million cubic feet. Another storage reservoir has recently been built on Beaver River, which drains Wild Rice Lake.

In order to determine the amount of power available along St. Louis, River, a survey was made during 1910 from Scanlon to the crossing of the Duluth & Iron Range Railroad near Skibo. From the data collected, sheets have been prepared showing a profile of the water surface, a plan of the river, contours along the banks, and prominent natural and artificial features. The results of this survey have been published on separate sheets, which may be obtained by applying to the district engineer, United States Geological Survey, Old Capitol Building, St. Paul, Minn. From this survey the following table of elevations and distances has been compiled:

Distances and elevations along St. Louis River.

Place.	Distance above Scanlon.	Elevation.
	Miles.	*Feet.*
Scanlon River	0	1,101
Cloquet:		
Lower dam, tailwater	2	1,105
Lower dam, headwater	2	1,155
Upper dam, tailwater	3	1,156
Upper dam, headwater	3	1,172
Foot of rapids	9	1,176
Head of rapids	13	1,201
Cloquet River	18	1,206
Congo	27	1,208
Gowan	33	1,216
Floodwood	39	1,225
Whiteface	45	1,226
Elmer	55	1,233
Swan	64	1,241
Casco	72	1,251
Zim Bridge	78	1,261
Great Northern Railway	88	1,292
Forbes	91	1,294
Miller truck road	98	1,308
Otter Creek	104	1,315
Embarrass River	106	1,317
Vermilion Lake road	114	1,330
Aurora bridge	127	1,364
Partridge River	127	1,370
Foot of rapids	130	1,386
Head of rapids	131	1,413
Foot of rapids	132	1,414
Head of rapids, logging dam	135	1,476
Below logging dam	143	1,495
Head of rapids	147	1,544
Duluth & Iron Range Railroad	149	1,562

Water power is developed at two points on the St. Louis. At Cloquet a head of 66 feet is utilized in developing about 7,000 horsepower, and near Thompson a head of 375 feet is utilized in developing an average of 15,000 horsepower.

A survey similar to that of the St. Louis was made in 1910 of Cloquet River from Brimson to the mouth. From this survey the following table of elevations and distances has been compiled:

Distances and elevation along Cloquet River.

Place.	Distance below Brimson.	Elevation.
	Miles.	*Feet.*
Duluth & Iron Range Railroad	0	1,468
West Branch Cloquet River	5	1,459
Foot of rapids	5	1,453
Head of rapids	13	1,438
Foot of rapids	14	1,420
Little Cloquet River	23	1,395
Head of rapids	25	1,394
Foot of rapids	25	1,385
Alden Lake outlet	27	1,383
Below dam, Alden Lake outlet	27	1,377
Vermilion Lake road	31	1,363
Foot of rapids	32	1,354
Head of Big Falls	32	1,353
Foot of Big Falls	33	1,332
Island Lake	34	1,330
High dam, headwater,	42	1,330
High dam, tailwater	42	1,319
Duluth & Northeastern Railroad	53	1,312
Foot of rapids	55	1,296
Head of rapids	59	1,289
United States Geological Survey gaging station at Independence	61	1,270
Duluth, Missabe & Northern Railway	66	1,240
St. Louis River	70	1,206

The following table of approximate elevations and distances has been compiled from various sources:

Elevations and distances along Whiteface River.

Place.	Distance above mouth.	Elevation.
	Miles.	*Feet.*
St. Louis River	0	1,226
Sec. 24, T. 52 N., R. 20 W	7	1,232
Meadowlands	18	1,259
Sec. 29, T. 54 N., R. 18 W	26	1,269
Kelsey	30	1,281
Sec. 9, T. 54, N., R. 17 W	36	1,306
Bassett	80	1,610
Jack Pine Lake outlet	86	1,660

The chief industry in this part of the State is logging. Very little land has been cleared and cultivated. Swamps, impassable during the summer months, make much of the area, and little drainage work has been done. About 117,000 acres has been ditched in St. Louis County.

ST. LOUIS RIVER NEAR THOMSON, MINN.

This station, which is located just below the tailrace of the Great Northern power house, 3 miles east of Thomson, in sec. 11, T. 48 N., R. 16 W., was established October 5, 1909, in cooperation with the Great Northern Power Co., which furnishes the daily gage readings.

No important tributary enters within several miles of the station.

The chain gage is located just below the tailwater of the power house, and is read four times daily—at 8 and 11 a. m. and 2 and 5 p. m.—the average of these readings being taken as the mean for the day. As the plant is operated 24 hours each day, though with varying load, the fluctuations at the gage are not so great as they would be if the turbine was closed a part of the time.[1]

The datum of the gage has not been changed since the station was established.

Discharge measurements are made from a car and cable 1,500 feet below the gage.

The records do not indicate the natural flow of the river at all times, as the flow is to a certain extent regulated by reservoirs above. The dam at Thomson is designed to hold 24 hours' supply of water for the power plant, and the discharge from a large part of the entire drainage area above the gaging station is controlled by logging dams. The logging dams in general are closed during the winter months to store the flow, in order to drive logs to Cloquet in the spring, and when the drives are finished the dams are left open until it is time to store water for the next season's drive.

[1] A brief description of this power plant is given in the cooperative report published by the State Drainage Commission, St. Paul, Minn., entitled "Report of water resources investigation of Minnesota during 1909-10."

The discharge at this station has been reported as practically unaffected by ice, but in November, 1910, the stage became extremely low and the water froze, making the gage heights of little value as indications of discharge. During the winter of 1910 no water flowed over the spillway, and the daily discharge was computed from the amount of water passing the turbines, as recorded by the power company.

The station affords excellent conditions for determining flow, and, except for possible errors in the mean gage height for the day, the records should be good.

Discharge measurements of St. Louis River near Thomson, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1909.					
Oct. 5	Follansbee and Gray	240	1,430	2.56	2,610
Nov. 2	G. A. Gray	250	1,700	3.33	3,960
1910.					
Jan. 12	Gray and King	177	910	.90	[a] 709
Apr. 13	Follansbee and Gray	208	1,240	1.88	1,850
June 16	C. R. Adams	190	1,000	.92	921
July 27	G. A. Gray	188	906	.64	613
Sept. 13	C. R. Adams	195	1,050	1.22	1,080

[a] Probably affected by meter freezing.

Daily gage height, in feet, of St. Louis River near Thomson, Minn., for 1910.

[N. Van Valkenburgh, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.30	0.65	0.65	2.80	2.63	2.48	0.16	1.99	1.32	2.01	1.40
2	1.22	.61	.70	2.85	1.82	2.11	.20	1.97	1.24	2.27	.46
3	1.21	.58	.67	3.12	2.08	1.99	.26	2.21	.95	2.30	1.34
4	1.38	.74	.61	3.02	1.66	1.84	.28	2.06	.98	1.90	1.42
5	1.38	.72	.68	3.03	2.62	1.82	.30	2.59	.85	1.95	1.44
6	1.19	.73	.80	3.10	2.15	1.78	.29	2.39	.98	1.83	.61
7	1.11	.72	.88	2.64	1.81	1.65	.32	1.80	.97	1.85	.42
8	1.02	.75	.98	2.70	1.95	1.69	.34	.34	1.24	1.70	.41
9	1.02	.62	.95	2.20	2.02	1.36	.33	1.24	1.45	1.26	.50
10	1.00	.65	.90	2.90	2.03	1.73	.32	.59	1.71	1.01	.38
11	.99	.70	.82	1.28	1.92	1.00	.26	.46	1.81	.97	....
12	.93	.63	.88	1.80	1.68	....	.31	.40	1.58	.52	....
13	.83	.48	.92	1.88	1.60	.42	.32	.36	1.28	.45	....
14	.62	.72	1.09	1.70	1.30	.85	.30	.32	....	.45	....
15	.72	....	1.16	2.04	1.27	1.26	.32	.31	....	.47	....
16	.73	....	1.30	2.20	1.20	.86	.35	.36	....	.39	....
17	.78	.80	1.36	1.96	1.31	.62	.32	.37	....	.88	....
18	.78	.75	1.59	1.76	1.15	.65	.34	.31	....	1.70	....
19	.82	.64	1.60	2.46	1.04	.43	.30	.35	....	1.81	....
20	.92	.63	1.85	3.20	1.21	.26	.44	.40	.44	1.44	....
21	.89	.74	1.98	3.48	1.53	.54	.42	.36	.36	1.64	....
22	.82	.70	2.19	3.83	2.17	.38	.35	.36	.39	1.59	....
23	.80	.68	2.40	3.42	2.06	.36	.38	.85	.40	1.64	....
24	.81	.75	2.48	3.35	2.10	.35	.45	.94	.35	1.55	....
25	.99	.80	2.55	3.00	2.66	.39	.95	1.37	.39	1.48	....
26	.82	.80	2.94	3.33	2.89	.40	1.05	1.47	.35	1.02	....
27	.76	.75	2.95	2.90	2.59	.05	.68	1.42	.38	1.40	....
28	.63	.80	2.67	2.82	2.40	.06	.84	1.43	.40	1.46	....
29	.59	....	2.54	2.77	2.33	.07	.89	1.35	1.01	1.48	....
30	.50	....	2.54	2.63	2.02	.11	1.00	1.42	2.01	1.58	....
31	.72	....	2.56	....	2.32	....	1.42	1.39	....	1.48	....

NOTE.—No flow over dam Nov. 11 to Dec. 31, 1910. Gage observations during this period discontinued because of ice.

Daily discharge, in second-feet, of St. Louis River near Thomson, Minn., for 1909–10.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1909.				1909.				1909.			
1	......	3,970	3,200	11	1,980	2,120	3,420	21	2,900	2,880	2,100
2	......	3,780	3,780	12	1,470	1,620	3,150	22	3,430	2,420	1,650
3	......	3,590	4,250	13	1,400	1,440	2,880	23	3,850	2,120	1,560
4	......	3,710	4,270	14	1,510	1,880	2,760	24	3,800	1,630	1,810
5	2,540	4,600	4,270	15	2,680	2,170	2,860	25	4,220	2,200	1,740
6	2,070	3,920	4,200	16	2,620	2,960	2,790	26	4,640	2,320	1,650
7	1,640	3,240	3,560	17	2,800	2,330	2,320	27	4,640	3,210	1,720
8	1,920	2,740	3,530	18	3,530	2,100	1,980	28	4,510	3,300	1,790
9	2,340	2,440	2,760	19	2,880	2,370	2,000	29	4,740	2,870	1,520
10	2,300	2,220	3,120	20	3,460	3,030	2,110	30	4,320	3,240	1,700
								31	4,040	......	1,430

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1910.												
1	1,210	645	645	3,030	2,790	2,580	360	1,960	1,230	1,990	1,310	275
2	1,130	617	680	3,100	1,760	2,110	380	1,940	1,150	2,310	521	248
3	1,120	597	659	3,530	2,070	1,960	410	2,230	885	2,340	1,250	293
4	1,290	710	617	3,370	1,590	1,790	420	2,050	912	1,860	1,330	294
5	1,290	695	666	3,380	2,770	1,760	430	2,730	798	1,920	1,350	318
6	1,110	702	755	3,500	2,160	1,720	425	2,460	912	1,770	617	273
7	1,030	695	823	2,800	1,750	1,580	441	1,740	903	1,800	497	238
8	948	718	912	2,880	1,920	1,620	452	452	1,150	1,630	491	269
9	948	624	885	2,220	2,000	1,270	446	1,150	1,360	1,170	545	289
10	930	645	840	3,180	2,010	1,660	441	604	1,640	939	474	259
11	921	680	772	1,190	1,880	930	410	521	1,750	903	319	294
12	867	631	823	1,740	1,610	714	436	485	1,500	558	407	303
13	780	533	858	1,830	1,520	497	441	463	1,190	515	336	300
14	624	695	1,010	1,630	1,210	798	430	441	1,090	515	375	284
15	695	715	1,080	2,020	1,180	1,170	441	436	995	527	316	309
16	702	735	1,210	2,220	1,120	806	458	463	898	480	280	293
17	740	755	1,270	1,930	1,220	624	441	468	800	823	346	274
18	740	718	1,510	1,700	1,070	645	452	436	703	1,630	321	268
19	772	638	1,520	2,560	966	503	430	458	606	1,750	332	310
20	858	631	1,800	3,660	1,120	410	509	485	509	1,350	327	291
21	832	710	1,950	4,140	1,450	571	497	463	463	1,560	360	283
22	772	680	2,210	4,790	2,180	474	458	463	480	1,510	319	301
23	755	666	2,480	4,040	2,050	463	474	798	485	1,560	355	289
24	764	718	2,580	3,920	2,100	458	515	876	458	1,470	322	237
25	921	755	2,680	3,340	2,830	480	885	1,280	480	1,390	348	298
26	772	755	3,240	3,880	3,160	485	975	1,380	458	948	316	268
27	725	718	3,260	3,180	2,730	308	666	1,330	474	1,310	324	290
28	631	755	2,840	3,060	2,480	312	789	1,340	485	1,370	332	273
29	604	......	2,660	2,990	2,380	316	832	1,260	939	1,390	296	282
30	545	......	2,660	2,790	2,000	335	930	1,330	1,990	1,500	256	246
31	695	......	2,690	......	2,370	......	1,330	1,300	......	1,390	......	278

NOTE.—Daily discharge determined from a discharge rating curve well defined above 500 second-feet. No flow over the dam Nov. 11 to Dec. 31; daily discharge during this period taken directly from the records of flow through the wheels and gate openings, kept by the Great Northern Power Co.

Monthly discharge of St. Louis River near Thomson, Minn., for 1909–10.

[Drainage area, 3,420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
October 5-31	4,740	1,400	3,050	0.892	0.90	B.
November	4,600	1,440	2,750	.804	.90	B.
December	4,270	1,430	2,640	.772	.89	B.
1910.						
January	1,290	545	862	.252	.29	B.
February	755	533	683	.200	.21	C.
March	3,260	617	1,570	.459	.53	B.
April	4,790	1,190	2,920	.854	.95	B.
May	3,160	966	1,920	.561	.65	B.
June	2,580	308	978	.286	.32	B.
July	1,330	360	549	.161	.19	C.
August	2,730	436	1,090	.319	.37	B.
September	1,750	458	923	.270	.30	B.
October	2,340	480	1,360	.398	.46	B.
November	1,350	256	499	.146	.16	B.
December	318	237	282	.082	.09	B.
The year	4,790	237	1,140	.332	4.52	

WHITEFACE RIVER AT MEADOWLANDS, MINN.

This station, which is located at the highway bridge at Meadowlands, Minn., in sec. 14, T. 53 N., R. 19 W., was established June 7, 1909.

The nearest tributary is a very small stream that enters from the east half a mile above.

The gage is a staff at the bridge.

Discharge measurements at high and ordinary stages are made from the bridge; low-water measurements are made by wading at the rapids nearly 2 miles below the station.

Whiteface River is used extensively for log driving, and the flow is to a large extent controlled by logging dams above the station. The opening and closing of the gates of these dams causes fluctuations in gage height amounting to several feet, and the records of extreme stage are therefore of little value.

The relation of gage height to discharge is affected by backwater from log jams, and the discharge has been determined from a number of discharge rating curves, some of which have been applied indirectly. The records can not be considered better than fair.

Discharge measurements of Whiteface River at Meadowlands, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	Hoyt & Gibson	104	661	6.52	708
Aug. 5	G. A. Gray	104	588	5.71	341
Aug. 24*a*	.....do	104	643	6.09	677
Oct. 3	.....do	104	470	5.09	309
1910.					
Apr. 21	.....do	84	659	6.22	656
July 29*a*	.....do	132	227	4.50	215

a Wading measurement.

Daily gage height, in feet, of Whiteface River at Meadowlands, Minn., for 1910.

[A. F. Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.85	5.3	5.85	3.8	5.65	3.7	6.4	3.8
2		4.8	4.25	5.4	3.7	4.5	3.8	5.4	3.8
3		4.7	7.15	5.3	3.8	3.5	3.8	7.0	3.8
4		4.65	6.95	5.0	3.8	3.4	3.8	6.5	3.8
5		4.6	4.9	4.8	4.0	3.4	4.0	6.0	3.8
6		4.45	3.9	5.0	4.0	3.4	4.25	6.5	3.8
7		4.3	3.95	5.65	3.8	3.4	4.45	6.0	3.8
8		4.3	3.9	6.35	3.75	3.4	3.95	5.5	3.8
9		4.25	3.9	5.0	3.7	3.4	4.0	4.75	3.7
10		5.85	3.8	4.3	3.65	3.4	4.15	4.2	3.7
11		4.5	3.9	3.95	3.55	3.4	4.2	4.1	
12		4.25	3.9	4.4	3.45	3.4	4.1	4.1	
13		4.1	5.3	8.05	3.4	3.75	3.8	4.2	
14		6.05	3.9	6.3	3.4	4.2	3.8	4.0	
15		4.3	4.4	3.85	3.4	4.0	3.8	4.0	
16		4.65	3.9	3.55	3.4	4.4	3.7	4.0	
17		4.25	3.7	3.6	3.3	4.4	3.65	4.0	
18		4.45	3.85	3.45	3.3	4.35	3.5	3.9	
19		6.65	3.95	3.4	3.2	4.2	3.5	3.9	
20		6.35	4.0	3.4	3.3	4.0	3.4	3.8	
21		5.85	5.05	3.4	3.3	3.9	3.4	4.9	
22		4.25	5.25	3.4	3.3	3.9	3.4	5.2	
23		6.95	5.6	3.4	3.5	3.8	3.3	5.0	
24		6.0	8.15	3.4	3.5	3.8	3.4	4.8	
25		6.75	8.0	3.65	3.4	3.8	3.5	4.7	
26		6.2	7.1	4.35	3.3	3.75	3.7	4.4	
27		5.9	6.7	4.20	3.3	3.7	3.9	4.3	
28	4.8	4.65	6.75	4.05	3.3	3.7	4.4	4.3	
29	4.9	4.55	6.25	4.0	3.7	3.7	4.6	4.3	
30	4.8	7.1	6.0	4.0	3.5	3.8	6.0	4.2	
31	4.8		6.05		6.65	3.7		4.0	

NOTE.—Ice present from Jan. 1 to about Mar. 27 and from Nov. 5 to Dec. 31.

Daily discharge, in second-feet, of Whiteface River at Meadowlands, Minn., for 1909–10.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov
1909.							1909.						
1	......	40	1,130	510	355	440	16	120	95	2,580	260	510	350
2	......	35	960	470	315	395	17	120	60	2,450	205	505	350
3	......	35	870	365	305	260	18	760	220	2,250	190	465	250
4	......	35	575	390	570	350	19	80	585	1,990	190	530	290
5	......	35	325	320	250	470	20	50	140	1,190	365	420	365
6	......	30	375	220	255	385	21	50	635	1,040	475	400	345
7	570	30	210	190	225	385	22	45	2,480	950	720	570	365
8	480	30	220	170	245	295	23	690	2,520	950	1,130	610	345
9	310	30	430	165	220	465	24	280	2,710	635	860	600	405
10	345	30	750	165	245	250	25	335	2,520	550	605	675	470
11	305	40	3,400	160	225	225	26	135	2,250	520	670	645	440
12	120	50	2,820	150	370	225	27	95	1,800	515	750	645	450
13	165	90	2,400	180	395	240	28	75	1,200	460	680	690	505
14	570	90	2,580	275	480	345	29	50	1,300	550	610	550	440
15	120	95	2,930	360	495	385	30	45	800	645	480	430	470
							31	......	1,310	645	......	405	......

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.									
1	....	285	390	545	115	485	105	730	115
2	....	275	178	415	105	215	115	415	115
3	....	255	1,000	390	115	85	115	940	115
4	....	245	922	315	115	75	115	765	115
5	....	235	295	275	140	75	140	590	115
6	....	208	125	315	140	75	178	765	115
7	....	185	132	485	115	75	208	590	115
8	....	185	125	712	110	75	132	440	115
9	....	178	125	315	105	75	140	265	105
10	....	545	115	185	100	75	162	170	105
11	....	215	125	132	90	75	170	155	....
12	....	178	125	200	80	75	155	155	....
13	....	155	390	1,300	75	110	115	170	....
14	....	608	125	695	75	170	115	140	....
15	....	185	200	120	75	140	115	140	....
16	....	245	125	90	75	200	105	140	....
17	....	178	105	95	65	200	100	140	....
18	....	208	120	80	65	192	85	125	....
19	....	818	132	75	55	170	85	125	....
20	....	712	140	75	65	140	75	115	....
21	....	545	328	75	65	125	75	295	....
22	....	178	378	75	65	125	75	365	....
23	....	922	470	75	85	115	65	315	....
24	....	590	1,350	75	85	115	75	275	....
25	....	852	1,290	100	75	115	85	255	....
26	....	660	980	192	65	110	105	200	....
27	....	560	835	170	65	105	125	185	....
28	275	245	852	148	65	105	200	185	....
29	295	225	678	140	105	105	235	185	....
30	275	980	590	140	85	115	590	170	....
31	275	....	608	....	818	105	....	140	....

NOTE.—Daily discharge for 1909 determined by indirect method for shifting channels. Daily discharge for 1910 determined from a fairly well defined discharge rating curve.

Monthly discharge of Whiteface River at Meadowlands, Minn., for 1909-10.

[Drainage area, 442 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
June 7-30	760	45	246	0.557	0.50	C.
July	2,710	30	688	1.56	1.80	C.
August	3,400	150	1,230	2.78	3.20	C.
September	1,130	150	409	.925	1.03	C.
October	690	220	439	.993	1.14	C.
November	505	225	365	.826	.92	C.
1910.						
April	980	155	395	.894	1.00	C.
May	1,350	105	431	.975	1.12	C.
June	1,300	75	267	.604	.67	C.
July	818	55	112	.253	.29	C.
August	485	75	130	.294	.34	C.
September	590	65	139	.314	.35	C.
October	940	115	311	.704	.81	C.
November 1-10	....	....	113	.256	.10	C.

CLOQUET RIVER AT INDEPENDENCE, MINN.

This station, which is located at the highway bridge at Independence, in sec. 26, T. 52 N., R. 17 W., was established June 28, 1909.

The nearest tributary is a small stream that enters from the north just above the station.

Cloquet River is used extensively for log driving, and the run-off from by far the greater part of the drainage area above Independence is controlled by logging dams. The opening and shutting of the gates at these dams cause violent fluctuations in the gage height during the day, amounting at times to several feet, and consequently the mean daily gage height, which is the mean of readings taken morning, noon, and night, can be considered only approximate during the log-driving season. The daily discharge data as a whole have little value, the chief purpose of the records being to show the approximate mean monthly discharge and total volume available for storage.

Backwater at the gage may also be caused by log jams forming below the station, but as jams may form at any point along the stream it is impossible to select a more satisfactory site.

Observations are discontinued from November to April because of ice. The mean monthly flow during this period is estimated from records of flow at Island Lake logging dam above Independence and records of the discharge from Wild Rice Lake on Beaver River, which enters Cloquet River between Island Lake dam and the station. Only one other stream, and that is relatively unimportant, enters above the station. These records are kept by the Great Northern Power Co. and furnished through its courtesy.

The records can not be considered better than fair, or possibly during certain seasons good.

Discharge measurements of Cloquet River at Independence, Minn., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1909.					
June 28	G. A. Gray	168	566	6.78	1,720
July 15	Robert Follansbee	122	156	4.01	94.8
Aug. 6	G. A. Gray	164	445	5.90	840
23	.....do	168	565	6.61	1,440
Oct. 4	.....do	167	553	6.50	1,430
1910.					
July 28[a]	G. A. Gray	102	217	4.88	316

[a] Wading section.

Daily gage height, in feet, of Cloquet River at Independence, Minn., for 1909.

[Fred Haakensen, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.1	6.5	6.1	6.0	6.9	6.0	16		4.25	7.9	4.5	6.8	5.0	8.4
2		4.0	6.4	4.95		6.15	6.3	17		4.2	7.8	4.45	7.2	5.8	8.3
3		4.0	7.4	4.55		6.9	6.2	18		4.25	7.6	4.4	7.6	5.55	8.4
4		4.0	7.3	5.1	6.4	7.9	5.35	19		6.6	8.0	4.5	7.4	5.6	9.2
5		4.0	7.8	4.7	5.55	7.5	5.3	20		6.8	7.3	4.5	6.5	5.15	8.7
6		3.95	5.85	4.5	5.1	6.8	6.45	21		7.4	7.3	4.95	6.35	5.05	8.4
7		3.95	4.75	4.4	5.4	6.45	7.3	22		8.6	7.5	5.6	6.6	5.15	8.9
8		3.9	7.1	4.3	6.1	6.1	6.7	23		8.8	6.9	6.35	6.3	5.25	9.2
9		3.9	5.15	4.25	5.6	5.85	6.9	24		8.3	6.25	7.4	6.8	5.3	9.2
10		3.9	4.75	4.25	5.3	5.85	7.0	25		8.5	4.85	8.3	6.7	5.6	8.9
11		3.9	6.6	4.2	5.0	5.1	7.8	26		9.1	6.5	7.8	7.2	5.9	
12		3.95	6.9	4.25	4.95	4.8	7.7	27		9.1	6.1	7.7	7.4	5.85	
13		4.0	7.5	4.35	6.0	4.7	7.7	28	6.7	8.1	6.9	7.2	7.9	5.3	
14		4.1	8.2	4.45	5.95	4.75	8.6	29	6.2	6.1	6.9	7.0	7.8	5.3	
15		4.1	8.0	4.45	7.2	4.85	8.7	30	5.5	6.6	6.8	6.2	7.9	5.5	
								31		6.6	6.45		7.4		

NOTE.—Gage heights for 1909 supersede those published in Water-Supply Paper 264. It was necessary to apply a correction to all gage heights below 5 feet because of an error in setting low-water section of the gage.

Daily gage height, in feet, of Cloquet River at Independence, Minn., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	....	7.04	5.72	5.13	4.62	4.38	5.53	....	4.87
2	....	7.83	6.32	4.91	4.65	5.48	5.19	4.42	4.87
3	....	7.82	5.37	6.13	4.77	5.92	5.12	4.22	4.76
4	....	7.76	6.96	5.64	4.79	7.11	4.71	4.27	4.37
5	....	7.60	6.09	6.28	4.68	6.95	6.57	4.10	4.12
6	....	6.82	5.88	6.37	4.70	4.95	7.42	4.07	4.19
7	....	6.79	5.54	6.38	4.70	5.25	6.84	4.05	3.94
8	....	5.58	5.82	5.65	4.77	5.19	5.01	3.94	3.92
9	....	7.49	6.33	5.36	4.72	4.60	6.83	3.99	3.94
10	....	5.55	5.72	5.07	4.74	4.22	6.51	3.96	3.98
11	....	5.30	5.32	5.07	4.75	4.26	5.94	3.95	3.89
12	....	5.07	4.83	5.04	5.00	4.20	5.54	3.94	3.87
13	....	5.07	4.70	5.02	4.99	4.32	5.36	3.92	3.82
14	....	5.01	4.73	4.80	5.02	4.46	5.12	3.94	3.85
15	....	5.04	5.58	4.65	4.84	4.38	4.90	3.95	3.85
16	....	5.16	5.30	4.68	4.58	4.30	4.77	3.95	....
17	....	5.24	5.06	4.83	4.60	4.26	4.72	4.81	....
18	....	5.24	4.76	4.83	4.70	4.32	4.61	7.90	....
19	....	5.32	4.71	4.62	4.52	4.62	4.50	7.19	....
20	....	6.76	5.38	4.66	4.44	4.98	4.45	5.80	....
21	....	7.58	5.66	4.86	4.40	4.86	4.42	5.37	....
22	....	7.18	5.43	4.76	4.40	5.91	4.41	5.19	....
23	....	7.53	5.61	4.68	4.50	5.51	4.42	4.93	....
24	....	6.62	6.31	4.59	6.78	5.87	4.42	4.78	....
25	7.10	6.63	6.04	4.78	5.06	5.97	4.38	4.89	....
26	7.35	6.07	6.04	5.03	4.72	5.74	4.50	5.33	....
27	5.78	5.92	6.06	4.78	4.92	4.93	4.81	4.93	....
28	5.96	5.68	5.21	4.57	4.98	5.74	5.21	4.89	....
29	6.00	6.39	5.01	4.51	4.56	5.52	4.92	4.89	....
30	6.35	5.92	5.24	4.58	4.47	5.24	4.80	4.85	....
31	6.68	....	5.30	....	4.39	5.78	....	4.85	....

NOTE.—Ice present from Jan. 1 to Mar. 24 and from Nov. 16 to Dec. 31.

Daily discharge, in second-feet, of Cloquet River at Independence, Minn., for 1909–10.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.							1909.						
1	......	103	1,370	1,000	920	1,850	16	......	128	3,270	185	1,720	350
2	......	90	1,270	331	1,040	1,040	17	......	119	3,120	172	2,250	775
3	......	90	2,530	199	1,150	1,850	18	......	128	2,820	160	2,820	622
4	......	90	2,390	392	1,270	3,270	19	......	1,480	3,430	185	2,530	650
5	......	90	3,120	244	622	2,670	20	......	1,720	2,390	185	1,370	416
6	......	85	810	185	392	1,720	21	......	2,530	2,390	331	1,220	371
7	......	85	260	160	540	1,320	22	......	4,390	2,670	650	1,480	416
8	......	80	2,110	138	1,000	1,000	23	......	4,710	1,850	1,220	1,180	465
9	......	80	416	128	650	810	24	......	3,910	1,130	2,530	1,720	490
10	......	80	260	128	490	810	25	......	4,230	294	3,910	1,600	650
11	......	80	1,480	119	350	392	26	......	5,190	1,370	3,120	2,250	845
12	......	85	1,850	128	331	277	27	......	5,190	1,000	2,970	2,530	810
13	......	90	2.670	149	920	244	28	1,600	3,590	1,850	2,250	3,270	490
14	......	103	3.750	172	882	260	29	1,080	1,000	1,850	1,980	3,120	490
15	......	103	3,430	172	2,250	294	30	595	1,480	1,720	1,080	3,270	595
							31	......	1,480	1,320	......	2,530	......

Daily discharge, in second-feet, of Cloquet River at Independence, Minn., for 1909–10—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1910.									
1	....	2,030	723	406	219	156	612	216	302
2	....	3,160	1,190	316	228	584	435	165	302
3	....	3,150	525	1,030	267	860	402	123	264
4	....	3,060	1,930	674	274	2,120	247	133	153
5	....	2,820	992	1,160	238	1,920	1,450	103	106
6	....	1,750	831	1,240	244	331	2,560	99	117
7	....	1,710	617	1,250	244	465	1,770	96	84
8	....	639	789	680	267	435	354	84	82
9	....	2,660	1,200	520	251	213	1,760	89	84
10	....	622	723	379	257	123	1,380	86	88
11	....	490	500	379	260	130	875	85	79
12	....	379	288	367	350	119	617	84	78
13	....	379	244	358	346	142	520	82	73
14	....	354	254	277	358	175	402	84	76
15	....	367	639	228	291	156	312	85	76
16	....	421	490	238	207	138	267	85	70
17	....	460	375	288	213	130	251	280	70
18	....	460	264	288	244	142	216	3,270	70
19	....	500	247	219	191	219	185	2,240	70
20	....	1,670	530	232	170	342	172	775	70
21	....	2,780	686	298	160	298	165	525	70
22	....	2,220	556	264	160	852	162	435	70
23	....	2,710	656	238	185	600	165	323	70
24	....	1,500	1,180	210	1,700	824	165	270	70
25	2,110	1,520	952	270	375	898	156	308	70
26	2,460	976	952	363	251	736	185	505	70
27	762	860	968	270	320	323	280	323	70
28	890	698	445	205	342	736	445	308	70
29	920	1,260	354	188	202	606	320	308	70
30	1,220	860	460	207	178	460	277	294	70
31	1,580	....	490	....	158	762	....	294	....

NOTE.—Discharges during 1909–1910, except those for period Nov. 16–30, 1910, which were estimated, are based on a rating curve well defined below 2,000 second-feet but somewhat uncertain above.

Monthly discharge of Cloquet River at Independence, Minn., for 1909–10.

[Drainage area, 698 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
1909.						
January	....	....	a 160	0.229	0.26	C.
February	....	....	a 195	.279	.29	C.
March	....	....	a 275	.394	.45	C.
July	5,190	80	1,370	1.96	2.26	B.
August	3,750	260	1,940	2.78	3.20	B.
September	3,910	119	819	1.17	1.30	B.
October	3,270	331	1,540	2.21	2.55	B.
November	3,270	260	875	1.25	1.40	B.
December	....	....	a 840	1.20	1.61	C.
1910.						
January	....	....	b 220	.315	.36	C.
February	....	....	b 300	.430	.45	C.
March	2,460	....	b 370	.530	.57	C.
April	3,160	354	1,420	2.03	2.26	B.
May	1,930	244	679	.973	1.12	B.
June	1,250	188	435	.623	.70	B.
July	1,700	158	295	.423	.49	B.
August	2,120	119	516	.739	.85	B.
September	2,560	156	570	.817	.91	B.
October	3,270	82	392	.562	.65	B.
November	....	....	100	.143	.16	B.
December	....	....	b 80	.115	.13	C.
The year	3,270	....	444	.636	8.61	

a Estimated by means of climatologic records and comparison with flow of St. Louis River.
b Estimated from records of Great Northern Power Co.

