Water-Supply and Irrigation Paper No. 124 Series P, Hydrographic Progress Reports, 28

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1904

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

BY

H. K. BARROWS and JOHN C. HOYT

PART I.—Atlantic Coast of New England Drainage

WASHINGTON
GOVERNMENT PRINTING OFFICE
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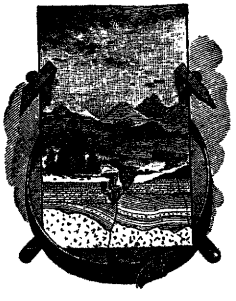

WASHINGTON

GOVERNMENT PRINTING OFFICE

1905

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DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
HYDROGRAPHIC BRANCH,
Washington, D. C., March 16, 1905.

SIR: I transmit herewith the manuscript of Part I of a series of twelve papers which compose the Report of Progress of Stream Measurements for the Calendar Year 1904. Parts I to VI of this report contain the results of the data collected in the territory east of Mississippi River. Parts VII to XII are devoted to the data collected in the territory west of Mississippi River.

The larger part of the original data for this report was collected under the direction of district hydrographer H. K. Barrows, who was assisted by S. K. Clapp, F. E. Pressey, and T. W. Norcross. The assembling of the data and its preparation for publication were done under the direction of John C. Hoyt, who has been assisted by R. H. Bolster, Robert Follansbee, Willis E. Hall, A. H. Horton, and H. D. Padgett.

I request that this manuscript be published as one of the series of Water-Supply and Irrigation Papers.

Very respectfully,

F. H. NEWELL, *Chief Engineer.*

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1904.

PART I.

By H. K. Barrows and John C. Hoyt.

INTRODUCTION.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. Since that date the work has been continually and gradually extended as larger funds became available. The first distinctive appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500, "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (Digest of Appropriations for 1895, p. 270.)

Since that time a similar act has been passed each year and the appropriations have gradually increased, as shown in the following table:

Annual appropriations for hydrographic surveys.

Year ending June 30, 1895	$12,500
Year ending June 30, 1896	20,000
Year ending June 30, 1897	50,000
Year ending June 30, 1898	50,000
Year ending June 30, 1899	50,000
Year ending June 30, 1900	50,000
Year ending June 30, 1901	100,000
Year ending June 30, 1902	100,000
Year ending June 30, 1903	200,000
Year ending June 30, 1904	200,000
Year ending June 30, 1905	200,000
Year ending June 30, 1906	200,000

The chief feature of the work of the hydrographic division is the systematic study of the flow of the surface waters and the conditions

affecting the same. In this connection other information that may be of use to the engineer or others in hydrographic studies, such as river profiles, duration and extent of damage by floods, water-power data, etc., is collected. Furthermore, the work has been so directed that the information collected will be of direct value in the commercial and agricultural development of the country.

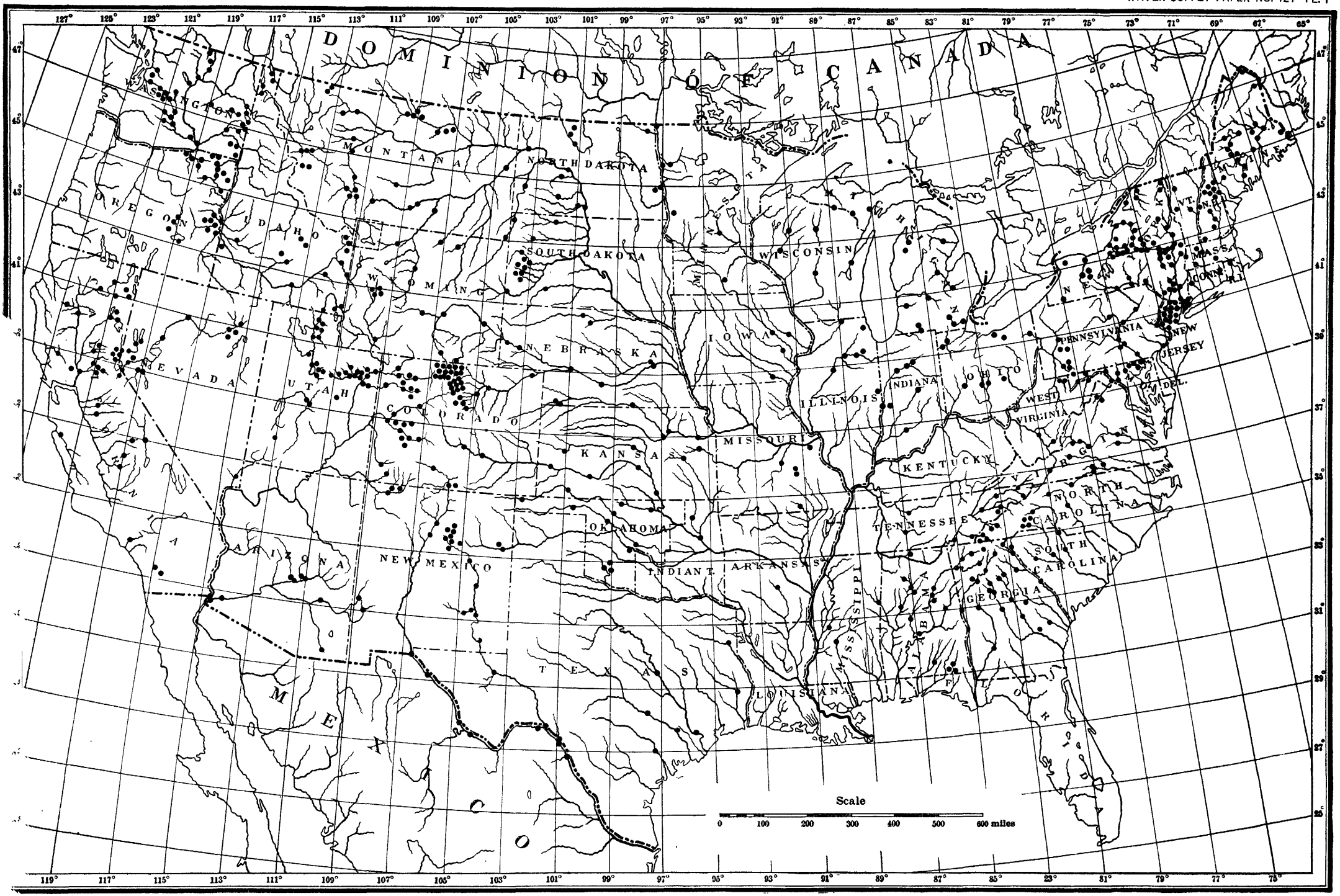
As a result of the increased appropriations since June 30, 1902, the work has been largely extended and thoroughly systemized. The various States have been grouped into districts, each of which is under the supervision of a district hydrographer who, with a corps of assistants, devotes his whole time to the study of the hydrographic resources of his district.

The methods used in the collection of these data and in their preparation for publication are given in detail in Water-Supply Paper No. 94. (Hydrographic manual, U. S. Geol. Survey.)

The general plan of stream gaging which has been developed is to obtain eventually data in regard to the flow of all the important streams in the United States. With this in view gaging stations are established at points where the data will be of greatest commercial value. At these stations discharge measurements are taken from time to time at typical river stages, and the daily surface fluctuation is obtained by means of gage readings. From these two factors it is possible to estimate both the total flow and its distribution through the period of observations.

The selection of the site for a gaging station and the length of time the station is maintained depend largely upon the needs of each locality. If the stream is to be used for water power, special efforts are made to obtain information concerning the low-water flow. If water is to be stored, the high waters are given special attention. In all sections certain permanent stations are maintained for general statistical purposes to show the conditions which exist through long periods. They also act as primary stations, and are used in connection with short series of measurements to determine the flow in particular portions of the drainage basin.

Gaging stations are divided into two general classes: First, current-meter stations; and second, weir stations. The former class is subdivided as to location into bridge, cable, boat, and wading stations. Fig. 1 shows a cable station with car, tag-line, inclined gage, etc. In addition to the bridge, cable, or boat, the equipment of a current-meter gaging station consists in a gage for determining the daily fluctuations of the water surface, bench marks to which the zero of the gage is referred, and permanent marks on the bridge or a tagged line indicating the points of measurement. Where the current is swift some appliance—generally a secondary cable—is necessary to hold the meter in position below the surface.



MAP OF THE UNITED STATES, SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1904.

Gaging stations are generally located at bridges, if the channel conditions are satisfactory, as from them the meter can be easily manipulated, and the cost of the equipment is comparatively small. The stations are located as far as possible at points where the channel is straight, both above and below the gaging section, and where there are no cross currents, backwater, or boils. The bed of the stream should be as clear as possible from large projections and of a permanent character. The banks should be high, and should overflow at high stages only. Great care is taken in the selection and equipment of gaging stations, in order that the data may have the required degree of accuracy.

On many of the larger rivers where water power is developed by dams estimates of flow are obtained by observing the head on the crest and using a weir formula. On the smaller streams sharp-crested weirs are in some cases erected.

The principal instrument used in stream-measurement work is the current meter, by which the velocity of the flow of water is determined.

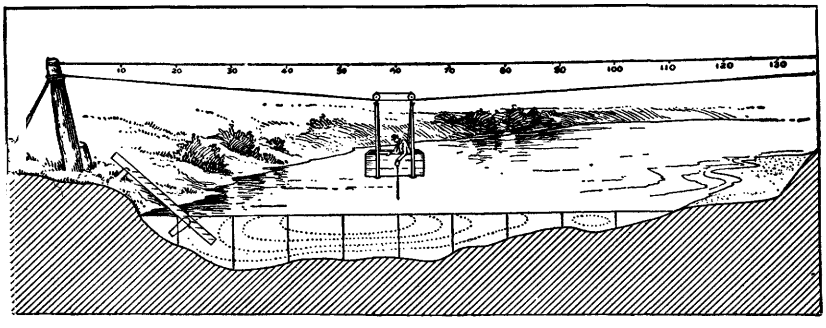


FIG. 1.—Cable station, showing section of river, car, gage, etc.

After years of experience the Survey has adopted the Price current meter for general work. This meter, as is shown on Pl. II, is made in two sizes, known as the large and small Price. The small Price has been largely developed by the officers of the Survey, using the Price acoustic meter as a basis.

A discharge measurement is the determination of the quantity of water flowing past a certain point at a given time. This quantity is the product of two factors: (1) The mean velocity, which is the function of the cross section, surface slope, wetted perimeter, and roughness of bed; (2) the area, which depends upon the permanency of the bed and the fluctuations of the surface, which govern the depth.

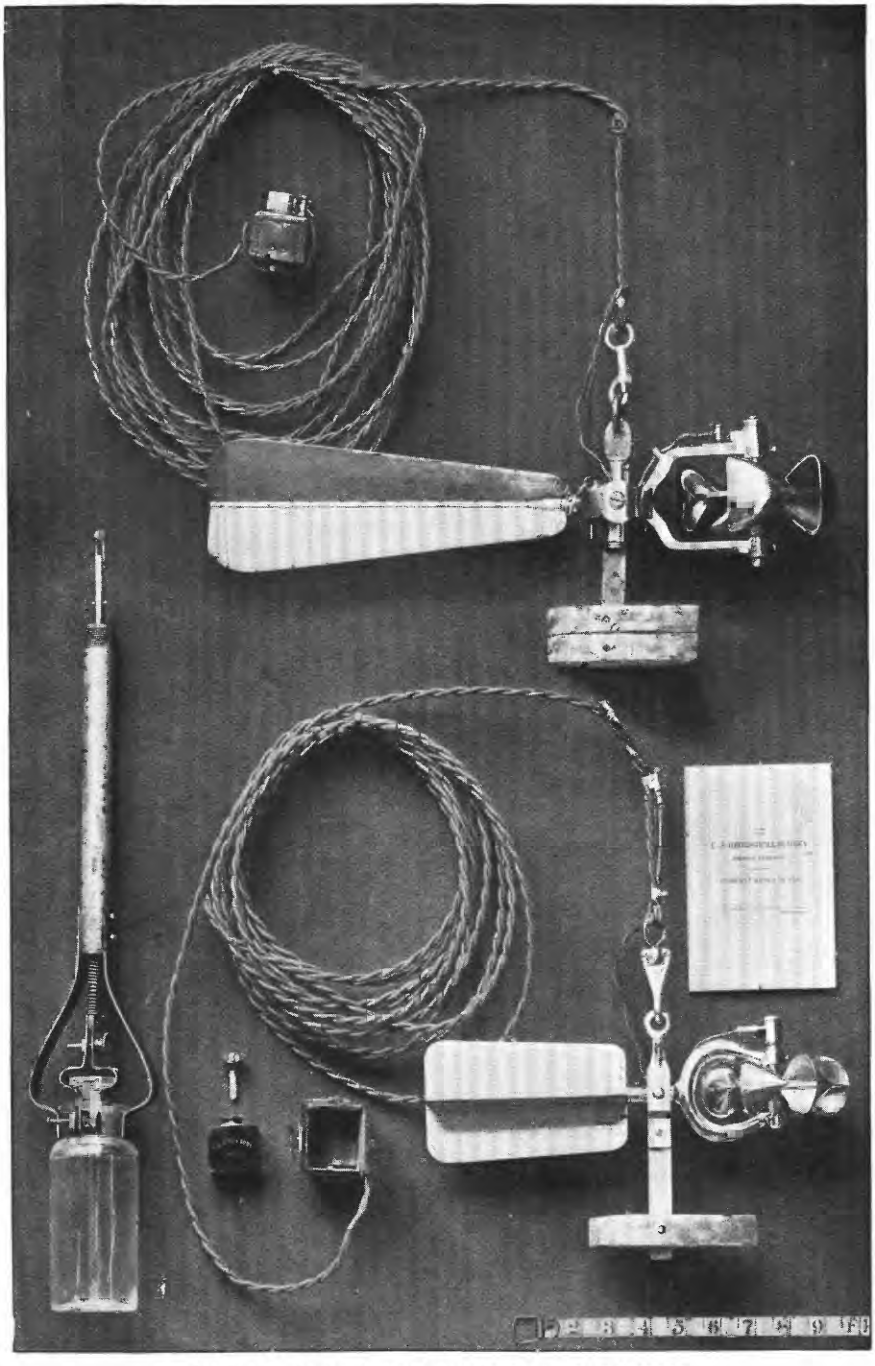
In making the measurement an arbitrary number of points are laid off perpendicular to the thread of the stream (see fig. 1). These points are usually at regular intervals, varying from 2 to 20 feet, depending upon the size and conditions of the stream. They are known as measuring points, and at them the observed data, the velocities and sound-

ings, are taken. The perpendiculars dropped from the measuring points divide the gaging section into strips, and for each strip or pair of strips the mean velocity, area, and discharge are determined independently; thus conditions existing in one part of the stream are not distributed to parts where they do not apply.

The methods of obtaining velocity with the current meters which are in general use may be grouped into three classes: Single point, multiple point, and integration.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth, for which the coefficient for reducing to mean velocity has been determined. Extensive experiments by vertical velocity-curves show that the thread of mean velocity lies at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and it is at this depth that the meter is held in the majority of the measurements, this being known as the six-tenth depth method. It is found by a large number of vertical velocity-curve measurements, taken on various streams and under various conditions, that the coefficient for reducing the velocity obtained at six-tenths depth to mean velocity is practically unity, ranging, in a series of 910 measurements made at 39 gaging stations, between 0.94 and 1.04, with a mean for the 910 observations of 1.00. In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the action of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocities taken at the subsurface has been found by repeated experiments with vertical velocity-curves to be from 0.85 to 0.95, depending upon the depth of the stream and velocity and channel conditions. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The three principal multiple-point methods in general use are: The vertical velocity-curve; top and bottom; and top, bottom, and mid depth. In the vertical velocity-curve method a series of velocity determinations are taken in the vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve through these points, the vertical velocity-curve is produced, which shows the change in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the depth into the area bounded by this mean velocity-curve and the initial line. Owing to the length of time it takes to make these measurements, they are seldom used except for determining coefficients for purposes of comparison, and for measurements under ice.



PRICE ELECTRIC CURRENT METERS, WITH BUZZERS.

In the second multiple-point method the meter is held from 0.5 to 1 foot below the surface and about 0.5 foot above the bottom, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. This method is not well adapted for general work, as the roughness of the bottom disturbs the velocity at that point. For shallow streams with comparatively smooth beds good results are obtained by this method. In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing the sum of the top velocity twice the mid-depth velocity, and the bottom velocity by 4.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface. The number of revolutions and the time taken in the operation is noted, and the mean velocity is found by dividing the number of revolutions by the number of seconds taken in the run. This method has the advantage in that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor for determining the discharge of the stream, depends upon the stage of the river, which is taken on a gage, and the general contour of the bed of the stream, which is found by sounding. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For stations with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also used for obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at the various points of measurements the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or double strip. The total discharge and area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of 1 foot. There is a convenient relation between the second-foot and the acre-foot; 1 second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, which equals 1.9835 acre-feet, or, approximately, 2 acre-feet.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area, on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet" and "depth in inches" represent the actual quantities of water which are produced during the periods in question, while "second-feet," on the contrary, is merely a rate of flow per second.

The base data for computing the daily discharge of a stream are the daily gage heights and the various discharge measurements, of which there should be sufficient number to cover the range of stage. The fundamental laws upon which these computations are based are the following:

(1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant;

(2) Neglecting the change of slope due to the rise and fall of the stream, the discharge will be the same whenever the stream is at a given stage; and

(3) The discharge is both a function of, and increases gradually with, the gage heights (2 and 3 depend on 1).

As the beds of many streams are changeable, the problem divides itself into two classes: (1) Those of streams with permanent or practically permanent beds, and (2) those of streams with changeable beds. The base data and methods of obtaining them are the same for either class, and it is only in the computation of the mean daily flow that different methods are necessary.

In determining the daily discharge of streams with permanent beds, the results of the discharge measurements are plotted on cross-section paper, with gage heights as ordinates and discharges as abscissas. Through these points a smooth curve is drawn, which shows the discharge for any gage height, and from which a rating table is prepared. The mean velocity and area determined for each discharge measurement are also plotted. Through these points the curves of mean

velocity and of area are drawn, and the rating curve is largely determined by taking the product of the mean velocity and the area at various stages as determined by these curves. These curves of mean velocity and area are of special value in determining the location of the rating curve for stages at which actual discharge measurements are not available and for extending the discharge curve outside the limits of the measurements. In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is found from the curve. The first and second differences of these discharges are then taken and adjusted according to the law that they shall either be constant or increasing, never decreasing. The discharges in the table are then changed in accordance with these adjusted differences. In making up the station rating curve, the individual discharge measurements and the conditions under which they were taken are carefully studied, in order that proper weight shall be given to each measurement. Rating curves in general take the form of a parabola, and as a rule the high-water portion of the curve approaches a straight line. For stations of permanent character, the results of the measurements from year to year should be within 5 per cent of the curve, with the exception of those taken during high water, when the probable error may be as high as 10 per cent.

The determination of the daily discharge of streams with changeable beds is difficult, and unless frequent discharge measurements are made, the results obtained are only roughly approximate. For streams with continually shifting beds, such as Colorado River and the Rio Grande, discharge measurements are made every two or three days, and the discharges for the intervening days are obtained by interpolation, modified by the gage heights for these days. For stations with beds which shift slowly, or are only materially changed during floods, station rating curves and tables can be prepared for the periods between changes, and satisfactory results can be obtained with two or three measurements a month, providing measurements are taken soon after the changes occur.

In determining the flow for periods when the streams are frozen, special rating curves and tables have to be prepared from measurements taken under these conditions. The methods of constructing these curves and tables are the same as for open sections. The discharge measurements, however, are taken either by integration in verticals or by the vertical velocity-curve method, as sufficient experiments have not been made on ice-covered streams to determine the laws which govern the position of the thread of mean velocity.

The Report of Progress of Stream Measurements for the Calendar Year 1904, of which this is Part I, is published in a series of twelve Water-Supply Papers, Nos. 124–135, inclusive, under the subtitles following.

Part 1. Atlantic coast of New England drainage.
Part 2. Hudson, Passaic, Raritan, and Delaware River drainages.
Part 3. Susquehanna, Patapsco, Potomac, James, Roanoke, Cape Fear, and Yadkin River drainages.
Part 4. Santee, Savannah, Ogeechee, Altamaha rivers, and Eastern Gulf of Mexico drainage.
Part 5. Eastern Mississippi River drainage.
Part 6. Great Lakes and St. Lawrence River drainage.
Part 7. Hudson Bay, Minnesota, Wapsipinicon, Iowa, Des Moines, and Missouri River drainages.
Part 8. Platte, Kansas, Meramec, Arkansas, and Red River drainages.
Part 9. Western Gulf of Mexico drainage.
Part 10. Colorado River and Great Basin drainage.
Part 11. The Great Basin and Pacific Ocean drainage in California.
Part 12. Columbia River and Puget Sound drainage.

The territory covered by each paper is given in the subtitle, and the larger drainages are, for convenience in arrangement, subdivided into smaller ones, under which the data are arranged, as far as practicable, geographically.

These papers contain the data that have been collected at the regular gaging stations, the results of the computations based upon the observations and such other information that has been collected that has a direct bearing on these data, including, as far as practicable, descriptions of the drainage areas and the streams draining them.

For each regular station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off.

The descriptions of stations give, as far as possible, such general facts about the locality and equipment as would enable the reader to find the station and use the same. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year. This includes the date, the hydrographer's name, the gage height, and the discharge in second-feet.

The table of daily gage heights gives for each day the mean height of the surface of the river as found from the mean of the gage readings taken on that day. At most of the stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated run-off the column headed "Maximum" gives the mean flow for the day when the mean gage height was the highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this 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" gives the average flow for each second during the month. Upon this mean the computations for the three remaining columns which are defined on page 14 are based.

In the computations for the tables of this report the following general and special rules have been used:

Fundamental rules for computation.

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should in general be expressed by at least two and by not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is 5 times the average per cent error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

5. In constructing and applying rating tables a maximum limit of one-half per cent error should seldom be exceeded.

Special rules for computation.

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out at least to three significant figures, except in the case of decimals, where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

The results of the stream measurements made during previous years by the United States Geological Survey can be found in the following

Survey publications. A detailed index of these reports is given in Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35 to 39, inclusive; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47 to 52, inclusive; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124 to 129, inclusive.
West of Mississippi River, Water-Supply Papers Nos. 130 to 135, inclusive.

A limited number of these are for free distribution, and as long as the supply lasts they may be obtained by application to the Director United States Geological Survey or to members of Congress. Other copies are filed with the Superintendent of Public Documents, Washington, D. C., from whom they may be had at prices slightly above cost. Copies of Government publications are, as a rule, furnished to the public libraries in our large cities, where they may be consulted by those interested.

COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the resident hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

Connecticut.—Resident hydrographer, N. C. Grover, until July 1, after that time H. K. Barrows,[a] assisted by S. K. Clapp and T. W. Norcross. Acknowledgment should be made to Edwin D. Graves, chief engineer of the Connecticut River bridge and highway district, for gage heights of Connecticut River near Hartford.

[a] The office of the resident hydrographer for New England, 6 Beacon street, Boston, Mass.

Maine.—Resident hydrographer, N. C. Grover, until July 1, after that time H. K. Barrows; assisted by F. E. Pressey. Acknowledgments should be made to the Bangor and Aroostook Railroad and the Somerset Railroad for annual passes issued to N. C. Grover (later to H. K. Barrows) and F. E. Pressey; to the Maine Central Railroad for annual pass, good between Portland and Vanceboro, issued to N. C. Grover (later to F. E. Pressey), and to the Portland and Rumford Falls Railroad for trip passes issued when desired. Thanks are due to the following individuals and corporations for data furnished and assistance rendered: H. S. Ferguson, engineer for the Great Northern Paper Company, for furnishing data on flow of Penobscot River at Millinocket; Dr. L. S. Chilcott, of Bangor, for gage readings of Phillips Lake; Hollingsworth & Whitney Company, of Winslow, through James L. Dean, their engineer, for records of flow of the Kennebec at Waterville; C. S. Humphreys, C. E., of Madison, for assistance in installing gage at Madison electric plant on Sandy River, and the use of the plant for the purpose of procuring data on flow; the Chase Manufacturing Company, at Waterville, for the use of their dam on Messalonskee River for measurement purposes; Alex. H. Twombley, engineer for the Forest Paper Company, of Yarmouthville, for records of flow of the Cobbossecontee; C. A. Mixer, engineer for the Rumford Falls Power Company, for records of flow of Androscoggin River at Rumford Falls; S. D. Warren & Co., of Westbrook, for records of flow of the Presumscot.

Massachusetts.—Resident hydrographer, N. C. Grover, until July 1; after that time, H. K. Barrows, assisted by S. K. Clapp and T. W. Norcross. Acknowledgments should be made to the Boston and Albany Railroad for pass, good between Boston and Pittsfield, issued to H. K. Barrows; R. A. Hale, principal assistant engineer of the Essex Company, Lawrence, for records of flow of Merrimac River at that point; Frederic P. Stearns, chief engineer of the Metropolitan Water and Sewerage Board, for records of flow of Sudbury and Nashua rivers and Lake Cochituate; X. H. Goodnough, chief engineer State Board of Health, for information regarding various streams in Massachusetts; the George H. Gilbert Manufacturing Company, of Ware, for assistance in procuring records of flow of Ware River at Gilbertville; the George H. Gilbert Manufacturing Company and the Otis Company, of Ware, for assistance in maintaining gaging station at Ware; John T. F. MacDonnell, of Holyoke, for the use of the dam at West Warren for measurement purposes; the West Warren Paper Company, through Dwight Holland, manager, for assisting in procuring data regarding flow of Swift River at West Ware.

New Hampshire.—Resident hydrographer, N. C. Grover, until July 1; after that time, H. K. Barrows, assisted by S. K. Clapp, F. E. Pressey, and T. W. Norcross. Acknowledgments should be made to the Maine Central and Boston and Maine Railroad for passes in New Hampshire, issued to N. C. Grover (later to H. K. Barrows) and S. K. Clapp; Walter H. Sawyer, agent of the Union Water Power Company, Lewiston, for assisting in procuring records of flow of Androscoggin River at Errol dam, and for other data concerning Androscoggin River; Hollis French, of French & Hubbard, Boston, for data regarding flow of the Merrimac at Garvins Falls and the use of this plant for measurement purposes; also to G. G. Shedd, resident engineer at this point, for assistance rendered. Measurements of Connecticut River at Orford were made in part by Prof. C. A. Holden, of Dartmouth College.

Rhode Island.—Resident hydrographer, N. C. Grover, until July 1; after that time, H. K. Barrows, assisted by S. K. Clapp and T. W. Norcross.

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ST. JOHN RIVER DRAINAGE BASIN.

St. John River drains the largest basin between St. Lawrence River on the north and Susquehanna River on the south. Its total drainage area is stated by Wells[a] to be 26,000 square miles, of which approximately 7,500 square miles lie in Maine, its basin occupying the whole northern portion of the State. The extreme headwaters lie in the mountainous region between Maine and Canada, at elevations of 1,500 and 2,000 feet; thence its waters flow at first generally northeasterly through Maine. From the point of junction of the northwest and southwest branches, where the river first takes its name, to its junction with St. Francis River, a distance of 90 miles, its course lies wholly in Maine, although a portion of the tributary area lies in Canada. In this distance Alleguash River is the only tributary of importance. Wells estimates the average slope in the 90 miles to be 1.6 feet per mile. From its junction with St. Francis River the St. John forms the northern boundary of Maine for 70 miles. Within this distance the slope is slightly greater than above, having been estimated to be 2.7 feet per mile, while the volume is considerably augmented by two important tributaries—Fish River from the south and Madawaska River from the north. At the point where it leaves the State line the river has an elevation of about 420 feet above sea level and drains an area of 8,765 square miles, of which 4,670 square miles are in Maine and 4,095 square miles in Canada. Beyond this point it receives the waters of Aroostook and Meduxnekeag rivers, the basins of which are almost entirely in Maine, besides several smaller tributaries having their sources, and in some cases a large portion of their drainage basins, in the same State.

The underlying rock is generally deep and either calcareous or clay slate. The basin is well forested; large areas have never been touched by the ax, while other portions have been lumbered for pine only. Probably 85 to 90 per cent of the whole basin tributary to the river at the eastern boundary of Maine is in forest.

According to Wells, the ponds and lakes in this basin in Maine aggregate a total surface area of 314 square miles. Of this water surface 120 square miles, or 38 per cent, are tributary to Alleguash River (36 square miles of which have been diverted to Penobscot River); 60 square miles, or 19 per cent, are tributary to Aroostook River; and 80 square miles, or 25 per cent, are tributary to Fish River. At the outlets of several of these lakes dams have been built which store water to be used in transporting logs.

Prior to 1845, a canal was cut from Telos Lake in the Alleguash basin to Webster Lake in the Penobscot basin, and a dam was constructed between Chamberlain and Eagle lakes. Thus, by means of

[a] Wells, Walter, The water power of Maine, 1869.

these artificial structures, Chamberlain Lake, with its drainage basin of 270 square miles, was made tributary to the Penobscot. This diversion of St. John water is still continued. During the log-driving season, which varies considerably in its duration, nearly all of the run-off from this area is thrown to the Penobscot, while during the remainder of the year the gates in the dam at Chamberlain Lake are opened and water is allowed to flow both ways. On account of the fact that the gates in the dam at the outlet of Chamberlain Lake are about 2 feet lower than those in the dam at Telos Lake, the flow from this basin to the St. John is greater than that to the Penobscot when the gates in both are open. As the surface of the lake is lowered the proportion flowing to the St. John increases until at extreme low water none flows to the Penobscot.

Both the upper St. John and Alleguash rivers are generally inaccessible. The middle portion, forming the northern boundary of the State, may be reached on the Canadian side at any point by the Temiscouata Railroad, or in Maine at Fort Kent and Van Buren by the Bangor and Aroostook Railroad, while the basins of Fish and Aroostook rivers are rendered easily accessible by means of the latter road. The drainage areas of the stream and its principal tributaries are as follows:

Drainage areas of St. John River and principal tributaries.

River.	Locality.	Area.
		Square miles.
St. John	Below Allegash	4,320
Do	Eastern boundary of Maine	8,765
St. Francis	Mouth	580
Madawaska	do	1,085
Tobique	do	1,705
Alleguash	do	1,500
Fish	do	910
Do	Wallagrass	890
Aroostook	Mouth	2,350
Do	Fort Fairfield	2,230
Meduxnekeag	Mouth	520

No measurements of flow of St. John River have been published. The United States Geological Survey maintains gaging stations in this basin on Fish River at Wallagrass, Me., and on Aroostook River at Fort Fairfield, Me.

FISH RIVER AT WALLAGRASS, ME.

Fish River enters the St. John from the south at Fort Kent. It has a total drainage area of 910 square miles, all of which lies in Maine, and of which 80 square miles are water surface. The basin is very

generally wooded, probably 75 or 80 per cent of its area being still in forest. Of the several available power sites one only is partially developed and used for the manufacture of lumber. The underlying rock is shale or slate, and in general is well covered by soil.

The gaging station at Wallagrass was established by N. C. Grover on July 29, 1903. It is located just below the outlet of Wallagrass Brook. The area of the drainage basin at this point is 890 square miles. A standard chain gage is attached to trees on the bank; length of chain, 39.75 feet. It is referred to bench marks as follows: (1) Copper bolt in ledge 600 feet downstream from gage; elevation, 11.73. (2) Nail driven in blazed birch tree 5 feet upstream from gage; elevation, 11.91 feet. Elevations refer to datum of gage. The measurements of flow are made from a cable located about 1,500 feet downstream from the gage, or by wading at low stages of the river. The channel is straight 500 feet above and 300 feet below the cable, and is about 100 feet wide. The bed is permanent and of gravel. The depth increases gradually from either bank to a maximum at low water of 3.5 feet near the center. The current at the cable is generally strong. At extreme low water the observed mean velocity was 0.63 of a foot per second. The banks are high and are not liable to overflow. The gage is read once a day by Vital E. Michaud, of Wallagrass.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Fish River at Wallagrass, Me., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 18	F. E. Pressey	269	0.97	2.80	260
September 18	do	269	.97	2.80	261
October 20	do	53	2.80	2.40	148
October 20	do	208	.69	2.40	144
October 29	do	205	.63	2.13	129
October 29	do	33	3.30	2.06	109
November 12	do	241	.83	2.50	200
1904.					
May 5	F. E. Pressey	1,680	4.57	12.98	7,690
May 5	do	1,680	4.49	12.97	7,540
June 2	do	990	3.53	8.95	3,490
June 2	do	1,000	3.50	9.00	3,500
June 16	do	740	2.48	6.35	1,840
June 16	do	730	2.40	6.29	1,760
August 9	do	305	1.16	3.19	355
October 27	do	615	2.24	5.39	1,380

Mean daily gage height, in feet, of Fish River at Wallagrass, Me., for 1904.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.3	3.5	10.6	9.3	5.0	3.6	3.2	6.0	5.0	3.6
2	.....	4.3	3.3	11.2	8.0	4.9	3.4	3.2	6.0	5.0	a3.7
3	.....	4.3	3.1	12.3	8.8	4.8	3.4	3.3	6.1	4.9	3.8
4	.....	4.3	3.1	12.8	8.2	4.7	3.4	4.0	6.2	4.8	3.8
5	.....	4.3	3.2	13.2	8.1	4.8	3.3	4.2	6.4	4.7	3.7
6	.....	4.3	3.2	13.4	8.1	4.7	3.3	4.3	6.4	4.6	3.7
7	.....	4.3	3.2	13.6	8.0	4.6	3.2	4.3	6.3	4.6	3.6
8	.....	4.3	3.3	13.4	7.8	4.6	3.2	4.4	6.1	4.5	3.3
9	.....	4.4	3.3	13.2	8.0	4.4	3.2	4.4	6.1	4.4	3.3
10	.....	4.5	3.3	13.3	7.7	4.3	3.3	4.4	6.1	4.3	3.3
11	.....	4.7	3.6	13.4	7.0	4.2	3.4	4.4	6.1	4.4	(b)
12	.....	4.7	3.8	13.6	6.8	4.1	3.3	4.4	6.1	4.6	.....
13	.....	4.7	4.0	13.6	6.7	4.2	3.2	4.5	6.1	4.5	.....
14	4.2	4.7	4.2	13.4	6.6	4.5	3.3	4.6	6.0	4.3	.....
15	4.2	4.7	4.3	12.7	6.4	4.4	3.2	4.6	5.9	4.3	c5.2
16	4.2	4.6	4.4	12.4	6.4	4.4	3.2	4.7	5.9	4.2	.....
17	4.3	4.6	4.5	12.0	6.1	4.3	3.2	4.7	5.9	4.2	.....
18	4.3	4.6	4.6	11.8	6.1	4.2	3.2	4.7	5.9	4.0	.....
19	4.3	4.6	4.8	11.6	6.0	4.2	3.2	4.8	5.9	3.9	.....
20	4.3	4.6	5.0	11.4	5.7	4.1	3.2	5.0	5.8	3.8	.....
21	4.4	4.7	5.2	11.1	6.8	4.0	3.2	5.0	5.8	3.8	d4.4
22	4.5	4.8	5.4	10.9	6.0	3.9	3.2	5.0	5.8	3.7	.....
23	4.5	4.8	5.6	10.6	5.2	3.9	3.3	5.0	5.6	3.7	.....
24	4.3	4.8	5.9	10.4	5.3	3.9	3.3	5.1	5.6	3.7	.....
25	4.3	4.8	6.5	10.1	5.1	3.8	3.4	5.2	5.5	3.7	.....
26	4.3	4.7	7.2	10.0	4.9	3.8	3.4	5.2	5.5	3.7	.....
27	4.3	4.5	7.6	9.9	5.0	3.7	3.3	5.2	5.4	3.7	.....
28	4.3	4.3	8.0	9.6	5.3	3.7	3.3	5.2	5.3	3.6	.....
29	4.3	4.2	9.1	10.1	5.3	3.8	3.3	5.2	5.3	3.6	.....
30	.....	4.0	10.3	9.8	5.1	3.7	3.2	5.4	5.3	3.6	e4.2
31	.....	3.8	.....	9.2	.....	3.7	3.2	.....	5.0	.....	.....

a River frozen over. b Ice 0.5 foot thick.
c Ice 1.2 foot thick. d Ice 1.6 foot thick. e Ice 1.9 foot thick.

NOTE.—Gage readings through ice taken to surface of water in a hole cut in the ice.

AROOSTOOK RIVER AT FORT FAIRFIELD, ME.

Aroostook River enters the St. John from the west near Aroostook Junction in the province of New Brunswick. It has a total drainage area of 2,350 square miles, of which 2,320 square miles lie in Maine. Probably 80 per cent of the whole basin is in forest. The underlying rock is usually slate. Lake storage is used for driving logs only. Water power is used in Presque Isle. The principal falls on the river, known as Aroostook Falls, lie in Canada.

This gaging station was established by N. C. Grover on July 31, 1903. It is located at the steel highway bridge in the village of Fort Fairfield. The drainage area at this point is 2,230 square miles. A standard chain gage is attached to the steel webbing of the upstream truss; length of chain 27.61 feet. It is referred to bench marks as follows: (1) Northwest corner of south abutment, elevation 22.43 feet.

(2) Marked point on connection plate near gage, elevation 23.60 feet. Elevations refer to datum of gage. The initial point for soundings is on the right bank at the lower end of the inclined end post of the downstream truss. The channel is straight for at least 1,000 feet above and 1,000 feet below the station, and is about 350 feet wide, broken by three piers. The bed is of gravel and permanent. The banks are high and not liable to overflow. The current is medium at low water and swift at high water; the least observed mean velocity was 0.74 of a foot per second, at gage height 3.31 feet. The depths are small at low water, averaging about 2 feet. The gage is read twice daily by C. C. Harvey.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Aroostook River at Fort Fairfield, Me., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 13	N. C. Grover	547	1.44	3.70	785
September 10	do	363	.74	3.31	270
October 27	F. E. Pressey	406	.80	3.36	326
1904.					
May 3	F. E. Pressey	4,690	5.94	13.33	27,900
May 10	do	3,050	5.24	10.02	16,000
May 25	do	2,180	4.62	8.21	10,100
May 25	do	2,100	4.58	8.05	9,620
June 4	do	1,220	3.48	5.75	4,250
June 14	do	1,030	3.21	5.34	3,310
August 11	do	428	.97	3.44	415
October 25	do	950	2.66	4.96	2,530

Mean daily gage height, in feet, of Aroostook River at Fort Fairfield, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					12.80	6.90	5.50	3.95	3.50	6.35	4.90	3.90
2					13.60	6.50	5.20	3.85	3.55	6.95	4.80	4.20
3					13.25	6.15	5.35	3.80	3.60	6.85	4.70	4.30
4					12.55	5.80	5.65	3.70	3.95	6.45	4.60	4.30
5			[a]5.00		12.35	6.15	5.70	3.70	5.55	6.10	4.55	4.20
6		[b]4.10			12.75	6.30	5.60	3.70	6.05	5.85	4.50	4.10
7					12.55	6.65	5.10	3.60	5.75	5.65	4.50	4.30
8					11.90	6.80	4.80	3.60	5.30	5.50	4.35	4.35
9	5.10				11.30	6.70	4.60	3.60	5.10	5.35	4.30	4.30
10					10.70	6.25	4.35	3.60	4.85	5.30	4.25	4.30
11					10.10	5.90	4.25	3.60	4.55	5.30	4.20	4.45
12			[c]5.20	10.50	9.90	5.80	4.05	3.55	4.40	5.40	4.05	4.55

[a] Ice 2.2 feet thick. [b] Ice 2.1 feet thick; gage height to top of ice=5.1 feet. [c] Ice 1.7 feet thick.

Mean daily gage height, in feet, of Aroostook River at Fort Fairfield, Me., for 1904—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
13	.....	[a] 4.10	.....	.....	9.50	5.70	4.05	3.60	4.35	5.35	4.00	4.35
14	.....	.....	.....	.....	8.95	5.40	4.35	3.65	4.20	5.15	4.10	4.20
15	.....	.....	.....	.....	8.95	5.15	4.90	3.70	4.20	4.95	4.30	4.20
16	5.20	.....	.....	10.10	8.85	4.95	4.95	3.80	5.35	5.10	4.00	4.10
17	.....	.....	.....	.....	8.60	4.80	4.65	3.85	6.10	5.05	3.95	[b] 4.10
18	.....	.....	.....	.....	.....	4.65	4.50	3.80	5.95	4.95	4.10	.....
19	.....	.....	[c] 5.00	7.80	.....	4.45	4.25	3.80	5.85	4.90	3.75	.....
20	.....	[d] 4.10	.....	.....	.....	4.45	4.20	3.85	5.80	4.85	3.75	.....
21	.....	.....	.....	.....	.....	4.30	4.00	3.80	5.80	4.80	3.95	.....
22	.....	.....	.....	.....	.....	4.15	4.00	3.90	5.65	4.80	4.05	.....
23	[e] 4.90	.....	.....	.....	.....	4.00	3.90	3.95	5.45	4.80	4.10	.....
24	.....	.....	.....	.....	.....	3.95	3.75	3.90	5.25	4.95	3.90	[f] 4.10
25	.....	.....	.....	.....	.....	4.10	3.70	3.85	5.20	5.05	3.90	.....
26	.....	.....	.....	.....	.....	4.30	3.70	3.80	5.55	5.00	3.85	.....
27	.....	[c] 5.00	.....	.....	.....	5.95	3.75	3.65	5.80	5.00	3.90	.....
28	.....	.....	.....	.....	.....	6.25	3.75	3.55	5.75	5.10	3.90	.....
29	.....	.....	.....	.....	.....	5.75	3.75	3.50	5.55	5.15	4.20	.....
30	[a] 4.60	.....	.....	13.35	.....	5.35	3.85	3.50	5.50	5.05	3.95	.....
31	.....	.....	.....	.....	.....	.....	3.90	3.50	.....	5.00	.....	[g] 4.10

[a] Ice 2 feet thick; gage height to top of ice=5 feet.
[b] Ice .2 foot thick.
[c] Ice 2.1 feet thick.
[d] Ice 2.2 feet thick; gage height to top of ice=5 feet.
[e] Ice 1.5 feet thick.
[f] Ice .8 foot thick.
[g] Ice 1.1 feet thick.

NOTE.—During frozen season gage readings are to surface of water in hole cut in ice. Ice floats normally on water except as noted.

Rating table for Aroostook River at Fort Fairfield, Me., from August 1, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.00	48	3.95	1,022	5.70	4,005	8.00	9,500
3.05	79	4.00	1,087	5.80	4,215	8.20	10,100
3.10	112	4.10	1,220	5.90	4,425	8.40	10,710
3.15	147	4.20	1,360	6.00	4,635	8.60	11,330
3.20	185	4.30	1,500	6.10	4,845	8.80	11,960
3.25	226	4.40	1,645	6.20	5,060	9.00	12,600
3.30	270	4.50	1,795	6.30	5,275	9.20	13,240
3.35	317	4.60	1,950	6.40	5,495	9.40	13,900
3.40	368	4.70	2,110	6.50	5,715	9.60	14,560
3.45	422	4.80	2,275	6.60	5,940	9.80	15,230
3.50	478	4.90	2,445	6.70	6,165	10.00	15,910
3.55	535	5.00	2,620	6.80	6,395	10.50	17,650
3.60	593	5.10	2,805	6.90	6,630	11.00	19,400
3.65	652	5.20	2,995	7.00	6,865	11.50	21,200
3.70	712	5.30	3,190	7.20	7,345	12.00	23,000
3.75	772	5.40	3,390	7.40	7,840	12.50	24,850
3.80	833	5.50	3,595	7.60	8,360	13.00	26,700
3.85	895	5.60	3,800	7.80	8,910	13.50	28,600
3.90	958						

The foregoing table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1903 and 1904. It is well defined between gage heights 3.30 feet and 13.30 feet. The table has been extended beyond these limits. Below gage height 3.3 feet the curve is very uncertain.

Estimated monthly discharge of Aroostook River at Fort Fairfield, Me., for 1903 and 1904.

[Drainage area, 2,230 square miles.]

Month.	Discharge in second-feet.			Run off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
August	1,290	368	641	0.287	0.331
September	1,087	226	473	.212	.236
October	422	79	217	.097	.112
November	2,110	270	910	.408	.455
December 1–14	1,645	317	1,100	.326	.170
1904.					
May 1–17	28,980	11,330	19,920	8.93	5.65
June	6,630	1,022	3,648	1.64	1.83
July	4,005	712	1,825	.818	.943
August	1,022	478	734	.329	.379
September	4,845	478	2,985	1.34	1.49
October	6,748	2,275	3,352	1.50	1.73
November	2,445	772	1,348	.604	.674
December 1–17	1,872	958	1,429	.641	.405

ST. CROIX RIVER DRAINAGE BASIN.

St. Croix River is formed by two branches; one, known as the upper St. Croix or Chiputneticook River, is the outlet of Schoodic Lakes; the other, Kennebasis River, is the outlet of the western lakes of the area, known as Kennebasis Lakes. The upper St. Croix, with its tributary lakes, forms nearly half of the eastern boundary of Maine, separating that State from New Brunswick. The total drainage area of the main stream is about 1,630 square miles, of which 920 square miles are tributary to the great reservoir systems controlled by dams at Vanceboro and Princeton. The length of the stream from the headwaters to the mouth is 100 miles. The basin is, in general, lower than that of any of the larger streams of the State flowing into the Atlantic, its headwaters having an elevation of about 540 feet. The fall from Chiputneticook (the lower of the Schoodic Lakes) to tide water, a distance of 54 miles, is, however, 382 feet, or 7 feet to the mile. At a number of places where falls and rapids occur water power has been or can easily be developed.

The lake surface of the upper St. Croix is approximately 50 square miles, and that of the West Branch 70 square miles in area, taking into account only the principal lakes and ponds. Indeed, above Vanceboro and Princeton, each branch of the river is simply a succession of lakes to almost the extreme headwaters. Wells estimated the total lake surface of the St. Croix as not less than 150 square miles, or nearly one-tenth of the total basin. The drainage area at various points on the river is given in the following table:

Drainage area of St. Croix River.

