Water-Supply and Irrigation Paper No. 165 Series P, Hydrographic Progress Reports, 41

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

REPORT

OF

PROGRESS OF STREAM MEASUREMENTS

FOR

THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART I.—Atlantic Coast of New England Drainage

BY

H. K. BARROWS and JOHN C. HOYT

WASHINGTON
GOVERNMENT PRINTING OFFICE
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INTRODUCTION.

ORGANIZATION AND SCOPE OF WORK.

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. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging 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." (Stat. L., vol. 28, p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.

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

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. There is also collected information concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely upon the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes to show the conditions existing through long periods. They are also used as primary stations, and their records in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The Report of Progress of Stream Measurements, which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware River drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin River drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

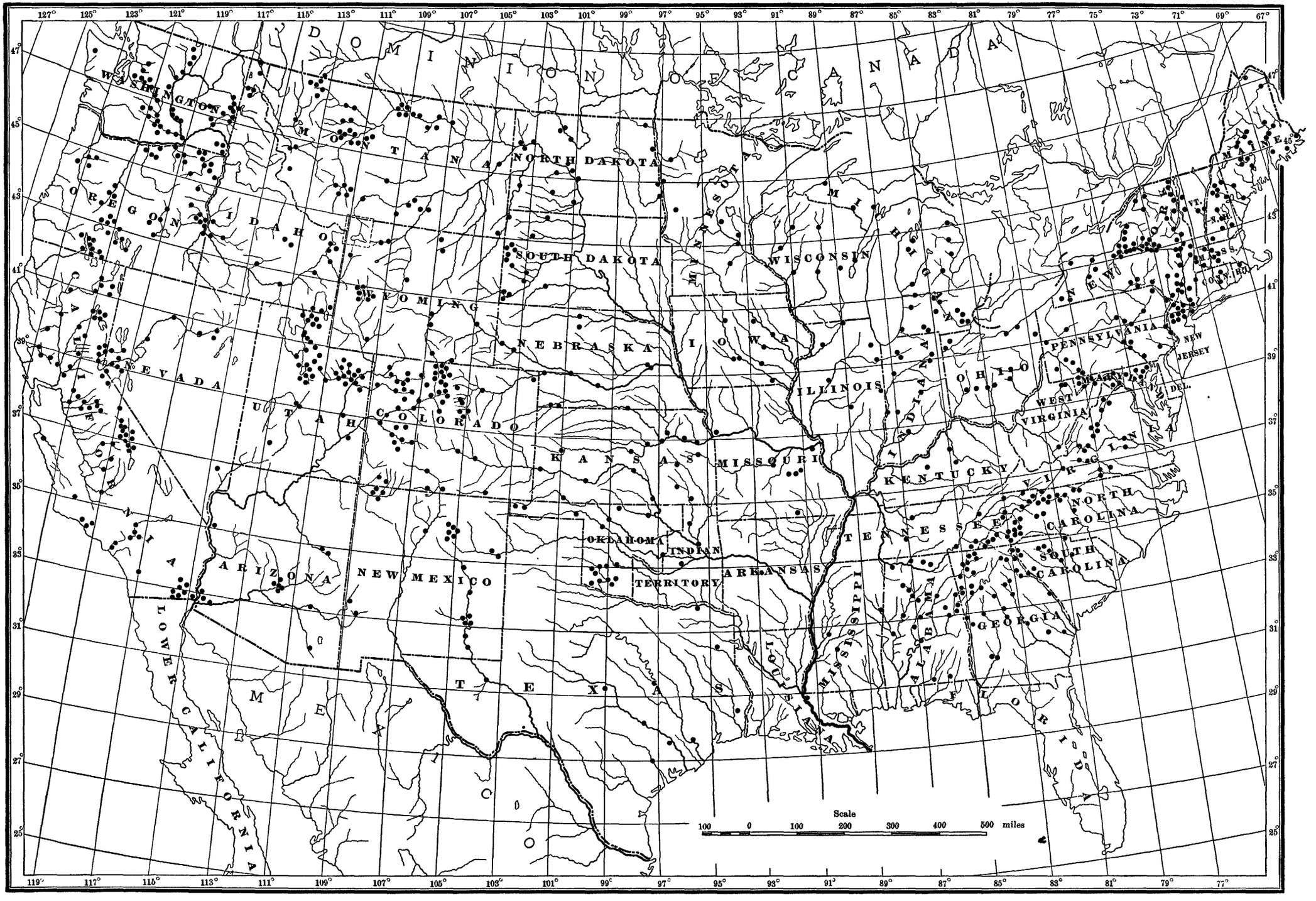
These papers embody the data collected at the regular gaging stations, the results of the computations based upon the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided and the facts have been arranged as far as practicable geographically.

List of drainage basins in the United States.

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor Northern Atlantic.



MAP OF THE UNITED STATES, SHOWING LOCATION OF PRINCIPAL RIVER STATIONS MAINTAINED DURING 1905.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.	Great Pedee (Yadkin).
Chowan.	Santee.
Roanoke.	Savannah.
Tar.	Ogeechee.
Neuse.	Altamaha.
Cape Fear.	Minor Southern Atlantic.

EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.	Pearl.
Apalachicola.	Minor Eastern Gulf of Mexico.
Mobile.	

EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.	Upper eastern Mississippi.
Ohio.	

ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.	Niagara River.
Lake Michigan.	Lake Ontario.
Lake Huron.	Lake Champlain (Richelieu River).
Lake St. Clair.	Minor St. Lawrence.
Lake Erie.	

WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.	Lower western Mississippi.
Missouri.	Arkansas.
Meramec.	Red.

WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.	Guadelupe.
Neches.	San Antonio.
Trinity.	Nueces.
Brazos.	Rio Grande.
Colorado (of Texas).	Minor Western Gulf of Mexico.

COLORADO RIVER DRAINAGE BASIN.

THE GREAT BASIN.

Wasatch Mountains.	Sierra Nevada.
Humboldt.	Minor streams in Great Basin.

PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.	Columbia.
San Francisco Bay.	Puget Sound.
Northern Pacific.	

HUDSON BAY DRAINAGE BASINS.

DEFINITIONS.

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

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

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

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

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

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

EXPLANATION OF TABLES.

For each regular gaging 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, based upon all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and 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, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most 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 monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was 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" is the average flow for each second during the month. Upon this the computations for the two remaining columns, which are defined above, 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 be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of 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.

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 to at least 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.

CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second, equals 448.8 gallons per minute, equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile, equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equals 15 United States gallons per second.
100 California miner's inches equals 77 Colorado miner's inches.
100 California miner's inches for one day equals 4 acre-feet.
100 Colorado miner's inches equals 2.60 second feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 130 California miner's inches.
100 Colorado miner's inches for one day equals 5.2 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.44 acre-feet.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards, equals 5,280 feet, equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet, equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.

1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch, equals 1 ton per square foot, equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1¼ horsepowers equal about 1 kilowatt.

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

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\, \sqrt{h^3}$; l = length of weir in inches; h = head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1: 125000, 1 mile=0.50688 inch.
Scale 1: 90000, 1 mile=0.70400 inch.
Scale 1: 62500, 1 mile=1.01376 inches.
Scale 1: 45000, 1 mile=1.40800 inches.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data upon which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n, which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible

where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams, dams, or other artificial obstructions that the gage height shall be an index of the discharge.

There are generally pertinent to a gaging station certain permanent or semipermanent structures which are usually referred to as "equipment." These are: A gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge, or a tagged line indicating the points of measurement, and where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the

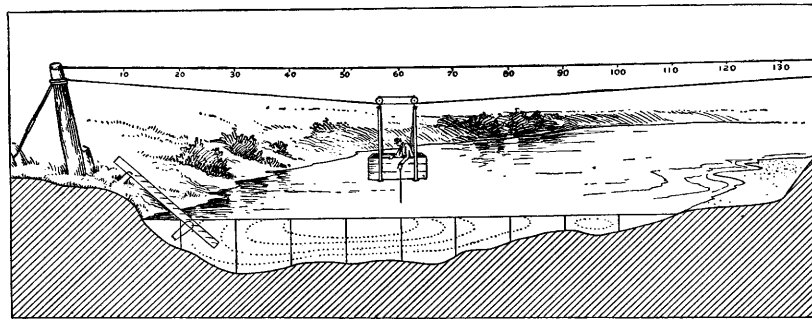


FIG. 1.—Cable station, showing section of river, car, gage, etc.

most satisfactory surface floats, and it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at

different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and has been extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading; and gaging stations may be classified in accordance with such use. (Fig. 1 shows a typical cable station.)

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying grom 2 to 20 feet, depending upon the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

There are in general use three classes of methods of measuring velocity with current meters—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are—the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each 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 among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

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 by 6 the sum of the top velocity, 4 times the mid depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

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 generally occurs 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, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

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 effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending upon the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. 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 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, and noting the number of revolutions and the time taken in the operation. This method has the advantage 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 in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. 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 streams 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 of value in 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 various points of measurement, 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 the 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 determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to the lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending upon whether or not the bed of the stream is permanent.

For stations on streams with permanent beds, the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to

any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends upon the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend upon the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

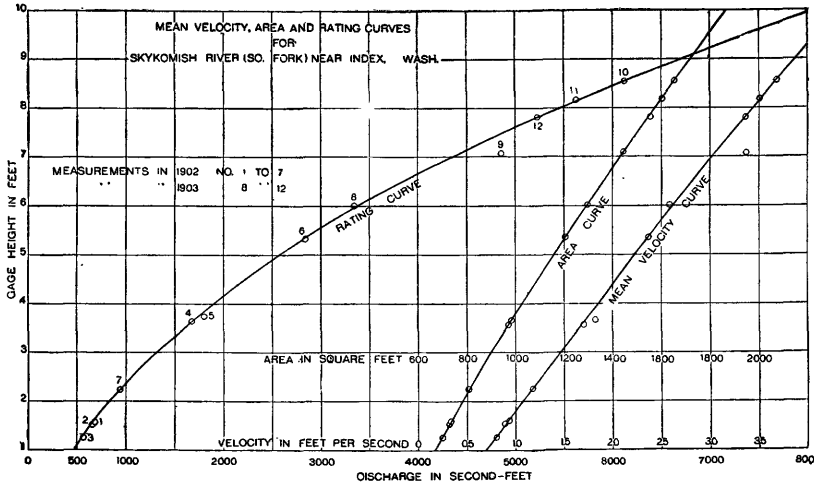


FIG 2.—Discharge, area, and mean velocity curves for South Fork of Skykomish River near Index, Wash.

The construction of the rating table depends upon the following laws of flow for open, permanent channels: (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. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be therefore a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are, therefore, constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station, the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

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

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ST. JOHN RIVER DRAINAGE BASIN.

DESCRIPTION OF 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 northeastward 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, though 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 at 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

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

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 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 Railway, 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.
		Sq. miles.
St. John	Below Alleguash	4,320
Do	Fort Kent gaging station	5,280
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 gaging station	890
Aroostook	Mouth	2,350
Do	Fort Fairfield gaging station	2,230
Meduxnekeag	Mouth	520

ST. JOHN RIVER AT FORT KENT, ME.

This station was established October 13, 1905, by F. E. Pressey. It is located at the footbridge which crosses the St. John near Fort Kent post-office, a short distance above the point where Fish River enters the St. John. The drainage area at this point is 5,280 square miles.

The channel is straight for about 1,000 feet, both up and down stream. The bed is of gravel, rocky and permanent. Both banks are high, rocky, cleared, and not subject to overflow, except in extreme freshets. There are from one to four channels, depending on the stage of the river, and the river at ordinary stage is about 500 feet wide. The flow of the river at this point is entirely free, and there are no dams in this region. About 50 miles downstream are the Grand Falls, an important undeveloped water power.

Measurements of flow will probably be made from the upstream side of the footbridge, to which the gage is attached. The initial point for soundings will probably be the river edge of the left abutment.

The gage is an inclined staff 22 feet long, in two sections, attached to the concrete pier nearest the New Brunswick shore of the river. The lower part of the gage is placed in a groove in the side of the pier. The upper part is fastened to the downstream end of the same pier. The gage is read by A. J. Long. It is referred to bench marks as follows: (1) Copper bolt in bowlder on right bank, about 250 feet below the bridge; elevation, 12.99 feet. (2) Top of igneous rock on right bank about 200 feet below the bridge, marked "B. M. -2"; elevation, 12.64 feet. Elevations refer to datum of the gage.

Discharge measurement of St. John River at Fort Kent, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
Oct. 13[a]	F. E. Pressey	230	385	1.71	2.55	660

[a] Measured partly from a boat and partly by wading.

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 80 square miles of which 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 July 29, 1903, by N. C. Grover. It is located just below the outlet of Wallagrass Brook.

The channel is straight for 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 measuring section is generally strong. The banks are high and are not liable to overflow.

Discharge measurements are made from a cable or by wading at low stages of the river.

A standard chain gage, which is read once each day by Vital E. Michaud, is attached to trees on the bank about 1,500 feet upstream from the cable. The length

of the chain is 39.75 feet. The gage is referred to bench marks as follows: (1) Copper bolt in ledge 600 feet downstream from gage; elevation, 11.73 feet. (2) Nail driven into blazed birch tree 5 feet upstream from gage; elevation, 11.91 feet. Elevations refer to datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 16–17; 124, pp 21–22.
Discharge: 97, p 17; 124, p 22.
Gage heights: 97, p 17; 124, p 23.

Discharge measurements of Fish River at Wallagrass, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
May 18	Barrows and Pressey	155	940	2.92	7.84	2,740
June 29	E. C. Murphy	146	540	1.80	4.83	970
August 30	F. E. Pressey	92	168	.50	2.00	84
October 10	do	90	152	.32	1.74	48

Daily gage height, in feet, of Fish River at Wallagrass, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	3.8	2.8	7.4	7.0	4.7	.....	1.9	.....	.....	.....
2	.....	.....	.....	.....	7.5	6.8	4.7	2.8	1.9	2.0	2.0	.....
3	.....	.....	.....	.....	7.5	6.8	4.7	2.7	.....	.....	.....	.....
4	3.5	.....	.....	.....	7.6	6.7	.....	.....	2.0	2.0	2.0	.....
5	.....	.....	.....	.....	7.8	6.5	4.7	2.6	.....	.....	.....	2.5
6	.....	.....	.....	4.1	7.8	6.3	.....	.....	2.0	2.0	2.0	.....
7	.....	.....	.....	.....	8.3	6.3	4.6	2.6	2.0	1.8	.....	.....
8	.....	3.8	.....	.....	8.2	6.0	4.5	.....	.....	.....	2.0	.....
9	.....	.....	3.9	4.6	8.1	6.0	.....	2.6	2.0	1.8	.....	.....
10	.....	.....	.....	.....	8.0	5.8	4.3	.....	2.0	.....	2.0	.....
11	.....	.....	.....	.....	7.9	5.9	.....	2.5	.....	1.8	2.0	.....
12	3.5	.....	.....	.....	8.0	6.0	4.2	2.6	2.0	.....	.....	.....
13	.....	.....	.....	5.8	8.0	6.2	4.0	.....	.....	1.7	2.0	.....
14	.....	.....	3.7	.....	7.9	6.2	.....	2.5	1.8	1.7	2.0	.....
15	.....	3.9	.....	.....	7.8	6.2	3.8	2.4	.....	.....	.....	.....
16	.....	.....	.....	6.9	7.8	5.8	.....	.....	1.8	1.8	2.1	2.7
17	.....	.....	.....	7.0	8.0	5.4	3.7	2.3	.....	.....	.....	.....
18	3.5	.....	.....	7.1	7.9	5.4	.....	.....	1.8	1.8	2.1	.....
19	.....	.....	.....	7.0	7.8	5.6	3.5	2.3	1.9	1.8	.....	.....
20	.....	.....	.....	7.0	7.4	5.6	3.5	.....	.....	.....	2.1	.....
21	.....	.....	.....	7.1	7.4	5.7	.....	2.2	1.9	1.8	.....	.....
22	.....	3.9	.....	7.1	7.5	5.6	3.4	.....	.....	.....	2.1	.....
23	.....	.....	.....	7.1	7.6	5.6	.....	2.2	1.9	1.8	2.1	2.8
24	.....	.....	3.7	7.0	8.3	5.5	3.3	2.2	.....	1.8	.....	.....
25	3.4	.....	.....	7.0	8.0	5.3	3.1	.....	1.9	.....	2.2	.....
26	.....	.....	.....	6.8	7.8	5.2	.....	2.1	1.9	1.8	.....	2.6
27	.....	.....	.....	6.8	7.4	5.1	3.1	.....	.....	.....	.....	.....
28	.....	.....	.....	7.0	7.4	5.0	.....	2.0	1.9	1.8	2.2	.....
29	.....	.....	3.0	6.9	7.3	4.8	3.0	.....	.....	.....	.....	.....
30	.....	.....	.....	7.0	7.3	4.8	.....	2.0	1.9	1.8	.....	.....
31	3.9	.....	.....	.....	7.1	.....	2.8	.....	.....	1.8	.....	.....