BASINS TRIBUTARY TO LAKE MICHIGAN.

ESCANABA RIVER BASIN.

GENERAL FEATURES.

Escanaba River rises in the western part of Marquette County, near Lake Michigamme, and takes a general southeasterly course to Little Bay de Noquette, an arm of Lake Michigan, which it enters near Escanaba, Mich. Its length is about 90 miles and its drainage area, which lies in the central part of the Northern Peninsula of Michigan, comprises about 890 square miles.

The basin is long and narrow and comparatively regular in outline, the average width of its lower half being less than 10 miles, its extreme width about 25 miles, and its length about 70 miles. In its upper course the river flows through an area of crystalline rocks, but farther down the rocks are sandstones and limestones. The headwaters of the river have an elevation of about 1,600 feet above sea level, and at its mouth the elevation is 580 feet, making a total descent of about 1,000 feet, or an average fall of over 10 feet to the mile.

The tributaries of the river are small, the West Branch being the only one of importance.

The mean annual rainfall in this part of Michigan is about 32 inches. The winters are severe; the snowfall is heavy and lasts for considerable periods, and ice covers the streams to a thickness of about 2 feet for three to four months.

Lumbering is yet an active industry in this basin, although the greater part of the best timber has been cut off and the river is still used extensively for logging. The change in the forest conditions has probably not affected the run-off of the stream.

Storage sites have not been sought, but suitable locations for reservoirs could doubtless be found, as the basin contains some lakes and swamps.

Little is known of the available water power, but as the average fall is high, favorable sites are probably numerous. A few power sites not far from the mouth of the river have been developed, and at least one of these plants is of comparatively recent installation.

ESCANABA RIVER NEAR ESCANABA, MICH.

This station, which is located at a highway bridge between Escanaba and Gladstone, Mich., about 9 miles north of Escanaba and 4 miles above the mouth of the river, was established August 25, 1903. Discharge measurements were made at this station in April, May, and July, 1903, but daily gage heights were not obtained until August 25, 1903. The station was discontinued March 31, 1909, and reestablished June 1, 1909.

The chain gage is attached to the bridge, from which all measurements are made.

Although the current is swift at the measuring section, gage heights are affected by ice, which in some years covers the stream to a thickness of 2 feet for four months, and during the logging season the gage heights are sometimes affected by log jams.

This station was last inspected July 16, 1908. The accuracy of the daily and monthly discharge given below therefore depends on the permanency of flow and of elevation of the gage since that date. On November 6 the gage weight was lost, and hence all gage heights July 16, 1908, to November 5, 1910, are of necessity considered correct. A new chain and weight was installed November 15, 1910. Readings subsequent to that date are correct, provided there has been no change in the structure to which the gage is attached since July 16, 1908.

Conditions of flow are believed to be permanent. The gage reader at this station was paid by the Geological Survey of Michigan for 1910.

Daily gage height, in feet, of Escanaba River near Escanaba, Mich., for 1910.

[Miss Olive Beauchamp, observer.]

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

NOTE.—River frozen over Jan. 1 to about Mar. 25 and Dec. 11–31. Gage heights during these periods taken to water surface. Ice varied in thickness from 0.5 to 2 feet.
The gage weight was lost Nov. 6 and replaced Nov. 15. (See description.)

Daily discharge, in second-feet, of Escanaba River near Escanaba, Mich., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,860	2,530	790	205	205	480	410	790	410
2	2,530	2,380	880	165	250	480	410	790	350
3	2,380	1,810	790	165	300	410	550	710	350
4	2,090	1,550	710	205	300	410	480	790	410
5	2,230	1,680	790	90	205	410	880	790	350
6	2,530	1,420	1,180	205	250	410	880	760	300
7	2,860	1,300	1,300	250	250	410	790	730	....
8	2,690	1,300	970	205	205	410	630	700	....
9	2,530	970	790	250	250	300	480	670	....
10	2,230	970	710	205	205	350	480	640	....
11	1,950	880	710	205	250	350	410	600	....
12	2,230	790	630	250	250	410	410	570	....
13	2,090	790	550	205	205	550	410	540	....
14	1,810	710	480	205	250	410	410	510	....
15	1,950	710	550	205	300	410	410	480	....
16	1,680	710	480	250	250	350	350	480	....
17	1,810	790	480	300	250	300	350	480	....
18	1,950	1,070	410	205	250	300	350	410	....
19	1,950	1,680	410	125	205	300	350	410	....
20	1,810	1,680	300	125	205	300	350	480	....
21	1,550	1,810	350	165	205	300	410	480	....
22	1,420	1,680	300	250	250	250	480	410	....
23	1,550	1,550	250	205	630	300	480	410	....
24	1,680	1,420	205	250	630	410	480	410	....
25	1,680	1,420	300	300	710	410	550	410	....
26	1,810	1,300	250	300	880	410	710	410	....
27	2,530	1,180	205	350	880	410	710	410	....
28	2,690	1,070	165	410	630	410	790	410	....
29	2,860	970	250	350	630	410	790	410	....
30	2,690	880	205	250	550	410	710	480	....
31	....	880	....	165	550	....	710	....	....

NOTE.—Daily discharge determined from a discharge rating curve well defined above 300 second-feet. Discharge Nov. 6-14 interpolated.

Monthly discharge of Escanaba River near Escanaba, Mich., for 1910.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	....	....	300	0.375	0.43	D.
February	....	....	250	.312	.32	D.
March	....	....	990	1.24	1.43	D.
April	2,860	1,420	2,150	2.69	3.00	B.
May	2,530	710	1,290	1.61	1.86	B.
June	1,300	165	546	.682	.76	B.
July	410	90	226	.282	.33	C.
August	880	205	367	.459	.53	B.
September	550	250	382	.478	.53	B.
October	880	350	536	.670	.77	B.
November	790	410	552	.690	.77	B.
December	....	....	275	.344	.40	D.
The year	....	....	656	.820	11.13	

NOTE.—Discharge during the period when ice existed estimated by means of climatologic records and comparison with records of Menominee River.
Mean discharge Dec. 7-31 estimated at 250 second-feet.
The accuracy of the discharge is somewhat uncertain. (See description.)

MENOMINEE RIVER BASIN.

GENERAL FEATURES.

Menominee River, throughout its length of about 104 miles, forms part of the boundary line between northern Michigan and Wisconsin, and its drainage basin therefore lies in both States. The river is formed by the junction of Michigamme and Brule rivers, and flows southeastward, emptying into Green Bay, an arm of Lake Michigan, near Menominee, Mich. Its total drainage area is about 4,000 square miles.

Michigamme River is said to rise in Lake Michigamme, the largest lake in the Menominee drainage basin, but the lake has a feeder which may be considered the continuation of the river and which rises within 12 miles of Lake Superior. The length of the Michigamme to its extreme source is about 72 miles; to Lake Michigamme about 51 miles. It is noteworthy that four of the largest tributaries enter the main stream above Iron Mountain, Mich., about three-fifths of the total drainage area being above this point. This characteristic increases the value of the stream for water-power development. Downstream from the Michigamme, on the right or west bank, the following important tributaries enter: Paint River, which is called a tributary of Brule River, although it is much the larger stream of the two and Brule, Pine, and Pemebonwon rivers, on the left or east bank are Sturgeon and Little Cedar rivers.

The drainage basin is narrow in its lower part and widest at the sources of the tributaries which form the rivers. The surface is in general covered deeply by glacial drift, but the Menominee and all its tributaries flow over crystalline rocks as far south as the mouth of Pike River, or fully two-thirds of its length. Below the mouth of the Pike the river flows over sandstones and limestones. Most of the rapids and falls occur in the area of crystalline rocks above the mouth of Pike River, although there are several rapids and falls below this point. The country through which the river flows is almost mountainous.

The Wisconsin tributaries rise in a high, flat plateau, abounding in lakes and swamps, among which Flambeau and Wisconsin rivers also head. Some of these rivers head in lakes only a few rods apart, and even in the same swamps in which the tributaries of the Menominee head. These lakes and swamps are nearly 1,600 feet above sea level, or about 1,000 feet above Lake Michigan. The Michigan branches flow from a similar region of equal or higher elevation. The numerous lakes and swamps make the flow of the river uniform and steady.

The elevation of the headwater streams is, as stated, about 1,600 feet above sea level; at the junction of Brule and Michigamme rivers the elevation is about 1,300 feet; at the highway bridge near Iron Mountain, Mich., the elevation is about 1,050 feet; and at the mouth of the river it is 580 feet.

The mean annual rainfall is about 32 inches. The winters are severe, the snowfall being heavy and remaining on the ground for long periods, and the streams being ice covered from three to four months.

Probably all the first-class timber has been cut from this area, and that being cut at the present time is the smaller and less valuable timber that was left. The condition of the forests, so far as effect on run-off is concerned, does not differ greatly from their original condition, as the region is not thickly settled and a second growth soon springs up.

The feasibility of storage has not been fully investigated, but lakes and swamps are numerous and must afford many excellent reservoir sites. At the present time lumbermen store water for running logs, and the enlargement of many of the logging dams would undoubtedly give good-sized reservoirs.

Some excellent water-power sites have been developed on the main stream and tributaries, but many others, some of which have hardly been seen except by the lumbermen, are awaiting utilization. With opportunities for storage with which to produce a uniform and increased low-water flow, and with the favorable arrangement of its drainage basin, this river will in time be one of the biggest power producers in this section.

The river is still used for running logs, and the lumbermen's dams for holding water for flooding modify the normal flow of the stream considerably. Dams on the stream for power development should be so built as not to interfere with the use of water for log running.

Iron is mined at many places in the upper two-thirds of the basin and the section is fairly well covered with railroads.

MENOMINEE RIVER NEAR IRON MOUNTAIN, MICH.

This station, which is located at the Homestead highway bridge across Menominee River, about 3½ miles south of Iron Mountain, Mich., was established September 4, 1902, discontinued March 31, 1909, and reestablished June 5, 1909.

Pine River is tributary to the Menominee about 5 miles above the station.

The gage was formerly located on the right abutment of the bridge, from which all measurements are made, but on November 18, 1904, a chain gage was attached to the bridge in order to obtain gage readings during the winter months, as ice formed at the gage on the abutment.

The winters are severe in this locality, but as the current is swift the river is rarely entirely closed at this section. As is shown by the discharge measurements, however, there is backwater from ice below the station.

The stream is used extensively for logging and is subject to artificial control at times. Log jams often occur below the station and produce backwater at the gage. Except as above stated the station is an excellent one.

The gage reader's salary during 1910 was paid by the Penn Iron Mining Co., Vulcan, Mich., and the Oliver Iron Mining Co., Iron Mountain, Mich.

Discharge measurements of Menominee River near Iron Mountain, Mich., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 15	V. H. Reineking	200	727	0.82	971
Oct. 3	do	200	830	1.30	1,220
6	do	208	1,260	3.45	2,560
7	do	190	1,020	2.40	1,950

Daily gage height, in feet, of Menominee River near Iron Mountain, Mich., for 1910.

[A. J. St. Arnauld, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.4	1.7	5.7	6.0	3.1	4.0	1.1	2.1	0.9	1.6	0.8
2	2.5	2.4	1.7	6.2	6.0	3.6	0.9	1.1	1.0	0.9	1.5	0.8
3	2.7	2.4	1.7	6.0	6.2	3.6	3.4	1.1	2.0	1.3	1.5	0.8
4	2.7	2.4	1.7	5.7	4.3	3.5	1.0	2.5	2.0	3.4	1.4	0.8
5	2.6	2.5	1.7	5.7	4.3	4.9	1.1	1.8	1.4	3.7	1.3	0.8
6	2.6	2.4	1.7	4.4	4.3	4.5	0.9	1.5	1.0	4.4	1.2	0.8
7	2.6	2.4	1.7	5.5	4.2	3.2	0.9	1.2	2.8	2.4	1.2	0.8
8	2.6	2.4	1.7	6.4	3.8	3.0	0.6	1.2	1.0	2.4	1.2	0.8
9	2.8	2.3	1.9	5.5	3.4	3.9	0.8	1.0	1.8	2.0	1.1	0.8
10	2.8	2.3	2.3	5.8	2.4	1.7	1.0	1.0	1.1	1.5	1.1	0.8
11	3.0	2.3	2.3	5.5	2.9	2.1	1.4	1.0	1.1	1.5	1.1	1.0
12	3.0	2.3	2.3	4.8	2.5	2.1	1.4	0.9	1.1	1.2	1.1	1.0
13	3.2	2.3	2.3	4.1	2.6	1.7	1.0	0.8	1.8	1.0	1.1	1.0
14	3.3	2.3	2.3	3.3	2.6	1.5	1.6	0.8	1.1	1.0	1.1	......
15	3.3	2.0	2.6	4.0	2.6	1.5	1.4	0.8	0.95	1.0	1.1	......
16	3.3	2.0	2.9	4.1	2.6	1.6	1.4	0.8	0.8	1.1	1.0	......
17	3.0	2.0	2.9	4.1	2.9	1.7	1.0	0.8	1.1	1.1	1.0	......
18	3.0	2.0	3.1	4.1	2.9	1.7	1.0	0.8	0.9	1.1	1.0	1.6
19	2.8	2.0	3.1	4.8	2.6	3.0	1.0	0.8	1.5	1.1	1.0	......
20	2.6	2.0	3.7	5.6	5.0	3.2	0.6	0.8	1.1	1.1	1.0	......
21	2.6	1.8	4.9	3.3	4.4	0.8	0.6	......	0.8	1.1	1.0	......
22	2.6	1.8	6.7	3.3	7.5	0.8	0.6	......	0.8	1.6	1.0	......
23	2.6	1.8	4.7	3.3	3.3	1.9	0.6	......	1.0	1.9	1.0	......
24	2.6	1.8	5.4	3.3	4.5	0.9	1.0	......	0.9	1.9	0.9	......
25	2.4	1.8	6.2	4.4	2.8	0.9	1.4	......	0.8	1.8	0.9	......
26	2.4	1.7	6.2	4.8	2.9	0.7	1.8	......	0.9	1.7	0.9	1.6
27	2.4	1.7	6.2	5.3	3.1	0.7	2.0	......	1.1	1.7	0.9	......
28	2.4	1.7	6.2	6.0	3.0	3.6	1.8	......	1.2	1.6	0.9	......
29	2.4	......	5.7	5.5	6.4	0.8	1.6	......	1.1	1.6	0.9	......
30	2.4	......	5.4	6.0	7.4	3.4	1.6	......	1.5	1.6	0.8	......
31	2.4	......	5.5	......	4.1	......	1.4	......	......	1.6	......	......

NOTE.—River open at gage during winter months but relations between gage height and discharge was affected by ice below the station Jan. 1 to about Mar. 20, and about Dec. 10 to 31.
No information available regarding backwater from log jams.

Daily discharge, in second-feet, of Menominee River near Iron Mountain, Mich., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4,400	4,680	2,290	2,960	1,080	1,620	985	1,340	940
2		4,870	4,680	2,660	985	1,080	1,030	985	1,280	940
3		4,680	4,870	2,660	2,510	1,080	1,560	1,180	1,280	940
4		4,400	3,180	2,580	1,030	1,880	1,560	2,510	1,220	940
5		4,400	3,180	3,660	1,080	1,440	1,220	2,740	1,180	940
6		3,260	3,180	3,340	985	1,280	1,030	3,260	,120	940
7		4,200	3,110	2,360	985	1,120	2,080	1,820	1,120	940
8		5,060	2,810	2,220	860	1,120	1,030	1,820	1,120	940
9		4,200	2,510	2,880	940	1,030	1,440	1,560	1,080	940
10		4,490	1,820	1,390	1,030	1,030	1,080	1,280	1,080	940
11		4,200	2,150	1,620	1,220	1,030	1,080	1,280	1,080	
12		3,580	1,880	1,620	1,220	985	1,080	1,120	1,080	
13		3,040	1,940	1,390	1,030	940	1,440	1,030	1,080	
14		2,440	1,940	1,280	1,340	940	1,080	1,030	1,080	
15		2,960	1,940	1,280	1,220	940	1,010	1,030	1,080	
16		3,040	1,940	1,340	1,220	940	940	1,080	1,030	
17		3,040	2,150	1,390	1,030	940	1,080	1,080	1,030	
18		3,040	2,150	1,390	1,030	940	985	1,080	1,030	
19		3,580	1,940	2,220	1,030	940	1,280	1,080	1,030	
20		4,300	3,750	2,360	860	940	1,080	1,080	1,030	
21	3,660	2,440	3,260	940	860		940	1,080	1,030	
22	5,360	2,440	6,180	940	860		940	1,340	1,030	
23	3,500	2,440	2,440	1,500	860		1,030	1,500	1,030	
24	4,110	2,440	3,340	985	1,030		985	1,500	985	
25	4,870	3,260	2,080	985	1,220		940	1,440	985	
26	4,870	3,580	2,150	900	1,440		985	1,390	985	
27	4,870	4,020	2,290	900	1,560		1,080	1,390	985	
28	4,870	4,680	2,220	2,660	1,440		1,120	1,340	985	
29	4,400	4,200	5,060	940	1,340		1,080	1,340	985	
30	4,110	4,680	6,080	2,510	1,340		1,280	1,340	940	
31	4,200		3,040		1,220			1,340		

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

Monthly discharge of Menominee River near Iron Mountain, Mich., for 1910.

[Drainage area, 2,420 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January			1,000	0.413	0.48	D.
February			800	.331	.37	D.
March	5,360		2,260	.934	1.08	C.
April	5,060	2,440	3,710	1.53	1.71	B.
May	6,180	1,820	3,030	1.25	1.44	B.
June	3,660	900	1,840	.760	.85	B.
July	2,960	860	1,220	.504	.58	B.
August	1,880	940	1,410	.583	.67	B.
September	2,080	940	1,170	.483	.54	A.
October	3,260	985	1,420	.587	.68	A.
November	1,340	940	1,080	.446	.50	A.
December			850	.351	.40	C.
The year	6,180		1,650	.682	9.30	

NOTE.—Average discharge Aug. 21-31 estimated 2,000 second-feet.

Discharge for the period during which ice existed estimated by means of climatologic records and comparison with Escanaba River.

Mean discharge Mar. 1-20 estimated 1,060 second-feet. Mean discharge Dec. 11-31 estimated 807 second-feet.

WOLF RIVER BASIN.

GENERAL FEATURES.

Wolf River rises in a number of small lakes in the western part of Forest County, in northeastern Wisconsin, flows southward and unites with upper Fox River at a point about 10 miles west of Lake Winnebago. Though nominally a branch of Fox River it is really the master stream, as its discharge is more than three times that of the Fox. It is about 180 miles long and its drainage area comprises about 3,600 square miles. All the largest tributaries are from the west, the more important ones (beginning at the source) being West Wolf, Red, Embarrass, Little Wolf, and Waupaca rivers.

The basin is about 110 miles long and 35 miles in average width. In the upper half of its course the river flows over crystalline rocks and descends very rapidly. At the Chicago & Northwestern Railway crossing, 2 miles west of Lenox, the elevation of the river is 1,560 feet; in the 80 miles between this point and Shawano the river descends, in many rapids and falls, about 770 feet, or nearly 10 feet to the mile. Shawano marks the point of transition from ancient crystalline rocks to sandstones, and here the river also crosses the old coast line of Lake Michigan and enters the region of red clay. Below Shawano, which is the head of navigation, the stream is sluggish, its descent being only 42 feet to Lake Winnebago, a distance of 80 miles. The banks are low, and in high water the adjoining flats are covered with water for several miles from the river.

Lumbering has been carried on very extensively in this area, and all the best timber has been cut off. At present time the run of logs is small, and a great part of the timber is used for making paper pulp. Above Shawano the drainage basin is thinly settled, and the condition of the forests, so far as it affects the run-off of the river, shows little change from original conditions, as a second growth has sprung up after the operations of the lumbermen.

The mean annual rainfall in this part of Wisconsin is about 32 inches. The winters are severe. Snowfall is comparatively heavy and lasts for considerable periods. Ice forms on the river from 1 to 2 feet in thickness and remains for about three months.

The feasibility of storage has not been investigated, but the lakes and swamps in the basin must afford opportunities for making reservoirs. The lumbermen have built many dams for holding water for flooding logs, and by increasing the height of these dams large reservoirs could undoubtedly be created.

Excellent sites for water power exist and their development awaits only a demand for power. A few power plants have already been put in operation.

LITTLE WOLF RIVER NEAR NORTHPORT, WIS.[1]

This station, which is located at the highway bridge known as Phillips bridge, about 3 miles southwest of Northport, Wis., in the southeastern part of sec. 8, T. 22 N., R. 14 E., about 3 miles from Wolf River, was established October 13, 1907, and discontinued December 31, 1910. The station was established and maintained by D. W. Mead, who furnished the records.

The drainage area above the section is about 460 square miles.

The stream is covered with ice 1 to 2 feet thick for about three months each year.

A staff gage is attached to the right abutment of the bridge, from which discharge measurements are made. So far as known. the datum of the gage has remained unchanged.

Daily gage height, in feet, of Little Wolf River near Northport, Wis., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	2.6	2.7	2.2	3.7	1.8	1.3	1.2	1.6	1.6	1.4	1.5
2	2.4	2.6	2.7	2.3	3.6	1.5	1.3	1.2	1.6	1.6	1.4	1.9
3	2.5	2.6	2.7	2.2	3.5	1.4	1.2	1.2	1.6	1.4	1.4	1.8
4	2.5	2.5	2.8	1.9	3.3	1.5	1.2	1.1	1.6	1.6	1.3	1.9
5	2.5	2.6	2.8	2.0	3.3	1.5	1.2	1.1	1.6	1.7	1.3	1.8
6	2.5	2.6	3.0	2.3	3.2	1.8	1.2	1.1	1.7	1.7	1.5	1.9
7	2.5	2.6	2.7	2.4	2.8	1.8	1.3	1.2	1.8	1.5	1.3	1.8
8	2.5	2.5	3.3	2.8	2.8	1.9	1.2	1.1	1.7	1.4	1.4	2.0
9	2.5	2.6	3.2	2.5	2.5	1.5	1.2	1.1	1.7	1.4	1.3	1.9
10	2.5	2.6	3.3	2.6	2.3	1.6	1.2	1.2	1.6	1.3	1.4	1.9
11	2.6	2.5	3.0	2.4	1.8	1.5	1.1	1.2	1.5	1.3	1.5	1.8
12	2.6	2.5	3.0	2.2	1.6	1.5	1.2	1.1	1.7	1.2	1.5	1.8
13	2.5	2.6	4.8	1.8	1.6	1.5	1.2	1.2	2.0	1.2	1.5	1.9
14	2.6	2.6	4.7	2.4	1.5	1.5	1.2	1.2	2.4	1.2	1.4	1.8
15	2.6	2.7	4.7	1.8	1.5	1.4	1.2	1.3	2.6	1.3	1.3	1.8
16	......	2.6	4.8	2.0	1.5	1.4	1.2	1.3	1.8	1.4	1.6	1.7
17	......	2.6	4.7	1.9	1.6	1.4	1.2	1.3	1.7	1.4	1.4	1.7
18	......	2.5	4.5	2.1	1.8	1.4	1.2	1.2	1.7	1.3	1.1	1.7
19	......	2.5	4.2	2.2	1.8	1.4	1.1	1.3	1.7	1.3	1.2	1.7
20	......	2.7	3.5	2.5	2.0	1.4	1.1	1.2	1.6	1.2	1.5	1.7
21	......	2.6	3.4	2.5	1.9	1.3	1.1	1.2	1.5	1.2	1.3	1.7
22	......	2.6	3.2	2.4	1.6	1.3	1.2	1.2	1.5	1.5	1.5	1.7
23	2.7	2.6	3.0	2.6	1.7	1.3	1.1	1.4	1.5	1.6	1.3	1.8
24	2.6	2.6	3.2	3.7	1.9	1.3	1.3	1.6	1.6	1.4	1.3	1.8
25	2.6	2.6	3.2	4.4	1.7	1.3	1.3	1.5	1.6	1.3	1.5	1.7
26	2.6	2.7	3.1	4.7	1.7	1.3	1.1	1.4	1.7	1.2	1.4	1.7
27	2.6	3.0	2.8	4.8	1.6	1.3	1.2	1.5	1.9	1.2	1.3	1.8
28	2.9	2.5	2.7	4.5	1.5	1.2	1.2	1.5	2.1	1.3	1.4	1.9
29	2.7	......	2.6	4.2	1.7	1.2	1.3	1.4	1.6	1.2	1.4	1.9
30	2.5	......	2.6	4.2	1.7	1.3	1.2	1.6	1.7	1.2	1.2	1.9
31	2.7	......	2.5	......	1.6	......	1.2	1.7	......	1.3	......	1.9

NOTE.—Relation of gage height to discharge probably affected by ice during January, February, March, and December.

GRAND RIVER BASIN.

GENERAL FEATURES.

Grand River rises in the southern part of Jackson County, in the southeast-central part of Michigan, flows northward to Lansing, thence northwestward to the central part of Ionia County, and

[1] Information in regard to this stream is contained in Bull. Wisconsin Geol. and Nat. Hist. Survey No. 20, entitled "The water powers of Wisconsin," by Leonard S. Smith.

finally westward to Grand Haven, Mich., where it enters Lake Michigan. Its length by general course is about 200 miles, but following the numerous bends the distance is at least 300 miles. The principal tributaries, beginning at the source, are: From the right, Portage, Red Cedar, Lookingglass, Maple, Flat, and Rogue rivers; from the left there is only one of any importance, Thornapple River. The total drainage area is about 5,570 square miles, which makes it the largest stream in Michigan.

The drainage basin is fairly regular in outline. It lies at the southern border of the pine belt and is for the most part cleared and is now thickly settled, having become a rich agricultural region. The area is overlain with glacial drift with outcroppings of rock at rare intervals. At Grand Rapids, which is the head of navigation, the stream passes over a limestone ledge, making a considerable fall at Grand Ledge. About 12 miles west of Lansing there is a similar descent over sandstone. Below Grand Rapids the flow is very sluggish. In the upper half of this stretch the banks of the river are locally high, forming natural levees; below Lamont bayous and swamps are common between the river banks and the foothills bordering the valley. The valley of the river proper is narrow; gravel bluffs from 50 to 60 feet high stand close to the stream in some places. The northwestern and southeastern portions of the basin are thickly interspersed with small lakes, a number of which have no surface outlet.

The elevation of the sources of the river is about 1,000 feet; at Lansing the elevation is about 820 feet; at Grand Rapids it is about 590 feet; at the mouth of the river the elevation is 581 feet; the total descent is therefore about 400 feet, which produces a rather low average fall.

The basin contains no noteworthy forested areas, all timber having been cut off some years ago.

The mean annual rainfall is 30 to 35 inches. The winters are comparatively mild. In general the snowfall is not heavy and ice does not form very thick.

Storage sites have not been investigated, but it is thought that some of the lakes and swamps might be converted into good-sized reservoirs by means of dams of ordinary height.

The stream is of considerable value for water power, and some sites are still undeveloped. At the present time about 5,000 horsepower is developed at the larger plants on the main stream and tributaries.

GRAND RIVER AT GRAND RAPIDS, MICH.

This station, which is located at the Fulton Street Bridge in Grand Rapids, Mich., was established March 12, 1901.

The drainage area above the station is about 4,900 square miles.

In November, 1907, a new staff gage, with zero corresponding to the city datum, was attached to the bridge, from which discharge measurements are made. Readings taken on this gage were first reported in December, 1907. The zero of the gage in use prior to November, 1907, was 0.55 foot below the city datum. All gage readings, however, have been corrected to the city datum, and all published gage heights are therefore referred to the same datum.

Ice forms in winter and changes the relation between gage heights and discharge. The operation of power plants above the section modifies the low-water flow.

The two or three measurements that have been taken at this station since 1905 indicate that the 1905 discharge table does not hold after that year; therefore estimates for the flow for later years have not been made. This station was last inspected October 21, 1908.

The records are furnished by the city engineer of Grand Rapids.

Daily gage height, in feet, of Grand River at Grand Rapids, Mich., for 1910.

[F. F. Smith, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	1.85	2.02	0.50	......	1.05	—0.65	—0.80	—0.68	—0.50	—0.45	—0.58
2	......	1.85	3.30	.50	3.35	1.12	— .70	— .80	— .72	......	— .45	— .58
3	3.00	1.75	4.85	......	4.40	1.30	......	— .80	— .78	— .52	— .40	— .58
4	3.00	1.65	6.05	.25	5.58	1.55	......	— .80	......	— .28	— .38	......
5	3.00	1.60	7.50	.30	5.95	......	— .80	— .88	......	.00	— .38	— .58
6	3.05	......	10.83	.20	6.00	1.85	— .85	— .90	— .75	— .05	......	— .58
7	3.00	1.65	11.78	.30	5.85	2.35	— .85	......	— .70	— .05	— .40	— .58
8	2.90	1.65	12.42	.30	......	2.15	— .88	— .80	— .60	— .1	— .38	— .58
9	......	1.70	12.28	.40	4.40	1.82	— .80	— .90	— .70	......	— .38	— .58
10	2.50	2.00	11.48	......	3.60	1.55	......	— .85	— .68	— .05	— .42	— .58
11	2.45	1.65	10.48	.15	2.85	1.15	— .70	—1.00	......	— .22	— .58	......
12	2.55	1.30	9.32	.05	2.60	......	— .65	— .80	— .60	— .32	— .55	— .58
13	2.40	......	......	— .15	1.82	.70	— .65	— .90	— .48	— .42	......	— .55
14	2.55	1.20	8.32	— .20	1.22	.45	— .70	......	— .40	— .50	— .58	— .55
15	2.60	.95	6.45	— .30	......	.10	— .70	— .90	— .40	— .65	— .58	— .55
16	......	.95	5.45	— .35	.72	.15	— .80	— .95	— .40	......	— .58	— .55
17	2.45	1.00	4.75	......	.75	— .05	......	— .90	— .42	— .58	— .58	— .55
18	2.30	1.15	4.20	.25	.80	— .05	— .75	— .90	......	— .45	— .58	......
19	2.35	1.28	3.55	.88	.68	......	— .85	— .90	— .45	— .48	— .58	— .55
20	2.22	......	......	.80	.50	— .15	— .85	— .85	— .50	— .45	......	— .55
21	2.05	1.42	3.40	.55	.50	— .22	— .85	......	— .55	— .40	— .52	— .55
22	2.18	......	3.55	.45	......	— .45	— .85	— .90	— .50	— .38	— .60	— .55
23	......	1.58	2.85	.50	2.22	— .55	— .88	— .52	— .45	......	— .58	— .55
24	2.25	1.40	2.60	......	3.58	— .50	......	— .50	— .55	— .35	......	— .55
25	2.65	1.50	2.30	.25	3.72	— .55	— .65	— .55	......	— .30	— .55	......
26	2.60	1.60	1.95	1.15	3.35	......	— .65	— .55	— .45	— .32	— .58	......
27	2.60	......	......	2.22	2.75	— .50	— .70	— .55	— .52	— .45	......	— .62
28	2.55	1.90	1.25	2.70	2.20	— .60	— .60	......	— .52	— .45	— .58	— .68
29	2.30	......	1.60	3.28	......	— .60	— .60	— .60	— .50	— .40	— .58	— .72
30	......	......	1.30	3.60	......	— .65	— .70	— .60	— .48	......	— .55	— .72
31	2.05	......	.75	......	1.15	......	......	— .62	......	— .45	......	— .72

MANISTEE RIVER BASIN.

GENERAL FEATURES.

Manistee River rises in several lakes along the boundary line between Antrim and Otsego counties in the north-central part of Michigan, flows southwestward across Kalkaska, Wexford, and Manistee counties, and empties into Lake Michigan at Manistee, Mich. It has but two important tributaries, both of which enter in the lower part of the river—Big Bear on the right and the South Branch of the Manistee on the left. The length of the river is about 110 miles, not taking into account the numerous bends and angles; but following its windings its total length must be about 200 miles, for it is very crooked. The drainage area comprises about 2,120 square miles.

The soil of the area is sandy, and the stream derives a large part of its supply from springs along the banks of the main river and its tributaries. The country is flat or rolling. The elevation of the sources of the river is about 1,200 feet and the elevation of the mouth is 581 feet, a total fall of 620 feet.

Practically all the better timber has been cut from this area, although lumbering is still carried on to some extent.

The mean annual rainfall is about 35 inches. The winters are not severe. There is a fairly heavy fall of snow, and ice forms on the river about 1 foot in thickness during severe cold spells. The large amount of spring water helps to keep the river open.

Storage problems have not been studied, but as the basin contains many lakes it must afford conditions for creating reservoirs to conserve and regulate the flow.