	Sq. miles.
Main river:	
Vanceboro dam, foot of the Schoodic Lakes	420
Little Falls	500
Immediately above mouth of West Branch	690
Immediately below mouth of West Branch	1,360
Sprague Falls	1,390
Calais, lower dam	1,530
Mouth of river, eastern border of town of Calais	1,630
West Branch:	
Princeton dam	500
Confluence with main river	670

A large proportion of the drainage basin is still covered with timber, and above Vanceboro and Princeton the region is for the most part wild and inaccessible. The greater part of the timber land in this region is controlled by sawmill owners at Calais and St. Stephen. In 1898 the amount of lumber sawed annually had decreased from about 100 million feet to 25 million feet, and since then the number of sawmills has been greatly reduced. In 1901 the lumber sawed amounted to 28 million feet, showing that the rate of cutting has remained nearly constant during the last few years. There are on this stream favorable locations for paper and pulp mills, but arrangements would have to be made with the sawmill owners in order to obtain a supply of timber.

The river is navigable as far as Calais, except during two months of the year, when it is frozen. Calais has railroad connection with Bangor directly over the Washington County Railroad, and, by way of Vanceboro, over the Canadian Pacific and the Maine Central railroads. There is also a short road connecting Princeton with Calais. Above Princeton the transportation facilities are poor.

ST. CROIX RIVER AT SPRAGUES FALLS, NEAR BARING, ME.

This station was established December 4, 1902, by F. E. Pressey. The drainage area at this point is 1,390 square miles. A standard chain gage is attached to the lower guard timber of the Washington County Railroad bridge; length of chain, 24.84 feet. It is referred to bench marks as follows: (1) The downstream corner of bridge seat on

right abutment; elevation, 17.60 feet. (2) Copper bolt in bowlder on right bank about 200 feet downstream from the bridge; elevation, 15.98 feet. Elevations refer to the datum of the gage.

The measurements of flow are made from a car suspended on a steel cable stretched over the river about one-half mile above the bridge. The initial point for soundings is 60 feet from small pine tree near anchorage on right bank. The channel is straight for 100 feet above and 1,000 feet below the cable, and has an unbroken width of about 200 feet at ordinary stages. The banks are high and rocky, and the bed is rocky and permanent. The observed mean velocity at the cable has varied between 5.49 feet per second at gage height 9.70 feet and 1.29 feet per second at gage height 6.53 feet. The measurement at gage height 6.11 feet was made from the bridge to which the gage is attached; mean velocity, 1.41 feet per second. The gage is read twice daily by Simeon Phinney, section foreman on the Washington County Railroad, who resides in Baring, Me.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of St. Croix River at Sprague's Falls, near Baring, Me., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 21	R. M. Connor	1,070	5.50	9.70	5,880
April 20	do	984	5.15	9.30	5,060
April 28	do	751	3.59	8.30	2,700
April 29	do	778	3.84	8.40	2,990
May 18	do	628	2.30	7.20	1,450
May 19	do	658	2.34	7.30	1,540
September 9	F. E. Pressey	609	1.29	6.53	787
September 9[a]	do	609	1.31	6.55	796
October 1	N. C. Grover	418	1.41	6.11	589
1904.					
April 27	F. E. Pressey	990	4.89	9.27	4,840
August 23[a]	do	570	2.39	7.10	1,360

[a] Made at bridge.

Mean daily gage height, in feet, of St. Croix River at Sprague Falls, near Baring, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.0	[a]8.0	8.2	[b]8.0	.....	8.4	8.1	8.0	6.9	7.4	7.3	6.8
2	8.0	8.0	8.2	8.0	11.0	8.4	8.1	7.9	6.9	.....	7.2	6.8
3	8.1	8.0	8.2	.....	10.9	8.3	.....	7.7	6.9	7.3	7.0	6.8
4	8.3	8.0	8.2	8.1	10.0	8.3	8.0	7.6	.....	7.2	7.0	.....
5	8.3	8.0	8.2	8.1	10.0	.....	8.0	7.5	7.0	7.1	6.9	6.9
6	8.3	8.0	.....	8.3	9.8	8.4	7.9	7.5	7.0	7.0	.....	7.2
7	8.3	.....	8.2	8.6	9.7	8.4	7.8	.....	7.0	6.9	6.9	7.3
8	8.3	7.8	[c]8.5	8.8	.....	8.4	8.3	7.3	6.9	6.9	6.9	7.4
9	.....	7.8	8.5	9.4	8.5	8.4	8.3	7.2	6.8	.....	6.9	7.4
10	.....	7.7	8.5	.....	8.6	8.4	.....	7.2	6.8	6.7	6.9	7.4
11	.....	7.7	8.5	12.4	8.7	8.4	8.5	7.2	.....	6.7	6.8	.....
12	8.0	[d]7.7	8.5	12.4	10.1	.....	8.6	7.2	6.7	6.7	6.8	7.9
13	8.0	7.7	.....	12.0	11.7	8.1	8.8	7.2	6.7	6.7	.....	7.9
14	8.0	.....	8.6	11.4	11.9	8.1	8.8	.....	6.7	7.0	6.8	7.9
15	8.0	7.8	8.6	10.9	.....	7.9	8.9	7.2	7.0	7.1	6.8	7.7
16	8.0	7.8	8.6	10.5	11.2	7.9	8.9	7.1	7.1	.....	6.8	7.5
17	7.9	7.8	8.6	.....	10.5	7.9	.....	7.1	7.1	7.0	6.7	7.5
18	7.8	[e]7.8	8.6	9.4	10.5	7.9	8.6	7.1	.....	7.0	6.6	.....
19	7.7	7.8	8.6	9.4	10.4	.....	8.6	7.1	7.0	7.0	6.6	7.2
20	7.7	7.8	.....	9.6	10.2	7.8	8.6	7.1	6.9	7.0	.....	7.0
21	7.8	.....	8.5	9.4	10.1	7.8	8.6	.....	6.8	6.9	6.7	6.7
22	7.9	[f]8.0	8.5	9.4	.....	8.2	8.6	7.2	6.8	6.9	6.8	7.0
23	7.9	8.0	8.4	9.4	9.9	8.2	8.6	7.2	6.8	.....	6.8	7.0
24	.....	8.0	8.4	.....	9.8	8.2	.....	7.1	6.8	7.8	6.9	7.0
25	8.0	8.1	8.4	9.3	9.8	8.2	8.6	7.1	.....	7.7	7.0	.....
26	8.0	8.1	8.4	9.3	9.6	.....	8.6	7.1	7.1	7.5	7.1	6.9
27	[g]8.0	8.1	8.4	9.3	9.6	8.1	8.7	7.1	7.1	7.4	.....	6.9
28	8.0	.....	8.4	9.3	9.5	8.1	8.7	.....	7.0	7.4	7.0	6.9
29	8.0	8.1	8.0	9.3	.....	8.1	8.7	7.0	7.0	7.4	6.9	6.8
30	8.0	.....	8.0	9.4	8.9	8.1	8.7	6.9	7.0	.....	6.8	6.8
31	.....	.....	8.0	.....	8.7	.....	.....	6.9	.....	7.3	.....	6.8

[a] Ice 0.85 foot thick.
[b] River clear of ice.
[c] Ice 1 foot thick.
[d] Ice 1.1 feet thick.
[e] Ice 1.25 feet thick.
[f] Thaw; water running on top of ice.
[g] Water and ice same height; ice 0.4 foot thick; river froze about Jan. 19.

NOTE.—During frozen season gage readings are to surface of water in hole cut in ice.

Rating table for St. Croix River at Sprague Falls, near Baring, Me., from December 4, 1902, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
5.9	525	7.1	1,330	8.3	2,775	9.5	5,450
6.0	655	7.2	1,440	8.4	2,920	9.6	5,750
6.1	585	7.3	1,550	8.5	3,075	9.7	6,055
6.2	620	7.4	1,660	8.6	3,245	9.8	6,360
6.3	660	7.5	1,775	8.7	3,430	10.0	6,970
6.4	710	7.6	1,890	8.8	3,635	10.2	7,580
6.5	770	7.7	2,010	8.9	3,855	10.4	8,190
6.6	840	7.8	2,130	9.0	4,090	10.6	8,800
6.7	925	7.9	2,255	9.1	4,340	10.8	9,410
6.8	1,020	8.0	2,380	9.2	4,605	11.0	10,020
6.9	1,120	8.1	2,510	9.3	4,880	11.5	11,545
7.0	1,225	8.2	2,640	9.4	5,160		

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1903 and 1904. It is well defined between gage heights 6.10 feet and 9.50 feet. The table has been extended beyond these limits. Above gage height 9.60 the rating curve is a tangent, the difference being 305 per tenth.

Estimated monthly discharge of St. Croix River at Sprague Falls, near Baring, Me., for 1904.[a]

[Drainage area, 1,390 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	14,290	2,380	6,027	4.34	4.84
May	12,760	3,075	7,026	5.05	5.82
June	2,920	2,130	2,605	1.87	2.09
July	3,855	2,130	3,089	2.22	2.56
August	2,380	1,120	1,495	1.08	1.24
September	1,330	925	1,140	.820	.915
October	2,130	925	1,368	.984	1.13
November	1,550	840	1,102	.793	.885
December	2,255	925	1,418	1.02	1.18

[a] Sunday discharges interpolated.

MACHIAS RIVER DRAINAGE BASIN.

The Machias may be taken as fairly representative of several of the smaller streams of Maine which empty their waters directly into the ocean, and which are commonly referred to as "coastal rivers." Its total drainage basin is 495 square miles, nearly all of which lies in Washington County, Me. Its extreme headwaters lie at an elevation of nearly 500 feet, and are not more than 50 miles from tide water. Wells listed 20 lakes in this basin, aggregating 29.5 square miles in area of water surface. Without important exception these lie, however, in the extreme headwaters. Dams are maintained at several of the outlets of the lakes, and the stored water is used for log driving.

The underlying rock is usually granite. Probably 70 to 80 per cent of the basin is still in forest.

MACHIAS RIVER NEAR WHITNEYVILLE, ME.

This gaging station was established October 17, 1903, by F. E. Pressey, at the bridge of the Washington County Railroad, near Whitneyville. The drainage area at this point is 465 square miles. A standard chain gage is attached to the guard timber on the downstream side of the bridge; length of chain, 25.34 feet. It is referred to the following-described bench marks: (1) Copper bolt in outcropping ledge on upstream side of railroad track and 170 feet from the face of left abutment; elevation, 20.12 feet. (2) Downstream outer corner of bridge seat of right abutment; elevation, 18.05 feet. (3) Marked point on floor beam of bridge at zero end of gage; elevation, 23.89 feet. Elevations refer to datum of the gage. The initial point for soundings is on the left bank at the lower end of the inclined end post of the downstream truss. The velocity is small at low water. Meter measurements may be made by wading at a point 200 feet above the bridge at low stages of the river. The water is confined to one channel at the bridge at all stages; the width is about 130 feet.

A short distance above the station is a dam which stores water for use by the mills in Machias. The gates in this dam are opened and closed each day during low stages of the river. As a result the river fluctuates as much as 0.5 of a foot on the gage. The bed is sandy, but permanent. The gage is read twice daily by George McKenzie, a farmer of Whitneyville.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Machias River near Whitneyville, Me., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
October 17	F. E. Pressey	647	0.34	6.63	221
1904.					
April 26	F. E. Pressey	1,030	1.92	9.67	1,970
April 28	do	1,230	2.42	11.19	2,970
May 17	do	1,250	2.94	11.64	3,670
May 20	do	1,360	3.16	12.41	4,300
May 20	do	1,360	3.07	12.38	4,170
May 21	do	1,320	2.88	12.07	3,800
August 22	do	860	1.28	8.54	1,100
August 24	do	730	.74	7.51	540
November 7	do	580	.56	6.40	325

Mean daily gage height, in feet, of Machias River near Whitneyville, Me., for 1904.

Day.	Jan.[a]	Feb.[a]	Mar.[a]	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[a]
1	7.3	7.9	7.8	9.3	12.4	10.0	7.5	6.0	6.0	7.9	6.2	6.4
2	7.2	7.8	7.8	9.4	11.9	10.0	7.6	5.7	5.8	8.1	6.2	6.4
3	7.2	[b]7.7	[c]8.0	9.9	11.2	10.0	7.8	5.4	6.0	7.6	6.0	6.2
4	7.1	7.7	8.8	9.6	10.1	10.0	7.8	5.2	5.8	7.2	6.4	6.2
5	7.2	7.6	9.4	9.4	9.2	10.0	7.2	5.4	6.2	7.0	6.5	5.8
6	[d]7.2	7.6	9.5	9.6	8.8	9.4	7.0	5.4	6.8	6.8	6.4	5.6
7	7.2	7.7	9.3	10.0	8.3	9.7	6.9	5.6	5.6	6.8	6.5	5.5
8	7.2	7.6	10.4	10.4	8.2	10.3	6.9	6.0	6.7	6.8	6.4	5.4
9	7.2	8.0	12.2	11.4	7.9	9.6	6.8	5.9	6.5	6.9	6.0	5.6
10	7.2	7.6	11.8	12.8	9.2	8.8	7.6	5.2	6.3	6.8	6.2	6.2
11	7.2	[e]7.7	11.0	14.0	10.9	8.2	7.3	5.4	5.0	6.6	6.4	6.3
12	7.3	7.8	10.5	13.3	13.9	8.1	6.8	5.7	5.0	6.1	6.2	6.2
13	7.3	7.7	10.4	12.8	15.6	7.9	7.0	5.8	5.6	6.8	6.6	6.2
14	7.6	7.7	9.6	12.4	14.0	7.6	7.2	5.9	6.2	7.6	7.0	[f]6.2
15	7.7	7.6	9.2	11.6	11.4	7.6	7.2	6.1	7.9	7.0	7.4	6.2
16	7.7	7.6	9.0	10.6	10.6	7.5	7.0	6.0	10.8	7.1	7.4	6.2
17	7.7	7.5	8.7	10.1	11.9	7.4	7.4	5.8	9.4	7.0	6.6	[g]6.4
18	7.6	[h]7.4	8.2	9.8	12.9	7.2	7.2	6.2	8.2	6.6	7.0	6.2
19	7.6	7.3	8.0	9.7	13.0	7.4	6.3	6.2	7.5	6.4	6.4	6.1
20	7.6	7.2	8.0	9.8	12.4	7.2	6.3	5.7	6.9	6.1	6.4	[i]6.1
21	7.6	7.2	8.2	9.5	12.0	7.2	6.3	8.1	6.7	6.4	6.4	6.1
22	7.6	7.4	8.1	[j]9.2	11.7	7.2	6.0	8.6	6.6	8.0	6.4	[k]6.3
23	7.5	8.0	8.3	9.2	11.4	7.2	5.9	8.0	6.6	9.3	6.7	6.2
24	7.5	8.4	8.8	9.3	10.6	7.2	6.6	7.5	6.4	8.5	6.8	6.1
25	7.5	[l]8.6	9.2	9.3	9.6	7.2	6.6	7.0	7.2	7.6	7.3	6.1
26	7.5	8.6	9.7	9.6	9.4	7.3	6.2	6.2	8.0	7.2	7.4	6.0
27	7.6	8.4	11.0	10.6	9.2	7.2	6.2	5.2	7.8	7.2	7.0	6.0
28	7.5	8.2	11.0	11.2	9.5	7.0	6.0	5.8	7.0	7.0	6.6	6.2
29	7.7	7.9	10.4	11.4	9.8	6.8	5.8	5.8	7.0	6.8	6.2	6.4
30	7.7	.....	9.7	12.4	9.9	6.8	5.7	6.2	7.1	6.8	6.3	6.2
31	7.8	.....	9.3	.....	9.9	.....	6.0	6.2	.....	6.5	.....	[m]6.3

[a] Ice January 1 to March 21 and December 9–31. No estimate.
[b] Ice 1.35 feet thick.
[c] Ice 1.25 feet thick.
[d] Ice 0.65 foot thick.
[e] Ice 1.5 feet thick.
[f] Gage reading to surface of ice=6.3; ice 0.7 foot thick.
[g] Gage reading is to surface of ice; ice 0.8 foot thick.
[h] Ice 1.65 feet thick.
[i] Ice 0.8 foot thick.
[j] River clear of ice.
[k] Gage reading is to surface of ice; ice 1.0 foot thick.
[l] Ice 1.4 feet thick.
[m] Gage reading is to surface of ice; ice 1.1 feet thick.

NOTE.—Unless otherwise noted, gage heights during frozen season are to surface of water in hole cut in ice.

Rating table for Machias River near Whitneyville, Me., from October 17, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet*	*Second-feet.*
6.6	258	7.4	500	8.4	1,000	10.0	2,130
6.7	283	7.5	542	8.6	1,120	10.5	2,545
6.8	309	7.6	587	8.8	1,250	11.0	2,980
6.9	336	7.7	634	9.0	1,380	11.5	3,430
7.0	365	7.8	682	9.2	1,520	12.0	3,900
7.1	395	7.9	730	9.4	1,660	12.5	4,375
7.2	427	8.0	780	9.6	1,810	13.0	4,860
7.3	462	8.2	890	9.8	1,970		

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1903 and 1904. It is well defined between gage heights 7.5 feet and 12.5 feet. The table has been extended beyond these limits, and is very uncertain below 7 feet.

Estimated monthly discharge of Machias River near Whitneyville, Me., for 1903 and 1904.

[Drainage area, 465 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
October 18–31	1,060	258	562	1.21	.630
November	1,185	336	652	1.40	1.56
December	1,217	445	703	1.51	1.74
1904.					
March 22–31	2,980	835	1,834	3.94	1.47
April	5,860	1,520	2,681	5.77	6.44
May	7,570	730	2,979	6.41	7.39
June	2,375	309	989	2.13	2.38
July	682	104	334	.718	.828
August	1,120	54	216	.465	.536
September	2,800	41	438	.942	1.05
October	1,590	159	448	.963	1.11
November	500	144	265	.570	.636
December 1–8	213	71	142	.305	.091

PENOBSCOT RIVER DRAINAGE BASIN.

This basin, which has a total area of about 8,500 square miles, lies wholly in Maine. It extends from the Atlantic Ocean on the south to the basin of the St. John on the north, a distance of 160 miles; and from the New Brunswick boundary on the east to the Quebec boundary on the west, a distance of 115 miles. The general elevation of the basin is lower than that of the drainage basins to the west. The headwaters of the main river lie in the mountainous region on the boundary of Quebec at an elevation of nearly 2,000 feet. The slopes of the upper tributaries are generally steep. Chesuncook Lake lies near the center of the basin at an elevation of 930 feet. From this point to tidewater, the distance along the river is about 121 miles, indicating an average slope of 7.7 feet to the mile. This is concentrated at intervals by ledges where water power has been or may be developed. The water from some 800 square miles of the basin is discharged into the main river below its lowest available water power at Bangor.

Taken as a whole, the basin is rather uniform in its topographic features. Hills and low mountains stretch from near the sea to above Bangor; farther north is an undulating plain, while to the west the surface becomes more broken and is greatly diversified by hills, detached peaks, lakes, ponds, and swamps. At the south the basin merges into that of the Kennebec, and at the north into that of the Alleguash, terminating on the northwest, at the boundaries of the State, in a region of highland intermingled with swamps and lagoons. The whole northern basin of the main river and its tributaries is in forest. Original growth covers a large portion of this area, and in general, wherever cuttings have been made, a dense second growth has sprung up. Extensive areas in the southern basin have been cleared and converted into farms. Probably 70 to 80 per cent of the whole basin above Bangor is in forest. Throughout the upper portion of the basin slate is the principal outcropping rock, being succeeded to the east and south by schists, gneiss, and granite. The soil is mainly clay, gravel, and loam.

The drainage area of the river and its chief tributaries are given in the following table.

Drainage areas of Penobscot River and principal tributaries. [a]

River.	Locality.	Drainage area.
		Square miles.
Penobscot	Opposite northwest extremity of Moosehead Lake, township of Seboomook, immediately below mouth of Nulhedus Creek.	510
Do	Entrance into Chesuncook Lake	850
Do	Outlet of Chesuncook Lake	1,450
Do	Millinocket, outlet of Twin Lakes	1,880
Do	Immediately below mouth of East Branch of Penobscot. [a]	3,260
Do	Immediately below mouth of Mattawamkeag. [a]	4,940
Do	West Enfield, immediately below mouth of Piscataquis. [a]	6,630
Do	Sunk Haze Rips [a]	7,260
Do	Old Town, above mouth of Pushaw River [a]	7,340
Do	Bangor, above mouth of Kenduskeag River [a]	7,720
Do	Mouth [a]	8,550
Cauquomogomoc	Entrance into Chesuncook Lake	230
East Branch of Penobscot	Grindstone [a]	1,130
Do	Mouth [a]	1,160
Mattawamkeag	Immediately below outlet of Baskahegan Lake.	190
Do	Mouth	1,510
Piscataquis	Low's bridge	280
Do	Dover	330
Do	Mouth	1,500
Passadumkeag	....do	400
Cold Stream	....do	37
Do	Enfield post-office	26
Phillips Lake outlets:		
Northern outlet at junction with.	Phillips Lake	11.5
Northern outlet	East Holden	12.3
Phillips Lake area		1.4

[a] Includes Chamberlain Lake basin (270 square miles). See description of St. John River drainage basin.

The United States Geological Survey now maintains gaging stations at the following places in the Penobscot basin: On the Penobscot at West Enfield; East Branch of the Penobscot at Grindstone; Mattawamkeag at Mattawamkeag; Piscataquis near Foxcroft; Cold Stream at Enfield; Phillips Lake and its outlets in Holden and Dedham.

The discharge of the Penobscot is also obtained at Millinocket from data furnished by private parties.

PENOBSCOT RIVER AT MILLINOCKET, ME.

The discharge of Penobscot River at Millinocket has been computed and the data furnished by H. S. Ferguson, engineer for the Great Northern Paper Company. These results were obtained by considering the flow through the wheels, the flow over the dam, and such quantities of water as are used from time to time by the log sluice, filters, etc. The wheels were rated at Holyoke, Mass., before being placed in position. As the head under which they work, averaging about 110 feet, is much greater than the head under which they were tested, numerous tube float measurements of flow in the canal leading to the mill have been made by Mr. Ferguson, in order to determine just how much water the mill used under different conditions of gate openings. In addition to this, during 1904 a series of current-meter measurements were made by the United States Geological Survey to check results as obtained by the floats, and to enable a suitable coefficient to be obtained for use with the float measurements. It is believed by means of these various checks upon the measurements that a very good estimate has been made for the flow through the wheels. The dam, known as Quakish Lake dam, is of concrete, resting on rock, and does not leak. The flow over it was computed by use of the formula, $Q = c\ b\ H^{\frac{3}{2}}$, in which c is a variable coefficient obtained (1) from the results of weir measurements made by Mr. Ferguson on 10-foot portion of the dam, and (2) from a study of the results of experiments made by George W. Rafter at the Cornell testing flume.

When the flow of the river is less than 2,500 second-feet all of the water is generally used through the mill; at higher stages the excess is wasted over the dam. The flow over the flashboards, which are used whenever possible, is computed by use of the formula $Q = 3.33\ b\ H^{\frac{3}{2}}$. The area of the drainage basin at Millinockett is 1,880 square miles. Several dams, which have been constructed at points in the basin above this point, store water on a surface of practically 80 square miles. This water is used for log driving and for manufacturing purposes. Quakish Lake dam is at elevation 456.3 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Mean daily discharge, in second-feet, of Penobscot River at Millinocket, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	237	413	403	315	(a)	4,705	4,088	2,366	2,027	3,005	2,255	(a)
2	141	360	407	284	2,266	4,566	4,894	4,977	2,389	(a)	2,261	2,261
3	159	410	416	560	2,294	4,247	4,490	4,988	2,020	2,186	2,251	2,292
4	417	401	389	338	2,150	4,151	4,520	4,982	2,653	(a)	2,326	2,204
5	405	409	414	221	2,297	4,844	4,247	4,958	2,420	2,298	2,336	2,285
6	421	403	109	582	2,332	4,746	4,309	2,424	2,014	2,026	2,298	2,250
7	436	200	368	1,013	2,326	5,345	4,330	2,077	2,018	2,313	2,271	2,002
8	392	436	404	681	2,116	4,900	2,448	2,308	2,026	2,363	2,347	2,359
9	398	415	392	702	(a)	4,353	4,535	4,913	1,996	2,350	2,367	2,366
10	385	448	397	436	2,235	4,353	2,031	4,936	2,024	2,437	2,331	(a)
11	430	423	391	639	2,306	4,209	3,386	4,936	2,390	2,077	2,318	(a)
12	393	438	492	1,019	2,332	4,197	3,076	4,939	2,331	2,062	2,355	(a)
13	345	430	467	995	2,315	4,730	3,068	4,924	2,041	2,341	2,394	(a)
14	244	198	737	1,087	2,384	3,848	2,219	4,659	2,400	2,048	2,310	(a)
15	362	411	724	973	5,100	3,193	2,010	4,789	2,019	2,005	(a)	2,200
16	438	433	828	859	5,010	2,433	2,007	4,937	2,023	2,311	(a)	2,000
17	216	434	799	1,095	10,255	2,415	3,093	4,959	(a)	2,015	(a)	2,250
18	376	434	421	1,056	11,314	2,417	2,031	4,921	2,162	2,026	(a)	2,005
19	332	433	793	1,094	11,682	2,277	2,392	2,347	2,339	2,423	(a)	2,010
20	205	403	488	1,112	11,673	2,418	2,906	2,014	2,025	2,042	(a)	(a)
21	428	188	788	1,108	10,671	2,434	4,097	2,027	2,018	2,059	2,293	(a)
22	414	200	814	1,473	7,043	2,454	2,420	2,178	2,327	2,049	2,291	(a)
23	297	200	462	1,457	7,824	2,433	2,037	2,008	(a)	2,015	2,289	(a)
24	149	275	470	1,072	9,276	2,424	3,658	2,378	(a)	2,310	2,255	2,003
25	450	426	453	1,473	8,645	3,125	2,005	2,017	2,212	2,403	(a)	2,000
26	416	415	818	1,463	5,266	5,028	2,019	2,002	2,005	2,055	(a)	2,549
27	431	404	615	1,469	4,737	4,757	3,663	2,000	2,002	2,067	2,555	2,003
28	214	189	823	1,807	3,710	4,171	(a)	2,312	2,023	2,077	2,302	2,012
29	238	368	408	1,802	3,831	3,106	(a)	2,022	2,003	2,027	2,003	(a)
30	249	.....	444	1,805	5,142	2,488	3,703	2,035	2,010	(a)	2,010	2,287
31	150	.....	420	.....	5,448	.....	2,005	2,119	.....	(a)	.....	2,002

a Owing to incompleteness of records discharge can not be computed.

PENOBSCOT RIVER AT WEST ENFIELD, ME.

This station was established by N. C. Grover on November 5, 1901, and in previous reports has been designated as being at Montague, Me. In 1904 the name of this village was changed to West Enfield. It is located at the steel highway bridge, about 1,000 feet below the mouth of Piscataquis River. The drainage area at this point is 6,630 square miles, including the area of the drainage basin of Chamberlain Lake (270 square miles), which flows into the Penobscot part of the year only.[a] The measurements are made from the bridge. A standard chain gage is fastened to the steel webbing on the upstream side of the bridge; length of chain, 34.49 feet. It is referred to bench marks as follows: (1) The top of the northwest corner of first course below bridge seat, easterly abutment; elevation, 25.78 feet. (2) Copper bolt in outcropping ledge under bridge, near east abutment; elevation, 6.71 feet. (3) Marked point on bottom chord of bridge, under gage;

a See description of St. John River drainage basin.

elevation, 29.52 feet. All elevations are above gage datum and gage datum is at an elevation of 125.38 feet above mean sea level, as determined by the Penobscot River survey of 1904. The initial point for soundings is on the easterly abutment, at the extreme end of the inclined end post on downstream side of bridge. The channel is straight for 1,000 feet above and 3,000 feet below the station, is about 870 feet wide, and is broken by four piers. The banks are high and rocky, and the bed permanent and rocky, with some gravel. The observed mean velocity has varied from 5.05 feet per second at gage height 12.90 to 1.08 feet per second at gage height 1.54. Water power is used on both the Penobscot and Piscataquis rivers within a mile above the station. Fluctuations at the gage of 0.2 or 0.3 of a foot during low water are caused by changes in gate openings at the mills above. The gage is read twice daily by A. H. Hanson, a merchant in West Enfield.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Penobscot River at West Enfield, Me., in 1901–1904.

Date	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1901.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
November 5	F. E. Pressey	2,200	1.38	2.00	3,030
1902.					
March 28	F. E. Pressey	11,380	5.05	12.80	57,400
April 8	do	9,520	4.62	10.90	43,900
July 15	N. C. Grover	4,650	2.42	5.10	11,300
August 28	F. E. Pressey	3,590	2.11	3.80	7,580
September 15	do	3,680	2.11	3.90	7,770
October 11	R. M. Connor	3,640	2.05	3.75	7,450
1903.					
May 14	F. Collins	6,140	2.86	6.65	17,600
May 25	E. C. Murphy	3,960	2.12	4.10	8,410
June 11	N. C. Grover	3,140	1.88	3.21	5,910
August 7	F. E. Pressey	3,210	1.91	3.22	6,140
October 15	N. C. Grover	1,920	1.08	1.54	2,070
October 23	F. E. Pressey	1,970	1.20	1.58	2,370
1904.					
April 26	N. C. Grover	8,770	3.67	9.70	32,200
May 18	F. E. Pressey	10,900	4.51	12.06	49,200
May 27	do	7,210	3.07	8.01	22,100
June 14	N. C. Grover	5,380	2.49	5.82	13,400
October 17	University of Maine students.[a]	4,000	2.02	4.23	8,100
October 20	do	3,800	1.89	3.90	7,200
October 25	do	5,000	2.16	5.25	10,800
October 31	do	4,450	2.16	4.73	9,600

[a] Under direction of Prof. H. S. Boardman.

Mean daily gage height, in feet, of Penobscot River at West Enfield, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	a 2.80	.....	.....	12.30	7.20	4.25	4.05	2.80	7.05	4.65	3.20
2	.....	.....	.....	.....	12.00	6.80	5.15	3.70	2.70	6.90	4.45	3.15
3	.....	.....	.....	.....	11.60	7.75	5.90	4.30	2.80	6.30	4.45	3.40
4	b 3.50	.....	.....	6.15	11.20	7.15	6.20	4.70	2.80	5.65	4.30	3.45
5	.....	.....	.....	6.25	11.15	6.50	5.75	4.55	3.55	5.30	4.20	3.50
6	.....	.....	.....	6.50	10.65	6.90	5.45	4.40	3.70	5.05	4.10	3.50
7	.....	.....	c 2.70	6.75	10.10	7.20	5.10	4.15	3.65	4.75	4.15	3.45
8	.....	d 2.60	.....	7.60	9.10	7.55	4.70	4.05	3.35	4.65	4.50	3.70
9	.....	.....	.....	e 8.70	8.45	6.95	4.45	4.15	3.20	4.55	4.40	3.85
10	.....	.....	.....	9.65	8.45	6.60	4.35	4.10	3.20	4.35	4.30	4.25
11	f 3.30	.....	.....	10.75	10.10	6.50	5.00	4.20	3.10	4.20	4.20	4.25
12	.....	.....	.....	11.20	11.60	6.40	4.35	4.30	3.00	4.15	4.10	4.15
13	.....	.....	.....	11.00	11.80	6.20	4.25	4.20	3.05	4.10	4.05	(g)
14	.....	.....	h 4.90	10.40	10.90	5.90	4.50	4.10	2.75	4.20	4.05	.....
15	.....	i 2.40	.....	9.85	10.25	5.50	4.75	4.00	3.05	4.20	3.95	.....
16	.....	.....	.....	9.05	10.70	5.05	4.25	4.10	4.35	4.15	3.70	.....
17	.....	.....	.....	8.30	11.85	4.90	3.85	3.95	4.80	4.15	3.60	.....
18	a 3.40	.....	.....	7.90	11.90	5.20	4.50	3.75	4.50	4.10	3.50	.....
19	.....	.....	.....	7.80	11.55	5.85	3.80	3.50	4.15	4.05	3.60	j 4.30
20	.....	.....	.....	7.90	11.80	5.50	3.90	3.15	4.25	4.00	3.55	.....
21	.....	.....	k 4.70	7.80	12.00	5.15	4.05	3.45	4.10	3.90	3.55	.....
22	.....	l 2.60	.....	7.75	11.20	5.00	4.20	3.85	4.20	4.55	3.90	.....
23	.....	.....	.....	7.90	10.60	4.95	3.50	3.55	4.10	5.80	3.85	.....
24	.....	.....	.....	8.20	10.45	4.75	3.40	3.40	4.15	5.65	3.85	.....
25	a 3.20	.....	.....	8.60	9.90	4.55	3.65	3.30	4.75	5.25	3.80	.....
26	.....	.....	.....	9.85	8.80	4.65	3.35	3.15	5.30	5.05	3.70	m 4.30
27	.....	.....	.....	10.15	8.05	4.90	3.80	2.95	5.10	5.45	3.65	.....
28	.....	.....	a 6.00	10.25	7.95	4.75	4.15	2.70	4.65	5.65	3.40	.....
29	.....	n 2.40	.....	10.35	7.60	4.15	3.45	2.80	4.85	5.45	3.30	.....
30	.....	.....	.....	11.10	7.30	3.75	3.25	2.80	5.45	5.10	3.20	.....
31	.....	.....	.....	.....	7.35	.....	3.30	2.75	.....	4.70	.....	.....

NOTE.—During frozen season readings are to surface of water in hole cut in ice.

a Ice 1.15 feet thick.
b Ice 1 foot thick.
c Ice 1.6 feet thick.
d Ice 1.25 feet thick.
e Clear of ice.
f Ice 1.1 feet thick.
g Frozen over.
h Ice 1.5 feet thick.
i Ice 1.35 feet thick.
j Ice 0.65 foot thick.
k Ice 1.4 feet thick.
l Ice 1.5 feet thick.
m Ice 0.75 foot thick.
n Ice 1.65 feet thick.

Rating table for Penobscot River at West Enfield, Me., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.7	4,420	4.1	7,740	6.0	13,580	8.8	26,620
2.8	4,620	4.2	8,020	6.2	14,270	9.0	27,860
2.9	4,830	4.3	8,310	6.4	14,980	9.2	29,100
3.0	5,050	4.4	8,600	6.6	15,720	9.4	30,360
3.1	5,270	4.5	8,900	6.8	16,500	9.6	31,640
3.2	5,500	4.6	9,200	7.0	17,300	9.8	32,960
3.3	5,730	4.7	9,500	7.2	18,140	10.0	34,300
3.4	5,960	4.8	9,800	7.4	19,020	10.5	37,760
3.5	6,200	4.9	10,100	7.6	19,940	11.0	41,320
3.6	6,440	5.0	10,400	7.8	20,920	11.5	45,000
3.7	6,690	5.2	11,000	8.0	21,980	12.0	48,820
3.8	6,940	5.4	11,620	8.2	23,080	12.5	52,780
3.9	7,200	5.6	12,260	8.4	24,220	13.0	56,920
4.0	7,470	5.8	12,910	8.6	25,040		

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1904. It is well defined between gage heights 3.90 feet and 12.10 feet. The table has been extended beyond these limits, and is uncertain below gage height 3.9 feet. The discharge as given by the 1904 curve is several per cent smaller than the 1903 curve, owing to obstructions in the river below the station.

Estimated monthly discharge of Penobscot River at West Enfield, Me., for 1904.

[Drainage area, 6,630 square miles.][a]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 9–30	42,780	20,670	30,110	4.54	3.71
May	51,180	18,580	36,880	5.56	6.41
June	20,670	6,815	13,200	1.99	2.22
July	14,270	5,615	8,540	1.29	1.49
August	9,500	4,520	6,889	1.04	1.20
September	11,780	4,420	7,239	1.09	1.22
October	17,510	7,200	10,240	1.54	1.78
November	9,350	5,500	7,335	1.11	1.24
December 1–12	8,165	5,385	6,615	.998	.445

[a] Includes Chamberlain Lake drainage. See description of St. John River drainage basin.

PENOBSCOT RIVER (EAST BRANCH) AT GRINDSTONE, ME.

This station was established October 23, 1902, by F. E. Pressey. It is located at the Bangor and Aroostock Railroad bridge, one-half mile south of the railway station. The measurements are made from the

railway bridge. The drainage area at this point is 1,130 square miles, including the Chamberlain Lake basin (270 square miles). The initial point for soundings is on the left bank, at the lower end of the inclined end post. The gage is of the standard chain type; length of chain, 31.99 feet. The scale board is nailed to the guard timber on the upstream side of the bridge. It is referred to the following-described bench marks: (1) Southwest corner of bridge seat on east abutment; elevation, 26.32 feet. (2) Copper bolt in ledge under north end of bridge; elevation, 8.78 feet. (3) Marked point on center stringer, near gage; elevation, 29.78 feet. All elevations are above gage datum. The channel both above and below this station is straight. The flow is moderately rapid at medium and high stages of the river. Observed mean velocities range from 2.27 feet per second at gage height 8.10 feet, to 0.18 foot per second at gage height 4.32 feet. Fluctuations in stage are usually slow, as no water power is used on the river above the station. Dams are maintained at the outlets of several of the lakes and ponds near the source of the river, and the impounded water is used for log driving. The bed is rocky and permanent; the stream is confined to the channel by the abutments of the bridge and has a width of about 275 feet, broken by one pier. Practically all land areas in this basin are in forest. The gage is read twice daily by Harry Stinson.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Penobscot River (East Branch) at Grindstone, Me., 1902–1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1902.		*Feet.*	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
October 23	F. E. Pressey	226	1,410	0.50	5.15	706
November 26	do	225	1,490	.62	5.41	921
1903.						
April 9	N. C. Grover	262	2,170	2.15	7.85	4,670
April 14	do	266	2,270	2.36	8.10	5,350
April 22	F. E. Pressey	258	1,930	1.67	7.20	3,230
May 23	C. N. McCulloch	245	1,830	1.41	6.64	2,580
September 9	N. C. Grover	228	1,270	.17	4.32	223
September 26	do	236	1,510	.54	5.36	824
October 28 [a]	F. E. Pressey	230	648	.73	4.58	474
1904.						
April 29	N. C. Grover	270	2,450	3.34	9.13	8,180
October 24	F. E. Pressey	247	1,740	1.28	6.32	2,230

[a] Measurement made from boat.

Mean daily gage height, in feet, of Penobscot River (East Branch) at Grindstone, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	.....	10.30	8.70	6.10	7.00	4.60	7.15	5.60	.....
2	.....	.....	.....	.....	10.80	8.60	6.30	6.80	4.60	7.30	5.60	.....
3	4.20	.....	.....	.....	10.25	8.20	6.60	6.60	4.70	7.30	5.60	[a]4.30
4	.....	.....	.....	[b]4.80	9.60	7.25	6.80	6.60	5.40	6.90	5.30	.....
5	.....	.....	.....	.....	9.60	7.35	6.80	6.70	5.60	6.55	5.30	.....
6	.....	.....	[c]3.40	.....	9.40	8.20	6.40	6.80	5.40	6.30	5.30	.....
7	.....	[d]3.30	.....	.....	8.40	7.90	6.20	6.95	5.05	6.10	5.30	.....
8	.....	.....	.....	.....	7.65	7.90	6.20	7.00	5.00	6.05	5.30	.....
9	.....	.....	.....	.....	7.30	8.05	6.20	7.00	5.00	5.90	5.30	.....
10	[e]3.50	.....	.....	6.50	7.75	8.20	6.20	7.00	4.80	5.80	5.30	[f]4.10
11	.....	.....	.....	.....	8.30	8.20	6.20	7.00	4.70	5.80	5.20	.....
12	.....	.....	.....	.....	9.05	8.20	6.20	6.80	4.70	5.85	5.20	.....
13	.....	.....	[g]3.40	.....	9.50	8.05	6.20	6.80	4.70	5.60	5.30	.....
14	.....	[d]3.30	.....	.....	8.65	8.05	6.05	5.40	4.70	5.60	5 30	.....
15	.....	.....	.....	.....	8.60	6.30	5.65	5.80	5.10	5.60	5.20	.....
16	.....	.....	.....	.....	7.30	6.40	5.60	5.80	6.20	5.60	5.30	.....
17	[b]3.50	.....	.....	6.50	8.70	6.50	6.10	5.55	5.25	5.60	5.30	.....
18	.....	.....	.....	6.50	8.15	6.60	6.40	5.45	5.60	5.50	5.30	[e]8.00
19	.....	.....	.....	6.50	8.40	6.15	6.55	5.25	5.65	5.50	5.30	.....
20	.....	.....	[h]3.60	6.50	8.75	5.30	6.60	5.20	5.70	5.40	5.30	.....
21	.....	[d]3.30	.....	6.70	9.00	5.50	6.80	5.50	5.55	5.40	5.30	.....
22	.....	.....	.....	7.00	7.65	5.40	6.80	5.30	5.35	6.90	5.30	.....
23	.....	.....	.....	7.20	7.95	5.10	6.95	5.30	5.30	7.15	5.30	.....
24	[b]3.50	.....	.....	7.20	7.90	5.10	7.20	5.40	5.30	6.35	5.30	.....
25	.....	.....	.....	7.75	7.45	5.10	7.20	5.20	5.80	6.30	5.30	[i]8.00
26	.....	.....	.....	8.30	7.20	5.20	7.20	5.20	6.05	6.20	[j]5.30	.....
27	.....	.....	[k]4.40	9.00	7.90	5.20	7.20	5.20	6.10	6.10	.....	.....
28	.....	[k]3.20	.....	9.20	8.70	5.20	7.20	4.90	6.10	6.00	.....	.....
29	.....	.....	.....	9.20	8.90	5.20	7.20	4.85	6.55	6.00	[a]5.30	.....
30	.....	.....	.....	9.90	8.70	5.90	7.20	4.70	6.90	5.75	.....	.....
31	[b]3.50	.....	.....	.....	8.70	.....	7.10	4.60	.....	5.60	.....	[l]3.80

[a] Ice 0.85 feet thick.
[b] Ice 1.35 feet thick.
[c] Ice 2.15 feet thick.
[d] Ice 1.7 feet thick.
[e] Ice 1.15 feet thick.
[f] Ice 1 foot thick.
[g] Ice 2.1 feet thick.
[h] Ice 2 feet thick.
[i] Ice 1.4 feet thick. Gage height to top of ice=6.6 feet.
[j] River frozen November 26.
[k] Ice 1.85 feet thick.
[l] Ice 1.6 feet thick. Gage height to top of ice=4.7 feet.

NOTE.—During frozen season gage readings are to surface of water in hole cut in ice.

Rating table of Penobscot River (East Branch) at Grindstone, Me., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.7	190	4.8	480	6.2	1,755	8.2	5,580
3.75	196	4.9	534	6.3	1,895	8.4	6,090
3.8	202	5.0	593	6.4	2,040	8.6	6,630
3.85	209	5.1	660	6.5	2,190	8.8	7,190
3.9	216	5.2	735	6.6	2,350	9.0	7,770
3.95	224	5.3	815	6.7	2,510	9.2	8,350
4.0	233	5.4	900	6.8	2,675	9.4	8,940
4.1	252	5.5	990	6.9	2,845	9.6	9,540
4.2	273	5.6	1,085	7.0	3,020	9.8	10,140
4.3	296	5.7	1,185	7.2	3,390	10.0	10,750
4.4	323	5.8	1,285	7.4	3,790	10.2	11,370
4.5	356	5.9	1,395	7.6	4,205	10.4	11,990
4.6	393	6.0	1,505	7.8	4,640	10.6	12,610
4.7	434	6.1	1,625	8.0	5,100	10.8	13,230

The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 4.5 feet and 8 feet. Above gage height 8 feet the curve is somewhat uncertain. The table has been extended beyond these limits.

Estimated monthly discharge of Penobscot River (East Branch) at Grindstone, Me., for 1904.

[Drainage area, 1,130 square miles.] [a]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 17–30	10,440	2,190	4,738	4.19	2.18
May	13,230	3,390	6,799	6.02	6.94
June	6,910	660	3,074	2.72	3.03
July	3,390	1,085	2,349	2.08	2.40
August	3,020	393	1,629	1.44	1.66
September	2,845	393	982	.869	.970
October	3,590	900	1,739	1.54	1.78
November 1–25	1,085	735	841	.744	.692

[a] Drainage area includes Chamberlain Lake drainage basin of 270 square miles. See description of St. John River drainage basin.

MATTAWAMKEAG RIVER AT MATTAWAMKEAG, ME.

This station was established August 26, 1902, by F. E. Pressey. It is located at the Maine Central Railroad bridge in the village of Mattawamkeag. The area of the drainage basin at this point is 1,510 square miles. The initial point for soundings is on the south abutment at the lower end of the inclined end post of the downstream truss. The gage is of the standard chain type; length of chain, 33.40 feet. The scale board is nailed to the guard timber of the lower side of the bridge. It is referred to bench marks, as follows: (1) Southwest corner of bridge seat of north abutment; elevation, 26.87 feet. (2) Copper bolt in bowlder north of bridge and west of railroad; elevation, 19.01 feet. (3) Marked point on stringer near gage; elevation, 31.42 feet. All elevations are above gage datum, and gage datum is at elevation 185.93 feet above mean sea level, as determined by the Penobscot River survey of 1904. The channel both above and below this station is straight, and has a width of about 400 feet at ordinary stages, broken by two piers. The bed of the stream is rocky and permanent. The water is confined to the channel by the abutments of the bridge. The observed mean velocities at this station have been between 4.11 feet per second at gage height 9.15 feet and 0.90 of a foot per second at gage height 2.75 feet. Low-water measurements are made by wading at a point about 1 mile above the station, where the velocities are greater than at the bridge and the bed is gravelly. The bridge is slightly oblique to the thread of the stream.

Dams are maintained at the outlets of several of the lakes and ponds in this basin, and the stored water is used for driving logs. Probably 90 per cent of the land surface is in forest. The gage is read twice daily by W. T. Mincher.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Mattawamkeag River at Mattawamkeag, Me., 1902–1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1902.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 31	F. E. Pressey	550	2.13	4.40	1,170
August 27	do	685	2.34	4.70	1,600
September 16	do	815	2.06	5.00	1,680
November 8	do	1,160	2.63	5.89	3,050
1903.					
April 4	F. E. Pressey	2,380	4.11	9.15	9,780
April 25	do	1,560	3.47	7.15	5,410
May 18	do	540	2.33	4.58	1,260
May 25	C. N. McCulloch	530	2.09	4.45	1,110
June 11	F. E. Pressey	355	2.09	4.02	742
August 8	do	310	1.80	3.87	558
September 11	N. C. Grover	220	1.55	3.39	340
October 14	do	135	.90	2.75	121
October 23[a]	F. E. Pressey	204	1.47	3.32	300
1904.					
April 15	F. E. Pressey	2,690	4.68	9.85	12,600
April 27	N. C. Grover	2,510	4.55	9.50	11,400
October 20	F. E. Pressey	727	2.42	5.07	1,760

[a] Measurement made by wading.