Daily gage height, in feet, of Fish River at Wallagrass, Me., for 1905—Continued.

NOTE.—River frozen January 1 to March 23 and November 14 to December 31. For this period the readings were to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 4	3.5	3.8	1.3	March 9	3.9	3.9	0.2
January 12	3.5	3.7	1.3	March 14	3.7	3.8	.4
January 18	3.5	3.7	1.4	November 14	2.0	.....	.2
January 25	3.4	3.9	1.0	November 28	2.2	2.2	.1
January 31	3.9	.....	(a)	December 5	2.5	2.5	.1
February 8	3.8	.....	(a)	December 16	2.7	2.7	.1
February 15	3.9	4.1	.3	December 23	2.8	2.8	.1
February 22	3.9	4.0	.2	December 26	2.6	2.6	.4
March 1	3.8	3.9	.1				

a Ice thin.

Station rating table for Fish River at Wallagrass, Me., from July 29, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.70	47	3.40	429	5.20	1,167	8.40	3,174
1.80	59	3.50	462	5.40	1,268	8.60	3,328
1.90	72	3.60	496	5.60	1,372	8.80	3,487
2.00	86	3.70	531	5.80	1,479	9.00	3,650
2.10	102	3.80	567	6.00	1,590	9.20	3,817
2.20	120	3.90	604	6.20	1,705	9.40	3,988
2.30	139	4.00	642	6.40	1,824	9.60	4,162
2.40	159	4.10	681	6.60	1,946	9.80	4,339
2.50	180	4.20	721	6.80	2,071	10.00	4,520
2.60	203	4.30	762	7.00	2,200	10.50	4,990
2.70	227	4.40	803	7.20	2,331	11.00	5,490
2.80	252	4.50	845	7.40	2,464	11.50	6,000
2.90	279	4.60	888	7.60	2,599	12.00	6,550
3.00	307	4.70	932	7.80	2,738	12.50	7,100
3.10	336	4.80	977	8.00	2,880	13.00	7,650
3.20	366	4.90	1,023	8.20	3,025	13.50	8,250
3.30	397	5.00	1,070				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1903–1905. It is well defined throughout.

Estimated monthly discharge of Fish River at Wallagrass, Me., for 1903–1905.

[Drainage area, 890 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
August	681	366	484	0.544	0.627
September	366	139	242	.272	.304
October	139	86	93.6	.105	.121
November 1–29	279	102	204	.229	.247
1904.					
May	8,370	3,817	6,360	7.15	8.24
June	3,902	1,023	2,045	2.30	2.57
July	1,070	531	742	.834	.962
August	496	366	392	.440	.507
September	1,268	366	898	1.01	1.13
October	1,824	1,070	1,513	1.70	1.96
November	1,070	496	727	.817	.912
1905.					
April 16–30	2,265	2,071	2,151	2.42	1.35
May	3,099	2,265	2,761	3.10	3.58
June	2,200	977	1,514	1.70	1.90
July	932	252	597	.671	.774
August	252	79	158	.178	.205
September	86	59	74.3	.083	.093
October	86	47	62.8	.071	.082
November 1–13	86	72	84.9	.095	.046

NOTE.—Ice conditions November 30 to December 31, 1903, and during December, 1904. No estimate made from February 14 to April 30, 1904, on account of probable ice conditions. Discharge for 1905 interpolated on days when gage was not read. See table of gage heights.

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.

The gaging station was established July 31, 1903, by N. C. Grover. It is located at the steel highway bridge in the village of Fort Fairfield.

The channel is straight for at least 1,000 feet above and 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.

Discharge measurements at all ordinary stages are made from the bridge to which the gage is attached. The initial point for soundings is on the right bank at the lower end of the inclined end post of the downstream truss. At low water discharge measurements are made by wading at a section a short distance below the bridge.

A standard chain gage, which is read twice each day by F. E. Petersen, is attached to the steel webbing of the upstream truss of the bridge. The length of the chain is 27.61 feet. The gage 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 the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 17–18; 124, pp 23–24.
Discharge: 97, p 18; 124, p 24.
Discharge, monthly: 124, pp 26.
Gage heights: 97, p 18; 124, pp 24–25.
Rating table: 124, pp 25.

Discharge measurements of Aroostock River at Fort Fairfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 15	Barrows and Pressey	397	1,660	3.67	6.67	6,090
June 27	E. C. Murphy	301	750	2.07	4.30	1,550
August 24	F. E. Pressey	241	355	.49	3.10	175
October 16[a]	do	187	224	.52	2.96	117

[a] By wading about 900 feet below gage.

Daily gage height, in feet, of Aroostook River at Fort Fairfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	.....	.....	5.85	4.2	3.5	3.05	3.1	3.1	.....
2	.....	.....	.....	.....	.....	5.7	4.2	3.5	3.1	3.1	3.15	.....
3	.....	.....	.....	.....	.....	5.65	4.3	3.5	3.1	3.15	3.3	.....
4	.....	4.4	4.6	.....	.....	5.6	4.35	3.45	3.0	3.1	3.55	.....
5	.....	.....	.....	.....	.....	5.65	4.3	3.35	3.15	3.1	3.85	.....
6	.....	.....	.....	.....	.....	5.5	4.25	3.3	3.2	3.1	3.6	.....
7	4.1	.....	.....	.....	.....	5.3	4.2	3.25	3.15	3.05	3.45	.....
8	.....	.....	.....	.....	.....	5.15	4.05	3.3	3.05	3.0	3.3	.....
9	.....	.....	.....	.....	.....	4.95	3.7	3.2	3.1	3.0	3.3	3.6
10	.....	.....	.....	.....	.....	4.65	3.85	3.3	3.1	3.0	3.4	.....
11	.....	4.4	4.5	.....	.....	4.6	3.8	3.3	3.0	3.0	3.4	.....
12	.....	.....	.....	.....	.....	4.6	3.75	3.3	3.0	3.05	3.4	.....
13	.....	.....	.....	.....	.....	4.8	3.65	3.3	3.1	3.0	3.4	.....
14	4.3	.....	.....	.....	.....	5.05	3.65	3.4	3.05	3.0	3.4	.....
15	.....	.....	.....	.....	.....	5.2	3.6	3.35	3.0	3.0	3.35	.....
16	.....	.....	.....	.....	.....	5.15	3.55	3.3	3.0	3.0	3.4	3.5
17	.....	.....	4.7	.....	.....	4.95	3.6	3.3	3.0	3.0	3.4	.....
18	.....	4.3	.....	.....	.....	4.75	3.6	3.3	3.1	3.1	3.4	.....
19	.....	.....	.....	.....	.....	4.8	3.55	3.3	3.1	3.0	3.4	.....
20	.....	.....	4.7	.....	.....	4.9	3.55	3.3	3.15	3.1	3.35	.....
21	4.4	.....	.....	.....	.....	5.05	3.6	3.3	3.15	3.1	3.45	.....
22	.....	.....	.....	.....	.....	5.05	3.5	3.25	3.2	3.1	3.4	.....
23	.....	.....	.....	.....	.....	4.95	3.5	3.2	3.2	3.1	3.4	3.7
24	.....	.....	.....	.....	.....	4.75	3.5	3.15	3.1	3.1	3.4	.....
25	.....	4.4	.....	.....	.....	4.55	3.5	3.0	3.1	3.1	3.4	.....
26	.....	.....	.....	.....	.....	4.5	3.5	3.1	3.15	3.1	3.4	.....
27	.....	.....	4.8	.....	.....	4.4	3.5	3.0	3.1	3.0	3.4	.....
28	4.4	.....	5.1	.....	.....	4.4	3.5	3.05	3.2	3.1	3.1	.....
29	.....	.....	5.9	.....	.....	4.25	3.5	3.1	3.2	3.1	3.4	.....
30	.....	.....	.....	.....	.....	4.2	3.45	3.1	3.15	3.1	3.4	.....
31	.....	.....	.....	.....	.....	.....	3.5	3.05	.....	3.1	.....	3.6

NOTE.—River was frozen January 1 to about April 1 and December 1–31. River frozen over above and below bridge November 21–30. During frozen period the readings were to the surface of the water in a hole cut in the ice.

The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 7	4.1	4.3	1.3
January 14	4.3	4.4	1.5
January 21	4.4	4.5	1.6
January 28	4.4	4.6	2.0
February 4	4.4	4.7	2.1
February 11	4.4	4.6	2.1
February 18	4.3	4.6	2.2
February 25	4.4	4.6	2.4
March 4	4.6	4.5	2.2
March 11	4.5	4.7	2.1
March 17	4.7	4.9	(a)
March 20	4.7	4.8	(a)
March 27	4.8	4.8	(a)
March 28	5.1	5.4	(a)
March 29	5.9	6.3	(a)
December 9	3.6	3.8	.6
December 16	3.5	3.7	.85
December 23	3.7	3.7	1.0
December 31	3.6	.....	1.1

a Ice unsafe.

Station rating table for Aroostook River at Fort Fairfield, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.90	95	4.60	1,984	6.30	5,275	9.00	12,600
3.00	130	4.70	2,150	6.40	5,495	9.20	13,240
3.10	180	4.80	2,320	6.50	5,715	9.40	13,900
3.20	240	4.90	2,494	6.60	5,940	9.60	14,560
3.30	310	5.00	2,672	6.70	6,165	9.80	15,230
3.40	390	5.10	2,854	6.80	6,395	10.00	15,910
3.50	480	5.20	3,040	6.90	6,630	10.20	16,600
3.60	580	5.30	3,230	7.00	6,865	10.40	17,300
3.70	690	5.40	3,423	7.20	7,345	10.60	18,000
3.80	810	5.50	3,619	7.40	7,840	10.80	18,700
3.90	940	5.60	3,818	7.60	8,360	11.00	19,400
4.00	1,075	5.70	4,019	7.80	8,910	11.50	21,200
4.10	1,215	5.80	4,222	8.00	9,500	12.00	23,000
4.20	1,360	5.90	4,427	8.20	10,100	12.50	24,850
4.30	1,510	6.00	4,635	8.40	10,710	13.00	26,700
4.40	1,664	6.10	4,845	8.60	11,330	13.50	28,600
4.50	1,822	6.20	5,060	8.80	11,960		

NOTE.—The above table is applicable only for open-channel conditions. It is based on fifteen discharge measurements made during 1903–1905. It is well defined throughout, and is the same as the 1904 curve above 6 feet. The 1903–4 rating table as published was very much in error below 3.4 feet. The above table is considered to give reasonably close results for low-water stages.

Estimated monthly discharge of Aroostook River at Fort Fairfield, Me., for 1905.

[Drainage area, 2,230 square miles.]

Month.	Discharge in second-feet.			Run-off	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
June	4,324	1,360	2,644	1.18	1.32
July	1,587	435	785	.352	.406
August	480	130	291	.130	.150
September	240	130	184	.083	.093
October	210	130	162	.073	.084
November[a]	875	180	390	.175	.195

[a] Estimates November 21–30 only approximate owing to ice above and below the gage.

ST. CROIX RIVER DRAINAGE BASIN.

DESCRIPTION OF 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 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.

	Sqnare 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
At gaging station below Sprague Falls	1,420
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 saw-

mills 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, and during the present season the St. Croix Paper Company is developing the Sprague Falls privilege, where a 6,000-horsepower installation of wheels is being made to utilize a head of from 40 to 44 feet.

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

This station was established December 4, 1902, by F. E. Pressey, and has been located until the present season a short distance above Sprague Falls, near Baring. A chain gage was attached to the lower guard timber of the Washington County Railway bridge. Measurements of flow were made from a car suspended from a cable about one-half mile above the bridge.

June 8, 1905, this gaging station was moved about 1½ miles downstream on account of the building of a paper mill and dam at Sprague Falls, which will cause backwater effect for several miles. The drainage area at the new location is 1,420 square miles.

The channel is straight for 1,000 feet above and 500 feet below the cable, and has an unbroken width of about 290 feet at ordinary stages. The bed of the stream is of gravel and rocks. The right bank is high and steep; the left bank is of medium height and may overflow at very high water. The current is strong at high stages and well sustained at low water. The nearest dam downstream is at Baring, a distance of about 4 miles.

Discharge measurements are made by means of a cable and car.

A vertical staff gage 5½ feet long is attached to a large bowlder on the left bank about 1 mile below the new dam at Sprague Falls and about 400 feet upstream from the cable. A standard chain gage has also been attached to an oak tree on the left bank about 300 feet above the staff gage for use during high water. The length of the chain is 11.20 feet. Gage heights are observed once each day by Simeon Phinney, of Baring. These gages are referred to bench marks as follows: (1) Copper bolt in bowlder to which staff gage is attached; elevation, 14.32 feet. (2) Nail driven horizontally into the north side of oak tree to which the chain gage is attached, about 1 foot above the ground; elevation, 17.30 feet. (3) Nail in branch of above-mentioned oak tree; elevation, 23.82 feet. All elevations refer to gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 14; 97, p 20; 124, pp 27-28.
Discharge: 97, p 20; 124, p 28.
Discharge, daily: 97, p 22.
Discharge, monthly: 97, p 23; 124, p 30.
Gage heights: 82, p 14; 97, p 21; 124, p 29.
Rating table: 97, p 21; 124, p 30.

Discharge measurements of St. Croix River at Sprague Falls, near Baring, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.[a]	Discharge.
		Feet.	*Sq. feet.*	*Ft. per. sec.*	*Feet.*	*Sec.-feet.*
April 11	F. E. Pressey	218	1,140	5.64	9.64	6,430
June 14	do	295	1,090	2.17	7.73	2,370
September 6	do	292	790	1.48	6.74	1,170
September 7	do	292	790	1.44	6.75	1,140
October 5	do	283	660	.97	6.23	640
November 20[b]	do	288	785	1.27	6.69	995

[a] Old gage used for measurement of April 11 and new gage used thereafter.
[b] Anchor ice probably affects results.