The opportunities for water power have not been fully investigated. Good sites, however, must be available at various places, as the fall of the river is considerable and the flow is well sustained during dry spells by the numerous springs.

The stream is used considerably for logging, but the lumber interests are becoming less every year.

MANISTEE RIVER NEAR SHERMAN, MICH.

This station, which is located at North Bridge, about 1 mile from Sherman, Mich., was established July 10, 1903.

Wheeler Creek enters immediately below the station.

The river freezes over in winter, making necessary special studies to determine the winter flow. The constancy of flow of this stream, as shown in the following tables, is remarkable and is due to springs and ground-water flow. The maximum recorded mean flow for any month from 1903 to 1910 is only 2½ times the minimum recorded mean flow. It has consequently been possible to make fairly close estimates of the discharge for the periods during which ice was present by taking advantage of these facts and by utilizing climatologic data.

The stream is used for logging, and at times sunken logs in the bed of the stream may affect the gage heights.

The chain gage is attached to the bridge, from which all discharge measurements are made. The datum of the gage has remained unchanged.

The records are reliable and accurate prior to the last inspection by the Survey, October 23, 1908, except as conditions noted above may affect the gage readings. The chain length was found to be correct March 1, 1910, and a measurement made in 1911 indicates that the datum of the gage and the relation of gage height to discharge have remained unchanged. Conditions of flow are believed to be permanent.

The gage reader's salary has been paid for 1910 by William G. Fargo, Jackson, Mich.

Daily gage height, in feet, of Manistee River near Sherman, Mich., for 1910.

[F. G. Bullock, observer.]

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.40	2.10	2.20	3.60	3.00	2.45	2.10	1.85	2.30	2.05	2.71	2.60
2	2.40	2.10	2.20	3.45	2.85	2.45	2.10	1.82	2.30	1.98	3.05	2.57
3	2.45	2.05	2.22	3.25	2.70	2.45	2.00	1.85	2.20	2.00	3.05	2.50
4	2.45	2.05	2.30	3.20	2.60	2.45	1.90	1.90	2.10	2.10	2.92	2.49
5	2.45	2.00	2.30	3.15	2.60	2.45	1.80	1.85	2.10	2.10	2.82	2.42
6	2.45	1.95	2.40	3.15	2.50	2.45	1.80	1.80	2.02	2.10	2.72	2.37
7	2.45	2.00	2.80	3.20	2.40	2.45	1.85	1.78	1.95	2.10	2.62	2.29
8	2.45	2.10	2.80	3.15	2.40	2.40	1.90	1.75	1.95	2.10	2.60	2.29
9	2.40	2.10	2.70	3.05	2.35	2.30	1.90	1.75	2.10	2.10	2.60	2.24
10	2.45	2.20	2.80	3.05	2.30	2.30	2.28	1.75	2.10	2.10	2.65	2.19
11	2.40	2.20	2.80	2.95	2.30	2.30	2.35	1.75	2.12	2.10	2.68	2.20
12	2.40	2.20	2.70	2.82	2.25	2.30	2.30	1.75	2.32	2.10	2.80	2.36
13	2.40	2.10	2.55	2.75	2.20	2.20	2.22	1.75	2.48	2.10	2.80	2.35
14	2.40	2.10	2.60	2.60	2.20	2.20	2.20	1.75	2.50	2.10	2.74	2.20
15	2.40	2.10	2.60	2.52	2.20	2.10	2.10	1.75	2.50	2.10	2.69	2.20
16	2.30	2.00	2.52	2.52	2.20	2.10	2.00	1.92	2.45	2.02	2.66	2.21
17	2.30	2.00	2.60	2.50	2.25	2.05	1.90	2.05	2.45	2.00	2.58	2.20
18	2.30	1.92	2.70	2.50	2.30	2.00	1.85	2.10	2.38	2.00	2.48	2.20
19	2.25	1.90	2.70	2.42	2.30	2.00	1.85	2.10	2.20	1.98	2.38	2.20
20	2.20	2.00	3.25	2.40	2.30	2.00	1.85	2.00	2.15	1.98	2.30	2.20
21	2.20	1.98	3.60	2.40	2.35	2.00	1.82	2.00	2.15	2.04	2.30	2.20
22	2.20	1.95	4.10	2.35	2.35	2.00	1.80	1.90	2.15	2.10	2.30	2.14
23	2.20	1.95	4.35	2.35	2.42	2.00	1.80	2.25	2.15	2.10	2.38	2.18
24	2.20	1.90	4.32	2.35	2.52	2.00	2.12	2.40	2.15	2.10	2.52	2.30
25	2.20	2.00	4.40	2.45	2.50	2.00	2.18	2.35	2.15	2.10	2.56	2.18
26	2.20	2.00	4.40	2.82	2.48	2.00	2.00	2.50	2.15	2.09	2.60	2.10
27	2.20	2.10	4.30	3.15	2.45	2.00	2.00	2.55	2.15	2.32	2.60	2.10
28	2.30	2.10	4.30	3.20	2.45	2.00	2.00	2.55	2.12	2.55	2.60	2.18
29	2.20	......	4.15	3.20	2.50	2.00	1.90	2.48	2.10	2.70	2.62	2.20
30	2.10	......	4.10	3.10	2.50	2.05	1.90	2.40	2.05	2.70	2.61	2.26
31	2.10	......	3.90	......	2.50	......	1.85	2.40	......	2.70	......	2.22

NOTE.—No information regarding ice, but the gage heights were apparently affected little if any by the presence of ice during the winter months.

Daily discharge, in second-feet, of Manistee River near Sherman, Mich., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,020	917	952	1,500	1,250	1,040	917	834	987	900	1,140	1,100
2	1,020	917	952	1,440	1,190	1,040	917	825	987	876	1,270	1,090
3	1,040	900	959	1,360	1,140	1,040	883	834	952	883	1,270	1,060
4	1,040	900	987	1,330	1,100	1,040	850	850	917	917	1,220	1,060
5	1,040	883	987	1,310	1,100	1,040	819	834	917	917	1,180	1,030
6	1,040	866	1,020	1,310	1,060	1,040	819	819	890	917	1,140	1,010
7	1,040	883	1,170	1,330	1,020	1,040	834	813	866	917	1,100	984
8	1,040	917	1,170	1,310	1,020	1,020	850	804	866	917	1,100	984
9	1,020	917	1,140	1,270	1,000	987	850	804	917	917	1,100	966
10	1,040	952	1,170	1,270	987	987	980	804	917	917	1,120	948
11	1,020	952	1,170	1,230	987	987	1,000	804	924	917	1,130	952
12	1,020	952	1,140	1,180	970	987	987	804	994	917	1,170	1,010
13	1,020	917	1,080	1,150	952	952	959	804	1,050	917	1,170	1,000
14	1,020	917	1,100	1,100	952	952	952	804	1,060	917	1,150	952
15	1,020	917	1,100	1,070	952	917	917	804	1,060	917	1,130	952
16	987	883	1,070	1,070	952	917	883	857	1,040	890	1,120	956
17	987	883	1,100	1,060	970	900	850	900	1,040	883	1,090	952
18	987	857	1,140	1,060	987	883	834	917	1,020	883	1,050	952
19	970	850	1,140	1,030	987	883	834	917	952	876	1,020	952
20	952	883	1,360	1,020	987	883	834	883	934	876	987	952
21	952	876	1,500	1,020	1,000	883	825	883	934	897	987	952
22	952	866	1,730	1,000	1,000	883	819	850	934	917	987	931
23	952	866	1,840	1,000	1,030	883	819	970	934	917	1,020	945
24	952	850	1,830	1,000	1,070	883	924	1,020	934	917	1,070	987
25	952	883	1,870	1,040	1,060	883	945	1,000	934	917	1,080	945
26	952	883	1,870	1,180	1,050	883	883	1,060	934	914	1,100	917
27	952	917	1,820	1,310	1,040	883	883	1,080	934	994	1,100	917
28	987	917	1,820	1,330	1,040	883	883	1,080	924	1,080	1,100	945
29	952	......	1,750	1,330	1,060	883	850	1,050	917	1,140	1,100	952
30	917	......	1,730	1,290	1,060	900	850	1,020	900	1,140	1,100	973
31	917	......	1,640	......	1,060	......	834	1,020	......	1,140	......	959

NOTE.—Daily discharge determined from a discharge rating curve well defined below 1,700 second-feet.

Monthly discharge of Manistee River near Sherman, Mich., for 1910.

[Drainage area, 900 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,040	917	992	1.10	1.27	B.
February	952	850	901	1.00	1.04	B.
March	1,870	952	1,330	1.48	1.71	B.
April	1,500	1,000	1,200	1.33	1.48	A.
May	1,250	952	1,030	1.14	1.31	A.
June	1,040	883	946	1.05	1.17	A.
July	1,000	819	880	.978	1.13	A.
August	1,080	804	895	.994	1.15	A.
September	1,060	866	952	1.06	1.18	A.
October	1,140	876	937	1.04	1.20	A.
November	1,270	987	1,110	1.23	1.37	A.
December	1,100	917	977	1.09	1.26	B.
The year	1,870	804	1,010	1.12	15.27	

NOTE.—Accuracy for January, February, March, and December reduced on account of the possibility of ice effect.

BASINS TRIBUTARY TO LAKE HURON.

AU SABLE RIVER BASIN.

GENERAL FEATURES.

The drainage basin of Au Sable River lies in the northeastern part of Michigan. The river rises in the heart of the plateau region in the central part of northern Michigan, in the southern part of Otsego County, flows southward along the western side of Crawford County to Grayling, then turns and flows eastward across Crawford and Oscoda counties, thence southeastward, and enters Lake Huron at Au Sable. The South Branch and the North Branch are the principal tributaries. The river is about 100 miles long, not following the bends, and its total drainage area comprises about 2,010 square miles.

Along the lower 20 miles of the river the basin is narrow, the average width being about 5 miles, but farther up the width increases to about 30 miles. The area is underlain by shales which have been so deeply covered with glacial drift that rock outcrops are rare. The upper end of the narrow part of the basin is rolling and hilly; the lower part is level and undulating. In its wider part the basin consists chiefly of sand and gravel plains with undrained hollows. The elevation of the sources of the river is about 1,250 feet; at Bamfield, about 40 miles from the mouth, following the river, the elevation is about 850 feet; the elevation at the mouth is 581 feet.

This district was at one time noted for its white pine, but the area is now almost entirely cleared of its valuable native timber and is in great part covered with scrub conifers.

The mean annual rainfall is 30 to 35 inches. It is possible that deforestation has increased the flow of this stream by allowing the rainfall to be entirely absorbed by the sand and gravel soil. The water thus absorbed reappears as springs. The springs, which occur wherever the streams have cut down through the sand and gravel to the underlying clay, help maintain the flow of the stream in dry periods and tend to keep the river open during the winter months, although the winters are severe, snowfall being comparatively heavy and ice of considerable thickness forming on the streams.

The arrangement of this basin is very favorable for water-power developments, as three-fourths of the area lies above the narrow part, in which the sites are found. Along this section the bed of the stream is of firm clay and in many places the river is flanked by high terraced clay cliffs rising 60 to 100 feet above it. Extensive investigations are now being made preparatory to developing the power.

The river is still used for logging, but the run of logs is small.

AU SABLE RIVER AT BAMFIELD, MICH.

This station, which is located at the steel highway bridge at Bamfield, Mich., was established August 27, 1902.

The measuring section formerly used was at a wooden bridge about 400 feet above the new steel bridge from which measurements are now made. The steel bridge was begun in March, 1907, and finished in July, 1907.

The staff gage, which is fastened to a pier of the old bridge, is unchanged, and the section at the gage has not been altered in any way. A slight backwater effect has, however, been caused at the section where the gage is located by changes made in the channel below the gage at the time of the erection of the new steel bridge. The determinations of monthly discharge from March, 1907, to December, 1908, as published in Water-Supply Paper 244, are about 4 per cent or less in excess of their true values according to stage.

It is probable that the river is used for log driving only in the spring of the year, for during the summer and fall the gage heights are fairly uniform. As sunken logs are removed from the river twice each year they have little if any effect on the gage readings.

Winters are severe in this locality. The river generally freezes over, but does not remain closed longer than one or two months. Any increase in gage height during the winter months, unless caused by a thaw, is generally caused by backwater from ice jams formed by anchor ice.

Because of changes in channel, the estimates for 1910 are withheld until more data are available.

Daily gage height, in feet, of Au Sable River at Bamfield, Mich., for 1910.

[Mrs. W. H. Bamfield, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25			2.44	1.88	1.68	0.98	0.90	1.40	1.11	1.47	1.34
2			3.45	2.35	1.83	1.71	.92	.91	0.98	1.10	1.50	1.39
3				2.09	1.79	1.66	.90	.92	0.91	1.20	1.47	1.44
4		3.10		2.05	1.71	1.58	.84	.96	1.08	1.26	1.42	1.41
5			3.22	1.98	1.60	1.52	.89	.86	1.15	1.45	1.39	1.38
6			2.61	2.02	1.50	1.62	.97	.92	1.45	1.54	1.42	1.38
7			1.70	2.05	1.52	1.55	1.00	.99	1.38	1.50	1.48	1.30
8			1.79	2.09	1.42	1.48	1.50	.96	1.46	1.41	1.47	1.36
9		3.70	1.78	2.10	1.40	1.46	1.45	.98	1.30	1.34	1.50	1.41
10			1.80	2.03	1.41	1.35	1.40	.89	1.22	1.22	1.50	1.50
11			1.55	1.96	1.44	1.31	1.80	.98	1.26	1.16	1.39	1.42
12	4.00		2.00	1.94	1.38	1.31	1.30	1.01	1.45	1.18	1.44	1.30
13			2.15	1.80	1.38	1.28	1.06	1.06	1.71	1.14	1.49	1.30
14			2.34	1.75	1.40	1.20	1.11	1.02	1.68	1.10	1.39	1.40
15			2.46	1.70	1.44	1.24	1.19	1.11	1.55	1.10	1.34	1.29
16			2.72	1.73	1.40	1.26	1.32	1.50	1.40	1.05	1.30	1.22
17			2.76	1.83	1.36	1.31	1.19	1.25	1.40	1.02	1.47	1.20
18			2.72	1.88	1.31	1.30	1.05	1.10	1.44	1.03	1.48	1.19
19	3.25	3.80	2.78	1.90	1.44	1.26	1.00	.98	1.40	1.00	1.48	1.11
20			2.72	1.92	1.48	1.31	.98	.94	1.32	1.11	1.44	1.19
21			2.84	1.98	1.44	1.40	.96	1.10	1.41	1.34	1.32	1.12
22			3.44	1.98	1.46	1.29	1.00	1.11	1.33	1.50	1.26	1.10
23		3.35	3.52	1.94	1.56	1.26	1.04	1.04	1.24	1.41	1.24	3.70
24			3.62	1.96	1.76	1.17	1.35	1.00	1.22	1.30	1.20	3.10
25			3.49	1.81	1.85	1.09	1.10	1.10	1.30	1.30	1.24	3.00
26	3.00		3.36	2.00	1.68	1.08	1.65	1.16	1.32	1.54	1.25	2.90
27			3.07	2.00	1.65	1.09	1.35	1.20	1.22	1.66	1.24	3.00
28			2.88	1.96	1.51	1.08	.98	1.25	1.31	1.74	1.29	2.85
29			2.78	1.81	1.41	.98	1.45	1.26	1.35	1.75	1.38	2.61
30			2.61	2.00	1.45	.94	1.05	1.20	1.19	1.61	1.31	2.59
31			2.58		1.52		.96	1.12		1.50		2.60

NOTE.—Gage heights affected by ice Jan. 1 to Mar. 5 and Dec. 6–31. Gage heights during these periods taken to water surface.

BASINS TRIBUTARY TO LAKE ERIE.

HURON RIVER BASIN.

GENERAL FEATURES.

The drainage basin of Huron River lies in the southeastern part of Michigan. The river rises in several small lakes near Pontiac, in Oakland County, flows southwestward until it enters Washtenaw County, and then turns to the southeast and joins Lake Erie near the mouth of Detroit River. Its length, not following the bends of the river, is about 80 miles, and its total drainage area comprises about 1,060 square miles. The only important tributary is Mill Creek, which enters on the right bank at Dexter, Mich. The greatest length of the drainage basin—about 50 miles—parallels Detroit River at a distance of 25 to 30 miles. This basin is connected with Lake Erie by a long narrow valley averaging not more than 5 miles in width, extending from a point near Ypsilanti southeastward to Lake Erie, a distance of 28 miles. In this stretch a large part of the total fall of the river occurs.

The northern part of the catchment area is rolling and its topography is complex. The stream flows through a series of lakes, and north of Dover the basin is largely composed of lakes and surrounding marshes. In the vicinity of Ann Arbor the topography is very rolling. Below Ypsilanti the country is flat.

The elevation of the sources of the river is about 900 feet above sea level; at Portage Lake, where the river turns and flows southeastward, the elevation is 850 feet; at Ypsilanti the elevation is 690 feet; at the mouth of the river it is 573 feet.

There are no forested areas in this section. The mean annual rainfall is about 35 inches. The winters are comparatively mild; the snowfall is not heavy and ice does not form very thick.

Storage problems have not been studied, but the numerous lakes and swamps afford a natural storage and produce a steady flow.

The conditions for water power on this stream are nearly ideal, as almost the entire catchment area is situated above the portion of the river that is best suited for the location of dams. A few sites below Ann Arbor have been developed, and opportunities for further development exist in this stretch of the river.

HURON RIVER AT DEXTER, MICH.

This station, which is located at the highway bridge at Dexter, Mich., was established September 1, 1904.

Mill Creek enters a short distance above the station.

On March 12, 1908, the staff gage which was in use until that time was carried out by the ice; a chain gage was installed March 26, 1908, at the same datum as the staff gage. As the current is swift at the section, little ice forms and the gage heights are only slightly affected thereby. The datum of the gage has remained unchanged. The high water that carried away the gage produced a permanent change in the bed of the river and altered the relation between the gage heights and discharge which existed prior to March 12, 1908.

A small headrace runs to an abandoned mill on the left bank, but at ordinary and low stages there is little or no flow in this canal; at high stages a small amount of water may pass around the gage through this raceway.

The salary of the gage reader at this station is paid by the Washtenaw Light & Power Co., Ann Arbor.

The discharge measurements taken at this station plot very erratically, and any estimates of discharge attempted on the basis of the records which follow should be used with great caution. This station was last inspected October 16, 1909.

Daily gage height, in feet, of Huron River at Dexter, Mich., for 1910.

[Elisha White, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.75	0.55	2.25	0.50	1.45	0.30	-0.30	-0.30	-0.35	-0.20	-0.15	0.05
2	.35	.50	2.60	.45	1.80	.35	- .30	- .32	- .35	- .20	- .15	.05
3	.35	.50	2.60	.40	2.50	.70	- .30	- .35	- .35	- .20	- .10	.05
4	.82	.50	2.60	.35	2.35	.70	- .30	- .35	- .32	- .20	- .10	.00
5	.80	.50	2.70	.35	2.05	.70	- .30	- .35	- .20	- .20	- .10	.00
6	.80	.50	2.80	.35	1.90	.70	- .30	- .35	- .15	- .10	- .10	.00
7	.75	.80	2.80	.35	1.72	.70	- .30	- .35	- .10	- .05	- .10	.00
8	.68	.75	2.78	.35	1.70	.70	- .30	- .35	- .15	- .05	- .10	.00
9	.65	.58	2.65	.35	1.58	.68	- .32	- .35	- .20	- .10	- .10	.05
10	.80	.50	2.50	.35	1.45	.58	- .35	- .35	- .20	- .10	- .10	.05
11	.70	.50	2.40	.30	1.28	.50	- .35	- .35	- .20	- .10	- .05	.22
12	.40	.50	2.22	.30	1.12	.50	- .25	- .35	- .20	- .12	- .05	.20
13	.40	.50	2.15	.22	.98	.45	- .25	- .40	- .22	- .15	- .05	.20
14	.40	.50	1.95	.20	.88	.38	- .30	- .40	- .25	- .15	- .05	.20
15	.32	.45	1.75	.20	.78	.30	- .30	- .40	- .25	- .15	- .05	.20
16	.20	.40	1.55	.15	.68	.25	- .32	- .35	- .25	- .20	- .05	.20
17	.20	.40	1.42	.15	.60	.20	- .35	- .30	- .25	- .20	- .05	.20
18	.45	.60	1.30	.18	.55	.15	- .35	- .30	- .25	- .20	- .05	.20
19	.50	.60	1.20	.25	.48	.10	- .38	- .35	- .25	- .20	- .05	.20
20	.50	.58	1.20	.30	.45	.10	- .40	- .35	- .25	- .20	- .05	.20
21	.50	.50	1.18	.30	.42	.10	- .40	- .35	- .28	- .20	- .10	.30
22	.70	.45	1.10	.30	.40	.00	- .40	- .35	- .30	- .18	- .10	.20
23	.70	.45	1.05	.30	.40	.00	- .40	- .35	- .30	- .15	- .10	.05
24	.65	.50	1.00	.32	.58	- .05	- .35	- .35	- .15	- .15	- .10	.00
25	.62	.50	.92	.55	.50	- .10	- .30	- .35	- .15	- .15	- .05	.25
26	.55	.55	.85	1.08	.48	- .18	- .30	- .30	- .15	- .15	- .05	.30
27	.55	1.35	.78	1.45	.45	- .25	- .30	- .30	- .15	- .15	.05	.28
28	.55	1.80	.70	1.48	.40	- .25	- .30	- .35	- .15	- .15	.10	.15
29	.55	......	.65	1.35	.38	- .28	- .30	- .35	- .15	- .15	.10	.00
30	.55	......	.58	1.30	.30	- .30	- .30	- .35	- .15	- .15	.10	.00
31	.55	......	.50	......	.30	......	- .30	- .35	......	- .15	......	.00

HURON RIVER AT GEDDES, MICH.

This station, which is located at the power plant of the Washtenaw Light & Power Co. at Geddes, Mich., was established February 1, 1904.

Fleming Creek enters from the north about half a mile below the station.

The flow of the river at this point is determined by computing the flow through the turbines by knowing the head-gate opening, rating of the wheels, and the number of hours the turbines are run. The flow over the crest of the dam is determined by considering the dam as a weir, the proper coefficient to be applied being assumed.

The records at this station are furnished by the Washtenaw Light & Power Co., of Ann Arbor, Mich. The computations of the discharge are furnished by Gardner S. Williams.

Daily discharge, in second-feet, of Huron River at Geddes, Mich., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,087	537	887	413				164	160	220
2	1,105	489	1,191	407				146	148	191
3	1,337	239	1,755	618				126	164	208
4	1,378	442	1,417	600				149	150	186
5	1,320	464	1,154	582				161	151	178
6	1,295	508	1,043	632				151	158	202
7	1,220	500	1,382	647				166	130	202
8	1,156	462	1,045	620				197	150	165
9	1,031	496	1,057	550				179	168	176
10	1,038	278	955	548				156	175	164
11	941	440	848	546				215	165	190
12	919	387	796	436				166	208	191
13	852	358	735	440				168	129	180
14	852	344	719	440				229	190	184
15	728	353	682	416				143	168	201
16	647	368	626	406				166	173	160
17	626	356	578	386				141	175	181
18	626	360	561	356				152	151	165
19	636	409	518	264				149	167	173
20	692	385	483	318				148	190	171
21	709	470	478	352				150	164	108
22	639	421	507	307				169	189	180
23	558	476	497	270				172	168	166
24	535	510	511	196				144	178	172
25	535	546	510	195				140	189	185
26	512	761	528	174				151	182	130
27	613	941	468	160				157	208	165
28	569	858	457	116				156	211	177
29	519	813	486	68				155	236	190
30	511	668	390	69				179	226	187
31	506		465					117		179

Monthly discharge of Huron River at Geddes, Mich., for 1910.

[Drainage area, 757 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January			a 468	0.618	0.71
February			a 496	.655	.68
March	1,378	506	829	1.10	1.27
April	941	239	488	.645	.72
May	1,755	390	765	1.01	1.16
June	647	68	384	.507	.57
July			a 123	.162	.19
August			a 106	.140	.16
September			a 152	.201	.22
October	229	117	160	.211	.24
November	236	129	174	.230	.26
December	220	108	178	.235	.27
The year			360	.476	6.45

a Estimated from discharge records at Superior dam, about 1½ miles below Geddes.

HURON RIVER AT FLAT ROCK, MICH.

This station, which is located at the highway bridge at Flat Rock, Mich., about half a mile below the crossing of the Detroit, Toledo & Ironton Railroad, was established August 6, 1904.

No important tributaries enter near the station.

The staff gage is located at the measuring section. The datum of the gage has remained unchanged.

The ordinary flow of the stream is controlled by a dam and power plant immediately above the station, but the operation of this plant is assumed to have but little effect on the diurnal fluctuation of stage. The nearness of the mill prevents the formation of ice in winter at the gaging section, but jams frequently form below the station, causing backwater.

All discharge measurements are made from the bridge.

The salary of the gage reader at this station is paid by the Washtenaw Light & Power Co., Ann Arbor, Mich. This station was last inspected October 16, 1908. The accuracy of the daily and monthly discharges therefore depends on the permanency of conditions of flow and of the elevation of the gage since that date. Conditions of flow are believed to be permanent.

Daily gage height, in feet, of Huron River at Flat Rock, Mich., for 1910.

[C. L. Metler, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.8	3.4	6.4	2.9	4.45	2.45	0.95	0.6	0.55	0.95	0.9	1.35
2	2.65	3.25	7.1	2.8	5.35	2.45	.8	.55	.6	.95	.85	1.25
3	2.55	3.3	7.85	2.5	6.8	2.4	.8	.6	.55	1.0	.95	1.2
4	2.8	3.45	8.5	2.35	7.5	3.35	.8	.65	.9	1.0	.9	1.2
5	2.75	3.3	8.75	2.85	7.1	3.45	.75	.65	.9	1.05	.9	1.2
6	2.55	......	8.4	2.7	6.35	3.4	.9	.7	.65	.95	.9	1.2
7	2.55	3.0	7.7	2.7	6.6	3.5	.8	.7	.75	.95	.9	1.3
8	2.3	2.95	7.45	2.6	5.2	3.3	.65	.75	1.0	.95	1.3	1.15
9	2.4	2.9	7.05	2.55	4.95	3.2	.65	.7	.95	.95	1.05	1.35
10	2.3	2.95	6.75	2.4	4.95	3.0	.7	.7	1.0	.95	.9	1.1
11	2.55	2.85	6.5	2.15	4.65	2.9	.8	.6	.9	1.05	1.1	1.2
12	2.4	2.65	6.25	2.4	4.45	2.85	.55	.7	.9	.85	1.15	1.1
13	2.35	2.55	6.05	2.0	4.15	2.45	.95	.65	.85	.95	.95	1.35
14	2.55	2.5	5.8	1.95	3.85	2.55	.75	.6	.6	.9	1.0	1.15
15	2.55	2.55	5.55	1.9	3.6	2.3	.75	.55	.8	.85	1.05	1.05
16	2.5	3.1	5.2	1.85	3.35	2.15	.75	.7	.75	.95	1.1	1.05
17	2.3	3.2	4.9	1.95	3.4	2.15	.8	1.0	.75	1.0	1.15	1.75
18	2.9	3.1	4.7	1.8	3.1	2.1	.7	.7	.95	1.0	1.05	1.2
19	3.05	2.85	4.35	2.3	2.95	1.75	.7	.65	.8	.9	.95	1.2
20	3.2	2.8	4.3	3.35	2.8	1.25	.75	.7	.85	.95	1.0	1.25
21	3.35	2.8	4.35	2.55	2.8	1.75	.7	.65	.75	.9	1.05	1.25
22	4.35	2.85	4.55	2.85	2.75	1.5	.7	.6	......	1.05	1.0	1.4
23	3.6	2.75	4.3	2.7	2.75	1.35	.7	.65	......	1.0	1.0	1.45
24	3.5	2.75	4.05	2.55	3.2	1.2	.65	.55	.9	1.05	......	1.50
25	3.55	2.75	3.95	2.55	2.95	.95	.6	.6	.95	.95	1.15	1.65
26	3.5	2.6	3.8	3.75	2.95	.9	.5	.5	1.0	.85	1.05	1.85
27	3.6	3.7	3.4	4.6	2.65	.85	.7	.5	1.15	.95	1.15	1.4
28	3.65	5.3	3.3	5.3	2.55	.95	.6	.65	.85	1.0	1.2	1.35
29	3.6	......	3.4	5.05	2.45	1.05	.7	.85	.95	1.05	1.25	1.4
30	3.5	......	3.15	4.6	2.3	.9	.6	.65	.9	.9	1.4	1.3
31	3.45	......	3.1	......	2.35	......	.7	.7	......	.9	......	1.35

NOTE.—Gage heights may have been affected by back water from ice jams at times during January, February, March, and December.

Daily discharge, in second-feet, of Huron River at Flat Rock, Mich., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	668	849	1,870	697	1,190	570	220	157	148	220	211	302
2	625	802	2,120	668	1,500	570	192	148	157	220	202	280
3	597	818	2,420	583	2,010	556	192	157	148	230	220	270
4	668	864	2,680	542	2,280	834	192	166	211	230	211	270
5	655	818	2,780	682	2,120	864	183	166	211	240	211	270
6	597	772	2,640	639	1,850	849	211	174	166	220	211	270
7	597	727	2,360	639	1,940	880	192	174	183	220	211	291
8	529	712	2,260	611	1,450	818	166	183	230	220	291	260
9	556	697	2,100	597	1,360	787	166	174	220	220	240	302
10	529	712	1,990	556	1,360	727	174	174	230	220	211	250
11	597	682	1,900	490	1,260	697	192	157	211	240	250	270
12	556	625	1,820	556	1,190	682	148	174	211	202	260	250
13	542	597	1,750	452	1,090	570	220	166	202	220	220	302
14	597	583	1,660	440	991	597	183	157	157	211	230	260
15	597	597	1,570	427	911	529	183	148	192	202	240	240
16	583	757	1,450	415	834	490	183	174	183	220	250	240
17	529	787	1,340	440	849	490	192	230	183	230	260	391
18	697	757	1,280	403	757	477	174	174	220	230	240	270
19	742	682	1,160	529	712	391	174	166	192	211	220	270
20	787	668	1,140	834	668	280	183	174	202	220	230	280
21	834	668	1,160	597	668	391	174	166	183	211	240	280
22	1,160	682	1,220	682	654	334	174	157	192	240	230	312
23	911	655	1,140	639	654	302	174	166	201	230	230	323
24	880	655	1,060	597	787	270	166	148	211	240	245	334
25	896	655	1,020	597	712	220	157	157	220	220	260	368
26	880	611	975	959	712	211	140	140	230	202	240	415
27	911	943	849	1,240	625	202	174	140	260	220	260	312
28	927	1,480	818	1,480	597	220	157	166	202	230	270	302
29	911	....	849	1,400	570	240	174	202	220	240	280	312
30	880	....	772	1,240	529	211	157	166	211	211	312	291
31	864	....	757	....	542	....	174	174	....	211	....	302

NOTE.—Daily discharge determined from a discharge-rating curve fairly well defined.
Discharge as determined may be too high at times during January, February, March, and December on account of possible ice jams.

Monthly discharge of Huron River at Flat Rock, Mich., for 1910.

[Drainage area, 1,000 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	1,160	529	719	0.719	0.83	D.
February	1,480	583	745	.745	.78	D.
March	2,780	757	1,580	1.58	1.82	C.
April	1,480	403	688	.688	.77	B.
May	2,280	529	1,080	1.08	1.24	B.
June	880	202	509	.509	.57	B.
July	220	140	179	.179	.21	B.
August	230	140	167	.167	.19	B.
September	260	148	200	.200	.22	B.
October	240	202	222	.222	.26	B.
November	312	202	240	.240	.27	B.
December	415	240	293	.293	.34	C.
The year	2,780	140	551	.551	7.50	

NOTE.—Accuracy for January, February, March, and December reduced on account of the possibility of ice effect.

CATTARAUGUS CREEK BASIN.

GENERAL FEATURES.

Cattaraugus Creek rises in the southwestern part of Wyoming County, flows westward, and enters Lake Erie about 25 miles southwest of Buffalo, on the boundary line between Erie and Chautauqua counties. The stream is about 55 miles long and drains an area comprising approximately 560 square miles.[1] Through a large part of its course it forms the boundary between Erie and Chautauqua counties. Its head waters rise at an elevation of between 1,900 to 2,000 feet.

The drainage basin is hilly, fairly well timbered, and rather narrow. There are few tributary streams, those most important entering the river from the south. South branch of Cattaraugus Creek, the largest tributary, enters at a point about 2 miles above Gowanda. There is a dam at Gowanda which is used for developing electric power and also for running a local gristmill and foundry. Formerly there was a dam at Versailles, but it was washed out by a flood a few years ago and at present practically the only power plants on the stream are those at Gowanda.