Mean daily gage height, in feet, of Mattawamkeag River at Mattawamkeag, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					10.70	6.40	4.50	3.75	3.50	6.10	5.40	5.20
2					11.00	6.30	4.50	3.50	3.40	6.45	5.30	5.10
3	[a]4.60				11.10	6.20	4.75	3.65	3.45	6.60	5.20	5.00
4					11.00	6.20	4.90	3.70	3.60	6.45	4.95	5.10
5					10.75	6.25	4.90	3.70	3.75	6.25	4.85	5.20
6			[b]5.00		10.40	6.50	4.90	3.70	4.10	6.05	5.15	5.30
7		[b]4.20			10.10	6.95	4.90	3.70	4.40	5.85	5.15	5.50
8					[c]8.20	9.95	7.05	4.85	3.55	4.30	5.65	5.10	5.80
9					7.60	9.45	6.80	4.70	3.40	4.20	5.45	5.10	5.80
10	[d]4.40				8.20	9.40	6.70	4.70	3.55	4.05	5.30	5.05	5.70
11					9.00	9.15	6.60	4.30	3.70	4.00	5.30	4.90	5.70
12					9.75	9.65	6.50	4.20	3.80	3.90	5.20	4.80	5.70
13			[b]6.30		9.95	10.85	6.20	4.30	3.80	3.90	5.10	4.80	5.70
14		[b]4.20			10.05	11.40	6.10	4.30	3.80	3.80	5.25	4.75	5.60
15					9.90	11.70	6.05	4.40	3.75	4.25	5.40	4.65	5.50
16					9.65	11.55	6.00	4.50	3.55	4.55	5.40	4.40	5.40

[a] Ice 1.2 feet thick. [b] Ice 1.7 feet thick. [c] River clear of ice. [d] Ice 1.6 feet thick.

Mean daily gage height, in feet, of Mattawamkeag River at Mattawamkeag, Me., for 1904—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
17	[a] 4.10	.....	.....	9.50	11.30	6.00	4.45	3.60	4.90	5.30	4.40	5.30
18	.....	.....	.....	9.10	10.75	6.00	4.35	3.80	5.05	5.20	4.55	5.20
19	.....	.....	.....	8.90	9.65	6.00	4.10	3.90	5.00	5.20	4.80	5.10
20	.....	.....	[a] 6.30	8.80	9.35	5.85	4.20	3.90	5.10	5.10	5.10	5.00
21	.....	[a] 4.30	.....	8.70	9.35	5.45	4.10	4.00	5.20	5.00	4.80	(b)
22	.....	.....	.....	8.70	8.75	5.15	4.05	4.00	5.10	5.15	4.70	.....
23	.....	.....	.....	8.70	8.60	4.95	4.00	4.00	5.20	5.45	4.75	.....
24	[a] 4.00	.....	.....	8.75	8.55	4.80	3.90	4.00	5.20	5.50	5.00	.....
25	.....	.....	.....	9.05	8.35	4.65	3.85	4.00	5.35	5.60	4.95	.....
26	.....	.....	.....	9.35	7.80	4.45	3.60	4.00	5.65	5.75	5.15	[c] 4.30
27	.....	.....	[d] 6.30	9.55	7.55	4.35	3.70	3.85	5.80	5.90	5.30	.....
28	.....	[a] 4.50	.....	9.75	7.50	4.45	3.80	3.70	5.80	5.90	5.20	.....
29	.....	.....	.....	9.95	7.20	4.60	3.80	3.70	5.70	6.00	5.20	.....
30	.....	.....	.....	10.30	6.75	4.60	3.90	3.65	5.75	5.85	5.20	.....
31	[a] 4.20	.....	.....	.....	6.50	.....	3.90	3.65	.....	5.65	.....	.....

[a] Ice 1.7 feet thick.
[b] River frozen over.
[c] Ice 0.4 foot thick.
[d] Ice 1.4 feet thick.

NOTE.—During frozen season gage readings are to surface of water in hole cut in ice.

Rating table of Mattawamkeag River at Mattawamkeag, Me., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.7	110	3.9	630	5.4	2,350	7.8	6,800
2.75	121	4.0	710	5.5	2,500	8.0	7,260
2.8	133	4.1	790	5.6	2,650	8.2	7,740
2.85	146	4.2	880	5.7	2,810	8.4	8,235
2.9	160	4.3	975	5.8	2,970	8.6	8,740
2.95	175	4.4	1,075	5.9	3,135	8.8	9,260
3.0	191	4.5	1,175	6.0	3,305	9.0	9,780
3.1	226	4.6	1,285	6.2	3,645	9.5	11,170
3.2	262	4.7	1,400	6.4	3,995	10.0	12,570
3.3	300	4.8	1,520	6.6	4,355	10.5	14,070
3.4	340	4.9	1,650	6.8	4,725	11.0	15,600
3.5	382	5.0	1,790	7.0	5,110	11.5	17,200
3.6	432	5.1	1,930	7.2	5,510		
3.7	490	5.2	2,070	7.4	5,930		
3.8	556	5.3	2,210	7.6	6,360		

The above table is applicable only for open-channel conditions. It is based upon 16 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 2.7 feet and 10 feet. The table has been extended above gage height 10 feet. Below gage height 7.2 feet the table is the same as the 1903 table.

Estimated monthly discharge of Mattawamkeag River at Mattawamkeag, Me., for 1904.

[Drainage area, 1,510 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 8–30	13,470	6,360	10,360	6.86	5.87
May	17,840	4,175	11,590	7.68	8.85
June	5,210	1,025	3,088	2.04	2.28
July	1,650	432	1,014	.672	.775
August	710	340	534	.354	.408
September	2,970	340	1,440	.954	1.06
October	4,355	1,790	2,725	1.80	2.08
November	2,350	1,075	1,743	1.15	1.28
December 1–20	2,970	1,790	2,359	1.56	1.16

PISCATAQUIS RIVER NEAR FOXCROFT, ME.

This station was established August 17, 1902, by F. E. Pressey. It is located at Low's bridge, about halfway between Guilford and Foxcroft. The area of the drainage basin at this point is 280 square miles. The initial point for soundings is on the left bank at the top of the face of the left abutment. The gage is a painted staff spiked to the left abutment. It is referred to bench marks as follows: (1) Top of second course from top of left abutment; elevation, 17.80 feet. (2) Copper bolt in ledge, 150 feet north of highway and 75 feet west of river; elevation, 20.97 feet. (3) Marked point on bottom chord of upstream truss of bridge, 30 feet from initial point; elevation, 21.80 feet. All elevations are above gage datum. The channel both above and below the station is straight and has a width of about 90 feet at ordinary stages. The banks are high and rocky; the bed is rough and rocky, but permanent.

Observed mean velocities at the station have been between 3.63 feet per second at gage height 4.30 feet and 0.54 of a foot at gage height 2 feet. Low-water measurements are made by wading, either above or below the bridge, at points where the bed is fine gravel, and the velocity is greater than at the bridge. Water power is used at several manufacturing plants within a few miles above the station. As a result of the interruptions, due to the irregular use of water at the mills, the river fluctuates, at low stages, through nearly a foot on the gage within the day. The small amount of stored water in this basin is generally used for log driving. Slopes are steep. The river rises and falls rapidly. Probably 50 per cent of the basin is in forest. The gage is read twice daily by A. F. D. Harlow.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Piscataquis River near Foxcroft, Me., 1902–1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1902.		*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 13	F. E. Pressey	317	3.15	3.70	1,000
August 16	do	199	1.67	2.80	332
September 10	do	189	1.52	2.75	288
October 18	do	112	.54	2.00	61
1903.					
April 6	F. E. Pressey	409	3.63	4.30	1,490
May 14	E. G. Hartford	210	1.76	2.80	370
May 14	do	210	1.76	2.79	368
June 12	F. E. Pressey	156	1.03	2.48	160
June 12	do	164	1.27	2.64	208
June 12	do	156	1.08	2.47	169
September 16	N. C. Grover	136	.82	2.19	112
October 3[a]	do	11	2.00	1.52	22
October 31[a]	F. E. Pressey	22	1.41	1.78	31
October 31[a]	do	118	.67	1.94	79
October 31[a]	do	79	.47	1.78	37
November 24[a]	do	139	1.30	2.50	181
1904.					
April 22	F. E. Pressey	355	3.35	4.00	1,190
May 13	do	610	6.31	5.92	3,850
May 13	do	620	6.31	5.98	3,910
June 2	N. C. Grover	208	1.99	2.90	415

[a] Measurements by wading.

Mean daily gage height, in feet, of Piscataquis River near Foxcroft, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.0	3.8	3.0	4.7	7.0	2.4	3.2	2.3	2.0	4.0	3.2	2.4
2	3.0	3.4	3.0	4.6	5.6	2.3	3.4	2.4	2.0	4.0	3.2	2.8
3	3.0	3.0	3.0	4.5	5.2	2.3	3.7	2.2	2.0	3.6	3.0	2.8
4	3.1	2.9	3.1	4.3	5.5	2.3	3.7	2.1	2.5	3.5	3.0	2.6
5	3.0	2.8	3.3	4.2	4.9	2.7	3.6	2.1	2.6	3.2	3.0	2.8
6	3.2	2.8	3.6	5.0	4.8	3.4	3.2	2.1	2.6	3.2	2.8	2.7
7	3.2	2.2	3.6	5.0	4.6	4.2	3.2	2.1	2.6	3.0	3.0	2.6
8	3.0	2.8	3.8	5.5	3.8	3.6	3.0	2.1	2.6	3.0	3.0	2.6
9	2.9	2.8	4.4	5.8	4.0	3.3	3.0	2.2	2.6	2.4	3.0	2.6
10	2.5	2.8	4.9	7.0	6.4	3.2	2.9	2.2	2.2	2.2	3.0	2.6
11	3.2	2.8	5.2	10.2	6.9	2.6	2.9	2.4	3.6	2.6	3.0	2.7
12	3.2	2.6	5.0	8.6	8.2	2.0	2.9	2.4	3.3	2.6	3.0	2.6

Mean daily gage height, in feet, of Piscataquis River near Foxcroft, Me., for 1904—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
13	3.2	2.5	4.6	6.2	6.2	2.0	3.0	2.4	2.2	2.6	2.6	2.7
14	3.4	2.6	4.6	4.6	5.4	2.3	3.2	2.4	2.3	2.6	3.0	2.5
15	3.4	2.8	4.5	4.2	4.4	2.3	3.2	2.7	2.8	2.7	3.1	2.4
16	3.5	2.8	4.4	4.0	5.8	2.5	3.0	2.6	3.5	2.6	3.6	2.4
17	3.5	2.8	4.2	3.8	6.6	2.7	2.8	2.6	3.0	2.6	3.2	2.4
18	3.7	2.8	4.2	3.6	5.6	2.7	2.8	2.6	2.8	2.6	3.0	2.1
19	3.9	2.7	3.9	3.8	4.8	2.7	2.7	2.6	3.0	2.6	2.8	2.8
20	3.4	2.4	3.8	4.0	5.0	2.7	2.7	2.6	3.0	2.6	2.6	3.0
21	3.2	2.0	3.8	4.1	4.4	2.7	2.7	2.9	2.8	3.0	2.8	2.8
22	3.2	2.4	3.8	4.0	4.2	2.6	2.6	3.0	2 8	4.5	2.9	2.8
23	3.3	2.8	3.6	4.0	4.3	2.6	2.5	2.9	2.8	3.9	3.0	2.8
24	3.2	3.0	4.3	4.8	4.0	2.6	2.4	2.7	2.7	3.5	2.8	2.8
25	3.7	3.2	4.4	5.2	3.7	2.6	2.3	2.6	2.6	3.2	2.9	2.6
26	3.2	3.0	4.6	5.4	3.0	2.5	2.3	2.6	2.6	3.4	2.8	2.8
27	3.4	3.0	5.1	5.4	3.6	3.1	2.3	2.3	2.7	4.0	2.5	2.8
28	3.2	3.0	5.2	5.4	3.5	3.0	2.4	2.2	2.7	3.8	2.6	3.2
29	2.9	2.9	5.0	6.0	3.3	2.7	2.3	2.4	2.8	3.5	2.6	3.0
30	3.0	.....	4.8	6.7	3.4	2.6	2.3	2.2	4.0	3.4	2.4	2.8
31	3.0	.....	4.6	.....	3.4	.....	2.3	2.1	.....	3.2	.....	2.8

Rating table of Piscataquis River near Foxcroft, Me., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.0	64	2.7	267	3.8	1,023	5.2	2,635
2.05	72	2.75	292	3.9	1,113	5.3	2,785
2.1	81	2.8	318	4.0	1,208	5.4	2,940
2.15	90	2.85	345	4.1	1,303	5.5	3,100
2.2	100	2.9	374	4.2	1,403	5.6	3.265
2.25	111	2.95	405	4.3	1,508	5.8	3,610
2.3	123	3.0	437	4.4	1,615	6.0	3,970
2.35	135	3.1	502	4.5	1,725	6.2	4,335
2.4	148	3.2	569	4.6	1,840	6.4	4,705
2.45	163	3.3	638	4.7	1,960	6.6	5,080
2.5	180	3.4	709	4.8	2,085	6.8	5,460
2.55	199	3.5	782	4.9	2,215		
2.6	220	3.6	858	5.0	2,350		
2.65	243	3.7	938	5.1	2,490		

The above table is applicable only for open-channel conditions. It is based upo 20 discharge measurements made during 1902 to 1904, inclusive. It is well defined between gage heights 1.5 feet and 6.0 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Piscataquis River near Foxcroft, Me., for 1904.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	1,113	180	587	2.10	2.42
February	1,023	64	348	1.24	1.34
March	2,635	437	1,459	5.21	6.01
April	15,050	858	3,004	10.7	11.9
May	8,840	437	2,532	9.04	10.4
June	1,403	64	319	1.14	1.27
July	938	123	388	1.39	1.60
August	437	81	174	.621	.716
September	1,208	64	325	1.16	1.29
October	1,725	100	587	2.10	2.42
November	858	148	395	1.41	1.57
December	569	81	273	.975	1.12
The year	15,050	64	866	3.09	42.06

COLD STREAM AT ENFIELD, ME.

Cold Stream is the outlet from Cold Stream Pond—really a series of ponds comprising a total area of water surface of about 10 square miles, the largest, which is mostly in the town of Enfield, having about 8 square miles area.

Cold Stream flows into Passadumkeag Stream, a tributary of the Penobscot, at a distance of some 4½ miles from Cold Stream Pond, and has a total drainage area of about 37 square miles. The basin is mostly wooded and only sparsely settled. During the first half mile the fall is rapid, but through the rest of its course the stream runs through a great swamp, and is tortuous in its course, with sluggish current. Near the village of Enfield a fall of perhaps 10 to 12 feet has in the past been developed for power for a saw and shingle mill, but is not now in use. This drainage basin has been considered as a source of water supply for the district, which includes Bangor and some other adjacent towns.

This station was established June 14, 1904, by N. C. Grover, and was located at the highway bridge, about three-fourths of a mile south of Enfield, on the road to Passadumkeag. During the summer it was found that the gage was within the influence of back water from Passadumkeag Stream, and consequently, on September 12, 1904, the gage was taken from the highway bridge mentioned above and placed

about 200 feet below the old mill, near Enfield post-office. The drainage area at this point is about 26 square miles.

The gage is a standard chain, attached to a clump of maple trees on the right bank of the river; length of chain, 10.24 feet. It is referred to the following bench marks: (1) Spike in maple tree near the gage; elevation, 6.89 feet above gage datum. (2) Point on a rock marked "B. M.—2," about 8 feet downstream from the gage on the right bank; elevation, 4.55 feet above gage datum. (3) Center of the gage-box pulley; elevation, 9.03 feet above gage datum. Discharge measurements are made at low and medium stages by wading in the vicinity of the gage. High-water measurements are made from the bridge about 600 feet above the gage. The stream is fairly straight in the vicinity of the gage, and is about 30 feet wide at ordinary stages. The bed of the stream is rocky and permanent; the banks are not high and probably overflow at high stages. The width is about 30 feet; depth about 0.9 of a foot; velocity is high at all stages. The gage is read daily by Mr. A. J. Twombley, a farmer, at Enfield.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Cold Stream at Enfield, Me., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 9	H. K. Barrows	17	2.12	2.72	36
October 12	F. E. Pressey	20	1.85	2.75	37
October 21	do	23	2.43	2.92	56
November 4	do	25	2.16	2.90	54

Mean daily gage height, in feet, of Cold Stream at Enfield, Me., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	2.9	2.9	2.6	17	2.9	3.0	2.7	2.7
2	.....	2.9	2.8	2.7	18	2.9	3.0	2.9	2.7
3	.....	2.9	2.8	2.7	19	2.8	3.0	2.8	2.6
4	.....	2.9	3.0	2.7	20	2.8	3.0	2.7	2.7
5	.....	3.0	2.8	2.8	21	2.8	2.8	2.8	2.6
6	.....	2.8	2.8	2.8	22	2.8	3.0	2.8	2.7
7	.....	2.8	2.8	2.7	23	2.8	3.0	2.7	2.7
8	.....	2.8	2.8	2.7	24	2.9	3.0	2.6	2.7
9	.....	2.9	2.8	2.7	25	2.9	3.0	2.7	2.6
10	2.4	2.8	2.8	2.8	26	2.8	3.0	2.8	2.6
11	2.8	2.5	2.8	2.7	27	2.8	3.0	2.8	2.7
12	2.8	2.7	2.8	2.8	28	2.8	3.0	2.8	2.7
13	2.7	2.7	2.7	2.8	29	2.8	3.0	2.7	2.6
14	2.7	2.7	2.7	2.7	30	3.0	3.0	2.6	2.7
15	2.9	2.7	2.7	2.6	31	.....	3.0	.....	2.6
16	2.9	2.8	2.7	2.6					

PHILLIPS LAKE AND OUTLETS IN HOLDEN AND DEDHAM, ME.

Phillips Lake drains an area of about 11.5 square miles, and has a water surface of about 1.4 square miles. It is situated about 10 miles southeast of the city of Bangor. The shores are generally rocky and the adjacent country mostly wooded and only sparsely settled. The water is apparently of excellent quality and of considerable depth. This lake is being prominently considered as a new source of water supply for the city of Bangor. There are two drainage outlets of this lake. The greater amount of water flows from the northern end of the lake northerly through the village of East Holden; thence southerly through Long Pond and into Penobscot River below Bucksport. The total length of this outlet is 18 miles. The other outlet, situated at the southeast end of the lake in the town of Dedham, flows into Green Lake and thence into Union River. Through this outlet there is flow only during medium and high stages.

The United States Geological Survey maintains gages at the two outlets of the lake; also a gage for obtaining a record of lake level.

The station at the northern outlet was established July 7, 1904, by F. E. Pressey. It is located about 1¼ miles from the lake, one-fourth mile south of the village of East Holden and 175 feet south of an old mill. The drainage area at this point is 12.3 square miles. A plain staff gage was first used, attached vertically to a maple tree on the right bank, but this was replaced on December 6, 1904, by a standard chain gage attached to the same maple tree; length of chain, 9.48 feet. The gage is referred to bench marks as follows: (1) A spike, approximately vertical, in the foot of the tree to which the gage is attached, inclosed in a circle and marked "B. M.—1"; elevation, 5.24 feet above the gage datum. (2) The highest point on a large stone about 25 feet upstream from the gage in the bed of the stream. It is inclosed in a circle and marked "B. M.—2"; elevation, 5.51 feet above gage datum. (3) Spike driven into maple tree to which gage is attached, approximately horizontal, for use in measuring to the water surface; elevation, 6.17 feet above gage datum. (4) Center of gage-box pulley; elevation, 8.30 feet above gage datum.

Discharge measurements are made at ordinary stages by wading near the gage. At high water they are made from a railroad bridge about one mile upstream. The channel is straight for about 10 or 12 feet above the gage and curved just below the gage. The bed is rocky and rough but permanent. The banks are high and not subject to overflow. There is but one channel at all stages. The ordinary width is about 10 feet; depth, 0.8 of a foot; velocity, high at all stages. The gage is read once each day by Lewis Pinkham, of East Holden.

The station at the southeast outlet was established July 19, 1904, by H. K. Barrows. It is located at the highway bridge about 1½ miles

southeast of Lake House railroad station, and is about 700 feet southeast of the Maine Central Railroad crossing. A plain staff gage is fastened vertically to the logs of the floor and the right abutment of the single-span highway bridge. It is referred to bench marks as follows: (1) A point and circle on stone of the southeast abutment of the bridge marked "B. M.—1"; elevation, 6.31 feet above the gage datum. (2) Highest point of stone about 50 feet north of the gage on the west side of the road, inclosed by a circle and marked "B. M.—2"; elevation, 10.04 feet above the gage datum.

Discharge measurements are made at low and medium stages by wading just below the bridge, and at high stages from the downstream side of the bridge to which the gage is attached. The channel is curved for about 25 feet above the station and straight for some 30 feet below. The bed of the stream is of gravel, rough but permanent. The banks are rocky, wooded, and liable to overflow. There is but one channel at all stages. The gage is read only when meter measurements are made.

The station on Phillips Lake was established July 19, 1904, by H. K. Barrows. It is located about one-fourth mile west of Lake House railroad station. The gage is a plain, vertical staff fastened to a bowlder on the east shore of the lake about 300 feet northwest of Dr. L. S. Chilcott's cottage. It is referred to bench marks as follows: (1) A point on ledge of rock east of the gage, inclosed by a circle and marked "B. M.—1"; elevation, 10.28 feet above gage datum. (2) A point on a ledge of rock about 10 feet west of the gage, inclosed by a circle and marked "B. M.—2"; elevation, 11.86 feet above gage datum. This gage has been read at intervals of a week or two, and results furnished through the courtesy of Dr. L. S. Chilcott, of Bangor, during the summer and fall of 1904.

An additional vertical staff gage, referred to the same datum, was established on December 6, 1904. It is fastened to the east abutment of the Maine Central Railroad bridge over the northern end of Phillips Lake. It is referred to bench marks as follows: (1) The northwest corner of wing wall at west end of bridge; elevation, 16.79 feet above gage datum. This gage is read once a week by H. C. Lord, section foreman of the Maine Central Railroad, who lives at East Holden.

Observations at these stations during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Phillips Lake, north outlet, at East Holden, Me., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 19	H. K. Barrows	7.86	1.23	1.55	9.66
August 18	F. E. Pressey	6.54	.97	1.45	6.29
October 17	do	4.36	1.29	1.46	5.64

Discharge measurements of Phillips Lake, southeast outlet, near Greenlake, Me., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 19	H. K. Barrows	1.23	0.89	1.42	1.09
August 18	F. E. Pressey	.20	.35	1.14	.07
October 17	do	1.25	1.18	1.49	1.48

Mean daily gage height, in feet, of Philips Lake, north outlet, at East Holden, Me., for 1904.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.70	1.45	(a)	1.45	1.80
2	.....	1.70	1.50	.....	1.45	1.90
3	.....	1.65	1.48	.....	1.45	2.00
4	.....	1.65	1.45	.....	1.45	1.80
5	.....	1.65	1.45	.....	1.45	1.70
6	.....	1.60	1.45	.....	1.45	1.70
7	1.60	1.60	1.45	.....	1.45	1.70
8	1.60	1.60	1.45	.....	1.45	1.70
9	1.60	1.60	1.45	.....	1.45	1.70
10	1.60	1.55	1.42	.....	1.45	1.65
11	1.60	1.55	1.40	.....	1.45	1.65
12	1.60	1.55	1.40	.....	1.45	1.65
13	1.60	1.48	1.40	.....	1.45	1.70
14	1.55	1.45	1.40	.....	1.45	1.70
15	1.50	1.40	1.40	.....	1.45	1.65
16	1.50	1.40	1.40	.....	1.45	1.65
17	1.50	1.40	1.40	1.45	1.45	1.65
18	1.50	1.40	1.40	1.45	1.45	1.65
19	1.52	1.40	1.40	1.45	1.45	1.70
20	1.55	1.40	1.40	1.45	1.45	1.65
21	1.52	1.62	1.40	1.45	1.50	1.70
22	1.50	1.50	1.40	1.45	1.50	1.75
23	1.50	1.48	1.40	1.45	1.50	1.70
24	1.50	1.45	1.40	1.45	1.55	1.60
25	1.50	1.45	1.40	1.45	1.60	1.65
26	1.50	1.45	1.40	1.45	1.65	1.65
27	1.55	1.45	1.40	1.45	1.70	1.65
28	1.70	1.45	1.40	1.45	1.75	1.70
29	1.70	1.48	1.40	1.45	1.75	1.65
30	1.70	1.45	1.40	1.45	1.75	1.65
31	1.70	1.45	.....	1.45	.....	1.65

a No gage readings October 1–16.

Mean daily gage height, in feet, of Phillips Lake, at East Holden, Me., for 1904.

Day.	July.	Aug.	Oct.	Dec.	Day.	July.	Aug.	Oct.	Dec.
6	.....	6.50	.....	8.30	19	7.05	.....	.....	.....
14	.....	6.37	.....	.....	21	.....	6.62	.....	.....
17	.....	.....	7.34	.....	22	.....	6.70	.....	.....
18	.....	6.40	.....	.....	31	6.70	.....	.....	.....

KENNEBEC RIVER DRAINAGE BASIN.

Kennebec River is one of the best streams in the United States for the development of water power. Its basin, which lies wholly within the State of Maine, between those of the Androscoggin and the Penobscot, is 150 miles in length and from 50 to 80 miles in width in the main portion, embracing a total area of 6,110 square miles. Of this area 1,330 square miles are tributary to Moosehead Lake, in which the river has its source. The upper tributaries, however, rise in the hilly, forested areas lying to the east and west of that lake. Of these, Moose River is the most important. The northern part of the drainage basin is broken by offsets from the White Mountains. Nearly the whole of the upper portion is forest covered and in its original wild state.

Below the outlet of Moosehead Lake the hills close in upon the river, forming a narrow, rocky chasm, with steep and precipitous sides. From Moosehead Lake to The Forks the river is a torrent, the total fall in the 23 miles being 500 feet. Dead River is tributary to the Kennebec at The Forks. Below this junction the river flows with a lesser slope in a narrow, winding bed about 20 miles to Bingham; thence through a broader valley in which are located many farms. There are between Bingham and tide water a number of large falls at which water power has been developed.

The prevailing rock in the northern part of the basin is slate, with a belt of sandstone to the west and a district of granite to the east of Moosehead. South of Bingham mica-schists run into the clay slate in spots and elsewhere into gneiss, but (except where broken by intrusions of granite, as at Hallowell and Augusta) slate prevails as far as Gardiner. Below the latter city gneiss predominates, with stretches of mica-schists on the east bank. The surface materials are finely pulverized. Water-retaining sands and gravels are more abundant in the northern part, succeeded by a greater proportion of loam and clay to the south.

The areas of the drainage basins of the river and its principal tributaries are given in the following table.

Drainage areas of Kennebec River and principal tributaries.

River.	Locality.	Drainage area.
		Square miles.
Kennebec	Outlet of Moosehead Lake	1,330
Do	The Forks	1,670
Do	Immediately below mouth of Dead River	2,540
Do	Caratunk Falls, Solon	2,790
Do	North Anson, above mouth of Carrabassett River.	2,880
Do	Madison	3,310
Do	Norridgewock	4,020
Do	Fairfield	4,370
Do	Waterville, above mouth of Sebasticook River.	4,380
Do	Waterville, below mouth of Sebasticook River.	5,310
Do	Augusta	5,710
Do	Head of Merrymeeting Bay	6,110
Moose	Mouth	680
Roach	Roach River	85
Dead	Mouth, The Forks	870
Carrabassett	North Anson, above Embden Brook	340
Do	Mouth	395
Sandy	Farmington	350
Do	Mouth	670
Sebasticook	do	930
Messalonskee	do	208
Cobbosseecontee	do	240

The United States Geological Survey now maintains gaging stations at the following places in the Kennebec drainage: On the Kennebec at The Forks and at North Anson; on Moose River at Rockwood; on Roach River at Roach River; on Dead River at The Forks; on Carrabassett River at North Anson; on Sandy River near Madison; on Messalonskee River at Waterville.

In addition, figures of flow are furnished the Survey by private parties for Kennebec River at Waterville, and Cobbossecontée River at Gardiner.

KENNEBEC RIVER AT THE FORKS, ME.

This station was established by N. C. Grover, September 28, 1901, at the wooden highway bridge across Kennebec River at The Forks, above the mouth of Dead River. The drainage area at the station is 1,670 square miles. Of this area 1,330 square miles are tributary to

Moosehead Lake, while the remaining 340 square miles are drained into the Kennebec by small streams with steep slopes and no storage. Practically all land surfaces above this point are in forest. There are two gages—one, a vertical rod, is attached to the timber retaining wall on the left bank about 75 feet above the bridge; the other is of the standard chain type, and is attached to the bridge floor; length of chain, 17.18 feet. The datum of the two gages is the same and is referred to two bench marks; (1) the top of a bolt on the east abutment, north side of bridge; elevation, 12.85 feet above gage datum; (2) marked point on the floor of the bridge near the east end of the gage box; elevation, 15.42 feet above gage datum; gage datum is at elevation 562.85 feet above mean sea level, as determined by the Kennebec River survey of 1904. The initial point of soundings is on the left bank, marked by a rod across the bridge, just above the abutment and below the bridge floor. The channel is straight above the station for about 200 feet and below for a distance of 500 feet, is unbroken by piers, and is about 125 feet wide at ordinary stages of the river. The current is swift; observed mean velocities ranged from 7.67 feet per second at gage height, 5.60 to 0.86 of a foot per second at gage height 0.90. The banks are high and rocky and the bed is rocky and permanent. The gage is read twice daily by William W. Young.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Kennebec River at The Forks, Me., 1901–1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1901.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 28	N. C. Grover	774	2.40	2.60	1,860
October 20	do	550	.86	.90	.473
1902.					
April 25	N. C. Grover	930	3.76	3.70	3,500
June 16	do	1,160	7.64	5.60	8,860
June 25	do	1,050	5.61	4.75	5,900
September 29	F. E. Pressey	730	2.03	2.10	1,480
1903.					
August 18	N. C. Grover	979	4.27	3.95	4,180
November 4	do	614	1.23	1.26	757
November 4	do	614	1.24	1.26	759
1904.					
July 27	H. K. Barrows	650	1.63	1.70	1,060
August 29	do	863	3.15	3.12	2,720

Mean daily gage height, in feet, of Kennebec River at The Forks, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.90	2.30	a2.40	2.00	4.85	5.75	4.10	2.25	3.05	2.60	1.45	2.10
2	b1.90	.....	.....	4.25	5.65	4.20	2.40	3.10	2.35	1.40	2.10
3	.....	.....	.....	1.50	3.70	6.25	4.75	3.70	3.60	2.05	1.40	2.10
4	.....	c2.30	.....	.80	3.50	5.90	4.60	3.25	4.10	1.85	1.40	d2.50
5	.....	.....	.....	.80	3.40	6.30	4.40	3.30	4.05	1.95	1.55	e2.40
6	.....	.....	.....	.90	3.40	5.90	4.10	3.25	3.85	1.50	1.70	e2.40
7	a2.00	.....	a2.20	1.10	3.30	6.40	4.15	3.15	3.30	1.35	2.50	f2.60
8	.....	.....	2.40	g1.20	3.30	4.75	3.95	3.10	3.05	1.30	2.65	h2.70
9	a1.90	.....	2.50	g6.80	3.20	5.35	4.00	3.05	2.90	1.30	2.15	i2.80
10	.....	.....	a2.50	g2.60	3.70	5.10	4.05	3.35	2.80	1.60	2.10	h3.10
11	.....	c2.60	.....	g3.20	5.30	6.10	4.30	3.25	2.70	2.30	1.95	i3.20
12	c1.90	j2.60	a2.30	g3.70	4.80	6.30	4.85	3.65	2.60	2.85	2.00	3.30
13	1.90	j2.60	.....	2.80	4.00	7.00	5.25	3.55	2.60	3.05	2.15	3.30
14	2.10	.....	.....	2.80	3.20	6.90	5.30	3.75	2.65	3.10	2.30	3.50
15	.....	2.60	.....	3.10	4.10	4.20	5.20	3.30	2.95	3.10	2.20	3.50
16	c2.00	.....	a2.10	3.10	4.30	4.20	6.10	2.10	2.20	3.05	2.30	3.80
17	.....	.....	.....	2.90	4.65	4.45	5.50	3.90	1.90	3.00	2.20	3.80
18	.....	c2.40	.....	1.80	4.80	3.90	4.40	3.35	1.80	2.65	2.20	4.00
19	c2.00	.....	2.30	2.10	5.65	3.90	4.15	3.50	1.70	2.40	2.15	4.10
20	.....	2.40	j2.40	1.70	5.30	k7.50	4.10	3.40	1.50	2.30	2.10	4.10
21	c2.00	.....	2.40	1.70	4.90	.....	4.00	2.35	1.50	2.25	2.15	4.20
22	c2.00	.....	.....	1.80	3.10	k4.60	5.85	2.30	1.70	2.55	2.10	4.40
23	.....	.....	.....	1.90	5.25	k3.85	2.15	1.50	1.75	2.30	2.05	4.20
24	.....	.....	2.40	2.65	4.25	k3.85	6.10	1.75	2.00	2.05	2.05	4.40
25	c2.30	.....	2.40	3.35	5.60	k3.90	4.20	2.00	2.60	2.40	2.00	4.60
26	.....	.....	2.40	3.20	4.50	4.35	3.60	2.25	2.60	2.25	2.00	4.60
27	.....	c2.40	2.40	3.25	4.55	4.35	3.50	2.55	2.55	2.00	2.05	4.60
28	c2.30	.....	2.30	3.30	4.45	4.30	3.40	3.10	2.70	1.70	2.00	4.80
29	c2.40	.....	2.30	3.40	5.50	4.10	3.70	3.20	2.55	1.80	2.00	4.50
30	.....	.....	2.10	3.95	5.55	4.00	3.40	3.10	2.70	1.55	2.10	4.80
31	.....	.....	2.20	.....	5.25	.....	3.05	3.10	.....	1.50	.....	4.70

a Ice 2.2 feet thick. *b* Ice 1.4 feet thick. *c* Ice 2 feet thick.
Anchor ice caused backwater effect on gage estimated as follows:
d 0.4 foot.
e 0.3 foot.
f 0.5 foot.
g Ice from Dead River formed a jam a short distance below gage and caused backwater.
h 0.6 foot.
i 0.7 foot.
j Ice 2.1 feet thick.
k Log jam formed short distance below gage caused estimated backwater effect on gage of 0.3 foot.

NOTE.—During frozen season gage readings are to surface of water in hole cut in ice.

Rating table for Kennebec River at The Forks, Me., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.9	480	1.6	1,040	2.7	2,000	4.4	5,020
.95	520	1.7	1,120	2.8	2,105	4.6	5,510
1.0	560	1.8	1,200	2.9	2,220	4.8	6,040
1.05	600	1.9	1,285	3.0	2,350	5.0	6,620
1.1	640	2.0	1,365	3.1	2,490	5.2	7,280
1.15	680	2.1	1,445	3.2	2,635	5.4	8,010
1.2	720	2.2	1,525	3.4	2,950	5.6	8,780
1.25	760	2.3	1,610	3.6	3,310	5.8	9,620
1.3	800	2.4	1,700	3.8	3,700	6.0	10,510
1.4	880	2.5	1,800	4.0	4,120		
1.5	960	2.6	1,900	4.2	4,560		

The foregoing table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1901 to 1904, inclusive. It is well defined between gage heights 1 foot and 5 feet. Above 6 feet gage height the discharges are estimated by logarithmic extension of the discharge curve.

Estimated monthly discharge of Kennebec River at The Forks, Me., for 1904.

[Drainage area, 1,670 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April (10–30)	4,015	1,120	2,226	1.33	1.04
May	8,780	2,635	5,255	3.15	3.63
June	18,090	3,805	8,001	4.79	5.34
July	10,960	1,485	5,232	3.13	3.61
August	3,910	960	2,440	1.46	1.68
September	4,330	960	2,078	1.24	1.38
October	2,490	800	1,565	.937	1.08
November	1,950	880	1,377	.825	.920

KENNEBEC RIVER NEAR NORTH ANSON, ME.

This station was established on October 18, 1901, by N. C. Grover. It is located 1½ miles east of North Anson, above the mouth of Carrabassett River. The drainage area at this point is 2,880 square miles. Measurements are made from the wooden highway bridge across the Kennebec, known locally as Patterson Bridge. There are three gages: One is a vertical rod fastened to the bridge pier; another, for high-water observations, is a vertical rod attached to the right abutment; the third is a low-water gage of the standard chain type, and is attached to the wooden truss on the upstream side of the bridge; length of chain, 30.40 feet when gage was established, but changed to 30.36 feet, July 26, 1904, owing to settlement of bridge. Gage datum is elevated 241.24 feet above mean sea level, as determined by the Kennebec River survey of 1904. The datum of the three gages is the same and is referred to four bench marks: (1) Top of pier back of the gage; elevation, 22.50 feet. (2) Top of the southeast corner of the twelfth stone from the top of west abutment; elevation, 9.55 feet. (3) Copper bolt in bowlder on right bank about 100 feet above the bridge; elevation, 10.66 feet. (4) Marked point on the bottom chord of the bridge near the chain gage; elevation, 25.15 feet originally; changed to 25.03, July 26, 1904. The initial point for soundings is on the left bank at the outside of the end post of the center truss of the bridge. The channel is straight above the station for 500 feet and below for 1,000 feet and has a width of about 350 feet, broken by one pier The current is

moderately rapid, except near the left bank; observed mean velocities at the station have ranged from 3.65 feet per second at gage height 6.80 feet to 1.40 feet per second at gage height 2.85. Low-water measurements are made from a boat about 1,000 feet below the station at a section where there is a better distribution of current. The right bank is high and rocky, while the left bank is comparatively low and subject to overflow at the time of highest water. The bed of the stream is rocky, with sand over a portion of the section, and is permanent. The gage is read twice daily by Mrs. C. S. Benjamin, the toll collector at the bridge.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Kennebec River near North Anson, Me., 1901–1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1901.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
October 14	N. C. Grover	1,540	2.02	3.20	3,120
October 18	do	1,500	1.64	3.00	2,460
1902.					
July 29	F. E. Pressey	2,390	2.60	4.55	6,220
1903.					
March 28	F. E. Pressey	2,900	3.93	6.50	11,400
May 27	do	1,970	1.59	3.25	3,130
June 15	do	3,050	3.64	6.80	11,100
June 16	do	2,424	2.79	4.90	6,740
June 16	do	2,250	2.48	4.38	5,580
July 17	do	1,920	1.54	3.25	2,960
August 15	do	2,120	1.89	3.78	4,000
September 24	N. C. Grover	1,790	1.40	2.85	2,500
November 6	F. E. Pressey	428	2.83	2.00	[a] 1,200
1904.					
January 27	F. E. Pressey	393	1.90	[b] 3.40	749
January 28	do	398	1.97	[b] 3.40	786
March 2	do	285	1.86	[c] 3.55	529
March 4	do	285	2.01	[c] 3.65	572
June 10	do	2,770	3.09	6.00	8,560
July 26	H. K. Barrows	1,780	1.35	2.94	2,400
August 30	do	1,940	1.65	3.43	3,210

[a] Different section.
[b] River frozen. Gage height to water surface. Ice 2.2 feet thick.
[c] River frozen. Gage height to water surface. Ice 2.5 feet thick.

Mean daily gage height, in feet, of Kennebec River near North Anson, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	a 3.60	b 4.80	9.65	6.00	4.30	5.00	3.40	5.70	3.05	c 6.05
2	3.70	.....	a 3.60	4.90	8.65	6.00	4.55	4.50	3.40	5.05	2.95	.....
3	.....	.....	a 3.60	4.90	8.70	5.20	4.90	4.20	3.65	4.55	2.75	.....
4	.....	.....	a 3.60	4.90	7.75	5.20	4.75	4.40	4.20	3.95	2.75	.....
5	.....	.....	a 3.60	4.90	7.25	5.70	4.50	4.70	4.65	3.80	2.75	.....
6	.....	d 3.50	.....	5.00	7.40	6.05	4.30	4.80	4.25	3.40	2.80	e 5.00
7	.....	.....	.....	5.15	7.15	7.40	4.25	4.10	4.00	3.15	3.15	.....
8	.....	.....	.....	5.50	6.05	6.90	4.10	4.50	3.80	3.00	3.45	.....
9	f 3.50	.....	.....	5.75	6.70	6.35	4.05	3.60	3.60	2.95	3.35	.....
10	.....	.....	.....	g 6.85	9.10	6.60	3.95	3.45	3.45	2.95	3.15	.....
11	.....	.....	h 4.00	8.45	8.50	6.45	3.95	3.25	3.15	3.15	3.20	.....
12	.....	.....	i 4.40	10.10	10.70	5.85	5.00	3.30	3.20	3.35	3.20	.....
13	.....	f 3.20	.....	8.60	8.35	5.60	5.60	3.90	3.15	3.70	3.15	.....
14	.....	.....	.....	6.80	7.00	5.35	5.35	3.50	3.15	3.80	3.30	.....
15	.....	.....	.....	5.00	6.10	5.05	5.10	3.40	3.45	3.75	3.15	.....
16	f 3.40	.....	.....	4.90	9.90	5.05	5.10	3.95	3.95	3.75	3.15	j 4.00
17	.....	.....	.....	4.40	9.95	4.80	4.80	4.90	3.90	3.90	3.15	.....
18	.....	.....	.....	4.00	8.15	4.50	4.80	4.50	3.40	3.75	3.15	.....
19	.....	.....	k 4.20	3.65	7.35	4.50	4.80	3.65	3.20	3.30	3.05	.....
20	.....	f 3.50	.....	4.25	7.35	4.60	3.85	3.85	3.00	3.25	2.95	.....
21	.....	.....	.....	4.10	6.35	4.95	4.00	4.20	2.90	3.20	3.00	.....
22	.....	.....	.....	3.80	6.80	4.60	3.05	3.70	3.05	4.70	3.40	.....
23	b 3.20	.....	.....	4.15	6.40	4.80	3.05	3.80	3.00	4.80	3.20	.....
24	.....	.....	.....	4.80	5.90	4.25	3.40	3.00	3.05	4.55	3.25	l 3.80
25	.....	.....	.....	5.60	5.55	4.10	3.55	3.00	3.30	4.20	3.15	.....
26	.....	.....	m 4.40	5.90	5.90	4.30	3.25	2.85	3.80	3.75	3.20	.....
27	m 3.40	f 3.70	.....	6.00	5.85	4.35	3.65	2.95	3.80	4.15	3.20	.....
28	m 3.40	.....	.....	6.15	5.45	4.40	4.15	3.25	3.80	4.20	3.55	.....
29	.....	.....	.....	7.05	6.20	4.30	3.90	3.50	4.00	3.50	5.10	.....
30	b 3.20	.....	.....	8.95	6.30	4.20	3.95	3.40	5.10	3.30	5.75	.....
31	.....	.....	.....	.....	5.90	.....	3.95	3.40	.....	3.20	.....	n 5.00

a Ice 2.5 feet thick.
b Ice 2 feet thick.
c River frozen over.
d Ice 1.9 feet thick.
e Ice 0.35 foot thick,
f Ice 1.85 feet thick.
g River clear of ice.
h Ice 2.8 feet thick.
i Ice 2.4 feet thick.
j Ice 0.6 foot thick.
k Ice 2.7 feet thick.
l Ice 0.9 foot thick; gage reading to top of ice = 3.8.
m Ice 2.2 feet thick.
n Ice 1.8 feet thick; gage reading to top of ice = 5.0.

NOTE.—During frozen season gage readings are to surface of water in hole cut in ice.

Rating table of Kennebec River near North Anson, Me., from January 1 to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.75	2,150	4.0	4,587	5.5	8,360	7.0	12,680
2.8	2,224	4.1	4,825	5.6	8,630	7.2	13,300
2.85	2,302	4.2	5,065	5.7	8,900	7.4	13,920
2.9	2,384	4.3	5,305	5.8	9,170	7.6	14,540
2.95	2,468	4.4	5,545	5.9	9,450	7.8	15,160
3.0	2,554	4.5	5,785	6.0	9,730	8.0	15,780
3.1	2,729	4.6	6,035	6.1	10,020	8.2	16,420
3.2	2,908	4.7	6,285	6.2	10,310	8.4	17,060
3.3	3,091	4.8	6,535	6.3	10,600	8.6	17,700
3.4	3,281	4.9	6,790	6.4	10,890	8.8	18,340
3.5	3,479	5.0	7,050	6.5	11,180	9.0	18,980
3.6	3,685	5.1	7,310	6.6	11,480	9.5	20,630
3.7	3,899	5.2	7,570	6.7	11,780	10.0	22,280
3.8	4,121	5.3	7,830	6.8	12,080	10.5	23,980
3.9	4,351	5.4	8,090	6.9	12,380		

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1901 to 1904, inclusive. It is fairly well defined between gage heights 2 feet and 5 feet. Above gage height 5 feet the curve is somewhat uncertain. The table has been extended beyond these limits.

Estimated monthly discharge of Kennebec River near North Anson, Me., for 1904.

[Drainage area, 2,880 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 10–30	22,620	3,791	9,755	3.39	2.65
May	24,660	8,225	13,940	4.84	5.58
June	13,920	4,825	7,783	2.70	3.01
July	8,630	2,641	5,250	1.82	2.10
August	7,050	2,302	4,265	1.48	1.71
September	7,310	2,384	3,747	1.30	1.45
October	8,900	2,462	4,221	1.47	1.70
November	9,035	2,150	3,146	1.09	1.22

KENNEBEC RIVER AT WATERVILLE, ME.

The only long-continued observations of the flow of the river are those which have been made at Waterville by the Hollingsworth & Whitney Company, which kindly furnishes the results for publication.

The works of that company are above the mouth of Sebasticook River. The tributary drainage area of the Kennebec at that point is about 4,380 square miles. Observations are made at 12 o'clock noon of each day, that hour having been chosen, after investigation, as a time when the flow is least affected by storage at dams upstream and as giving most nearly the average for the day.