Daily gage height, in feet, of St. Croix River at Sprague Falls, near Baring, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	7.9	7.9	9.2	8.3	7.2	8.4	7.8	6.7	.....	6.0	6.2
2	6.8	7.9	7.9	.....	8.3	7.2	.....	7.5	6.6	6.3	6.0	6.2
3	6.8	7.9	8.0	9.3	8.2	7.2	8.8	7.4	.....	6.3	6.0	.....
4	6.9	7.9	8.0	9.2	8.2	.....	9.0	7.4	6.7	6.3	6.0	8.4
5	6.9	.....	.....	8.9	8.2	7.2	9.0	.....	6.7	6.3	.....	8.4
6	6.9	7.9	8.0	8.9	8.2	.....	8.9	.....	6.7	6.3	6.2	8.4
7	6.8	7.9	7.9	9.1	.....	7.2	8.8	7.3	6.7	6.3	6.2	8.4
8	.....	7.9	7.9	9.3	7.8	7.2	8.7	7.2	6.7	.....	6.2	8.0
9	7.5	7.9	7.9	.....	7.8	7.2	.....	7.2	6.7	6.2	6.3	8.0
10	7.5	7.9	7.9	9.7	8.4	7.1	8.5	7.1	.....	6.1	6.3	.....
11	7.5	7.9	7.9	9.7	8.5	.....	8.5	7.1	6.7	6.1	6.3	.....
12	7.5	.....	.....	9.7	8.6	7.5	8.5	7.1	6.7	6.1	.....	.....
13	7.5	.....	7.9	9.6	.....	7.7	8.4	.....	6.7	6.1	6.3	.....
14	.....	7.9	7.9	9.7	.....	7.6	8.3	7.0	6.8	6.1	6.3	9.2
15	.....	7.9	7.9	9.7	9.0	7.6	8.1	7.0	6.8	.....	6.2	9.2
16	7.5	7.9	7.9	9.7	9.0	7.6	.....	7.0	6.7	6.0	6.2	9.2
17	7.5	7.9	7.9	9.6	7.8	7.6	8.0	7.0	.....	6.0	6.6	.....
18	7.5	7.9	7.9	9.3	9.0	.....	8.0	7.0	6.6	6.0	6.7	.....
19	7.5	.....	.....	8.7	8.0	8.4	8.0	7.0	6.6	6.0	.....	.....
20	7.6	7.9	7.8	8.7	8.0	8.5	8.1	.....	6.6	6.0	6.9	6.7
21	7.6	7.9	7.8	8.8	7.8	8.6	8.1	6.9	6.6	6.0	6.9	6.7
22	.....	7.9	7.8	8.9	7.8	8.6	8.1	6.8	6.6	.....	6.9	7.3
23	7.6	7.8	7.8	.....	7.7	8.6	.....	6.8	6.6	6.0	6.5	.....
24	7.6	7.8	7.7	9.4	7.6	8.6	8.1	6.8	.....	6.0	6.5	.....
25	7.6	7.8	7.7	9.1	7.4	.....	8.1	6.8	6.5	6.0	6.5	.....
26	7.6	.....	.....	8.6	7.4	8.6	8.2	6.8	6.4	6.0	.....	.....
27	.....	7.8	8.0	8.3	7.4	8.6	8.1	.....	6.4	6.0	6.4	.....
28	.....	7.9	8.0	8.1	.....	8.6	8.1	6.7	6.3	6.0	6.3	7.3
29	.....	.....	8.0	8.1	7.2	8.6	8.1	6.7	6.3	.....	6.2	7.3
30	7.9	.....	8.2	.....	7.2	8.6	.....	6.7	6.3	6.0	6.2	7.3
31	7.9	.....	8.9	.....	7.2	.....	8.0	6.7	.....	6.0	.....	.....

NOTE.—Gage heights from January 1 to June 30 are for old gage at railroad bridge and are used with rating table for that point. After July 1 gage heights are for gage in new position, for which a rating table is not yet prepared.

River frozen January 1 to March 31 and December 14-31. During frozen season gage heights are to the surface of the water in a hole cut in the ice. The following measurements of thickness of ice were made: December 14-16, 0.3 foot; December 20-22, 0.6 foot; December 28-30, 1.3 feet.

Station rating table for St. Croix River at Sprague Falls, near Baring, Me., from December 4, 1902, to June 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Fect.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
6.00	555	7.00	1,225	8.00	2,380	9.00	4,090
6.10	585	7.10	1,330	8.10	2,510	9.10	4,340
6.20	620	7.20	1,440	8.20	2,640	9.20	4,605
6.30	660	7.30	1,550	8.30	2,775	9.30	4,880
6.40	710	7.40	1,660	8.40	2,920	9.40	5,160
6.50	770	7.50	1,775	8.50	3,075	9.50	5,450
6.60	840	7.60	1,890	8.60	3,245	9.60	5,750
6.70	925	7.70	2,010	8.70	3,430	9.70	6,055
6.80	1,020	7.80	2,130	8.80	3,635		
6.90	1,120	7.90	2,255	8.90	3,855		

NOTE.—The above table is applicable only for open channel conditions. It is based on 1903 and 1904 discharge measurements. It is fairly well defined between gage heights 6 feet and 7.5 feet. Above gage height 7.5 feet it is unreliable.

Estimated monthly discharge of St. Croix River at Spragues Falls, near Baring, Me., for 1905.[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	6,055	2,510	4,531	3.26	3.64
May	4,090	1,440	2,494	1.79	2.06
June	3,245	1,330	2,267	1.63	1.82

[a] Discharge interpolated on days when the gage was not read.

MACHIAS RIVER DRAINAGE BASIN.

DESCRIPTION OF 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 Railway, near Whitneyville. The drainage area at this point is 465 square miles.

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 foot on the gage. Backwater effect occurs during a considerable portion of the time, owing to the influence of the dam at Machias, about 4 miles below, or to the accumulation of logs, and the gage heights are consequently unreliable. The water is confined to one channel at all stages; the width is about 130 feet. The bed is sandy, but permanent.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is on the left bank at the lower end of the inclined end post of the downstream truss. Low-water measurements may be made by wading at a point 200 feet above the bridge at low stages of the river.

A standard chain gage, which is read twice each day by George McKenzie, is attached to the guard timber on the downstream side of the bridge. The length of the chain is 25.34 feet. The gage is referred to bench marks as follows: (1) Copper bolt in outcropping ledge on upstream side of railroad track, 170 feet from the face of the 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.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 24; 124, p 31.
Discharge: 97, p 24; 124, p 32.
Discharge, monthly: 124, p 33.
Gage heights: 97, p 24; 124, p 32.
Rating table: 124, p 33.

Discharge measurements of Machias River near Whitneyville, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Second-feet.*
May 13	Barrows and Pressey	124	715	1.39	7.49	992
June 15[a]	F. E. Pressey	125	1,000	1.34	9.57	1,340
September 8	do	125	770	1.30	7.88	1,000
October 3	do	124	560	.38	6.48	210
November 21	do	124	585	.74	6.47	430

[a] River filled with logs below station.

Daily gage height, in feet, of Machias River, near Whitneyville, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.2	.....	.....	13.2	8.8	8.4	7.5	7.0	5.2	6.3	6.0	6.3
2	.....	.....	7.1	12.6	8.6	8.6	7.5	7.2	5.4	5.8	6.5	6.1
3	.....	7.2	.....	11.4	8.2	8.9	8.2	6.9	5.9	5.9	7.0	7.4
4	.....	.....	.....	10.6	8.1	9.3	9.2	6.7	6.6	5.9	6.9	9.6
5	6.5	.....	.....	9.9	8.1	9.2	8.8	6.4	6.8	5.7	7.0	10.1
6	.....	.....	.....	10.2	7.7	9.2	8.1	6.5	7.3	5.5	7.0	7.8
7	6.8	.....	.....	11.8	7.6	9.8	7.7	6.4	8.3	5.4	7.3	7.1
8	8.2	.....	.....	12.5	7.7	9.8	7.6	6.1	7.8	5.6	7.7	6.3
9	8.7	.....	.....	11.8	7.7	9.8	7.4	6.2	7.4	5.6	7.6	5.6
10	8.5	7.0	7.1	11.2	8.0	9.8	7.2	5.8	7.0	5.5	7.4	6.1
11	8.2	.....	.....	10.9	8.0	9.5	7.2	6.1	6.8	5.5	7.2	6.3
12	8.1	.....	.....	11.0	7.6	9.6	7.3	6.0	6.4	5.7	6.6	6.1
13	8.0	.....	.....	11.1	7.5	10.0	7.2	6.3	6.6	5.6	6.6	6.1
14	8.0	.....	.....	11.1	7.8	9.9	7.0	6.2	7.2	5.6	6.7	.....
15	7.9	.....	.....	11.2	7.6	9.6	6.8	6.1	7.4	6.1	6.8	.....
16	7.8	.....	6.8	11.3	7.8	9.3	7.0	5.9	7.0	5.9	6.6	.....
17	.....	7.3	.....	10.8	8.7	9.0	7.8	6.0	7.0	6.0	7.6	.....
18	.....	.....	.....	9.4	9.4	8.8	7.8	6.0	6.7	5.8	7.6	.....
19	.....	.....	7.2	9.0	9.2	8.5	6.8	6.0	6.6	5.6	7.3	.....
20	7.6	.....	7.4	8.6	8.9	8.4	6.8	5.9	6.8	5.9	6.9	.....
21	.....	.....	7.6	8.5	8.4	8.6	6.7	6.4	6.8	5.6	6.7	.....
22	.....	.....	7.5	9.0	7.8	8.3	6.6	6.3	6.6	6.3	6.4	.....
23	7.2	.....	7.4	9.6	7.4	8.1	6.7	6.2	6.5	6.1	6.6	.....
24	.....	.....	7.5	9.5	7.1	7.9	6.7	6.1	6.6	5.8	6.8	.....
25	.....	7.1	7.6	9.3	6.8	7.6	6.7	5.9	6.6	5.8	6.7	.....
26	.....	.....	8.3	9.2	6.6	7.5	6.5	5.8	6.6	5.7	6.7	.....
27	.....	.....	9.2	9.2	6.6	7.7	6.4	5.4	6.6	5.8	6.6	.....
28	.....	.....	9.9	9.0	6.4	8.1	6.5	5.7	6.4	5.8	6.4	.....
29	.....	.....	10.4	8.4	6.4	8.0	6.4	5.7	6.0	5.5	5.2	.....
30	7.2	.....	11.0	8.7	6.4	7.8	6.6	5.9	6.1	5.4	6.2	.....
31	.....	.....	12.5	.....	7.2	.....	6.7	5.8	.....	5.4	.....	.....

Daily gage height, in feet, of Machias River, near Whitneyville, Me., for 1905—Cont'd.

NOTE.—River frozen January 1 to March 31 and December 14–31. During frozen period gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	6.2	6.3	1.2
January 16	7.8	8.2	1.2
January 20	7.6	8.0	1.4
January 23	7.2	7.4	1.4
January 30	7.2	7.4	2.05
February 3	7.2	7.4	2.05
February 10	7.0	7.15	2.15
February 17	7.3	7.5	1.9
February 25	7.1	7.3	1.8
March 2	7.1	7.3	1.6
March 10	7.1	7.2	.7
March 16	6.8	7.0	1.15
March 23	7.4	7.4	1.25
March 31	.....	River clear of ice.	

April 1–17, jam of logs in river. April 18, log jam broken; gage height fell 1.3 feet in three hours.

PENOBSCOT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Penobscot 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 tide water 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 about 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.

Surveys have been made in the Penobscot River drainage basin by the United States Geological Survey as follows: In 1904, plan and profile of Penobscot River

between tide water and Twin Lake at Norcross; in 1905, plan and profile of West Branch of Penobscot River from Chesuncook Lake to Seboomook.

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

Drainage areas of Penobscot River and principal tributaries.

River.	Locality.	Area.
		Sq 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, at gaging station 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 at gaging station [a]	1,130
Do	Mouth [a]	1,160
Mattawamkeag	Immediately below outlet of Baskahegan Lake	190
Do	At gaging station near mouth	1,510
Piscataquis	Low's bridge	280
Do	Dover	330
Do	Mouth	1,500
Passadumkeag	....do	400
Cold Stream	....do	37
Do	At gaging station near Enfield post-office	26
Phillips Lake outlets:		
Northern outlet	Junction with Phillips Lake	11.5
Do	East Holden, at gaging station	12.3
Phillips Lake		[b]1.4

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

[b] Area of water surface.

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 obtain a suitable coefficient for use with the float measurements. It is believed that by means of these various checks on the measurements

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 a 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 $Q=3.33\,b\,h^{\frac{3}{2}}$. Several dams which have been constructed at points in the basin above this mill 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 an elevation of 456.3 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 19; 97, pp 26–27; 124, p 36.
Discharge, daily: 82, pp 19–20; 97, p 27; 124, p 37.
Discharge, monthly: 82, p 21.

Daily discharge, in second-feet, of Penobscot River at Millinocket, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,235	2,122	2,577	1,299	2,504	8,906	2,063	4,712	2,395	2,235	428	452
2	2,396	2,132	2,108	1,018	2,548	7,372	3,922	4,817	2,392	2,510	453	451
3	2,143	2,137	2,119	1,278	2,521	2,553	2,627	4,971	2,300	2,505	437	332
4	2,125	1,970	2,181	1,287	2,519	2,448	2,300	4,981	2,207	2,420	437	452
5	2,145	2,355	2,266	1,282	2,532	2,088	2,738	4,607	2,200	1,993	348	453
6	2,161	2,142	2,190	1,685	2,536	2,109	2,677	4,077	2,352	2,080	439	448
7	2,163	2,150	2,129	2,106	2,329	2,094	2,046	4,294	2,356	2,088	437	457
8	2,186	2,151	2,020	2,119	2,523	2,110	2,044	4,766	2,381	1,965	438	456
9	2,165	2,151	1,965	2,152	2,529	2,105	2,054	5,297	2,086	2,081	444	445
10	2,174	2,063	1,972	2,138	2,524	2,093	2,058	4,393	2,063	2,091	440	315
11	2,595	2,524	1,987	2,426	2,527	2,463	3,599	2,232	2,068	2,095	456	435
12	2,155	2,465	1,883	2,544	6,185	2,416	2,063	2,028	2,075	2,090	359	408
13	2,145	2,158	1,968	2,545	6,658	2,094	2,066	2,111	2,072	2,098	470	440
14	2,140	2,169	1,960	2,540	5,646	2,524	2,061	2,234	2,068	2,090	465	444
15	2,254	2,160	1,198	2,542	7,187	2,111	2,061	2,074	2,070	1,970	455	436
16	2,318	2,174	2,201	2,625	7,186	2,104	2,855	2,358	2,072	2,070	462	427
17	2,113	2,157	2,039	2,575	7,107	2,085	2,322	3,285	1,944	1,661	424	303
18	2,165	2,032	1,728	2,528	7,660	2,367	2,045	3,159	2,415	1,656	450	425
19	2,165	2,232	1,125	2,535	8,492	2,092	2,035	3,170	2,420	1,663	343	431
20	2,191	2,143	1,368	2,516	8,378	2,088	2,015	2,595	2,090	1,411	470	432
21	2,169	2,163	1,266	2,526	8,844	2,058	2,058	2,253	2,500	716	453	432
22	2,463	2,169	1,279	2,482	8,181	2,066	2,048	2,051	2,488	358	464	428
23	2,475	2,164	1,264	2,376	7,619	2,078	2,343	2,064	2,495	430	456	425
24	2,169	2,192	1,290	2,460	7,800	2,477	2,348	2,048	2,505	421	443	173
25	2,141	2,163	1,787	2,530	8,006	2,477	2,084	2,037	2,510	422	445	140
26	2,137	2,273	1,038	2,521	9,078	2,070	2,068	2,050	2,508	429	364	428
27	2,545	2,191	1,305	2,516	8,862	3,570	2,053	2,042	2,522	430	424	438
28	2,066	2,164	1,296	2,509	9,435	1,973	2,058	2,180	2,520	441	356	444
29	2,165	.....	1,308	2,527	9,330	2,476	2,057	2,034	2,522	355	448	444
30	2,425	.....	1,280	2,429	9,171	2,491	3,283	2,036	2,510	435	441	449
31	2,133	.....	1,299	.....	9,059	.....	4,184	2,227	.....	438	.....	444

Estimated monthly discharge of Penobscot River at Millinocket, Me., for 1905.

[Drainage area, 1,880 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,595	2,066	2,226	1.18	1.36
February	2,524	1,970	2,181	1.16	1.21
March	2,577	1,038	1,722	.916	1.06
April	2,625	1,018	2,221	1.18	1.32
May	9,435	2,329	6,047	3.22	3.71
June	8,906	1,973	2,665	1.42	1.58
July	4,184	2,015	2,395	1.27	1.46
August	5,297	2,028	3,070	1.63	1.88
September	2,522	1,944	2,303	1.22	1.36
October	2,510	355	1,473	.784	.904
November	470	343	432	.230	.257
December	457	140	409	.218	.251
The year	9,435	140	2,262	1.20	16.35

PENOBSCOT RIVER AT WEST ENFIELD, ME.