The average rainfall on the drainage basin is approximately 40 inches.

CATTARAUGUS CREEK AT VERSAILLES, N. Y.

This station, which is located at the highway bridge in the village of Versailles, about 8 miles above the mouth of the stream, 6 miles below Gowanda and 3 miles from Lawton station, on the Erie Railroad, was established September 23, 1910, in cooperation with the New York State Water Supply Commission.

A standard chain gage is attached to the upstream side of the bridge over the right-hand channel. The bridge consists of three spans of 117 feet each.

Discharge measurements are made from the downstream side of the bridge.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission.

Discharge measurements of Cattaraugus Creek at Versailles, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 24	C. C. Covert	118	167	5.02	148
Sept. 23	.....do	130	185	5.00	137

[1] From Fifth Ann. Rept. New York State Water Supply Comm.

Daily gage height, in feet, of Cattaraugus Creek at Versailles, N. Y., for 1910.

[James A. Palmer, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		5.05	6.45	6.45	16		5.08	6.18	5.45
2		4.95	6.55	6.42	17		5.02	6.10	5.60
3		4.90	6.15	6.15	18		5.05	6.02	5.60
4		5.05	5.78	5.95	19		5.02	5.98	5.82
5		5.01	5.60	5.90	20		5.02	5.90	5.80
6		5.20	5.60	5.68	21		5.00	5.82	5.72
7		6.15	5.70	5.70	22		5.62	5.80	5.62
8		5.55	5.72	5.65	23	5.05	5.75	5.85	5.70
9		5.28	5.78	5.60	24	5.01	5.40	6.68	5.72
10		5.22	7.68	5.72	25	5.09	5.48	6.95	5.70
11		5.18	7.32	5.70	26	5.05	5.85	6.55	5.75
12		5.12	6.48	5.64	27	5.05	5.55	6.22	5.70
13		5.08	6.30	5.55	28	5.05	6.38	6.20	5.70
14		5.08	6.25	5.65	29	5.05	6.30	6.68	6.98
15		5.08	6.22	5.60	30	5.05	6.22	6.40	7.30
					31		6.10		6.42

NOTE.—Gage heights probably somewhat affected by ice during the greater part of December. The ice passed out of the creek Dec. 29.

BASINS TRIBUTARY TO LAKE ONTARIO.

GENESEE RIVER BASIN.

GENERAL FEATURES.

Genesee River rises in Potter County, Pa., 8 or 10 miles south of the New York-Pennsylvania boundary, flows northwestward for about 32 miles, then turns to the northeast and discharges into Lake Ontario, 7 miles north of Rochester. Its entire length, following bends, is about 135 miles, and its drainage area comprises about 2,450 square miles.

In the northern portion of this basin the topography is rolling, with long easy slopes except along the streams, most of which flow in deep ravines hemmed in by steep banks. There is a gradual rise in a general way through the lakes, and in the upper half of the basin the country becomes rough and is broken by ridges whose summits attain elevations of 2,000 to 2,500 feet above sea level.

The mean annual precipitation in the Genesee basin is about 34 inches, ranging from 30 inches in the lower part of the basin to 42 inches in the higher altitudes in the southern part. The winters are rather less severe than in the westerly or northerly parts of New York State, although the rivers are generally frozen over for varying periods of time.

The series of remarkable lakes tributary to the Oswego basin is continued westward into the basin of the Genesee and includes Conesus, Hemlock, Canadice, and Honeoye. These lakes serve as natural reservoirs, and their inlets drain considerable areas at their upper ends. The slopes adjacent to the lakes themselves are narrow and steep and are drained by gullies and torrential brooks. Below the lakes the area is rolling and the soil is rich and extensively cultivated. The areas and elevations of these lakes are shown in the following table:

Areas and elevations of lakes in the Genesee River basin.[a]

Lake.	Elevation.	Water-surface area.	Drainage area.
	Feet.	*Sq. miles.*	*Sq. miles.*
Hemlock Lake	896	2.8	46.8
Canadice Lake	1,092	.7	12.6
Honeoye Lake	800	2.5	39.6

[a] These lake basins are shown on the Honeoye, Canandaigua, Naples, and Wayland topographic atlas sheets of the United States Geological Survey, from which the areas have been taken, with the exception of those for Hemlock and Canadice lakes, which are from surveys of Rochester water works.

Other excellent storage sites exist in the Genesee basin, and extensive surveys and studies have been made by the State Water Supply Commission of New York, which has suggested a dam at Portage, furnishing a storage capacity of 18,000,000,000 cubic feet, 11,000,000,000 cubic feet of which will be available for commercial purposes. Such a reservoir would materially help to control the floods upon the Genesee, which under the present conditions periodically cause much damage.

In the 39 miles between Belmont, in central Allegany County, and Portage the river falls 253 feet. At Portage there is a total fall of about 300 feet, made up in three portions, and thence nearly to Mount Morris the river flows at the botton of a deep gorge. From Mount Morris to Rochester the valley is broad and open and the stream is bordered by meadows which are subject to overflow. At Rochester there is another abrupt descent in three heavy falls, amounting to about 360 feet within the city, most of which has been developed.

The State has maintained a dam above Rochester for diverting water to the Erie Canal, and in the basin of Black Creek, one of the upper tributaries of the Genesee from the west, are two reservoirs owned by the State, also used for the benefit of the Erie Canal.

Cuba reservoir, on the Genesee-Allegheny divide, receives a drainage from a tributary area of 26.6 square miles, having a storage volume of 454,000,000 cubic feet. The overflow from this reservoir enters Allegheny River, but the storage water may be turned into the summit of the abandoned Genesee Valley canal and thence into Genesee River.

In the improved barge canal, now under construction, the water supply for this section is to be taken from Lake Erie, and it is probable that no diversion for this purpose will be necessary from the Genesee drainage basin.

GENESEE RIVER AT ST. HELENA, N. Y.

This station, which is located at the steel highway bridge, about 6 miles, by river, below Genesee Lower Falls, 4 miles from Castile, and 5½ miles from Portageville, was established August 14, 1908, in cooperation with the State Water Supply Commission of New York.

The bed of the stream at this point is of coarse gravel with few rocks, and is fairly permanent. There are two channels at low stages and three during high water.

The datum of the chain gage attached to the bridge has remained the same during the maintenance of the station. Two gage readings are made each day.

Discharge measurements are made from the highway bridge or by wading.

There has recently been constructed at this station a concrete well and shelter which contain a self-recording gage. The gage house is located on the downstream side, left-hand end of the bridge. A 4-inch cast-iron water pipe leads to a point in the river channel near the present chain gage. The gage heights here published are taken from the chain gage.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Genesee River at St. Helena, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	C. C. Covert	296	889	4.92	3,380
July 19	W. G. Hoyt	103	203	2.06	226
Aug. 26	C. C. Covert	102	168	1.92	159
Oct. 24[a]	W. G. Hoyt	133	150	2.14	214
Nov. 17	.....do	176	392	3.24	1,010
Dec. 9[b]	.....do	194	298	2.85	645

[a] Measurement made at wading section above bridge.
[b] Measurement made under partial ice cover; considerable slush ice running; no great backwater effect.

Daily gage heights, in feet, of Genesee River at St. Helena, N. Y., for 1910.

[Herman Piper, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.28	2.85	9.27	3.31	4.90	2.85	2.01	1.78	1.85	2.12	2.58	3.55
2	2.25	2.72	8.82	3.14	6.80	2.78	1.88	1.90	2.12	2.02	2.50	3.55
3	2.60	2.95	8.22	2.98	6.65	2.81	1.68	1.88	2.12	1.95	2.45	3.42
4	2.85	2.72	7.22	3.11	6.75	2.71	1.73	1.82	2.15	2.08	2.60	3.38
5	2.68	2.78	6.77	3.08	5.35	2.75	1.95	1.82	2.08	1.98	2.30	3.30
6	2.88	2.65	7.12	2.98	4.72	2.73	1.95	1.78	2.52	2.02	2.20	3.08
7	2.95	2.60	9.42	2.88	4.25	2.73	1.75	1.55	2.85	2.25	2.32	2.98
8	2.92	2.78	6.27	2.78	3.95	2.68	1.75	1.55	2.70	2.38	2.30	2.90
9	2.82	2.75	5.52	2.84	3.78	2.65	1.91	1.80	2.42	2.25	2.32	2.82
10	2.98	2.68	4.85	2.74	3.68	2.61	1.91	1.95	2.28	2.18	3.0	2.82
11	2.88	2.62	4.62	2.71	3.50	2.61	1.91	2.15	2.12	2.15	3.95	2.92
12	2.78	2.45	4.55	2.58	3.35	2.65	1.85	2.02	2.05	2.02	3.48	2.85
13	2.75	4.25	4.82	2.54	3.22	2.55	2.25	1.70	2.15	1.60	3.50	2.68
14	2.72	4.05	4.29	2.48	3.08	2.45	2.83	1.70	2.12	1.75	3.22	2.72
15	2.85	3.92	4.02	2.51	2.98	2.35	2.48	1.90	1.95	2.00	3.32	2.65
16	2.72	3.89	3.92	2.54	2.88	2.51	2.28	1.95	2.08	1.75	3.25	2.58
17	2.75	4.47	3.77	2.64	2.88	2.55	2.25	1.62	1.92	1.95	3.28	2.65
18	3.10	4.07	3.57	3.44	2.78	2.45	2.15	1.72	1.65	1.95	3.15	2.68
19	4.40	3.77	3.75	4.36	2.85	2.41	2.04	2.05	1.92	1.88	3.10	2.78
20	4.25	3.59	5.56	4.76	2.68	2.35	2.45	2.02	1.92	1.95	3.00	2.78
21	4.20	3.62	5.71	4.83	2.75	2.31	1.80	1.70	1.88	2.10	2.92	2.65
22	6.88	3.57	5.18	4.60	2.62	2.28	1.72	1.90	1.82	1.88	2.82	2.48
23	5.45	3.82	5.31	3.90	2.65	2.25	1.72	1.80	1.75	1.82	2.92	2.58
24	4.70	3.52	5.24	6.60	2.88	2.15	1.65	1.88	1.85	2.10	3.00	2.55
25	4.45	6.42	5.31	8.40	2.92	2.03	2.00	1.58	1.95	2.05	4.08	2.60
26	3.80	6.85	4.76	9.30	3.08	2.05	2.02	1.92	1.92	2.18	4.08	2.52
27	3.75	6.69	4.28	6.88	2.95	2.11	1.70	1.65	2.75	2.45	3.65	2.58
28	3.48	7.72	3.98	5.45	2.82	2.01	1.88	1.52	2.48	2.48	3.38	2.62
29	3.25	......	3.81	5.85	2.68	1.98	1.90	1.80	2.35	2.72	3.40	2.78
30	3.12	......	3.46	6.10	2.78	1.95	1.82	1.68	2.25	2.52	4.10	7.80
31	3.02	......	3.44	......	2.95	......	1.65	1.80	......	2.62	......	5.05

NOTE.—Relation of gage height to discharge probably affected by the presence of ice from Jan. 1 to 18, Feb. 5 to 27, and Dec. 10 to 31. Gage heights during these periods were taken to water surface.

Daily discharge, in second-feet, of Genesee River at St. Helena, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	150	672	19,500	1,070	3,390	672	187	121	140	226	470	1,290
2	150	568	17,000	919	8,340	614	148	154	226	191	420	1,290
3	150	756	14,000	783	7,880	638	98	148	226	169	391	1,170
4	150	568	9,730	894	8,180	560	109	132	239	211	482	1,130
5	150	500	8,250	868	4,360	591	169	132	211	178	308	1,060
6	150	450	9,380	783	3,030	575	169	121	432	191	260	868
7	150	450	20,300	698	2,210	575	114	73	672	284	319	783
8	150	400	6,740	614	1,780	538	114	73	552	351	308	715
9	150	400	4,750	664	1,560	517	157	126	374	284	319	647
10	150	400	3,290	583	1,440	489	157	169	298	252	800	600
11	150	350	2,840	560	1,240	489	157	239	226	239	1,780	550
12	150	350	2,710	470	1,100	517	140	191	201	191	1,220	500
13	150	350	3,230	445	988	451	284	102	239	80	1,240	450
14	150	400	2,270	408	868	391	656	102	226	114	988	400
15	150	400	1,870	426	783	335	408	154	169	184	1,080	350
16	150	400	1,740	445	698	426	298	169	211	114	1,020	300
17	150	350	1,540	510	698	451	284	84	160	169	1,040	300
18	150	350	1,310	1,190	614	391	239	107	91	169	928	250
19	2,450	350	1,520	2,390	672	368	198	201	160	148	885	250
20	2,210	400	4,840	3,110	538	335	391	191	160	169	800	200
21	2,130	400	5,220	3,250	591	313	126	102	148	218	732	200
22	8,600	400	3,980	2,800	496	298	107	154	132	148	647	200
23	4,580	350	4,260	1,710	517	284	107	126	114	132	732	200
24	2,990	300	4,110	7,720	698	239	91	148	140	218	800	200
25	2,540	300	4,260	14,900	732	194	184	77	169	201	1,950	200
26	1,580	300	3,110	19,700	868	201	191	160	160	252	1,950	200
27	1,520	2,000	2,260	8,600	758	222	102	91	591	391	1,400	200
28	1,220	11,700	1,810	4,580	647	187	148	69	408	408	1,130	200
29	1,020	....	1,590	5,580	538	178	154	126	335	568	1,150	400
30	902	....	1,200	6,260	614	169	132	98	284	432	1,980	6,000
31	817	....	1,190	....	758	....	91	126	....	496	....	3,000

NOTE.—Daily discharge determined from a well-defined discharge rating curve. Discharge for the periods during which ice was present, Jan. 1 to 18, Feb. 5 to 27, and Dec. 10 to 31, approximately determined from climatological records and the discharge at Rochester.

It should be noted that the determination of the daily discharge for Jan. 1 to 18, Feb. 5 to 27, and Dec. 10 to 31 have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

Monthly discharge of Genesee River at St. Helena, N. Y., for 1910.

[Drainage area, 1,030 square miles.]

Month.	Discharge in second-feet.				Run off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	8,600	....	1,140	1.11	1.28	C.
February	11,700	....	880	.854	.89	D.
March	20,300	1,190	5,480	5.32	6.13	A.
April	19,700	408	3,100	3.01	3.36	A.
May	8,340	496	1,860	1.81	2.09	A.
June	672	169	407	.395	.44	B.
July	656	91	191	.185	.21	B.
August	239	69	131	.127	.15	B.
September	672	91	256	.249	.28	B.
October	568	80	238	.231	.27	B.
November	1,980	260	918	.891	.99	A.
December	....	....	778	.763	.88	C.
The year	20,300	69	1,280	1.24	16.97	

NOTE.—The computations for January, February, December, and the year have been revised and supersede those previously published in the sixth annual report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

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

This station, which is at the highway bridge known as Jones Bridge, about 5 miles below Mount Morris, and a short distance below the inflow of Canaseraga Creek, was established May 22, 1903, was discontinued April 30, 1906, and reestablished August 12, 1908, in cooperation with the State Water Supply Commission of New York.

The bed is of sandy clay, and probably subject to change at times. The stream flows in one channel at low stages and two channels at high. The current is good at medium and high stages, but poor at low stages.

The datum of the chain gage attached to the bridge has remained permanent during the maintenance of the station.

Discharge measurements are made from a foot bridge erected on the outriggers of the downstream side of the bridge or by wading.

Conditions for making discharge measurements are favorable and a fairly good rating curve has been developed.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Genesee River at Jones Bridge, near Mount Morris, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	C. C. Covert	153	852	9.38	3,700
21	.....do	145	677	8.70	2,770
July 20	W. G. Hoyt	75	205	4.08	323
Aug. 22[a]	C. C. Covert	48	45.6	3.35	103
Oct. 25	W. G. Hoyt	70	193	3.96	244
Nov. 18	.....do	91	333	5.58	968

[a] Measurement made at wading section.

Daily gage height, in feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1910.

[Elizabeth Trewer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.45	8.05	27.85	6.20	12.90	5.50	3.65	3.60	3.70	4.00	4.70	6.85
2	4.50	7.70	27.70	5.95	16.10	5.25	3.45	3.65	3.85	4.05	4.60	6.40
3	5.00	8.20	27.40	5.75	18.15	5.20	3.45	3.65	3.90	3.90	4.50	6.10
4	5.40	8.85	25.95	5.70	21.10	5.05	3.45	3.60	4.00	3.90	4.65	5.95
5	5.35	7.55	24.05	5.70	15.80	5.00	3.65	3.55	4.05	3.70	4.45	6.00
6	5.30	7.45	23.20	5.65	11.75	5.05	3.55	3.55	4.75	3.90	4.25	5.25
7	5.25	7.00	25.75	5.45	9.55	5.10	3.70	3.35	5.10	4.20	4.25	5.35
8	5.35	6.90	23.70	5.30	8.40	5.10	3.60	3.40	4.90	4.45	4.30	5.60
9	5.30	7.30	18.40	5.15	8.35	5.00	3.60	3.45	4.55	4.20	4.30	6.05
10	5.30	7.15	17.85	5.00	7.45	4.90	3.10	3.55	4.25	4.15	4.70	6.05
11	5.30	6.85	11.25	5.15	7.05	4.80	3.50	3.85	3.95	4.10	6.60	7.70
12	5.30	6.95	10.00	5.15	6.45	4.85	3.50	3.90	3.95	4.05	6.40	7.70
13	5.30	6.90	9.40	5.05	6.25	4.80	3.65	3.60	4.00	4.00	5.70	7.65
14	5.30	6.80	8.75	4.90	6.05	4.60	4.75	3.70	4.00	3.95	5.70	7.40
15	5.30	6.80	8,35	4.80	5.75	4.50	4.70	3.45	3.75	3.70	5.70	7.35
16	5.30	6.70	7.80	4.80	5.60	4.60	4.45	3.70	4.00	3.25	5.70	7.10
17	5.25	7.20	7.50	4.90	5.50	4.56	4.20	3.45	4.00	3.45	5.70	6.35
18	5.25	9.25	7.10	5.75	5.35	4.40	4.15	3.30	3.40	3.85	5.60	......
19	6.95	9.90	7.00	7.80	5.20	4.40	4.10	3.75	3.90	3.60	5.40	......
20	9.85	9.70	10.45	8.75	5.10	4.55	4.00	3.95	3.90	3.70	5.40	......
21	10.95	9.70	13.45	9.25	5.20	4.50	3.70	3.85	3.75	3.55	5.25	......
22	19.25	9.70	11.45	9.80	5.20	4.35	3.80	3.40	3.75	3.55	5.20	......
23	19.55	9.70	11.40	8.05	5.15	4.20	3.60	3.60	3.60	3.25	5.10	......
24	15.75	9.70	10.70	11.20	5.20	4.10	3.30	3.55	3.50	3.60	5.05	6.40
25	12.55	9.70	10.95	22.25	5.55	3.90	3.60	3.55	3.20	3.90	6.85	......
26	11.15	9.50	10.25	24.65	5.65	3.80	......	3.75	3.80	4.05	7.35	......
27	10.45	8.55	8.75	24.45	5.55	3.90	......	3.60	3.90	4.50	6.55	......
28	9.75	15.45	7.85	18.50	5.35	3.95	3.80	3.60	4.50	4.40	6.00	......
29	8.90	......	7.15	13.40	5.15	3.95	3.60	3.20	4.25	4.60	7.25	......
30	8.50	......	6.70	17.65	5.10	3.85	3.65	3.60	4.20	4.80	7.70	13.0
31	8.25	......	6.35	......	5.15	......	3.10	3.80	......	4.70	......	......

NOTE.—More or less backwater caused by ice probably existed at this station from Jan. 1 to Feb. 27 and from Dec. 4 to 31. Gage heights taken to water surface except those for Dec. 18 to 31, which were to the top of the ice.

Daily discharge, in second-feet, of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1910.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		17,800	1,340	5,880	960	190	175	205	300	575	1,700
2		17,700	1,200	8,440	835	138	190	250	318	530	1,450
3		17,500	1,090	10,100	810	138	190	265	265	490	1,280
4		16,300	1,060	12,400	735	138	175	300	265	552	
5		14,800	1,060	8,200	710	190	162	318	205	470	
6		14,100	1,040	4,980	735	162	162	598	265	390	
7		16,200	935	3,440	760	205	112	760	370	390	
8		14,500	860	2,660	760	175	125	665	470	410	
9		10,300	785	2,630	710	175	138	510	370	410	
10		9,840	710	2,060	665	60	162	390	352	575	
11		4,620	785	1,820	620	150	250	282	335	1,560	
12		3,750	785	1,480	642	150	265	282	318	1,450	
13		3,330	735	1,370	620	190	175	300	300	1,060	
14		2,890	665	1,260	530	598	205	300	282	1,060	
15		2,630	620	1,090	490	575	138	220	205	1,060	
16		2,270	620	1,010	530	470	205	300	90	1,060	
17		2,090	665	960	510	370	138	300	138	1,060	
18		1,850	1,090	885	450	352	109	125	250	1,010	
19		1,790	2,270	810	450	335	220	265	175	910	
20		4,060	2,890	760	510	300	282	265	205	910	
21		6,320	3,220	810	490	205	250	220	162	835	
22		4,760	3,610	810	430	235	125	220	162	810	
23		4,730	2,430	785	370	175	175	175	90	760	
24		4,240	4,590	810	335	100	162	150	175	735	
25		4,420	13,400	985	265	175	162	80	265	1,700	
26		3,920	15,300	1,040	235	195	220	235	318	2,000	
27		2,890	15,100	985	265	215	175	265	490	1,530	
28	7,900	2,300	10,400	885	282	235	175	490	450	1,230	
29		1,880	6,280	785	282	175	80	390	530	1,940	
30		1,620	9,680	760	250	190	175	370	620	2,210	
31		1,420		785		60	235		575		

NOTE.—Daily discharge determined from a well-defined discharge rating curve. Discharge July 26 and 27 interpolated.

The determinations of daily discharges for January, February, and December 4–31, previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York, have been revised but are not republished because approximate.

Monthly discharge of Genesee River at Jones Bridge, near Mount Morris, N. Y., for 1910.

[Drainage area, 1,410 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January			1,400	0.993	1.14	C.
February	7,900		1,000	.709	.74	C.
March	17,800	1,420	6,990	4.96	5.72	A.
April	15,300	620	3,510	2.49	2.78	A.
May	12,400	760	2,630	1.86	2.14	A.
June	960	235	541	.384	.43	A.
July	598	60	226	.160	.18	B.
August	282	80	178	.126	.15	B.
September	760	80	316	.224	.25	A.
October	620	90	300	.213	.25	A.
November	2,210	390	989	.701	.78	A.
December			900	.638	.74	C.
The year	17,800	60	1,580	1.12	15.30	

NOTE.—Monthly discharge for January, February, and December computed from the discharge at St. Helena and Rochester, with due consideration to the relative drainage areas.

The computations for the winter months and the year have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

GENESEE RIVER NEAR ROCHESTER, N. Y.

This station, which is located at the Elmwood Avenue highway bridge about 3½ miles south of the city of Rochester, at the north end of South Park, was established by the United States Geological Survey February 9, 1904, and has been maintained in cooperation with the Barge canal and the State Water Supply Commission to date.

The bed of the river is composed of gravel and is fairly permanent. The bridge consists of six spans of about 125 feet each.

A staff gage is fastened to the downstream face of the first pier from the right-hand abutment of the bridge. This has been read under the direction of E. A. Fisher, city engineer. During the summer of 1910 a Gurley recording gage was installed in the pump house located at the right-hand end of the bridge and since December, 1910, nearly continuous records have been obtained. The datum for both the staff and recording gages has remained the same; zero of gage 506.848, Barge canal datum.

Discharge measurements are made from the downstream side of the bridge.

Conditions are very favorable for making accurate measurements, although in periods of low water low velocities may affect the accuracy somewhat.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Genesee River near Rochester, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Oct. 22	Hoyt and Shuttleworth	338	1,110	1.07	369
Nov. 18	W. G. Hoyt	248	1,380	1.85	1,320

Daily gage height, in feet, of Genesee River near Rochester, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	2.00	6.60	2.20	6.00	1.80	1.10	1.00	0.76	1.30	1.20	......
3	1.00	2.00	7.20	2.20	5.40	1.80	1.10	1.00	1.00	1.30	1.30	2.32
3	1.00	2.00	9.00	2.00	6.60	1.80	1.10	1.00	1.00	1.30	1.30	......
4	1.00	2.00	10.80	1.90	7.50	1.70	1.10	.95	1.00	1.30	1.30	2.09
5	1.00	2.00	11.00	1.90	7.40	1.70	1.10	.95	1.00	1.30	1.30	2.01
6	1.00	2.00	10.40	1.90	5.40	1.80	1.08	.90	1.60	1.40	1.30	1.90
7	1.00	2.00	9.90	1.80	4.00	1.80	1.05	.90	2.20	1.60	1.30	1.80
8	1.00	1.90	9.60	1.80	3.50	1.80	1.02	.90	2.00	1.60	1.30	1.90
9	1.00	1.90	9.30	1.80	3.10	1.80	1.00	.90	1.50	1.50	1.30	2.10
10	1.00	1.80	8.20	1.80	3.00	1.70	1.00	.90	1.50	1.40	1.30	1.70
11	1.00	1.70	5.70	1.70	2.80	1.70	1.00	1.00	1.40	1.40	1.40	1.70
12	1.00	1.70	4.40	1.70	2.50	1.70	1.00	1.00	1.30	1.20	2.30	1.50
13	1.00	1.70	4.00	1.60	2.50	1.70	.98	1.00	1.20	1.20	2.10	1.56
14	1.00	1.70	3.80	1.60	2.30	1.60	1.00	1.00	1.15	1.20	1.90	1.43
15	1.00	1.70	3.50	1.50	2.10	1.60	1.00	.99	1.10	1.20	1.90	1.42
16	1.00	1.70	3.20	1.50	2.00	1.50	1.30	.98	1.20	1.10	1.90	1.49
17	1.00	1.90	3.00	1.50	2.00	1.50	1.30	1.00	1.10	1.10	1.90	1.52
18	1.20	2.40	2.90	1.70	2.00	1.40	1.10	1.00	1.05	1.10	1.90	1.33
19	1.30	3.00	2.70	1.90	1.90	1.40	1.10	1.00	1.00	1.00	1.90	1.24
20	1.60	3.00	2.70	2.80	1.90	1.40	1.10	1.00	1.02	1.00	1.90	1.32
21	3.60	3.00	5.10	3.50	1.80	1.40	1.10	.98	1.02	1.00	1.80	1.51
22	4.00	3.00	4.80	3.30	1.70	1.30	1.10	.97	1.00	1.00	1.70	1.52
23	5.00	3.00	4.30	3.20	1.60	1.30	1.00	1.00	1.00	1.00	1.60	1.31
24	5.10	3.00	4.20	3.30	1.70	1.30	1.00	1.00	1.00	1.00	1.60	1.24
25	4.00	3.00	4.00	6.80	1.90	1.20	1.10	1.00	1.10	1.10	1.60	1.28
26	3.60	3.00	4.00	7.60	2.00	1.20	1.10	.97	1.10	1.20	2.50	1.35
27	3.20	3.00	3.50	8.20	2.00	1.20	1.10	.95	1.05	1.20	2.60	1.21
28	2.80	3.00	3.00	8.20	2.00	1.10	1.05	.90	1.05	1.20	2.30	1.24
29	2.60	....	2.70	6.80	1.90	1.10	1.00	.88	1.10	1.20	2.30	1.29
30	2.20	....	2.50	6.50	1.90	1.10	1.00	.86	1.10	1.20	2.80	1.46
31	2.00	....	2.30	....	1.80	....	1.00	.79	....	1.20	....	3.73

NOTE.—Relation of gage height to discharge probably affected by the presence of ice from Feb. 17 to 28 and from Dec. 15 to 30. There was also probably some slight effect from ice during the first part of January and February. Gage heights were probably taken to water surface.

Daily discharge, in second-feet, of Genesee River near Rochester, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	320	1,600	13,200	1,960	11,400	1,300	405	320	174	610	500	2,640
2	320	1,600	15,100	1,960	9,620	1,300	405	320	320	610	610	2,180
3	320	1,600	21,400	1,600	13,200	1,300	405	320	320	610	610	1,970
4	320	1,600	28,200	1,450	16,100	1,150	405	285	320	610	610	1,760
5	320	1.600	29,000	1,450	15,800	1,150	405	285	320	610	610	1,620
6	320	1,600	26,600	1,450	9,620	1,300	388	250	1,000	730	610	1,450
7	320	1,600	24,700	1,300	5,800	1,300	362	250	1,960	1,000	610	1,300
8	320	1,450	23,600	1,300	4,600	1,300	337	250	1,600	1,000	610	1,450
9	320	1,450	22,500	1,300	3,720	1,300	320	250	860	860	610	1,780
10	320	1,300	18,500	1,300	3,500	1,150	320	250	860	730	610	1,150
11	320	1,150	10,500	1,150	3,100	1,150	320	320	730	730	730	1,150
12	320	1,150	6,840	1,150	2,500	1,150	320	320	610	500	2,140	860
13	320	1,150	5,800	1,000	2,500	1,150	306	320	500	500	1,780	944
14	320	1,150	5,320	1,000	2,140	1,000	320	320	452	500	1,450	769
15	320	1,150	4,600	860	1,780	1,000	320	313	405	500	1,450	700
16	320	1,150	3,940	860	1,600	860	610	306	500	405	1,450	650
17	320	1,000	3,500	860	1,600	860	610	320	405	405	1,450	600
18	500	900	3,300	1,150	1,600	730	405	320	362	405	1,450	550
19	610	900	2,900	1,450	1,450	730	405	320	320	320	1,450	500
20	1,000	1,000	2,900	3,100	1,450	730	405	320	337	320	1,450	450
21	4,840	1,000	8,780	4,600	1,300	730	405	306	337	320	1,300	450
22	5,800	1,000	7,940	4,160	1,150	610	405	299	320	320	1,150	400
23	8,500	900	6,580	3,940	1,000	610	320	320	320	320	1,000	450
24	8,780	800	6,320	4,160	1,150	610	320	320	320	320	1,000	450
25	5,800	800	5,800	13,900	1,450	500	405	320	405	405	1,000	400
26	4,840	800	5,800	16,400	1,600	500	405	306	405	500	2,500	450
27	3,940	1,500	4,600	18,500	1,600	500	405	285	362	500	2,700	450
28	3,100	2,500	3,500	18,500	1,600	405	362	250	362	500	2,140	450
29	2,700	....	2,900	13,900	1,450	405	320	238	405	500	2,140	500
30	1,960	....	2,500	12,900	1,450	405	320	226	405	500	3,100	750
31	1,600	....	2,140	....	1,300	....	320	186	....	500	....	5,150

NOTE.—Daily discharge determined from a well-defined discharge rating curve. Discharge for periods during which ice existed, Feb. 17 to 28 and Dec. 15 to 30, determined approximately by means of climatological records.

Determinations of daily discharge for Feb. 17 to 28 and Dec. 15 to 30 have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

Monthly discharge of Genesee River near Rochester, N. Y., for 1910.

[Drainage area, 2,360 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	8,780	320	1,920	.814	.94	B.
February	....	....	1,260	.534	.56	C.
March	29,000	2,140	10,600	4.49	5.18	A.
April	18,500	860	4,620	1.96	2.19	A.
May	16,100	1,000	4,130	1.75	2.02	A.
June	1,300	405	906	.384	.43	A.
July	610	320	379	.161	.19	B.
August	320	186	291	.123	.14	B.
September	1,960	174	533	.226	.25	A.
October	1,000	320	537	.228	.26	A.
November	3,100	500	1,290	.547	.61	A.
December	5,150	....	1,110	.466	.49	B.
The year	29,000	174	2,300	.975	13.26	

NOTE.—The computations for February, December, and the year have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

CANASERAGA CREEK BASIN

GENERAL FEATURES.

Canaseraga Creek, one of the most important tributaries of Genesee River from the east, rises in the extreme northwestern corner of Steuben County and flows northwestward, joining the Genesee a short distance below the village of Mount Morris.

Keshequa Creek, the principal tributary of Canaseraga Creek, rises among the hills of northern Allegany County and flows north and northeast through Nunda and Tuscarora, joining Canaseraga Creek near Sonyea. Throughout its length of some 20 miles it flows through a narrow valley and falls about 1,200 feet. No power is developed, as the flow during the summer averages only 3 to 6 second-feet. The yearly rainfall is a little above the average for the Genesee Valley and ranges from 28 to 36 inches.

Throughout its course Canaseraga Creek winds across a flat, fertile valley devoted almost entirely to agriculture. From the village of Dansville to Mount Morris, a distance of 22½ miles, its velocity is so slow that the large amount of silt brought down from the foothills by the smaller streams is deposited in the creek bed, raising it to an elevation higher, in many places, than the surrounding country. The deposit of silt and the extremely tortuous course of the creek cause the 11,000 acres, which border the stream below Dansville, to become annually inundated by the flood waters. The State Water Supply Commission, acting on the petition of the people residing in the vicinity and under the authority acquired in 1906 when the duties of the River Improvement Commission were transferred to them, have sold bonds to the extent of $200,000 and work is now being started which is expected to alleviate much of the damage caused by floods.