When the flow of the river is less than 3,500 second-feet, the whole amount is diverted through the water wheels of the mill, of which there are 48. Water in excess of the above amount is wasted over the dam. All of the wheels have been tested at Holyoke under practically the same head as used at Waterville. Discharge curves for the wheels and for overflow of the dam, both with and without flashboards, were constructed several years ago by Mr. Sumner Hollingsworth. Estimates of daily flow are made by means of these diagrams. The leakage through the crib dam has never been measured, but 100 second-feet are added arbitrarily to cover this item.

Mean daily discharge, in second-feet, of Kennebec River at Waterville, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,313	953	1,018	8,733	34,770	7,532	6,131	5,080	3,514	10,460	4,148	2,903
2	975	918	1,047	7,980	33,910	10,490	5,980	5,168	3,692	7,968	3,908	2,891
3	1,381	917	1,044	6,770	23,890	10,220	4,872	4,086	3,415	6,806	3,649	3,462
4	714	944	1,132	7,211	22,060	8,675	4,140	4,983	3,602	5,960	3,521	1,545
5	896	1,248	1,370	6,777	20,730	10,310	7,370	4,923	5,534	4,183	3,516	3,150
6	552	940	100	8,349	21,970	10,610	6,174	4,508	5,921	4,064	2,689	2,894
7	959	543	659	9,541	18,370	12,740	5,585	3,843	5,458	4,305	3,494	2,783
8	956	940	2,063	15,620	13,390	14,460	5,428	4,817	5,170	3,875	3,486	2,764
9	1,545	629	2,616	23,240	12,810	11,250	5,628	4,378	3,597	3,959	3,573	2,859
10	100	654	2,982	33,340	25,760	13,250	3,423	3,943	4,050	4,045	3,793	2,895
11	830	1,891	3,552	33,530	30,910	12,000	5,442	4,556	2,610	3,828	3,223	100
12	1,218	615	3,291	27,600	37,840	11,190	5,590	4,970	3,779	4,116	3,764	3,183
13	916	713	3,033	23,080	26,850	7,402	7,049	6,273	3,779	4,027	2,659	2,302
14	1,909	100	3,254	14,620	19,610	6,051	8,263	5,247	3,176	4,284	4,096	2,459
15	1,163	645	3,232	12,310	15,510	5,919	6,969	5,687	3,777	4,159	3,512	2,587
16	1,543	1,389	2,799	10,590	28,760	5,801	6,989	5,326	6,978	3,144	4,071	2,323
17	100	538	2,736	8,813	37,560	5,552	3,694	5,087	5,822	4,350	4,365	2,596
18	912	1,432	2,513	8,343	27,440	6,388	5,512	5,419	4,531	4,464	2,875	1,249
19	1,577	578	2,097	7,947	20,680	4,670	5,774	4,918	4,030	4,121	2,898	3,163
20	905	1,393	1,413	8,414	24,520	6,458	4,346	4,261	4,055	4,062	2,678	3,178
21	1,764	100	2,426	10,530	20,910	6,401	4,969	4,380	2,961	3,322	3,755	2,771
22	900	1,031	2,497	10,460	17,880	6,324	4,692	6,720	3,767	5,179	4,078	3,423
23	910	908	3,078	11,110	15,150	5,979	2,941	5,280	4,004	6,866	4,053	2,775
24	303	1,329	3,372	11,740	14,530	5,834	3,987	4,537	3,722	5,722	658	2,899
25	1,012	987	4,064	15,180	13,970	5,579	4,998	3,913	2,691	4,214	4,105	1,966
26	995	1,295	10,470	16,320	13,010	5,110	4,805	4,112	4,082	4,146	2,407	2,074
27	1,642	1,420	11,080	17,810	11,120	7,848	4,699	3,535	4,042	4,816	3,465	3,127
28	638	100	11,380	15,930	11,200	7,251	4,933	2,950	4,381	4,516	2,962	2,833
29	634	651	10,400	20,910	8,277	11,860	5,619	4,256	4,251	3,964	2,353	2,474
30	629	.....	8,449	36,110	9,031	5,423	5,523	4,152	8,111	2,768	.....	3,048
31	348	.....	8,189	.....	9,774	.....	4,550	4,534	.....	4,139	.....	2,764

MOOSE RIVER NEAR ROCKWOOD, ME.

This station was established September 7, 1902, by N. C. Grover. It is located 4 miles west of Kineo, Me., and 2 miles from the mouth of the river. The drainage basin is 680 square miles at this point. Water is stored by dams at the outlets of several of the lakes and ponds in the basin above, but all of such stored water is used for log driving. The stage of the river changes very slowly after the end of the log-driving season. Practically all of the land areas in this basin are in forest. Measurements are made from a car suspended from a steel cable, or by wading at low water. The initial point for soundings is on the right bank, 1 foot from a birch tree, to which the tag line and cable are attached. There are two gages: One is a painted post driven into the clay bed of the river and braced from several trees; the other is a standard chain gage attached to trees on the bank. The datum of the two gages is the same, and is referred to bench marks as follows: (1) Copper bolt in bowlder 8 feet from corner of house of Peter Callaghan; elevation, 14.58 feet. (2) Highest point of large bowlder on right bank 150 feet below the cable; elevation, 5.75 feet. The channel is about 220 feet wide at ordinary stages and is straight both above and below the station. The banks are high and rocky; the bed of the stream is rocky and permanent. The gage is read twice daily by Peter Callaghan.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Mean daily gage height, in feet, of Moose River near Rockwood, Me., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.55	4.65	4.00	2.50	2.30	4.70	3.75	2.70
2	.....	6.90	4.60	3.95	2.50	2.35	5.05	3.70	2.60
3	.....	7.15	4.55	4.10	2.50	2.40	5.10	3.60	2.50
4	.....	7.10	4.25	4.20	2.50	2.55	5.10	3.60	2.50
5	.....	7.30	4.25	4.10	2.40	2.85	5.05	3.50	2.50
6	.....	7.55	4.55	4.00	2.30	3.05	5.00	3.50	2.50
7	.....	7.40	4.70	3.85	2.30	3.10	4.90	3.40	2.50
8	.....	7.30	4.95	3.75	2.20	3.10	4.80	3.40	2.40
9	.....	7.25	5.05	3.60	2.20	3.05	4.65	3.30	2.35
10	1.80	7.35	5.00	3.50	2.15	3.00	4.60	3.20	2.30
11	3.15	8.00	5.05	3.45	2.20	3.00	4.50	3.15	.....
12	3.45	9.05	5.25	3.35	2.30	2.95	4.40	3.10	.....
13	3.70	9.10	5.05	3.40	2.30	2.90	4.40	3.10	.....
14	3.85	8.70	4.80	3.35	2.40	2.90	4.35	3.10	.....
15	4.00	8.10	4.65	3.30	2.50	2.95	4.25	3.10	.....
16	4.10	7.90	4.45	3.20	2.50	3.20	4.15	3.10	.....
17	4.15	7.90	4.25	3.15	2.50	3.45	4.05	3.00	.....
18	4.20	7.65	4.10	3.00	2.40	3.50	4.00	2.90	.....
19	4.20	7.25	4.10	2.90	2.40	3.70	3.90	2.90	.....
20	4.20	7.05	.....	2.70	2.45	3.70	3.80	2.90	.....
21	4.30	6.85	.....	2.60	2.50	3.75	3.80	2.90	.....
22	4.30	6.60	.....	2.50	2.65	3.80	3.90	2.90	.....
23	4.30	6.50	4.65	2.40	2.70	3.80	4.00	2.90	.....
24	4.50	6.30	4.65	2.40	2.70	3.80	4.10	2.80	.....
25	4.75	6.00	4.70	2.40	2.70	3.95	4.00	2.80	.....
26	5.05	5.65	4.60	2.40	2.70	4.05	4.00	2.80	.....
27	5.30	5.45	4.55	2.45	2.60	4.20	4.00	2.80	.....
28	5.55	5.30	4.55	2.50	2.50	4.30	3.90	2.80	.....
29	5.85	5.05	4.60	2.50	2.50	4.30	3.90	2.70	.....
30	6.20	5.05	4.20	2.50	2.45	4.50	3.80	2.70	.....
31	.....	4.95	.....	2.50	2.40	.....	3.80	.....	.....

ROACH RIVER AT ROACH RIVER, ME.

This stream, which has a total drainage area of 120 square miles, enters Moosehead Lake from the east. Its basin is completely forested. Dams at the outlets of several ponds control the flow of the river. The gage is located at about 100 feet downstream from the lowest of these dams, at which point the river is so completely under control that the stage does not vary perceptibly for weeks at a time. Impounded water is used for log driving.

This station was established November 10, 1901, by N. C. Grover. The drainage area at this point is 85 square miles. The gage is a vertical rod spiked to the timber retaining wall on the right bank of the stream. It is referred to a bench mark, which is a cross cut in the highest timber of the crib to which the gage is spiked; elevation, 9 feet. Meter measurements of flow are made by wading, or from a boat at a section about 2,000 feet downstream from the gage. The bed of the stream at this point is rocky and permanent. The channel is straight and about 60 feet wide. The gage is read twice daily by C. H. Sawyer.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Mean daily gage height, in feet, of Roach River at Roach River, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	(a)	(a)	2.30	4.80	2.30	2.30	2.20	2.20	2.30	2.30	2.10
2				2.30	5.30	5.50	2.30	2.20	2.20	2.30	2.20	2.10
3				2.30	5.55	5.50	2.30	2.20	2.20	2.30	2.10	2.10
4				2.30	5.40	5.50	2.30	2.20	2.60	2.30	2.10	(b)
5				2.30	5.40	5.50	2.30	2.20	2.25	2.30	2.10	.....
6				2.30	5.40	5.50	2.30	4.00	2.30	2.30	2.10	.....
7				2.30	5.40	5.50	2.30	3.80	2.30	2.30	2.10	.....
8				2.30	5.40	5.50	2.30	3.00	2.55	2.30	2.10	.....
9				2.30	2.30	3.30	2.30	3.00	2.80	2.30	2.10	.....
10				2.30	2.30	3.30	2.30	3.00	2.80	2.30	2.10	.....
11				2.30	2.30	3.30	2.30	2.60	2.30	2.30	2.10	.....
12				2.30	5.40	3.30	2.30	2.60	2.30	2.30	2.10	.....
13				2.30	5.40	2.50	2.30	3.40	2.30	2.30	2.10	.....
14				2.30	2.30	2.50	2.30	3.40	2.30	2.30	2.10	.....
15				2.30	2.30	2.50	2.30	3.40	2.30	2.30	2.10	.....
16				2.30	2.30	2.50	2.30	2.85	2.30	2.30	2.10	.....
17				2.20	5.50	2.30	2.30	2.30	2.30	2.30	2.10	.....
18				2.20	5.50	2.30	2.60	2.30	2.30	2.30	2.10	.....
19				2.20	2.30	2.30	2.60	2.30	2.30	2.30	2.10	.....
20				2.20	2.30	2.30	2.60	2.30	2.30	2.30	2.10	.....
21				2.20	5.50	2.30	2.60	2.30	2.30	2.55	2.10	.....
22				2.20	5.50	2.30	3.00	2.30	2.30	2.30	2.10	.....
23				2.20	2.30	2.30	2.60	2.70	2.30	2.65	2.10	.....
24				2.20	3.90	2.30	2.20	2.70	2.30	3.00	2.10	.....
25				2.20	3.90	2.30	2.20	2.20	2.30	3.00	2.10	.....
26			2.30	2.20	5.50	2.30	2.20	2.20	2.30	3.00	2.10	.....
27			2.30	2.20	2.30	2.30	2.20	2.20	2.30	3.40	2.10	.....
28			2.30	2.20	5.50	2.30	2.20	2.60	2.30	3.40	2.10	.....
29			2.30	3.30	2.30	2.30	2.20	2.20	2.30	3.40	2.10	.....
30			2.30	4.20	5.50	2.30	2.20	2.20	2.30	3.00	2.10	.....
31			2.30	.....	5.50	.....	2.20	2.20	.....	3.00	.....	.....

a River frozen January 1 to March 25.
b River frozen December 4–31, inclusive.

DEAD RIVER NEAR THE FORKS, ME.

This tributary of the Kennebec has its headwaters in the mountains between Maine and Canada, and flows in a general easterly direction, entering the Kennebec at The Forks. Its basin contains 870 square miles and is 40 miles in extreme length by 30 miles in width, and is almost entirely covered with forests. Through a large portion of its length the river flows through swamps; in its lower course it has considerable fall. The only dams on the stream are owned by the log-driving companies, and the gates are kept open after the drives are out of the river.

This gaging station was established by N. C. Grover on September 29, 1901. It is located 1½ miles west of The Forks. The measurements are made from a car suspended from a steel cable. The gage is a vertical rod attached to a large bowlder on the left bank about 700 feet below the cable. It is referred to a bench mark, a copper bolt set in a bowlder 9.5 feet from the gage; elevation, 7.97 feet above zero of the gage. The channel is straight for 500 feet above and below the cable, and is about 225 feet wide at ordinary stages. The banks are rocky and are subject to overflow in extreme freshets. The bed is rocky and permanent. The current is rapid; the lowest observed mean velocity is 0.65 of a foot per second at gage height 0.69. The gage is read twice daily by Jeremiah Durgin, jr., a farmer at The Forks.

The observations at this station during 1904 have been made under the direction of H. K. Barrow, district hydrographer.

Discharge measurements of Dead River near The Forks, Me., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 8	F. E. Pressey	900	3.86	3.00	3,470
June 9	do	1,780	8.57	6.35	15,300
June 21	do	444	1.48	1.05	655
June 21	do	453	1.49	1.05	676
July 27	H. K. Barrows	349	.80	.72	279
August 29	do	376	.98	.78	370

Mean daily gage height, in feet, of Dead River near The Forks, Me., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.15	2.25	1.05	0.95	0.75	2.15	1.35	0.95
2	.....	4.90	2.45	1.20	.95	.75	3.05	1.35	.95
3	.....	5.35	4.15	1.45	.85	.75	3.00	1.35	.95
4	.....	5.40	3.45	1.70	.85	.85	2.70	1.25	1.05
5	4.95	6.85	2.45	1.55	.80	1.25	2.60	1.20	1.05
6	.....	5.25	4.65	1.40	.75	1.45	2.55	1.15	1.15
7	.....	4.55	3.45	1.25	.75	1.30	2.25	1.15	1.15
8	.....	4.45	4.65	1.20	.65	1.20	1.70	1.25	1.15
9	(a)	4.15	4.75	1.00	.65	1.05	1.40	1.25	1.25
10	2.85	4.75	4.50	1.00	.65	1.05	1.35	1.25	1.40
11	2.05	5.15	3.75	1.10	.75	.95	1.25	1.20	(b)
12	3.25	4.55	3.45	1.40	.75	.95	1.25	1.15	.....
13	3.35	4.25	2.60	1.50	.85	1.05	1.15	1.15	.....
14	3.35	4.05	2.10	1.50	.95	1.25	1.25	1.15	.....
15	2.35	5.60	1.80	1.30	.95	1.60	1.15	1.05	.....
16	2.20	4.30	1.50	1.15	.85	1.80	1.15	1.05	.....
17	1.95	4.60	1.40	1.00	.85	1.70	1.25	1.15	.....
18	1.80	4.15	1.20	1.05	.85	1.50	1.15	1.15	.....
19	1.85	6.15	1.05	.95	.85	1.35	1.15	1.05	.....
20	1.85	5.55	1.05	.95	.75	1.45	1.15	1.05	.....
21	1.85	5.65	1.05	.95	1.15	1.35	1.70	1.05	.....
22	1.95	5.45	1.10	.95	1.65	1.35	2.15	1.05	.....
23	2.05	4.80	1.15	.85	1.70	1.35	2.55	1.05	.....
24	2.35	4.65	1.20	.85	1.50	1.25	2.75	1.05	.....
25	2.50	2.85	1.35	.75	1.05	1.25	2.60	1.05	.....
26	3.30	3.05	1.45	.75	.90	1.40	2.40	1.05	.....
27	3.00	5.40	1.45	.65	.80	1.60	1.85	.95	.....
28	3.85	2.90	1.35	.65	.75	1.65	1.65	1.00	.....
29	6.05	4.85	1.20	.75	.75	1.75	1.50	1.00	.....
30	4.45	2.75	1.10	.85	.75	1.85	1.40	.95	.....
31	.....	1.95	.....	.95	.75	.....	1.35	.....	.....

a River clear of ice April 9.
b River frozen over; anchor ice affects gage readings. No readings during frozen period.

CARRABASSETT RIVER AT NORTH ANSON, ME.

This river enters the Kennebec from the west at North Anson. Its basin has steep slopes, partly in farm lands, with no large natural reservoirs. Dams have been constructed and power used at New Portland, East New Portland, and North Anson.

This gaging station was established on October 19, 1901, by N. C. Grover. It is located above Embden Brook and below Anson Brook. The drainage area is 340 square miles at this point. Gagings are made by wading at low stages or from a boat at high stages of the river. There are two gages. One is a vertical rod attached to a tree; the other is a standard chain gage attached to trees on the bank; length of chain, 36.73 feet. The datum of the two gages is the same, and is referred to two bench marks: (1) Point on root of a blazed spruce

tree 40 feet from the vertical gage; elevation, 10.78 feet. (2) Copper bolt set in a large bowlder at the outlet of Anson Brook; elevation, 11.40 feet. The channel is straight 500 feet above the station and 300 feet below, and is about 150 feet wide, divided into two parts at low stages of the river by a gravelly bar. The bed is of coarse gravel and permanent. Observed mean velocities range from 3.35 feet per second at gage height 2.68 feet to 0.93 of a foot per second at gage height 0.60 foot. The gage is read once daily by N. Q. Hilton, a farmer at North Anson.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Carrabassett River at North Anson, Me., 1902–1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1902.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 27	N. C. Grover	1,330	3.14	4.30	4,170
July 30	F. E. Pressey	203	.95	.60	192
October 30	do	564	3.21	2.47	1,810
October 30	do	632	3.35	2.67	2,120
October 31	do	458	2.99	1.99	1,370
November 1	do	388	2.91	1.69	1,130
November 2	do	326	2.71	1.42	882
November 1	do	379	2.86	1.60	1,080
November 3	do	314	2.71	1.35	851
1903.					
May 26	N. C. Grover	151	1.38	.45	208
July 17	F. E. Pressey	264	1.33	.90	348
August 15	do	215	1.39	.71	300
September 23	N. C. Grover	42	1.81	.15	76
November 6	F. E. Pressey	94	1.76	.30	165
1904.					
August 30	H. K. Barrows	100	1.54	.40	154

Mean daily gage height, in feet, of Carrabassett River at North Anson, Me., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	7.3	0.9	0.4	0.7	0.3	2.1	1.1	0.8
2	.....	.....	4.9	.9	.8	.7	.3	1.8	1.1	.8
3	.....	.....	4.0	.8	1.0	.6	.3	1.4	1.0	1.0
4	[a]1.9	.....	4.2	.8	.9	.5	.5	1.2	1.0	1.1
5	.....	.....	4.4	.8	.6	.4	.7	1.0	1.0	.9
6	.....	.....	3.7	1.1	.6	.4	.5	.9	.8	.8
7	.....	.....	3.8	2.3	.7	.4	.4	.9	.8	1.0
8	.....	.....	2.6	1.8	.5	.4	.4	.8	.8	.8
9	.....	.....	2.4	1.5	.4	.4	.3	.8	.7	.7
10	.....	4.7	9.5	1.3	.3	.4	.3	.8	.8	.7
11	.....	5.2	5.8	1.1	.3	.6	.3	.7	.8	.7
12	.....	4.1	4.6	.9	2.3	1.3	.3	.7	.8	.7
13	.....	3.3	3.5	.8	1.5	1.2	.4	.7	.6	.6
14	.....	2.7	2.9	.7	1.9	.9	.3	.8	.7	.7
15	.....	2.2	2.4	.6	1.4	.9	.9	.8	.9	.6
16	.....	1.9	11.3	.5	1.1	.8	1.9	.8	.8	.7
17	.....	1.6	6.6	.5	.8	.7	1.3	.7	.7	.7
18	.....	1.7	4.1	.5	.7	.6	1.0	.7	.8	.6
19	.....	1.8	3.3	.4	.5	.5	.9	.7	.9	.7
20	.....	2.8	4.4	.4	.4	.4	.9	.6	.9	.7
21	.....	2.5	3.1	.3	.4	2.7	.9	.6	.7	.7
22	.....	2.3	2.5	.3	.3	1.6	.9	.4	1.2	.7
23	.....	2.5	2.2	.5	.3	1.3	.8	2.5	.9	.8
24	.....	3.2	2.0	.5	.2	1.0	.7	1.9	.8	.8
25	.....	3.9	1.7	.4	.3	.8	.5	1.6	.9	.8
26	.....	3.4	1.6	.6	.3	.7	.4	1.4	1.0	.7
27	.....	3.7	1.5	.4	.2	.5	.4	1.9	.9	.8
28	.....	3.4	1.4	.3	.9	.5	.4	1.6	.7	.9
29	.....	4.7	1.3	.1	1.8	.5	.7	1.5	.8	.9
30	.....	7.1	1.2	.2	1.4	.4	2.8	1.3	.8	.9
31	.....	.....	1.0	.....	.9	.4	.....	1.2	.....	.9

[a] Gage reading to water surface in hole cut in ice at gage; otherwise no readings during frozen season.

Rating table for Carrabassett River at North Anson, Me., from November 1, 1901, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.1	60	1.5	965	2.9	2,325	4.6	4,575
.2	96	1.6	1,050	3.0	2,450	4.8	4,845
.3	135	1.7	1,135	3.1	2,580	5.0	5,115
.4	177	1.8	1,225	3.2	2,710	5.2	5,385
.5	223	1.9	1,315	3.3	2,840	5.4	5,655
.6	272	2.0	1,405	3.4	2,970	5.6	5,925
.7	327	2.1	1,495	3.5	3,100	5.8	6,195
.8	392	2.2	1,585	3.6	3,230	6.0	6,465
.9	464	2.3	1,680	3.7	3,360	6.5	7,140
1.0	542	2.4	1,775	3.8	3,495	7.0	7,815
1.1	625	2.5	1,875	3.9	3,630	8.0	9,165
1.2	710	2.6	1,980	4.0	3,765	9.0	10,515
1.3	795	2.7	2,090	4.2	4,035	10.0	11,865
1.4	880	2.8	2,205	4.4	4,305	11.0	13,215

The above table is applicable only for open-channel conditions. It is based upon 12 discharged measurements made during 1902 to 1904. It is well defined between gage heights 0.2 feet and 2.5 feet. Above 2.5 the curve depends on one measurement at 4.3 feet. The table has been extended beyond these limits. Above 3.7 feet the rating curve is a tangent, the difference being 135 per tenth.

Estimated monthly discharge of Carrabassett River at North Anson, Me., for 1904.

[Drainage area, 340 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April 10–30	7,950	1,050	2,913	8.57	6.69
May	13,690	542	3,574	10.5	12.1
June	1,680	60	404	1.19	1.33
July	1,680	96	440	1.29	1.49
August	2,090	177	404	1.19	1.37
September	2,205	135	379	1.11	1.24
October	1,875	177	670	1.97	2.27
November	710	272	438	1.29	1.44
December	625	272	384	1.13	1.30

SANDY RIVER NEAR MADISON, ME.

This stream rises near Rangeley Lake, flowing first southeasterly, then in the last third of its course flowing northeasterly into Kennebec River about 2 miles below the village of Madison. It has a total length of about 50 miles, and while there are a few small ponds in its basin, its storage capacity is small, and the flow is quite variable. It resembles very much in this way Carrabassett River—the slopes being usually steep and the fall very rapid throughout the greater part of its course. Comparatively few water-power developments have been made, namely, at New Sharon, Farmington, and at the point described below near Madison.

This station was established March 23, 1904, by F. E. Pressey. It is located at the dam of the Madison Electric Works just over the town line in Stark, but is nearest Madison post-office. The drainage area at this point is about 650 square miles. The dam rests on ledge rock, has a fairly level crest, 341.4 feet in length between vertical abutments. The crest is 1 foot wide on top, sloping from the upstream edge, 4.75 horizontal to 1.25 vertical, while the downstream face of the dam is vertical. The level top is of dressed stone (6-cut), while the remainder is quarry faced, but care has been taken to leave no considerable projection on the approach to the crest. Provision has been made for the installation of flashboards when necessary. The head developed by the dam is about 15 feet, which is used in a power development on the right bank, consisting of a head bay nearly 100 feet long, decreasing in width from 40 to 20 feet at the racks, and one pair of 36-inch McCormick turbines (rated at Holyoke) with complete arrangements for a second pair if found necessary. This plant is owned by the Madison village corporation, and is used for furnishing light and power. The pondage extends back something like 2 miles, but there is no side flowage. When water is more than 3 feet deep on the dam, the crest is increased in length about 87.5 feet by flowing over the wall of the fore bay. The wheels and generators are in operation only during the night, so that the discharge has been based upon a gage height read late in the afternoon just before starting up; and it is believed that the pondage effect has been wholly eliminated in this way.

A plain vertical staff gage was first fastened to the retaining wall of the dam; the elevation of the 100-foot mark at the gage being equal to the elevation of the crest of the masonry dam. This has been superseded, however, by a float gage referred to the same datum and installed through the courtesy and assistance of C. S. Humphreys, C. E., of Madison, engineer in charge. At the same time another float gage

was placed to record the height of water in the tailrace, so that in case it becomes necessary to use the turbines in estimating flow, records of the head on the wheels may be obtained. The gages are referred to the following bench mark: A point inclosed by a circle on the north side of the wing wall, about 22.8 feet from its end at the dam, marked "B. M." Its elevation is 102.98 feet above gage datum. The gages are read twice daily by Marcus W. Moore, electrician at the station.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

MESSALONSKEE RIVER AT WATERVILLE, ME.

This river enters the Kennebec from the west at Waterville. It has a total drainage area of 208 square miles, of which 30 square miles are lake surface. Messalonskee Lake, which is the nearest of these to the mouth of Kennebec River, has a fall of about 210 feet in a distance of 10 miles, which is practically all utilized.

The United States Geological Survey has maintained a gage at the dam of the Chase Manufacturing Company, in Waterville, since June 18, 1903. The drainage area at this point is about 205 square miles. A vertical staff gage is fastened to the wheel pit, just above the dam. The zero of the gage corresponds to the level of the crest of the dam and is referred to a bench mark as follows: Copper bolt in ledge on opposite side of the river from the end of the dam; elevation, 14.51 feet above the crest of the dam. The dam is a new crib, without leakage, and with a good crest. Generally the water is not used for power purposes at night, and the gage is read while the wheels are not running. At other times the amount of water used through the wheels is added to that which flows over the dam. Flashboards are maintained during low stages of the river. The gage is read once a day by Ernest E. Bowie, watchman at the mill.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Mean daily discharge, in second-feet, of Messalonskee River at Waterville, Me., for 1904.

Date.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	408	.....	.....	273	126	105	149	118	118
2	.....	336	.....	.....	314	149	113	118	118	118
3	.....	292	.....	.....	273	134	118	105	113	126
4	.....	360	.....	.....	251	144	96	90	118	77
5	.....	432	.....	.....	229	149	90	96	126	64
6	.....	533	.....	.....	251	157	105	105	105	69
7	.....	559	.....	.....	273	85	113	90	113	64
8	.....	533	.....	408	273	118	118	90	85	59
9	.....	615	.....	383	284	126	118	77	77	77
10	.....	899	.....	314	212	126	126	85	85	90
11	.....	840	.....	292	149	134	77	90	64	64
12	.....	840	.....	336	244	126	77	90	69	77
13	205	870	.....	212	177	134	96	96	85	90
14	360	811	.....	292	251	113	96	90	105	64
15	336	724	.....	251	251	85	118	90	105	64
16	301	642	.....	205	[a]64	118	218	64	90	77
17	284	559	.....	251	105	126	149	64	90	54
18	251	615	.....	212	134	134	118	69	85	64
19	273	642	.....	183	157	126	105	64	85	54
20	230	642	.....	193	134	134	118	85	90	64
21	260	642	.....	205	200	200	105	64	90	41
22	273	.....	.....	193	185	126	90	134	96	54
23	587	.....	.....	177	157	144	85	200	105	41
24	724	.....	.....	273	134	126	90	134	105	41
25	724	.....	.....	251	118	126	90	118	118	105
26	697	.....	.....	229	157	126	96	105	126	90
27	507	.....	.....	244	149	134	64	118	113	77
28	383	.....	.....	244	167	90	69	134	90	46
29	360	.....	.....	251	185	126	105	118	77	54
30	408	.....	.....	251	157	126	90	118	85	64
31	432	.....	.....	.....	105	96	.....	118	.....	64

[a] 12-inch flashboards on from July 16 to December 31, inclusive.

COBBOSSEECONTEE RIVER AT GARDINER, ME.

Cobbosseecontee River drains a group of lakes lying from 5 to 15 miles westerly from Augusta, having areas aggregating 19 square miles, and empties into the Kennebec 6 miles below that city at Gardiner. Its total drainage area is about 240 square miles. From the ordinary surface of Lake Maranacook, one of the upper lakes, to mean tide at the mouth of the river the fall is 206 feet, and in the lower three-fourths of a mile it is said to be 136 feet. From above the uppermost of the 8 dams controlled by the Gardiner Water Power Company, which are in the latter three-fourths of a mile, the municipal water supply for Gardiner is drawn and pumped by water power. Record is kept of the water pumped and of the water that passes the dam through a waste gate. The sum of these quantities represents the yield of the drainage area at the upper dam, records of which have been kept by the Gardiner Water Power Company for a series of years, and have been furnished to the Survey by their engineer, A. H. Twombly.

The record for 1904 is presented in the accompanying table. On Sundays and legal holidays the gates are closed and no water is permitted to run, unless the lakes are full. This is a most remarkable example of the regularity of flow that can be obtained with proper storage.

Mean daily discharge, in second-feet, of Cobbosseecontee River at Gardiner, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	200	180	160	280	2,747	280	280	265	265	265	250	220
2	200	180	160	280	2,497	280	280	265	265	00	250	220
3	00	180	160	00	1,859	280	30	265	265	265	250	220
4	200	180	200	280	725	280	29	265	00	265	250	00
5	200	180	200	280	351	00	280	265	265	265	250	220
6	200	180	00	286	283	280	280	265	265	265	00	220
7	200	00	220	306	280	280	280	00	265	265	220	220
8	200	160	250	286	393	280	280	265	265	265	220	220
9	200	160	250	320	500	280	280	265	265	00	220	220
10	00	160	280	532	956	280	00	265	265	265	220	220
11	200	160	290	618	1,406	280	280	265	00	250	220	00
12	180	160	280	497	2,129	00	280	265	265	250	220	220
13	180	160	186	399	1,699	280	280	265	265	250	00	200
14	180	00	280	270	1,105	280	280	00	265	250	220	180
15	180	160	280	276	362	280	280	265	265	250	220	150
16	180	160	280	276	280	280	280	265	265	00	220	130
17	00	160	280	270	537	280	00	265	265	250	220	125
18	180	130	280	270	670	280	280	265	00	250	220	00
19	180	125	280	270	699	00	280	265	265	250	220	115
20	180	125	00	250	699	280	280	265	265	250	00	115
21	180	00	280	372	699	280	265	00	265	250	220	110
22	180	120	280	462	634	280	265	265	265	250	220	110
23	180	135	280	421	489	280	265	265	265	00	220	100
24	00	150	280	250	415	280	00	265	265	250	00	100
25	180	160	337	331	300	280	265	265	00	250	220	48
26	180	160	494	331	280	00	265	265	265	250	220	48
27	180	160	649	405	280	280	265	265	265	250	00	100
28	180	00	564	565	280	280	265	00	265	250	220	100
29	180	160	529	2,652	00	280	265	265	265	250	220	100
30	180	.....	329	2,747	280	280	265	265	00	200	220	100
31	00	.....	280	.....	280	.....	.....	265	.....	250	.....	100

ANDROSCOGGIN RIVER DRAINAGE BASIN.

Androscoggin River is formed by the junction of Magalloway River and the outlet of the Umbagog-Rangeley lakes near the Maine-New Hampshire boundary line. For about 35 miles it flows southward into the State of New Hampshire, then turns abruptly to the east and flows into the State of Maine, then turns to the south and joins the Kennebec in Merrymeeting Bay. The last fall on the Androscoggin is at Brunswick, Me., above which place the drainage area is 3,470 square miles, about 80 per cent of which is in Maine. The greatest length of the basin is 110 miles, the greatest width 70 miles, while the river itself measures about 200 miles in length from the sources of Magallo-

way River to the coast. The following table gives the drainage areas of the river and of some of its chief tributaries:

Drainage areas of Androscoggin River and principal tributaries.

River.	Locality.	Drainage area.
		Square miles.
Androscoggin	Immediately below junction of Umbagog outlet and Magalloway River, at Errol dam.	1,090
Do	Berlin	1,350
Do	Gorham	1,375
Do	Shelburne	1,500
Do	Rumford Falls	2,090
Do	Dixfield	2,230
Do	Livermore Falls	2,550
Do	Lewiston Falls	2,950
Do	Brunswick	3,470
Umbagog outlet	Immediately above junction with Magalloway River.	590
Magalloway	Mouth	500
Little Androscoggin	do	380

The lower part of the basin is hilly and moderately wooded, while the upper two thirds is broken and mountainous, heavily timbered, and with a gravelly, sandy soil. Granite, gneiss, and mica-schists abound along the main course of the river, with clay slate in the upper part of the basin. The river, like others on the southern slopes of Maine, generally has a rocky bed, particularly where falls occur; has high banks, and is seldom subject to overflow, all of which are features of advantage in the development of water powers. Below Berlin the facilities for rail transportation are excellent. Tide-water navigation extends to the falls at Brunswick.

The United States Geological Survey now maintains gaging stations on this river at Shelburne, N. H., and Dixfield, Me.

In addition to these stations, data on the flow of the Androscoggin River is obtained through private parties, at the following points: Errol dam, N. H.; Gorham, N. H.; and at Rumford Falls, Me.

ANDROSCOGGIN RIVER AT ERROL DAM, NEW HAMPSHIRE.

Four large storage dams are maintained in the Umbagog-Rangeley Lake system. They are located at the outlets of Rangeley, Moosehicmaguntic, Richardson, and Umbagog lakes. Errol dam, at the outlet of Umbagog Lake, is the lowest of the series and is below the mouth of Magalloway River. The other three dams control completely the flow from the basin above Richardson Lake, aggregating 520 square miles in area. Errol dam controls in part the run-off from a total area of 1,090 square miles, which includes the area tributary to Richardson

Lake mentioned above, but its height is not sufficient to store the total freshet flow.

The United States Geological Survey, cooperating with Walter H. Sawyer, agent of the Union Water Power Company, Lewiston, Me., is making a series of measurements of flow through the gates at Errol dam. A continuous record of gate openings is kept and when a sufficient number of measurements have been made to warrant the construction of a rating curve for the gates a continuous record of flow at this point will be available. The results of these measurements are not yet ready for publication.

ANDROSCOGGIN RIVER AT GORHAM, N. H.

During the year 1903 the Berlin Mills Company constructed a tight crib dam in Androscoggin River at Gorham. From November 27, 1903, until the end of the year estimates of discharge were obtained by means of a rectangular notch constructed in the dam, and the records furnished by H. S. Ferguson, engineer for the company. (For which see Water-Supply Paper No. 97.) No records of flow are available for 1904 at this point. Drainage area here is 1,375 square miles.

ANDROSCOGGIN RIVER AT SHELBURNE, N. H.

This station was established May 30, 1903, by N. C. Grover. It is located at the steel highway bridge about one-half mile north of the railway station at Shelburne. The drainage area at this point is 1,500 square miles. A standard chain gage is attached to the guard timber on the downstream side of the bridge; length of chain, 20.66 feet when gage was established. This was changed to 20.72 feet on August 4, 1904, owing to change in flooring of bridge and consequent position of gage. It is referred to bench marks as follows: (1) Marked point on south edge of most westerly cylindrical pier; elevation, 17.82 feet. (2) Marked point on lower chord near gage; elevation, 18.77 feet. (3) Highest point of bowlder near most easterly pier; elevation, 7.14 feet. All elevations refer to the datum of the gage. The initial point for soundings is on the left bank of the river at the end of the inclined end post of the downstream truss. The channel of the river is straight for 500 feet above and 1,000 feet below the station, is about 400 feet wide at ordinary stages, and is broken by two piers. The bed of the river is sandy and usually permanent, but in case of serious obstructions to the channel by ice or logs, noticeable changes take place. The velocity is swift at high stages, but becomes low and poorly distributed, with considerable obliquity, at medium and low water conditions, when measurements are made from a boat at a point about 1,000 feet below the bridge, where an excellent site exists for gaging. The banks on both sides are subject to overflow in extreme freshets. The gage is read twice daily by James Simpson, postmaster at Shelburne.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Androscoggin River at Shelburne, N. H., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 18	N. C. Grover	1,010	2.00	4.55	2,020
May 12	S. K. Clapp	2,420	4.08	7.65	9,880
May 25	N. C. Grover	1,600	2.61	5.59	4,170
June 15	S. K. Clapp	1,280	1.95	4.72	2,500
July 22	do	953	1.43	3.94	1,360
August 29[a]	F. E. Pressey	650	2.98	4.48	1,940
November 15[a]	do	510	2.35	4.22	1,200

[a] Made from boat.

Mean daily gage height, in feet, of Androscoggin River at Shelburne, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	.....	6.70	5.10	4.95	4.00	4.40	4.40	4.80	4.65
2	.....	.....	.....	.....	7.55	5.00	5.00	4.00	4.30	4.50	4.70	4.70
3	[a] 6.30	.....	.....	[b] 6.30	8.30	4.95	5.10	4.00	4.35	4.40	4.55	[c] 4.90
4	.....	.....	.....	.....	8.60	4.90	5.05	4.05	4.40	4.40	4.45	.....
5	.....	.....	.....	.....	8.55	4.90	5.10	4.10	4.40	4.40	4.40	.....
6	.....	.....	[d] 6.20	.....	8.50	4.90	5.20	4.00	4.40	4.40	4.35	.....
7	.....	[e] 6.20	.....	.....	8.50	4.95	5.10	4.10	4.40	4.35	4.30	.....
8	.....	.....	.....	.....	8.50	5.00	5.05	4.20	4.40	4.40	4.40	.....
9	.....	.....	.....	[f] 5.25	8.55	4.95	5.00	4.10	4.30	4.40	4.30	.....
10	[g] 6.10	.....	.....	6.35	8.35	4.90	4.95	4.10	4.40	4.50	4.40	.....
11	.....	.....	.....	6.10	8.60	4.90	4.85	4.10	4.40	4.50	4.35	6.25
12	.....	.....	.....	5.35	7.75	4.80	4.85	4.10	4.45	4.50	4.30	.....
13	.....	.....	[h] 6.30	4.90	7.30	4.80	4.70	4.20	4.40	4.40	4.30	[i] 6.30
14	.....	[j] 5.40	.....	4.40	6.80	4.70	4.65	4.35	4.40	4.45	4.35	.....
15	.....	.....	.....	4.50	6.75	4.60	4.35	4.40	4.40	4.50	4.35	.....
16	.....	.....	.....	4.45	7.00	4.60	4.25	4.40	4.40	4.40	4.20	.....
17	[k] 6.30	.....	.....	4.45	7.85	4.50	4.35	4.30	4.40	4.50	4.20	.....
18	.....	.....	.....	4.60	7.55	4.60	4.40	4.20	4.45	4.40	4.20	.....
19	.....	.....	.....	4.70	7.60	4.60	4.15	4.15	4.50	4.40	4.20	[l] 6.40
20	.....	.....	[m] 6.70	4.80	7.50	4.60	4.20	4.20	4.50	4.50	4.30	.....
21	.....	[n] 5.20	.....	4.60	6.70	4.50	4.05	4.20	4.40	5.00	4.30	.....
22	.....	.....	.....	4.60	6.25	4.60	4.00	4.15	4.45	5.00	4.20	.....
23	.....	.....	.....	4.70	6.05	4.55	3.95	4.00	4.45	4.75	4.20	.....
24	[o] 6.10	.....	.....	5.00	5.90	4.60	4.05	4.10	4.40	4.65	4.20	.....
25	.....	.....	.....	5.70	5.70	4.65	4.00	4.10	4.50	4.55	4.20	[p] 6.30
26	.....	.....	.....	5.70	5.60	4.70	4.10	4.10	4.50	4.70	4.20	.....
27	.....	.....	[k] 8.50	5.50	5.30	4.70	4.00	4.10	4.50	5.05	4.15	.....
28	.....	[e] 6.40	.....	5.80	5.35	4.75	3.95	4.20	4.50	5.10	4.10	.....
29	.....	.....	.....	7.05	5.20	4.80	3.95	4.30	4.45	4.95	4.20	.....
30	.....	.....	.....	6.85	5.10	4.85	4.05	4.30	4.50	4.95	4.30	.....
31	[q] 6.40	.....	.....	.....	5.10	.....	4.10	4.40	.....	4.80	.....	.....

[a] Ice 1.25 feet thick.
[b] Ice 1.85 feet thick.
[c] Frozen over.
[d] Ice 2.9 feet thick.
[e] Ice 3.5 feet thick.
[f] Ice went out during night.
[g] Ice 1.9 feet thick.
[h] Ice 2.85 feet thick.
[i] Ice 2.1 feet thick.
[j] Ice 4.1 feet thick.
[k] Ice 2.5 feet thick.
[l] Ice 2.2 feet thick.
[m] Ice 2.7 feet thick.
[n] Ice 4.35 feet thick.
[o] Ice 2.75 feet thick.
[p] Gage height to top of ice=6.55; ice 2.1 feet thick.
[q] Ice 3.1 feet thick.

NOTE.—Gage heights during frozen season are to surface of water in hole cut in ice under gage.

ANDROSCOGGIN RIVER AT RUMFORD FALLS, ME.

One of the finest water powers in the Atlantic Coast drainage is at Rumford Falls. Here the Androscoggin descends 177 feet in 1 mile in several pitches over granite ledges. A comprehensive plan of development has been laid out and partly executed. It contemplates the use of power from three levels—a high-level canal, with a fall of 97 feet to the middle level, which receives also a direct and independent supply of water from the river. The water in the middle-level canal is then used and discharged after a fall of 50 feet into the low level, from which in turn there is a final drop of 30 feet to the river. Dams have been built at the entrance of the high and middle level canals. At present about 19,000-horsepower are utilized, largely in the manufacture of pulp and paper. An economical development of the entire fall of 177 feet would furnish 50,000 horsepower. This power is 85 miles by rail from Portland, and for pulp and paper manufacture has the advantage of excellent transportation facilities. Androscoggin River is used for floating down pulp wood and timber from the headwaters to the mills, and the Rumford Falls and Rangeley Lakes Railroad, extending into the forests with its extension into the Megantic region, makes available the remoter resources of spruce, poplar, and birch.

The discharge of Androscoggin River at Rumford Falls since 1892 has been computed by Charles A. Mixer, resident engineer of the Rumford Falls Power Company. These statistics are obtained by adding the actual measured quantities passing through the wheels to the computed flow over the dam, using the customary Francis weir formula with modified coefficient. They have been published from time to time by the United States Geological Survey, and a complete record up to 1902 will be found in Water-Supply Paper No. 69.

ANDROSCOGGIN RIVER NEAR DIXFIELD, ME.

This station was established August 22, 1902, by F. E. Pressey. It is located about one-half mile west of Dixfield, at the highway bridge on the road to West Peru. The measurements are made from this bridge or from a boat at low water. The initial point for soundings is at the lower end of the inclined end post of the downstream truss on the left bank of the river. The gage is of the standard chain type; the scale board is nailed to the guard timber on the lower side of the bridge; length of chain, 31.76 feet. It is referred to bench marks as follows: (1) Southeast corner of bridge seat on north abutment; elevation, 24.77 feet. (2) Copper bolt in ledge under east end of bridge; elevation, 11.53 feet. (3) Top of short post at west hanger in east span; elevation, 33.15 feet when gage was established; found to be 33.08 feet on August 3, 1904; probably due to settlement of post. All elevations refer to the datum of the gage. The channel is straight for 1,000 feet above and one-half mile below the station, and is about 600 feet wide, broken by three piers. The banks are high

and not liable to overflow. The bed of the stream is rocky in the left half and sandy in the right half. The velocity is medium at high stages, but is poorly distributed at low water, when the current is sluggish in the right half. Under such conditions measurements are made from the bridge for only the two left-hand portions of the channel, while the remaining part is gaged by wading at a point about 250 feet downstream—it being possible to do this on account of a sandy bar separating these two parts. The gage is read twice daily by S. F. Robinson.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurement of Androscoggin River near Dixfield, Me., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 3	H. K. Barrows	1,200	1.31	7.68	1,570

Mean daily gage height, in feet, of Androscoggin River near Dixfield, Me., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	8.85	12.95	8.80	8.60	7.80	7.55	8.55	8.25	7.90
2	a 9.60	.....	b 9.40	8.65	12.45	8.75	8.85	7.85	7.45	8.45	8.10	8.00
3	.....	c 9.20	.....	8.70	12.30	8.70	8.95	7.75	7.50	8.20	8.00	7.70
4	.....	.....	.....	8.65	12.45	8.60	8.85	7.85	7.70	8.15	7.95	7.65
5	.....	.....	.....	8.50	12.30	8.65	8.90	7.75	7.60	8.05	8.00	7.80
6	.....	c 9.20	.....	8.90	12.15	8.75	8.85	7.70	7.30	7.90	7.90	8.10
7	d 9.60	.....	.....	9.30	11.65	8.95	8.55	7.65	7.60	7.95	7.90	8.10
8	.....	.....	b 9.85	9.25	11.55	8.95	8.20	7.50	7.60	8.00	8.00	8.50
9	.....	.....	.....	10.00	11.45	8.90	8.15	7.55	7.55	7.90	7.90	9.10
10	.....	.....	.....	11.20	12.25	8.80	8.10	7.65	7.45	7.90	7.95	10.00
11	d 9.70	c 9.10	b10.30	12.00	12.10	8.75	8.00	7.65	7.55	8.05	7.95	.....
12	.....	.....	.....	10.95	11.80	8.75	8.10	7.65	7.40	8.00	8.00	.....
13	d 9.70	.....	.....	10.20	11.10	8.70	8.15	7.75	7.60	7.95	8.00	.....
14	d 9.00	.....	.....	9.55	10.65	8.70	8.05	7.80	7.70	8.00	7.95	.....
15	.....	c 9.10	b10.10	9.10	10.30	8.70	7.90	7.50	8.40	7.95	7.85	e 9.40
16	f 9.50	.....	.....	9.05	11.00	8.60	7.95	7.75	9.15	7.95	8.05	.....
17	.....	.....	b 9.70	8.80	12.05	8.65	7.85	7.70	8.50	7.65	7.90	.....
18	.....	c 9.10	.....	8.85	11.60	8.60	7.70	7.60	8.00	8.00	7.75	.....
19	.....	.....	.....	9.05	11.50	8.50	7.80	7.55	7.55	7.90	7.90	.....
20	g 9.50	.....	.....	9.50	12.35	8.55	7.70	7.60	7.55	7.85	7.75	.....
21	.....	.....	.....	9.25	11.30	8.55	7.60	9.05	7.85	7.85	7.85	.....
22	.....	h 9.20	.....	9.20	10.45	8.55	7.55	8.50	8.20	11.05	7.95	.....
23	.....	.....	i 9.20	9.45	10.10	8.60	7.45	8.25	8.05	9.45	7.95	.....
24	c 9.40	.....	.....	9.90	9.95	8.60	7.70	8.00	7.90	8.60	8.00	j10.00
25	.....	.....	.....	10.55	9.65	8.50	7.80	7.90	7.90	8.60	8.05	.....
26	.....	.....	k 9.60	10.85	9.50	8.60	7.95	7.80	7.90	8.65	8.00	.....
27	.....	i 9.40	12.25	10.70	9.40	8.55	8.20	7.70	8.25	9.00	7.90	.....
28	.....	.....	11.85	10.60	9.25	8.55	8.20	7.70	8.00	8.85	7.90	.....
29	.....	.....	10.10	12.25	9.10	8.50	8.35	7.50	7.90	8.60	7.90	.....
30	c 9.20	.....	9.15	13.65	8.95	8.45	8.25	7.55	8.40	8.40	7.85	.....
31	.....	.....	8.80	.....	8.85	.....	7.80	7.60	.....	8.10	.....	f 9.90

a Ice 0.9 foot.
b Ice 1.8 feet.
c Ice 1.5 feet.
d Ice 1.2 feet.
e Ice 0.7 foot.
f Ice 1.3 feet.
g Ice 1.4 feet.
h Ice 1.7 feet.
i Ice 1.6 feet.
j Ice 1.1 feet.
k Channel cut through at 2 p. m.