This station was established by N. C. Grover, November 5, 1901, and prior to 1904 was designated as being at Montague, Me. In 1904 the name of this village was changed to West Enfield. The gaging station is located at the steel highway bridge, about 1,000 feet below the mouth of Piscataquis River.

The channel is straight for 1,000 feet above and 3,000 feet below the station, about 870 feet wide, and broken by four piers. The banks are high and rocky, and the bed permanent and rocky, with some gravel. The velocity is good at all stages. Water power is used on both Penobscot and Piscataquis rivers within a mile above the station. Fluctuations at the gage of 0.2 or 0.3 foot during low water are caused by changes in gate openings at the mills above.

Discharge measurements are made from the bridge. The initial point for soundings is on the easterly abutment, at the extreme end of the inclined post on the downstream side of the bridge.

A standard chain gage, which is read twice each day by A. H. Hanson, is fastened to the steel webbing on the upstream side of the bridge. The length of the chain was 34.49 feet when the gage was established, but changed to 34.44 feet June 24, 1905, owing to settling.

The gage is referred to bench marks as follows: (1) Top of 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 the gage; elevation, 29.52 feet. All elevations are above gage datum, which is at an elevation of 125.38 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 15; 82, p 16; 97, p 28; 124, pp 37–38.
Discharge: 65, p 15; 82, p 17; 97, p 28; 124, p 38.
Discharge, monthly: 82, p 18; 97, pp 31–32; 124, p 40.
Gage heights: 65, p 15; 82, p 17; 97, pp 29–30; 124, p 39.
Rating tables: 82, p 18; 97, p 31; 124, p 40.

Discharge measurements of Penobscot River at West Enfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 17	University of Maine students, under direction of Prof. H. S. Boardman.	886	8,200	3.32	9.00	27,200
May 1	do	869	5,900	2.69	6.40	15,900
September 29	do	690	2,730	1.48	2.70	4,050
September 30	do	690	2,730	1.48	2.65	4,060
October 3	do	675	2,410	1.64	2.40	3,960
October 5	do	643	2,350	1.44	2.12	3,390
October 18	do	620	2,173	1.27	1.90	2,770
October 19	do	620	2,047	1.39	1.90	2,840
October 24	do	579	1,728	1.10	1.30	1,900
October 25	do	577	1,670	1.12	1.25	1,870

Daily gage height, in feet, of Penobscot River at West Enfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	12.1	6.65	6.15	2.6	3.8	3.05	2.3	1.3	3.1
2	5.35	.....	.....	12.45	6.7	5.85	2.85	3.65	2.95	2.4	1.45	2.25
3	.....	.....	.....	11.85	6.6	5.45	3.55	3.5	3.05	2.4	1.85	1.9
4	.....	.....	.....	10.55	6.65	5.1	3.75	3.45	3.0	2.35	2.0	2.4
5	.....	.....	.....	10.05	6.6	4.9	4.0	3.65	3.05	2.15	1.8	2.9
6	.....	4.95	4.85	10.0	6.4	4.65	3.6	3.7	3.05	2.15	1.9	2.85
7	.....	.....	.....	10.7	6.2	4.9	3.25	3.1	2.8	1.95	1.95	2.8
8	.....	.....	.....	11.45	6.1	4.7	2.95	3.15	2.55	2.1	1.8	2.7
9	5.75	.....	.....	10.8	6.3	4.35	2.75	3.3	2.4	2.0	1.95	2.7
10	.....	.....	.....	10.15	6.3	4.1	2.95	3.7	2.35	1.9	1.8	2.95
11	.....	.....	.....	9.75	6.2	4.0	3.2	3.45	2.3	2.0	1.7	.....
12	.....	.....	.....	9.8	6.1	4.3	3.7	2.75	2.2	2.0	1.35	.....
13	.....	4.85	4.55	9.75	6.45	4.5	3.2	2.55	2.45	2.1	1.65	.....
14	.....	.....	.....	9.45	6.2	4.65	3.1	2.8	2.1	2.1	1.7	.....
15	.....	.....	.....	9.25	6.05	4.65	2.95	2.65	2.25	2.2	1.35	.....
16	5.65	.....	.....	9.1	6.35	4.6	2.65	2.55	2.2	2.15	1.3	.....
17	.....	.....	.....	8.9	6.4	4.6	3.35	2.95	2.15	2.0	1.9	.....
18	.....	.....	.....	8.55	6.8	4.25	3.45	3.2	2.35	1.9	2.0	.....
19	.....	.....	.....	8.0	7.4	3.95	3.2	3.2	2.5	1.9	2.1	.....
20	.....	4.75	4.28	7.65	8.05	4.0	3.1	3.05	2.6	1.9	2.25	.....
21	.....	.....	4.35	7.6	7.85	3.85	3.0	3.1	2.6	1.65	2.05	.....
22	.....	.....	4.5	7.95	7.55	3.75	2.9	2.65	2.6	1.3	1.9	.....
23	5.65	.....	4.45	8.1	7.35	3.65	2.9	2.45	2.45	1.6	1.8	.....
24	5.65	.....	4.6	8.1	7.05	3.4	3.2	2.25	2.35	1.3	1.8	.....
25	5.55	.....	4.75	7.85	7.1	3.25	3.15	2.05	2.65	1.25	1.5	.....
26	5.65	.....	5.35	7.65	7.1	3.15	3.35	2.05	2.5	1.2	1.15	2.4
27	5.55	5.15	5.75	7.35	7.05	3.35	3.2	2.45	2.5	1.3	1.7	.....
28	.....	.....	6.35	7.4	6.9	3.35	3.15	2.65	2.6	1.3	2.15	.....
29	.....	.....	7.5	7.1	6.7	3.05	3.25	2.7	2.65	1.0	1.8	.....
30	5.45	.....	8.8	6.85	6.45	2.95	3.3	2.55	2.55	1.2	2.0	.....
31	.....	.....	10.65	.....	6.1	.....	3.45	2.8	.....	1.3	.....	.....

NOTE.—River was frozen January 1–21, open January 22–25, frozen January 26 to March 19, and open at the gage March 20 to April 10. The ice broke up at the bridge March 31. Jam of ice below the gage April 1–10. River clear of ice April 11. River frozen December 1–31, but open at the gage until December 11. During frozen periods gage heights are to the surface of the water in a hole cut in the ice.

The following thicknesses of ice were measured:

	Foot.		Foot.
January 2	0.8	February 20	0.8
January 9	.75	February 27	.7
January 16	.6	March 6	.4
January 27	.3	March 13	.3
January 30	.5	December 26 (gage height to top of ice 2.6 feet)	.8
February 6	.7		
February 13	.75		

Station rating table for Penobscot River at West Enfield, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	1,630	2.70	4,130	4.40	8,580	7.20	18,440
1.10	1,735	2.80	4,340	4.50	8,880	7.40	19,350
1.20	1,845	2.90	4,560	4.60	9,180	7.60	20,290
1.30	1,960	3.00	4,785	4.70	9,485	7.80	21,260
1.40	2,080	3.10	5,020	4.80	9,790	8.00	22,270
1.50	2,205	3.20	5,260	4.90	10,100	8.20	23,320
1.60	2,330	3.30	5,510	5.00	10,410	8.40	24,410
1.70	2,465	3.40	5,770	5.20	11,040	8.60	25,540
1.80	2,600	3.50	6,035	5.40	11,680	8.80	26,710
1.90	2,740	3.60	6,300	5.60	12,335	9.00	27,900
2.00	2,885	3.70	6,570	5.80	13,000	9.50	31,030
2.10	3,040	3.80	6,845	6.00	13,685	10.00	34,330
2.20	3,200	3.90	7,125	6.20	14,395	10.50	37,780
2.30	3,370	4.00	7,405	6.40	15,135	11.00	41,370
2.40	3,550	4.10	7,695	6.60	15,915	11.50	45,070
2.50	3,735	4.20	7,990	6.80	16,730	12.00	48,840
2.60	3,930	4.30	8,285	7.00	17,570	12.50	52,680

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1904–5. It is well defined between gage heights 1.2 feet and 12 feet.

Estimated monthly discharge of Penobscot River at West Enfield, Me., for 1905.

[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 (11–30)	32,990	16,940	24,280	3.66	2.72
May	22,530	13,860	16,430	2.48	2.86
June	14,215	4,672	8,226	1.24	1.38
July	7,405	3,930	5,281	.797	.919
August	6,845	2,962	4,794	.723	.834
September	4,902	3,040	3,883	.586	.654
October	3,550	1,630	2,667	.402	.464
November	3,285	1,790	2,569	.387	.432

[a] Includes Chamberlain Lake drainage. See description of St. John River drainage basin, p. 20.

EAST BRANCH PENOBSCOT RIVER AT GRINDSTONE, ME.

This station was established October 23, 1902, by F. E. Pressey. It is located at the Bangor and Aroostook Railroad bridge, one-half mile south of the railroad station.

The channel is straight both above and below the station. The flow is moderately rapid at medium and high stages of the river, but sluggish at low water. 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.

Discharge measurements are made from the railway bridge. The initial point for soundings is on the left bank at the lower end of the inclined end post.

A standard chain gage, which is read twice each day by Harry Stinson, is fastened to the guard timber on the upstream side of the bridge. The length of the chain was 31.99 feet when the gage was established, but changed to 31.95 feet July 5, 1905, owing to settling. The gage is referred to bench marks as follows: (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.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 22; 97, pp 32–33; 124, pp 40–41.
Discharge: 82, p 22; 97, p 33; 124, p 41.
Discharge, monthly: 97, p 34; 124, p 43.
Gage heights: 82, p 22; 97, p 33; 124, p 42.
Rating table: 97, p 34; 124, p 43.

Discharge measurements of East Branch Penobscot River at Grindstone, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
April 14	F. E. Pressey	259	2,070	1.97	7.45	4,080
October 17	do	225	1,170	.10	3.96	122

Daily gage height, in feet, of East Branch Penobscot River at Grindstone, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					7.35	6.25	5.35	5.4	7.3	4.2	4.5	5.2
2				7.15	7.25	5.95	5.4	5.05	7.3	4.15	4.5	
3					7.1	6.05	5.55	4.9	7.3	4.1	4.5	
4			5.55		6.95	6.45	5.55	4.75	7.05	4.1	4.5	
5					6.4	7.15	5.55	4.7	6.25	4.1	4.4	
6		5.55			5.85	7.35	5.6	4.8	6.1	4.1	4.4	
7	5.65			8.95	5.95	7.05	5.35	4.9	5.85	4.1	4.4	
8				8.55	5.9	7.05	5.3	4.9	5.3	4.1	4.4	
9				8.4	5.85	7.05	5.35	4.9	5.15	4.4	4.4	4.4
10				7.85	5.85	7.15	5.4	4.65	4.8	4.3	4.4	
11			5.55	7.45	5.85	7.1	6.35	4.6	4.6	4.1	4.4	
12		5.55		7.45	5.85	7.05	6.15	4.5	4.4	4.1	4.5	
13				7.45	5.85	7.05	6.05	4.5	4.2	4.1	4.7	
14				7.2	6.1	7.05	6.0	4.5	4.2	4.1	4.7	
15				6.95	6.2	7.05	5.9	4.5	4.4	4.1	4.7	
16	5.65			6.95	6.35	7.05	5.9	4.5	4.4	4.1	4.7	4.4
17				6.7	6.5	6.8	5.9	4.5	4.5	4.2	4.7	
18		5.55	5.25	6.25	7.0	6.25	6.15	4.5	4.5	4.3	4.7	
19				6.15	7.4	5.35	6.7	4.5	4.5	4.3		
20				6.15	7.55	5.4	6.9	4.5	4.5	4.3		
21	5.55			6.85	7.5	5.15	6.9	4.5	4.5	4.3		
22				7.25	7.25	5.05	6.9	4.5	4.5	4.3		
23				7.75	7.25	5.05	6.85	4.4	4.3	4.3	4.9	
24				7.85	7.25	5.05	6.8	4.4	4.2	4.3		
25				7.9	7.45	5.1	7.0	4.4	4.2	4.05		
26		5.55	5.55	7.35	7.55	5.25	7.35	5.85	4.2	3.9		4.4
27				7.0	7.55	5.25	7.4	6.2	4.2	3.9		
28				7.05	7.25	5.3	7.4	6.35	4.2	3.9		
29				7.05	7.15	5.35	7.4	6.8	4.2	3.8		
30	5.6			7.15	6.6	5.35	7.4	6.9	4.2	3.8		4.4
31					6.35		7.4	7.1		3.8		

NOTE.—River frozen January 1 to April 7 and November 19 to December 31. During frozen period gage heights were read to the surface of the ice.

The following measurements of the thickness of the ice were made:

	Feet.		Feet.
January 7	1.8	March 18	2.3
January 16	2.0	March 26	1.8
January 21	2.0	April 2	1.0
January 30	2.0	November 23	.2
February 6	2.3	December 1	.5
February 12	2.3	December 9	.5
February 18	2.3	December 16	.7
February 26	2.4	December 26	.7
March 4	2.4	December 30	.7
March 11	2.4		

Station rating table for East Branch Penobscot River at Grindstone, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.80	140	4.90	570	6.00	1,580	7.20	3,495
3.90	160	5.00	630	6.10	1,705	7.40	3,880
4.00	185	5.10	700	6.20	1,840	7.60	4,285
4.10	210	5.20	775	6.30	1,980	7.80	4,710
4.20	240	5.30	855	6.40	2,130	8.00	5,155
4.30	275	5.40	940	6.50	2,285	8.20	5,620
4.40	315	5.50	1,030	6.60	2,445	8.40	6,110
4.50	360	5.60	1,130	6.70	2,610	8.60	6,630
4.60	405	5.70	1,235	6.80	2,780	8.80	7,190
4.70	455	5.80	1,345	6.90	2,955	9.00	7,780
4.80	510	5.90	1,460	7.00	3,130	9.20	8,380

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1902–1905, and is well defined.

Estimated monthly discharge of East Branch Penobscot River at Grindstone, Me., for 1905.

[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 7–30	7,630	1,772	3,842	3.40	3.03
May	4,182	1,402	2,742	2.43	2.80
June	3,782	665	2,039	1.80	2.01
July	3,880	855	2,143	1.90	2.19
August	3,310	315	820	.726	.837
September	3,685	240	911	.806	.899
October	315	140	221	.196	.226
November 1–18	455	315	374	.331	.222

[a] Includes Chamberlain Lake drainage. See description of St. John River drainage basin, p. 20.

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 channel is straight both above and below the station 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 current is strong at high and medium at low stages. 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.

Discharge measurements at ordinary and high stages are made from the bridge, which is slightly oblique to the thread of the stream. The initial point for soundings is on the south abutment at the lower end of the inclined end post of the downstream truss. 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.

A standard chain gage, which is read twice each day by W. T. Mincher, is attached to the guard timber of the lower side of the bridge. The length of the chain is 33.40 feet. The gage 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, which is at elevation 185.93 feet above mean sea level, as determined by the Penobscot River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, pp 22–23; 97, p 35; 124, p 44.
Discharge: 82, p 23; 97, p 35; 124, p 45.
Discharge, daily: 97, p 37.
Discharge, monthly: 97, p 38; 124, p 47.
Gage heights: 82, p 23; 97, p 36; 124, pp 45–46.
Rating table: 97, p 36; 124, p 46.

Discharge measurements of Mattawamkeag River at Mattawamkeag, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 13	F. E. Pressey	404	2,460	4.37	9.40	10,740
May 5	do	396	1,350	3.07	6.69	4,150
June 23	Pressey and Adams	338	660	2.21	4.91	1,460
October 24	F. E. Pressey	153	120	.98	2.65	117
October 25[a]	do	100	88	1.18	2.62	104
November 15[a]	do	145	176	2.19	3.61	385

[a] Measurement made by wading about 1 mile above gage.