CANASERAGA CREEK AT DANSVILLE, N. Y.

This station, which is located at the highway bridge 1 mile due west from the village of Dansville and about 22 miles above the mouth of the stream, was established July 21, 1910, in cooperation with the New York State Water Supply Commission.

A staff gage, bolted to the downstream, left-hand wing wall, is read twice daily. The bed of the stream at this point is composed of sand and gravel and may shift during high water.

Low-water measurements are made by wading below the bridge; and high-water measurements will be made from the bridge.

The rating curve is not yet sufficiently developed to warrant publishing the discharge.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Canaseraga Creek at Dansville, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 21a	W. G. Hoyt	42	22.7	1.75	27.3
Aug. 21a	C. C. Covert	43	29.6	1.72	36.0
Oct. 26a	F. J. Shuttleworth	44	22.6	1.80	30.7

a Measurement made at wading section.

Daily gage height, in feet, of Canaseraga Creek at Dansville, N. Y., for 1910.

[Floyd Harter, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.75	1.82	1.75	1.78	1.92	16		1.72	1.72	1.70	1.85	
2		1.75	1.75	1.70	1.80	1.98	17		1.75	1.75	1.72	1.82	
3		1.78	1.88	1.70	1.75	2.08	18		1.78	1.75	1.72	1.82	
4		1.78	1.80	1.68	1.80	2.02	19		1.85	1.78	1.68	1.92	
5		1.75	1.75	1.68	1.80	2.00	20		1.78	1.75	1.68	1.88	
6		1.75	1.85	1.75	1.80	1.92	21	1.75	1.75	1.72	1.72	1.82	
7		1.78	1.78	1.95	1.78	1.90	22	1.72	1.75	1.72	1.75	1.80	
8		1.75	1.75	1.78	1.78	1.82	23	1.75	1.72	1.72	1.72	1.85	
9		1.75	1.78	1.75	1.90	1.88	24	1.78	1.70	1.85	1.75	1.80	
10		1.92	1.75	1.75	2.02	1.85	25	1.75	1.72	1.78	1.88	2.08	
11		1.82	1.72	1.72	2.15		26	1.75	1.82	1.75	1.82	2.02	
12		1.75	1.72	1.75	1.92		27	1.75	1.75	1.75	1.82	1.95	
13		1.75	1.72	1.72	1.80		28	1.80	1.75	1.72	1.80	2.05	
14		1.75	1.75	1.70	1.82		29	1.75	1.72	1.72	1.82	2.00	
15		1.72	1.72	1.72	1.80		30	1.85	1.72	1.75	1.80	1.92	
							31	1.75	1.72		1.82		

NOTE.—Relation between gage height and discharge affected by presence of ice Dec. 10 to 31.

KESHEQUA CREEK AT SONYEA, N. Y.

This station, which is located at the upper highway bridge in the village of Sonyea, about 2 miles above the mouth of the stream, was established July 22, 1910, in cooperation with the New York State Water Supply Commission.

A staff gage for low-water observations is fastened to a pile on the right-hand bank between the two bridges, directly back and across from the Craig Colony power house. On October 25, a chain gage, for observation at high stages, was installed on the upstream side of the upper bridge.

At ordinary stages discharge measurements are made by wading. During high stages measurements may be made from either bridge.

The bed of the creek is composed of gravel and sand and the channel shifts from year to year. The rating curve is not yet developed.

Information in regard to this station is contained in the annual reports of the State water supply commission and the State engineer and surveyor, State of New York.

Discharge measurements at Keshequa Creek at Sonyea, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.[a]	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 22[b]	W. G. Hoyt	18	6.16	0.55	2.61
Aug. 26[b]	C. C. Covert	8.6	2.6	.52	1.96
Oct. 25[b]	W. G. Hoyt	22	8.6	[c].61	4.99

[a] Staff gage. [b] Measurement made at wading section. [c] Chain gage read 3.46.

Daily gage height, in feet, of Keshequa Creek at Sonyea, N. Y., for 1910.

[Elmer E. Reynolds, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.55	0.65	0.55	0.65	0.95	16		0.55	0.60	0.55	0.78	
2		.62	.60	.55	.65	.85	17		.60	.60	.55	.75	
3		.58	.65	.55	.70	.80	18		.62	.60	.55	.75	
4		.55	.65	.55	.68	.75	19		.75	.60	.55	.75	
5		.55	.68	.55	.65	.80	20		.70	.62	.55	.70	
6		.58	.68	.62	.65	.80	21		.62	.65	.55	.75	
7		.55	.65	.80	.65	.80	22	0.55	.60	.65	.58	.75	
8		.55	.68	.80	.70	.80	23	.58	.60	.65	.60	.70	
9		.58	.68	.75	.70	.80	24	.55	.60	.60	.60	.70	
10		.62	.60	.68	.80		25	.55	.60	.60	.60	.82	
11		.72	.60	.65	.85		26	.58	.58	.60	.60	.85	
12		.65	.60	.65	.80		27	.55	.65	.60	.60	.82	
13		.62	.62	.65	.80		28	.55	.60	.55	.65	.80	
14		.58	.62	.60	.78		29	.55	.60	.55	.65	.88	
15		.55	.60	.55	.80		30	.55	.58	.55	.65	.88	
							31	.55	.60		.65		

NOTE.—Readings discontinued Dec. 10 because of ice. All gage heights refer to staff gage.

CANADICE LAKE OUTLET NEAR HEMLOCK, N. Y.

Canadice Lake is tributary to Genesee River through Hemlock Lake outlet and Honeoye Creek. Hemlock Lake is used as a source of water supply for the city of Rochester. The gaging station was established at the outlet at the foot of the lake by the city engineer's department of Rochester in February, 1903.

A standard thin-edged weir with a 5-foot crest and two end contractions is so arranged with needle timbers at the ends that during high water the length may be increased to 14.96 feet with no end contractions. The weir crest stands 3 feet above the stream channel and is never submerged by backwater. There are two additional rectangular gates, each 1 foot square, with three complete contractions and a fourth partial contraction at the bottom. The outflow from the lake at the dam above the weir is controlled by gates.

A reading of the depth on the weir is taken each morning and also for each change of the gates, the depth being read to hundredths and corrections being made for velocity of approach for the larger discharges. The discharge is calculated by the Francis formula. The record has been furnished by E. A. Fisher, city engineer, and John F. Skinner, principal assistant city engineer, of Rochester, N. Y.

Information in regard to this station is contained in the reports of the State engineer and surveyor and the city engineer of Rochester.

Monthly discharge of Canadice Lake outlet near Hemlock, N. Y., for 1910.

[Drainage area, 12.6 square miles.]

Month.	Discharge in second-feet.		Run-off (depth in inches on drainage area).	Mean elevation of lake above low-water mark, in feet.
	Mean.	Per square mile.		
January	3.701	0.294	0.34	−1.409
February	4.127	.328	.34	− .768
March	22.975	1.82	2.10	+1.929
April	11.005	.873	.97	2.054
May	24.226	1.92	2.21	2.800
June	5.661	.449	.50	2.473
July	4.570	.363	.42	1.904
August	4.266	.339	.39	1.481
September	4.987	.396	.44	1.330
October	4.796	.381	.44	.927
November	5.933	.471	.53	.539
December	5.831	.463	.53	.523
The year	8.506	.675	9.21	1.148

NOTE.—The figures showing monthly discharge in second-feet per square mile and run-off depth in inches on drainage area do not represent natural flow, as the discharge is controlled through head gates.

OSWEGO RIVER BASIN.

GENERAL FEATURES.

Oswego River is formed by the union of Seneca and Oneida rivers about 12 miles northwest of Syracuse, whence its course is northwestward to Oswego, where it enters Lake Ontario. The length of the river from the junction to the mouth is about 20.5 miles, and the drainage basin in this district is a narrow strip of moderately rolling country. Above the junction of Seneca and Oneida rivers the basin spreads out, attaining a total width east and west of about 100 miles and north and south of about 80 miles. The total drainage area is about 5,000 square miles.

The rise is, on the whole, gradual from the low level lands which border Lake Ontario to the north-south ridges which separate the various lakes south of Seneca River and which farther south become merged with the still more elevated country lying along the southern boundary of the Lake Ontario drainage basin.

The most remarkable feature of the drainage basin is the chain of lakes stretching across its southern border. From west to east the principal lakes are, in order, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Oneida. These seven lakes include a water surface of approximately 280 square miles, increased by four smaller lakes—Cross, Onondaga, Otisco, and Cazenovia—to about 295 square miles. The larger of the lakes—Oneida, Cayuga, and Seneca—are used for steam-towing navigation, having connection with the Erie and Oswego canals. Cayuga and Seneca lakes are noted for their depth and for the abrupt slopes of their beds. The influence of the lakes on Oswego River is of the utmost importance in contributing to the steadiness of its flow.

A fall of 100 feet in the course of the main river is largely utilized by seven dams, which also partly canalize the stream. The intervening stretches are covered by the Oswego Canal, which draws its water supply from the river.

The mean annual precipitation in this basin is about 35 inches, and the winters are rather less severe than farther east and north in the State.

The Oswego and its tributaries are important in connection with the new barge canal. The Oswego itself is to be canalized and serve as a connection from the main canal at Three Rivers to Lake Ontario. The route of the main canal passes through Oneida Lake down Oneida River to its junction with Seneca River at Three River Point, thence up Seneca River in its general westward course. The water supply for the Oswego River section will be furnished from this drainage.

ONEIDA RIVER AT CAUGHDENOY, N. Y.

This station, which takes the place of the station on Oneida River near Euclid, N. Y., is located at Caughdenoy, about 6 miles above the old Euclid Station at Oak Orchard State dam, half a mile below the mouth of Caughdenoy Creek (which enters from the north) and 5 miles below Lake Oneida.

The station is maintained by the State engineer, by whom the following description and records of discharge have been furnished.

A masonry dam was completed across Oneida River at Caughdenoy during the summer of 1909. This dam has a substantially level crest, 415 feet long. The crest is at elevation 369.4 feet and has an ogee cross section with a slope, or batter, on the upstream portion of the crest, of 1 foot rise in 2 feet horizontal width. The downstream portion of the crest is rounded, with a radius of 3.24 feet.

The gage is located about 150 feet upstream from the dam, on the right-hand side of the stream. The channel at this point is about 350 feet wide, the average bottom elevation being 365.0. The discharge from the dam has been calculated from United States Geological Survey experiments on a dam of ogee cross section similar in form, and an allowance has been made for velocity of approach. During the summer, and also to some extent during the winter, water is diverted past the left-hand end of the dam through the Caughdenoy lock. An estimate of the amount of diversion has been made and included in the calculated discharge of the river.

Information in regard to this station is contained in the report of the New York State engineer and surveyor.

Daily discharge, in second-feet, of Oneida River at Caughdenoy, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,730	5,122	5,678	4,943	2,102	1,806	862	388	264	......	289	1,868
2	2,456	5,122	6,900	4,760	2,051	1,596	845	388	388	289	325	1,747
3	2,730	4,760	7,945	4,907	2,127	1,376	810	362	325	442	388	1,747
4	2,730	4,760	8,866	4,907	2,000	1,706	776	388	325	337	528	1,747
5	2,730	4,760	9,112	4,871	1,878	1,878	793	456	388	415	456	1,747
6	2,730	5,122	10,136	4,907	1,878	1,624	706	388	456	617	415	1,696
7	3,089	5,122	10,619	4,604	1,830	1,706	671	325	......	337	993	1,641
8	2,730	5,122	10,619	4,174	2,000	1,706	635	325	388	428	810	1,696
9	2,730	5,488	10,860	4,041	1,706	1,878	600	337	325	289	1,030	1,477
10	2,730	5,122	10,860	3,653	1,569	2,000	564	289	388	325	810	1,260
11	2,730	5,122	10,860	3,846	1,569	2,127	......	456	......	289	845	1,260
12	3,089	5,122	10,860	3,590	1,569	1,951	325	......	......	325	899	1,219
13	3,089	5,122	10,860	3,526	1,487	1,830	264	......	456	315	706	1,302
14	3,089	4,760	10,377	3,309	1,487	1,757	......	496	456	325	671	1,260
15	3,089	4,376	9,894	3,400	1,487	1,706	456	469	456	325	741	1,219
16	3 089	4,376	9,894	3,526	1,439	1,624	388	415	388	313	1,229	1,219
17	3,089	4,376	9,358	3,278	1,487	1,596	456	337	388	325	1,542	1,159
18	3,400	4,760	9,358	2,942	1,069	1,542	388	313	388	325	1,229	1,159
19	3,089	4,760	9,358	2,647	671	1,439	......	388	388	313	1,397	1,020
20	3,089	4,760	9,358	2,620	1,376	1,376	388	456	325	325	1,542	1,059
21	3,089	5,122	9,358	2,647	1,229	1,376	388	456	325	242	1,757	1,059
22	4,041	5,122	8,866	2,647	1,149	1,376	362	456	325	289	1,757	1,059
23	4,041	5,122	8,866	2,647	1,878	1,376	456	456	264	......	1,706	1,179
24	4,376	4,760	8,866	2,647	1,706	1,189	456	442	617	52	1,757	1,139
25	4,376	4,760	8,866	2,620	1,878	1,189	......	496	374	264	1,706	1,139
26	5,122	4,760	8,866	2,510	1,854	1,069	456	325	337	120	1,757	1,219
27	5,488	4,760	9,358	1,990	1,830	974	362	264	428	161	1,757	1,059
28	5,122	5,488	8,866	1,941	1,878	918	362	264	242	242	1,878	1,099
29	5,122	......	4,907	1,747	1,951	881	388	325	325	264	1,951	1,099
30	5,122	......	4,978	1,586	1,878	845	456	388	456	242	1,902	1,302
31	5,122	......	4,907	......	1,757	......	388	388	......	289	......	1,344

Monthly discharge, in second-feet, of Oneida River at Caughdenoy, N. Y., for 1910.

[Drainage area, 1,377 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	5,488	2,730	3,524	2.559	2.950
February	5,488	4,376	4,747	3.447	3.590
March	10,860	4,907	8,983	6.524	7.521
April	4,943	1,586	3,381	2.455	2.739
May	2,127	671	1,670	1.213	1.399
June	2,127	845	1,514	1.099	1.226
July (27 days)	862	264	519*a*	0.377	*a* 0.435
August (29 days)	496	264	387*a*	0.281	*a* 0.324
September (27 days)	617	242	377*a*	0.274	*a* 0.306
October (29 days)	617	52	304*a*	0.221	*a* 0.255
November	1,951	289	1,159	0.842	0.939
December	1,868	1,020	1,329	0.965	1.112
The year	10,860	52	2,326	1.688	22.160

a Computed as if complete months.

SALMON RIVER BASIN.

GENERAL FEATURES.

Salmon River rises in the southwestern part of Lewis County, N. Y., flows southward and then northward, and enters Lake Ontario near Port Ontario. Its drainage area comprises about 285 square miles. The topography is in general rolling, and the soil is sandy, rock lying near the surface in the upper part of the basin, where there are extensive tracts of virgin forest.

The mean annual precipitation is about 35 inches, and during the winter there is usually a heavy fall of snow, which accumulates in the forested areas to a depth of several feet. The gradual melting of this snow in the spring tends to prevent high freshets.

The basin affords several opportunities for storage. At High Falls there is an undeveloped fall of about 110 feet, occurring in a very short distance. Considering its size, this river affords rather important opportunities for the development of power.

SALMON RIVER NEAR PULASKI, N. Y.

This station, which is located at Fox's bridge, the first highway bridge above the village of Pulaski, was established by the United States Geological Survey September 5, 1900, discontinued June 30, 1907, reestablished August 16, 1908, and discontinued December 6, 1908. It was maintained during these periods in cooperation with the State engineer and surveyor. On July 14, 1910, it was reestablished by the Survey in cooperation with the State Water Supply Commission of New York.

A vertical staff gage was attached to the upstream end of the center pier, with its zero 11.59 feet below the bench mark, which is the top of the capstone of the center pier. This gage was removed by ice during the winter of 1901–2 and then replaced July 23, 1902, by a chain gage, having its zero 12.79 feet below the original bench mark. The gage datum has remained permanent since July 23, 1902.

Discharge measurements are made from the bridge or by wading.

The station can be reached by a short drive from either Pulaski or Richland. Conditions are poor for records during the winter, when the channel usually becomes clogged by ice. The open-channel rating curve is fairly good.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Salmon River near Pulaski, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 13	W. G. Hoyt	168	239	2.61	168
Aug. 25	....do	169	234	2.61	*a* 181

a Measurement made at wading section.

Daily gage height, in feet, of Salmon River near Pulaski, N. Y., for 1910.

[Seymour J. Fox, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	2.50	3.47	2.58	3.10	3.20	16	2.58	2.62	2.60	2.68	3.52	3.00
2	......	2.50	3.60	2.58	3.10	3.18	17	2.72	2.85	2.65	2.62	3.42	3.30
3	......	2.62	3.12	2.50	3.70	3.10	18	2.70	2.80	2.50	2.60	3.35	......
4	......	2.58	3.75	2.48	3.55	3.10	19	2.50	3.28	2.50	2.60	3.28	......
5	......	2.88	3.50	2.92	3.50	3.02	20	2.48	3.38	2.60	2.60	3.25	......
6	......	3.50	3.70	4.05	3.42	2.90	21	2.52	2.98	2.50	2.55	3.10	......
7	......	3.90	3.72	4.10	3.50	2.90	22	2.50	2.72	2.55	2.55	3.30	......
8	......	3.15	3.25	3.65	3.38	2.90	23	2.62	2.75	2.45	2.68	3.28	......
9	......	2.90	3.05	3.20	3.38	3.00	24	2.65	2.60	2.50	3.00	3.35	......
10	......	2.92	3.00	3.12	3.65	3.00	25	2.55	2.60	2.65	2.98	3.50	......
11	......	3.85	2.70	3.00	4.80	3.00	26	2.55	2.75	2.60	3.75	3.48	......
12	......	3.62	2.78	3.88	4.30	3.00	27	2.50	2.90	2.68	3.58	3.38	......
13	......	3.35	2.60	2.78	4.02	3.10	28	2.60	2.82	2.62	3.52	3.30	......
14	2.78	2.85	2.62	2.70	3.75	3.05	29	2.55	2.62	2.62	3.52	3.28	......
15	2.55	2.72	2.70	2.70	3.60	3.00	30	2.50	2.50	2.68	3.38	3.28	......
							31	2.60	2.65	......	3.22	......	......

NOTE.—Ice present Dec. 9 to 31.

Daily discharge, in second-feet, of Salmon River near Pulaski, N. Y., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	118	666	145	400	465	16	145	160	152	183	707	......
2	......	118	775	145	400	452	17	200	260	172	160	696	......
3	......	160	413	118	865	400	18	191	235	118	152	572	......
4	......	145	912	112	732	400	19	118	521	118	152	521	......
5	......	275	690	296	690	352	20	112	595	152	152	500	......
6	......	690	865	1,230	626	285	21	125	329	118	135	400	......
7	......	1,060	884	1,290	690	285	22	118	200	135	135	535	......
8	......	432	500	820	595	285	23	160	213	103	183	521	......
9	......	285	370	465	595	......	24	172	152	118	340	572	......
10	......	296	340	413	820	......	25	135	152	172	329	690	......
11	......	1,010	191	340	2,290	......	26	135	213	152	912	674	......
12	......	793	226	1,040	1,540	......	27	118	285	183	758	595	......
13	......	572	152	226	1,190	......	28	152	245	160	707	535	......
14	226	260	160	191	912	......	29	135	160	160	707	521	......
15	135	200	191	191	775	......	30	118	118	183	595	521	......
							31	152	172	......	479	......	......

NOTE.—Daily discharge determined from a fairly well defined discharge rating curve.
The computations have been revised and supersede those previously published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

Monthly discharge of Salmon River near Pulaski, N. Y., for 1910.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
July 14-31	226	112	147	0.568	0.38	B.
August	1,060	118	336	1.30	1.50	B.
September	912	103	318	1.23	1.37	B.
October	1,040	112	423	1.63	1.88	B.
November	2,290	400	720	2.78	3.10	B.
December	....	....	335	1.29	1.49	D.

NOTE.—Discharge for the period during which ice existed, Dec. 9 to 31, estimated by means of comparisons with the run-off from adjacent drainages.
Mean discharge Dec. 9 to 31 estimated 324 second-feet.
The computations have been revised and supersede data contained in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor, State of New York.

BLACK RIVER BASIN.

GENERAL FEATURES.

Black River rises in the western part of Hamilton County, N. Y., flows southwestward across Herkimer County into Oneida County, turns near Forestport and runs somewhat west of north through Lewis County to eastern Jefferson County, and then flows westward to Black River Bay, at the eastern extremity of Lake Ontario. Its total drainage area is 1,930 square miles. The upper part of the basin is very rugged and mountainous, contains a large number of lakes, and is in a part of the Adirondack forest.

The mean annual precipitation is about 40 inches, ranging from 55 inches in the extreme headwaters to perhaps 30 inches near Lake

Erie. The winters are generally quite severe, and the stream flow is affected by ice for periods of several months.

The regimen of the river is controlled by storage on its upper tributaries (including Beaver River at Beaver), a series of reservoirs at the headwaters of Moose River, and additional reservoirs at Forestport and on the headwaters of the main river.

Water is diverted from Black River through Forestport feeder to supply the Black River Canal at Boonville. A portion of this diverted water flows northward from Boonville and enters Black River again at Lyons Falls; the remainder flows southward through the Black River Canal and enters the Erie Canal at Rome.

BLACK RIVER NEAR FELTS MILLS, N. Y.

This station, which is located at the dam of the Harmon Paper Co., formerly owned by the Black River Traction Co., near the village of Felts Mills, 7 miles upstream from the old Huntingtonville gaging station on this stream, was established August 29, 1902. Since May 1, 1907, the station has been maintained by the State engineer and surveyor, by whom the 1910 data have been furnished for publication.

The dam is of sawed timber, rests on limestone foundation, and is very nearly water-tight. It has a slope on the upstream face of 2.88 horizontal to 1 vertical. The crest is protected by boiler plate, and the downstream face is vertical, giving a free overfall. The main crest is 380.6 feet long. There are two additional sections on the right-hand side, one 14.1 feet long and the other 17.9 feet. A similarly constructed dam, 117 feet long, at the left bank, serves as an auxiliary spillway and as a headrace wall.

During the summer of 1910 a new dam was constructed about 100 feet downstream from the paper mill. For description see Water-Supply Paper 304 (in preparation).

The gage, which is read twice daily, at 7 a. m. and 6 p. m., is attached vertically to a crib at the left-hand side of the stream above the mill. Correction is made to the gage readings for velocity of approach during high water. The discharge over the spillways has been calculated by means of the weir formula, using coefficients derived from experiments of the United States Geological Survey for a dam of similar cross section.

A wood-pulp mill has been constructed adjacent to this dam, and was put in operation during 1907. The mill contains four 72-inch and one 45-inch Smith-McCormick turbines. A record is kept of the hours run and gage opening of each wheel, as well as of the head under which the wheels operate.

Information in regard to this station is contained also in the reports of the New York State engineer and surveyor.

Daily discharge, in second-feet, of Black River near Felts Mills, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,462	2,546	6,079	13,849	a 2,842	3,913	902	1,189	2,142	2,746	2,946	1,413
2	1,165	2,378	8,283	14,676	2,967	4,090	861	869	1,903	a 2,562	2,558	1,413
3	2,123	2,420	10,472	a 14,676	3,658	3,468	a 100	902	1,864	2,353	2,474	1,207
4	1,246	2,128	13,137	13,029	4,289	3,578	100	924	a 1,784	2,311	2,474	a 1,207
5	1,370	2,036	14,161	11,211	6,024	a 2,842	924	1,317	2,266	2,104	2,906	1,207
6	1,700	a 998	a 13,849	9,823	6,495	3,205	896	3,263	2,266	2,144	a 3,448	1,040
7	1,700	1,913	14,827	8,319	2,647	3,468	896	a 3,406	1,945	2,661	3,237	1,040
8	1,320	1,341	14,553	8,086	a 4,747	4,371	868	3,143	1,905	2,784	2,964	873
9	a 1,040	1,597	13,481	7,319	4,128	5,045	832	2,620	1,786	a 2,784	3,081	873
10	1,848	1,796	11,910	a 6,808	3,683	4,694	a 323	2,161	1,554	2,394	3,631	1,040
11	1,639	1,837	7,704	6,136	3,683	4,024	1,124	1,999	a 1,372	2,025	5,158	a 1,207
12	1,389	1,718	8,231	5,183	3,534	a 3,287	933	2,693	1,168	1,826	3,631	1,413
13	1,608	a 555	a 6,304	4,530	3,123	4,042	868	3,519	1,286	1,786	a 4,312	1,597
14	2,169	2,018	6,291	3,933	2,699	3,500	896	a 2,336	1,231	1,786	3,121	1,498
15	1,369	1,597	4,884	3,448	a 2,151	3,197	938	2,088	1,231	1,786	2,722	1,624
16	a 1,165	1,637	4,561	3,139	4,740	3,081	922	2,126	1,190	a 1,594	2,516	1,564
17	1,805	1,716	3,496	a 2,545	4,233	2,662	a 754	1,786	1,190	1,268	2,349	1,442
18	1,303	2,005	3,365	2,545	4,816	2,607	1,365	1,865	a 1,044	1,259	2,182	a 873
19	1,352	1,967	3,605	2,842	5,077	a 1,888	901	1,983	1,190	1,259	2,019	1,442
20	1,608	a 1,249	a 4,094	4,560	5,699	3,159	911	2,023	1,231	1,308	a 1,888	1,317
21	2,128	2,269	6,134	3,947	3,143	2,307	901	a 2,023	1,190	1,317	1,655	1,067
22	2,800	1,921	7,255	3,469	a 2,842	2,142	902	1,983	1,190	1,217	1,352	1,067
23	a 4,530	1,963	7,731	2,842	3,500	1,903	863	1,877	1,190	(a)	1,475	1,067
24	6,715	2,046	8,498	a 3,029	3,465	1,594	a 515	1,435	1,190	1,268	1,655	1,067
25	6,183	2,130	8,753	3,635	4,062	1,511	1,183	1,090	a 1,190	1,268	2,019	a 873
26	5,785	2,509	10,137	3,386	5,045	a 201	933	1,050	1,231	1,317	2,151	1,067
27	5,567	a 1,888	a 11,978	3,980	4,062	1,231	942	1,035	1,236	1,826	a 1,888	1,216
28	3,632	3,714	11,715	3,683	3,733	996	933	a 1,035	1,231	2,946	1,655	1,337
29	2,823	....	11,715	3,980	a 3,931	996	942	1,020	1,246	3,181	1,655	1,478
30	a 2,151	....	11,211	2,829	3,941	996	881	1,040	2,746	a 2,282	1,413	1,796
31	2,517	....	10,708	....	3,765	....	a 674	1,058	....	3,237	....	2,242

a Sunday.

Monthly discharge, in second-feet, of Black River near Felts Mills, N. Y., for 1910.

[Drainage area, 1,851 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Per square mile.	
January	6,715	1,040	2,426	1.311	1.508
February	3,714	555	1,925	1.040	1.082
March	14,827	3,365	9,004	4.864	5.594
April	14,676	2,545	6,048	3.267	3.659
May	6,495	2,151	3,959	2.139	2.460
June	5,045	201	2,800	1.513	1.695
July	1,365	100	838	.452	.520
August	3,519	869	1,834	.991	1.140
September	2,746	1,044	1,506	.814	.912
October (30 days)	3,237	1,217	2,020	1.091	a 1.255
November	5,158	1,352	2,551	1.378	1.543
December	2,242	873	1,276	.689	.792
The year	14,827	100	3,016	1.629	22.160

a Computed for 31 days.

MOOSE RIVER AT MOOSE RIVER, N. Y.

This station, which is located in the village of Moose River, about 3 miles downstream from the McKeever station on the Adirondack division of the New York Central & Hudson River Railroad, was established June 5, 1900.

At McKeever is a timber dam used for power and water regulation for log driving, so that during portions of the year two gage readings a day may not give a good mean. From the dam to the station the velocity is relatively slow, but below the station it is very high. Just above the station is a small island, upon which ice and log jams occasionally form.

At the station the bed of the river is cobble with occasional large bowlders, the current is smooth, and the depth fairly uniform. The stream freezes over in winter with alternate layers of ice and snow.

Since July, 1903, discharge measurements have been made from a cable having a clear span of 269 feet. A staff gage divided into two parts is fastened to the left bank a short distance above the cable. The elevation of the gage zero was changed on February 28, 1903, from 15.36 to 15.53. A fairly accurate rating curve has been developed for the open-water channel.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Moose River at Moose River, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	W. G. Hoyt	218	768	2.51	862
July 11	J. J. Phelan	204	413	.88	260

Daily gage heights, in feet, of Moose River at Moose River, N. Y., for 1910.

[Chris. Hannon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1		7.1	6.2	4.3	2.4	0.9	0.95	0.85	3.1	2.5	1.3
2	1.0		6.95	6.1	4.2	2.9	.95	.95	.8	2.85	2.5	1.2
3	1.0		6.5	5.95	4.2	3.25	.9	.95	.7	2.8	2.6	1.35
4	1.25		5.65	5.8	4.1	2.9	1.0	2.4	.8	2.7	2.6	0.0
5	1.35		5.1	5.2	4.2	2.9	1.1	4.1	.8	2.55	2.65	1.45
6	1.55		4.8	5.05	4.35	3.2	1.2	3.2	.9	2.4	2.65	1.7
7	1.7		4.8	5.35	4.05	3.55	1.1	2.95	1.05	2.25	2.6	1.6
8	1.7		4.7	5.1	3.75	3.75	.95	2.65	1.4	2.2	2.45	1.35
9			4.8	4.35	3.4	3.7	1.0	2.3	1.35	2.05	2.35	.95
10			4.8	3.9	3.1	3.55	.9	2.45	1.3	2.0	2.3	.8
11			4.65	3.35	2.8	3.25	.9	3.0	1.3	1.9	2.2	.8
12			4.5	3.15	2.45	3.2	.8	3.35	1.4	1.8	2.1	.7
13			4.35	3.0	2.1	2.9	.8	3.1	1.35	1.65	2.1	.7
14			4.3	2.95	1.6	2.4	.8	2.7	1.45	1.6	2.0	.8
15			4.2	2.75	.3	2.2	.8	2.6	1.45	1.6	2.0	.8
16			4.0	2.7	1.2	2.05	.8	2.5	1.3	0.0	1.9	.9
17			3.55	2.7	1.4	2.0	.3	2.35	1.4	1.6	1.75	.8
18			3.3	2.6	1.65	1.9	.8	2.15	1.4	1.6	1.7	.7
19			3.1	2.6	2.0	1.8	.9	2.0	1.25	1.7	1.6	.7
20			2.85	2.5	2.3	1.7	.8	1.95	1.2	1.8	1.5	.8
21			2.6	2.5	2.45	1.6	.8	1.8	1.3	1.95	1.5	.8
22			2.85	2.4	2.7	1.5	.7	1.65	1.3	1.95	1.5	.7
23			3.3	2.4	3.0	1.3	.7	1.45	1.4	2.0	1.5	.8
24			4.05	2.4	3.25	.3	.8	1.2	1.4	2.15	1.6	.9
25			5.65	2.4	2.95	1.15	.9	.95	1.5	2.35	1.5	.95
26			6.85	3.1	2.9	1.15	.95	.75	1.5	2.55	1.5	.8
27			6.35	3.85	2.8	1.1	.9	.55	1.65	2.35	1.4	1.25
28			5.95	3.8	2.7	1.05	.8	0.0	1.95	2.3	1.4	1.7
29			6.3	3.95	2.55	1.0	.75	.6	2.4	2.2	1.4	1.75
30			6.15	4.25	2.35	.9	.9	.95	3.05	2.35	1.3	1.6
31			6.15		2.2		1.05	.9		2.4		1.45

NOTE.—Relation of gage height to discharge affected by the presence of ice during January and February, but probably not materially affected during December.