PRESUMPSCOT RIVER DRAINAGE BASIN.

This is one of the most interesting as well as one of the best water-power streams of its size in the United States. It is the outlet of Sebago Lake, which lies about 17 miles northwest of Portland. The lake is fed by Crooked River, a stream heading 35 miles farther north and within 3 miles of the Androscoggin. The area of the lake is 50 square miles, the area of its drainage basin at the outlet of the lake 420 square miles, and the total drainage area of the river at its mouth 600 square miles. The northern part of the basin is mountainous and wooded, while the southern part is moderately hilly and cleared of trees. Granite, gneiss, and mica schists appear at many points, and the soil is gravelly and sandy.

According to the survey made by Joseph A. Warren, of Cumberland Mills, the fall from the crest of the stone dam at the foot of Sebago Lake to mean low tide at the foot of the lower falls is 265.16 feet in a distance of 21.65 miles, or an average of 12.25 feet per mile. In the lower two-thirds of this distance, or from Gambo Falls to tide water, nearly one-half of the whole fall, or 132 feet, has been developed, and an aggregate probably exceeding 6,000 net horsepower is in use. The remainder of the fall, however, between Gambo Falls and Sebago Lake, amounting to 133 feet, is either unimproved or but slightly utilized. At Great Falls, in this stretch, there is a descent of 22 feet, which has been used in the past but is now idle. It is proposed, however, to employ the power in the generation of electricity for delivery in Portland.

The tributaries of Presumpscot River are not of much importance, but some of them are outlets of ponds and have considerable fall, thus affording constant though small power. Crooked River, the chief feeder of Sebago Lake, has a number of falls, some of which are utilized.

The chief interest attaching to the river is its regularity of flow, which is due to dams at the outlet of the lake. Nowhere in the United States is there a better example of the success of storage of water and regulation of the flow of a stream than on the Presumpscot.

PRESUMPSCOT RIVER AT OUTLET OF SEBAGO LAKE, MAINE.

Since January, 1887, the flow from Sebago Lake has been regularly recorded, the quantity being deduced from the openings in the gates at the dam, the discharging capacity of which under different conditions of head has been determined and tabulated by Hiram F. Mills, of Lowell. Since January, 1872, a continuous record of the level of the lake surface has been kept. An unusually complete and valuable series of data has thus been obtained, which has been furnished to the United States Geological Survey by S. D. Warren & Co. The lake fills rap-

idly after March 1, attaining its maximum height between April 15 and June 1, and then gradually subsides as water is withdrawn for mill purposes, until a minimum stage is reached, sometimes in the autumn, but usually in the winter. The records of the daily discharge of the river at the outlet of the lake, published in Water-Supply Paper No. 69, show the remarkable uniformity of flow, which, as already stated, is due largely to artificial regulation. On Sundays the gates are closed, so that only the waste is allowed to reach the river.

Mean daily discharge, in second-feet, of Presumpscot River at outlet of Sebago Lake, Maine, for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	678	500	370	589	333	712	724	640	757	642	688	660
2	678	500	450	604	633	786	719	627	745	333	694	647
3	617	500	440	300	627	728	333	627	734	705	694	642
4	617	500	430	552	644	687	367	618	333	681	687	358
5	617	500	437	601	648	333	687	630	767	673	698	625
6	617	500	417	581	627	701	675	753	747	676	500	655
7	617	450	437	571	709	720	675	333	722	653	761	635
8	617	450	435	596	333	728	680	633	725	647	687	665
9	617	450	422	587	673	727	658	642	795	333	687	552
10	583	450	452	300	720	718	333	629	570	668	670	648
11	583	450	468	524	730	731	628	617	333	682	682	360
12	583	450	447	581	722	333	674	609	787	685	687	603
13	583	450	250	595	734	713	702	601	745	668	705	602
14	583	417	472	560	599	739	700	333	645	670	667	593
15	583	417	522	622	333	742	701	598	632	683	765	583
16	583	417	566	669	769	743	659	578	653	333	702	582
17	533	417	563	300	720	743	333	641	648	708	700	567
18	533	417	531	601	695	706	678	640	333	663	688	322
19	533	417	537	653	694	333	641	635	718	670	690	567
20	533	333	250	501	684	753	645	639	632	673	358	570
21	533	250	524	663	688	693	614	333	615	622	655	570
22	533	325	594	648	333	718	604	615	656	653	673	537
23	533	375	623	650	675	694	526	635	658	333	675	540
24	500	393	569	333	682	673	333	650	688	698	677	533
25	500	427	437	680	680	696	658	792	333	665	697	475
26	500	417	504	664	702	333	696	763	770	679	603	470
27	500	377	300	681	703	655	690	600	683	668	358	495
28	500	417	443	662	789	694	648	333	660	668	718	537
29	500	388	493	631	0	657	619	655	649	635	653	443
30	500	.....	562	583	79	661	608	805	663	333	655	500
31	.....	.....	581	.....	586	.....	333	780	.....	677	.....	502

SACO RIVER DRAINAGE BASIN.

This river receives its headwaters from the valleys and slopes of the White Mountains at elevations of 4,000 to 5,000 feet. It drains an area of 1,720 square miles, of which 900 square miles lie in New Hampshire and the remainder in Maine. The slopes at the headwaters are very steep, with no lake storage. In the lower river are many good water powers, part of which are in use. The upper por-

tions of the basin are generally in forest, but much of the large growth has been cut, and over large areas the evergreen trees have been entirely removed. In the lower basin are many farms and villages. The underlying rock is generally granite, appearing at the surface in many mountain summits.

SACO RIVER NEAR CENTER CONWAY, N. H.

This station was established August 26, 1903, by N. C. Grover. It is located at the wooden highway bridge between Center Conway and Redstone, about 2 miles from each place. The drainage basin at this point has an area of 385 square miles. A standard chain gage is attached to the floor of the bridge; length of chain, 30.44 feet. It is referred to bench marks as follows: (1) Marked point on lower chord of bridge near gage; elevation, 27.72 feet. (2) South end of top of west abutment; elevation, 25.14 feet. The channel is straight for 2,000 feet above and 300 feet below the station, and is about 200 feet wide at ordinary stages, broken by one pier. The banks are high and are not liable to overflow, except in very extreme freshets. The bed is of sand and gravel and is permanent. At low water the observed mean velocity is small, being 1.18 feet per second at gage height 4.3. Low-water measurements are usually made by wading about 400 feet above the bridge, where a mean velocity of 1.22 feet per second was observed at gage height 3.92. The gage is read twice daily by Albert P. Davidson.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Saco River near Center Conway, N. H., in 1903 and 1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.			*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
Aug. 26	H. K. Barrows	167	429	1.18	4.31	504
27[a]	do	277	294	1.30	4.13	382
Sept. 19[a]	do	275	295	1.22	3.92	359
1904.						
Apr. 19	N. C. Grover	227	738	2.20	5.87	1,623
May 2	S. K. Clapp	251	1,477	3.88	9.00	5,730
13	do	235	986	2.83	7.00	2,786
26	N. C. Grover	224	740	2.12	5.76	1,567
June 14	S. K. Clapp	144	417	1.17	4.11	488
July 21[a]	do	230	119	1.27	3.39	151
Aug. 9	do	200	141	1.31	3.45	185
Oct. 11[a]	T. W. Norcross	280	320	1.14	3.88	365
11[a]	do	280	321	1.14	3.92	366

[a] At wading section.

Mean daily gage height, in feet, of Saco River near Center Conway, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	5.75	9.90	4.70	4.10	3.45	3.38	5.46	4.36	.....
2	.....	.....	.....	5.50	9.22	4.65	4.38	3.46	3.37	4.94	4.62	.....
3	7.10	.....	.....	5.55	8.60	4.58	4.18	3.56	3.37	4.68	4.30	.....
4	.....	.....	.....	5.30	8.82	4.52	3.98	3.67	3.82	4.50	4.25	.....
5	.....	.....	.....	5.28	9.02	4.52	3.84	3.60	3.76	4.26	4.14	.....
6	.....	.....	[a] 7.50	5.75	8.48	4.68	3.78	3.54	3.54	4.19	4.15	.....
7	6.10	.....	.....	6.18	7.72	4.72	3.74	3.52	3.45	4.26	4.15	.....
8	.....	.....	.....	5.98	7.72	4.61	3.66	3.45	3.41	3.98	4.10	.....
9	.....	.....	.....	7.10	7.58	4.47	3.62	3.42	3.37	3.94	4.00	.....
10	[b] 7.00	.....	.....	9.70	8.85	4.38	3.58	3.42	3.41	3.93	3.95	.....
11	.....	.....	.....	8.68	9.10	4.28	3.57	3.44	3.36	4.04	3.95	(c)
12	.....	.....	.....	7.75	7.68	4.20	3.60	3.48	3.32	3.89	3.90	.....
13	.....	.....	(c)	7.08	7.04	4.15	3.70	3.46	3.32	3.89	3.85	.....
14	.....	[d] 6.40	.....	6.60	6.68	4.12	3.62	3.47	3.26	3.57	4.05	.....
15	.....	.....	.....	6.20	7.10	4.07	3.58	3.44	5.34	3.86	4.05	.....
16	.....	.....	.....	6.05	8.94	4.05	3.54	3.44	5.43	3.85	4.00	.....
17	[e] 7.00	.....	.....	5.70	8.06	3.58	3.45	3.42	4.41	3.92	3.95	.....
18	.....	.....	.....	5.70	7.58	3.92	3.46	3.42	4.05	3.92	3.75	[f] 4.25
19	.....	.....	.....	5.82	9.24	3.84	3.42	3.35	3.90	3.83	(g)	.....
20	.....	.....	(c)	6.20	9.58	3.83	3.42	3.54	3.86	3.88	(g)	.....
21	.....	[d] 6.20	.....	5.88	7.78	3.75	3.40	6.18	3.92	8.13	4.1	.....
22	.....	.....	.....	5.72	6.98	3.88	3.38	4.48	4.05	5.86	4.2	.....
23	.....	.....	.....	5.94	6.16	3.95	3.38	4.04	3.68	5.86	4.1	.....
24	[h] 7.00	.....	.....	6.35	6.28	3.83	3.40	3.62	3.76	5.25	4.1	.....
25	.....	.....	.....	7.20	6.01	3.75	3.46	3.72	4.75	4.92	4.0	[i] 4.30
26	.....	.....	.....	7.90	5.78	3.70	3.52	3.63	4.34	5.12	3.9	.....
27	.....	.....	(c)	7.75	5.58	3.70	3.56	3.56	4.20	4.90	4.0	.....
28	.....	[d] 6.70	.....	7.78	5.35	3.65	3.74	3.54	4.42	4.56	4.1	.....
29	.....	.....	.....	10.02	5.01	3.71	3.58	3.48	4.00	4.49	(g)	.....
30	.....	.....	.....	10.82	4.91	3.70	3.51	3.44	5.88	4.45	.....	.....
31	[h] 6.75	.....	[j] 7.15 6.52	.....	4.75	.....	3.48	3.42	.....	4.46	.....	.....

[a] Ice 2.50 feet.
[b] Ice 1.25 feet.
[c] Ice unsafe to go upon.
[d] Ice 2 feet.
[e] Ice 1.35 feet.
[f] Gage height to top ice=4.5 feet—ice 1.15 feet thick.
[g] Frozen over.
[h] Ice 1.50 feet.
[i] Gage height to top ice=4.3 feet—ice 1.13 feet thick.
[j] Morning and evening readings.

NOTE.—Gage heights during frozen season are to surface of water in hole in ice under gage.

Rating table of Saco River near Center Conway, N. H., from August 27, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.25	117	4.2	475	5.9	1,675	8.2	4,420
3.3	133	4.3	525	6.0	1,765	8.4	4,740
3.35	149	4.4	575	6.1	1.855	8.6	5,060
3.4	166	4.5	625	6.2	1,950	8.8	5,390
3.45	183	4.6	675	6.3	2,050	9.0	5,730
3.5	200	4.7	730	6.4	2,150	9.2	6,080
3.55	217	4.8	795	6.5	2,250	9.4	6,440
3.6	235	4.9	865	6.6	2,350	9.6	6,800
3.65	253	5.0	935	6.7	2,460	9.8	7,175
3.7	271	5.1	1,005	6.8	2,570	10.0	7,555
3.75	289	5.2	1,080	6.9	2,680	10.2	7,935
3.8	307	5.3	1,160	7.0	2,790	10.4	8,315
3.85	325	5.4	1,240	7.2	3,030	10.6	8,710
3.9	343	5.5	1,320	7.4	3,280	10.8	9,110
3.95	361	5.6	1,405	7.6	3,545		
4.0	380	5.7	1,495	7.8	3,825		
4.1	425	5.8	1,585	8.0	4,120		

The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is well defined between gage heights 3.40 feet and 9 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Saco River near Center Conway, N. H., for 1903 and 1904.

[Drainage area, 385 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
August 26–31	530	350	402	1.04	0.23
September	405	193	264	.69	.77
October	2,270	200	550	1.43	1.65
November 1–26	465	239	339	.88	.85
1904.					
April	9,110	1,160	2,815	7.31	8.16
May	7,365	760	3,682	9.56	11.02
June	742	228	451	1.17	1.31
July	565	159	250	.65	.75
August	1,930	149	276	.72	.83
September	1,657	120	411	1.07	1.19
October	4,345	224	754	1.96	2.26
November 1–18	685	289	424	1.10	.735

MERRIMAC RIVER DRAINAGE BASIN.

This basin, which has a total drainage area of 5,015 square miles, lies in the States of New Hampshire and Massachusetts; of this, 3,815 square miles are in the former State and 1,200 square miles in the latter. Merrimac River is formed at Franklin, N. H., by the junction of Pemigewasset and Winnepesaukee rivers. The headwaters of the Pemigewasset lie in the White Mountain region at elevations of approximately 2,000 feet; thence they flow southerly through New Hampshire with very steep slopes. On this branch of the Merrimac there is very little lake storage. Squam and New Found lakes, aggregating about 20 square miles of surface area, are the only bodies of water of any importance. Above Plymouth probably 85 per cent of the basin is in heavy forest. A very insignificant amount of water power is utilized. Winnepesaukee River has its headwaters in the eastern part of the State. A prominent characteristic of its basin is the extent of the lake surface, aggregating 100 square miles. The fall from Winnepesaukee Lake to the junction with Pemigewasset River is 225 feet in a distance of 14 miles.[a]

From Franklin Merrimac River flows southerly through the State of New Hampshire for 56 miles, receiving Contoocook River from the west and Suncook River from the east. After entering Massachusetts the river deflects to the east and flows in an easterly and northeasterly direction, a distance of 40 miles, to Newburyport, where it enters an arm of the sea. Tide flows to Lawrence.

The United States Geological Survey maintains gaging stations in this basin on Merrimac River at Franklin Junction; on Pemigewasset River at Plymouth; on Contoocook River at West Hopkinton, and on Suncook River at East Pembroke.

In addition, data of flow are furnished the Survey by private parties or corporations for Merrimac River at Garvins Falls, near Concord, N. H.; Merrimac River at Lawrence; Sudbury River at Framingham; Lake Cochituate at Cochituate, Mass., and the South Branch of Nashua River at Clinton, Mass.

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[a] Tenth Census, vol. 16, p. 50.

Drainage areas of Merrimac River and some of its principal tributaries are given in the following table:

Drainage area of Merrimac River and tributaries.

River.	Locality.	Drainage area.
		Sq. miles.
Merrimac	Mouth	5,015
Do	Lawrence dam	4,664
Do	Lowell dam	4,127
Do	Garvins Falls	2,340
Do	Franklin Junction	1,460
Pemigewasset	Plymouth	615
Do	Junction with Winnepesaukee	1,085
Winnepesaukee	Junction with Pemigewasset	435
Contoocook	West Hopkinton	410
Do	Mouth	750
Suncook	East Pembroke	250
Do	Mouth	270

MERRIMAC RIVER AT FRANKLIN JUNCTION, N. H.

This station was established July 8, 1903, by H. K. Barrows. It is located at the wooden railway bridge near Franklin Junction, about a mile below the union of Pemigewasset and Winnepesaukee rivers. The drainage area at this point is 1,460 square miles. A standard chain gage is fastened to the guard timber of the bridge; length of chain, 47.08 feet. It is referenced by bench marks as follows: (1) Marked point on lower chord near gage; elevation, 46.54 feet. (2) Top of north rail at west portal of bridge; elevation, 47.08 feet. (3) Spike in telegraph pole nearest west end of bridge; elevation, 46.38 feet. (4) Top of northwest nut on guard timber; elevation, 47.28 feet. All elevations refer to the datum of the gage. The initial point for soundings is at the top of the face of the right abutment at the upstream side of the bridge. The channel is straight above and below the bridge and is about 200 feet wide at ordinary stages, broken by one pier. The banks are high and rocky and not subject to overflow. The bed is rocky and permanent. The current is swift, having an observed mean velocity of 1.53 feet per second at a gage height of 4.20, the lowest measurement made. The gage is read twice daily by F. R. Roers.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Merrimac River at Franklin Junction, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 13	H. K. Barrows	805	1.84	4.46	1,480
July 14	do	768	1.85	4.42	1,420
July 31	do	840	1.93	4.66	1,620
September 5	do	840	2.00	4.67	1,680
September 9	do	745	1.53	4.20	1,140
October 8	N. C. Grover	724	1.48	4.17	1,070
1904.					
April 6	N. C. Grover	1,250	4.31	6.83	5,400
April 21	S. K. Clapp	1,260	3.96	6.46	4,990
May 4	do	1,830	5.46	8.92	9,990
May 24	N. C. Grover	1,285	4.15	6.88	5,330
June 8	S. K. Clapp	1,020	3.10	5.47	3,170
July 7	do	812	2.09	4.51	1,700
September 23	T. W. Norcross	790	2.03	4.66	1,600
November 8	do	855	1.79	4.50	1,530

Mean daily gage height, in feet, of Merrimac River at Franklin Junction, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.70	.....	.....	7.75	12.90	5.30	4.50	4.40	4.10	7.00	4.85	4.00
2	4.80	.....	.....	7.15	10.10	5.20	4.90	4.40	4.20	5.70	4.80	4.00
3	4.70	.....	.....	6.10	8.90	5.20	4.55	4.40	4.10	5.60	4.70	3.90
4	(a)	.....	.....	6.30	8.80	5.20	4.50	4.35	3.90	5.45	4.70	3.60
5	.....	.....	.....	6.15	8.60	4.80	4.50	4.40	4.20	5.30	4.60	3.90
6	.....	.....	.....	6.90	8.45	5.35	4.40	4.50	4.30	5.10	4.30	4.00
7	.....	.....	.....	7.90	7.45	5.50	4.40	3.95	4.25	4.90	4.40	4.10
8	.....	.....	.....	7.90	6.70	5.45	4.40	4.50	4.20	4.70	4.45	4.20
9	.....	.....	.....	9.40	7.05	5.40	4.40	4.30	4.20	4.10	4.40	4.10
10	.....	.....	.....	11.50	7.00	5.20	3.90	4.30	4.15	4.60	4.40	4.10
11	.....	.....	.....	10.65	7.00	5.05	4.25	4.35	4.10	4.80	4.30	4.45
12	.....	.....	.....	8.35	6.90	4.90	4.30	4.40	4.10	4.70	4.30	4.80
13	.....	.....	.....	7.90	6.70	5.10	4.20	4.50	4.20	4.80	4.30	4.50
14	.....	.....	.....	7.10	6.70	4.80	4.25	3.90	4.20	4.80	4.30	4.30
15	.....	.....	5.50	6.55	6.60	4.60	4.30	4.10	5.00	4.75	4.40	4.40
16	.....	.....	5.50	6.30	7.90	4.60	4.20	4.15	7.05	4.20	4.40	4.40
17	.....	.....	5.10	6.30	11.40	4.60	3.70	4.10	5.55	4.40	4.40	4.40
18	.....	.....	5.10	6.10	10.40	4.50	4.10	4.10	4.55	4.50	4.30	(a)
19	.....	.....	4.70	6.15	7.90	4.35	4.15	4.05	4.60	4.60	4.20	.....
20	.....	.....	4.15	6.20	12.50	4.30	4.10	4.25	4.60	4.60	4.05	.....
21	.....	.....	4.50	6.30	9.80	4.25	4.20	7.60	4.70	4.70	4.20	.....
22	.....	.....	4.45	6.40	7.20	4.30	4.20	5.90	4.90	7.85	4.40	.....
23	.....	.....	4.70	6.55	7.30	4.30	4.10	5.65	4.75	.....	4.35	.....
24	.....	.....	5.80	6.70	6.85	4.35	3.75	5.70	4.50	.....	4.30	.....
25	.....	.....	6.30	7.65	6.20	4.20	3.95	5.10	3.95	.....	4.30	.....
26	.....	.....	7.10	8.70	6.30	4.15	4.10	4.40	5.80	.....	4.30	.....
27	.....	.....	8.10	8.55	6.25	4.10	4.20	4.40	5.45	.....	3.60	.....
28	.....	.....	9.10	10.10	5.90	4.10	4.40	3.75	5.20	.....	4.00	.....
29	.....	.....	7.80	12.30	5.30	4.20	4.45	4.05	5.20	.....	3.95	.....
30	.....	.....	7.70	13.45	5.50	4.30	4.30	4.15	7.70	.....	3.90	.....
31	.....	.....	7.70	.....	5.50	.....	3.75	4.10	.....	.....	.....	.....

(a) River frozen from January 4 to March 15 and from December 18 to 31.

Rating table for Merrimac River at Franklin Junction, N. H., from July 8, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.6	460	4.9	2,065	6.2	4,310	8.6	9,265
3.7	570	5.0	2,220	6.3	4,500	8.8	9,715
3.8	680	5.1	2,380	6.4	4,690	9.0	10,170
3.9	795	5.2	2,540	6.6	5,070	9.5	11,320
4.0	910	5.3	2,705	6.8	5,460	10.0	12,470
4.1	1,030	5.4	2,875	7.0	5,850	10.5	13,670
4.2	1,150	5.5	3,045	7.2	6,250	11.0	14,870
4.3	1,270	5.6	3,220	7.4	6,660	11.5	16,080
4.4	1,395	5.7	3,395	7.6	7,075	12.0	17,330
4.5	1,520	5.8	3,575	7.8	7,500	12.5	18,580
4.6	1,645	5.9	3,755	8.0	7,930		
4.7	1,775	6.0	3,940	8.2	8,370		
4.8	1,915	6.1	4,125	8.4	8,815		

The above table is applicable only for open-channel conditions. It is based upon 14 discharge measurements made during 1903 and 1904. It is well defined between gage heights 4.15 feet and 8.90 feet. The table has been extended beyond these limits.

Estimated monthly discharge of Merrimac River at Franklin Junction, N. H., for 1903 and 1904.

[Drainage area, 1,460 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
July 9–31	3,431	703	1,676	1.15	0.894
August	2,909	795	1,475	1.01	1.16
September	1,482	350	1,007	.690	.770
October	2,380	150	1,345	.921	1.06
November	1,710	680	1,155	.791	.882
December	4,348	680	1,412	.967	1.11
1904.					
March 15–31	10,400	1,090	4,307	2.95	1.86
April	20,950	4,125	7,825	5.36	5.98
May	19,580	2,705	7,754	5.31	6.12
June	3,045	1,030	1,866	1.28	1.43
July	2,065	570	1,203	.824	.950
August	7,075	625	1,650	1.13	1.30
September	7,285	795	1,951	1.34	1.50
October 1–22	7,608	1,030	2,415	1.65	1.35
November	1,990	460	1,312	.899	1.00
December 1–17	1,915	460	1,139	.780	.493

MERRIMAC RIVER AT GARVINS FALLS, NEW HAMPSHIRE.

A new stone masonry dam was completed at Garvins Falls, on Merrimac River, during the spring of 1904. The drainage area at this point is about 2,340 square miles. This dam was built by the Manchester Traction, Light and Power Company. It has a total length of about 550 feet, and is somewhat similar in section to the dam at Holyoke, Mass. Very careful records of the pond and tailrace levels, wheel openings, etc., are kept here, and will be furnished to the United States Geological Survey. The average head on wheels is about 29 feet.

During 1904 a number of current-meter measurements have been made by the United States Geological Survey for the purpose of rating the turbines and to assist in computing flow over the dam. The publication of estimates of flow at this point is withheld awaiting confirmation of data.

MERRIMAC RIVER AT LAWRENCE, MASS.

Records of flow of this river at Lawrence have been kept for more than fifty years, but have never been published in full. Figures for the monthly maximum and minimum discharges from 1890 to 1897 were published in the Nineteenth Annual Report, Part IV; the daily discharge for 1897, 1898, and 1899 in Water-Supply Paper No. 35; the daily discharge for 1900 in Water-Supply Paper No. 47; the daily discharge for 1901 and 1902 in Water-Supply Paper No. 82; for 1903 in Water-Supply Paper No. 97. These figures are furnished by R. A. Hale, principal assistant engineer of the Essex Water Power Company.

For a portion of the year water from the Sudbury and Nashua River drainage basins is wasted into the Merrimac, and therefore the drainage area is a somewhat variable quantity. During the dry months a very small amount is received. The following tables give the flow of the Merrimac at Lawrence, also the quantity wasted from the Sudbury and Nashua River drainage basins that reaches the Merrimac. The latter table is based on data furnished by the Metropolitan Water and Sewerage Board of Boston. The drainage areas are as follows:

Drainage areas in Merrimac River basin.

	Sq. miles.
Total of Merrimac River drainage basin above Lawrence	4,664
Nashua River drainage basin above gaging station	119
Sudbury River drainage basin, Framingham, Dam No. 1	75
Cochituate River drainage basin	19
Total of Nashua, Sudbury, and Cochituate River drainage basins	213
Net drainage basin of Merrimac River, excluding Nashua, Sudbury, and Cochituate River basins	4,451

The quantity as measured at Lawrence includes the water from Sudbury, Nashua, and Cochituate rivers, and in getting the absolute yield

of the river this should be considered in reference to the drainage areas, either by deducting it from the Merrimac flow and using the net area of the Merrimac and the net flow of the Merrimac, or by getting the total yield of both the Sudbury and Nashua rivers with the Merrimac and using the total area.

Flow of Merrimac River at Lawrence, Mass., for 1904.

[Cubic feet per second for twenty-four hours.]

Day.	Quantity of water passing—					
	January.	February.	March.	April.	May.	June.
1	2,825	4,039	4,034	17,994	46,336	6,252
2	2,265	3,115	3,828	21,175	38,498	5,241
3	1,901	3,041	3,949	23,976	29,795	6,233
4	4,265	2,854	4,274	22,677	22,895	5,574
5	2,796	2,812	3,667	19,056	20,321	5,431
6	2,753	2,109	4,373	17,218	18,408	6,292
7	2,644	1,242	6,085	17,726	16,477	6,583
8	2,724	3,801	6,730	19,432	13,731	8,287
9	1,904	3,152	10,627	20,738	13,193	8,368
10	1,298	2,896	13,740	28,174	13,244	7,520
11	3,852	2,869	14,711	36,984	14,560	6,298
12	2,901	2,813	13,406	33,942	17,567	5,269
13	2,878	1,852	11,664	27,748	17,469	5,921
14	2,798	1,017	10,881	22,937	13,795	5,115
15	3,059	3,728	9,728	19,028	11,340	4,465
16	2,095	2,965	8,831	16,369	11,657	4,175
17	1,613	2,873	7,883	14,613	15,507	3,921
18	3,936	2,660	7,353	14,544	19,890	2,748
19	3,042	2,737	6,668	14,624	16,912	2,862
20	2,769	1,909	6,817	15,183	21,331	4,193
21	2,920	899	8,714	14,449	27,354	3,592
22	2,820	3,679	9,198	14,355	22,002	2,914
23	1,753	3,364	9,500	13,300	17,542	2,911
24	1,062	3,394	11,360	12,254	14,211	2,946
25	3,621	3,592	14,370	12,684	11,326	1,918
26	2,869	4,129	23,479	13,620	10,999	1,805
27	2,832	3,392	35,149	15,139	10,508	4,002
28	2,875	3,397	36,205	20,584	9,431	3,024
29	2,914	5,043	31,579	35,300	8,496	3,017
30	2,241	.....	23,660	45,300	7,704	3,132
31	1,681	.....	19,408	.....	7,721	.....
Total	81,906	85,373	381,871	621,123	540,220	140,009
Average	2,642	2,944	12,318	20,704	17,426	4,667

Flow of Merrimac River at Lawrence, Mass., for 1904—Continued.

Day.	Quantity of water passing—					
	July.	August.	September.	October.	November.	December.
1	3,236	3,230	2,271	4,759	3,084	2,606
2	3,516	2,681	2,254	5,205	3,086	2,500
3	5,193	2,321	1,643	5,457	3,063	1,659
4	4,586	2,651	393	4,359	3,181	390
5	5,174	2,647	409	3,977	2,112	2,640
6	4,575	1,799	3,378	3,623	1,656	2,434
7	3,795	327	2,844	3,213	3,813	2,469
8	3,340	3,163	2,370	2,128	3,006	2,498
9	2,496	2,850	2,301	1,377	2,795	2,031
10	2,302	2,620	1,546	3,923	2,567	1,392
11	4,225	2,382	358	3,131	2,667	289
12	2,881	2,529	2,303	2,973	1,702	2,255
13	2,783	1,578	2,275	2,798	431	2,028
14	2,716	288	2,295	3,067	3,656	2,018
15	2,713	3,065	2,586	2,124	3,293	2,033
16	1,667	2,850	3,396	1,946	3,107	1,977
17	928	2,445	7,983	4,023	3,070	1,153
18	3,758	2,549	5,595	3,031	2,858	177
19	2,714	2,495	5,526	2,925	2,131	1,775
20	2,662	1,550	4,423	2,780	1,049	1,886
21	2,638	393	3,397	2,933	3,629	1,978
22	2,403	5,267	3,156	2,076	3,094	1,962
23	1,384	5,819	3,121	6,130	3,055	1,861
24	367	4,494	2,003	6,808	1,096	1,164
25	2,601	3,468	1,601	5,330	4,010	154
26	2,680	3,489	3,942	4,607	2,632	302
27	2,397	1,927	3,142	4,002	1,649	2,462
28	2,485	767	3,887	3,894	3,697	2,705
29	2,579	3,487	3,504	3,075	3,173	3,017
30	1,661	2,402	3,486	2,674	2,540	3,022
31	260	2,298	.....	4,364	.....	1,541
Total	86,715	79,831	87,388	112,712	80,902	56,378
Average	2,797	2,575	2,913	3,636	2,697	1,819

Average weekly flow of Merrimac River at Lawrence, Mass., for 1904.

Week ending Sunday—	Merrimac River at Lawrence (total drainage area= 4,664 square miles).	Wasting into Merrimac from—				Net yield of Merrimac River from 4,452 square miles.	
		Nashua River at Clinton (drainage area= 118 square miles).	Sudbury River at Dam 1 (drainage area= 75 square miles).	Lake Cochituate, Bonnister Brook (drainage area= 19 square miles).	Total waste of those watersheds (total drainage area= 212 square miles).	Cubic feet per second.	
	Cubic feet per second for seven days.					Seven days.	Per square mile.
December 25	1,540	3	2	0	5	1,535	0.345
December 18	1,663	3	2	0	5	1,658	.372
September 11	1,887	3	2	0	5	1,882	.423
January 1, 1905	1,929	3	2	0	5	1,924	.432
December 11	1,965	3	2	0	5	1,960	.440
July 31	2,095	3	11	0	14	2,081	.467
September 4	2,107	3	12	0	15	2,092	.470
August 21	2,192	3	20	0	23	2,169	.487
August 14	2,201	3	16	0	19	2,182	.490
August 7	2,237	4	14	0	18	2,219	.498
July 24	2,275	3	12	0	15	2,260	.508
December 4	2,366	4	2	0	6	2,360	.530
November 13	2,426	4	3	0	7	2,419	.543
February 21	2,539	4	62	0	66	2,473	.556
July 17	2,559	3	14	0	17	2,542	.571
January 24	2,615	3	39	0	42	2,573	.578
January 10	2,626	4	25	0	29	2,597	.583
February 14	2,629	4	54	0	58	2,571	.578
January 31	2,719	4	53	0	57	2,662	.598
November 20	2,738	4	3	0	7	2,731	.613
November 27	2,738	3	2	0	5	2,733	.614
January 17	2,742	4	34	0	38	2,704	.607
February 7	2,745	3	51	0	54	2,691	.604
October 16	2,852	4	2	0	6	2,846	.639
June 26	2,897	8	18	4	30	2,867	.644
November 6	2,935	4	7	0	11	2,924	.657
September 25	3,318	3	2	0	5	3,313	.744
October 23	3,414	4	2	0	6	3,408	.766
October 9	3,448	3	2	0	5	3,443	.773
February 28	3,564	4	117	0	121	3,443	.773
July 3	3,589	6	22	0	28	3,561	.800
August 28	3,604	3	32	0	35	3,569	.802
July 10	3,753	3	22	0	25	3,728	.837
September 18	3,776	4	2	0	6	3,770	.847
October 2	3,989	3	2	0	5	3,984	.895
March 6	4,167	4	112	0	116	4,051	.910
June 19	4,172	11	29	2	42	4,130	.928
October 30	4,341	3	2	0	5	4,336	.974
June 5	6,308	5	64	12	81	6,227	1.398

Average weekly flow of Merrimac River at Lawrence, Mass., for 1904—Continued.

Week ending Sunday—	Merrimac River at Lawrence (total drainage area= 4,664 square miles).	Wasting into Merrimac from—				Net yield of Merrimac River from 4,452 square miles.	
		Nashua River at Clinton (drainage area= 118 square miles).	Sudbury River at Dam 1 (drainage area= 75 square miles).	Lake Cochituate, Bonnister Brook (drainage area= 19 square miles).	Total waste of those watersheds (total drainage area= 212 square miles).	Cubic feet per second.	
	Cubic feet per second for seven days.					Seven days.	Per square mile.
1904.							
June 12	6,945	99	77	15	191	6,754	1.517
March 20	8,309	7	151	0	158	8,151	1.831
March 13	10,995	8	303	0	311	10,684	2.400
May 29	11,788	23	39	14	76	11,712	2.631
April 24	14,101	38	142	19	199	13,902	3.123
May 15	14,453	171	222	45	438	14,015	3.148
March 27	15,967	8	248	0	256	15,711	3.529
May 22	19,236	113	123	32	268	18,968	4.261
April 10	20,717	179	323	100	602	20,115	4.519
May 8	22,875	115	285	17	417	22,458	5.044
April 17	24,517	397	236	112	745	23,772	5.340
April 3	24,857	12	195	33	240	24,617	5.530
May 1	26,995	813	617	76	1,506	25,489	5.725
Total, 52 weeks	335,415	2,133	3,835	481	6,449	328,966	73.892
Weekly average	6,450	41	74	9	124	6,326	1.421

PEMIGEWASSET RIVER AT PLYMOUTH, N. H.

This station was established September 5, 1903, by N. C. Grover. It is located at the wooden highway bridge, below the mouth of Bakers River, in the town of Plymouth. The drainage area at this point is about 615 square miles. The headwaters of the river lie in the mountainous country to the west of Mount Washington, at elevations of more than 2,000 feet. At North Woodstock Pemigewasset River is formed by the junction of East Branch, Middle Branch, and Moosilauke Brook, at an elevation of about 700 feet. Thence the waters flow south, receiving Mad River from the east and Bakers River from the west, until at Plymouth, about 20 miles below North Woodstock, the elevation is between 400 and 500 feet. The underlying rock in this basin is usually granite, exposed in the mountain summits. The basin contains some of the best spruce standing in New England. Large areas in the basin of East Branch are still in virgin forest; other areas have been practically stripped, especially on Hancock Brook, a tributary of East Branch, and in the basin of Middle Branch.

The height of water at Plymouth has been recorded daily since January 1, 1886, during which time extensive deforestation in the basin

above has taken place. This record of gage height has been kindly given to the United States Geological Survey by Locks and Canals Company, of Lowell, Mass. From these the daily discharge of the river since that date has been estimated from measurements of flow at the station during 1903 and 1904.

A standard chain gage is attached to the guard rail of the sidewalk of the bridge on the upstream side; length of chain, 34.69 feet. It is referred to bench marks as follows: (1) Marked point on rail of bridge near gage; elevation, 34.00 feet. (2) North corner of intermediate cast-iron gage set by Locks and Canals Company, of Lowell, Mass.; elevation, 13.27 feet. (3) North corner of lowest cast-iron gage set by same company; elevation, 7.11 feet. All elevations refer to the datum of the gage. The initial point for soundings is at the top of the face of the right abutment on the upstream side. The channel is straight for 1,000 feet above and below the bridge, and is about 180 feet wide at ordinary stages, broken by one pier. The banks are high and rocky. The bed is permanent; rocky in the right half and gravelly in the left. The velocity is rapid in the right and sluggish in the left half. At low water the measurements of flow through the left channel are made by wading. The lowest observed mean velocity is one foot per second. The gage is read twice daily by Frank Morton.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Pemigewasset River at Plymouth, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per. sec.*	*Feet.*	*Second-feet.*
September 5	N. C. Grover	250	1.08	1.85	270
September 22	H. K. Barrows	238	1.00	1.74	238
October 9	N. C. Grover	243	1.17	1.98	285
1904.					
April 14	N. C. Grover	931	2.88	4.75	2,680
April 14	do	920	2.80	4.70	2,580
April 20	S. K. Clapp	836	2.70	4.34	2,257
April 30	do	2,043	5.65	10.36	12,800
May 21	do	1,360	4.17	6.75	5,675
May 25	N. C. Grover	782	2.55	4.06	2,000
June 9	do	559	1.86	3.02	1,042
July 5	S. K. Clapp	288	1.45	2.12	419
July 26	do	197	.91	1.55	179
August 5	do	278	1.61	2.11	448
August 23	H. K. Barrows	630	2.03	3.15	1,280
September 23	S. K. Clapp	350	1.84	2.47	642
October 14	T. W. Norcross	399	1.81	2.65	722
November 22	do	356	1.73	2.54	616

Mean daily gage height, in feet, of Pemigewasset River at Plymouth, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.20	a 3.90	.....	.....	8.85	2.85	2.05	1.78	1.82	5.55	2.82	2.20
2	5.15	.....	.....	6.70	7.85	2.80	3.00	1.88	1.90	4.55	2.72	2.20
3	.....	.....	.....	.....	6.88	2.62	3.00	1.98	1.72	3.90	2.70	2.20
4	b 4.75	.....	c 4.65	.....	7.12	2.48	2.55	2.48	2.20	3.50	2.62	1.75
5	.....	a 3.65	.....	d 6.12	7.30	2.40	2.10	1.98	2.35	3.20	2.55	2.20
6	.....	.....	.....	3.42	6.75	2.72	2.06	1.98	1.90	3.05	2.50	1.90
7	.....	.....	e 4.60	5.80	5.80	2.98	2.01	1.80	1.90	2.90	2.50	2.00
8	f 3.90	a 4.25	.....	5.50	6.00	3.20	1.85	1.82	1.88	2.88	2.40	2.00
9	.....	.....	e 8.60	7.20	5.68	3.15	1.88	1.72	1.80	2.70	2.35	1.95
10	.....	.....	.....	9.40	6.45	2.78	1.80	1.70	1.80	2.75	2.20	2.05
11	g 4.20	.....	.....	7.88	8.25	2.55	1.78	1.70	1.45	2.82	2.15	1.95
12	.....	c 3.30	i 6.70	6.45	6.45	2.35	1.72	2.10	1.80	2.95	2.20	2.00
13	.....	.....	.....	5.55	5.28	2.32	1.82	2.05	1.62	2.82	2.10	1.80
14	.....	.....	i 6.65	4.78	4.82	2.25	1.92	1.85	1.62	2.88	2.40	2.00
15	j 4.40	c 4.10	.....	4.48	4.70	2.15	1.82	1.80	4.65	2.72	2.10	1.90
16	.....	.....	.....	4.18	8.02	2.00	1.72	2.00	4.82	2.60	2.20	1.90
17	.....	.....	.....	3.95	9.90	1.88	1.70	1.98	3.40	2.50	2.00	2.00
18	j 4.30	.....	.....	3.80	6.28	1.95	1.62	1.92	2.95	2.35	2.15	1.90
19	.....	c 4.15	k 4.30	4.05	6.82	1.90	1.68	1.90	2.60	2.50	2.15	2.10
20	.....	.....	.....	4.28	9.50	1.90	1.60	2.30	2.50	2.35	2.20	2.05
21	.....	.....	.....	3.92	6.62	1.95	1.62	6.62	2.80	3.20	2.35	2.05
22	j 4.10	e 4.20	h 5.10	3.92	5.40	2.00	1.58	3.80	2.85	7.88	2.60	1.90
23	.....	.....	.....	4.32	4.75	2.12	1.52	3.22	2.48	5.60	2.40	1.90
24	.....	.....	.....	5.25	4.35	2.00	1.45	2.85	2.40	3.88	2.20	2.05
25	j 4.20	.....	.....	6.70	3.98	1.98	1.58	2.50	5.30	3.42	2.20	2.20
26	.....	.....	8.30	7.52	3.80	1.95	1.58	2.32	3.75	3.35	2.30	2.10
27	.....	e 4.50	12.45	7.28	3.48	1.90	1.98	2.20	3.72	4.28	2.45	2.15
28	.....	.....	.....	7.82	3.42	1.88	2.50	2.00	3.20	3.62	2.45	2.30
29	j 4.30	c 4.55	10.00	8.88	3.30	1.92	2.05	1.90	3.00	3.25	2.40	2.30
30	.....	.....	.....	9.68	3.08	1.98	2.32	1.85	7.22	3.15	2.30	2.30
31	.....	.....	8.40	.....	2.95	.....	1.85	1.85	.....	2.98	.....	2.25

a Ice 1.65 feet.
b Ice 1.4 feet.
c Ice 1.7 feet.
d Ice went out.
e Ice 1.8 feet.
f Ice 1.5 feet.
g Ice 1.55 feet.
h Ice 2.2 feet.
i Ice 2.8 feet.
j Ice 1.6 feet.
k Ice 2.3 feet.

NOTE.—Gage heights during frozen season are to surface of water in hole cut in ice under gage.

Rating table for Pemigewasset River at Plymouth, N. H., from September 5, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.25	117	2.7	780	4.9	2,860	8.2	8,370
1.3	124	2.8	860	5.0	2,980	8.4	8,770
1.35	132	2.9	940	5.1	3,100	8.6	9,170
1.4	140	3.0	1,020	5.2	3,220	8.8	9,570
1.45	149	3.1	1,110	5.3	3,350	9.0	9,970
1.5	160	3.2	1,200	5.4	3,480	9.2	10,370
1.55	172	3.3	1,290	5.5	3,620	9.4	10,790
1.6	185	3.4	1,380	5.6	3,770	9.6	11,210
1.65	200	3.5	1,470	5.7	3,920	9.8	11,630
1.7	215	3.6	1,560	5.8	4,080	10.0	12,050
1.75	232	3.7	1,650	5.9	4,240	10.5	13,100
1.8	250	3.8	1,740	6.0	4,400	11.0	14,150
1.85	270	3.9	1,830	6.2	4,720	11.5	15,200
1.9	290	4.0	1,920	6.4	5,060	12.0	16,250
1.95	315	4.1	2,020	6.6	5,400	12.5	17,300
2.0	340	4.2	2,120	6.8	5,750	13.0	18,350
2.1	395	4.3	2,220	7.0	6,110	14.0	20,450
2.2	455	4.4	2,320	7.2	6,470	15.0	22,550
2.3	515	4.5	2,420	7.4	6,830	16.0	24,650
2.4	575	4.6	2,530	7.6	7,210	17.0	26,750
2.5	640	4.7	2,640	7.8	7,590	18.0	28,850
2.6	710	4.8	2,750	8.0	7,970		

NOTE.—This table has been applied back to January 1, 1886, as no discharge measurements were made previous to 1903.

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.6 and 6.7 feet. Above 6.7 feet the curve depends on one measurement at 10.3 feet. The table has been extended beyond these limits. Above gage height 9.2 feet the rating curve is a tangent, the difference being 210 per tenth.

Estimated monthly discharge of Pemigewasset River at Plymouth, N. H., 1886–1904.