Daily gage height, in feet, of Mattawamkeag River, at Mattawamkeag, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0				6.9	5.3	4.2	3.5	2.8	2.7	2.6	4.9
2				11.4	6.8	5.3	4.2	3.5	2.8	2.6	2.7	4.9
3				8.85	6.7	5.3	4.2	3.5	2.8	2.6	2.7	4.7
4				8.6	6.7	5.2	4.2	3.45	2.8	2.5	3.4	4.8
5		4.7	4.9	8.45	6.65	5.2	4.2	3.3	2.9	2.5	3.5	4.9
6				8.65	6.5	5.2	4.2	3.3	3.1	2.5	3.6	5.05
7				9.2	6.3	5.2	4.2	3.3	3.1	2.5	3.6	5.0
8				9.8	6.2	5.1	4.2	3.2	3.2	2.5	3.6	4.9
9	4.2			10.0	6.1	5.1	4.2	3.2	3.2	2.5	3.6	4.8
10				10.0	6.1	4.95	4.2	3.25	3.2	2.5	3.6	4.65
11				9.9	6.1	4.85	4.1	3.4	3.1	2.5	3.7	4.5
12		4.7	4.7	9.6	6.15	4.7	4.1	3.4	3.0	2.5	3.7	4.4
13				9.45	6.1	4.65	4.0	3.4	3.0	2.6	3.7	4.4
14				9.3	5.95	4.8	4.0	3.25	3.2	2.6	3.7	4.55
15				9.3	5.65	4.95	3.9	3.1	3.4	2.6	3.6	4.8
16	4.7			9.3	5.65	5.2	3.9	3.1	3.35	2.6	3.6	4.9
17				9.15	5.9	5.55	3.8	3.0	3.3	2.5	3.7	4.9
18				8.8	6.1	5.25	3.7	3.2	3.2	2.5	3.95	4.85
19			4.7	8.4	6.5	5.35	3.7	3.2	3.2	2.6	4.25	4.75
20		4.4		8.15	6.75	5.7	3.7	3.2	3.3	2.6	4.6	4.8
21				7.9	7.35	5.6	3.7	3.15	3.2	2.7	4.3	4.8
22	4.7			7.9	7.2	5.1	3.7	3.0	3.2	2.7	4.05	4.7
23				8.0	7.2	4.95	3.7	2.9	3.1	2.7	3.9	4.7
24				8.0	7.3	4.75	3.55	2.85	2.0	2.7	3.9	4.6
25				8.0	7.15	4.55	3.4	3.0	2.95	2.7	4.0	4.6
26		4.7	4.9	7.9	6.8	4.4	3.6	3.1	2.8	2.7	4.0	4.5
27				7.7	6.45	4.3	3.7	3.0	2.8	2.7	4.0	4.5
28				7.35	6.0	4.4	3.6	2.9	2.7	2.6	4.0	4.4
29	4.7			7.1	5.6	4.3	3.45	2.9	2.7	2.6	4.15	4.4
30				7.0	5.45	4.3	3.5	2.7	2.7	2.6	4.4	4.5
31					5.3		3.5	2.8		2.6		4.5

NOTE.—River frozen January 1 to April 1, and December 17–31. For these periods the gage-height readings were taken to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	4.0		0.7
January 9	4.2		1.0
January 16	4.7		1.2
January 22	4.7		1.3
January 29	4.7	5.0	1.3
February 5	4.7	4.9	1.6
February 12	4.7	4.9	1.6
February 20	4.4	4.6	1.6
February 26	4.7	4.9	1.6
March 5	4.9	5.0	1.6
March 12	4.7	4.9	1.6
March 19	4.7	4.9	1.6
March 26	4.9	5.1	1.6

April 6, river clear of ice. May 8–9 and November 3, no record; gage heights estimated. December 17–31, river frozen over, but not safe to go upon; ice 0.6 foot thick December 31.

Station rating table for Mattawamkeag River at Mattawamkeag, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	86	4.00	660	5.50	2,359	8.00	7,275
2.60	100	4.10	736	5.60	2,505	8.20	7,750
2.70	114	4.20	818	5.70	2,658	8.40	8,235
2.80	134	4.30	906	5.80	2,818	8.60	8,730
2.90	160	4.40	1,000	5.90	2,985	8.80	9,235
3.00	190	4.50	1,100	6.00	3,160	9.00	9,750
3.10	223	4.60	1,206	6.20	3,525	9.20	10,275
3.20	258	4.70	1,318	6.40	3,900	9.40	10,820
3.30	295	4.80	1,436	6.60	4,285	9.60	10,380
3.40	334	4.90	1,559	6.80	4,675	9.80	11,945
3.50	375	5.00	1,687	7.00	5,075	10.00	12,520
3.60	420	5.10	1,817	7.20	5,495	10.50	14,000
3.70	470	5.20	1,949	7.40	5,920	11.00	15,590
3.80	525	5.30	2,083	7.60	6,360		
3.90	590	5.40	2,219	7.80	6,810		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1902–1905. It is well defined between gage heights 2.6 feet and 9.5 feet.

Estimated monthly discharge of Mattawamkeag River at Mattawamkeag, Me., for 1905.

[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 2–30	16,910	5,075	9,194	6.09	6.57
May	5,812	2,083	3,898	2.58	2.97
June	2,658	906	1,695	1.12	1.25
July	818	334	601	.398	.459
August	375	114	250	.166	.191
September	334	114	209	.138	.154
October	114	86	98.7	.065	.075
November	1,206	100	541	.358	.399
December 1–16	1,752	1,000	1,461	.967	.595

PISCATAQUIS RIVER NEAR FOXCROFT, ME.

This station was established August 17, 1902, by F. E. Pressey. It is located at Low's bridge, about half way between Guilford and Foxcroft.

The channel is straight above and below the station, and has a width at ordinary stages of about 90 feet. The banks are high and rocky; the bed is rough and rocky, but permanent. The current is strong at high and medium at low stages. 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.

Discharge measurements are made at ordinary and high stages from the bridge. The initial point for soundings is on the left bank at the top of the face of the left abutment. 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.

A staff gage is spiked vertically to the left abutment. It is read twice each day by A. F. D. Harlow. The gage 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 the initial point; elevation, 21.80 feet. All elevations are above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 23; 97, pp 38–39; 124, pp 47–48.
Discharge: 82, p 23; 97, p 39; 124, p 48.
Discharge, monthly: 82, p 24; 97, p 41; 124, p 50.
Gage heights: 82, p 24; 97, p 40; 124, pp 48–49.
Rating tables: 82, p 24; 97, p 40; 124, p 49.

Discharge measurements of Piscataquis River near Foxcroft, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 15	F. E. Pressey	128	550	5.24	5.35	2,880
June 20	Pressey and Adams	104	230	1.85	3.04	425

Daily gage height, in feet, of Piscataquis River near Foxcroft, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	3.1	3.8	8.3	3.5	2.9	2.4	2.4	2.1	2.0	2.0	2.1
2	3.5	3.1	3.8	6.5	3.8	2.8	2.8	2.4	2.3	2.2	2.0	2.2
3	3.5	3.2	3.8	6.5	4.0	2.8	3.7	2.4	1.8	2.3	2.0	2.2
4	3.2	3.7	3.8	4.8	4.5	2.8	3.3	2.4	2.2	2.3	2.0	2.4
5	3.2	2.8	3.6	4.3	4.4	2.6	3.0	2.4	2.3	2.3	1.7	2.4
6	3.1	3.2	3.5	5.2	4.4	3.0	2.8	.8	2.6	2.2	2.0	2.4
7	3.0	3.7	3.0	8.2	4.2	3.0	2.8	2.0	2.6	2.0	2.0	2.4
8	3.0	3.7	2.6	5.7	4.0	2.8	2.8	2.1	2.7	1.8	2.0	2.4
9	3.4	3.2	2.6	4.7	3.9	2.8	2.6	2.1	2.2	2.3	2.3	2.2
10	4.0	3.2	2.5	4.7	3.9	2.7	2.6	2.2	2.0	2.3	2.2	2.0
11	4.0	3.2	2.4	4.7	3.1	2.4	2.6	2.2	2.3	2.3	2.0	2.2
12	4.0	3.2	2.4	4.9	3.1	2.6	2.6	2.2	2.4	2.3	1.7	2.5
13	4.0	3.2	2.5	5.0	3.3	3.1	2.5	1.5	2.4	2.3	2.0	2.6
14	4.0	3.2	2.5	4.8	3.7	3.1	2.5	2.3	2.4	2.3	2.2	2.6
15	3.6	3.3	2.6	5.2	4.1	3.0	2.0	2.3	2.4	1.7	2.0	2.6
16	4.0	3.4	2.6	5.0	3.3	3.0	2.0	2.3	2.3	2.2	1.9	2.6
17	3.6	3.3	2.6	4.6	3.3	2.8	2.2	2.2	2.0	2.2	2.2	2.2
18	3.7	3.2	2.6	4.3	3.3	2.9	2.0	2.2	2.0	2.2	2.4	2.1
19	3.8	2.8	2.4	4.4	3.3	3.3	2.0	2.2	1.7	2.0	2.6	2.2
20	3.7	3.0	2.8	3.6	3.8	3.5	2.1	2.2	1.7	1.9	2.2	2.0
21	3.4	3.0	3.0	3.9	3.8	3.4	2.1	2.2	1.8	1.9	2.2	2.0
22	3.4	3.1	3.0	4.6	3.4	3.2	2.0	2.2	2.2	1.6	2.2	2.0
23	3.6	3.2	3.1	4.7	3.2	3.1	2.0	2.2	2.2	1.9	2.1	2.0
24	3.6	3.3	3.2	4.3	3.2	2.9	2.2	2.2	1.9	1.9	2.0	2.0
25	3.6	3.4	3.2	4.2	3.2	3.0	2.2	2.2	2.0	1.9	1.9	2.0
26	3.4	4.2	3.2	4.3	3.1	2.8	2.2	2.2	2.0	1.9	1.8	2.0
27	3.6	4.2	4.8	4.4	3.3	2.9	2.2	1.8	2.2	1.9	2.3	2.0
28	3.4	4.0	5.4	4.4	3.3	2.9	2.2	2.0	2.2	1.9	2.2	2.0
29	2.8	.....	6.5	3.8	2.9	2.8	2.2	2.0	1.9	1.5	2.2	1.9
30	3.2	.....	6.6	3.5	2.9	2.5	2.2	2.1	1.9	1.5	2.0	1.9
31	3.2	.....	8.0	.....	2.9	.....	2.5	2.1	.....	1.5	.....	1.9

NOTE.—Ice in river broke up March 30; river clear of ice April 7. River did not freeze at section near gage during 1905.

Station rating table for Piscataquis River near Foxcroft, Me., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.50	19	2.70	267	3.90	1,113	5.20	2,635
1.60	24	2.80	318	4.00	1,208	5.40	2,940
1.70	31	2.90	374	4.10	1,303	5.60	3,265
1.80	40	3.00	437	4.20	1,403	5.80	3,610
1.90	51	3.10	502	4.30	1,508	6.00	3,970
2.00	64	3.20	569	4.40	1,615	6.20	4,335
2.10	81	3.30	638	4.50	1,725	6.40	4,705
2.20	100	3.40	709	4.60	1,840	6.60	5,080
2.30	123	3.50	782	4.70	1,960	6.80	5,460
2.40	148	3.60	858	4.80	2,085	7.00	5,840
2.50	180	3.70	938	4.90	2,215		
2.60	220	3.80	1,023	5.00	2,350		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1902–1905. It is well defined between gage heights 1.5 feet and 6 feet.

Estimated monthly discharge of Piscataquis River near Foxcroft, Me., for 1905.

[Drainage area, 280 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January [a]	1,208	64	788	2.81	3.24
February [a]	1,403	318	674	2.41	2.51
March [a]	7,810	148	1,119	4.00	4.61
April [a]	8,425	782	2,460	8.79	9.81
May	1,725	374	858	3.06	3.53
June	782	148	395	1.41	1.57
July	938	64	200	.714	.823
August [b]	148	5	96.4	.344	.397
September	267	31	103	.368	.411
October	123	19	76.1	.272	.314
November	220	31	82.2	.294	.328
December	220	51	108	.385	.444
The year	8,425	5	580	2.07	27.99

[a] Estimates January 1 to April 7 may have been affected by ice conditions on the river. The river was open at the gage.
[b] August 6, discharge estimated at 5 second-feet. The water was held back on account of construction work on the river.

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 an area of about 8 square miles.

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 but 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, with a 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 backwater 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 the Enfield post-office. The drainage area at this point is about 26 square miles.

The stream is fairly straight in the vicinity of the measuring section and is about 30 feet wide at ordinary stages. The depth is usually about 0.9 foot and the velocity is high at all stages. The bed of the stream is rocky and permanent; the banks are not high and probably overflow at high stages.

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.

A standard chain gage which is read once each day by A. J. Twombley, is fastened to a clump of maple trees on the right bank of the river. The length of the chain is 10.24 feet. The gage is referred to bench marks as follows: (1) Spike in maple

tree near the gage; elevation, 6.89 feet. (2) Point on a rock marked "B. M.–2," about 8 feet downstream from the gage, on the right bank; elevation, 4.55 feet. (3) Center of the gage-box pulley; elevation, 9.03 feet. Elevations are above gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pages 50–51.

Discharge measurements of Cold Stream at Enfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28	F. E. Pressey	33	19.7	1.15	2.68	22.6
May 3	do	41	44	3.81	3.33	168
May 8	do	33	19.3	1.52	2.63	29.3
May 26	do	32	23	2.23	2.78	52
May 26	do	28	18.2	3.03	2.78	55
May 26	do	16.5	22	1.87	2.78	42
June 24	do	32	23	2.30	2.80	52
October 23	do	30	14.1	1.51	2.68	21.3
November 28	do	34	12.4	1.28	2.64	15.9

Daily gage height, in feet, of Cold Stream at Enfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.7	2.8	2.9	3.9	2.8	2.7	2.7	2.5	2.7	2.6	2.7
2	2.6	2.8	2.7	2.8	3.6	2.7	2.7	2.6	2.5	2.7	2.6	2.6
3	2.7	2.7	2.8	2.8	3.4	2.7	2.8	2.6	2.6	2.7	2.7	2.6
4	2.7	2.7	2.6	2.9	3.4	2.8	2.8	2.5	2.6	2.6	2.7	2.6
5	2.6	2.7	2.6	2.9	3.1	2.8	2.8	2.5	2.7	2.6	2.7	2.6
6	2.6	2.7	2.6	3.0	2.9	2.8	2.8	2.5	2.6	2.7	2.7	2.6
7	2.6	2.7	2.8	3.0	2.7	2.8	2.7	2.5	2.6	2.7	2.7	2.7
8	2.8	2.7	2.8	2.8	2.6	2.8	2.7	2.5	2.8	2.6	2.6	2.7
9	2.8	2.7	2.7	2.7	2.6	2.8	2.8	2.5	2.8	2.6	2.6	2.7
10	2.7	2.7	2.7	2.7	3.0	2.8	2.8	2.5	2.8	2.6	2.6	2.6
11	2.7	2.7	2.8	2.7	3.2	2.8	2.8	2.5	2.8	2.6	2.7	2.9
12	2.7	2.7	2.8	2.7	3.2	2.7	2.8	2.4	2.8	2.7	2.7	2.8
13	2.7	2.7	2.7	2.7	3.1	2.8	2.8	2.4	2.8	2.7	2.6	2.6
14	2.6	2.7	2.7	2.6	3.1	2.7	2.9	2.4	2.8	2.7	2.6	2.6
15	2.6	2.8	2.7	2.7	3.0	2.8	2.9	2.4	2.7	2.7	2.7	2.6
16	2.6	2.7	2.7	2.7	3.0	2.8	2.8	2.5	2.7	2.7	2.7	2.6
17	2.8	2.7	2.6	2.7	2.7	2.7	2.7	2.5	2.7	2.6	2.7	2.6
18	2.8	2.7	2.6	2.6	2.7	2.7	2.8	2.5	2.7	2.6	2.7	2.6
19	2.7	2.7	2.7	2.6	2.6	2.8	2.8	2.5	2.8	2.6	2.6	2.6
20	2.8	2.7	2.7	2.7	2.7	2.8	2.8	2.5	2.8	2.6	2.6	2.6
21	2.9	2.7	2.7	2.6	2.7	2.8	2.8	2.5	2.8	2.7	2.6	2.7
22	2.8	2.7	2.8	2.6	2.7	2.9	2.9	2.5	2.7	2.6	2.6	2.7
23	2.7	2.7	2.8	2.7	2.7	2.9	2.8	2.5	2.7	2.6	2.6	2.6
24	2.7	2.7	2.7	2.6	2.8	2.9	2.8	2.5	2.7	2.6	2.6	2.6
25	2.7	2.7	2.7	2.6	2.8	2.8	2.9	2.5	2.7	2.7	2.6	2.6
26	2.6	2.7	2.8	2.6	2.7	2.8	2.8	2.5	2.7	2.7	2.6	2.6
27	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.6	2.8	2.6	2.6	2.6
28	2.7	2.6	2.6	2.8	2.8	2.8	2.9	2.5	2.8	2.7	2.7	2.6
29	2.7	.....	2.7	3.6	2.8	2.8	2.8	2.5	2.8	2.7	2.7	2.6
30	2.6	.....	2.8	3.7	2.8	2.8	2.7	2.5	2.8	2.7	2.7	2.6
31	2.6	.....	2.8	.....	2.8	.....	2.6	2.5	.....	2.7	.....	2.6

NOTE.—River was frozen December 11–13; ice reached a thickness of 0.3 foot.