Daily discharge, in second-feet, of Moose River at Moose River, N. Y., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6,060	4,660	2,240	800	265	278	252	1,220	855	375
2	5,820	4,510	2,140	1,080	278	278	240	1,060	855	345
3	5,110	4,280	2,140	1,320	265	278	215	1,020	910	390
4	3,860	4,070	2,040	1,080	290	800	240	965	910	90
5	3,140	3,260	2,140	1,080	315	2,040	240	882	938	420
6	2,780	3,080	2,290	1,290	345	1,290	265	800	938	500
7	2,780	3,460	1,990	1,550	315	1,120	302	725	910	465
8	2,670	3,140	1,720	1,720	278	938	405	700	828	390
9	2,780	2,290	1,430	1,670	290	750	390	630	775	278
10	2,780	1,850	1,220	1,550	265	828	375	610	750	240
11	2,620	1,400	1,020	1,320	265	1,150	375	570	700	240
12	2,450	1,260	828	1,290	240	1,400	405	535	650	215
13	2,290	1,150	650	1,080	240	1,220	390	482	650	215
14	2,240	1,120	465	800	240	965	420	465	610	240
15	2,140	995	135	700	240	910	420	465	610	240
16	1,940	965	345	630	240	855	375	90	570	265
17	1,550	965	405	610	135	775	405	465	518	240
18	1,360	910	482	570	240	675	405	465	500	215
19	1,220	910	610	535	265	610	360	500	465	215
20	1,060	855	750	500	240	590	345	535	435	240
21	910	855	828	465	240	535	375	590	435	240
22	1,060	800	965	435	215	482	375	590	435	215
23	1,360	800	1,150	375	215	420	405	610	435	240
24	1,990	800	1,320	135	240	345	405	675	465	265
25	3,860	800	1,120	330	265	278	435	775	435	278
26	4,880	1,220	1,080	330	278	228	435	882	435	240
27	4,880	1,800	1,020	315	265	185	482	775	405	340
28	4,280	1,760	965	302	240	90	590	750	405	500
29	4,810	1,900	882	290	228	195	800	700	405	518
30	4,580	2,190	775	265	265	278	1,180	775	375	465
31	4,580	....	700	....	302	265	....	800	....	420

NOTE.—Daily discharge determined from a discharge rating curve well defined between 240 and 3,650 second-feet. The determination of daily discharge during December may be somewhat in error as a result of backwater from ice.

Monthly discharge of Moose River at Moose River, N. Y., for 1910.

[Drainage area, 346 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	....	....	600	1.73	1.99	D.
February	....	....	500	1.45	1.51	D.
March	6,060	910	3,030	8.76	10.10	C.
April	4,660	800	1,940	5.61	6.26	B.
May	2,290	135	1,160	3.35	3.86	B.
June	1,720	135	814	2.35	2.62	A.
July	345	135	258	.746	.86	A.
August	2,040	90	679	1.96	2.26	A.
September	1,180	215	410	1.18	1.32	A.
October	1,220	90	681	1.97	2.27	A.
November	938	375	620	1.79	2.00	B.
December	518	90	308	.890	1.03	C.
The year	6,060	90	917	2.65	36.08	

NOTE.—Monthly discharge for January and February estimated at approximately 25 per cent of the discharge of Black River at Felts Mills. This ratio holds quite consistently for these two stations during the open-water period.

The determination of mean discharge for November, as published in the Sixth Annual Report of the New York State Water Supply Commission and in the 1910 report of the State engineer and surveyor, was slightly in error and has been corrected in the above table.

STREAMS FLOWING DIRECTLY TO ST. LAWRENCE RIVER.

OSWEGATCHIE RIVER BASIN.

GENERAL FEATURES.

Oswegatchie River has its source in the region of lakes and timbered swamps in the southern part of St. Lawrence County, N. Y. The largest of the lakes is Cranberry Lake, which affords valuable storage to water-power users on its outlet, East Branch of Oswegatchie River. The East and West branches flow in a general northwesterly direction and unite near Talcville. From Gouverneur to Oxbow the river flows southwestward; it then turns sharply and flows northeastward to Rensselaer Falls, turns again to the northwest, receives the outlet of Black Lake at Galilee, and finally enters the St. Lawrence at Ogdensburg. Its total drainage area comprises about 1,600 square miles.

The mean annual precipitation is about 35 inches, and winter conditions are usually severe.

The basin affords many opportunities for water storage and the utilization of these sites is especially desirable on account of the quick-spilling character of this area and the tendency to floods. Considerable water power is developed, mostly in small units, and there is a large amount of undeveloped power.

OSWEGATCHIE RIVER NEAR OGDENSBURG, N. Y.

This station, which is located at what is known as the Eel Weir highway bridge, about 5½ miles upstream from Ogdensburg, N. Y., and about a mile below Black Lake outlet, was established April 22, 1903, and has been maintained continuously since that date.

There are three dams in the vicinity of the gaging station on Oswegatchie River—one at Heuvelton, about 5 miles above; one at Rensselaer Falls, 10 miles above; and one in the city of Ogdensburg, about half a mile above the outlet.

The channel is open at this station throughout the year. The stream bed is rocky and permanent, and the results are considered fairly good for all stages.

The datum of the chain gage attached to the bridge has remained the same since the beginning of the record.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission of New York and State engineer and surveyor, State of New York.

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

August 24, 1910: Width, 150 feet; area of section, 297 square feet; gage height, 4.73 feet; discharge, 696 second-feet.

Daily gage height, in feet, of Oswegatchie River near Ogdensburg, N. Y., for 1910.

[Joseph La Rue, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.1	6.1	5.7	6.9	5.3	5.4	4.7	4.4	4.6	4.7	5.8	5.9
2	5.0	6.0	6.2	6.7	5.3	5.4	4.7	4.5	4.6	4.7	6.0	5.8
3	5.0	5.8	7.0	6.7	5.3	5.3	4.7	4.5	4.6	4.7	5.8	5.8
4	5.2	5.8	7.5	6.7	5.3	5.3	4.8	4.5	4.6	4.7	5.7	5.8
5	5.0	5.6	8.1	6.7	5.4	5.3	4.8	4.5	4.6	4.7	5.7	5.8
6	5.0	5.5	8.3	6.5	5.6	5.4	4.7	4.5	4.7	4.7	5.6	5.8
7	4.9	5.5	8.8	6.5	6.2	5.3	4.7	4.5	4.9	4.7	5.6	5.7
8	4.9	5.5	8.9	6.2	6.1	5.2	4.7	4.6	4.9	4.8	5.6	5.7
9	4.9	5.3	9.1	6.2	6.1	5.2	4.7	4.5	4.9	4.9	5.6	5.6
10	5.0	5.2	9.1	6.1	5.9	5.2	4.6	4.6	4.9	4.9	5.6	5.5
11	5.0	5.1	9.0	6.0	5.9	5.2	4.6	4.6	4.9	5.0	6.0	5.4
12	4.9	5.1	8.6	5.9	5.9	5.5	4.6	4.7	4.9	5.2	6.0	5.3
13	4.9	5.1	8.5	5.9	5.7	5.5	4.7	4.7	5.0	5.2	6.1	5.3
14	4.8	5.0	8.3	5.8	5.6	5.3	4.7	4.7	4.9	5.3	6.2	5.2
15	4.8	5.0	7.9	5.6	5.6	5.3	4.7	4.7	5.0	5.3	6.3	5.2
16	4.8	5.0	7.6	5.6	5.5	5.3	4.6	4.7	4.9	5.3	6.3	5.1
17	4.8	4.9	7.3	5.4	5.4	5.3	4.6	4.7	4.9	5.3	6.2	5.1
18	4.8	4.9	6.9	5.4	5.3	5.1	4.6	4.7	4.9	5.3	6.1	5.1
19	4.8	4.9	6.6	5.4	5.2	5.1	4.6	4.6	4.9	5.2	6.0	5.1
20	5.0	4.9	6.6	5.6	5.1	5.1	4.4	4.6	4.9	5.2	6.0	5.0
21	5.0	4.9	6.6	5.6	5.3	5.1	4.4	4.7	4.8	5.2	6.0	5.0
22	5.2	4.9	6.6	5.6	5.3	5.1	4.4	4.7	4.8	5.1	6.0	5.0
23	5.5	5.0	6.6	5.6	5.3	5.1	4.5	4.7	4.8	5.1	5.9	5.0
24	6.0	5.0	6.6	5.6	5.3	5.0	4.5	4.6	4.8	5.0	5.9	5.0
25	6.2	5.0	6.8	5.5	5.4	5.0	4.5	4.6	5.0	5.0	5.8	5.0
26	6.4	5.0	6.8	5.6	5.5	5.0	4.5	4.6	4.9	5.0	5.8	5.0
27	6.4	5.0	6.9	5.6	5.5	5.0	4.5	4.6	4.9	5.0	5.8	5.0
28	6.5	5.2	7.1	5.3	5.4	4.9	4.5	4.6	4.8	5.2	5.9	5.1
29	6.4	......	7.1	5.3	5.5	4.8	4.5	4.6	4.8	5.3	6.0	5.1
30	6.3	......	7.1	5.3	5.5	4.8	4.5	4.6	4.8	5.5	6.0	5.1
31	6.1	......	7.2	......	5.4	......	4.4	4.6	......	5.8	......	5.2

NOTE.—Relation of gage height to discharge at this station not affected by ice.

Daily discharge, in second-feet, of Oswegatchie River near Ogdensburg, N. Y., for 1910.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,380	3,730	2,640	6,070	1,770	1,970	720	330	580	720	2,890	3,160
2	1,200	3,440	4,020	5,480	1,770	1,970	720	450	580	720	3,440	2,890
3	1,200	2,890	6,360	5,480	1,770	1,770	720	450	580	720	2,890	2,890
4	1,570	2,890	7,850	5,480	1,770	1,770	870	450	580	720	2,640	2,890
5	1,200	2,400	9,660	5,480	1,970	1,770	870	450	580	720	2,640	2,890
6	1,200	2,180	10,300	4,890	2,400	1,970	720	450	720	720	2,400	2,890
7	1,030	2,180	11,800	4,890	4,020	1,770	720	450	1,030	720	2,400	2,640
8	1,030	2,180	12,100	4,020	3,730	1,570	720	580	1,030	870	2,400	2,640
9	1,030	1,770	12,700	4,020	3,730	1,570	720	450	1,030	1,030	2,400	2,400
10	1,200	1,570	12,700	3,730	3,160	1,570	580	580	1,030	1,030	2,400	2,180
11	1,200	1,380	12,400	3,440	3,160	1,570	580	580	1,030	1,200	3,440	1,970
12	1,030	1,380	11,200	3,160	3,160	2,180	580	720	1,030	1,570	3,440	1,770
13	1,030	1,380	10,900	3,160	2,640	2,180	720	720	1,200	1,570	3,730	1,770
14	870	1,200	10,300	2,890	2,400	1,770	720	720	1,030	1,770	4,020	1,570
15	870	1,200	9,050	2,400	2,400	1,770	720	720	1,200	1,770	4,310	1,570
16	870	1,200	8,150	2,400	2,180	1,770	580	720	1,030	1,770	4,310	1,380
17	870	1,030	7,250	1,970	1,970	1,770	580	720	1,030	1,770	4,020	1,380
18	870	1,030	6,070	1,970	1,770	1,380	580	720	1,030	1,770	3,730	1,380
19	870	1,030	5,180	1,970	1,570	1,380	580	580	1,030	1,570	3,440	1,380
20	1,200	1,030	5,180	2,400	1,380	1,380	330	580	1,030	1,570	3,440	1,200
21	1,200	1,030	5,180	2,400	1,770	1,380	330	720	870	1,570	3,440	1,200
22	1,570	1,030	5,180	2,400	1,770	1,380	330	720	870	1,380	3,440	1,200
23	2,180	1,200	5,180	2,400	1,770	1,380	450	720	870	1,380	3,160	1,200
24	3,440	1,200	5,180	2,400	1,770	1,200	450	580	870	1,200	3,160	1,200
25	4,020	1,200	5,780	2,180	1,970	1,200	450	580	1,200	1,200	2,890	1,200
26	4,600	1,200	5,780	2,400	2,180	1,200	450	580	1,030	1,200	2,890	1,200
27	4,600	1,200	6,070	2,400	2,180	1,200	450	580	1,030	1,200	2,890	1,200
28	4,890	1,570	6,660	1,770	1,970	1,030	450	580	870	1,570	3,160	1,380
29	4,600	......	6,660	1,770	2,180	870	450	580	870	1,770	3,440	1,380
30	4,310	......	6,660	1,770	2,180	870	450	580	870	2,180	3,440	1,380
31	3,730	......	6,960	......	1,970	......	330	580	......	2,890	......	1,570

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

Monthly discharge of Oswegatchie River near Ogdensburg, N. Y., for 1910.

[Drainage area, 1,580 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
January	4,890	870	1,960	1.24	1.43	A.
February	3,730	1,030	1,670	1.06	1.10	A.
March	12,700	2,640	7,780	4.92	5.67	A.
April	6,070	1,770	3,240	2.05	2.29	A.
May	4,020	1,380	2,270	1.44	1.66	A.
June	2,180	870	1,550	.981	1.09	A.
July	870	330	578	.366	.42	B.
August	720	330	588	.372	.43	B.
September	1,200	580	924	.585	.65	B.
October	2,890	720	1,350	.854	.98	A.
November	4,310	2,400	3,210	2.03	2.26	A.
December	3,160	1,200	1,840	1.16	1.34	A.
The year	12,700	330	2,250	1.42	19.32	

RAQUETTE RIVER BASIN.

GENERAL FEATURES.

Raquette River drains a long, narrow basin extending from northern Hamilton County to St. Lawrence River. Its sources are on an elevated plateau, dotted with mountains, interspersed with lakes, in general timbered, and containing numerous marsh areas, many of which are on the divide and feed streams flowing into adjacent drainages.

The mean annual precipitation is about 38 inches, ranging from about 42 inches in the headwaters to 32 inches near the St. Lawrence. Winter conditions are the usual ones occurring in the Adirondack region, and snow and ice prevail for several months.

Raquette River possesses remarkable facilities for storage and has been very extensively studied by the State Water Supply Commission of New York. They propose a large reservoir at Tupper Lake to afford an effective storage of about 10,000,000,000 cubic feet. They further estimate that about double this amount will be required to adequately regulate the flow of the river. This additional storage it is planned to obtain by a system of smaller reservoirs, involving the following lakes and ponds: Little Tupper, Forked, Raquette, Blue Mountain, Utowana, Brandreth, Horseshoe, and Long lakes, South and Slim ponds, and Dead Creek.

The river also affords many opportunities for power development and, in the words of the State Water Supply Commission, "presents in many ways one of the most attractive fields for water-power and storage studies in the State."

RAQUETTE RIVER AT RAQUETTE FALLS, NEAR COREYS, N. Y.

This station, which is located near the center of Raquette Falls, about 6 miles by river upstream from the village of Axton, which is 12 miles by road from the village of Tupper Lake, was established August 27, 1908, in cooperation with the State Water Supply Commission of New York.

The river flows in one channel at all stages. The current is favorable for making discharge measurements. The bed is composed of large bowlders and is permanent. At low stage the current is sluggish; at high and medium stages the current is suitable for good discharge measurements.

The datum of the staff gage has remained the same during the maintenance of the station.

Measurements are made from a car hung from a cable which was erected during the summer of 1909. Previous to that time measurements were made by wading about 2,000 feet downstream.

The low-water portion of the curve is well defined. No measurements have as yet been made to determine the high-water discharge.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	C. C. Covert	106	623	5.8	3,730
May 26	W. G. Hoyt[1]	89	424	4.26	1,020
July 7	do	88	252	2.00	294
July 23	C. C. Covert	67	184	1.40	141
Nov. 7	F. J. Shuttleworth	89	258	2.54	470

[1] Log jam below gage caused backwater.

Daily gage height, in feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

[C. A. De Lancett, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	5.75	4.2	4.3	2.4	1.5	1.6	1.9	2.4	2.1
2	....	5.8	4.4	4.5	2.2	1.5	1.7	2.0	2.4	2.1
3	....	5.6	4.5	4.5	2.1	1.4	1.7	2.0	2.4	2.1
4	....	5.4	5.1	4.0	2.1	1.7	1.8	2.0	2.4	2.1
5	....	5.4	5.6	3.8	2.1	1.9	1.9	2.0	2.4	2.1
6	....	5.3	5.4	3.9	2.1	1.9	2.5	2.0	2.4	2.1
7	....	5.4	5.2	4.0	2.0	1.8	2.5	2.0	2.5	2.2
8	....	5.5	5.2	4.2	1.9	1.7	2.5	2.0	2.5	2.4
9	....	5.4	5.1	4.1	1.9	1.7	2.4	2.0	2.5	2.7
10	....	5.4	5.1	4.1	1.8	1.7	2.3	2.0	2.5	2.8
11	....	5.4	5.0	4.1	1.8	1.6	2.2	2.0	2.4	3.0
12	....	5.1	4.8	4.1	1.8	1.6	2.2	2.0	2.4	3.0
13	....	4.9	4.6	3.9	1.8	1.6	2.2	2.0	2.4	2.9
14	....	4.7	4.4	3.8	1.7	1.6	2.1	2.0	2.4	2.7
15	....	4.7	4.3	3.6	1.6	1.8	2.1	2.0	2.4	2.7
16	....	4.5	4.3	3.6	1.6	1.8	2.0	2.0	2.3	2.5
17	....	4.5	4.3	3.6	1.6	1.9	2.0	2.0	2.3	2.3
18	....	4.5	4.4	3.6	1.6	2.0	2.0	1.9	2.3	2.1
19	....	4.7	4.4	3.5	1.5	1.9	2.0	1.9	2.2	2.1
20	....	5.1	4.0	3.4	1.5	1.8	2.0	1.9	2.2	2.0
21	....	4.9	4.1	3.3	1.5	1.8	1.9	1.8	2.2	1.9
22	....	5.1	3.9	3.2	1.5	1.7	1.9	1.8	2.2	1.9
23	....	4.9	3.5	3.0	1.4	1.6	1.9	1.9	2.2	1.9
24	....	4.7	3.7	2.9	1.4	1.6	1.9	1.9	2.1	1.9
25	....	4.5	3.9	2.8	1.4	1.7	1.9	2.1	2.1	1.9
26	....	4.4	4.1	2.8	1.5	1.8	1.8	2.3	2.1	1.9
27	....	4.3	4.3	2.7	1.6	1.8	1.8	2.3	2.1	1.8
28	....	4.3	4.8	2.6	1.6	1.7	1.8	2.3	2.1	1.8
29	....	4.2	3.7	2.5	1.5	1.7	1.8	2.3	2.1	1.9
30	5.15	4.2	3.8	2.4	1.5	1.6	1.8	2.4	2.2	2.1
31	5.65	....	4.3	....	1.5	1.6	....	2.4	....	2.3

NOTE.—Ice present at this station from Jan. 1 to about Mar. 29, and from about Dec. 7 to 31. The gage readings during December were probably to water surface.

For a few days in the latter part of May the gage heights were affected by backwater from a log jam, which was probably carried out May 28 by flood from Cold River.

Daily discharge, in second-feet, of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	3,660	1,640	1,750	420	170	190	265	420	320
2	....	3,740	1,860	1,970	350	170	215	290	420	320
3	....	3,430	1,970	1,970	320	150	215	290	420	320
4	....	3,130	2,700	1,450	320	215	240	290	420	320
5	....	3,130	3,430	1,280	320	265	265	290	420	320
6	....	2,980	3,130	1,360	320	265	460	290	420	320
7	....	3,130	2,840	1,450	290	240	460	290	460	....
8	....	3,280	2,840	1,640	265	215	460	290	460	....
9	....	3,130	2,700	1,540	265	215	420	290	460	....
10	....	3,130	2,700	1,540	240	215	385	290	460	....
11	....	3,130	2,570	1,540	240	190	350	290	420	....
12	....	2,700	2,320	1,540	240	190	350	290	420	....
13	....	2,440	2,080	1,360	240	190	350	290	420	....
14	....	2,200	1,860	1,280	215	190	320	290	420	....
15	....	2,200	1,750	1,120	190	240	320	290	420	....
16	....	1,970	1,750	1,120	190	240	290	290	385	....
17	....	1,970	1,750	1,120	190	265	290	290	385	....
18	....	1,970	1,860	1,120	190	290	290	265	385	....
19	....	2,200	1,860	1,040	170	265	290	265	350	....
20	....	2,700	1,450	970	170	240	290	265	350	....
21	....	2,440	1,540	900	170	240	265	240	350	....
22	....	2,700	1,360	830	170	215	265	240	350	....
23	....	2,440	1,040	710	150	190	265	265	350	....
24	....	2,200	1,200	655	150	190	265	265	320	....
25	....	1,970	1,360	600	150	215	265	320	320	....
26	....	1,860	1,540	600	170	240	240	385	320	....
27	....	1,750	1,750	550	190	240	240	385	320	....
28	....	1,750	2,320	505	190	215	240	385	320	....
29	....	1,640	1,200	460	170	215	240	385	320	....
30	2,770	1,640	1,280	420	170	190	240	420	350	....
31	3,430	....	1,750	....	170	190	....	420	....	....

NOTE.—Daily discharges determined from a fairly well defined discharge rating curve. No correction made for effect of log jam the latter part of May.

Monthly discharge of Raquette River at Raquette Falls, near Coreys, N. Y., for 1910.

[Drainage area, 418 square miles.]

Month.	Discharge in second-feet.			Second-feet per square mile.	Run-off (inches on drainage area).	Run-off (per cent of precipitation).
	Maximum.	Minimum.	Mean.			
January			250	0.598	0.69	D.
February			300	.718	.75	D.
March			1,500	3.59	4.14	D.
April	3,740	1,640	2,550	6.10	6.81	B.
May	3,430	1,040	1,980	4.74	5.46	B.
June	1,970	420	1,150	2.75	3.07	B.
July	420	150	226	.541	.62	B.
August	290	150	218	.522	.60	B.
September	460	190	299	.715	.80	B.
October	420	240	304	.727	.84	B.
November	460	320	388	.928	1.04	B.
December			200	.478	.55	D.
The year	3,740		780	1.87	25.37	

NOTE.—Mean discharge for January, February, March, and December has been estimated from the discharge at Piercefield and at other stations in northern New York. The determinations are only approximate.

No revision has been made in the discharge published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor.

RAQUETTE RIVER AT PIERCEFIELD, N. Y.

This station, which is located about three-fourths of a mile above the head of Black Rapids, one-half mile downstream from the dam of the International Paper Co. at Piercefield, and about 12½ miles below the mouth of Bog River, where it enters Tupper Lake, was established August 20, 1908, in cooperation with the New York State Water Supply Commission.

A vertical-staff gage was used from the date of establishment to September 3, 1910. After September 3, 1910, a chain gage, located at the same point as the staff gage, has been used. The gage datum has remained constant since the establishment of the station.

The bed of the stream is rocky, rough, and permanent, and a good discharge rating curve has been developed. The head of Black Rapids forms a pool extending back as far as the tailrace of the power plant of the International Paper Co.

During the low-water period the dam of the International Paper Co. controls the flow of the stream at the gaging station, but the mill usually runs for 24 hours each day except Sunday, on which day there is considerable decrease in stage.

Discharge measurements at low and medium stages are made from a boat just above Black Rapids. High-water measurements are made from the highway bridge about three-fourths of a mile above the station and one-fourth mile above the dam of the International Paper Co.

The relation of gage height to discharge is seldom affected by ice when the gage observations are made to water surface, as the swift water in Black Rapids and at the control point at the head of the rapids rarely freezes. Several measurements made during the winter indicate that the open-water discharge rating curve is applicable during the winter.

Although the discharge at this station is somewhat affected by artificial control, the records are believed to be fairly good.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Piercefield, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 28[a]	C. C. Covert	124	2,020	5.7	2,920
31[a]	.....do	124	2,020	6.6	3,670
May 27[a]	W. G. Hoyt	124	1,920	5.25	2,430
July 8[b]	.....do	97	548	2.22	586
Aug. 19[b]	.....do	98	499	2.12	566

[a] Measurement made at highway bridge above dam. Pond above and underneath bridge full of pulp wood, which affected the surface velocities.
[b] Measurement made from boat at cable.

Daily gage height, in feet, of Raquette River at Piercefield, N. Y., for 1910.

[W. B. Graves, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.65	2.4	......	6.8	......	4.8	1.6	1.9	2.1	2.4	2.5
2	1.0	2.6	2.7	......	6.8	......	4.35	1.4	1.8	1.0	2.48	2.3
3	2.0	2.6	2.7	7.45	6.8	......	1.0	1.4	1.7	1.35	2.50	2.3
4	1.95	......	2.7	7.5	6.85	......	1.0	1.3	.0	2.1	2.58	.0
5	......	2.6	2.7	7.5	6.85	......	3.5	1.4	.0	2.15	2.5	2.12
6	2.0	1.5	1.85	7.55	6.7	......	3.4	1.4	1.85	2.1	.15	2.25
7	......	2.5	3.35	7.5	6.6	......	2.9	.0	2.12	2.15	1.55	2.2
8	1.9	2.7	4.25	7.5	6.4	......	2.25	.0	2.1	2.2	2.25	2.0
9	1.1	2.6	4.25	7.5	6.4	......	2.3	1.65	2.15	.15	2.40	1.9
10	2.0	......	4.25	7.3	6.4	......	1.0	2.0	2.2	.85	3.05	1.9
11	......	......	4.25	7.5	6.4	......	2.1	.0	.0	1.75	2.65	.0
12	2.0	2.5	4.25	7.5	6.35	......	2.2	.0	3.25	2.10	2.75	.0
13	2.6	2.4	3.6	7.5	6.3	......	1.95	.0	2.3	2.05	.0	2.1
14	2.6	2.7	4.8	7.4	5.9	......	2.2	.0	1.95	2.10	1.7	2.05
15	2.0	......	4.8	7.3	5.45	......	2.0	.0	1.75	2.00	3.05	2.0
16	1.1	2.7	4.85	7.1	5.6	......	1.9	.0	1.9	.15	3.2	2.0
17	......	......	4.85	6.8	5.55	......	1.0	.0	1.6	2.05	3.15	1.55
18	1.95	2.7	4.85	6.75	5.5	......	2.0	1.0	.2	2.20	3.05	.0
19	1.8	2.7	4.8	6.9	5.4	......	2.0	2.15	2.2	2.35	3.10	1.5
20	2.0	2.7	4.65	6.4	5.1	......	2.05	1.65	2.2	2.40	.0	2.0
21	......	2.7	4.65	6.5	5.4	......	2.1	.3	2.2	2.40	1.6	1.9
22	2.0	2.7	4.6	6.4	5.6	......	2.15	.0	2.2	2.40	2.4	1.9
23	1.0	2.7	4.5	6.4	5.6	......	2.2	1.32	2.2	.15	2.8	1.9
24	2.45	2.7	4.5	5.9	5.6	......	1.0	1.9	2.2	1.3	3.0	1.9
25	2.5	2.7	4.5	7.0	5.6	4.8	1.75	2.15	.2	2.05	3.0	.0
26	2.5	2.9	4.8	6.8	5.4	4.6	2.15	2.05	1.0	2.15	3.1	.0
27	2.5	1.9	5.1	6.8	5.4	4.8	2.2	2.0	1.35	2.20	.0	.0
28	2.5	......	6.1	6.9	5.4	5.4	2.2	.2	2.15	2.32	1.65	.0
29	2.5	......	6.4	6.9	5.4	5.4	1.95	.0	2.2	2.4	2.4	.0
30	2.1	......	6.9	6.8	5.4	4.8	1.9	1.75	2.1	.2	2.5	.0
31	2.55	......	6.65	......	5.4	......	.0	2.05	......	1.55	......	.0

NOTE.—Some of the gage readings for this station are erroneous, and for this cause gage readings as recorded by the observer from June 1 to 24 are omitted altogether. The readings recorded as 0 in the above table are especially incorrect, the gage height probably being considerably higher on those days. In the period Dec. 27 to 31 the plant of the International Paper Co. is known to have been in operation; on other days for which the gage height is recorded as 0 or other abnormally low value, the plant is assumed to have been closed and the discharge stored above the dam.

Gage heights Jan. 1 to Mar. 12 are to the top of ice. December gage heights are probably to water surface.

Daily discharge, in second-feet, of Raquette River at Piercefield, N. Y., for 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	487	735	635	3,820	3,980	....	2,020	369	456	521	635	675
2	218	715	755	4,720	3,980	....	1,680	316	426	218	667	595
3	487	715	755	4,720	3,980	....	218	316	397	303	675	595
4	472	715	755	4,780	4,040	....	218	290	90	521	707	90
5	480	715	755	4,780	4,040	....	1,160	316	90	539	675	528
6	487	342	441	4,840	3,870	....	1,000	316	441	521	101	576
7	472	675	1,080	4,780	3,760	....	845	90	528	539	356	557
8	456	755	1,600	4,780	3,560	....	576	90	521	557	576	487
9	241	715	1,600	4,780	3,560	....	595	383	539	101	635	456
10	487	715	1,600	4,540	3,560	....	218	487	557	186	920	456
11	487	675	1,600	4,780	3,560	....	521	90	90	412	735	90
12	487	675	1,600	4,780	3,500	....	557	90	1,020	521	778	90
13	715	635	1,220	4,780	3,450	....	472	90	595	504	90	521
14	715	755	2,020	4,660	3,050	....	557	90	472	521	397	504
15	487	755	2,020	4,540	2,600	....	487	90	412	487	920	487
16	241	755	2,060	4,320	2,750	....	456	90	456	101	995	487
17	356	755	2,060	3,980	2,700	....	218	90	369	504	970	356
18	472	755	2,060	3,920	2,650	....	487	218	105	557	920	90
19	426	755	2,020	4,090	2,560	....	487	539	557	615	945	342
20	487	755	1,900	3,560	2,290	....	504	383	557	635	90	487
21	487	755	1,900	3,660	2,560	....	521	114	557	635	369	456
22	487	755	1,860	3,560	2,750	....	539	90	557	635	635	456
23	218	755	1,780	3,560	2,750	....	557	295	557	101	800	456
24	655	755	1,780	3,050	2,750	....	218	456	557	290	895	456
25	675	755	1,780	4,200	2,750	2,020	412	539	105	504	895	90
26	675	845	2,020	3,980	2,560	1,860	539	504	218	539	945	90
27	675	456	2,290	3,980	2,560	2,020	557	487	303	557	90	450
28	675	456	3,250	4,090	2,560	2,560	557	105	539	603	383	450
29	675	....	3,560	4,090	2,560	2,560	472	90	557	635	635	450
30	521	....	4,090	3,980	2,560	2,020	456	412	521	105	675	450
31	695	....	3,820	....	2,560	....	90	504	....	356	....	450

NOTE.—Daily discharge determined from a well-defined discharge rating curve. During the period Jan. 1 to Mar. 12, when the gage heights were taken to the top of the ice, the discharge rating curve was applied directly, as the ice was less than one-half foot thick and was probably constantly in a state of flotation. Discharge interpolated for days on which gage heights are missing, except on Feb. 28 and April 1 and 2 when it was estimated. Discharge for days on which gage height was recorded as 0 estimated at 90 second-feet, except Dec. 27 to 31, when the plant of the International Paper Co. is known to have been running. For these days the discharge is estimated at 450 second-feet. The discharge for the period Aug. 11 to 17 is subject to considerable doubt.

Monthly discharge of Raquette River at Piercefield, N. Y., for 1910.

[Drainage area, 723 square miles.]

Month.	Discharge in second-feet.				Run-off (inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.		
January	695	218	503	0.696	0.80	C.
February	845	342	700	.968	1.01	C.
March	4,090	635	1,830	2.53	2.92	C.
April	4,840	3,050	4,270	5.91	6.59	C.
May	4,040	2,290	3,110	4.30	4.96	C.
June	....	....	2,040	2.82	3.15	C.
July	2,020	90	587	.812	.94	C.
August	539	90	269	.372	.43	C.
September	1,020	90	438	.606	.68	C.
October	635	101	446	.617	.71	C.
November	995	90	637	.881	.98	C.
December	675	90	410	.567	.65	C.
The year	4,840	90	1,270	1.757	23.82	

NOTE.—Discharge for June estimated from the discharge at Massena Springs. Monthly discharge for this station, as published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the New York State engineer and surveyor, has been corrected.

RAQUETTE RIVER AT MASSENA SPRINGS, N. Y.

This station, which is located at the highway bridge at Massena Springs, 1,000 feet above the New York Central & Hudson River Railroad bridge, used for freight transfer from the railroad station to Massena power plant, 8 miles below Raymondville, and about 10 miles above the mouth of the river, was established September 21, 1903, temporarily discontinued October 17, 1903, and reestablished April 9, 1904.

The nearest power plant is at Raymondville, about 8 miles above the station. The Sunday flow of the stream is often held back during the low-water season while ponds at mills above are being refilled, and under these conditions the effect of the storage may be shown in the stream for several days.

The original gage was a vertical staff fastened to a stone masonry wall on the left bank, 25 feet upstream from the bridge. This gage was replaced August 16, 1906, by a standard chain gage fastened to the upstream side of the highway bridge. The datum of the chain gage was made 1 foot lower than that of the staff gage in order to avoid negative readings.

Ice forms at this station to a thickness of 3 feet, and the gage records for December, January, February, and March are usually much affected.

Determinations of monthly discharge are considered good, but during the low-water period daily discharges may be considerably in error as a result of artificial control.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Raquette River at Massena Springs, N. Y., for 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 30	C. C. Covert	173	1,110	6.38	4,680
Aug. 23	W. G. Hoyt	166	341	1.90	597

Daily gage height, in feet, of Raquette River at Massena Springs, N. Y., for 1910.