[Drainage area, 615 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1886.					
April 15–30	13,310	2,805	7,247	11.78	6.57
May	4,975	1,182	2,334	3.80	4.38
June	2,350	593	1,085	1.76	1.96
July	1,713	395	551	.896	1.04
August	1,407	305	475	.772	.890
September	2,896	185	540	.878	.980
October	2,070	350	653	1.06	1.22
November 1–15	3,770	964	1,828	2.97	1.66
1887.					
April 15–30	15,720	2,717	7,295	11.86	6.62
May	16,460	2,190	6,871	11.17	12.88
June	20,450	766	3,006	4.89	5.46
July	8,970	766	2,002	3.26	3.76
August	2,020	593	1,040	1.69	1.95
September	900	350	565	.919	1.03
October	1,263	350	473	.769	.887
November 1–15	497	350	413	.672	.372
1888.					
April 15–30	22,760	1,858	5,309	8.64	4.82
May	20,140	3,415	8,756	14.24	16.42
June	5,400	350	1,867	3.04	3.39
July	1,632	350	697	1.13	1.30
August	2,020	305	684	1.11	1.28
September	7,685	350	1,816	2.95	3.29
October	6,290	1,335	2,729	4.44	5.12
November 1–15	7,020	1,857	3,066	4.99	2.78
1889.					
April 15–30	8,870	2,350	5,315	8.64	4.82
May	7,400	964	2,092	3.40	3.92
June	11,210	654	2,183	3.55	3.96
July	7,495	545	1,700	2.76	3.18
August	7,875	350	1,362	2.21	2.55
September	7,020	239	1,077	1.75	1.95
October	8,670	654	2,018	3.28	3.78
November 1–15	2,190	1,110	1,548	2.52	1.40

Estimated monthly discharge of Pemigewasset River at Plymouth, N. H., 1886–1904—Continued.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1890.					
April 15–30	8,970	3,620	5,714	9.29	5.18
May	17,510	2,270	6,619	10.76	12.41
June	3,770	710	1,690	2.75	3.07
July	7,495	395	1,154	1.88	2.17
August	10,680	270	1,671	2.72	3.14
September	15,410	900	3,302	5.37	5.99
October	7,210	964	2,101	3.42	3.94
November 1–15	1,857	1,110	1,360	2.21	1.24
1891.					
April 15–30	15,410	3,100	8,380	13.63	7.60
May	4,560	1,335	2,705	4.40	5.07
June	2,350	493	1,190	1.93	2.15
July	3,415	305	783	1.27	1.46
August	3,100	270	809	1.32	1.52
September	1,335	185	515	.837	.934
October	593	165	234	.380	.438
November 1–15	1,940	145	421	.685	.382
1892.					
April 15–30	2,618	900	1,467	2.39	1.33
May	7,020	1,407	3,277	5.33	6.13
June	10,170	497	2,290	3.72	4.15
July	9,670	270	1,695	2.76	3.18
August	6,290	185	1,211	1.97	2.27
September	9,670	350	1,029	1.67	1.86
October	710	327	466	.755	.870
November 1–15	3,920	545	1,385	2.25	1.25
1893.					
April 15–30	5,230	2,020	2,923	4.75	2.65
May	17,200	1,488	7,117	11.57	13.34
June	2,805	395	958	1.56	1.74
July	395	165	241	.392	.452
August	6,925	165	692	1.13	1.30
September	1,560	270	619	1.01	1.13
October	6,925	270	1,648	2.68	3.09
November 1–15	1,785	497	864	1.41	.787

Estimated monthly discharge of Pemigewasset River at Plymouth, N. H., 1886–1904—Continued.

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1894.					
April 15–30	18,560	2,805	6,513	10.59	5.91
May	14,680	654	2,519	4.10	4.73
June	6,290	497	1,380	2.24	2.50
July	766	165	419	.681	.785
August	270	145	170	.276	.318
September	4,400	145	598	.972	1.08
October	2,530	209	635	1.03	1.19
November 1–15	4,560	545	1,337	2.17	1.21
1895.					
April 15–30	13,730	3,.415	6,432	10.46	5.84
May	6,290	710	2,313	3.76	4.33
June	1,785	395	845	1.37	1.53
July	710	209	388	.631	.728
August	1,182	239	469	.763	.880
September	710	185	294	.478	.533
October	2,190	305	677	1.10	1.27
November 1–15	5,400	545	1,457	2.37	1.32
1896.					
April 15–30	18,560	2,530	7,986	12.99	7.25
May	2,618	593	1,358	2.21	2.55
June	1,632	239	716	1.16	1.29
July	3,285	185	497	.808	.932
August	1,335	239	493	.802	.925
September	6,290	270	1,298	2.11	2.35
October	11,210	545	1,738	2.83	3.26
November 1–15	19,610	900	3,560	5.79	3.23
1897.					
April 15–30	13,840	3,220	7,497	12.19	6.80
May	22,240	1,335	4,085	6.64	7.66
June	13,420	900	2,658	4.32	4.83
July	30,640	654	3,878	6.31	7.27
August	1,335	395	698	1.13	1.30
September	443	185	259	.421	.470
October	2,530	165	363	.590	.680
November 1–15	5,840	209	1,493	2.43	1.36

Estimated monthly discharge of Pemigewasset River at Plymouth, N. H., 1886–1904—Continued:

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1898.					
April 15–30	11,420	3,100	5,395	8.77	4.89
May	14,360	2,020	3,460	5.63	6.49
June	4,160	710	1,517	2.47	2.76
July	654	156	290	.472	.544
August	766	145	302	.491	.566
September	1,182	145	341	.554	.618
October	7,685	270	1,122	1.82	2.11
November 1–15	2,340	654	1,147	1.87	1.04
1899.					
April 15–30	14,880	4,805	9,448	15.36	8.57
May	16,140	964	3,680	5.98	6.89
June	1,182	239	458	.745	.831
July	836	185	317	.516	.595
August	497	132	197	.320	.369
September	836	120	193	.315	.351
October	2,270	132	307	.499	.575
November 1–15	3,220	185	788	1.28	.713
1900.					
April 15–30	19,610	4,000	9,870	16.05	9.25
May	13,000	1,560	3,953	6.42	7.40
June	6,470	209	900	1.46	1.63
July	1,110	185	263	.428	.493
August	900	147	250	.407	.469
September	710	134	215	.350	.390
October	3,770	209	730	1.19	1.37
November 1–15	7,685	239	1,866	3.03	1.69
1901.					
April 15–30	12,780	4,160	6,706	10.90	6.08
May	12,260	1,713	3,895	6.33	7.30
June	2,896	395	1,170	1.90	2.12
July	2,530	270	571	.928	1.07
August	6,290	270	1,016	1.65	1.90
September	395	185	259	.421	.470
October	3,770	209	660	1.07	1.23
November 1–15	710	239	361	.587	.327

Estimated monthly discharge of Pemigewasset River at Plymouth, N. H., 1886–1904—Continued.

Month.	Discharge in second feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
April 15–30	6,290	1,940	3,266	5.31	2.96
May	12,260	305	3,377	5.49	6.33
June	6,290	1,110	2,044	3.32	3.70
July	3,220	710	1,431	2.33	2.69
August	1,335	365	696	1.13	1.30
September	4,560	305	1,128	1.83	2.04
October	18,560	766	2,538	4.13	4.76
November 1–15	2,350	1,110	1,617	2.63	1.47
1903.					
April 15–30	3,100	350	1,729	2.81	1.56
May	3,620	395	1,285	2.09	2.41
June	10,900	350	2,099	3.41	3.80
July	2,896	310	725	1.18	1.36
August	2,190	443	758	1.23	1.42
September	497	144	264	.429	.479
October	1,605	149	486	.790	.911
November	710	215	412	.670	.748
December 1–20	940	215	376	.611	.454
1904.					
April 5–30	11,420	1,398	4,607	7.49	7.24
May	11,840	980	4,741	7.71	8.89
June	1,200	282	537	.873	.974
July	1,020	149	338	.550	.634
August	5,400	215	594	.966	1.11
September	6,470	149	1,045	1.70	1.90
October	7,780	545	1,522	2.47	2.85
November	876	340	554	.901	1.01
December	515	232	372	.605	.698

CONTOOCOOK RIVER AT WEST HOPKINTON, N. H.

This station was established July 9, 1903, by H. K. Barrows. It is located at the wooden highway bridge near the railway station at West Hopkinton. The drainage area at this point is 410 square miles. A standard chain gage is attached to the downstream side of the board covering of the bridge; length of chain, 26.11 feet. It is referred to

a bench mark on the highest point of the large rock on the south side of the road, 15 feet northwest of left abutment; elevation, 21.55 feet above gage datum. The initial point for soundings is at the downstream side of the left abutment at the top. The channel is straight for 300 feet above and 500 feet below the station, and is about 125 feet wide at ordinary stages. The banks are high and rocky and not subject to overflow. The bed is rough and rocky, but permanent. The current is rapid; the lowest observed mean velocity is 1.20 feet per second, at gage height 2.42 feet. The gage is read twice daily by Frank H. Carr.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Contoocook River at West Hopkinton, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
July 9	H. K. Barrows	208	1.79	3.00	372
July 14	N. C. Grover	179	1.90	2.93	340
July 30	H. K. Barrows	178	1.71	2.84	305
September 8	do	142	1.55	2.58	220
October 7	N. C. Grover	127	1.20	2.42	153
1904.					
April 8	N. C. Grover and S. K. Clapp.	556	6.15	5.70	3,420
April 22	S. K. Clapp	443	4.70	4.70	2,080
May 24	do	366	3.67	4.18	1,340
June 7	do	242	2.71	3.36	655
August 4	do	164	1.51	2.62	247
September 27	T. W. Norcross	160	1.43	2.60	229
October 15	do	202	1.47	2.91	298
November 4	do	169	1.40	2.68	237

Mean daily gage height, in feet, of Contoocook River at West Hopkinton, N. H., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.55	7.80	3.50	3.65	3.00	2.60	3.35	2.90	[a]3.75
2	.....	6.30	6.80	3.45	4.00	2.80	2.70	3.25	2.90	[a]3.70
3	.....	6.70	6.25	3.40	3.90	2.70	2.65	3.05	2.90	[a]3.70
4	.....	6.15	5.30	3.40	3.60	2.80	2.70	3.00	2.90	[a]3.70
5	.....	5.70	4.90	3.40	3.20	2.80	2.70	3.00	2.90	[b]
6	.....	5.60	4.50	3.40	3.15	2.70	2.65	2.90	2.90	.....
7	.....	5.80	4.30	3.60	3.10	2.70	2.65	2.90	2.85	.....
8	.....	6.00	4.20	3.80	3.10	2.70	2.70	2.90	2.80	.....
9	.....	6.35	4.10	3.70	3.00	2.70	2.70	2.80	2.85	.....
10	.....	7.70	4.30	3.55	2.95	2.60	2.70	2.80	2.80	.....
11	.....	8.15	5.00	3.40	2.90	2.80	2.60	2.75	2.80	.....
12	.....	7.15	5.10	3.30	2.85	3.40	2.70	2.90	2.80	.....
13	.....	6.30	4.80	3.15	2.85	3.25	2.70	3.00	2.80	.....
14	.....	5.85	4.40	3.10	2.80	3.10	2.60	3.10	2.80	.....
15	.....	5.40	4.20	3.20	2.80	2.90	3.80	3.10	2.90	.....
16	.....	5.15	4.50	3.10	2.75	2.80	4.80	3.10	3.05	.....
17	.....	5.00	4.50	3.10	2.75	2.75	4.55	3.00	3.10	.....
18	.....	5.00	4.30	3.00	2.80	2.65	3.85	2.80	3.10	.....
19	.....	5.20	5.00	3.00	2.80	2.60	3.50	2.80	3.15	.....
20	.....	5.30	6.20	2.90	2.80	2.70	3.15	2.90	3.00	.....
21	.....	5.10	5.85	2.90	2.85	3.35	3.05	3.00	3.10	.....
22	.....	4.90	5.30	2.90	2.80	3.60	2.90	3.60	3.20	.....
23	.....	4.70	4.80	2.90	2.80	3.30	2.80	3.80	3.20	.....
24	.....	4.50	4.40	2.95	2.75	3.00	2.80	3.55	3.30	.....
25	.....	4.55	4.20	2.95	2.80	2.90	2.80	3.35	3.30	.....
26	.....	4.50	4.20	2.90	2.80	2.80	2.80	3.25	3.20	.....
27	12.70	4.50	4.20	2.90	2.90	2.80	2.80	3.20	3.20	.....
28	10.90	6.00	4.05	2.80	2.90	2.70	2.85	3.15	[a]3.40	.....
29	8.50	8.70	3.80	2.75	2.90	2.70	2.85	3.00	[a]3.70	.....
30	6.85	9.30	3.65	3.00	2.90	2.60	3.10	3.00	[a]3.60	.....
31	6.25	.....	3.55	.....	2.80	2.60	.....	2.90	.....	.....

[a] Anchor ice affects gage heights.
[b] River frozen over. Gage not read during frozen season.

Rating table for Contoocook River at West Hopkinton, N. H., from July 9, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.5	185	3.6	825	4.7	2,060	5.8	3,580
2.6	220	3.7	915	4.8	2,195	5.9	3,720
2.7	255	3.8	1,005	4.9	2,330	6.0	3,860
2.8	295	3.9	1,100	5.0	2,465	6.1	4,005
2.9	335	4.0	1,200	5.1	2,600	6.2	4,150
3.0	380	4.1	1,310	5.2	2,740	6.4	4,440
3.1	435	4.2	1,420	5.3	2,880	6.6	4,730
3.2	500	4.3	1,540	5.4	3,020	6.8	5,020
3.3	570	4.4	1,660	5.5	3,160	7.0	5,310
3.4	650	4.5	1,790	5.6	3,300		
3.5	735	4.6	1,925	5.7	3,440		

The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1903 and 1904. It is well defined between gage heights 2.5 feet and 5.70 feet. The table has been extended beyond these limits. Above gage height 6 feet the rating curve is a tangent, the difference being 145 per tenth.

Estimated monthly discharge of Contoocook River at West Hopkinton, N. H., for 1903 and 1904.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
July 9–31	1,150	295	489	1.19	1.02
August	650	210	366	.893	1.03
September	408	161	240	.585	.653
October	1,150	170	488	1.19	1.37
November 1–25	1,081	248	396	.966	.898
1904.					
April	8,645	1,790	3,751	9.15	10.2
May	6,470	780	2,231	5.44	6.27
June	1,005	275	516	1.26	1.41
July	1,200	275	418	1.02	1.18
August	825	220	340	.829	.956
September	2,195	220	467	1.14	1.27
October	1,005	275	442	1.08	1.24
November 1–27	570	295	387	.944	.948

SUNCOOK RIVER AT EAST PEMBROKE, N. H.

This stream enters the Merrimac about 6 miles below Concord and is about 27 miles long, with a total drainage area of about 270 square miles. The drainage basin is hilly and broken; the bed and banks are apt to be rocky. This stream has a large fall, a considerable part of which has been developed.

A gaging station was established at East Pembroke on November 3, 1904, by H. K. Barrows. The drainage area at this point is about 250 square miles. A wooden staff gage is fastened to the abutment of the highway bridge over the canal channel to a mill near this point, which was recently destroyed by fire. This is near the Allenstown station on the Boston and Maine Railroad. At present all of the water, except a slight amount of leakage through the dam, goes through this canal. This is intended as a temporary station, and the gage is read by George P. Cass, of East Pembroke. The records of flow at this point will be published when completed.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

SUDBURY RIVER AT FRAMINGHAM AND LAKE COCHITUATE AT COCHITUATE, MASS.

Sudbury River, a small stream of eastern Massachusetts, receives water from an area west of Framingham. It flows thence in a northerly course through meadows and swamps and joins Assabet River to form Concord River, which in turn continues northerly, entering Merrimac River immediately below the city of Lowell. Storage reservoirs have been constructed by the city of Boston and the Metropolitan Water and Sewerage Board, controlling the greater part of the flow from this basin.

Lake Cochituate drains into Sudbury River a short distance below Framingham. It is controlled as a storage reservoir by the Metropolitan Water Works.

Sudbury River and Lake Cochituate have been studied by the engineers of the city of Boston, the State board of health of Massachusetts, and the Metropolitan Water and Sewerage Board, and records of rainfall in the Sudbury basin have been kept since 1875, and in the Cochituate basin since 1852, but the latter are considered of doubtful accuracy previous to 1872. The records of run-off from 1875 to 1898, inclusive, for Sudbury River, were published in the Twentieth Annual Report, Part IV, and those for Lake Cochituate from 1863 to 1899, inclusive, in Water-Supply and Irrigation Paper No. 35.

The following tables, furnished by Frederic P. Stearns, give the results for 1904; also the averages for thirty years for Sudbury River, and for forty-two years for Lake Cochituate.

Estimated monthly run-off of Sudbury River at Framingham, Mass.

Month.	Run-off.		Rainfall in inches.
	Second-feet per square mile.	Depth in inches.	
1904.			
January	0.738	0.851	4.87
February	1.365	1.472	3.00
March	4.640	5.349	2.72
April	5.096	5.685	8.87
May	2.699	3.112	2.65
June	.648	.723	2.80
July	.096	.111	1.96
August	.262	.303	3.86
September	.614	.685	5.80
October	.295	.348	1.64
November	.447	.499	1.73
December	.417	.481	2.92
The year	1.441	19.619	42.82
1875–1904.			
January	1.882	2.170	4.21
February	2.879	3.023	4.34
March	4.620	5.326	4.59
April	3.273	3.652	3.61
May	1.766	2.036	3.34
June	.807	.901	3.09
July	.299	.345	3.67
August	.450	.519	4.06
September	.368	.411	3.32
October	.327	.903	4.22
November	1.343	1.500	3.96
December	1.675	1.931	3.81
The year	1.673	22.717	46.22

Yield and rainfall in Lake Cochituate watershed.

[Drainage area, 18.87 square miles.]

Month.	Total yield in million gallons.	Yield of 1 square mile.		Total rainfall in inches.	Rainfall collected in inches.	Per cent collected.
		Million gallons per day.	Cubic feet per second.			
1904.						
January	343.9	0.588	0.910	4.75	1.05	22.1
February	412.6	.754	1.167	3.11	1.26	40.5
March	1,553.3	2.655	4.108	2.78	4.73	170.4
April	1,717.7	3.034	4.695	8.68	5.24	60.4
May	768.1	1.313	2.032	2.14	2.34	109.5
June	178.8	.316	.489	2.86	.55	19.1
July	22.4	.038	.059	1.80	.07	3.8
August	150.6	.257	.398	3.32	.49	14.8
September	329.5	.582	.901	6.78	1.00	14.8
October	137.8	.236	.364	1.66	.42	25.3
November	277.3	.490	.758	1.84	.85	46.0
December	263.9	.451	.698	2.39	.80	33.7
The year.	6,155.9	.891	1.379	42.11	18.80	44.6
1863–1904.						
January	27,622.0	1.124	1.739	165.60	2.01	50.9
February	35,927.9	1.606	2.484	169.39	2.61	64.7
March	54,884.1	2.234	3.455	186.91	3.98	89.5
April	41,312.8	1.738	2.688	155.31	3.00	81.1
May	24,495.9	.997	1.543	156.57	1.78	47.7
June	11,124.8	.468	.691	126.51	.81	26.8
July	7,329.6	.298	.462	173.60	.53	12.9
August	10,469.7	.426	.659	185.03	.76	17.3
September	10,031.9	.422	.653	147.27	.73	20.8
October	14,298.3	.582	.376	185.03	1.04	23.6
November	19,485.2	.820	1.268	175.20	1.42	33.9
December	23,651.8	.963	1.489	148.95	1.72	48.4
The year.	280,634.0	.970	1.500	1,975.37	20.38	43.3

Yield, in cubic feet per second per square mile, of Lake Cochituate watershed, 1900–1904.[a]

[Drainage area, 18.87 square miles.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
1900	1.060	4.136	4.020	1.454	1.641	0.455	0.293	0.558	0.640	0.689	1.087	1.502	1.445
1901	.840	.629	3.845	4.649	3.704	1.019	.792	1.101	1.012	1.083	1.034	3.675	1.959
1902	2.071	1.934	6.022	2.741	.955	.319	.398	.604	.688	.814	.710	2.052	1.612
1903	2.184	2.734	4.311	3.106	.689	2.132	.553	.408	.130	.886	.534	.815	1.531
1904	.910	1.167	4.108	4.695	2.032	.489	.059	.398	.901	.364	.758	.698	1.379

[a] Corrected for water drawn from Dudley Pond.

NASHUA RIVER (SOUTH BRANCH) AT CLINTON, MASS.

Since July, 1896, the flow of the South Branch of Nashua River has been measured at Clinton by the engineers of the Metropolitan Water and Sewerage Board. The results of these measurements have been furnished by Frederic P. Stearns, chief engineer. A large storage reservoir is now being constructed at Clinton, Mass. Water was stored to an appreciable extent in this reservoir during 1903. Beginning with 1897 the flow has been corrected for loss and gain of storage in ponds and mill reservoirs on the watershed, so that the results show the natural flow of the stream. The following tables give the results for 1904, also the average for the years 1897–1904, inclusive.

Yield and rainfall in Nashua River (South Branch) Watershed.

[Drainage area, 119 square miles.]

Month.	Total yield in million gallons.	Yield of 1 square mile.		Total rainfall in inches.	Rainfall collected in inches.	Per cent collected.
		Million gallons per day.	Cubic feet per second.			
1904.						
January	2,432.6	0.659	1.020	4.02	1.176	29.3
February	3,198.7	.927	1.434	2.66	1.547	58.1
March	11,094.8	3.008	4.653	3.40	5.361	157.7
April	10,654.1	2.984	4.617	7.45	5.149	69.1
May	5,524.5	1.498	2.317	2.99	2.671	89.3
June	2,719.8	.762	1.179	3.44	1.315	38.2
July	1,832.5	.497	.769	3.84	.886	23.1
August	1,309.1	.355	.549	3.68	.633	17.2
September	1,763.7	.494	.764	5.30	.853	16.1
October	1,281.9	.347	.538	1.78	.620	34.8
November	1,222.9	.343	.530	1.62	.591	29.0
December	1,621.5	.440	.680	2.88	.784	27.2
The year.	44,656.1	1.025	1.550	43.06	21.586	50.2
1897–1904.						
January	34,554.1	1.171	1.811	28.94	2.088	57.7
February	41,853.9	1.563	2.418	33.09	2.530	61.2
March	94,026.6	3.186	4.930	40.29	5.683	112.8
April	74,906.4	2.623	4.058	36.00	4.528	100.6
May	39,191.8	1.328	2.054	27.60	2.369	68.7
June	26,547.5	.929	1.438	35.15	1.605	36.5
July	15,625.2	.530	.819	35.48	.944	21.3
August	15,828.9	.536	.830	36.55	.957	20.9
September	10,218.0	.358	.553	28.24	.617	17.5
October	18,124.6	.614	.397	30.04	1.095	29.2
November	24,581.8	.861	.556	30.15	1.486	39.4
December	46,998.0	1.593	2.464	39.01	2.840	58.3
The year.	442,456.8	1.273	1.969	400.54	26.742	53.4

Yield, in cubic feet per second per square mile, of Nashua River (South Branch) watershed, 1897–1904.

[Drainage area, 119 square miles.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1897....	1.232	1.440	4.270	2.525	1.800	1.828	2.231	1.386	0.528	0.377	1.984	3.521	1.938
1898....	2.418	2.530	4.778	3.137	2.151	1.281	.514	2.049	1.045	2.334	3.358	3.189	2.400
1899....	3.236	1.687	4.295	5.224	1.344	.869	.548	.365	.387	.379	.665	.555	1.626
1900....	1.232	6.271	5.759	2.444	2.139	.894	.336	.304	.197	.437	1.354	2.429	1.956
1901....	.803	.551	4.205	7.711	4.222	1.525	.738	.792	.495	1.001	.799	5.002	2.332
1902....	2.579	2.168	6.176	3.341	1.595	.635	.452	.459	.372	1.471	.982	2.859	1.930
1903....	1.957	3.300	5.297	3.463	.880	3.297	.966	.734	.580	1.065	.981	1.476	1.988
1904....	1.020	1.434	4.653	4.617	2.317	1.179	.769	.549	.764	.538	.530	.680	1.550

BLACKSTONE RIVER DRAINAGE BASIN.

Blackstone River rises in Worcester County, near the city of Worcester, flowing in a southeasterly course and emptying into Providence River at Providence, below Pawtucket, where it is generally known as Seekonk River. It has always been important as a water-power stream, and has been very fully developed in this way. There are no large lakes in the basin but numerous small ponds and reservoirs used for storage, and the flow of the river is quite constant. It has numerous tributaries, all of which, though small, are utilized for power purposes.

A gaging station was maintained by the United States Geological Survey at Berkeley, R. I., from May, 1901, through the year 1902, and records obtained at this point may be found in Water-Supply and Irrigation Papers Nos. 65 and 82. This station has been discontinued, owing to backwater influence from dams and generally unsatisfactory conditions. The United States Geological Survey maintains a gaging station on Blackstone River at the present time at Woonsocket, R. I.

BLACKSTONE RIVER AT WOONSOCKET, R. I.

This station was established April 5, 1904, by N. C. Grover. It is located at "River Street Bridge," about midway between the railroad station at Woonsocket, R. I., and that of Blackstone, Mass., being 1½ miles from either of these two points. The drainage area at this point is 360 square miles. It is about 1 mile below the dam at Blackstone and one-half mile above the dam at Woonsocket, and probably the flow is somewhat influenced by this latter.

A standard chain gage is attached to the upstream side of the steel highway bridge; length of chain, 22.57 feet. The gage is referred to bench marks as follows: (1) On the corner of the upstream face of the right abutment; elevation, 18.23 feet above gage datum. (2) A marked point on the bridge near the gage; elevation, 20.26 feet above gage datum. (3) On the upstream face of left abutment; elevation, 18.46 feet above gage datum.

Discharge measurements are made from the 2-span bridge to which the gage is attached. The initial point for soundings is the face of the right abutment on the downstream side. The channel is straight for about 500 feet above and 800 feet below the station. The banks are high, rocky, and clean, and are not subject to overflow. The bed of the stream is of rock, gravel, and sand, and free from vegetation. The velocity is medium, but well sustained during low water. The gage is read twice daily by Gerald Fitzgerald.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Blackstone River at Woonsocket, R. I., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 5	N. C. Grover	741	1.82	4.04	1,350
April 5	S. K. Clapp	745	1.95	4.15	1,450
May 6	do	767	2.09	4.05	1,610
June 4	do	610	1.16	3.01	710
June 24	do	613	.95	2.87	583
August 3	do	553	.86	2.56	475
August 20	do	557	.79	2.54	439
September 19	H. K. Barrows	576	.88	2.60	509

Mean daily gage height, in feet, of Blackstone River at Woonsocket, R. I., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.0	3.0	2.8	2.6	2.2	2.3	2.4	2.4
2	.....	5.4	3.0	2.8	2.6	2.2	2.0	2.4	2.3
3	.....	4.8	3.0	2.6	2.5	2.2	2.5	2.4	2.2
4	.....	4.3	3.0	2.7	2.6	2.5	2.4	2.4	[a]1.8
5	4.1	4.0	3.0	2.8	2.6	2.5	2.4	2.3	2.2
6	4.0	4.0	3.0	2.8	2.3	2.2	2.4	2.4	2.2
7	3.6	3.6	3.0	2.8	2.6	2.2	2.4	2.3	2.2
8	3.8	3.6	3.2	2.8	2.4	2.2	2.4	2.2	2.2
9	3.8	3.8	3.2	2.2	2.2	2.3	2.4	2.2	2.2
10	5.4	4.4	3.0	2.4	2.2	2.1	2.4	2.2	2.3
11	6.2	4.4	3.0	2.6	2.4	2.5	2.4	2.4	2.5
12	5.2	4.2	2.9	2.8	2.4	2.4	2.4	[a]1.9	2.4
13	5.0	3.7	3.0	2.8	2.1	2.4	2.6	[a]1.8	2.3
14	4.6	3.6	2.9	2.7	2.6	2.4	2.6	2.4	2.2
15	4.4	3.5	2.8	2.8	2.6	3.2	2.4	2.5	2.2
16	4.2	3.6	2.8	2.1	2.4	4.2	2.4	2.5	2.2
17	4.2	3.4	2.8	2.6	2.5	3.8	2.4	2.5	[b]2.0
18	4.0	3.3	2.7	2.8	2.4	3.0	2.4	2.6	.....
19	3.6	3.4	2.8	2.7	2.4	2.8	2.4	2.6	.....
20	3.6	3.6	2.8	2.6	2.2	2.8	2.4	2.6	.....
21	3.8	3.4	2.8	2.6	2.8	2.6	2.6	2.5	.....

[a] Gage height not true indication of flow as water was drawn down at dam one-half mile below.
[b] River frozen over.

Mean daily gage height, in feet, of Blackstone River at Woonsocket, R. I., for 1904—Con.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
22	3.6	3.4	2.6	2.5	2.7	2.5	2.6	2.6	.....
23	3.3	3.4	2.7	2.4	2.6	2.6	2.4	2.4	.....
24	3.2	3.2	2.8	2.7	2.4	2.6	2.4	2.6	.....
25	3.2	3.2	2.7	2.5	2.5	2.4	2.4	2.4	.....
26	2.9	3.2	2.7	2.6	2.8	2.5	2.5	2.5	.....
27	3.2	3.2	2.8	2.6	2.4	2.5	2.6	2.5	.....
28	6.0	3.0	2.5	2.5	2.6	2.5	2.4	2.6	.....
29	8.7	2.9	2.6	2.6	2.2	2.6	2.1	2.6	.....
30	7.6	2.9	2.8	2.2	2.2	2.3	[a]1.8	2.5	.....
31	.....	3.0	.....	2.6	2.2	.....	2.4	.....	.....

[a] Gage height not true indication of flow as water was drawn down at dam one-half mile below.

THAMES RIVER DRAINAGE BASIN.

This stream drains the eastern part of Connecticut and small portions of Rhode Island and Massachusetts. The country thus included is hilly and contains many natural lakes and ponds which have been improved for reservoir purposes. This is a great manufacturing section, being especially noted for its cotton and woolen industries, and there are many important water-power privileges, both developed and undeveloped.

The Thames is formed at Norwich, Conn., by the union of the Shetucket and Yantic rivers, and at a distance of about 4½ miles from New London enters Long Island Sound. It is a tidal stream below Norwich. A few miles above Norwich Quinnebaug River enters the Shetucket from the east. This stream is the most important tributary of the Shetucket as regards size, storage facilities, etc. It rises in the southern part of Massachusetts in the town of Brimfield, and has a total length of about 60 miles. At Willimantic the Shetucket divides into the Willimantic and Nachaug rivers, which are, especially the former, important water-power streams.

Drainage areas of the Thames and its principal tributaries are given in the following table:

Drainage areas of Thames River and its principal tributaries.

River.	Locality.	Area.
		Square miles.
Thames	Norwich	1,300
Do	New London	1,400
Willimantic	Mouth	223
Nachaug	do	169
Quinnebaug	do	688
Shetucket	do	1,200
Yantic	do	98

The United States Geological Survey maintains a gaging station on Shetucket River a short distance below Willimantic, Conn.

SHETUCKET RIVER NEAR WILLIMANTIC, CONN.

This station was established April 4, 1904, by N. C. Grover. It is located at the highway bridge (locally known as Bingham Bridge), about 1 mile below Willimantic and 1 mile below the junction of Willimantic and Nachaug rivers. The drainage area at this point is 396 square miles. A standard chain gage is attached to the downstream side of the bridge near the center of the left span; length of chain, 22.49 feet. The gage is referred to bench marks as follows: (1) Marked point on bridge near the gage scale; elevation, 21.46 feet. (2) Top of left abutment on the downstream corner; elevation, 21.76 feet. (3) Top of face of right abutment on the downstream corner; elevation, 21.19 feet. (4) Top of downstream point of the pier; elevation, 19.77 feet. All elevations are referred to gage datum.

Discharge measurements are made from the 2-span steel bridge, total length 200 feet, to which the gage is attached. The initial point for soundings is the extreme outer edge of the end column of the downstream truss at the left bank. The channel is straight for about 800 feet above and below the station, and there are two channels at all stages. The banks are high, rocky, and clean, and not subject to overflow. The bed of the stream is of rock and permanent. Current is swift at all stages. The gage is read twice daily by Mrs. John Houle.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Shetucket River near Willimantic, Conn., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 4	N. C. Grover	689	2.32	4.78	1,600
May 5	S. K. Clapp	608	2.13	4.15	1,290
June 3	do	420	1.38	3.00	580
June 23	do	380	.84	2.54	320
August 2	do	392	1.13	2.79	443
August 19	do	401	.87	2.62	350
September 19	H. K. Barrows	468	1.16	3.08	544
October 3	T. W. Norcross	427	1.10	2.82	470
October 18	do	410	.97	2.70	400
November 28	do	435	1.13	2.99	493

Mean daily gage height, in feet, of Shetucket River at Willimantic, Conn., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.6	3.1	2.4	1.9	2.2	2.3	2.5	2.5
2	.....	4.8	3.1	2.2	2.8	2.1	2.4	2.4	2.5
3	.....	4.6	3.0	2.2	2.7	2.2	2.8	2.6	2.0
4	5.0	4.3	3.0	2.2	2.5	1.8	2.2	2.5	2.6
5	4.5	4.1	2.8	2.4	2.8	1.6	2.2	2.4	2.4
6	4.2	3.7	2.7	2.5	2.6	2.2	2.3	2.0	2.2
7	4.3	3.5	2.7	2.4	2.4	2.2	2.2	2.6	2.4
8	4.6	3.6	2.8	2.4	2.9	2.4	2.7	2.4	2.4
9	4.6	4.2	3.0	2.3	2.4	1.8	2.4	2.5	2.2
10	7.6	4.4	3.0	2.3	2.6	2.0	2.9	2.6	2.4
11	6.8	4.5	2.8	2.3	3.6	2.2	2.4	2.3	1.9
12	5.8	4.1	2.7	2.3	3.4	2.1	2.4	2.2	3.2
13	5.6	3.7	2.4	2.3	2.8	2.2	2.8	2.4	2.7
14	5.0	3.4	2.6	2.3	2.4	1.9	3.1	3.9	2.6
15	4.6	3.5	2.6	2.3	2.5	5.2	2.9	3.8	2.3
16	4.6	3.9	2.6	2.4	2.5	6.2	2.6	3.4	3.8
17	4.9	4.2	2.5	1.7	2.1	4.0	3.0	3.0	3.8
18	4.5	3.9	2.5	2.1	2.4	3.2	2.6	3.0	[a]2.9
19	4.2	3.6	1.9	2.1	2.4	3.0	2.8	2.6	[b]2.4
20	4.0	3.8	2.2	2.0	2.3	2.9	2.4	2.4	[c]1.6
21	4.0	3.5	2.2	2.0	3.7	2.6	2.7	2.8	[d]1.8
22	3.8	3.3	2.2	2.0	3.8	2.6	3.8	2.8	[b]2.5
23	3.6	3.2	2.2	2.0	3.2	2.0	3.4	2.8	[e]2.6
24	3.5	3.1	2.2	1.7	3.1	2.2	3.0	2.6	[d]2.4
25	3.6	3.0	2.2	2.2	2.4	2.5	3.0	2.6	[d]2.4
26	3.6	3.0	1.7	2.5	2.3	2.2	2.8	2.3	[b]2.9
27	3.8	3.0	2.2	2.6	1.9	2.6	2.8	2.4	[b]3.6
28	6.4	3.0	2.2	2.6	1.9	2.6	3.0	2.8	[f]5.8
29	7.3	2.8	2.2	2.5	2.2	2.6	2.7	2.4	7.0
30	6.5	2.7	2.2	1.9	2.2	2.4	2.5	2.5	6.6
31	.....	3.0	.....	1.8	2.3	.....	2.6	.....	4.8

[a] River frozen on December 18.
[b] Ice 0.4 foot thick.
[c] Ice 0.15 foot thick.
[d] Ice 0.25 foot thick.
[e] Ice 0.35 foot thick.
[f] No ice December 28–31.

NOTE.—During frozen season gage heights are to surface of water in hole cut in ice.

CONNECTICUT RIVER DRAINAGE BASIN.

Connecticut River has its source in Connecticut Lake, in northern New Hampshire. Its extreme headwaters, however, lie in the Province of Quebec and in the mountains on the northern boundary of New Hampshire; thence the river flows in a southerly direction between New Hampshire and Vermont and through Massachusetts and Connecticut into Long Island Sound. The total drainage area is 11,085 square miles, of which 155 square miles lie in the Province of Quebec. Its total length from Connecticut Lake to Long Island Sound is 345 miles. On its banks are many cities and towns of importance. It is in general closely followed by one or more railroad lines. Water power is used at several points, notably at Windsor locks in Connecticut, Holyoke and Turners falls in Massachusetts, and Bellows Falls and

Wilder in Vermont. The valley of Connecticut River proper is very generally in farm lands. Many of its tributary basins, however, especially in the northern portions, are heavily wooded.

Estimates of the flow of this river at Hartford, Conn., from 1871 to 1885, inclusive, have been published in the Fourteenth Annual Report of the United States Geological Survey, Part II, pages 140–146. Estimates of flow at Holyoke, Mass., from 1880 to 1895, inclusive, have been published in Bulletin No. 140, pages 37–41, and for 1896 and 1897 in the Nineteenth Annual Report, Part IV, page 116. The drainage areas of the river and of several of its tributaries are given in the following table:

Drainage area of Connecticut River and tributaries.

River.	Locality.	Area.
		Square miles.
Connecticut	In Canada	155
Do	Orford, N. H.	3,305
Do	Sunderland, Mass	7,700
Do	Hartford, Conn	10,235
Do	Mouth	11,085
Israel	Above South Branch	8.7
Do	Below South Branch	21.2
Ammonoosuc	Bretton Woods, N. H	34
Zealand	Mouth	14
Little	....do	12
White	Sharon, Vt	680
Ashuelot	Winchester, N. H	385
Deerfield	Mouth	667
Do	Deerfield, Mass	550
Chicopee	Mouth	730
Ware	....do	223
Do	Gilbertville, Mass	160
Do	Ware, Mass	162
Quaboag	Mouth	213
Do	West Warren, Mass	144
Swift	Mouth	218
Do	West Ware, Mass	188
Westfield	Mouth	518
Do	Russell, Mass	331

The United States Geological Survey maintains gaging stations in this basin on Connecticut River near Orford, N. H.; on Connecticut River at Sunderland, Mass.; on Israel River near Jefferson Highlands, N. H.; on Ammonoosuc River at Bretton Woods, N. H.; on Zealand River near Twin Mountain, N. H.; on Little River near Twin Mountain, N. H.; on White River at Sharon, Vt.; on Ashuelot River at Winchester, N. H.; on Deerfield River at Deerfield, Mass.; on Ware River near Ware, Mass.; on Quabog River near West Warren, Mass.; on Westfield River at Russell, Mass.

In addition, data regarding flow are obtained at the following places, through the assistance of private parties or corporations: Connecticut River at Hartford, Conn.; Ware River at Gilbertville, Mass.; and Swift River at West Ware, Mass.

CONNECTICUT RIVER NEAR ORFORD, N. H.

This station was established August 6, 1900, by E. G. Paul. It is located at the wooden highway bridge between Orford, N. H., and Fairlee, Vt., and is about 75 miles from the source of the stream. The drainage area at this point is 3,305 square miles. A standard chain gage is attached to the inside timbers of the upper side of the bridge, 125 feet from the left abutment; length of chain, 42.95 feet. It is referred to bench marks as follows: (1) Top of downstream corner of right abutment at face; elevation, 30.34 feet. (2) Top of downstream corner of left abutment at face; elevation, 31.08 feet. (3) Nail in root of elm tree on Orford side, 28.4 feet from southwest corner of bridge and 11.6 feet from produced line of downstream side of bridge; elevation, 40.11 feet. Elevations are above gage datum. The channel is straight for at least 1,000 feet above and 1,000 feet below the station, is about 275 feet wide at ordinary stages of the river, and is broken by one pier. The bed is of gravel and permanent, while the current is strong. The gage is read once daily by Frank H. Gardner, of Orford, N. H.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Connecticut River near Orford, N. H., 1900–1904.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1900.		*Feet.*	*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 7	E. G. Paul	235	1,110	1.38	3.60	1,530
1901.						
April 15	C. A. Holden	322	5,367	3.16	17.40	[a] 17,000
June 22	do	275	2,077	2.04	6.80	4,240
October 5	do	231	1,069	1.36	3.47	1,460
November 2	do	235	1,143	1.39	3.67	1,590
1902.						
April 10	C. A. Holden	296	3,510	3.06	11.63	10,700
November 22	do	278	2,140	2.09	6.80	4,470
1903.						
January 24	C. A. Holden	276	1,760	1.69	[b] 7.20	2,970
January 29	do	273	1,610	1.63	[c] 6.60	2,620
January 29	do	273	1,620	1.66	[d] 6.90	2,690
January 30	do	276	1,760	1.69	[b] 7.40	2,980
February 7	do	278	1,810	1.65	[e] 7.45	2,990
February 7	do	278	1,810	1.67	[e] 7.45	3,030
March 14	do	325	6,510	3.79	20.70	[a] 24,700
April 23	do	294	2,530	2.46	8.25	6,220
June 2	E. C. Murphy	280	1,040	1.13	3.26	1,170
July 16	N. C. Grover	264	1,180	1.29	3.53	1,520
August 29	C. A. Holden	252	1,450	1.48	4.55	2,150
September 19	do	225	826	.93	2.30	768
September 26	do	225	778	.87	2.13	673
1904.						
February 3	C. A. Holden	240	851	1.04	[f] 4.15	884
February 3	do	241	847	1.03	[g] 4.12	876
February 4	do	239	804	.98	[h] 4.08	785
February 4	do	236	804	.99	[i] 4.20	792
February 5	do	235	813	.97	[j] 4.03	790
February 5	do	235	805	.99	[j] 4.03	799
April 30	do	324	5,540	3.78	18.03	20,900
July 6	S. K. Clapp	275	1,480	1.59	4.74	2,350

[a] Discharge estimated.
[b] Gage height to bottom of ice 6.0 feet.
[c] Gage height to bottom of ice 5.4 feet.
[d] Gage height to bottom of ice 5.5 feet.
[e] Gage height to bottom of ice 6.05 feet.
[f] Gage height to bottom of ice 2.4 feet; ice 1.9 feet thick.
[g] Gage height to bottom of ice 2.37 feet; ice 1.95 feet thick.
[h] Gage height to bottom of ice 2.22 feet; ice 2.05 feet thick.
[i] Gage height to bottom of ice 2.19 feet; ice 2.05 feet thick.
[j] Gage height to bottom of ice 2.23 feet; ice 2.0 feet thick.

NOTE.—Gagings January 24 to February 7, 1903, and February 3 to 5, 1904, made through ice. Gage heights given in table are to surface of water in hole in ice.

Mean daily gage height, in feet, of Connecticut River near Orford, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.3	4.2	4.8	13.9	18.0	7.2	4.1	3.7	3.5	10.4	6.3	4.8
2	4.2	4.2	4.8	13.4	18.2	6.8	4.0	3.8	3.3	11.7	6.1	.....
3	4.2	4.2	4.8	13.2	17.4	6.6	4.0	3.8	3.4	11.5	6.1	4.4
4	4.2	4.1	4.8	11.9	17.2	6.1	4.2	3.6	3.4	11.1	5.9	[a]4.6
5	4.3	4.1	4.9	10.4	16.6	6.0	4.8	3.5	4.7	10.6	5.8	4.4
6	4.3	4.1	5.2	9.9	15.1	6.0	4.7	3.4	6.4	9.3	5.8	.....
7	4.3	[b]4.0	5.2	10.8	14.5	6.3	4.3	3.1	6.3	7.6	5.6	.....
8	4.0	4.0	5.3	11.4	13.2	7.4	3.9	2.9	5.5	7.4	5.5	.....
9	4.0	4.1	8.0	13.6	12.0	8.5	3.7	2.6	5.2	7.0	5.4	.....
10	[c]4.0	4.1	8.3	16.2	12.0	8.1	3.5	2.8	4.8	6.7	5.0	.....
11	3.9	4.1	7.5	17.6	12.2	7.1	3.6	3.4	4.0	6.7	4.8	[d]4.0
12	3.8	4.1	6.9	17.2	13.9	6.4	2.8	3.4	4.0	6.5	4.6	.....
13	3.8	4.1	6.4	15.8	13.1	5.8	2.9	3.6	3.5	7.0	4.4	.....
14	3.9	[e]4.1	6.1	14.0	11.2	5.4	3.4	3.8	3.5	6.7	4.9	.....
15	4.0	4.1	6.0	11.6	10.3	5.1	3.9	3.9	4.0	6.6	4.8	.....
16	4.0	4.2	5.8	10.1	14.0	4.7	4.0	3.8	7.5	6.6	[f]4.8	.....
17	[g]4.0	4.2	5.6	9.4	16.2	4.6	3.9	4.0	8.0	6.4	[h]4.6	.....
18	4.0	4.2	5.7	9.6	16.5	4.6	3.9	3.7	7.4	6.2	4.6	[i]3.8
19	3.9	4.2	5.5	9.4	18.5	4.5	3.1	3.6	6.9	5.9	4.4	.....
20	3.9	4.2	5.4	8.8	18.2	4.5	3.0	3.8	6.5	5.8	4.3	.....
21	3.9	[j]4.2	5.4	8.8	17.9	4.4	2.8	4.8	6.4	5.8	5.0	.....
22	4.0	4.2	5.6	9.0	15.1	3.7	2.7	6.4	7.6	7.6	5.0	.....
23	4.0	4.3	5.9	9.3	13.0	3.9	2.7	7.2	8.2	8.8	5.2	.....
24	[k]4.0	4.4	8.4	10.5	11.4	4.0	2.4	6.8	7.1	8.6	5.4	.....
25	4.0	4.4	8.4	11.8	10.3	4.1	2.5	6.6	6.9	8.0	5.5	[l]3.9
26	4.1	4.6	[f]13.5	14.8	10.0	4.0	2.6	6.0	8.0	7.9	5.4	.....
27	4.1	4.7	[f]18.2	15.6	9.5	4.1	2.6	5.2	9.4	7.7	5.0	.....
28	4.1	[m]4.9	[f]19.1	16.0	9.1	3.5	3.0	4.8	8.7	7.4	4.9	.....
29	4.2	4.8	[n]17.6	17.5	8.9	4.3	3.4	4.4	7.7	7.4	4.8	.....
30	4.2	.....	16.0	17.8	8.8	4.1	3.5	3.8	8.4	7.0	4.8	.....
31	[b]4.2	.....	14.6	.....	8.5	.....	3.6	3.3	.....	6.9	.....	.....