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 but sparsely settled. The water is apparently of excellent quality and of considerable depth. This lake is under consideration as a new source of water supply for the city of Bangor. It has two drainage outlets. The greater amount of water flows from the north end of the lake northward through the village of East Holden, thence southward 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 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 can be made from a railroad bridge about 1 mile upstream. The channel is straight for about 10 to 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 foot; velocity, high at all stages. The gage is read once each day by Lewis Pinkham, of East Holden.

The station at the southeastern 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 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 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, as the flow through this outlet is closely proportional to the lake height.

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 is not now in use, as 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 north 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.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 52–54.

Discharge measurements of Phillips Lake, northern outlet, at East Holden, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 17	F. E. Pressey	15.5	9.9	2.44	1.84	24.2
May 25[a]	do	17.0	11.1	2.45	1.90	27.2
April 29[a]	do	17.0	12.2	2.52	1.90	30.7
June 17	Pressey and Adams	12.5	11.5	1.87	1.82	21.5
August 11	F. E. Pressey	12.5	9.2	1.63	1.77	15.0
August 15	Barrows and Pressey	9.3	8.6	1.28	1.67	11.0
September 2	F. E. Pressey	9.5	9.3	1.35	1.74	12.6
October 21	do	5.7	3.0	.60	1.41	1.8

[a] From log across stream 100 feet below gage.

Discharge measurements of Phillips Lake, southeastern outlet, near Lake House railroad station, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Gage height, Phillips Lake.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet*	*Feet.*	*Sec.-ft.*
April 17	F. E. Pressey	8.0	19.3	2.26	2.80	9.40	42.7
April 29	do	8.0	15.4	.79	2.28	8.94	12.2
May 25	do	8.0	14.3	.83	2.20	8.97	11.9
June 17	Pressey and Adams	4.0	1.8	1.83	1.62	8.48	3.3
August 11	F. E. Pressey	2.5	1.19	1.05	1.38	7.37	1.25
August 15	Barrows and Pressey	2.5	1.06	.98	1.35	7.20	1.04
September 2	F. E. Pressey	.5	.08	.67	1.06	6.40	.05
October 21	do	.35	.05	.58	1.10	6.00	.03

Daily gage height, in feet, of Phillips Lake, northern outlet, at East Holden, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.75	1.6	2.05	1.9	1.9	1.85	1.55	1.8	1.4	1.7	1.5
2	1.6	1.75	1.6	1.8	1.9	1.9	1.9	1.55	1.8	1.4	1.5	1.5
3	1.6	1.75	1.6	1.8	1.85	1.9	1.9	1.55	1.8	1.4	1.5	1.7
4	1.6	1.75	1.6	1.85	1.95	1.9	1.9	1.55	1.8	1.4	1.5	1.7
5	1.7	1.75	1.6	1.9	1.9	1.9	1.7	1.55	1.8	1.4	1.5	1.55
6	1.7	1.7	1.6	2.2	1.95	2.0	1.7	1.55	1.6	1.4	1.5	1.55
7	1.7	1.7	1.6	2.2	1.9	1.9	1.5	1.8	1.5	1.4	1.5	1.55
8	2.7	1.7	1.55	2.1	1.9	1.9	1.5	1.85	1.45	1.4	1.55	1.55
9	2.55	1.7	1.55	2.0	1.9	1.9	1.5	1.8	1.4	1.4	1.6	1.6
10	2.15	1.7	1.55	1.9	1.9	1.9	1.5	1.8	1.4	1.4	1.55	1.75
11	2.05	1.7	1.5	1.9	1.9	1.9	1.5	1.8	1.4	1.4	1.5	1.9
12	1.95	1.7	1.5	1.9	1.95	1.85	1.5	1.8	1.4	1.4	1.5	1.7
13	1.95	1.7	1.5	1.8	1.95	1.9	1.55	1.8	1.4	1.4	1.5	1.6
14	1.9	1.7	1.5	1.8	1.95	1.85	1.55	1.8	1.4	1.4	1.5	1.6
15	1.9	1.7	1.5	1.8	1.95	1.85	1.55	1.8	1.4	1.8	1.5	1.6
16	1.9	1.7	1.5	1.85	2.0	1.85	1.55	1.75	1.4	1.5	1.6	1.6
17	1.85	1.65	1.5	1.85	2.05	1.85	1.55	1.7	1.4	1.4	1.6	1.6
18	1.85	1.65	1.5	1.8	2.0	1.85	1.55	1.7	1.4	1.4	1.55	1.6
19	1.85	1.65	1.55	1.9	2.0	1.9	1.55	1.7	1.4	1.4	1.5	1.9
20	1.8	1.65	1.6	1.9	2.0	1.95	1.55	1.7	1.4	1.4	1.5	1.9
21	1.8	1.65	1.55	1.85	2.0	1.95	1.55	.....	1.4	1.4	1.5	1.9
22	1.8	1.6	1.6	2.0	2.0	1.95	1.55	.....	1.4	1.8	1.5	2.3
23	1.8	1.6	1.6	2.0	2.0	1.9	1.55	1.9	1.4	1.5	1.5	1.9
24	1.8	1.6	1.6	2.0	2.0	1.9	1.55	1.9	1.4	1.5	1.5	2.0
25	1.8	1.6	1.7	2.0	1.95	1.9	1.55	1.9	1.4	1.5	1.4	2.4
26	1.8	1.6	1.9	1.95	1.95	1.85	1.55	1.9	1.4	1.5	1.4	2.0
27	1.8	1.6	1.95	1.9	1.9	1.9	1.55	1.85	1.4	1.5	1.4	1.9
28	1.8	1.6	2.0	1.9	1.9	1.85	1.55	1.85	1.4	1.5	1.4	1.9
29	1.8	.....	2.1	1.9	1.9	1.85	1.55	1.85	1.4	1.5	1.45	1.9
30	1.8	.....	2.1	1.9	1.9	1.85	1.55	1.8	1.4	1.5	1.5	1.8
31	1.75	.....	2.3	.....	1.9	.....	1.6	1.8	.....	1.5	.....	1.8

NOTE.—River did not freeze near gage during 1905.

Daily gage height, in feet, of Phillips Lake near East Holden, Me., for 1905.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			9.5			8.1					
2								6.4			6.5
3					8.7						
4	8.8	8.3								6.0	
5							7.6				
6				8.9							
7									6.3		
8			9.7			8.0					
9								6.4			7.4
10					8.6						
11	8.8	8.3								6.2	
12							7.4				
13				8.8							
14									6.2		
15			9.6			7.9	7.2				
16								6.4			7.6
17			9.4		8.5						
18	8.3	8.2								6.3	
19							7.1				
20				9.1							
21									6.1		
22			9.3			7.7					
23								6.4			7.6
24					8.2						
25	8.4	8.5		9.0						6.3	
26							6.7				
27				8.9							
28									6.0		
29			9.0			7.6					
30								6.3			7.6
31											

NOTE.—February 4, 11, gage height to top of ice; ice 4 inches thick. February 18, 25, and March 4, no ice at gage. April 22, ice left lake. December 16, 2 inches ice at gage. December 23, 30, no ice at gage.

KENNEBEC RIVER DRAINAGE BASIN.

DESCRIPTION OF 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 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 on 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. Between Bingham and tide water there are 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.

Surveys have been made in the Kennebec River drainage basin by the United States Geological Survey as follows: 1903 and 1904, plan and profile of Kennebec River between tide water and Moosehead Lake; 1905, plan and profile of Moose River between Moosehead and Brassua lakes, and above Brassua to near Little Brassua Lake; survey for plan of Brassua Lake and Wood Pond, showing shore lines, contours on banks, soundings, etc.

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.
		Sq. miles.
Kennebec	Outlet of Moosehead Lake	1,330
Do	The Forks at gaging station	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, at gaging station.	2,880
Do	Madison	3,310
Do	Norridgewock	4,020
Do	Fairfield	4,370
Do	Waterville, above mouth of Sebasticook River, at Hollingsworth & Whitney dam.	4,380
Do	Waterville, below mouth of Sebasticook River	5,310
Do	Augusta	5,710
Do	Head of Merrymeeting Bay	6,110
Moose	Mouth and at gaging station	680
Roach	Roach River	85
Do	Mouth	120
Dead	Mouth, The Forks, and at gaging station	870
Carrabassett	North Anson, above Embden Brook, at gaging station	340
Do	Mouth	395
Sandy	Farmington	350
Do	At gaging station	650
Do	Mouth	670
Sebasticook	.....do	930
Messalonskee	At gaging station	205
Do	Mouth	208
Cobbosseecontee	Mouth and at gaging station	240

KENNEBEC RIVER AT THE FORKS, ME.

This station was established September 28, 1901, by N. C. Grover, at the wooden highway bridge across Kennebec River at The Forks, above the mouth of Dead River. Of the drainage area at this station, 1,330 square miles are tributary to Moosehead Lake and the remaining 340 square miles drain into the Kennebec by small streams with steep slopes and no storage. Practically all land surfaces above this point are in forest.

The channel is straight for 200 feet above and 500 feet below the station, is unbroken by piers, and is about 125 feet wide at ordinary stages of the river. The current is swift at high and medium at low stages. The banks are high and rocky and the bed is rocky and permament.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank, marked by a rod across the bridge, just above the abutment and below the bridge floor.

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 a standard chain gage attached to the bridge floor. The length of the chain is 17.18 feet. Gage-height observations are made twice each day by William W. Young. 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; (2) marked point on the floor of the bridge, near the east end of the gage box, elevation, 15.42 feet. Elevations are above gage datum, which is 562.85 feet above mean sea level, as determined by the Kennebec River survey of 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 16; 82, pp 26–27; 97, p 43; 124; pp 56–57.
Discharge: 65, p 16; 82, p 27; 97, p 43; 124, p 57.
Discharge, monthly: 82, p 28; 97, p 45; 124, p 59.
Gage heights: 65, p 16; 82, p 27; 97, p 44; 124, p 58.
Rating tables: 82, p 28; 97, p 45; 124, p 58.

Discharge measurements of Kennebec River at The Forks, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 21	F. E. Pressey	121	660	1.82	1.90	1,200
July 18	do	119	620	1.53	1.53	950
September 4	H. K. Barrows	123	730	2.19	2.30	1,600

Daily gage height, in feet, of Kennebec River at The Forks, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.8	5.1	.....	2.95	4.25	.....	.....	1.4	2.7	1.6	1.6	1.3
2	4.7	5.1	.....	2.85	2.55	.....	.....	3.3	2.7	1.6	1.6	1.3
3	4.8	5.2	4.5	2.6	2.35	.....	.....	2.9	2.4	1.6	1.5	1.3
4	4.8	5.2	.....	2.05	3.25	.....	.....	2.65	2.3	1.6	1.5	1.3
5	4.9	5.2	.....	1.75	3.3	.....	.....	2.55	2.3	1.6	1.5	1.3
6	4.7	5.1	.....	1.6	2.55	.....	.....	2.5	2.0	1.55	1.5	1.3
7	4.5	5.1	.....	1.9	.....	.....	.....	2.55	1.8	1.45	1.5	1.2
8	4.2	5.1	.....	2.1	.....	.....	.....	2.75	1.85	1.4	1.5	1.15
9	4.5	5.1	.....	2.1	.....	.....	.....	2.9	1.9	1.4	1.5	1.1
10	4.2	4.9	.....	2.1	.....	.....	.....	2.8	1.9	1.5	1.5	1.1
11	4.2	4.7	4.0	2.25	.....	.....	.....	2.8	1.9	1.4	1.5	1.1
12	4.3	4.8	.....	2.5	.....	.....	.....	2.8	2.0	1.4	1.5	1.2
13	4.4	4.8	.....	2.75	.....	.....	.....	2.8	2.0	1.4	1.5	1.2
14	4.4	4.8	.....	2.8	.....	.....	.....	2.9	2.0	1.4	1.5	1.3
15	4.3	4.7	.....	2.8	.....	.....	.....	2.8	2.0	1.35	1.5	1.3
16	4.4	4.8	.....	2.75	.....	.....	.....	2.8	2.0	1.3	1.5	.....
17	4.5	4.8	.....	2.55	.....	.....	.....	2.8	1.9	1.25	1.5	.....
18	4.5	.....	3.8	2.3	.....	.....	.....	2.75	1.8	1.2	1.4	3.7
19	4.6	.....	.....	2.05	.....	.....	.....	2.65	1.8	1.2	1.4	.....
20	4.5	.....	3.6	2.15	.....	.....	.....	2.6	1.8	1.2	1.35	.....
21	4.5	4.9	3.5	1.9	.....	.....	.....	2.6	1.8	1.2	1.3	.....
22	.....	.....	3.5	2.3	.....	.....	.....	2.5	1.7	1.2	1.3	.....
23	4.6	.....	3.5	2.4	.....	.....	.....	2.5	1.7	1.2	1.15	.....
24	4.9	4.7	3.5	2.0	.....	.....	.....	2.5	1.7	1.2	1.1	.....
25	4.9	.....	3.4	2.0	.....	.....	.....	2.85	1.7	1.45	1.2	3.4
26	4.9	.....	2.55	2.15	.....	.....	.....	2.75	1.6	1.55	1.2	.....
27	5.0	.....	2.3	2.55	.....	.....	.....	2.75	1.5	1.7	1.2	.....
28	5.0	.....	2.35	2.65	.....	.....	.....	2.75	1.4	1.7	1.2	.....
29	5.0	.....	2.25	2.65	.....	.....	.....	2.75	1.5	1.7	1.2	.....
30	5.0	.....	2.0	2.55	.....	.....	.....	2.7	1.6	1.6	1.3	.....
31	5.0	.....	2.3	.....	.....	.....	.....	2.7	.....	1.6	.....	.....

NOTE.—Ice conditions January 1 to March 26 and December 16–31: January 24, gage reader estimates backwater effect of 0.2 foot due to ice; channel open 80 feet wide at the gage. January 29, channel open about 10 feet wide at the gage. February 1, river frozen over at the gage. Most of the ice went out during the week of March 20–26. December 18, rise in river due to anchor ice; estimated gage height, 2.1 feet. During frozen period gage heights are to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
February 21	4.9	4.9	0.2
February 24	4.7	4.7	.8
March 3	4.5	4.1	.9
March 11	4.0	4.2	1.0
March 18	3.8	3.8	1.0
December 18	3.7	3.7	.25
December 25	3.4	3.4	.3

From about May 1 to July 31 considerable fluctuations in gage heights, amounting to from 2 to over 5 feet, occur daily, due to the regulating of the flow at Indian Pond dam for the purpose of log driving. The morning and evening records obtained by the observer represented the maximum and minimum heights of each day during this period as well as could be determined. The range of the morning readings, May 7 to July 31, was 4.0 to 7.6 feet, and of the evening readings 1.5 to 2.5 feet.