[F. L. Babcock, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	6.95	4.7	4.65	3.35	2.05	1.65	1.85	2.5	2.1
2	....	7.1	4.7	4.65	3.2	2.0	1.62	2.15	2.15	2.3
3	....	7.2	4.75	4.5	3.1	2.1	1.75	1.5	2.75	2.65
4	....	7.15	5.05	4.35	2.3	1.9	1.25	2.15	2.85	2.4
5	....	7.05	5.95	4.1	3.35	1.75	1.7	1.95	2.95	2.85
6	....	7.15	6.0	4.4	2.85	1.65	2.2	2.1	2.85	3.05
7	....	7.05	5.65	4.25	2.2	1.85	2.15	1.9	3.05	3.45
8	....	6.95	5.5	4.8	1.85	2.0	2.3	2.7	2.95	3.55
9	....	7.0	5.65	5.0	1.75	2.8	2.45	3.35	2.4	3.6
10	....	6.85	5.65	4.85	2.35	2.45	2.65	3.0	2.65	4.1
11	....	6.95	5.55	4.75	2.05	1.7	2.5	2.8	3.2	4.25
12	7.6	6.95	5.65	4.75	2.25	1.6	2.2	2.35	3.05	4.15
13	7.7	7.05	5.65	4.9	2.2	1.65	2.35	2.2	3.1	3.7
14	7.8	6.95	5.7	4.5	1.7	1.55	2.35	3.15	3.35	3.85
15	7.5	6.95	5.25	4.45	1.88	1.75	2.15	2.55	3.4	3.75
16	7.45	6.55	5.25	4.6	2.15	1.75	2.35	2.3	2.95	3.6
17	7.25	6.2	5.35	4.35	2.05	1.8	2.55	2.0	3.15	3.85
18	6.9	6.3	5.25	4.35	1.75	1.65	2.1	2.5	3.25	3.95
19	6.65	6.25	5.1	4.45	2.12	1.65	2.15	2.4	3.05	4.05
20	7.15	6.35	4.85	4.7	2.15	1.4	2.25	1.95	2.85	3.0
21	6.95	6.25	4.7	4.15	2.15	1.25	2.05	1.8	2.8	....
22	6.9	5.8	4.9	4.15	1.65	1.45	1.6	2.0	3.25	....
23	6.6	5.6	4.95	4.05	1.9	1.85	1.4	2.25	2.55	....
24	6.1	5.25	4.65	3.9	1.8	2.05	1.6	2.15	2.35	....
25	6.3	5.5	4.65	3.72	1.6	1.9	1.65	2.4	2.85	....
26	6.55	5.4	4.75	3.6	2.2	1.7	1.65	2.45	3.05	....
27	6.75	5.25	4.75	3.3	2.25	1.7	2.05	2.75	2.8	3.4
28	6.8	5.15	4.75	3.3	1.7	1.55	2.3	3.05	2.75	....
29	6.4	5.05	4.65	3.05	1.6	1.55	1.6	3.3	2.95	....
30	6.45	4.9	4.5	3.08	1.75	2.0	1.75	3.1	1.65	....
31	6.6	....	4.35	....	2.15	1.4	....	3.0	....	....

NOTE.—Ice present at this station from Jan. 1 to Mar. 11 and from Dec. 1 to 31. Gage heights during December to water surface.

Daily discharge, in second-feet, of Raquette River at Massena Springs, N. Y., for 1910.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,050	5,210	2,790	2,740	1,590	675	457	559	955	....
2	1,050	5,400	2,790	2,740	1,470	645	443	735	735	....
3	1,050	5,520	2,840	2,600	1,390	705	506	388	1,120	....
4	1,050	5,460	3,120	2,460	825	586	284	735	1,200	....
5	1,050	5,330	4,060	2,240	1,590	506	481	616	1,270	....
6	1,050	5,460	4,110	2,500	1,200	457	765	705	1,200	....
7	1,480	5,330	3,730	2,370	765	559	735	586	1,350	....
8	2,200	5,210	3,580	2,880	559	645	825	1,090	1,270	....
9	3,000	5,270	3,730	3,080	506	1,160	922	1,590	890	....
10	3,500	5,090	3,730	2,930	858	922	1,060	1,310	1,060	....
11	5,000	5,210	3,630	2,840	675	481	955	1,160	1,470	....
12	6,040	5,210	3,730	2,840	795	433	765	858	1,350	....
13	6,180	5,330	3,730	2,980	765	457	858	765	1,390	....
14	6,310	5,210	3,780	2,600	481	410	858	1,440	1,590	....
15	5,900	5,210	3,320	2,550	575	506	735	988	1,630	....
16	5,840	4,730	3,320	2,700	735	506	858	825	1,270	....
17	5,580	4,330	3,420	2,460	675	532	988	645	1,430	....
18	5,150	4,440	3,320	2,460	506	457	705	955	1,510	....
19	4,850	4,390	3,180	2,550	717	457	735	890	1,350	....
20	5,460	4,500	2,930	2,790	735	345	795	616	1,200	....
21	5,210	4,390	2,790	2,280	735	284	675	532	1,160	....
22	5,150	3,890	2,980	2,280	457	366	433	645	1,510	....
23	4,790	3,680	3,030	2,190	586	559	345	795	988	....
24	4,220	3,320	2,740	2,060	532	675	433	735	858	....
25	4,440	3,580	2,740	1,900	433	586	457	890	1,200	....
26	4,730	3,480	2,840	1,800	765	481	457	922	1,350	....
27	4,970	3,320	2,840	1,550	795	481	675	1,120	1,160	....
28	5,030	3,220	2,840	1,550	481	410	825	1,350	1,120	....
29	4,560	3,120	2,740	1,350	433	410	433	1,550	1,270	....
30	4,620	2,980	2,600	1,370	506	645	506	1,390	457	....
31	4,790	....	2,460	....	735	345	....	1,310	....	....

NOTE.—Daily discharges determined from a well-defined discharge rating curve. Discharge Mar. 1 to 11 estimated from the discharge at Piercefield.

Monthly discharge of Raquette River at Massena Springs, N. Y., for 1910.

[Discharge area, 1,170 square miles.]

Month.	Discharge in second-feet.				Run-off (inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.		
January			690	0.590	0.68	D.
February			960	.820	.85	D.
March	6,310		4,040	3.45	3.98	B.
April	5,520	2,980	4,560	3.90	4.35	A.
May	4,110	2,460	3,210	2.74	3.16	A.
June	3,080	1,350	2,390	2.04	2.28	A.
July	1,590	433	770	.658	.76	A.
August	1,160	284	538	.460	.53	A.
September	1,060	284	666	.569	.63	A.
October	1,590	388	926	.791	.91	A.
November	1,630	457	1,210	1.03	1.15	A.
December			660	.564	.65	D.
The year	6,310	284	1,720	1.47	19.93	

NOTE.—Discharge for January, February, and December estimated from the discharge at Piercefield. No revision has been made in the determinations of discharge published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the State engineer and surveyor.

BOG RIVER NEAR TUPPER LAKE, N. Y.

This station, which is located above Bog River Falls, about 300 feet below the forks of Tupper Lake stream and Bog River, about 2½ miles above Big Tupper Lake in the town of Piercefield, and about 11 miles southwest of the town of Tupper Lake, was established August 24, 1908.

The staff gage is located about 2½ miles downstream at the head of Bog River Falls and is within a few rods of Big Tupper Lake. The elevation of the zero of the gage determined by the United States Geological Survey bench mark at Tupper Lake Junction, according to the levels of the State Water Supply Commission of New York, is 1,563.76 feet above mean tide.

The bed of the stream is sandy and contains scattered bowlders, but it is probably permanent and a good low-water rating curve has been developed.

Since the summer of 1909 discharge measurements are made from a car hung on a cable. Before that time the measurements were made by wading or from a boat.

Gage readings previous to 1910 were obtained either by a recording gage or by hydrographers and other engineers, who periodically visit the station.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission and the State engineer and surveyor, State of New York.

Discharge measurements of Bog River near Tupper Lake, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 2	C. C. Covert	72	220	2.82	368
May 20	W. G. Hoyt	65	245	3.06	494
25	.....do	75	289	3.38	664
July 6	.....do	51	108	1.53	101

Daily gage height, in feet, of Bog River near Tupper Lake, N. Y., for 1910.

[B. O. Lott, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		2.1	3.4	1.3	1.0	1.0	1.4	1.6
2		5.05	3.3	1.3	1.0	1.1	1.5	1.6
3	3.1	4.95	3.2	1.3	1.0	1.2	1.5	1.6
4	2.7	2.65	3.2	1.2	1.0	1.3	1.4	1.6
5	3.1	3.8	3.0	1.2	1.0	1.3	1.5	1.7
6	2.9	3.6	2.8	1.4	1.0	1.2	1.5	1.8
7	2.2	4.45	2.6	1.5	1.0	1.2	1.5	1.8
8	3.7	2.4	2.5	1.5	1.0	1.3	1.4	1.7
9	3.8	5.0	2.5	1.4	1.1	1.4	1.3	1.7
10	3.5	4.95	2.7	1.2	1.2	1.5	1.3	1.7
11	3.8	4.8	2.8	1.3	1.2	1.55	1.3	1.8
12	4.2	4.3	2.7	1.3	1.2	1.5	1.4	1.9
13	3.7	2.7	2.6	1.2	1.1	1.5	1.5	1.9
14	3.6	2.3	2.5	1.1	1.0	1.4	1.5	2.0
15	3.4	2.1	2.5	1.1	1.0	1.4	1.6	2.3
16	5.1	2.1	2.5	1.1	1.0	1.3	1.5	2.4
17	4.8	2.1	2.6	1.1	1.1	1.2	1.4	2.3
18	4.6	2.3	2.8	1.1	1.1	1.3	1.4	2.3
19	2.7	2.2	3.0	1.1	1.0	1.3	1.3	2.3
20	4.1	4.6	2.8	1.1	1.0	1.3	1.3	2.3
21	4.55	4.5	2.6	1.1	1.0	1.4	1.5	2.3
22	1.9	3.1	2.6	1.1	1.0	1.3	1.6	2.3
23	3.1	3.0	2.4	1.1	1.0	1.3	1.5	2.3
24	2.1	3.2	2.1	1.1	1.0	1.3	1.5	2.3
25	1.2	3.45	2.0	1.0	1.0	1.3	1.5	2.4
26	1.6	3.4	1.8	1.0	.9	1.3	1.6	2.4
27	1.9	3.4	1.5	1.0	.8	1.3	1.6	2.1
28	1.9	3.4	1.4	1.1	.8	1.3	1.7	2.0
29	2.0	3.4	1.4	1.1	.8	1.3	1.7	2.0
30	5.05	3.5	1.4	1.2	.8	1.3	1.6	1.9
31		3.4		1.1	.9		1.6	

NOTE.—No observations of gage heights for periods during which ice was present.

Daily discharge, in second-feet, of Bog River near Tupper Lake, N. Y., for 1910.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	500	186	625	60	28	28	72	100
2	500	1,650	580	60	28	37	85	100
3	495	1,580	535	60	28	48	85	100
4	340	325	535	48	28	60	72	100
5	495	825	455	48	28	60	85	115
6	415	720	375	72	28	48	85	131
7	208	1,230	310	85	28	48	85	131
8	770	254	280	85	28	60	72	115
9	825	1,610	280	72	37	72	60	115
10	670	1,580	340	48	48	85	60	115
11	825	1,470	375	60	48	92	60	131
12	1,060	1,130	340	60	48	85	72	148
13	770	340	310	48	37	85	85	148
14	720	230	280	37	28	72	85	166
15	625	186	280	37	28	72	100	230
16	1,690	186	280	37	28	60	85	254
17	1,470	186	310	37	37	48	72	230
18	1,330	230	375	37	37	60	72	230
19	340	208	455	37	28	60	60	230
20	1,000	1,330	375	37	28	60	60	230
21	1,300	1,260	310	37	28	72	85	230
22	148	495	310	37	28	60	100	230
23	495	455	254	37	28	60	85	230
24	186	535	186	37	28	60	85	230
25	48	648	166	28	28	60	85	254
26	100	625	131	28	20	60	100	254
27	148	625	85	28	14	60	100	186
28	148	625	72	37	14	60	115	166
29	166	625	72	37	14	60	115	166
30	1,650	670	72	48	14	60	100	148
31	....	625	....	37	20	....	100	....

NOTE.—Daily discharge determined from a discharge rating curve fairly well defined below about 800 second-feet. Discharge Apr. 1 and 2 estimated.

Monthly discharge of Bog River near Tupper Lake, N. Y., for 1910.

[Drainage area, 132 square miles.]

Month.	Discharge in second-feet.				Run-off (inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Second-feet per square mile.		
January	....	....	100	0.758	0.87	D.
February	....	....	100	.758	.79	D.
March	....	....	500	3.79	4.37	D.
April	1,690	48	648	4.91	5.48	B.
May	1,650	186	730	5.53	6.38	B.
June	625	72	312	2.36	2.63	B.
July	85	28	47.0	.356	.41	B.
August	48	14	28.8	.218	.25	B.
September	92	28	61.7	.467	.52	B.
October	115	60	83.3	.631	.73	B.
November	254	100	140	1.06	1.18	B.
December	....	....	80	.606	.70	D.
The year	1,690	14	236	1.79	24.31	

NOTE.—Monthly discharge for January, February, March, and December estimated from a consideration of general conditions of run-off in northern New York. Values approximate.

No revision has been made of discharge data published in the Sixth Annual Report of the New York State Water Supply Commission and the 1910 report of the New York State engineer and surveyor, although values for April published in those reports were changed by the addition of the estimated discharge on Apr. 1 and 2.

ST. REGIS RIVER BASIN.

GENERAL FEATURES.

St. Regis River rises in several small streams and lakes in the western part of Franklin County, at an elevation of about 1,500 feet above sea level, flows northwestward about 40 miles and then somewhat east of north for about 28 miles to its junction with St. Lawrence River near the State line. Its drainage area comprises 664 square miles.[1] The upper part of the basin consists of swamps and mountains from which most of the forest has been largely cut. On leaving the plateau the stream descends for 10 or 15 miles, in a succession of steep rapids and precipitous falls, through a rugged country to the lowlands bordering the St. Lawrence. In this stretch are excellent power sites, only a few of which have as yet been utilized. From the foot of the hills to the St. Lawrence the slope of the river is moderate and rock outcrop not frequent, consequently favorable sites for power development are scarce. According to report of the State Water Supply Commission for 1910, the present limit of profitable development through this low country, except as increased by regulation of stream flow, has probably been reached in the existing plants. A detailed description, showing all power developments and future possible developments, is given in the 1910 report of the State Water Supply Commission.

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

This station, which is located in the village of Brasher Center, 5 miles downstream from Brasher Falls, and about 12 miles above the mouth of the river, was established August 22, 1910, in cooperation with the New York State Water Supply Commission.

A chain gage is located on the downstream side of the bridge, over the right-hand channel.

Low-water measurements have been made by wading about 500 feet above the bridge; high-water measurements are made from the bridge. A rating table is not developed as yet and only discharge measurements and gage heights are published.

Information in regard to this station is contained in the annual reports of the State Water Supply Commission.

Discharge measurements of St. Regis River at Brasher Center, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec. ft.*
July 25	C. C. Covert	160	196	[a] 19.36	176
Aug. 20[b]	W. G. Hoyt	216	359	4.48	505

[a] Distance to water surface from reference point on first bridge above Helena.
[b] Measurement made at wading section, 200 feet upstream from gage.

[1] State Water Supply Commission.

Daily gage height, in feet, of St. Regis River at Brasher Center, N. Y., for 1910.

[George Myers, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.12	4.12	4.85	4.42	16		4.25	4.25	4.78	5.50
2		4.10	4.10	4.85	4.58	17		4.22	4.35	4.70	5.62
3		4.22	4.10	4.72	4.55	18		4.20	4.38	4.55	
4		4.18	4.25	4.78	4.70	19		4.20	4.30	4.62	
5		4.16	4.32	4.78	4.80	20		4.10	4.35	4.65	
6		4.22	4.40	4.88	4.68	21		4.12	4.25	4.48	
7		5.12	5.18	4.98	5.20	22	4.25	4.12	4.10	4.52	
8		5.22	5.50	4.88	5.20	23	4.16	4.16	4.12	4.50	
9		4.96	5.40	4.82	5.85	24	4.05	4.10	4.25	4.42	
10		4.70	5.22	4.78	6.00	25	4.11	4.12	4.60	4.60	
11		4.55	4.95	5.05	6.05	26	4.15	4.10	5.25	4.62	
12		4.41	4.75	5.08	6.05	27	4.25	4.12	5.45	4.62	
13		4.32	4.50	4.98	5.98	28	4.02	4.18	5.50	4.62	
14		4.25	4.35	4.88	5.85	29	3.95	4.20	5.40	4.55	
15		4.22	4.35	4.75	5.35	30	3.50	4.12	5.35	4.48	
						31	4.05		5.05		

NOTE.—Ice present Dec. 7–31.

RICHELIEU RIVER BASIN.

GENERAL FEATURES.

Richelieu River, the outlet of Lake Champlain, emerges from the lake at Rouse Point and flows northward to the St. Lawrence.

Lake Champlain occupies a long and narrow valley, extending in a north-south direction and forming a part of the boundary between New York and Vermont. The elevation of the lake is about 95 feet above tide, and the water-surface area is 436 square miles.

The drainage basin is irregular in form, being about 75 miles wide from a point opposite Middlebury, Vt., northward to the outlet of the lake at Rouse Point, on the international boundary. South of Middlebury the average width of the basin is about 35 miles, and the lake itself is very narrow, forming virtually a drowned river.

The tributary region is rugged and mountainous, covered with little depth of soil except in the stream valleys. The drainage is received almost entirely through large tributaries, there being little direct coast drainage into the lake. The total drainage area at the mouth of the lake is about 7,867 square miles (including lake surface).

LAKE CHAMPLAIN AT BURLINGTON, VT.

This station is located on the south side of the roadway leading to the docks of the Champlain Transportation Co., of Burlington, Vt., at a point about 80 feet from the roadway at the foot of King Street. Readings have been obtained since May 1, 1907.

A comparison of gage readings on calm days during 1907 and 1908, made under the direction of Prof. A. D. Butterfield, formerly of the University of Vermont, indicates that the zeros of the gages at Fort Montgomery and at Burlington are at substantially the same elevation, namely, 92.50 feet above mean sea level. The gage readings at Burlington during 1910, as published in the following table, were taken and 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 1910.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				5.40		3.80	3.15	1.90	1.40	1.00	1.20	1.35
2		[a]1.80	2.55	5.50		3.80	3.10	1.85			1.20	1.35
3			2.97		4.30	3.70		1.80		1.00	1.20	1.37
4				5.45	4.40	3.65		1.80		1.00		
5				5.40	4.50		2.95	1.80	1.33	1.00	1.25	1.37
6				5.30	4.50	3.60	2.90	1.80	1.30	1.00		1.35
7				5.38	4.50	3.60	2.85	1.80	1.25	1.05		1.35
8		[a]1.80		5.40		3.78	2.80	1.80	1.30	1.10	1.40	1.33
9			4.53	5.40	4.50	3.85	2.70				1.40	1.30
10			4.63		4.40	3.90		1.75	1.40	1.15	1.47	
11				5.38	4.00	3.90	2.65	1.75	1.40	1.15	1.40	
12			4.70	5.35	4.35		2.60	1.70	1.40	1.15	1.45	
13				5.30	4.30	3.85	2.50	1.70	1.35	1.17		
14	[a]0.71	1.80	4.78	5.20	4.28	3.85	2.45		1.33	1.17	1.45	
15			4.80	5.10		3.80	2.40	1.70	1.30	1.20	1.45	
16			4.75	5.05	4.05	3.75	2.40	1.70	1.30	1.20	1.45	
17			4.70		4.00	3.75		1.70	1.30	1.15	1.45	
18			4.70	4.85	3.90	3.70	2.40	1.65		1.15	1.45	
19	[a].70		4.55	4.85	3.85		2.35	1.65	1.25	1.10	1.43	
20				4.85	3.85	3.65	2.30	1.65	1.25	1.10		
21		1.90	4.60	4.80	3.80	3.60	2.25		1.20	1.10	1.40	
22			4.68	4.75		3.55		1.65	1.20	1.10	1.40	
23			4.65	4.70	3.75	3.50	2.15	1.60			1.40	
24	1.15		4.65		3.75	3.45		1.60	1.10	1.10	1.35	
25	1.40		4.75	4.60	3.60	3.40	2.10	1.60		1.10	1.35	
26			4.95	4.52	3.70		2.00	1.35	1.05		1.35	
27				4.45	3.75	3.40	1.95	1.35		1.15		1.25
28	1.60	2.00	5.15	4.45	3.75	3.40	1.95		1.05		1.35	
29			5.20	4.40			1.95	1.35	1.05	1.20	1.35	
30			5.30			3.15	1.95	1.40	1.05		1.35	
31			5.25		3.80			1.40		1.20	1.35	

[a] Surface of ice.

Breaking up of ice in Lake Champlain.

Year.	Ice broke up.	Steamers commenced running between Burlington and Plattsburg.	Year.	Ice broke up.	Steamers commenced running between Burlington and Plattsburg.
1897	Apr. 7	Apr. 10	1905	Apr. 14	Apr. 17
1898	Mar. 25	Mar. 26	1906	...do....	Do.
1899	Apr. 19	Apr. 20	1907	Apr. 16	Apr. 18
1900	Apr. 20	Apr. 21	1908	Apr. 14	Apr. 20
1901	Apr. 15	Apr. 17	1909	Apr. 13	Apr. 19
1902	Apr. 5	Apr. 7	1910	Mar. 28	Apr. 11
1903	Mar. 17	Mar. 25	1911	Apr. 24	Apr. 24
1904	Apr. 18	Apr. 19			

RICHELIEU RIVER AT FORT MONTGOMERY, N. Y.

This station is located in the fort, about one-half mile from the head of Richelieu River, at the outlet of Lake Champlain at Rouse Point, N. Y., where a record of gage heights has been kept by the United States Corps of Engineers since 1875. Through the courtesy of Maj. Edward Burr the daily gage readings are reported weekly to the United States Geological Survey.

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The entire surface of Lake Champlain freezes over nearly every winter, and the freezing may affect the discharge.

The elevation of gage zero at Fort Montgomery is 92.50 feet above mean sea level, according to the adjustment in 1906 of mean sea datum in this vicinity by the topographic branch of the United States Geological Survey. High-water level is at elevation 101.6 feet, and on November 13, 1908, an elevation of 91.9 feet was recorded at Fort Montgomery, probably the lowest on record.

The daily discharge of the lake has been determined from observations of the depth and discharge over the Chambly dam, 35 miles below the head of Richelieu River, made in 1898 by the United States Board on Deep Waterways. A rating table has been derived from the observations at the Chambly dam and the gage readings taken at Rouse Point. The area tributary to the river between Rouse Point and Chambly is 310 square miles, making the total drainage basin above Chambly 8,177 square miles.[1]

Estimates of monthly discharge are withheld pending the verification of the rating curve previously used to determine the discharge at this point.

All gage heights previously published, including those for 1910, have been referred to the gage zero instead of to sea level.

Information in regard to this station is contained in the reports of the New York State engineer and surveyor.

Daily gage height, in feet, of Richelieu River at Fort Montgomery, N. Y., for 1910.

[William McComb, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.5	1.45	2.1	5.3	4.2	3.6	3.05	1.8	1.2	1.3	1.2	1.25
2	.45	1.5	2.4	5.35	4.3	3.65	3.0	1.75	1.2	.9	1.4	1.3
3	.45	1.5	2.75	5.35	4.1	3.6	2.95	1.8	1.45	1.0	1.0	1.3
4	.4	1.55	2.95	5.45	4.15	3.5	2.85	1.85	1.15	1.45	.9	1.3
5	.45	1.5	3.15	5.35	4.4	3.5	2.9	1.75	1.2	1.1	1.1	1.2
6	.45	1.5	3.35	5.35	4.45	3.55	2.85	1.75	1.25	1.25	1.2	1.25
7	.4	1.6	3.65	5.25	4.5	3.55	2.85	1.7	1.25	1.0	1.3	1.25
8	.45	1.65	3.9	5.2	4.4	3.6	2.75	1.7	1.3	1.1	1.25	1.3
9	.45	1.65	4.1	5.25	4.4	3.75	2.7	1.75	1.3	1.2	1.3	1.2
10	.4	1.6	4.25	5.2	4.35	3.8	2.65	1.9	1.25	1.05	1.3	1.2
11	.4	1.55	4.35	5.2	4.3	3.8	2.6	1.7	1.3	1.1	1.35	1.2
12	.05	1.55	4.5	5.15	4.25	3.85	2.55	1.7	1.35	.85	1.3	1.1
13	.4	1.5	......	5.15	4.2	3.8	2.55	1.7	1.15	1.0	1.35	1.1
14	.4	1.5	......	5.15	4.1	3.75	2.5	1.65	1.15	1.0	1.3	1.2
15	.4	1.55	......	5.0	4.05	3.75	2.4	1.65	1.25	1.0	1.3	1.05
16	.45	1.55	......	4.95	4.05	3.65	2.3	1.6	1.2	.9	1.25	1.1
17	.45	1.55	4.5	5.25	4.0	3.7	2.25	1.65	1.15	1.0	1.25	1.2
18	.45	1.5	4.45	4.95	4.1	3.65	2.15	1.75	1.15	1.05	1.3	1.1
19	.4	1.6	......	4.8	3.8	3.6	2.15	1.5	1.1	1.1	1.25	1.15
20	.4	1.55	......	4.8	3.7	3.55	2.1	1.5	1.15	1.0	1.3	1.15
21	.45	1.6	......	4.7	3.7	3.55	2.3	1.55	1.1	.9	1.35	1.05
22	.5	1.65	......	4.65	3.65	3.5	2.25	1.6	1.05	1.4	1.25	1.1
23	.8	1.7	......	4.6	3.7	3.4	2.05	1.7	1.15	.9	1.3	1.25
24	1.0	1.7	......	4.55	3.7	3.35	2.05	1.6	1.45	.9	1.4	1.1
25	1.15	1.7	4.55	4.5	3.6	3.35	2.05	1.6	1.25	.95	1.25	1.05
26	1.25	1.75	4.7	4.5	3.6	3.3	1.95	1.45	1.15	.9	1.2	1.15
27	1.35	1.75	4.9	4.4	3.6	3.3	1.95	1.45	1.05	1.5	1.15	1.2
28	1.35	1.85	5.3	4.25	3.65	3.2	1.9	1.45	1.1	.95	1.2	1.2
29	1.35	......	5.15	4.3	3.65	3.15	1.9	1.25	1.05	1.0	1.25	1.15
30	1.5	......	5.2	4.6	3.65	3.1	1.95	1.25	1.25	1.05	1.2	1.25
31	1.45	......	......	......	3.6	......	1.8	1.5	......	1.2	......	1.3

[1] Rept. State Engineer and Surveyor of New York for 1910.

SARANAC RIVER BASIN.

GENERAL FEATURES.

Saranac River rises in the lakes in southeastern Franklin County, N. Y., and flows northeastward to a point near Cadyville and thence eastward into Lake Champlain at Plattsburg. The basin ranges in width from 10 to less than 25 miles and is about 60 miles long, the total drainage area comprising about 630 square miles. The southern boundary of the basin is the Ampersand Mountain range and the stream drains the north slope of the most elevated region of the State of New York.

About 16.2 per cent of the upper drainage is water surface. Owing to its somewhat equalized flow and rapid fall the stream presents many opportunities for power development. The mean annual precipitation is about 35 inches, and the winters are usually severe.

SARANAC RIVER NEAR PLATTSBURG, N. Y.

This station, which is located at the Lozier dam of the Plattsburgh Gas & Electric Co., about 6 miles above Plattsburg, was established March 27, 1903.

The record includes the flow over a spillway crest 171.75 feet in length, the discharge through two 5-foot waste gates when open, and the discharge through four 33-inch Victor turbines controlled by automatic governors. The records are furnished by Herbert A. Stutchbury, superintendent. Experiments have been made at Cornell University hydraulic laboratory on a model of the ogee section of the dam, from which coefficients have been derived for the calculation of the discharge over the dam.

The elevation of the zeros of both the spillway gage and the tailrace gage have remained the same during the maintenance of the station.

Tests made at this plant indicate that past computations of discharge at low stages are 20 per cent or more too low. The determinations of daily discharges are withheld pending further tests.

Information in regard to this station is contained in the reports of the New York State engineer and surveyor.

AUSABLE RIVER BASIN.

GENERAL FEATURES.

Ausable River is formed by the junction of its East and West branches, which head in the northwestern part of Essex County. The East Branch flows from upper Ausable Lake, at an elevation of 1,990 feet above sea level; the West Branch is formed by several small streams which lie in the valley to the west and north of East Branch. Both branches flow north and east to their junction in the village of Ausable Forks, from which point the river flows northeast, entering Lake Champlain about 10 miles south of Plattsburg, opposite and slightly north of the city of Burlington.

Throughout the entire course the river is fed by small mountain streams, which enter at nearly right angles from the mountains on either side. There are few lakes in this drainage basin to regulate the flow and, owing to the great differences of elevation throughout the area, the stream has what is called a flashy discharge, its fluctuations being large and rapid.

Owing to the fact that this basin lies on the eastern slope of the Adirondack Mountains, the average rainfall is less than for those basins whose streams rise in the western and southern slopes, the mean yearly precipitation being about 32 inches.

About 6,000 water horsepower is developed at the present time, principally on the West Branch.[1]

AUSABLE RIVER AT AUSABLE FORKS, N. Y.

This station, which is located in the village of Ausable Forks, about 15 miles above the mouth of the river, immediately below the junction of the East and West branches, was established August 27, 1910, in cooperation with the New York State Water Supply Commission.

A standard chain gage is fastened to a cantilever arm on the right hand bank, about 40 feet below the confluence of the East and West branches, in the village of Ausable Forks.

Measurements during this year have been made farther down stream by wading. On December 7, 1910, there was installed, 2 miles below the gage, a cable from which future measurements will be made.

The gage heights published below are slightly affected by the operation of pulp mills above the station.

Discharge measurements of Ausable River at Ausable Forks, N. Y., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 17	W. G. Hoyt	207	314	3.77	[a] 327
Dec. 9	Covert & Shuttleworth	182	313	3.85	[b] 271

[a] Measurement made at wading section.
[b] Measurement made under partial ice cover at cable station.

[1] See Fifth Ann. Rept. New York State Water Supply Comm., pp. 88, 147, 267.

Daily gage height, in feet, of Ausable River at Ausable Forks, N. Y., for 1910.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.60	3.66	3.78	3.72	16		3.61	3.62	3.83	3.97
2		3.60	3.66	3.72	3.72	17	3.76	3.64	3.62	3.72	3.90
3		3.61	3.83	3.76	3.68	18	3.67	3.61	3.66	3.70	3.88
4		3.68	3.74	3.87	3.70	19	3.74	3.62	3.62	3.80	4.02
5		3.82	3.74	4.08	3.73	20	3.68	3.59	3.64	3.69	3.90
6		4.38	3.78	4.22	3.73	21	3.64	3.61	3.61	3.84	3.77
7		4.09	3.96	4.12	3.86	22	3.64	3.60	3.62	3.80	3.88
8		3.66	3.90	3.82	3.80	23	3.62	3.62	3.64	3.76	3.86
9		3.66	3.80	3.74	3.72	24	3.62	3.60	3.68	3.73	3.82
10		3.72	3.83	3.82	3.83	25	3.62	3.56	3.72	3.77	3.88
11		3.56	3.93	3.82	3.73	26	3.62	3.58	3.66	3.74	4.12
12		3.72	3.82	3.90	3.86	27	3.59	3.70	3.80	3.68	3.84
13		3.62	3.72	3.78	3.87	28	3.59	3.69	4.41	3.74	3.74
14		3.62	3.74	3.77	3.96	29	3.62	3.67	4.13	3.68	3.78
15		3.60	3.68	3.76	4.02	30	3.58	3.70	3.80	3.73	3.78
						31	3.56		3.76		4.14

NOTE.—No information is available regarding the effect of ice; it is probable that the relation of gage height to discharge was more or less affected by ice during the greater part of December.

WINOOSKI RIVER BASIN.

GENERAL FEATURES.

Winooski River, which is one of the most important of the Vermont rivers draining into Lake Champlain, has its source in the Green Mountains in the east-central part of the State. The river is formed at Marshfield by several branches which start from many small ponds; it then flows in a general southwesterly direction as far as Montpelier, at which place it has received the drainage from Kingsbury Brook, Stevens Branch, Worcester Branch, Dog River, and several less important tributaries; from Montpelier its general course is northwestward to Lake Champlain, which it enters near Burlington, having been joined near Middlesex by Mad River and at Waterbury by Waterbury River. From mouth to source the river is about 60 miles long and its drainage area comprises about 995 square miles. The ratio of lake surface to the entire area is small.