[a] Ice 0.35 foot thick; reading to surface of water, 4.6.
[b] Ice 1.85 feet thick; reading to surface of water, 4.0.
[c] Ice 1.6 feet thick; reading to surface of water, 4.2.
[d] Ice 0.7 foot thick.
[e] Ice 1.9 feet thick.
[f] See rating table note.
[g] Ice 1.7 feet thick; reading to surface of water, 3.8.
[h] River frozen over.
[i] Ice 0.75 foot thick.
[j] Ice 2.2 feet thick.
[k] Ice 1.9 feet thick; reading to surface of water, 3.8.
[l] Ice 1.1 feet thick; reading to surface of water 4.0
[m] Ice 2.1 feet thick.
[n] Ice went out March 29.

NOTE.—Gage heights during frozen season to surface of ice except as noted.

Rating table for Connecticut River near Orford, N. H. from March 29[a] to November 16, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.0	640	3.8	1,600	7.2	4,780	10.8	9,400
2.1	680	3.9	1,670	7.4	5,000	11.0	9,700
2.2	725	4.0	1,740	7.6	5,220	11.5	10,450
2.3	770	4.2	1,880	7.8	5,440	12.0	11,200
2.4	815	4.4	2,030	8.0	5,660	12.5	11,980
2.5	860	4.6	2,190	8.2	5,900	13.0	12,770
2.6	905	4.8	2,350	8.4	6,140	13.5	13,560
2.7	950	5.0	2,520	8.6	6,380	14.0	14,340
2.8	1,000	5.2	2,700	8.8	6,640	14.5	15,120
2.9	1,050	5.4	2,880	9.0	6,900	15.0	15,910
3.0	1,100	5.6	3,070	9.2	7,160	15.5	16,700
3.1	1,160	5.8	3,270	9.4	7,420	16.0	17,480
3.2	1,220	6.0	3,470	9.6	7,690	16.5	18,260
3.3	1,280	6.2	3,680	9.8	7,970	17.0	19,050
3.4	1,340	6.4	3,900	10.0	8,250	17.5	19,840
3.5	1,400	6.6	4,120	10.2	8,530	18.0	20,620
3.6	1,460	6.8	4,340	10.4	8,810	19.0	22,190
3.7	1,530	7.0	4,560	10.6	9,100		

[a] Take 75 per cent of discharge in table, March 26, 27, and 28, on account of high water due probably to ice gorging; 90 per cent of discharge in table, November 17 to 30 on account of river being covered with thin ice.

The above table is applicable only for open-channel conditions. It is based upon 15 discharge measurements made during 1900 to 1904, inclusive. It is well defined between gage heights 2 feet and 12 feet. The table has been extended beyond these limits. Above gage height 12 feet the rating curve is a tangent, the difference being 157 per tenth. Two estimated and one measured discharge are used as the basis for extending the curve above gage height 12 feet.

Rating table for Connecticut River near Orford, N. H., from January 1 to March 25, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.0	800	4.65	1,190	5.6	1,820	6.9	2,730
4.05	830	4.7	1,220	5.7	1,890	7.0	2,800
4.1	860	4.75	1,250	5.8	1,960	7.1	2,870
4.15	890	4.8	1,280	5.9	2,030	7.2	2,940
4.2	920	4.85	1,310	6.0	2,100	7.3	3,010
4.25	950	4.9	1,340	6.1	2,170	7.4	3,080
4.3	980	4.95	1,370	6.2	2,240	7.5	3,150
4.35	1,010	5.0	1,400	6.3	2,310	7.6	3,220
4.4	1,040	5.1	1,470	6.4	2,380	7.7	3,290
4.45	1,070	5.2	1,540	6.5	2,450	7.8	3,360
4.5	1,100	5.3	1,610	6.6	2,520	7.9	3,430
4.55	1,130	5.4	1,680	6.7	2,590	8.0	3,500
4.6	1,160	5.5	1,750	6.8	2,660		

The above table is applicable only for ice conditions. It is based upon 12 discharge measurements made during 1903 and 1904 through holes cut in the ice. The thickness of ice varied from 1.2 feet to 2.05 feet. It is well defined between gage heights 4 feet and 8 feet.

NOTE.—Gage heights are to water surface.

Estimated monthly discharge of Connecticut River near Orford, N. H., for 1904.

[Drainage area, 3,305 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January [a]	980	620	765	0.231	0.266
February [a]	1,220	680	827	.250	.270
March [a]	19,990	1,160	4,688	1.52	1.75
April	20,310	6,640	12,320	3.73	4.16
May	21,400	6,260	13,760	4.16	4.80
June	6,260	1,400	3,009	.910	1.02
July	2,350	815	1,416	.428	.493
August	4,780	905	1,978	.598	.689
September	7,420	1,280	3,693	1.12	1.25
October	10,750	3,270	5,542	1.68	1.94
November [b]	3,790	1,760	2,568	.777	.867
December [c]	.....	.....	1,375	.416	.480
The year	21,400	620	4,328	1.32	16.41

[a] January 17 to March 25, inclusive, gage heights reduced 0.2 foot to bring them to surface of water instead of to surface of ice. This was necessary as ice table was based on gage heights to water surface. Miscellaneous readings to ice and water showed difference of 0.2 foot.

[b] November 17 to 30 river covered with thin ice. Discharge obtained by taking 90 per cent of open-channel flow.

[c] Mean discharge for December based upon discharge for seven days scattered through the month. Owing to thinness of ice the table for ice conditions was not considered applicable. The discharge was obtained by taking 88 per cent of the open-channel discharge with gage height to bottom of ice.

CONNECTICUT RIVER AT SUNDERLAND, MASS.

This station was established March 31, 1904, by N. C. Grover. It is located at a 5-span steel highway bridge, total length being about 830 feet, at Sunderland, Mass. The nearest railway station is at South Deerfield, Mass. The gaging station is about 18 miles above the dam at Holyoke and about 5 miles below that of Turners Falls. The drainage area at this point is about 7,700 miles. A standard chain gage is attached to the downstream side of the bridge near the left bank; length of chain, 42.79 feet. It is referred to bench marks as follows: (1) On the bottom chord of the bridge near the zero of the gage scale; elevation, 37.82 feet. (2) Corner of left bridge seat at the top of the downstream face; elevation, 37.06 feet. (3) Northwest corner of the coping of the downstream end of the pipe culvert, 250 feet east from the left end of bridge; elevation, 32.91 feet. All elevations are referred to gage datum.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the face of the left abutment at the top on the downstream side of the bridge. The channel is straight for 1,000 feet above and below the station. Both banks are high, rocky, and wooded and not subject to overflow. The bed of the stream is of gravel, clean, and permanent. There are 5 channels at all stages. The current is swift at high stages and medium at low stages. The gage is read twice daily by John Lawer.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Connecticut River at Sunderland, Mass., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 12	S. K. Clapp	13,550	4.05	17.65	55,000
April 26	do	9,200	3.75	12.15	34,500
May 17	do	7,760	3.32	10.17	25,800
June 2	do	4,110	2.46	5.45	10,100
June 21	do	2,740	1.93	3.45	5,300
July 29	do	2,070	1.77	2.55	3,660
August 18	do	2,000	1.70	2.60	3,390
October 28	T. W. Norcross	5,000	2.60	6.48	13,000
December 1	do	3,090	1.52	4.63	4,710

Mean daily gage height, in feet, of Connecticut River at Sunderland, Mass., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	12.50	19.60	6.35	3.90	3.35	3.10	8.30	5.65	4.60
2	.....	14.50	17.85	5.50	4.55	2.90	2.90	8.10	5.30	4.60
3	.....	14.75	16.25	5.50	4.55	2.75	2.65	8.30	5.15	5.15
4	.....	13.05	15.15	5.35	4.10	3.05	2.40	8.20	5.00	5.50
5	.....	11.70	14.15	5.10	3.75	3.10	2.35	7.60	4.90	4.90
6	.....	11.85	13.05	4.90	3.70	2.95	2.85	6.95	4.75	4.70
7	.....	12.50	12.15	5.50	3.60	2.90	2.85	6.25	4.50	4.80
8	.....	13.70	11.30	6.10	3.60	2.80	3.80	5.70	4.65	4.70
9	.....	15.80	10.50	7.50	3.50	2.25	3.85	5.30	4.40	4.70
10	.....	18.30	10.25	8.00	3.40	2.70	3.60	5.10	4.30	4.50
11	.....	18.55	10.30	6.85	3.15	3.05	3.40	5.25	4.10	[a]4.10
12	.....	17.55	10.90	5.80	3.05	2.90	3.15	5.50	4.00	.....
13	.....	16.15	11.00	5.15	2.70	2.35	3.00	5.70	3.80	.....
14	.....	14.65	10.35	5.00	2.85	2.30	2.90	5.60	3.85	.....
15	.....	12.90	9.30	4.60	2.70	2.20	6.70	5.60	4.10	.....
16	.....	11.45	9.40	4.30	2.70	1.75	8.70	5.50	4.10	.....
17	.....	10.40	10.10	4.10	2.70	2.55	7.25	5.10	4.10	[b]3.80
18	.....	9.95	10.90	3.90	2.95	2.60	6.80	5.10	3.75	.....
19	.....	10.20	12.10	3.40	2.85	2.70	6.40	4.85	3.65	.....
20	.....	10.10	14.65	3.10	2.90	3.05	5.65	4.70	3.80	.....
21	.....	9.55	15.10	3.20	2.80	5.15	4.90	4.80	3.85	.....
22	.....	9.25	14.00	3.30	2.55	5.00	4.65	10.20	4.20	.....
23	.....	9.30	12.40	3.10	2.45	5.10	5.10	9.40	4.75	.....
24	.....	9.55	10.70	3.05	1.90	5.00	5.50	8.35	4.70	[c]3.35
25	.....	10.40	9.40	3.00	2.45	5.10	5.20	7.50	4.60	.....
26	.....	12.10	8.80	2.95	2.55	4.70	5.05	6.80	4.40	.....
27	.....	13.25	8.60	3.00	2.40	4.50	6.10	6.30	4.40	.....
28	.....	16.05	8.10	2.90	2.50	4.10	6.40	6.50	4.35	.....
29	.....	21.25	7.40	3.05	2.60	3.55	6.40	6.40	4.50	.....
30	.....	21.40	7.00	3.20	2.70	3.30	6.90	6.05	4.70	.....
31	13.40	.....	6.85	.....	3.00	3.20	.....	5.80	.....	[d]5.40

[a] River frozen during night.
[b] Gage height to surface of ice=3.8; ice 0.65 foot thick.
[c] Gage height to surface of ice=3.4; ice 0.90 foot thick.
[d] Gage height is to surface of ice.

CONNECTICUT RIVER AT HARTFORD, CONN.

Daily readings of the height of water at Hartford have been recorded since February 8, 1896, by Edwin Dwight Graves, chief engineer Connecticut River bridge and highway district, and through his courtesy have been furnished to the United States Geological Survey.

These heights are read on what is known as the "Tollhouse gage," the zero of which is set at the low-water mark of 1801.[a] The highest water ever known in the river was in May, 1854—29 feet 10 inches; the lowest, in 1858—1½ inches below zero.

[a] See report Theodore G. Ellis, 1867 (Ex. Doc. H. R. No. 153, 40th Cong., 2d sess.).

This datum was used in the various surveys of the river below Hartford in 1866–67 (see previous reference); also the survey above Hartford in 1871–1878;[a] also survey of 1897.[b] It is now being used in a further survey of the river above Hartford by an engineer commission appointed by the Secretary of War to study the problem of river improvements above Hartford.

During the low-water periods the tidal wave comes up the river to Hartford. The visible effect of this wave is dependent upon the height of the water and the direction and course of the wind.

From figures given in the Report of the Chief of Engineers for 1878, pages 348–391, and from other data, computations of the discharge of Connecticut River at Hartford from 1871 to 1886, inclusive, were prepared and published in the Fourteenth Annual Report of the United States Geological Survey, Part II, pages 140–146.

Mean daily gage height, in feet, of Connecticut River at Hartford, Conn., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.4	3.6	5.2	12.7	19.2	5.4	2.5	1.5	1.9	5.1	4.2	2.5
2	4.3	3.8	5.0	14.1	18.2	5.0	3.8	2.2	2.0	5.7	4.1	2.5
3	3.9	3.5	4.9	15.2	16.7	4.5	3.8	2.5	2.0	5.6	4.0	2.9
4	3.5	3.4	5.7	14.6	15.0	4.2	3.3	2.4	2.0	6.0	4.0	2.6
5	3.9	3.2	6.0	12.7	13.6	3.9	3.0	2.5	1.6	5.7	4.3	2.0
6	3.8	3.4	6.1	11.5	12.3	4.1	2.9	2.6	2.2	5.4	4.1	3.2
7	3.8	3.2	6.5	11.4	11.1	4.5	3.0	2.4	2.7	4.7	3.2	3.1
8	3.8	3.3	11.2	12.0	10.1	5.7	3.0	2.5	2.6	4.3	2.9	3.0
9	4.3	4.0	14.5	13.0	9.5	5.9	2.9	2.4	2.5	3.6	3.0	3.0
10	3.4	3.8	14.8	15.8	9.3	8.2	2.8	2.0	2.5	3.2	3.0	2.9
11	3.5	4.1	13.7	17.4	9.0	7.1	2.6	2.1	1.6	3.5	2.9	2.4
12	4.2	4.3	11.6	17.4	8.8	5.8	2.7	2.1	1.8	3.4	2.5	1.6
13	4.0	4.3	11.0	16.6	9.0	4.9	2.5	2.3	2.1	4.0	2.2	3.4
14	4.1	3.8	9.7	15.3	8.9	4.2	2.0	1.5	2.2	3.9	2.8	3.2
15	3.6	4.0	8.8	13.6	8.3	3.9	2.0	1.2	3.8	3.8	3.2	2.8
16	3.5	4.0	8.0	11.9	7.9	3.7	2.0	2.0	8.9	3.9	3.2	3.2
17	3.1	3.3	7.3	10.5	8.2	3.4	1.5	2.2	8.2	3.8	2.9	3.2
18	2.6	3.2	7.0	9.6	8.6	3.0	1.4	2.0	6.0	3.7	3.5	2.7
19	3.4	3.5	6.9	9.3	9.3	2.4	2.4	1.9	5.1	3.9	3.4	2.4
20	3.4	3.4	6.9	9.3	10.9	2.7	2.4	3.0	4.9	3.7	2.6	3.0
21	3.3	2.7	7.5	9.0	12.6	3.2	2.5	2.3	3.9	4.4	2.7	2.7
22	3.5	3.8	7.1	8.4	12.6	3.2	2.7	3.6	3.0	6.8	3.0	2.3
23	3.8	5.6	6.8	8.0	11.7	2.9	3.1	3.5	3.0	8.4	2.8	2.3
24	3.8	6.0	7.7	7.8	10.3	2.6	2.3	3.2	3.1	7.4	3.5	2.5
25	3.8	6.0	9.7	8.2	8.6	2.5	1.5	3.0	3.4	6.4	3.2	2.0
26	4.4	5.5	11.6	9.0	7.6	2.0	2.0	3.0	3.1	5.6	2.6	1.5
27	4.3	5.5	17.6	10.3	7.3	1.2	1.8	2.5	3.6	4.8	2.2	2.8
28	3.8	4.9	20.0	12.6	7.2	2.1	1.6	2.2	4.0	4.4	2.0	4.0
29	4.0	5.0	18.4	16.3	6.6	2.4	1.7	2.0	4.3	4.6	3.3	4.4
30	4.5	.....	16.0	19.0	5.9	2.2	.9	2.0	4.4	4.3	2.8	4.4
31	3.5	.....	14.1	.....	5.7	.....	1.1	2.3	.....	4.1	.....	4.7

[a] Engineers' Report, 1878, pp. 348–391.

[b] Engineers' Report, 1898, pp. 976–988.

ISRAEL RIVER (ABOVE SOUTH BRANCH) NEAR JEFFERSON HIGHLANDS, N. H.

This station was established September 2, 1903, by N. C. Grover. It is located at a small wooden highway bridge in the town of Randolph, about halfway between the railway stations of Jefferson Highlands and Bowman, and 2½ miles from either place. The drainage basin at this point has an area of 8.7 square miles. The headwaters of the river lie on the slopes of Mount Adams and Mount Jefferson, at elevations approximating 5,000 feet. The length of the river from its source to the gaging station is about 5 miles. The elevation at the gaging station is about 1,400 feet. All slopes are steep; many are precipitous. There is no pondage or artificial storage of water. The underlying rock is granite, exposed in the mountain tops. The basin is generally in heavy virgin forest.

A standard chain gage is attached to the upstream truss of the bridge; length of chain, 15.43 feet. It is referred to bench marks as follows: (1) Marked point on east end of cross timber of bridge; elevation, 8.58 feet. (2) Top of bowlder, 150 feet east of bridge, 30 feet south of river; elevation, 11.99 feet. Elevations are above datum of gage. The channel is straight for 100 feet above and 50 feet below the station, and is about 20 feet wide. The banks are subject to overflow in extreme freshet. Velocities at low water average about 0.50 of a foot per second. Low-water measurements are made by wading about 20 feet above the bridge. The bed is gravelly and permanent. The gage is read once daily by E. A. Crawford, of Jefferson Highlands.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements on Israel River (above South Branch) near Jefferson Highlands, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 2	H. K. Barrows	14.1	0.67	1.20	9.4
September 18	do	14.1	.57	1.17	8.1
October 9	N. C. Grover	12.6	.46	1.15	5.8
1904.					
April 16	N. C. Grover	23	.94	1.44	22
April 18	do	24	.92	1.48	22
May 1	S. K. Clapp	46	2.18	2.33	100
May 11	do	48	2.44	2.35	117
May 25	do	29	1.14	1.60	33
June 15	do	16	.41	1.08	6.6
July 22	do	3.1	1.26	1.04	3.9
August 10	do	3	1.43	1.04	4.3
September 24	H. K. Barrows	17	1.04	1.41	18
October 13	T. W. Norcross	17	.75	1.32	12

Mean daily gage height, in feet, of Israel River (above South Branch) near Jefferson Highlands, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.20	0.80	0.80	1.40	2.35	1.35	1.10	1.20	1.10	1.60	1.45	1.20
2	1.20	.80	.80	1.30	2.00	1.30	1.10	1.18	1.32	1.60	1.45	1.20
3	1.10	.80	.80	1.30	1.90	1.40	1.45	1.30	1.60	1.60	1.40	1.20
4	1.05	.78	.80	1.30	2.10	1.35	1.45	1.30	1.55	1.50	1.35	1.20
5	1.00	.78	.80	1.30	2.10	1.30	1.30	1.20	1.50	1.50	1.35	1.18
6	[a]1.00	.78	.80	1.25	2.00	1.30	1.25	1.15	1.40	1.60	1.35	1.18
7	.90	1.80	.80	1.65	2.10	1.45	1.20	1.10	1.40	1.60	1.30	1.18
8	.90	2.50	.80	1.60	2.10	1.40	1.15	1.05	1.35	1.60	1.30	1.15
9	.85	2.80	.80	1.50	2.00	1.35	1.10	1.00	1.30	1.55	1.25	1.15
10	.85	3.00	.80	1.50	1.90	1.30	1.05	1.00	1.30	1.50	1.25	1.15
11	.85	2.50	.80	1.50	2.35	1.25	1.00	1.05	1.25	1.50	1.20	1.12
12	.85	1.50	.80	1.50	1.80	1.20	.95	1.10	1.20	1.40	1.20	1.12
13	.82	1.30	.80	1.70	1.70	1.15	1.20	1.35	1.15	1.35	1.20	1.10
14	.82	1.10	2.00	1.70	1.70	1.15	1.10	1.30	1.15	1.30	1.60	1.10
15	.82	1.00	3.20	1.50	1.65	1.12	1.08	1.62	2.15	1.30	1.30	1.10
16	.80	1.00	3.00	1.45	2.00	1.12	1.05	1.55	1.60	1.30	1.40	1.10
17	.80	.95	2.70	1.40	3.20	1.10	1.00	1.50	1.60	1.30	1.60	1.10
18	.80	.92	2.40	1.40	2.10	1.10	.98	1.40	1.30	1.30	1.50	(b)
19	.80	.90	3.20	1.45	2.25	1.05	.98	1.30	1.20	1.28	1.40	.....
20	.80	.88	4.30	1.45	2.30	1.00	.98	1.25	1.70	1.28	1.60	.....
21	.80	.88	4.00	1.50	2.00	.95	.98	1.68	1.60	1.28	1.60	.....
22	.80	.88	3.40	1.50	2.00	1.35	.95	1.62	1.60	1.25	1.50	.....
23	.80	.88	3.00	1.60	1.80	1.25	.95	1.60	1.50	2.00	1.40	.....
24	.80	.85	4.40	1.68	1.75	1.25	.98	1.55	1.40	1.90	1.20	.....
25	.80	.85	4.80	2.70	1.60	1.30	1.00	1.50	1.60	1.80	1.20	.....
26	.80	.85	4.70	1.70	1.65	1.25	1.20	1.40	1.60	1.70	1.20	.....
27	.80	.82	4.00	1.70	1.65	1.10	1.20	1.30	1.50	1.75	1.60	.....
28	.80	.82	2.00	1.90	1.55	1.10	1.15	1.20	1.40	1.70	1.60	.....
29	.80	.82	1.70	2.90	1.50	1.15	1.18	1.15	2.00	1.60	1.40	.....
30	.80	.....	1.40	2.30	1.45	1.15	1.20	1.15	1.90	1.55	1.20	.....
31	.80	.....	1.40	.....	1.40	.....	1.15	1.10	.....	1.55	.....	.....

[a] Ice 12 inches—6 solid—6 anchor.

[b] Frozen.

Rating table for Israel River (above South Branch) near Jefferson Highlands, N. H., from September 2, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.8	1.0	1.6	30	2.6	158	3.6	338
.85	1.2	1.7	38	2.7	176	3.7	356
.9	1.6	1.8	46	2.8	194	3.8	374
.95	2.2	1.9	55	2.9	212	3.9	392
1.0	3.0	2.0	67	3.0	230	4.0	410
1.1	5.3	2.1	79	3.1	248	4.2	446
1.2	8.6	2.2	93	3.2	266	4.4	482
1.3	13	2.3	108	3.3	284	4.6	518
1.4	18	2.4	124	3.4	302	4.8	554
1.5	24	2.5	140	3.5	320		

The foregoing table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 1.04 feet and 2.40 feet. The table has been extended beyond these limits. Above gage height 2.50 feet the rating curve is a tangent, the difference being 18 per tenth.

Estimated monthly discharge of Israel River (above South Branch) near Jefferson Highlands, N. H., for 1903 and 1904.

[Drainage area, 8.7 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September 2–30	8.6	4.8	6.09	0.700	0.755
October	29	4.8	9.28	1.07	1.23
November 1–17	17	4.8	8.70	1.00	.632
1904.					
March 14–31	554	18	259	29.77	19.93
April	212	13	39	4.48	5.00
May	266	18	66	7.59	8.75
June	21	2.2	10.1	1.16	1.29
July	21	2.2	6.46	.743	.857
August	36	3.0	14.3	1.64	1.89
September	86	5.3	24.7	2.84	3.17
October	67	10.6	26.4	3.03	3.49
November	30	8.6	17.5	2.01	2.24
December 1–17	8.6	5.3	6.85	.787	.498

NOTE.—Ice conditions November 18, 1903, to March 13, 1904, and December 18–31, 1904.

ISRAEL RIVER (BELOW SOUTH BRANCH) NEAR JEFFERSON HIGHLANDS, N. H.

This station was established September 2, 1903, by N. C. Grover. It is located at a small wooden highway bridge about 2 miles from the railway station at Jefferson Highlands, in the town of Jefferson. The drainage basin at this point is 21.2 square miles. South Branch of Israel River has its mouth above this station and below the station previously described. South Branch drains an area of 10.5 square miles; its headwaters are on the slopes of Mount Jefferson and Mount Dartmouth, at elevations of 3,000 to 5,000 feet. The extreme length from its source to its mouth is about 5 miles. The elevation at its mouth is about 1,350 feet. As all the slopes are steep there is little or no storage of water. The underlying rock is granite, exposed in

the mountain peaks. The basin has been generally "hard cut," as the lumbermen say, but has not been burned.

A standard chain gage is attached to the downstream side of the truss of the bridge; length of chain, 12.99 feet. It is referred to bench marks as follows: (1) Marked point on center cross timber of bridge; elevation, 8.14 feet. (2) Top of bowlder 50 feet north of bridge, 15 feet west of highway; elevation, 5.20 feet. Elevations are above datum of gage. The channel is straight for 100 feet above and 100 feet below the station, and is about 20 feet wide. The bed is rough and rocky, but permanent. The banks are subject to overflow in extreme freshets. At extreme low water the mean velocity observed was 0.79 feet per second. Depths average at low water about 1 foot. Gage is read once daily by E. A. Crawford, of Jefferson Highlands.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Israel River (below South Branch) near Jefferson Highlands, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 2	H. K. Barrows	13.3	1.35	1.13	17.9
September 18	do	12.3	1.21	1.10	14.9
October 9	N. C. Grover	10.4	1.11	1.03	11.5
1904.					
April 16	N. C. Grover	16	2.55	1.43	42
April 18	do	18	2.87	1.49	52
April 30	S. K. Clapp	64	4.75	2.55	304
May 1	do	54	4.29	2.28	232
May 11	do	57	4.80	2.40	273
May 25	do	24	3.33	1.64	80
June 15	do	12	1.25	1.09	15
July 22	do	10.4	.79	.94	8.2
August 10	do	11.5	.82	1.00	9.4
September 24	H. K. Barrows and T. W. Norcross.	18.5	1.99	1.40	36.8
October 13	T. W. Norcross	17	1.63	1.36	28
November 18	do	27	.89	1.98	24

Mean daily gage height, in feet, of Israel River (below South Branch) near Jefferson Highlands, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.60	0.85	0.85	1.40	2.35	1.35	1.10	1.20	1.10	1.60	1.45	1.80
2	1.40	.85	.85	1.35	2.00	1.30	1.10	1.15	1.30	1.60	1.45	1.70
3	1.10	.82	.82	1.35	1.90	1.40	1.45	1.30	1.60	1.60	1.40	1.60
4	1.08	.82	.82	1.35	2.10	1.35	1.40	1.30	1.50	1.60	1.35	1.60
5	1.00	.82	.82	1.30	2.10	1.30	1.30	1.20	1.50	1.50	1.35	1.40
6	[a]1.00	.82	.82	1.30	1.90	1.30	1.25	1.10	1.45	1.50	1.35	1.20
7	.95	[b]1.90	.82	1.70	2.10	1.45	1.20	1.05	1.45	1.60	1.30	1.20
8	.92	2.70	.80	1.60	2.00	1.40	1.15	1.05	1.40	1.60	1.30	1.20
9	.90	3.30	.80	1.60	1.90	1.35	1.10	1.00	1.35	1.55	1.30	1.15
10	.90	3.00	.80	1.50	1.90	1.30	1.05	1.00	1.30	1.50	1.28	1.15
11	.90	2.10	.80	1.50	2.40	1.25	1.00	1.10	1.25	1.50	1.25	1.15
12	.90	1.20	.80	1.50	1.85	1.20	.95	1.10	1.20	1.40	1.25	1.15
13	.88	1.20	.80	1.70	1.75	1.15	1.20	1.30	1.15	1.35	1.22	1.15
14	.88	1.10	2.40	1.70	1.70	1.15	1.10	1.20	1.15	1.30	1.65	1.15
15	.88	1.00	3.50	1.50	2.05	1.12	1.08	1.60	2.22	1.30	1.40	1.15
16	.85	1.00	3.40	1.45	2.10	1.12	1.05	1.50	1.60	1.28	1.20	1.15
17	.85	.90	3.00	1.40	3.25	1.10	1.00	1.40	1.60	1.28	1.60	1.15
18	.85	.90	3.70	1.40	2.05	1.10	.98	1.30	1.35	1.28	1.95	[c]
19	.85	.90	3.70	1.45	2.30	1.05	.98	1.20	1.20	1.25	1.90	.....
20	.85	.90	3.70	1.45	2.35	1.00	.98	1.15	1.70	1.25	1.60	.....
21	.85	.90	4.40	1.50	2.10	.95	.98	1.70	1.60	1.25	1.40	.....
22	.85	.88	4.20	1.50	2.00	1.35	.95	1.60	1.50	2.00	1.20	.....
23	.85	.88	3.70	1.60	1.80	1.30	.95	1.60	1.40	2.00	1.20	.....
24	.85	.88	3.00	1.70	1.70	1.25	.98	1.50	1.40	1.92	1.20	.....
25	.85	.88	4.70	2.70	1.65	1.30	1.00	1.40	1.60	1.85	1.20	.....
26	.85	.85	5.20	1.90	1.65	1.25	1.20	1.30	1.60	1.70	1.30	.....
27	.85	.85	5.00	1.80	1.75	1.15	1.20	1.25	1.50	1.70	1.60	.....
28	.85	.85	4.00	1.90	1.55	1.15	1.10	1.20	1.40	1.60	1.90	.....
29	.85	.85	2.20	2.70	1.50	1.10	1.30	1.15	2.05	1.50	1.90	.....
30	.85	.....	1.70	2.30	1.45	1.10	1.20	1.15	1.90	1.50	1.90	.....
31	.85	.....	1.40	.....	1.40	.....	1.15	1.10	.....	1.48	.....	.....

[a] Ice, 14 inches—8 in solid and 6 in anchor ice. [b] Anchor ice affects gage heights. [c] Frozen.

Rating table for Israel River (below South Branch) near Jefferson Highlands, N. H., from September 2, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.8	2.5	1.35	35	2.4	268	3.5	576
.85	3.7	1.4	40	2.5	296	3.6	604
.9	5.3	1.5	52	2.6	324	3.7	632
.95	7.4	1.6	67	2.7	352	3.8	660
1.0	10	1.7	86	2.8	380	4.0	716
1.05	13	1.8	108	2.9	408	4.2	772
1.1	16	1.9	132	3.0	436	4.4	828
1.15	19	2.0	157	3.1	464	4.6	884
1.2	22	2.1	184	3.2	492	4.8	940
1.25	26	2.2	212	3.3	520	5.0	996
1.3	30	2.3	240	3.4	548	5.2	1,052

The foregoing table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1903 and 1904. It is well defined between gage heights 0.94 foot and 2.60 feet. The table has been extended beyond these limits. Above gage height 2.10 feet the rating curve is a tangent, the difference being 28 per tenth.

Estimated monthly discharge of Israel River (below South Branch) near Jefferson Highlands, N. H., for 1903 and 1904.

[Drainage area, 21.2 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September 2–30	22	7	12.7	0.599	0.646
October	59	10	17.0	.802	.925
November 1–17	30	13	17.7	.835	.528
1904.					
March 14–31	1,052	40	578	27.26	18.25
April	352	30	86.5	4.08	4.55
May	506	40	152	7.17	8.27
June	46	7.4	25.0	1.18	1.32
July	46	7.4	17.4	.821	.946
August	86	10	30.4	1.43	1.65
September	218	16	57.4	2.71	3.02
October	157	26	62.3	2.94	3.39
November	144	22	53.3	2.51	2.80
December 1–17	108	19	35.6	1.68	1.06

NOTE.—Ice conditions November 18, 1903, to March 13, 1904, and December 18 to 31, 1904.

AMMONOOSUC RIVER AT BRETTON WOODS, N. H.

This station was established August 28, 1903, by N. C. Grover. It is located at the steel highway bridge near Mount Pleasant House at Bretton Woods. The drainage area at this point is 34 square miles. The headwaters of the river come from the westerly slopes of Mount Jefferson and Mount Washington and the lesser peaks of the White Mountains lying to the south. The underlying rock is granite, which is exposed at points in the river bed and on the various mountain summits. The slopes and valleys are usually well forested, with a preponderance of evergreen growth. The area was cut in large part for spruce several years ago, but now has a thick forest cover. There is no pondage or artificial storage. The slope of the river is steep.

A standard chain gage is attached to the floor on the downstream side of the bridge; length of chain, 18.86 feet. It is referred to the

following-described bench marks: (1) Marked point on bridge near gage; elevation, 17.36 feet. (2) Northwest corner of east abutment; elevation, 14.46 feet. (3) Top of bowlder 100 feet below bridge, between the river and tracks of Boston and Maine Railroad; elevation, 17.11 feet. Elevations are above datum of gage. Measurements of flow are made from a footbridge located about 300 feet downstream from the gage. The channel is straight for 300 feet above and 200 feet below this bridge, and is about 35 feet wide. The banks are high and not subject to overflow except in extreme freshet. The bed is somewhat rocky, but permanent. Low-water measurements are made by wading about 100 feet above the station, on account of small velocity at the station.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Ammonoosuc River at Bretton Woods, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 28	H. K. Barrows	69.2	0.65	1.65	45
September 2	do	62.0	.50	1.50	31
September 3	do	63.5	.46	1.48	29
September 17	do	45.4	.34	1.26	15
September 17	do	32.0	.49	1.26	16
October 10	N. C. Grover	61.8	.65	1.64	40
1904.					
April 15	N. C. Grover	94	.95	2.00	89
May 2	S. K. Clapp	166	2.81	3.20	467
May 9	do	175	3.62	3.47	634
May 10	do	175	3.58	3.51	627
May 20	do	167	2.99	3.15	499
May 25	do	91	1.35	2.19	123
June 10	do	66	.65	1.60	43
July 21 [a]	do	16	1.12	1.24	18
August 9 [b]	do	17	1.36	1.30	23
August 23	H. K. Barrows	82	.82	1.89	67
August 24 [c]	do	25	1.76	1.67	44
September 25	H. K. Barrows and T. W. Norcross.	94	1.25	2.26	118
October 11	T. W. Norcross	79	.78	1.84	62
November 17	do	62	.46	1.51	28

[a] Measured 400 feet above gage.
[b] Measured 300 feet above gage.
[c] Wading below gage.

Mean daily gage height, in feet, of Ammonoosuc River at Bretton Woods, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.55	.....	.....	1.85	3.78	1.88	1.40	1.40	1.35	2.75	1.85	1.50
2	1.50	.....	.....	1.90	3.20	1.75	1.78	1.38	1.48	2.55	1.80	1.55
3	.....	.....	2.10	1.90	2.90	1.75	2.02	1.58	1.48	2.40	1.80	1.55
4	1.55	.....	.....	1.90	3.30	1.70	1.65	1.50	1.90	2.20	1.80	1.55
5	.....	.....	1.88	1.88	3.45	1.70	1.62	1.38	1.58	2.10	1.80	1.52
6	.....	[a]1.40	.....	1.95	2.95	1.70	1.50	1.40	1.50	2.20	1.78	1.50
7	.....	.....	1.70	2.10	3.10	1.72	1.42	1.38	1.48	2.08	1.80	1.50
8	.....	.....	.....	2.60	3.18	1.78	1.38	1.32	1.45	1.72	1.72	1.50
9	1.50	.....	.....	3.35	2.90	1.68	1.35	1.30	1.42	1.90	1.70	[b]1.45
10	1.50	.....	.....	4.25	3.32	1.60	1.35	1.30	1.40	1.90	1.70	.....
11	1.45	.....	[c]1.75	2.95	3.50	1.55	1.35	1.48	1.38	1.82	1.58	.....
12	1.45	.....	[c]1.75	2.55	2.92	1.50	1.35	1.68	1.35	1.78	1.58	.....
13	1.45	[d]1.35	.....	2.35	2.78	1.50	1.45	1.55	1.40	1.80	1.55	.....
14	1.40	.....	.....	2.05	2.60	1.48	1.38	1.50	1.40	1.80	1.55	.....
15	.....	.....	1.50	2.00	2.92	1.45	1.30	1.75	3.15	1.78	1.55	.....
16	.....	.....	1.50	1.80	3.85	1.42	1.30	1.48	2.20	1.75	1.62	.....
17	1.40	.....	1.55	1.90	4.22	1.40	1.30	1.40	1.80	1.70	1.65	[g]1.40
18	.....	.....	.....	2.00	2.98	1.40	1.30	1.40	1.80	1.70	1.60	.....
19	.....	[e]1.40	1.50	2.10	3.35	1.35	1.28	1.35	2.15	1.68	1.58	.....
20	.....	.....	.....	2.10	3.20	1.35	1.25	1.92	1.82	1.65	1.52	.....
21	.....	.....	1.50	2.00	2.82	1.35	1.25	2.30	2.70	3.55	1.58	.....
22	.....	2.50	1.55	2.00	2.58	2.02	1.25	1.82	2.25	3.05	1.60	.....
23	2.10	2.40	2.15	2.02	2.45	1.65	1.25	1.95	1.85	2.48	1.60	.....
24	2.20	2.32	2.40	2.48	2.32	1.48	1.25	1.70	1.92	2.25	1.55	1.35
25	.....	2.15	3.05	3.25	2.22	1.40	1.25	1.58	2.12	2.20	1.50	.....
26	.....	.....	7.60	2.82	2.18	1.68	1.30	1.52	2.00	2.28	1.52	.....
27	.....	[f]1.50	4.02	3.05	2.25	1.48	1.60	1.50	1.92	2.32	1.62	.....
28	.....	.....	2.32	3.30	2.08	1.45	1.35	1.42	1.82	2.20	1.50	.....
29	1.60	.....	2.00	3.95	1.95	1.40	1.45	1.40	1.90	2.35	1.50	.....
30	.....	.....	2.00	3.75	1.90	1.40	1.42	1.40	2.90	2.00	1.50	.....
31	.....	.....	1.85	.....	1.85	.....	1.35	1.35	.....	1.98	.....	[h]1.30

[a] Ice 0.65 foot thick. [c] Ice 0.5 foot thick. [e] Ice 0.9 foot thick. [g] Ice 0.6 foot thick.
[b] Ice 0.15 foot thick. [d] Ice 0.85 foot thick. [f] Ice 0.4 foot thick. [h] Ice 0.75 foot thick.

NOTE.—Gage heights during frozen season are to surface of water in hole cut in ice under gage. Ice January 1 to March 25, also December 10–31.

Rating table for Ammonoosuc River at Bretton Woods, N. H., from August 28, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.25	15	1.8	58	2.7	238	3.8	820
1.3	18	1.85	63	2.8	277	3.9	880
1.35	21	1.9	68	2.9	318	4.0	940
1.4	24	1.95	74	3.0	365	4.2	1,060
1.45	27	2.0	80	3.1	415	4.4	1,180
1.5	31	2.1	93	3.2	465	4.6	1,300
1.55	35	2.2	108	3.3	520	4.8	1,420
1.6	39	2.3	125	3.4	580	5.0	1,540
1.65	43	2.4	146	3.5	640	5.5	1,840
1.7	48	2.5	172	3.6	700	6.0	2,140
1.75	53	2.6	203	3.7	760		

The foregoing table is applicable only for open-channel conditions. It is based upon 21 discharge measurements made during 1903 and 1904. It is fairly well defined between gage heights 1.25 feet and 3.50 feet. The table has been extended beyond these limits. Above gage height 3.30 feet the rating curve is a tangent, the difference being 60 per tenth.

Estimated monthly discharge of Ammonoosuc River at Bretton Woods, N. H., for 1903 and 1904.

[Drainage area, 34 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September	35	17	23.3	0.685	0.764
October	203	21	42.5	1.25	1.44
November	86	18	34.1	1.00	1.12
December 1–14	96	18	27.0	.794	.413
1904.					
March 26–31	3,100	63	734	21.59	4.82
April	1,090	58	245	7.21	8.04
May	1,072	63	362	10.65	12.28
June	82	21	37.5	1.10	1.23
July	82	15	25.5	.750	.865
August	125	18	35.6	1.05	1.21
September	440	21	80.5	2.37	2.64
October	670	43	123	3.62	4.17
November	63	31	42.5	1.25	1.40
December 1–9	35	27	32.1	.944	.316

ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

This gaging station was established August 29, 1903, by N. C. Grover. It is located about 800 feet above the mouth of the river, which empties into the Ammonoosuc at a point midway between Fabyans and Twin Mountain, and about 2½ miles from either place. The drainage basin at this point has an area of 14 square miles. The headwaters lie on the slopes of a spur of the White Mountains at elevations of 2,500 to 3,000 feet. The length of the river from its headwaters to its mouth is about 7 miles, at which point the elevation is approximately 1,500 feet. All slopes within the basin are steep. There is no pondage or artificial storage of water. The underlying rock is granite, which is exposed in the mountain peaks. About ten or twelve years ago this basin was entirely deforested and burned over. At the present time

there is a thick stand of deciduous growth of poplar and bird cherry, averaging 12 to 15 feet in height, which affords a thick covering during the summer months, but practically no cover during the winter and spring. Within the basin we find the usual conditions of this stage of reforestation after a thorough burning.

A standard chain gage is attached to trees on the bank; length of chain, 13.40 feet. It is referred to bench marks as follows: (1) Top of large bowlder under the gage; elevation, 3.56 feet. (2) Drift bolt driven into the maple tree to which the gage is attached; elevation, 11.32 feet. Elevations are above datum of gage. The lowest observed mean velocity has been 0.40 of a foot per second. Low-water measurements are made by wading. The bed is rough and rocky, but permanent. The banks are high and only subject to overflow in extreme freshets. The gage is read once a day by William Cote, of Twin Mountain.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Zealand River near Twin Mountain, N. H., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 29[a]	H. K. Barrows	29.1	0.45	2.01	13.1
September 3[a]	do	26.6	.40	1.98	10.7
September 18[a]	do	33.5	.68	2.22	22.9
October 10[a]	N. C. Grover	35.5	.76	2.29	27
1904.					
April 15	N. C. Grover	25.3	1.88	2.52	47.5
April 30	S. K. Clapp	79	4.09	3.55	323
May 10	do	56	3.25	3.00	182
May 19	do	80	4.60	3.60	368
May 20	do	54	3.37	3.08	182
May 25	do	21	2.10	2.49	44
June 10	do	10	2.10	2.18	21
July 21	do	6.8	1.12	1.88	7.6
August 9	do	8.4	1.49	1.94	12.5
August 23[a]	H. K. Barrows	40	.95	2.39	38
September 25[a]	do T. W. Norcross	46	1.48	2.65	68
October 12	do	33	.69	2.21	23

[a] Wading at different sections.

Mean daily gage height, in feet, of Zealand River near Twin Mountain, N. H., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	(a)	2.40	3.50	2.40	1.84	1.84	1.74	4.34	3.25	2.35
2	.....	2.45	3.40	2.40	1.84	1.84	1.94	4.14	3.35	2.45
3	.....	2.30	3.30	2.30	1.74	1.94	1.94	3.44	2.85	2.45
4	.....	2.30	3.10	2.20	1.74	1.94	1.84	2.84	2.75	2.75
5	.....	2.40	3.00	2.20	1.74	2.04	1.84	3.04	2.75	2.75
6	.....	2.40	3.00	2.10	1.74	1.84	2.04	2.84	2.65	2.55
7	.....	2.50	2.90	2.10	1.74	1.84	2.04	2.84	2.85	(a)
8	.....	2.70	2.70	2.10	1.84	1.94	1.94	2.74	2.85	.....
9	.....	2.70	2.60	2.00	1.84	1.84	1.94	2.44	2.65	.....
10	.....	3.00	2.60	2.10	1.74	1.84	1.84	2.64	2.75	.....
11	.....	3.20	2.70	2.10	1.74	1.84	1.84	2.84	2.75	.....
12	.....	3.00	2.70	2.10	1.94	1.84	1.94	2.84	2.65	.....
13	.....	2.90	2.60	2.05	1.94	1.74	1.94	2.64	2.85	.....
14	.....	2.80	2.70	2.00	1.84	1.74	4.34	2.34	2.75	.....
15	.....	2.70	2.50	2.00	1.84	1.84	3.24	2.24	2.85	.....
16	.....	2.60	2.50	2.00	1.84	1.84	2.84	2.24	2.85	.....
17	.....	2.45	2.80	1.95	1.84	1.74	2.34	2.94	2.65	.....
18	.....	2.40	3.00	2.00	1.74	1.94	2.24	2.84	2.65	.....
19	.....	2.40	2.90	2.00	1.84	1.94	1.84	2.74	2.65	.....
20	.....	2.40	2.70	2.00	1.84	1.84	2.24	1.94	2.85	.....
21	.....	2.30	2.70	2.00	1.84	2.84	2.84	3.84	2.95	.....
22	.....	2.30	2.50	1.90	1.94	2.24	2.64	4.34	2.95	.....
23	.....	2.40	2.50	2.10	1.94	2.44	2.34	3.84	2.85	.....
24	.....	2.50	2.40	2.10	1.84	2.24	2.34	3.74	2.85	.....
25	.....	2.60	2.40	2.00	1.74	1.94	2.64	3.74	2.85	.....
26	.....	2.60	2.40	1.90	1.84	1.84	3.84	3.34	2.65	.....
27	3.00	2.70	2.40	1.90	2.34	1.84	2.84	3.24	2.75	.....
28	2.70	3.00	2.50	1.90	2.14	1.84	2.84	2.84	2.75	.....
29	2.50	4.00	2.40	1.90	1.94	1.94	2.64	2.84	2.55	.....
30	2.50	3.70	2.40	1.90	1.94	1.94	2.24	3.24	2.35	.....
31	2.40	.....	2.30	.....	1.84	1.84	.....	3.24	.....	.....

a River frozen January 1 to March 26 and December 7–31.

Rating table for Zealand River near Twin Mountain, N. H., from August 29, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.75	4	2.2	22	2.7	82	3.6	368
1.8	5	2.25	25	2.8	109	3.7	402
1.85	6	2.3	28	2.9	139	3.8	436
1.9	8	2.35	31	3.0	170	3.9	470
1.95	10	2.4	35	3.1	202	4.0	504
2.0	12	2.45	40	3.2	234	4.1	538
2.05	14	2.5	45	3.3	266	4.2	572
2.1	16	2.55	52	3.4	300	4.3	606
2.15	19	2.6	61	3.5	334		

The above table is applicable only for open-channel conditions. It is based upon 16 discharge measurements made during 1903 and 1904. It is well defined between gage heights 1.88 feet and 3.60 feet. The table has been extended beyond these limits. Above gage height 3.30 feet the rating curve is a tangent, the difference being 34 per tenth.

Estimated monthly discharge of Zealand River near Twin Mountain, N. H., for 1903 and 1904.