Station rating table for Kennebec River at The Forks, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.10	630	2.00	1,305	2.90	2,325	3.80	3,825
1.20	695	2.10	1,395	3.00	2,470	4.00	4,220
1.30	765	2.20	1,490	3.10	2,620	4.20	4,635
1.40	835	2.30	1,590	3.20	2,775	4.40	5,070
1.50	910	2.40	1,700	3.30	2,935	4.60	5,535
1.60	985	2.50	1,815	3.40	3,100	4.80	6,020
1.70	1,060	2.60	1,935	3.50	3,270	5.00	6,525
1.80	1,140	2.70	2,060	3.60	3,450		
1.90	1,220	2.80	2,190	3.70	3,635		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1901–1905. It is well defined between gage heights, 1.1 feet and 5 feet. The extension above 5 feet is based on the extension of the area and velocity curves, the latter being determined by means of tables based on Kutter's formula.

Estimated monthly discharge of Kennebec River at The Forks, Me., for 1905.

[Drainage area, 1,670 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile	Depth in inches.
March 26–31	1,875	1,305	1,591	0.953	0.213
April	2,400	985	1,666	.998	1.11
May [a]	6,700	1,645	4,330	2.59	2.99
June [a]	8,330	4,780	5,408	3.24	3.62
July [a]	5,310	2,980	4,065	2.43	2.80
August	2,935	835	2,067	1.24	1.43
September	2,060	835	1,248	.747	.833
October	1,060	695	864	.517	.596
November	985	630	838	.502	.560
December 1–15	765	630	717	.429	.239

[a] The mean daily discharge, May 7 to July 31, was computed by averaging the discharges as applied to the morning and evening gage heights, taking account also of the relative length of the high and low water periods.

KENNEBEC RIVER NEAR NORTH ANSON, ME.

This station was established October 18, 1901, by N. C. Grover. It is located 1½ miles east of North Anson, above the mouth of Carrabassett River.

The channel is straight for 500 feet above and 1,000 feet below the station, and has a width of about 350 feet, broken by one pier. The current is swift at high stages and moderately rapid at low stages, except near the left bank. The right bank is high and rocky. 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.

Discharge measurements are made from the wooden highway bridge across the Kennebec, known locally as Patterson Bridge. The initial point for soundings is on the left bank, at the outside of the end post of the center truss of the bridge. 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.

Gage readings are made twice each day by Mrs. C. S. Benjamin, the toll collector at the bridge. There are three gages—one, for ordinary stages, 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, for low-water stages, is a standard chain gage attached to the wooden truss on the upstream side of the bridge. The length of the chain was 30.40 feet when the gage was established, but changed to 30.36 feet July 26, 1904, and to 30.23 feet July 19, 1905, owing to settling of the bridge. The gage datum is 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, as follows: (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 feet July 26, 1904, and to 24.91 feet July 19, 1905. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 16–17; 82, pp 28–29; 97, pp 45–46; 124, pp 59–60,
Discharge: 65, p 17; 82, p 29; 97, p 46; 124, p 60.
Discharge, monthly: 97, p 48; 124, p 62.
Gage heights: 65, p 17; 82, p 29; 97, p 47; 124, p 61.
Rating table: 97, p 47; 124, p 62.

Discharge measurements of Kennebec River near North Anson, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
February 9[a]	Barrows and Norcross	458	1,390	1.50	5.27	2,080
February 9[a]	do	458	1,390	1.54	5.32	2,140
April 19	F. E. Pressey	304	2,150	2.33	4.26	5,000
July 20	do	295	1,930	1.95	3.72	3,770
October 27	do	277	1,460	.90	2.30	1,320

[a] Gage height to top of ice, 5.42 feet. Thickness of ice at gage, 2.65 feet. Average thickness of ice at measuring section, 2 feet.

Daily gage height, in feet, of Kennebec River near North Anson, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				9.45				2.95	3.25	2.3	2.2	3.65
2				8.55				3.45	3.2	2.3	2.25	
3				8.95				4.15	2.95	2.3	2.15	
4		5.35	5.25	9.4				3.45	2.95	2.3	2.3	
5				8.4				3.3	3.1	2.3	2.2	
6				8.1				3.2	3.05	2.25	2.3	
7	5.65			8.9				3.3	2.95	2.1	2.3	
8		5.25		9.25				3.35	2.9	2.1	2.3	
9				8.5				3.4	2.75	2.1	2.3	3.45
10				7.0				3.35	2.75	2.1	2.35	
11		4.9	4.95	5.35				3.35	2.65	2.1	2.25	
12				5.5				3.3	2.55	2.1	2.2	
13				5.5				3.3	2.6	2.05	2.2	
14	6.55			4.9				3.4	2.5	2.0	2.25	
15				5.05				3.45	2.55	2.0	2.2	
16				4.9				3.45	2.65	2.1	2.15	3.35
17				4.65				3.35	2.4	2.05	2.4	3.35
18		5.15	4.85	4.5				3.55	2.7	2.1	2.8	3.45
19				4.3				3.5	2.75	1.95	2.1	
20				4.3				3.4	2.75	1.9	1.95	
21	5.65			4.35				3.2	2.85	1.9	2.1	
22				4.95				3.05	2.8	1.9	2.0	5.65
23				4.65				3.05	2.7	2.0	2.0	
24				4.7				2.95	2.6	1.95	2.1	
25		5.45	5.15	4.75				2.95	2.5	2.0	2.1	
26				4.4				3.15	2.35	2.05	2.15	
27			6.8	4.95				2.7	2.35	2.25	2.3	
28	5.55		6.9	4.7				2.4	2.3	2.2	2.45	5.75
29			7.9	4.9				2.7	2.3	2.25	2.7	
30			8.45	4.95				3.35	2.3	2.3	2.95	
31			8.95					3.2		2.2		

NOTE.—River frozen January 1 to about March 27, when river was probably clear of ice. Also ice conditions December 1–31; the river being closed with the exception of channels in each span, which were probably open during the whole month. Gage heights December 18, 22, and 28 probably affected by backwater from anchor ice. During frozen period gage heights are to the surface of the water in a hole cut in the ice. The ice thickness was measured as follows:

	Feet.		Feet.
January 7	1.9	March 18	2.7
January 14	2.2	March 25	2.5
January 21, 28, February 4	2.3	December 9	.4
February 8, 11, 18	2.2	December 16, 17	.6
February 25, March 4	2.4	December 18, 22	.7
March 11	2.3	December 28	1.0

Fluctuations in the gage heights occur from about May 1 to July 31, as at The Forks, but in less marked degree. (See note to gage-height table, Kennebec at The Forks, p. 54.)

Station rating table for Kennebec River near North Anson, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	990	2.90	2,184	3.90	4,169	4.90	6,532
2.00	1,080	3.00	2,450	4.00	4,385	5.00	6,790
2.10	1,182	3.10	2,621	4.10	4,606	5.20	7,316
2.20	1,294	3.20	2,797	4.20	4,832	5.40	7,858
2.30	1,415	3.30	2,978	4.30	5,062	5.60	8,415
2.40	1,544	3.40	3,164	4.40	5,297	5.80	8,984
2.50	1,680	3.50	3,355	4.50	5,536	6.00	9,565
2.60	1,822	3.60	3,551	4.60	5,779		
2.70	1,970	3.70	3,752	4.70	6,026		
2.80	2,024	3.80	3,958	4.80	6,277		

NOTE.—The above table is applicable only for open channel conditions. It is based on five discharge measurements made during 1904–5 and the form of the 1904 curve. It is well defined between gage heights 2.3 feet and 5 feet.

Estimated monthly discharge of Kennebec River near North Anson, Me., for 1905.

[Drainage area, 2,880 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 27–31	18,840	11,970	15,140	5.26	0.978
April	20,480	5,060	10,180	3.53	3.94
May[a]	12,000	6,940	8,704	3.02	3.48
June[a]	9,390	5,230	7,050	2.45	2.73
July[a]	9,110	2,380	5,481	1.90	2.19
August	4,720	1,544	2,896	1.01	1.16
September	2,885	1,415	1,970	.684	.763
October	1,415	990	1,205	.418	.482
November	2,265	1,035	1,385	.481	.537

[a] From May 1 to July 31, during the log-driving season, the discharge is a mean of the discharges corresponding to gage heights of the high and low daily periods, considering each period as lasting twelve hours.

KENNEBEC RIVER AT WATERVILLE, ME.

The only long-continued observations of the flow of the Kennebec 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. 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 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 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.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, pp 64–65; WS 27, p 9; 35, p 25; 47, p 29; 82, p 30; 97, pp 48–49; 124, pp 62–63.
Discharge: Ann 19, iv, p 72.
Discharge, daily: WS 27, pp 11–14; 35, p 26; 47, p 30; 82, pp 30–31; 97, p 49; 124, p 63.
Discharge, monthly: Ann 19, iv, pp 75–78; 20, iv, p 65; 21, iv, p 52; 22, iv, p 57; WS 82, pp 31–32.
Discharge, yearly: Ann 20, iv, p 46.
Hydrographs: Ann 19, iv, pp 72, 73, 74; 20, iv, p 65; 21, iv, p 53; 22, iv, p 58.
Rainfall and run-off relation: Ann 19, iv, p 74.

Daily discharge, in second-feet, of Kennebec River at Waterville, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,116	3,366	2,645	32,125	10,038	6,501	5,275	5,114	3,077	2,390	2,113	2,809
2	2,256	3,125	2,532	22,278	13,593	7,755	5,040	4,108	2,466	2,205	2,252	2,524
3	3,421	3,422	2,366	16,278	8,680	6,597	5,450	4,401	100	2,433	1,965	1,485
4	2,847	2,868	2,521	14,471	7,113	6,102	8,591	4,018	3,363	2,086	1,952	2,814
5	2,737	2,123	714	10,854	12,907	8,371	7,554	3,496	3,912	1,852	100	3,932
6	2,545	3,225	2,815	11,303	18,324	7,113	6,363	2,030	4,603	1,598	1,960	3,065
7	2,872	2,956	2,202	25,578	11,542	7,480	5,962	3,962	4,350	2,143	2,867	3,133
8	2,094	2,569	2,431	19,498	10,545	5,123	5,422	2,940	4,015	100	2,830	2,784
9	3,699	2,556	2,257	15,715	10,425	6,815	3,434	3,133	3,904	1,813	3,067	2,835
10	3,912	2,484	2,555	12,342	10,923	6,026	4,937	3,397	2,348	2,089	3,113	1,202
11	3,659	2,553	2,541	12,394	11,251	6,119	4,836	2,810	3,596	2,229	2,843	2,499
12	4,182	1,859	2,278	15,260	9,696	6,780	5,024	3,048	3,071	1,879	1,825	2,197
13	3,915	3,158	2,855	15,780	8,440	7,333	5,015	100	3,055	1,875	3,059	1,639
14	3,623	2,475	2,530	27,954	9,109	9,251	4,948	3,909	2,813	1,681	2,514	1,735
15	2,317	2,538	2,273	11,928	9,559	8,493	4,864	3,036	2,990	141	2,810	1,786
16	3,642	2,548	2,208	14,340	8,699	7,386	3,803	3,310	2,998	2,478	1,957	1,520
17	3,108	2,570	2,245	11,456	10,196	6,071	5,025	3,345	1,828	2,428	2,011	1,166
18	3,425	2,546	2,247	12,690	11,441	5,548	4,298	3,822	2,466	2,432	2,840	1,308
19	3,103	1,842	1,553	7,065	14,315	5,881	4,676	2,819	3,616	2,351	1,838	1,327
20	3,099	3,033	2,561	6,291	14,279	6,678	5,002	2,642	4,286	1,817	2,840	1,690
21	3,324	2,547	2,615	7,486	9,711	6,108	5,301	3,653	2,936	1,836	2,243	1,713
22	2,296	2,541	2,849	10,164	8,788	7,433	3,969	3,344	3,663	100	2,390	2,221
23	3,654	2,545	3,384	12,934	10,174	6,678	2,814	3,372	3,987	1,118	1,913	1,748
24	2,766	2,529	3,447	11,205	11,269	6,325	3,997	2,998	1,370	1,555	1,983	914
25	2,825	2,811	3,701	7,878	8,403	5,109	3,648	2,922	3,636	2,397	1,450	2,050
26	2,849	1,200	3,349	8,294	11,298	6,017	3,372	2,955	3,169	1,903	1,216	1,930
27	3,145	3,119	13,250	7,081	10,583	6,633	3,828	1,528	2,802	1,687	3,452	1,996
28	3,430	2,520	15,245	8,881	10,120	6,739	3,308	3,635	2,503	1,936	2,843	2,025
29	1,831	.....	20,950	8,901	8,241	6,672	3,473	3,087	2,206	100	2,547	2,620
30	3,700	.....	21,365	6,603	8,153	5,845	1,491	3,054	142	1,645	2,378	2,062
31	3,150	.....	26,230	.....	8,202	.....	3,986	3,161	.....	2,484	.....	1,212

Estimated monthly discharge of Kennebec River at Waterville, Me., for 1905.

[Drainage area, 4,380 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	4,182	1,831	3,082	0.704	0.812
February	3,422	1,200	2,630	.600	.625
March	26,230	714	5,249	1.20	1.38
April	32,120	6,291	13,500	3.08	3.44
May	18,320	7,113	10,520	2.40	2.77
June	9,251	5,109	6,699	1.53	1.71
July	8,591	1,491	4,668	1.07	1.23
August	5,114	100	3,198	.730	.842
September	4,603	100	2,974	.679	.758
October	2,484	100	1,767	.403	.465
November	3,452	100	2,306	.526	.587
December	3,932	914	2,063	.471	.543
The year	32,120	100	4,888	1.12	15.16

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., near the village of Rockwood, and 2 miles from the mouth of the river. 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.

The channel is straight above and below the station, and is about 220 feet wide at ordinary stages. The banks are high and rocky; the bed of the stream is rocky and permanent; the current is swift at high and medium at low stages.

Discharge measurements are made from a car suspended from a steel cable or by wading at low stages a short distance downstream. The initial point for soundings is on the right bank, 1 foot from a birch tree to which the cable and tag line are fastened.

Gage readings are made twice each day by Peter Callaghan. A standard chain gage is attached to trees on the bank, 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. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of United States Geological Survey:

Description: 82, p 36; 97, pp 49–50; 124, p 64.
Discharge: 82, p 36; 97, p 50.
Gage heights: 82, p 36; 97, p 50; 124, p 64.

Discharge measurements of Moose River near Rockwood, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 21	Barrows and Pressey	253	1,400	2.47	6.41	3,460
July 10	Pressey and Adams	232	700	1.36	3.58	950
Aug. 14[a]	H. K. Barrows	110	170	1.65	2.02	280
Nov. 2[b]	F. E. Pressey	107	88	1.26	1.56	111
Nov. 10[b]	do	121	114	1.41	1.72	161

[a] By wading 200 feet below cable. [b] By wading 150 feet below cable.