Along the river are several important power sites, some of which are already developed. The storage on the river, artificial or natural, is small, but it is believed that opportunities for development are fairly good.

In the upper part of the basin the country is mountainous and fairly well forested. Below Montpelier the slope of the river in general is rather flat.

The mean annual rainfall for this region is about 33 inches; at Burlington for a period of eighty-one years the mean is 32.68 inches. During the winter months the precipitation is generally the least of the year. The average depth of snow is about 24 inches, while the average temperature ranges through the year from about 66° to 15° F.

WINOOSKI RIVER ABOVE STEVENS BRANCH, NEAR MONTPELIER, VT.

This station, which is located about 3 miles above Montpelier at the plant of the Corry-Deavitt & Frost Electric Co., was established May 18, 1909, in cooperation with the State of Vermont.

The station is above the several large tributaries of Winooski River which enter in the vicinity of Montpelier.

The staff gage is bolted to a bowlder on the right bank about 100 feet below the power plant. No change has been made in the gage datum.

Discharge measurements are made from the lower railroad bridge about half a mile below the gage.

Daily fluctuations in the stage of the river are not usually great, as the power plant is operated throughout the twenty-four hours.

The flow during the winter is considerably affected by anchor ice.

Conditions for obtaining accurate discharge data are fair. The relation of gage heights to discharge is fairly well determined.

The gage heights at this station were furnished by the Corry-Deavitt & Frost Electric Co.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Winooski River above Stevens Branch, near Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 22	T. W. Norcross	70.5	230	3.14	274
Oct. 26	C. C. Covert	68	193	2.8	223

WINOOSKI RIVER AT MONTPELIER, VT.

This station, which is located at the covered wooden highway bridge near the Central Vermont Railroad station in Montpelier, was established in cooperation with the State of Vermont May 19, 1909. It is near the plant of the Colton Manufacturing Co., through whose courtesy the gage readings are obtained.

Worcester and Stevens branches enter above the gaging station, and Dog River enters just below.

Discharge measurements are made from a footbridge about half a mile below the chain gage which is located on the highway bridge. As the flow through the wheels is controlled by automatic governors and varies considerably throughout the day, many computations are necessary in order to obtain each daily discharge. Anchor ice during the winter sometimes affects the relation between gage height and discharge.

The gage datum has remained unchanged throughout the period of maintenance of this station. The discharge curve is well defined.

Special night readings of the gage show that there is a drop in stage of about 0.5 foot each night due to storage.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Winooski River at Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 22	T. W. Norcross	181	447	4.67	466
23	do	181	526	5.06	676
July 24	Brett and Butterfield	177	261	3.72	79
Oct. 26	C. C. Covert	182	501	4.70	589

WINOOSKI RIVER AT RICHMOND, VT.

This station, which is located at the steel highway bridge about one-fourth mile south of the railroad station at Richmond, Vt., was established June 25, 1903, discontinued May 1, 1907, reestablished July 8, 1910, and maintained temporarily until October 31, 1910, when it was again discontinued.

The datum of the chain gage has remained the same during the periods of maintenance of the station.

During the winter months the river is affected by ice.

Conditions for obtaining accurate discharge measurements are fairly good. Gage heights are more or less affected by controlled flow, but owing to the size of the stream the fluctuations are not sufficient to materially affect the accuracy of the results here published.

Discharge measurements of Winooski River at Richmond, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 9	Brett and Butterfield	138	186	4.31	408
Aug. 29	G. M. Brett	93	130	3.80	148

NOTE.—Measurements made by wading about 1,500 feet above the bridge.

Daily gage height, in feet, of Winooski River at Richmond, Vt., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		4.2	4.05	4.5	16	4.15	4.2	4.2	4.1
2		4.2	4.0	5.2	17	3.85	4.25	4.2	4.1
3		4.15	4.05	5.3	18	4.0	4.3	4.05	4.3
4		4.25	4.1	4.8	19	4.1	4.3	4.05	4.35
5		4.85	4.3	4.6	20	4.15	4.25	4.05	4.2
6		4.95	5.5	4.7	21	4.05	4.1	4.15	4.3
7		5.05	6.1	4.9	22	4.15	4.25	4.15	4.25
8		4.85	5.45	4.7	23	4.2	4.15	4.1	4.15
9		4.65	4.95	4.55	24	4.0	4.1	4.05	4.6
10		4.4	4.45	4.65	25	4.2	4.2	3.95	4.65
11	4.2	4.65	4.15	4.75	26	4.1	4.15	4.15	5.2
12	4.3	4.65	4.2	4.55	27	4.05	4.0	4.25	5.4
13	4.3	4.55	4.25	4.5	28	5.05	3.9	6.55	5.68
14	4.3	4.25	4.2	4.55	29	4.8	3.95	6.0	5.3
15	4.2	4.25	4.25	4.45	30	4.6	3.95	4.95	5.0
					31	4.15	4.0		4.9

Daily discharge, in second-feet, of Winooski River at Richmond, Vt., for 1910.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		340	260	540	16	312	340	340	285
2		340	235	1,200	17	170	370	340	285
3		312	260	1,300	18	235	400	260	400
4		370	285	800	19	285	400	260	435
5		850	400	620	20	312	370	260	340
6		950	1,520	710	21	260	285	312	400
7		1,050	2,220	900	22	312	370	312	370
8		850	1,460	710	23	340	312	285	312
9		665	950	580	24	235	285	260	620
10		470	505	665	25	340	340	212	665
11	340	665	312	755	26	285	312	312	1,200
12	400	665	340	580	27	260	235	370	1,410
13	400	580	370	540	28	1,050	190	2,840	1,720
14	400	370	340	580	29	800	212	2,090	1,300
15	340	370	370	505	30	620	212	950	1,000
					31	312	235		900

NOTE.—Daily discharge determined from a fairly well defined discharge rating curve.

Monthly discharge of Winooski River at Richmond, Vt., for 1910.

[Drainage area, 977 [a] square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.		
July 11-31	1,050	170	381	0.390	.30	B.
August	1,050	190	442	.452	.52	B.
September	2,840	212	641	.656	.73	B.
October	1,720	285	730	.747	.86	B.

[a] The measurement of drainage area has been revised since the publication of the data for 1903-1907.

STEVENS BRANCH OF WINOOSKI RIVER NEAR MONTPELIER, VT.

This station, which is located near the private covered wooden highway bridge on the Marvin farm, about 2 miles from Montgomery, on the road to Barre, and one-quarter mile above the junction of the Stevens Branch with Winooski River, was established July 5, 1910, in cooperation with the State of Vermont.

A 6-foot staff gage was attached vertically to a stump on the left bank, 60 feet below the bridge.

Discharge measurements are made by wading at the gage.

Conditions for obtaining low-water measurements at this station are good.

There is uncertainty regarding storage effect of mills on the daily gage height.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Stevens Branch of Winooski River near Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 5	G. M. Brett	51.5	69.4	1.79	77
23	Brett and Butterfield	48	45.1	1.38	14.3
Aug. 10	G. M. Brett	52	69.9	1.75	64.3
23	....do	51	61.1	1.63	46.2

WORCESTER BRANCH OF WINOOSKI RIVER AT MONTPELIER, VT.

This station, which is located a short distance below the Lane Manufacturing Co.'s plant at Montpelier and near the junction of Worcester Branch with the main river, was established May 15, 1909, in cooperation with the State of Vermont. This stream is one of the important tributaries of the Winooski.

The vertical staff gage is fastened to a stone wall and tree about 100 feet below the plant. The gage datum has remained unchanged.

Discharge measurements are made from a steel highway bridge about 300 feet below the staff gage. The conditions under which discharge measurements are made are good.

The gage heights are materially affected by ice during the winter.

The discharge rating curve is well developed. The gage heights are read under the direction of the Lane Manufacturing Co., through whose courtesy they are furnished.

During low stages no water flows over the dam, and there is only a little flow during the night when the power plant is shut down. During the 10 hours that the plant is in operation all water passes through the wheels.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Worcester Branch of Winooski River at Montpelier, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	T. W. Norcross	63	110	1.76	126
21	do	63	104	1.72	116
Oct. 26	C. C. Covert	66	170	2.20	201

DOG RIVER AT NORTHFIELD, VT.

This station, which was established May 14, 1909, in cooperation with the State of Vermont, was originally located at the wooden highway bridge, designated as the lower bridge, about 600 feet below the dam of the Rabidou Lumber Co. and about three-fourths of a mile from the railroad station at Northfield.

Discharge measurements were made from the bridge at which the staff gage is located and also from the highway bridge near Norwich University, designated as upper bridge. The datum of the original gage remained unchanged.

On account of the close proximity of the station to the lumber company's dam, the gage-height record was greatly affected by control of the flow by the company. Accordingly the lower bridge station was discontinued August 28, 1910, and a new station (upper bridge) was established August 23, 1910, at the highway bridge near the Norwich University grounds, approximately 1 mile above the original location. Measuring conditions at the present location are only fair. The staff gage is attached to the downstream side of left abutment. There is no backwater from the lumber company's dam at the new location.

Although the effect of controlled flow at the new location is not so marked as at the original station, the daily gage heights are still subject to much error caused by operations at dams higher up the river. Accordingly no estimates of discharge have been attempted for 1910.

Both stations are much affected by backwater from ice.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

With the exception of the computations of results and a few discharge measurements, all the data at this station have been obtained by the students of Norwich University, under the direction of Prof. C. S. Carleton.

Discharge measurements of Dog River at Northfield, Vt., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 19	Norwich University students	33.8	127	2.53	164
27	.....do	32.5	102	1.88	88.6
June 24	D. M. Wood	33	85.9	1.18	22.0
1910.					
Aug. 9	G. M. Brett	15	13.5	1.03	12.9
24	.....do	15.5	12.3	1.00	12.0

NOTE.—Gage heights refer to upper gage.

DOG RIVER NEAR MONTPELIER JUNCTION, VT.

This station, which is located at the covered wooden highway bridge, about half a mile above the mouth of the river, was established July 6, 1910, in cooperation with the State of Vermont.

A 6-foot wooden staff gage was attached vertically to the downstream end of the right-hand abutment. Discharge measurements are made about 100 feet below the gage by wading. Conditions for obtaining low-water measurements are good at this station.

There is uncertainty regarding the effect of mill storage on the fluctuation of the daily gage height.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Dog River near Montpelier Junction, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1910.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 6	G. M. Brett	28.5	32.7	1.65	36.5
24	Brett and Butterfield	27.5	27.5	1.42	14.7
Aug. 10	G. M. Brett	27	26.6	1.42	12.2
11	.....do	28	30.0	1.59	28.2

MAD RIVER NEAR MORETOWN, VT.

This station, which is located at the covered wooden highway bridge, known locally as Armstrong's Bridge, about 4 miles from Middlesex on the road to Moretown, was established July 6, 1910, in cooperation with the State of Vermont.

A 6-foot wooden staff gage was attached vertically to the downstream end of the left-hand abutment. Discharge measurements are made by wading about 1,000 feet below the bridge. The discharge rating curve is well defined between gage heights 1.4 and 1.9 feet.

There is uncertainty regarding the effect of control flow on the daily gage heights.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Mad River near Moretown, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 6	G. M. Brett	54.5	38.6	1.75	49.7
Aug. 8	.....do	67.8	102	1.92	63.1
8	.....do	67.8	102	1.92	68.9
22	.....do	53	69.9	1.60	20.1
28	A. D. Butterfield	52	21.4	1.48	13.6

LITTLE RIVER NEAR WATERBURY, VT.

This station, which is located near the covered wooden highway bridge, known locally as Barber's Bridge, about 3½ miles above Waterbury, on the road to Stowe, was established July 7, 1910, in cooperation with the State of Vermont.

A 6-foot wooden staff gage is attached to the right bank, about 75 feet below the bridge. Discharge measurements are made by wading about 100 feet above the bridge. Conditions at this station are good for low-water measurements.

The daily gage heights for this station are probably more or less affected by mill storage.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Little River near Waterbury, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 7	G. M. Brett	28.5	57.4	4.32	51.6
15	....do	28.5	41.6	4.24	40.3
Aug. 17	A. D. Butterfield	34	48.5	4.42	63.9

HUNTINGTON RIVER AT JONESVILLE, VT.

This station, which is located at Palmer's mill, three-fourths of a mile from Jonesville railroad station, was established July 16, 1910, in cooperation with the State of Vermont.

The staff gage is nailed to the cribwork at the intake to the wheels of Palmer's mill.

Discharge measurements are made by wading 200 feet above the mouth of the river, three-fourths of a mile below the gage. Insufficient data have been obtained to define the relation of gage heights to discharge.

The gage heights are furnished through the courtesy of G. W. Palmer.

The station is above and within the influence of the dam. The dam leaks badly and the pond above is filled with sediment and it can only be used for power purposes at extreme high water. The influence of this dam on the gage-height record is slight.

Accurate computation of the diurnal fluctuation of discharge has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since the gage heights recorded at this station may not be true indices of the daily discharge.

Discharge measurements of Huntington River at Jonesville, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.ft.*	*Feet.*	*Sec.-ft.*
July 16	G. M. Brett	27	11.2	3.25	12.0
Aug. 29	.....do	20	12.0	3.15	6.7

LAMOILLE RIVER BASIN.

GENERAL FEATURES.

Lamoille River has its source in several ponds, the largest of which is Caspian Lake, in the Green Mountain district of north-central Vermont, flows in a general westerly direction, and enters Lake Champlain near Champlain. Its most important tributaries are Alder and Wild brooks, Ginon River, North Branch, and Brown River.

Considerable areas in the upper part of the basin are in forest. Lakes are numerous and some storage has already been developed, but opportunities for improvement are many. Several power sites are yet undeveloped.

The mean annual rainfall in this region is probably about 34 inches. The general temperature changes and the winter conditions are similar to those in the Winooski basin. (See p. 101.)

LAMOILLE RIVER NEAR MORRISVILLE, VT.

This station, which is located at the Morrisville municipal plant, about 1½ miles below Morrisville, Vt., was established July 28, 1909, in cooperation with the State of Vermont.

Above the station the stream receives many tributaries, on some of which power plants are already installed; below the station no large tributary enters for about 8 miles, when Ginon River comes in at Johnson.

The chain gage, which is placed on the highway bridge just below the municipal plant, serves as an index of the total flow of the river and the height of the water in the tailrace. The datum of the gage has not been changed during the maintenance of this station. The gage heights are furnished through the courtesy of the Morrisville municipal plant.

Discharge measurements are made by wading at a ford about half a mile below the station and from the highway bridge.

During the winter months the flow is only slightly affected by ice.

The flow at the station is well regulated by about 550 acres of pond area, and the plant can be run throughout the year without auxiliary power. Extensive improvements are being made at the electric plant. On their completion it is expected that the flow of the river will be computed by measuring the flow over the dam and through the wheels. The dam is of concrete, of ogee section, and is 188 feet long. The water for the wheels is taken from the pond through about 1,200 feet of steel pipe to the power house, where a large standpipe with overflow is installed. The present equipment consists of one pair of 33-inch Victor turbines, hydraulically governed and operating under about a 40-foot head. Power is supplied chiefly for municipal lighting, but some is sold for industrial uses.

This station was replaced July 24, 1910, by a new station at Johnson, Vt.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Lamoille River near Morrisville, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 6[a]	D. M. Wood	58	190	2.40	146
Mar. 27	T. W. Norcross	96	459	5.71	1,680
Apr. 19	....do	80	326	3.76	510

[a] Measurement made under ice cover.

LAMOILLE RIVER AT JOHNSON, VT.

This station, which is located at a covered highway bridge in the town of Johnson, on the road to the railroad station, was established July 14, 1910, in cooperation with the State of Vermont to continue records formerly taken on this river in the vicinity of Morrisville.

The river bed consists of cobblestone, is permanent, and is regular in cross section. The velocity is uniform.

A chain gage, read twice daily, is attached to the upstream side of the bridge.

Measurements are made both by wading and from the bridge.

The rating table is not accurately developed for 1910.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Lamoille River at Johnson, Vt., in 1909–10.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1909.					
June 28[a]	D. M. Wood	82	142	2.51	128
1910.					
Mar. 27[b]	T. W. Norcross	95	424	5.45	1,640
Apr. 19	.....do	89	261	3.69	642
July 14	C. M. Brett	84	150	2.38	193
Aug. 20	.....do	82	169	2.68	226

[a] Conditions unfavorable for good measurement.
[b] Measurement partly made by subsurface method, using coefficient of 0.85.

MISSISQUOI RIVER BASIN.

GENERAL FEATURES.

Missisquoi River drains the northern part of Vermont and the southern parts of the Missisquoi and Brome districts, in the Province of Quebec, Canada. The river is formed by the junction of two branches, one rising in the mountainous region near Lowell, in the southwestern part of Orleans County, and flowing in a general northerly direction, the other rising near Bolton, Brome, and taking a southerly course. The two unite at Mansonville, in Brome, and the river takes a general westerly course to Lake Champlain, which it enters at Missisquoi Bay. From North Troy to Richford it lies in Canada. The important tributaries of the Missisquoi are the North Branch, Trout River, Tylers Branch, and Black Creek.

The mean annual rainfall in this region is probably about 40 inches. The driest year since 1892, according to observations made at Enosburg Falls, was 1908, when the precipitation amounted to 31.90 inches; the wettest was 1901, with 52.30 inches. The winters are severe. The snowfall has an average depth of about 26 inches, and the average temperature for January and February is 16° F.

Throughout its course the Missisquoi flows alternately through long stretches having gentle slope and shorter sections having much greater fall. The power sites along the river are fairly numerous, but storage is not well developed.

MISSISQUOI RIVER AT RICHFORD, VT.

This station, which is located just below the steel highway bridge in Richford, Vt., was established May 24, 1909, in cooperation with the State of Vermont. North Branch enters the main river a little below the station, but the tributaries above are small.

Three gages were used—a chain gage, which is located just below the mill of the Sweat-Comings Manufacturing Co., and two staff gages, which are attached to rocks in the river, one of which was washed away January 23, 1910, and the other September 22, 1910. All readings from the staff gages are referred to the chain gage. The readings were unreliable after September 10, 1910.

Discharge measurements were made by wading a short distance below the gage or from the highway bridge several miles below. When the latter place was used it was necessary to measure and subtract the flow of North Branch.

The water is used by the mill of the Sweat-Comings Manufacturing Co., the wheels operating under a head of about 15 feet. The gate openings are controlled hydraulically and cause great fluctuation in the gage heights in low-water periods.

The winter flow of the river is affected by anchor and shore ice, the channel being considerably narrowed.

Conditions for obtaining accurate discharge data are not good and the discharge curve is not accurately defined. This station was discontinued December 4, 1910.

Gage readings were furnished through the courtesy of the Sweat-Comings Manufacturing Co.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Missisquoi River at Richford, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 3[a]	D. M. Wood	183	826	5.75	244
Mar. 24[b]	T. W. Norcross	141	950	8.24	2,300
July 12	G. M. Brett	86	147	5.25	137
Aug. 19[c]	.....do	85	93	5.27	165

[a] Measurement made under partial ice cover.
[b] Measurement made at highway bridge, 3 miles below gage.
[c] Measurement made by wading.

ST. FRANCIS RIVER BASIN.

GENERAL FEATURES.

St. Francis River rises in Lake St. Francis, in the district of Beauce, in the southeastern part of the Province of Quebec. After flowing southwest for about 100 miles, it turns to the northwest at almost right angles in the district of Sherbrooke and joins St. Lawrence River in Lake St. Peter. Lake Memphremagog, which crosses the international boundary into Vermont, is tributary to St. Francis River near the bend through Magog River. The principal tributaries of Lake Memphremagog in Vermont are Clyde, Barton, and Black rivers.

Clyde River rises in a lake region near Island Pond, in the northeastern part of Vermont, and flows in a general northwesterly direction to Newport, where it enters Lake Memphremagog. Its basin is considerably broken with hills and low mountains.

Although its drainage area is smaller than that of some other Vermont rivers, it has great opportunities for development. The area contains many natural ponds, and it is possible to create several artificial ponds, which should make the flow of this river very uniform. The stream is very quick spilling. Many power plants are already in place.

No reliable information concerning the mean annual precipitation in this basin is available, but from the data at hand it seems that the average is about 38 inches. Winter conditions are similar to those in the Missisquoi basin.

CLYDE RIVER AT WEST DERBY, VT.

This station, which is located just below the Newport Electric Light Co.'s plant at West Derby, Vt., was established May 25, 1909, in cooperation with the State of Vermont.

At this place are two dams, both operated by the same management. At the upper dam part of the water is used by a paper mill, and the remainder of it is delivered to the water wheels at the electric plant through a steel penstock. The total operating head from this source is about 108 feet. All of the flow from the second dam is diverted to the wheels in the power house, giving a head of about 30 feet. There is practically no water storage at the upper dam, but a pond of considerable size may be made by building a dam above this point.

Near and below the station the river has rapid fall and the bed is very rough.

The low-water section of the staff gage is located about 75 feet below the plant; this was carried away by logs April 10 and replaced

April 18, 1910; the high-water section is nailed to a tree on the right bank, 10 feet farther downstream. July 12, 1910, a chain gage was installed at the same datum to replace the staff gages; all subsequent readings have been made from this gage. The gage datum has remained unchanged throughout the year. Gage heights are furnished by the Newport Electric Light Co.

Discharge measurements are made from a highway bridge about half a mile below the gage.

A good rating curve has not yet been developed. The daily gage heights are subject to much variation as a result of controlled flow.

Accurate computation of the diurnal fluctuation of discharge caused by the operation of the mills above the station has been rendered impossible by insufficient funds. It is proposed to install an automatic gage to determine the relation between the daily gage heights heretofore recorded and the true mean gage heights, thus making possible the publication of accurate computations of daily discharge from the inception of the station to date. The gage heights for 1910 are withheld pending this investigation, since no gage heights recorded at this station are true indices of the daily discharge.

Discharge measurements of Clyde River at West Derby, Vt., in 1910.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 25	T. W. Norcross	53	232	[a] 2.95	479
Apr. 18	.....do	55	237	[c] 2.82	495
20	.....do	53	231	[a] 2.78	459
July 12	G. M. Brett	50	184	[a] 2.01	114
Aug. 18	.....do	47	148	[b] 1.86	45.3

[a] Staff gage. [b] Chain gage. [c] Gage height fluctuated considerably during the measurement.

MISCELLANEOUS DISCHARGE MEASUREMENTS IN ST. LAWRENCE RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in St. Lawrence River drainage basin during 1904, 1905, 1906, and 1910:

Miscellaneous measurements in St. Lawrence River basin in 1904, 1905, 1906, and 1910.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1904.				*Feet.*	*Sec.-ft.*
Apr. 12	Canaseraga Creek	Genesee River	At highway bridge at Shakers' Crossing, ½ mile above the mouth of Canaseraga Creek.	7.58	1,050
July 16	do	do	do	3.8	242
1905.					
Mar. 24[a]	do	do	do	18.88	2,010
30	do	do	do	12.32	2,880
31	do	do	do	9.88	2,120
Apr. 1	do	do	do	7.88	1,440
Aug. 25	do	do	do	3.72	252
1906.					
Mar. 29	do	do	do	9.22	1,880
30	do	do	do	8.90	1,620
31[a]	do	do	do	13.55	1,670
Apr. 2	do	do	do	7.85	1,430
3	do	do	do	7.00	1,150
21	do	do	do	4.45	478
1910.					
Apr. 20	do	do	do	6.29	594
July 20	do	do	do	3.90	270
Aug. 21	do	do	do	2.53	37.4
Aug. 22[b]	do	do	do	2.53	36.6
Oct. 26	do	do	do	3.84	260

[a] Measurement affected by backwater from Genesee River.
[b] Made by wading below the bridge.
NOTE.—The gage datum is 25 feet below a reference point on horizontal tiebar 20 feet from left-hand end of downstream side of bridge.
The above measurements of Canaseraga Creek are affected by backwater from Genesee River during high stages of the latter.

Miscellaneous measurements in St. Lawrence River drainage basin in 1910.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Sept. 20	Peshtigo River	Lake Michigan	Near Crivitz, Wis.	1.85	488
Sept. 23[a]	Black River	Lake Ontario	1,000 feet above first highway bridge below Hawkinsville; 2 miles northwest of Boonville.	2.16	80.7
July 22	Raquette River	St. Lawrence River	Near Hosley Camp No. 2, about 1 mile below Forked Lake Outlet.	[b]1,741.6	60.4
25	St. Regis River	St. Lawrence River	At first bridge above Helena, N. Y.	[c]19.36	176
Oct. 29[d]	East Branch of Ausable River.	Ausable River, thence to Lake Champlain.	At highway bridge at Ausable Forks; about ½ mile above confluence with West Branch of Ausable River.	[e]17.75	289
Aug. 13	Winooski River	Lake Champlain	500 feet below farm bridge on L. D. Nute's farm above Marshfield, Vt.	[f]3.15	9.4

[a] This measurement does not include the diversion through Forestport feeder to Black River Canal.
[b] Forked Lake gage.
[c] Distance to water surface from outside upstream tiebar opposite, 166 feet.
[d] Drainage area, 196 square miles.
[e] Reference point to water surface.
[f] All gage heights are distances from reference points to water surface except as noted.

Miscellaneous measurements in St. Lawrence River drainage basin in 1910—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Aug. 13	Winooski River	Lake Champlain	400 feet above iron bridge about 1 mile below Marshfield, Vt.	10.3	30.0
6	Molly's Brook	Winooski River	Highway bridge on road 1 mile below pond between Marshfield and Danville, Vt.		1.3
5	Peacham's Pond Outlet.	do	At Bruce's Mill, Peacham, Vt.		4.0
13	do	do	50 feet above second highway bridge above dam of Molly Falls Power Co., Marshfield, Vt.	6.5	11.5
Sept. 2	Cranberry Meadow Pond Outlet.	do	50 feet below first stone culvert under highway above Nelson Pond, near Marshfield, Vt.	2.70	.74
2	Kingsbury Branch	do	At farm bridge 200 feet below junction with No. 10 Pond Brook, 2¼ miles above North Montpelier, Vt.	7.2	19.8
Aug. 12	do	do	At old bridge 500 feet below junction with No. 10 Pond Brook above Montpelier, Vt.	6.5	46.5
Sept. 2	Curtis Pond Outlet	Kingsbury Branch	Calais Center, Vt.		.26
Aug. 11	Stevens Branch	Winooski River	25 feet above highway bridge below Central Vermont Ry. station, Williamstown, Vt.	3.10	3.17
23	do	do	20 feet below highway bridge below Central Vermont Ry. station, Williamstown, Vt.	3.40	1.18
11	do	do	At bridge, South Barre, Vt.	8.25	11.4
12	Jail Branch	Stevens Branch	¾ mile from East Barre, Vt., on road to Orange, Vt.	[a] 2.0	22.7
23	do	do	do	1.34	4.97
11	do	do	200 feet above railroad bridge, Barre, Vt.	[b] 1.75	33.0
23	do	do	At railroad bridge, Barre, Vt.	24.58	23.2
13	Worcester Branch	Winooski River	Just above old mill site above Worcester, Vt.	[c] 1.6	13.6
31	do	do	do	[c] 1.27	3.96
12	No. 10 Pond Outlet	Worcester Branch	Just above highway bridge 2¼ miles above Montpelier, Vt.	8.4	23.0
Sept. 2	do	do	do	8.9	8.44
Aug. 9	Dog River	Winooski River	400 feet above Corks highway bridge near Northfield, Vt.		3.64
9	East Roxbury Branch of Dog River.	Dog River	50 feet above mouth near Northfield, Vt.		2.50
24	Union Brook	do	Northfield, Vt.		.09
9	Bull Run Brook	do	Under highway bridge, Northfield, Vt.	1.85	2.43
30	Mad River	Winooski River	Warren, Vt.		1.74
28	do	do	Waitsfield, Vt.		7.72
28	Mill Stream Branch of Mad River.	Mad River	Just above second mill, near Waitsfield, Vt.		2.47
20	Little River	Winooski River	100 feet below junction of East and West Branches, Stowe, Vt.	23.9	36.9
30	do	do	do	24.15	17.1
20	West Branch of Little River.	Little River	200 feet above junction of East and West Branches, Stowe, Vt.	23.9	23.6
30	do	do	100 feet above junction of East and West Branches, Stowe, Vt.	24.15	12 3
30	East Branch of Little River.	do	Just below tailrace of mill at Moss Glen Falls, Stowe, Vt.	10.0	.40

[a] Stake driven beside large rocks, with notch assumed at 2 feet.
[b] Gage at Marvin farm, 1.75.
[c] Stake driven on right bank.

NOTE.—Worcester Branch is named North Branch on 1909 post-route map.
Little River is named Waterbury River on 1909 post-route map.

SUMMARY OF DISCHARGE PER SQUARE MILE.

The following summary of discharge per square mile is given to allow ready comparison of relative rates of run-off from different areas in the St. Lawrence River drainage basin. It shows in a general way the seasonal distribution of run-off and the effect of snow, ground, surface, and artificial storage. But the most important fact worth noting is the almost entire lack of uniformity of agreement between any two stations. It indicates that the discharge of each stream is a law unto itself, and that all projects dependent upon stream flow, if they are to be developed along the safest and most economical lines, must be based on records of stream flow collected with great care over a long series of years as near the location of the project under consideration as possible:

Summary of discharge, in second-feet per square mile, for river stations in the St. Lawrence River drainage basin in 1910.

Gaging station.	Drainage area (square miles).	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
St. Louis River near Thomson, Minn.	3,420	0.25	0.20	0.46	0.85	0.56	0.29	0.16	0.32	0.27	0.40	0.15	0.08	0.33
Whiteface River at Meadowlands, Minn.	442	....	....	....	.89	.98	.60	.25	.29	.31	.70	....	....	....
Cloquet River at Independence, Minn.	698	.32	.43	.53	2.03	.97	.62	.42	.74	.82	.56	.14	.12	.64
Escanaba River near Escanaba, Mich.	800	.38	.31	1.24	2.69	1.61	.68	.28	.46	.48	.67	.69	.34	.82
Menominee River near Iron Mountain, Mich.	2,420	.41	.33	.93	1.53	1.25	.76	.50	.58	.48	.59	.45	.35	.68
Manistee River near Sherman, Mich.	900	1.10	1.00	1.48	1.33	1.14	1.05	.98	.99	1.06	1.04	1.23	1.09	1.12
Huron River at Geddes, Mich.	757	.62	.66	1.10	.64	1.01	.51	.16	.14	.20	.21	.23	.24	.48
Huron River at Flat Rock, Mich.	1,000	.72	.74	1.58	.69	1.08	.51	.18	.17	.20	.22	.24	.29	.55
Genesee River at St. Helena, N. Y.	1,030	1.11	.85	5.32	3.01	1.81	.40	.18	.13	.25	.23	.89	.76	1.24
Genesee River at Jones Bridge, near Mount Morris, N. Y.	1,410	.99	.71	4.96	2.49	1.86	.38	.16	.13	.22	.21	.70	.64	1.12
Genesee River near Rochester, N. Y.	2,360	.81	.53	4.49	1.96	1.75	.38	.16	.12	.23	.23	.55	.47	.98
Canadice Lake Outlet near Hemlock, N. Y.	126	.29	.33	1.82	.87	1.92	.45	.36	.34	.40	.38	.47	.46	.68
Oneida River at Caughdenoy, N. Y.	1,377	2.56	3.45	6.52	2.46	1.21	1.10	.38	.28	.27	.22	.84	.96	1.69
Salmon River near Pulaski, N. Y.	259	....	....	....	....	....	....	....	1.30	1.23	1.63	2.78	1.29	....
Black River near Felts Mills, N. Y.	1,851	1.31	1.04	4.86	3.27	2.14	1.51	.45	.99	.81	1.09	1.38	.69	1.63
Moose River at Moose River, N. Y.	346	1.73	1.45	8.76	5.61	3.35	2.35	.75	1.96	1.18	1.97	1.79	.89	2.65
Oswegatchie River near Ogdensburg, N. Y.	1,580	1.24	1.06	4.92	2.05	1.44	.98	.37	.37	.58	.85	2.03	1.16	1.42
Raquette River at Raquette Falls, near Coreys, N. Y.	418	.60	.72	3.59	6.10	4.74	2.75	.54	.52	.72	.73	.93	.48	1.87
Raquette River at Piercefield, N. Y.	723	.70	.97	2.53	5.91	4.30	2.82	.81	.37	.61	.62	.88	.57	1.76
Raquette River at Massena Springs, N. Y.	1,170	.59	.82	3.45	3.90	2.74	2.04	.66	.46	.57	.79	1.03	.56	1.47
Bog River near Tupper Lake, N. Y.	132	.76	.76	3.79	4.91	5.53	2.36	.36	.22	.47	.63	1.06	.61	1.79
Winooski River at Richmond, Vt.	977	....	....	....	....	....	....	....	.45	.66	.75	....	....	....

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