[Drainage area, 14 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
September	22	8	10.5	0.750	0.837
October	35	8	17.8	1.27	1.46
November	28	16	23.6	1.69	1.89
December 1–28	45	16	29.0	2.07	2.16
1904.					
March 27–31	170	35	75.4	5.39	1.00
April	504	28	97.9	6.99	7.80
May	334	28	101	7.21	8.31
June	35	8	15.0	1.07	1.19
July	30	4	7.35	.525	.605
August	121	4	13.0	.929	1.07
September	620	4	76.4	5.46	6.09
October	620	10	213	15.21	17.54
November	283	31	119	8.50	9.48
December 1–6	95	31	58.8	4.20	.937

LITTLE RIVER NEAR TWIN MOUNTAIN, N. H.

This station was established January 21, 1904, by F. E. Pressey. It is located at the rough wooden highway bridge about 2 miles southwest of Twin Mountain, N. H., and about 2 miles above the entrance of this river into Ammonoosuc River. The drainage area at this point is about 11 square miles. This drainage basin is adjacent to that of Zealand River previously described, and practically all forest cover has been removed from it. The slopes are steep and there is no pondage or artificial storage. This station was established in order to obtain comparative data as to the time and duration of freshets. A few discharge measurements have been made during 1904, but it is not intended to make any estimate of discharge for this point, but merely a record of gage heights.

A standard chain gage is attached to the floor on the downstream side of the bridge above referred to; length of chain, 12.92 feet. It is referred to bench marks as follows: (1) A marked point on the floor of the bridge near the zero of the gage scale; elevation, 11.42 feet above gage datum; (2) a cross on a bowlder on right bank, about 32 feet from end of gage box; elevation, 9.05 feet above gage datum.

The channel is straight for about 50 feet above and 800 feet below the station. The banks are rocky, low, and clean, and liable to overflow. The bed of the stream is of large bowlders and extremely rough. The current is swift at all stages. The gage is read twice daily by Edward Lynch.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Little River near Twin Mountain, N. H., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 23 [a]	H. K. Barrows	26	2.04	5.58	53
September 25 [a]	H. K. Barrows and T. W. Norcross.	32	2.06	5.75	66
October 12 [b]	T. W. Norcross	28	.94	5.30	26

[a] Wading 1 mile below gage. [b] Wading.

Mean daily gage height, in feet, of Little River near Twin Mountain, N. H., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.60	4.70	4.90	6.15	5.20	4.90	5.20	5.00	6.05	5.20	5.10
2	.....	4.65	4.60	4.90	5.70	5.10	5.10	5.05	5.00	5.75	5.20	5.10
3	.....	4.60	5.00	4.90	5.85	5.05	5.35	5.15	5.10	5.65	5.20	5.10
4	.....	4.60	5.85	4.95	6.00	5.10	5.00	5.10	5.30	5.55	5.20	5.10
5	.....	4.65	5.05	5.05	6.10	5.00	5.00	5.10	5.15	5.45	5.20	5.10
6	.....	4.60	4.70	5.05	6.10	5.10	5.00	5.10	5.10	5.55	5.15	5.10
7	.....	5.10	4.65	5.45	6.05	5.00	4.95	5.00	5.10	5.45	5.10	5.10
8	.....	6.05	7.20	5.65	6.00	5.00	4.90	5.00	5.10	5.40	5.10	5.10
9	.....	4.80	5.00	6.15	6.00	5.00	4.90	5.00	5.10	5.35	5.10	5.10
10	.....	4.70	4.95	6.20	5.85	5.00	4.90	5.00	5.00	5.30	[a] 5.25	5.10
11	.....	4.60	4.80	5.80	6.20	5.00	4.90	5.10	5.00	5.30	5.25	5.10
12	.....	4.60	4.80	5.50	5.90	4.90	4.90	5.15	5.00	5.30	5.20	5.10
13	.....	4.60	4.70	5.45	5.85	4.90	5.25	5.10	5.00	5.30	5.10	.....
14	.....	4.60	4.70	5.40	5.85	4.95	5.05	5.00	5.00	5.30	5.10	.....
15	.....	4.60	4.70	5.35	5.95	5.00	5.00	5.20	6.60	5.20	5.10	.....
16	.....	4.60	4.70	5.30	6.50	5.00	5.00	5.10	5.85	5.20	5.10	.....
17	.....	4.60	4.70	5.35	6.25	5.00	4.90	5.10	5.50	5.20	5.10	.....
18	.....	4.60	4.70	5.15	6.05	4.95	4.90	5.10	5.35	5.20	5.40	.....
19	.....	4.60	4.70	5.00	6.20	4.90	4.90	5.00	5.75	5.20	5.45	.....
20	.....	4.60	4.60	5.40	6.15	4.90	4.90	5.90	5.40	5.20	5.15	.....
21	4.65	4.60	4.60	5.15	5.90	4.90	4.80	5.85	5.95	6.20	5.25	.....
22	4.65	6.20	4.65	5.40	5.80	5.05	4.80	5.55	5.55	6.10	5.10	.....
23	5.05	5.00	6.85	5.15	5.70	5.00	4.80	5.75	5.45	5.90	5.10	.....
24	4.85	4.65	5.50	5.35	5.65	5.00	4.80	5.35	5.50	5.55	5.10	.....
25	4.70	4.60	5.70	5.95	5.60	4.90	4.90	5.30	5.75	5.50	5.10	.....
26	4.70	4.60	6.45	5.75	5.60	4.90	4.90	5.25	5.55	5.65	5.10	.....
27	4.70	4.70	5.40	5.55	5.55	4.90	5.10	5.15	5.45	5.55	5.20	.....
28	4.70	4.70	5.25	5.55	5.45	4.90	5.10	5.10	5.40	5.35	5.10	.....
29	4.65	4.70	5.15	6.00	5.30	4.90	5.45	5.10	5.45	5.30	5.40	.....
30	4.60	.....	5.20	6.10	5.25	4.90	5.15	5.05	6.05	5.25	5.10	.....
31	4.60	.....	5.10	.....	5.20	.....	5.00	5.00	.....	5.20	.....	.....

[a] After November 10 gage heights probably affected by anchor ice.

WHITE RIVER AT SHARON, VT.

This station was established June 30, 1903, by H. K. Barrows. It is located at the steel highway bridge near the railway station at Sharon. The drainage area at this point is 680 square miles. A standard chain gage is attached to the upstream truss of the bridge; length of chain, 27.58 feet. It is referred to bench marks as follows: (1) Marked point on post near gage; elevation, 29.96 feet; (2) on south side of east abutment; elevation, 24.59 feet. Elevations are above datum of gage. This station is located above and within the backwater from a crib dam, which is not used for power purposes, all water, except leakage, passing over the crest of the dam. The channel is straight for 500 feet above and 500 feet below the station. It is about 170 feet wide at ordinary stages. The current is sluggish at low water. Measurements at low stages are made by wading at a point about one-half mile above the bridge, where the bed is of gravel and the current swift. The gage is read twice daily by J. M. O'Connor, of Sharon.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of White River at Sharon, Vt., in 1903 and 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1903.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
June 30	H. K. Barrows	1,580	0.28	5.03	440
August 1 [a]	do	170	2.32	4.87	395
September 10 [a]	do	140	1.93	4.79	270
1904.					
April 7	N. C. Grover	1,840	1.69	6.63	3,110
May 3	S. K. Clapp	1,820	1.54	6.49	2,810
May 27	do	1,710	.69	5.58	1,180
July 7 [a]	do	62	2.37	4.51	147
July 7 [a]	do	52	2.46	4.49	128
July 27 [a]	do	86	3.67	4.70	316
September 26	T. W. Norcross	1,690	.75	5.59	1,260

[a] By wading.

Mean daily gage height, in feet, of White River at Sharon, Vt., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.20	7.20	5.20	4.75	4.50	4.50	5.90	6.15	.....
2	.....	6.15	6.80	5.20	4.80	4.50	4.40	5.90	6.05	.....
3	.....	.....	6.50	5.15	4.80	4.60	4.40	5.95	5.90	.....
4	.....	.....	6.40	5.10	4.70	4.60	4.45	5.85	5.75	.....
5	.....	.....	6.20	5.15	4.70	4.65	4.70	5.75	5.65	.....
6	.....	.....	6.00	5.20	4.60	4.65	4.80	5.65	5.75	.....
7	.....	6.80	5.80	5.10	4.55	4.70	4.90	5.55	5.85	.....
8	.....	6.80	5.70	5.10	4.50	4.70	4.95	5.45	5.90	.....
9	.....	7.70	5.65	5.05	4.50	(*a*)	4.95	5.35	5.85	.....
10	.....	7.60	5.80	5.00	4.60	.....	4.90	5.25	5.75	.....
11	.....	7.20	5.80	5.00	4.60	.....	4.80	5.15	5.65	.....
12	.....	6.85	5.65	4.90	4.60	.....	4.80	5.05	5.55	.....
13	.....	6.70	5.70	4.90	4.70	.....	4.70	4.95	(*b*)	.....
14	.....	6.30	5.65	4.90	4.70	.....	4.70	4.85	.....	.....
15	.....	6.10	5.70	4.80	4.70	.....	4.60	4.80	.....	.....
16	.....	6.10	5.85	4.80	4.60	.....	5.90	4.85	.....	.....
17	.....	5.90	5.60	4.75	4.60	.....	5.90	4.95	.....	.....
18	.....	6.00	5.70	4.70	4.50	.....	5.85	5.05	.....	.....
19	.....	6.05	6.30	4.80	4.50	4.50	5.75	5.15	.....	.....
20	.....	6.00	6.20	4.80	4.40	4.60	5.65	5.25	.....	.....
21	.....	5.90	6.05	4.75	4.35	4.70	5.55	5.50	.....	.....
22	.....	6.00	6.05	4.75	4.30	4.80	5.45	5.80	.....	.....
23	.....	6.00	5.75	4.55	4.45	4.80	5.35	6.35	.....	.....
24	.....	6.10	5.75	4.40	4.50	4.80	5.25	6.75	.....	.....
25	.....	6.70	5.75	4.50	4.60	4.70	5.15	6.80	.....	.....
26	.....	6.75	5.70	4.50	4.70	4.70	5.40	6.70	.....	.....
27	8.05	6.40	5.60	4.40	4.70	4.60	5.60	6.65	.....	.....
28	6.80	7.30	5.45	4.45	4.70	4.60	5.60	6.55	.....	.....
29	6.35	8.10	5.40	4.55	4.60	4.60	5.65	6.45	.....	.....
30	6.25	7.85	5.30	4.60	4.60	4.60	5.80	6.35	.....	.....
31	6.30	.....	5.30	.....	4.50	4.50	.....	6.25	.....	.....

a No gage heights taken from August 9–18, inclusive, on account of repairs to dam.
b Frozen over November 13. No records during frozen season.

Rating table for White River at Sharon, Vt., from July 1, 1903, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
4.5	140	4.9	418	5.6	1,228	6.4	2,645
4.55	169	4.95	464	5.7	1,370	6.5	2,850
4.6	199	5.0	513	5.8	1,525	6.6	3,055
4.65	230	5.1	619	5.9	1,695	6.7	3,265
4.7	263	5.2	732	6.0	1,875	6.8	3,475
4.75	298	5.3	849	6.1	2,060	6.9	3,685
4.8	335	5.4	970	6.2	2,250	7.0	3,900
4.85	375	5.5	1,095	6.3	2,445		

The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1903 and 1904. It is well defined between gage heights 4.50 feet and 6.70 feet. The table has been extended beyond these limits. Below 4.50 and above 7.0 the discharge can only be considered an approximation.

Estimated monthly discharge of White River at Sharon, Vt., for 1903 and 1904.

[Drainage area, 680 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
July	1,695	263	483	0.710	0.819
August	1,967	298	510	.750	.865
September	513	230	314	.462	.516
October	921	250	471	.693	.799
November 1–21	641	320	416	.612	.478
1904.					
March 27–31	6,270	2,348	3,417	5.02	0.934
April 1–2; 7–30	6,385	1,695	3,105	4.57	4.42
May	4,335	849	1,725	2.54	2.93
June	732	88	395	.581	.648
July	335	50	200	.294	.339
August [a]	335	140	217	.319	.368
September	1,695	88	758	1.11	1.24
October	3,475	335	1,540	2.26	2.61
November 1–12	2,155	1,160	1,569	2.31	1.03

[a] August 9–18 interpolated.

ASHUELOT RIVER AT WINCHESTER, N. H.

This station was established July 10, 1903, by H. K. Barrows. It is located at the steel highway bridge in the village of Winchester. The drainage area at this point is 385 square miles. A standard chain gage is attached to the bottom chord of the upstream truss; length of chain, 25.24 feet. It is referred to bench marks as follows: (1) East end of left abutment; elevation, 20.79 feet. (2) Top of watering trough in the village square; elevation, 25.18 feet. Elevations are above datum of gage. The channel is straight for 300 feet above and 500 feet below the station, and is about 70 feet wide at ordinary stages, broken by one pier. The current is sluggish at low stages of the river, the lowest observed mean velocity having been 0.39 foot per second at gage height 4.02.

The observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Ashuelot River at Winchester, N. H., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 7	N. C. Grover and S. K. Clapp	734	2.35	8.57	1,720
May 16	S. K. Clapp	490	1.65	5.98	810
May 31	do	425	1.21	5.32	515
June 17	do	294	.62	4.00	181
July 8	do	297	.66	4.05	196
July 27	do	270	.45	3.62	121
August 11	do	297	.44	4.05	131

Mean daily gage height, in feet, of Ashuelot River at Winchester, N. H., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.9	11.8	5.2	5.0	3.4	3.7	5.0	4.2	4.0
2	9.8	9.8	4.9	5.6	3.8	3.6	4.9	4.2	4.2
3	10.1	8.4	4.9	5.2	3.8	3.6	4.8	4.2	4.0
4	9.0	7.4	4.9	4.7	3.6	3.5	4.4	4.2	.....
5	8.2	7.0	4.6	4.6	3.9	3.4	4.4	4.2	.....
6	8.0	6.6	4.6	4.4	3.8	3.4	4.4	4.2	.....
7	8.4	6.2	5.0	4.3	3.5	3.6	4.4	4.2	.....
8	9.4	5.6	5.3	4.3	3.4	3.6	4.5	4.0	.....
9	9.9	5.7	5.3	4.4	3.5	3.6	4.5	4.1	.....
10	11.8	6.2	5.0	4.2	3.5	3.6	4.2	4.0	.....
11	12.5	6.8	4.8	4.4	4.1	4.1	4.2	3.9	.....
12	10.7	7.2	4.6	4.2	4.2	3.9	4.2	4.0	.....
13	9.4	6.7	4.5	3.8	4.2	4.1	4.1	4.1	.....
14	8.6	6.0	4.5	3.7	3.9	4.1	4.4	4.1	.....
15	7.8	5.6	4.3	3.6	3.6	5.6	4.4	4.1	.....
16	7.4	5.7	4.3	3.6	3.8	7.1	4.2	4.3	.....
17	7.2	6.0	4.2	3.4	3.8	5.4	4.1	4.2	.....
18	7.7	5.7	4.2	3.4	3.8	4.8	4.0	4.3	.....
19	7.6	5.9	4.2	3.6	3.7	4.2	4.2	4.2	.....
20	7.3	6.9	3.7	3.6	3.8	4.4	4.2	4.0	.....
21	7.0	7.2	4.1	3.5	4.4	4.5	4.1	4.1	.....
22	7.0	6.5	4.1	3.6	5.0	4.4	5.0	4.2	.....
23	6.9	6.2	4.2	3.5	4.8	4.5	5.4	4.3	.....
24	6.5	5.8	4.6	3.4	4.2	4.5	5.4	4.4	.....
25	6.6	5.5	4.2	3.4	4.0	4.5	4.8	4.5	.....
26	6.9	5.8	4.1	3.4	3.9	4.1	4.6	4.4	.....
27	6.9	5.7	4.0	3.7	3.9	4.2	4.6	4.4	.....
28	8.5	5.4	3.9	3.4	3.9	4.2	4.5	4.2	.....
29	11.2	5.1	3.9	3.5	3.6	4.2	4.2	4.2	.....
30	12.5	4.9	4.2	3.5	3.8	4.6	4.2	4.0	.....
31	.....	5.2	.....	3.4	3.7	.....	4.4	.....	.....

NOTE.—Gage not read during frozen season.

DEERFIELD RIVER AT DEERFIELD, MASS.

Deerfield River is one of the largest tributaries of Connecticut River, having a total drainage area of 667 square miles. It rises in southern Vermont, and joins Connecticut River about 1 mile southeast of Greenfield. It is important as a water-power stream, but is not well supplied with storage reservoirs, consequently subject to considerable fluctuations of flow.

A gaging station was established March 29, 1904, by N. C. Grover, at the suspension highway bridge, about one-fourth mile from West Deerfield railway station, and about 6 or 7 miles above the mouth of the river. The drainage area at this point is 550 square miles. About 2 miles below the station is an old dam, partially destroyed, and back water from Connecticut River reaches the site of this old dam. A standard chain gage is attached to the downstream side of the bridge; length of chain, 32.21 feet. The gage is referred to bench marks as follows: (1) Point on bottom chord of bridge, near the zero of gage scale; elevation, 31.49 feet. (2) On top of downstream foundation of bridge pier on the right bank; elevation, 28.92 feet. (3) Copper bolt set in ledge on left bank, 20 feet upstream from abutment; elevation, 21.04 feet. All elevations are referred to gage datum.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached, the initial point for soundings being the left end of the top chord of the stiffening truss at the downstream side. The channel is straight for about 600 feet above and 1,000 feet below the station. The banks are high, rocky, and clean, and not liable to overflow. The bed is clean and permanent, the left half being of gravel and the right half of sand. There is but one channel at all stages. The current is medium, becoming sluggish at low water, when measurements are made by wading at a point about one-half mile downstream. The gage is read twice daily by Mrs. Carrie I. Wellman.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Deerfield River at Deerfield, Mass., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
March 30	N. C. Grover	2,180	1.10	3.61	2,390
April 11	S. K. Clapp	2,500	2.32	4.68	5,810
April 25	do	2,480	2.02	4.58	5,010
May 18	do	2,270	1.50	3.75	3,420
June 1	do	1,920	.31	2.81	590
June 20 [a]	do	449	1.89	2.70	850
July 28 [a]	do	259	1.98	2.60	513
August 17 [a]	do	168	1.64	2.45	275
September 17	T. W. Norcross	2,015	.63	3.21	1,260
October 27	do	2,010	.49	2.90	981
November 30 [a b]	do	288	1.84	2.60	531

[a] By wading at different sections.
[b] River frozen at gage 0.1 foot thick. Gage height is to bottom of ice.

Mean daily gage height, in feet, of Deerfield River at Deerfield, Mass., for 1904.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.05	4.60	2.80	2.70	2.40	2.30	3.35	2.60	.....
2	.....	5.10	4.40	2.70	2.90	2.40	2.20	2.95	2.65	.....
3	.....	4.15	4.00	2.75	2.65	2.45	2.40	2.75	2.50	.....
4	.....	3.70	3.90	2.85	2.65	2.50	2.40	2.70	2.50	.....
5	.....	3.70	3.75	2.90	2.60	2.40	2.40	2.60	2.50	.....
6	.....	4.00	3.50	2.80	2.55	2.40	2.40	2.60	2.40	.....
7	.....	4.20	3.45	3.05	2.55	2.35	2.30	2.55	2.50	.....
8	.....	4.30	3.35	3.50	2.60	2.30	2.30	2.50	2.40	.....
9	.....	5.45	3.10	6.05	2.55	2.40	2.40	2.50	2.30	.....
10	.....	5.20	3.40	4.05	2.50	2.50	2.50	2.45	2.30	.....
11	.....	4.70	3.50	3.50	2.50	2.80	2.60	2.80	2.30	.....
12	.....	4.20	3.30	3.05	2.50	2.60	2.45	2.80	2.30	.....
13	.....	3.90	3.20	2.90	2.50	2.55	2.35	2.75	2.30	.....
14	.....	3.55	3.15	2.90	2.50	2.50	2.30	2.85	2.40	.....
15	.....	3.40	3.00	2.80	2.45	2.60	5.60	2.80	2.45	.....
16	.....	3.50	3.90	2.80	2.45	2.50	3.65	2.70	2.40	.....
17	.....	3.25	4.00	2.70	2.45	2.40	3.10	2.65	2.30	.....
18	.....	3.40	3.90	2.70	2.55	2.50	2.95	2.60	2.30	.....
19	.....	3.70	4.65	2.70	2.50	2.50	2.85	2.55	2.40	.....
20	.....	3.30	4.50	2.65	2.55	2.65	2.65	2.50	2.45	.....
21	.....	3.25	3.70	2.60	2.40	3.95	2.50	4.20	2.60	.....
22	.....	3.25	3.50	2.55	2.40	3.00	2.45	4.80	2.80	.....
23	.....	3.50	3.30	2.55	2.40	2.65	2.45	3.65	2.70	.....
24	.....	3.65	3.20	2.60	2.40	2.55	2.55	3.00	2.60	.....
25	.....	4.40	3.15	2.60	2.45	2.50	2.60	2.80	2.50	.....
26	.....	4.40	3.20	2.80	2.55	2.50	2.60	2.80	2.40	.....
27	.....	4.50	3.20	2.55	2.60	2.45	2.60	2.80	2.30	.....
28	.....	5.85	3.00	2.50	2.60	2.40	2.60	2.70	2.35	.....
29	3.85	5.95	2.90	2.35	2.50	2.40	2.80	2.70	2.40	.....
30	3.65	4.90	2.70	2.60	2.40	2.30	4.30	2.60	[a] 2.30	.....
31	3.65	.....	2.85	.....	2.40	2.30	.....	2.50	.....	.....

[a] River entirely frozen on November 30.

WARE RIVER NEAR WARE, MASS.

Ware River is formed in the town of Barre by the junction of several small streams. The surrounding country is hilly and largely cleared. The total drainage area is about 223 square miles, and is a tributary to Chicopee River, which drains a large section of central Massachusetts, and is the largest tributary of the Connecticut in respect to drainage area, its basin containing 730 square miles. It is formed at Three Rivers by the union in that vicinity of the Ware, Swift, and Quabog rivers; thence runs westerly about 15 miles, joining the Connecticut at Chicopee. Chicopee River and its tributaries are quite important water-power streams, and expensive developments have been made upon them.

A gaging station was established on September 15, 1904, by H. K. Barrows, at the steel highway bridge—span of about 85 feet—about 2 miles above the village of Ware. The drainage area at this point is 162 square miles. A standard chain gage is fastened to the floor timbers of the bridge on the upstream side toward the right bank; length of chain, 14.10 feet. It is referred to bench marks as follows: (1) On post of bridge railing at east end of gage; elevation, 17.01 feet. (2) On west abutment on downstream side about 18 inches from the corner near the truss; elevation, 11.48 feet. (3) Southeast corner of abutment of railroad culvert, about 250 feet north of the Boston and Maine Railroad crossing, west of gage; elevation, 18.63 feet. All bench marks are referred to gage datum.

Discharge measurements are made usually from the upstream side of the bridge to which the gage is attached. The initial point for soundings is left abutment at the top; the channel is curved for some little distance above the bridge and straight below the bridge. The bed of the stream is rocky with some gravel. The banks are medium in height and overflow at very high water, when there will be two or more channels. The current is swift at high stages and well sustained at low stages. The gage is read twice daily by M. N. Richards, a farmer. The expense of a gage reader at this point is borne equally by the Otis Company and the George H. Gilbert Manufacturing Company, both of Ware.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Ware River near Ware, Mass., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
September 15	H. K. Barrows	250	3.45	4.44	863
September 20	T. W. Norcross	106	1.59	2.59	169
October 5	do	95	1.75	2.63	166
October 19	do	106	1.93	2.70	205
October 29	do	113	1.71	2.80	193
November 14	do	89	1.49	2.46	133

Mean daily gage height, in feet, of Ware River near Ware, Mass., for 1904.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	2.75	2.40	2.60	17	3.50	2.40	2.70	.....
2	.....	2.50	2.75	2.60	18	2.75	2.35	2.50	.....
3	.....	2.90	2.60	2.60	19	2.80	2.70	2.30	.....
4	.....	2.85	2.65	2.10	20	2.55	2.50	2.00	.....
5	.....	2.70	2.60	2.75	21	2.60	2.80	2.90	.....
6	.....	2.70	2.15	2.70	22	2.85	2.90	2.80	.....
7	.....	2.60	2.60	2.70	23	2.70	2.70	2.75	.....
8	.....	2.30	2.70	2.50	24	2.60	3.00	2.50	.....
9	.....	2.15	2.75	2.45	25	2.30	2.75	2.70	.....
10	.....	2.55	2.75	(a)	26	2.55	2.90	2.40	.....
11	.....	2.80	2.65	.....	27	2.90	2.80	2.50	.....
12	.....	2.60	2.10	.....	28	2.50	2.70	3.20	.....
13	.....	2.65	2.15	.....	29	2.40	2.50	2.90	.....
14	.....	2.80	2.65	.....	30	2.80	2.40	2.70	.....
15	4.35	2.60	2.60	.....	31	.....	.....	2.45	.....
16	4.40	2.40	2.70	.....					

a River frozen over December 10–31.

WARE RIVER AT GILBERTVILLE, MASS.

Records of flow of Ware River have been kept at the lower mill through the courtesy and assistance of the George H. Gilbert Manufacturing Company, at Gilbertville, since September 22, 1904. The drainage area at this point is 160 square miles. The lower dam is 101.5 feet long with a fairly even crest. The greater part of the time, however, all of the water at this point is used through the wheels, and the record is kept largely by means of the record of wheel openings. These wheels have been rated at Holyoke, and, in addition to this, current-meter gagings are made from time to time as a check on the flow. The average head on wheels is about 19.5 feet. Records of flow at this point during 1904 are withheld, awaiting confirmation of data.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

QUABOG RIVER AT WEST WARREN, MASS.

Quabog River is some 25 miles in length with a drainage area of 213 square miles. It is an especially valuable stream as regards water power, on account of its well sustained flow and absence of effect from freshets. There is still a large amount of power below West Warren which is not developed.

A station for securing a record of flow of Quabog River has been maintained by the United States Geological Survey at West Warren at the dam of J. T. F. MacDonnell, of Holyoke, since October 22, 1904. The drainage area at this point is 144 square miles. The dam is timber crib, 102.7 feet long between vertical abutments, and affords a fall of about 13 feet. This dam is leased by the Composite Leather Company, but no power is used at the present time; so that the whole flow is over the dam.

A plain staff gage is placed near the canal head-gates at the dam, on the left side. Elevation 50 of this gage corresponds to the level of the crest of the dam. This gage is read once a day by Amory Crossman. Records of flow at this point during 1904 have been withheld, awaiting confirmation of data.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

SWIFT RIVER AT WEST WARE, MASS.

Swift River is some 30 miles long and drains a total area of 218 square miles. It drains a hilly country very similar to that of Ware River, but perhaps more thickly wooded. There is enough storage on this river to make the flow well sustained during the dry period.

Records of flow of Swift River have been kept at the mill of the West Ware Paper Company, through the courtesy of Mr. Dwight Holland, manager, since October 21, 1904. The drainage area at this point is 188 square miles. The dam at West Ware is timber crib; has a total length of 150 feet between vertical abutments, with a fairly good crest. A considerable portion of the time all of the water is used at this point through the wheels, and record is kept largely by means of them. One of the wheels has been rated at Holyoke, and additional current-meter measurements are made to serve as a check on the computations. The average head on the wheels is about 11 feet. Records of flow at this point during 1904 are withheld awaiting confirmation of data.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

WESTFIELD RIVER AT RUSSELL, MASS.

The main branch of Westfield River rises in the northeasterly part of Berkshire County, entering Connecticut River at Springfield, with a total length of about 55 miles. Its principal tributaries are the West Branch and Middle Branch, respectively; length of the West Branch from the mouth being 22 miles and that of the Middle Branch 24 miles. The country in this drainage basin is very hilly and even mountainous at its headwaters. Slopes are steep and rocky. There is little storage, consequently rapid fluctuations in the flow.

This station was established April 1, 1904, by N. C. Grover. It is located at the steel highway bridge of two spans, which are about 250 feet long, near the railway station at Russell, Mass. The drainage area at this point is 331 square miles. A standard chain gage is attached to the upstream side of the bridge near the center of the left span; length of chain, 23.98 feet. The gage is referred to bench marks as follows: (1) Top of plank floor near the zero of gage scale; elevation, 22.89 feet. (2) Upstream inner corner of left abutment near post; elevation, 22.31 feet. (3) Upstream inner corner of right abutment near post; elevation, 24.76 feet. All elevations are referred to gage datum.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the face of left abutment, downstream side at the top. The channel is straight for 1,000 feet above and below the station. The bed of the stream is of gravel and small bowlders, very rough but permanent. Both banks are high, rocky, and clean, and not subject to overflow. There are two channels at all stages; current is swift at all times. The gage is read twice daily by B. A. Silliman, station agent at Russell.

Observations at this station during 1904 have been made under the direction of H. K. Barrows, district hydrographer.

Discharge measurements of Westfield River at Russell, Mass., in 1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Square feet.	*Ft. per sec.*	*Feet.*	*Second-feet.*
April 2	N. C. Grover and S. K. Clapp.	700	7.13	3.37	4,990
April 27	S. K. Clapp	323	4.13	1.72	1,330
June 3	do	210	2.53	1.10	531
June 22	do	165	2.14	.98	353
July 29[a]	do	130	2.88	.85	374
July 30	do	132	1.59	.90	210
August 18	do	134	1.67	.90	224
September 16	H. K. Barrows and T. W. Norcross.	348	2.96	1.95	1,030
October 4	T. W. Norcross	167	1.49	.99	249
October 26	do	226	2.39	1.30	540
November 29[b]	do	161	1.21	.99	196

[a] Wading 1¼ miles below bridge. [b] Poor conditions due to anchor ice.

Mean daily gage height, in feet, of Westfield River at Russell, Mass., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.80	2.15	1.10	2.20	0.80	0.90	1.30	1.10	1.10
2	3.65	1.90	1.10	1.75	.90	.90	1.10	1.05	1.10
3	2.75	1.80	1.10	1.40	.85	.85	1.00	1.05	1.00
4	2.20	1.70	1.05	1.20	.80	.80	.95	1.10	1.05
5	2.20	1.60	1.20	1.10	.80	.80	.90	1.10	1.05
6	2.45	1.55	1.60	1.40	.80	.80	.90	1.10	1.00
7	2.65	1.50	3.60	1.15	.70	.70	.90	1.05	.....
8	2.70	1.40	2.15	1.00	.70	.80	.85	1.00	.....
9	3.20	1.50	4.15	.95	.80	.80	.80	1.00	.....
10	3.30	1.70	2.45	.90	.80	.80	.85	1.00	.....
11	2.65	1.60	1.90	.95	2.55	.85	.90	1.00	.....
12	2.40	1.45	1.65	.95	1.40	.80	1.00	1.00	.....
13	2.20	1.30	1.45	1.05	1.10	.80	1.15	.95	.....
14	1.95	1.25	1.35	1.05	1.00	.80	1.20	1.00	.....
15	1.80	1.20	1.30	.95	1.10	4.20	1.10	1.05	.....
16	1.80	1.90	1.20	.90	1.00	2.00	1.00	1.10	.....
17	1.75	1.65	1.15	.90	.90	1.40	.95	1.05	.....
18	1.90	1.50	1.10	1.20	.90	1.20	.90	.95	.....
19	2.00	1.85	1.05	1.05	.85	1.10	.90	1.00	.....
20	1.80	2.30	1.05	.90	1.20	1.05	.90	1.10	.....
21	1.70	1.75	1.00	.90	2.00	1.00	3.40	1.25	.....
22	1.65	1.45	1.00	.70	1.30	1.00	2.45	1.30	.....
23	1.65	1.35	1.00	.80	1.10	.95	1.70	1.20	.....
24	1.65	1.30	1.00	.90	1.00	1.00	1.40	1.20	.....
25	1.80	1.20	.95	1.00	.95	1.00	1.30	1.15	.....
26	1.80	1.70	1.00	1.00	.90	1.05	1.20	1.05	.....
27	1.85	1.50	.95	1.00	.90	1.00	1.20	.95	.....
28	3.30	1.30	.95	1.00	.80	1.00	1.20	1.00	.....
29	3.50	1.20	1.00	.95	.80	1.00	1.15	1.00	.....
30	2.55	1.15	1.35	.90	.80	1.55	1.10	1.10	.....
31	.....	1.15	.....	.80	.80	.....	1.10	.....	.....

HOUSATONIC DRAINAGE BASIN.

Housatonic River has its source in Berkshire County, Mass. It flows southerly across Massachusetts and the western end of Connecticut, entering Long Island Sound. Its course is nearly parallel to the eastern boundary of New York State, and it receives the drainage from Tenmile River in New York.

Tenmile River drains an area of diversified topography, including broad flats and marshes in the basin of Swamp River and extensive areas under cultivation and sparsely timbered hills in the region of the Chestnut Range. The drainage area lies chiefly in New York State, the stream crossing the line into Connecticut one-half mile above the junction with the Housatonic. Stations have been maintained in this basin on Housatonic River at Gaylordsville, Conn., and on Tenmile River near Dover Plains, N. Y.

HOUSATONIC RIVER AT GAYLORDSVILLE, CONN.

This station was established October 24, 1900, by E. G. Paul. The gage is located at the covered wooden highway bridge at Gaylordsville, Conn., 2 miles below the mouth of Tenmile River and 1¼ miles above the cable from which discharge measurements are made. The chain gage is fastened to the woodwork of the inside of the bridge. The length of the chain from the end of the weight to the marker is 30.45 feet. The gage is read twice each day by G. H. Munroe. On account of the poor cross section of the channel at the bridge, discharge measurements are made by means of a three-fourths-inch cable and car 1¼ miles below. The cable has a span of 200 feet. It is supported on the right bank by timbers 25 feet high, and is anchored to a large rock buried in the ground. On the left bank the cable is supported by a large sycamore tree and fastened to the base of a large oak. The initial point for soundings is the zero of the tagged wire at the sycamore tree which supports the cable on the left bank. The channel is straight for about 500 feet above and below the station. The current at the cable never becomes too sluggish to be accurately measured. At high water the current is swift and rough. Both banks are subject to overflow only at extreme freshets. Both banks have a sparse growth of trees and brush. The bed of the stream is composed of gravel and cobblestones, free from vegetation, and not subject to change. No bench mark has been established. The center of the gage pulley is 29.35 feet above gage datum.

The observations at this station during 1904 have been made under the direction of R. E. Horton, district hydrographer.

Discharge measurements of Housatonic River at Gaylordsville, Conn., in 1900–1904.

Date.	Hydrographer.	Area of section.	Mean velocity.	Gage height.	Discharge.
1900.		*Square feet.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
August 9 [a]	E. G. Paul	272	1.66	3.30	450
August 10 [a]	do	232	1.82	3.25	422
October 20	do	236	1.28	3.10	370
October 24	do	251	1.47	3.00	303
1901.					
March 30	A. K. Chittenden	1,014	4.64	6.20	4,718
April 27	do	1,311	5.65	7.20	7,419
August 3	A. E. Place	322	1.78	3.50	549
September 13	do	462	1.98	4.00	912
September 28	W. W. Schlecht	384	1.83	3.77	701
October 29	do	444	2.14	4.05	951
November 13	do	648	2.88	4.82	1,864
November 23	do	455	2.12	4.11	965
December 28	do	758	3.32	5.16	2,520
1902.					
January 11	W. W. Schlecht	677	3.23	5.00	2,184
February 14 [b]	do	446	2.49	8.30	1,111
March 4	do	2,090	6.51	9.90	13,600
March 18	do	1,469	5.64	7.63	8,259
May 3	do	1,010	4.41	6.10	4,459
June 23	do	498	2.36	4.46	1,177
July 11	H. K. Barrows	496	2.34	4.30	1,159
July 22	do	1,194	4.28	6.68	5,119
August 5	do	476	2.06	4.28	983
August 20	do	423	1.97	3.95	835
September 8	do	352	1.54	3.45	543
September 19	do	367	1.74	3.75	640
October 3	P. M. Churchill	693	3.08	5.35	2,133
November 15	F. H. Tillinghast	570	2.38	4.50	1,356
November 29	do	560	2.29	4.40	1,282
December 20	do	1,140	4.79	6.65	5,465
1903.					
January 23	F. H. Tillinghast	812	3.23	5.50	2,621
March 31	do	1,092	4.37	6.52	4,773
June 6	do	359	1.48	3.60	532
July 24	do	693	2.97	5.20	2,062
September 15	do	785	1.86	3.90	785
1904.					
July 16	C. C. Covert	363	1.64	3.80	596

[a] Measurement at different sections.

[b] Backwater from ice.

Mean daily gage height, in feet, of Housatonic River at Gaylordsville, Conn., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.85	6.85	6.25	6.15	6.00	4.85	5.40	3.80	3.55	4.45	4.25	4.25
2	4.75	6.15	6.05	6.75	5.90	4.75	5.85	3.80	3.60	4.50	4.40	4.25
3	4.05	6.60	6.30	6.60	5.60	4.65	5.20	3.85	3.55	4.30	4.45	4.15
4	4.10	6.65	7.65	6.70	5.55	4.60	4.65	4.00	3.60	4.00	4.50	4.05
5	4.10	6.40	6.10	6.45	5.25	4.55	4.35	4.00	3.60	4.20	4.45	4.00
6	4.05	6.45	5.45	6.10	5.20	4.45	4.40	3.85	3.15	4.25	4.45	3.85
7	[a] 4.10	6.30	[b] 6.00	6.10	5.05	4.20	4.55	3.85	3.40	4.20	4.30	4.00
8	3.95	8.45	9.15	6.00	5.10	5.30	4.60	3.70	3.35	4.10	4.20	4.05
9	4.10	8.00	7.35	6.15	4.65	6.55	4.50	3.40	3.45	4.15	4.25	3.95
10	4.55	8.40	6.65	6.50	4.50	7.35	4.45	3.85	3.70	4.05	4.20	3.90
11	4.65	8.50	6.75	6.45	4.55	7.05	4.30	3.90	3.70	3.75	4.25	3.85
12	4.55	6.90	6.00	6.40	4.60	6.60	3.85	5.30	3.60	4.15	4.15	4.05
13	5.50	6.30	5.60	6.30	4.50	6.15	4.30	4.85	3.35	4.25	4.20	4.00
14	5.85	7.10	5.45	6.15	4.70	5.55	4.25	3.90	3.35	4.25	4.45	3.90
15	6.15	6.90	5.30	5.85	4.70	5.10	4.15	3.90	7.35	4.00	4.45	3.95
16	6.20	6.10	5.05	5.90	5.25	5.05	4.15	4.20	6.60	4.15	4.55	4.15
17	[c] 6.35	6.10	5.00	5.55	5.00	4.85	4.00	4.10	6.00	4.20	4.45	4.20
18	5.95	6.25	4.95	5.60	5.25	4.75	4.00	4.00	5.00	4.05	4.30	[d] 4.15
19	5.85	6.10	5.05	5.50	5.25	4.70	4.05	3.80	4.65	4.05	4.30	4.10
20	6.25	[e] 5.90	5.30	5.45	5.15	4.60	3.55	4.05	4.55	4.20	4.25	4.05
21	6.40	6.50	5.30	5.50	5.15	4.25	3.90	4.40	4.55	5.10	4.30	4.20
22	6.60	7.10	5.65	5.40	5.15	4.65	4.00	4.50	4.15	6.10	4.35	4.25
23	7.80	8.50	5.65	5.30	4.95	4.50	3.70	4.25	4.00	5.85	4.60	4.05
24	9.25	8.00	6.35	5.15	4.70	4.30	3.50	4.20	3.95	5.05	4.55	4.20
25	9.25	[f] 8.00	6.50	5.05	4.90	4.00	3.75	4.10	4.45	5.40	4.30	4.30
26	[g] 8.55	7.00	6.80	5.10	4.75	4.25	3.70	3.80	4.30	5.25	4.50	4.30
27	9.15	4.00	7.55	5.20	5.75	4.15	4.55	3.80	4.25	4.85	4.20	4.25
28	8.00	[e] 5.00	7.50	6.15	5.30	3.75	4.10	3.80	4.40	4.80	4.05	4.70
29	8.05	4.20	7.05	6.40	5.10	4.15	3.95	3.35	4.30	4.70	4.10	4.50
30	7.85	.....	6.60	6.60	4.75	4.50	3.80	3.45	4.65	4.60	4.25	4.30
31	7.55	.....	6.10	.....	4.90	.....	3.80	3.50	.....	4.50	.....	[d] 4.20

[a] Ice 1 foot thick.
[b] Ice went out.
[c] Ice 1½ feet thick.
[d] December 18–31 river partly frozen. Ice 10–12 inches at gage.
[e] Ice 2½ feet thick.
[f] Ice 3 feet thick.
[g] Ice 2 feet thick.

Rating table for Housatonic River at Gaylordsville, Conn., from October 23, 1900, to December 31, 1904.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.5	120	4.6	1,506	6.7	5,448	8.8	10,980
2.6	157	4.7	1,642	6.8	5,692	8.9	11,250
2.7	193	4.8	1,778	6.9	5,936	9.0	11,530
2.8	230	4.9	1,914	7.0	6,180	9.1	11,800
2.9	266	5.0	2,050	7.1	6,440	9.2	12,080
3.0	303	5.1	2,216	7.2	6,700	9.3	12,350
3.1	352	5.2	2,382	7.3	6,960	9.4	12,630
3.2	402	5.3	2,548	7.4	7,220	9.5	12,900
3.3	451	5.4	2,714	7.5	7,480	9.6	13,180
3.4	501	5.5	2,880	7.6	7,744	9.7	13,460
3.5	550	5.6	3,076	7.7	8,008	9.8	13,740
3.6	618	5.7	3,272	7.8	8,272	9.9	14,020
3.7	686	5.8	3,468	7.9	8,536	10.0	14,300
3.8	754	5.9	3,664	8.0	8,800	10.1	14,600
3.9	822	6.0	3,860	8.1	9,070	10.2	14,900
4.0	890	6.1	4,080	8.2	9,340	10.3	15,200
4.1	986	6.2	4,300	8.3	9,610	10.4	15,500
4.2	1,082	6.3	4,520	8.4	9,880	10.5	15,800
4.3	1,178	6.4	4,740	8.5	10,150		
4.4	1,274	6.5	4,960	8.6	10,430		
4.5	1,370	6.6	5,204	8.7	10,700		

The above table is applicable only for open-channel conditions. It is based upon discharge measurement made during 1900–1904. It is fairly well defined between gage heights 3 feet and 5 feet. Above 5 feet the measurements are scattered.

Mean daily discharge, in feet, of Housatonic River at Gaylordsville, Conn., for 1904.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	4,190	3,860	1,850	2,710	754	584	1,320	1,130	1,130
2	.....	.....	.....	5,570	3,660	1,710	3,570	754	618	1,370	1,270	1,130
3	.....	.....	.....	5,200	3,080	1,570	2,380	788	584	1,180	1,320	1,030
4	.....	.....	.....	5,450	2,980	1,510	1,570	890	618	890	1,370	938
5	.....	.....	.....	4,850	2,460	1,440	1,230	890	618	1,080	1,320	890
6	.....	.....	.....	4,080	2,380	1,320	1,270	788	377	1,130	1,320	788
7	.....	.....	.....	4,080	2,130	1,080	1,440	788	501	1,080	1,180	890
8	.....	.....	11,940	3,860	2,220	2,550	1,510	,686	476	986	1,080	938
9	.....	.....	7,090	4,190	1,570	5,080	1,370	501	525	1,030	1,130	856
10	.....	.....	5,330	4,960	1,370	7,090	1,320	788	686	938	1,080	822
11	.....	.....	5,570	4,850	1,440	6,310	1,180	822	686	720	1,130	788
12	.....	.....	3,860	4,740	1,510	5,200	790	2,550	618	1,030	1,030	938
13	.....	.....	3,080	4,520	1,370	4,190	1,180	1,850	476	1,130	1,080	890
14	.....	.....	2,800	4,190	1,640	2,980	1,130	822	476	1,130	1,320	822
15	.....	.....	2,550	3,570	1,640	2,220	1,030	822	7,090	890	1,320	856
16	.....	.....	2,130	3,660	2,460	2,130	1,030	1,080	5,200	1,030	1,440	.....
17	.....	.....	2,050	2,980	2,050	1,850	890	986	3,860	1,080	1,320	.....
18	.....	.....	1,980	3,080	2,460	1,710	890	890	2,050	938	1,180	.....
19	.....	.....	2,130	2,880	2,460	1,640	938	754	1,570	938	1,180	.....
20	.....	.....	2,550	2,800	2,300	1,510	584	938	1,440	1,080	1,130	.....
21	.....	.....	2,550	2,880	2,300	1,130	822	1,270	1,440	2,220	1,180	.....
22	.....	.....	3,170	2,710	2,300	1,570	890	1,370	1,030	4,080	1,230	.....
23	.....	.....	3,170	2,550	1,980	1,370	686	1,130	890	3,570	1,510	.....
24	.....	.....	4,630	2,300	1,640	1,180	550	1,080	856	2,130	1,440	.....
25	.....	.....	4,960	2,130	1,910	890	720	986	1,320	2,710	1,180	.....
26	.....	.....	5,690	2,220	1,710	1,130	686	754	1,180	2,460	1,370	.....
27	.....	.....	7,610	2,380	3,370	1,030	1,440	754	1,130	1,850	1,080	.....
28	.....	.....	7,480	4,190	2,550	720	986	754	1,270	1,780	938	.....
29	.....	.....	6,310	4,740	2,220	1,030	856	476	1,180	1,640	986	.....
30	.....	.....	5,200	5,200	1,710	1,370	754	525	1,570	1,510	1,130	.....
31	.....	.....	4,080	.....	1,910	.....	754	550	.....	1,370	.....	.....

Estimated monthly discharge of Housatonic River at Gaylordsville, Conn., for 1904.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 8–31	11,940	1,980	4,496	4.41	3.94
April	5,570	2,130	3,833	3.76	4.20
May	3,860	1,370	2,214	2.17	2.50
June	7,090	720	2,212	2.17	2.42
July	3,570	550	1,199	1.18	1.36
August	2,550	476	929	0.911	1.05
September	7,090	377	1,364	1.34	1.50
October	4,080	720	1,493	1.46	1.68
November	1,510	938	1,212	1.19	1.33
December 1–15	1,130	788	914	.896	.500

INDEX.

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PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 124.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

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Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV,
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.

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