Daily gage height, in feet, of Moose River near Rockwood, Me., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.95	4.6	4.05	2.55	2.0	1.8	1.5	1.8
2	.....	5.95	4.4	4.05	2.5	2.0	1.8	1.6	1.8
3	4.2	6.05	4.55	4.1	2.4	2.0	1.8	1.5	1.8
4	4.45	6.2	4.55	4.1	2.4	2.0	1.8	1.55	1.9
5	4.7	6.3	4.75	4.1	2.3	2.05	1.8	1.6	1.9
6	4.95	6.45	4.6	4.0	2.3	2.1	1.8	1.6	1.9
7	5.0	6.6	4.5	.....	2.3	2.1	1.7	1.65	1.9
8	5.15	6.7	4.65	3.85	2.2	2.1	1.7	1.7	1.9
9	5.25	6.85	4.9	3.7	2.2	2.05	.....	1.7	1.9
10	.....	6.85	5.15	3.6	2.2	2.0	.....	1.7	2.0
11	5.3	6.9	5.0	3.5	2.2	2.0	1.7	1.7	2.0
12	5.4	6.85	5.2	3.4	2.2	2.0	1.6	1.7	2.0
13	5.5	6.7	5.1	3.35	2.15	2.0	1.7	1.7	2.0
14	5.65	6.6	5.1	3.25	2.1	1.9	1.7	.....	2.0
15	5.8	6.35	.....	3.2	2.1	1.9	1.7	.....	2.0
16	5.85	6.1	4.7	3.1	2.1	1.8	1.7	.....	2.0
17	5.8	5.8	4.65	3.05	2.1	1.8	1.6	1.8	2.0
18	5.45	5.7	4.7	3.0	2.05	1.85	1.6	1.8	2.0
19	5.2	6.0	4.6	3.0	2.0	1.9	1.6	1.8	1.9
20	5.15	6.5	4.6	2.95	2.0	1.9	1.6	1.8	1.9
21	5.15	6.5	4.6	2.85	2.0	1.9	1.7	1.8	1.9
22	5.25	6.35	4.6	2.8	2.0	1.9	1.7	1.7	1.9
23	5.3	6.15	4.55	2.8	2.0	1.9	1.65	1.7	1.9
24	5.35	5.9	4.45	2.7	2.0	1.9	1.6	1.8	1.9
25	5.35	5.75	4.4	2.7	2.0	1.9	1.6	1.8	1.9
26	5.35	5.45	4.3	2.6	2.0	1.9	1.6	1.8	.....
27	5.45	5.55	4.3	2.6	2.1	1.9	1.6	1.8	1.9
28	5.6	5.45	4.3	2.6	2.1	1.8	1 6	1.8	1.9
29	5.8	5.3	4.25	2.6	2.0	1.8	1.6	1.8	1.9
30	5.9	5.4	4.2	2.6	2.0	1.8	1.5	1.8	1.9
31	.....	5.05	.....	2.6	2.0	.....	1.5	.....	1.9

NOTE.—River frozen January 1 to April 2. November 14-16, gage heights omitted, owing to backwater, due to ice.

Station rating table for Moose River near Rockwood, Me., from September 4, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.30	70	2.50	414	3.70	1,032	4.90	1,964
1.40	88	2.60	454	3.80	1,098	5.00	2,055
1.50	108	2.70	496	3.90	1,166	5.20	2,240
1.60	130	2.80	539	4.00	1,236	5.40	2,432
1.70	154	2.90	584	4.10	1,308	5.60	2,629
1.80	180	3.00	631	4.20	1,382	5.80	2,830
1.90	208	3.10	681	4.30	1,459	6.00	3,035
2.00	238	3.20	733	4.40	1,538	6.20	3,245
2.10	270	3.30	788	4.50	1,620	6.40	3,455
2.20	303	3.40	846	4.60	1,703	6.60	3,670
2.30	338	3.50	906	4.70	1,788	6.80	3,890
2.40	375	3.60	968	4.80	1,875	7.00	4,110

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1902-1905. It is well defined between gage heights 1.5 feet and 6.5 feet.

Estimated monthly discharge of Moose River near Rockwood, Me., for 1902–1905.

[Drainage area, 680 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
September 4–30	1,098	375	682	1.00	1.00
October	1,703	733	919	1.35	1.56
November	1,703	968	1,237	1.82	2.03
December	906	539	652	.959	1.11
1903.					
January 1–10	539	454	513	.754	.280
March 21–31	4,628	2,679	3,874	5.70	2.33
April	4,055	2,432	3,061	4.50	5.02
July 7–31	496	375	454	.668	.621
August	631	270	462	.679	.783
September	303	98	184	.271	.302
October	130	88	101	.149	.172
November	180	88	131	.193	.215
December 1–16	154	88	124	.182	.107
1904.					
April 10–30	3,140	154	1,492	2.19	1.71
May	6,500	1,920	4,026	5.92	6.82
June (27 days)	2,194	1,236	1,646	2.42	2.43
July	1,308	338	704	1.04	1.20
August	454	254	358	.526	.606
September	1,538	303	801	1.18	1.32
October	2,055	1,032	1,420	2.09	2.41
November	1,000	454	649	.954	1.06
December 1–10	454	303	370	.544	.202
1905.					
April 3–30	2,932	1,382	2,353	3.46	3.60
May	4,000	2,102	3,189	4.69	5.41
June	2,240	1,382	1,742	2.56	2.86
July	1,308	454	795	1.17	1.35
August	434	238	287	.422	.486
September	270	180	220	.324	.362
October	180	108	147	.216	.249
November 1–13, 17–30	180	108	158	.232	.233
December	238	180	214	.315	.363

NOTE.—River frozen January 11 to March 20 and December 17–31, 1903; January 1 to April 9 and December 11–31, 1904; January 1 to April 2, 1905. Above estimates for 1903 and 1904 do not apply to the gage heights published in the 1903 and 1904 reports, as there was an uncorrected gage in those years; 1905, discharge interpolated on days when gage heights were not read, except November 14–16.

MISCELLANEOUS DISCHARGE MEASUREMENTS IN MOOSE RIVER BASIN.

The following miscellaneous discharge measurements were made in the Moose River basin in 1905:

Miscellaneous discharge measurements made in Moose River drainage basin in 1905.

Date.	Hydrographer.	Stream.	Locality.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
				Feet.	*Sq. feet.*	*Ft. p. sec.*	*Feet.*	*Sec.-ft.*
Aug. 11	Barrows and Pressey.	Misery Stream..	½ mile above Brassua Lake.	15	4.64	0.92	[a] 2.12	4.25
Aug. 12	.....do....	Brassua Stream.	1½ miles above Brassua Lake.	6	4.06	1.23	[a] 2.12	5.02
Aug. 12	.....do....	Moose River	Just above Little Brassua Lake and about 4 miles above Brassua Lake.	90	126	1.91	[a] 2.12	241
Oct. 30	.....do....	.....do.....	At outlet of Wood Pond.	82	57	1.12	[b] 1,154.65	64
Oct. 31	.....do....	Gander Brook ..	Near entrance to Wood Pond.	2	.26	.35	[b] 1,154.65	.09
Oct. 31	.....do....	Little Wood Pond Stream.	.....do.....	11	3.1	1.23	[b] 1,154.65	3.8
Nov. 1	.....do....	Moose River	Just above Attean Pond. [c]	55	49	1.51	[d] 1,154.69	74

[a] Probable gage height at Rockwood gage.
[b] Height of Wood Pond.
[c] Measurement made in rapids; bed very rough and measurement considered not good. 0.42 inch rain fell at Jackman during night of October 31.
[d] Height of Wood Pond November 2 at noon.

ROACH RIVER AT ROACH RIVER, ME.

Roach River, 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 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. It is located near the village of Roach River.

The channel is straight and about 60 feet wide. The bed of the stream is rocky and permanent. The current is moderate.

Discharge measurements are made by wading or from a canoe at a section 140 feet downstream from the gage.

The gage, which is read twice each day by C. H. Sawyer, is a vertical rod spiked to the timber retaining wall on the right bank of the stream. It is referred to bench marks as follows: (1) A cross cut in the highest timber of the crib to which the gage is spiked; elevation, 8.84 feet. (2) Circular chisel draft marked "B. M." on highest point of bowlder near cottage on left bank, about opposite the dam; elevation, 12.57 feet. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers, United States Geological Survey:

Description: 65, p 17; 82, pp 36–37; 97, p 51; 124, p 65.
Discharge: 82, p 37.
Discharge, monthly: 82, p 38; 97, p 52.
Gage heights: 65, p 18; 82, p 37; 97, p 51; 124, p 65.
Rating tables: 82, p 38; 97, p 52.

Discharge measurements of Roach River at Roach River, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
May 22[a]	Barrows and Pressey	120	258	2.78	4.07	718
May 22[a]	do	122	312	3.21	4.45	1,000
May 23[a]	do	112	188	2.79	3.59	524
November 7[b]	do	19	9.3	.58	1.95	5.4
November 7[b]	do	16	8.0	.42	1.90	3.4

[a] From canoe about 100 feet below gage. [b] By wading about 200 feet below gage.

Daily gage height, in feet, of Roach River at Roach River, Me., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.2	3.0	2.6	2.4	2.9	2.1	2.2	1.8
2	.....	2.2	4.2	2.6	2.4	2.9	2.1	2.2	1.8
3	.....	2.2	2.2	2.6	2.4	2.9	2.1	2.2	1.8
4	.....	2.2	4.8	2.6	2.4	2.8	2.1	2.2	1.8
5	.....	2.2	2.2	3.8	2.4	2.7	2.1	2.2	1.8
6	.....	2.2	2.2	3.5	3.5	2.65	2.1	2.2	1.8
7	.....	2.2	5.6	2.6	3.5	2.2	2.1	2.2	1.8
8	.....	2.2	3.9	2.6	3.5	2.2	2.1	2.2	1.8
9	.....	2.2	3.9	2.6	3.5	2.2	2.1	2.2	1.8
10	.....	2.2	5.6	2.6	3.5	2.2	2.1	2.2	1.8
11	.....	2.2	3.9	2.6	3.5	2.2	2.1	2.2	1.8
12	.....	2.2	2.2	2.6	3.5	2.2	2.1	2.2	1.8
13	.....	2.2	5.6	2.6	3.5	2.2	2.1	2.2	1.8
14	.....	2.2	2.2	3.0	3.4	2.2	2.1	2.2	1.8
15	.....	2.2	3.9	3.4	3.4	2.2	2.1	2.0	1.8
16	.....	2.2	5.6	3.0	3.4	2.2	2.1	2.0	1.8
17	.....	2.2	5.6	2.6	3.4	2.1	2.1	2.0	1.8
18	.....	2.2	2.2	2.5	3.3	2.1	2.1	2.0	1.8
19	.....	2.2	5.6	2.5	3.3	2.1	2.1	2.0	.....
20	.....	2.2	5.6	2.5	3.3	2.1	2.1	2.0	.....
21	2.4	2.2	5.6	2.5	3.3	2.1	2.1	2.0	1.7
22	2.4	2.2	5.05	2.5	3.3	2.1	2.1	2.0	.....
23	2.4	2.2	3.6	2.5	3.3	2.1	2.1	2.0	.....
24	2.4	2.2	2.6	2.5	3.2	2.1	2.2	2.0	.....
25	2.4	3.0	2.6	2.4	3.2	2.1	2.2	2.0	.....
26	2.4	3.0	2.6	2.4	3.2	2.1	2.2	2.0	.....
27	2.4	3.0	2.6	2.4	3.1	2.1	2.2	2.0	.....
28	2.4	3.0	2.6	2.4	3.1	2.1	2.2	2.0	.....
29	2.2	3.0	2.6	2.4	3.1	2.1	2.2	2.0	.....
30	2.2	3.0	2.6	2.4	3.0	2.1	2.2	2.0	.....
31	2.2	.....	2.6	.....	3.0	2.1	.....	2.0	.....

NOTE.—River frozen January 1 to March 20 and November 19 to December 31. November 21, gage height to top of ice, 1.8 feet; thickness of ice, 0.1 foot.

Station rating table for Roach River at Roach River, Me., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.80	0.8	2.70	186	3.80	640	4.90	1,170
1.85	1.5	2.80	221	3.90	685	5.00	1,225
1.90	3.4	2.90	258	4.00	730	5.10	1,280
1.95	6.5	3.00	298	4.10	775	5.20	1,335
2.00	12	3.10	338	4.20	820	5.30	1,390
2.10	27	3.20	379	4.30	865	5.40	1,445
2.20	46	3.30	421	4.40	915	5.50	1,500
2.30	68	3.40	463	4.50	965	5.60	1,555
2.40	94	3.50	506	4.60	1,015		
2.50	122	3.60	550	4.70	1,065		
2.60	153	3.70	595	4.80	1,115		

NOTE.—The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1902–1905. It is not well defined.

Estimated monthly discharge of Roach River at Roach River, Me., for 1904–5.

[Drainage area, 85 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 26–31	68	68	68.0	0.800	0.178
April	820	46	96.0	1.13	1.26
May	1,528	68	912	10.73	12.37
June	1,500	68	456	5.36	5.98
July	298	46	83.4	.981	1.13
August	730	46	182	2.14	2.47
September	221	46	80.8	.952	1.06
October	463	68	149	1.75	2.02
November	68	27	29.0	.341	.380
1905.					
March 21–31	94	46	80.9	.952	.389
April	298	46	96.4	1.13	1.26
May	1,555	46	668	7.86	9.06
June	640	94	182	2.14	2.39
July	506	94	376	4.42	5.10
August	258	27	71.5	.841	.970
September	46	27	31.4	.369	.412
October	46	12	27.4	.322	.371
November 1–18	.8	.8	.8	.0094	.0069

NOTE.—River frozen January 1 to March 25 and December 4–31, 1904; January 1 to March 20 and November 19 to December 31, 1905.

DEAD RIVER NEAR THE FORKS, ME.

Dead River 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 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 September 29, 1901, by N. C. Grover. It is located 1½ miles west of The Forks.

The channel is straight for 500 feet above and below the station 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.

Discharge measurements are made from a car suspended from a steel cable.

The gage, which is read twice each day by Jeremiah Durgin, jr., 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 the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 18; 82, pp 34–35; 97, p 53; 124, p 66.
Discharge: 65, p 18; 82, p 35; 97, p 53; 124, p 66.
Gage heights: 65, p 18; 82, p 35; 97, p 54; 124, p 67.

Discharge measurements of Dead River near The Forks, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 21	F. E. Pressey	235	685	2.64	1.82	1,810
June 1	do	233	660	2.30	1.75	1,520
June 1	do	233	660	2.29	1.75	1,510
July 18	do	220	470	1.47	1.09	690

Daily gage height, in feet, of Dead River near The Forks, Me., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.6	3.9	2.6	1.75	1.85	0.75	0.75	0.75	1.15
2	.....	3.35	4.15	2.55	2.2	1.85	.75	.75	.85	1.1
3	.....	3.4	3.55	1.9	2.3	1.55	.75	.75	.85	1.05
4	.....	2.9	5.85	1.7	2.4	1.4	.85	.75	.85	1.05
5	.....	2.6	4.25	1.65	2.2	1.2	.95	.75	.85	1.15
6	.....	2.45	4.05	1.65	2.0	1.0	1.05	.75	.85	1.15
7	.....	2.35	4.2	1.75	1.8	1.0	1.2	.75	.85	1.15
8	.....	2.35	4.25	1.65	1.6	1.05	1.25	.65	.95	1.15
9	.....	2.35	4.15	1.6	1.5	1.05	1.1	.65	.95	1.15
10	.....	2.45	4.3	1.55	1.45	1.05	.95	.65	.95	1.15
11	.....	2.45	4.55	1.55	1.35	1.05	.95	.65	.85	1.15
12	.....	2.65	4.15	1.8	1.45	.95	.85	.65	.75	1.05
13	.....	2.5	4.0	2.3	1.3	.95	.75	.65	.75	1.05
14	.....	2.3	3.8	2.2	1.2	1.05	.75	.65	.85	1.05
15	.....	2.35	3.5	1.95	1.1	1.05	.75	.75	.85	1.05
16	.....	2.35	5.7	1.85	1.05	1.15	.75	.75	.85	1.05
17	.....	2.95	5.05	1.85	1.0	1.3	.75	.75	.85	.....
18	.....	2.85	4.05	1.75	1.05	1.45	.9	.75	.95	.....
19	.....	2.2	3.8	2.0	1.25	1.3	1.1	.75	.95	.....
20	.....	1.9	5.2	2.3	1.65	1.15	1.15	.75	.95	.....
21	.....	2.4	5.1	2.65	1.95	1.15	1.05	.75	.95	.....
22	.....	3.25	4.85	2.65	1.35	1.05	.95	.75	.85	.....
23	.....	4.95	4.65	2.4	1.1	1.05	.95	.75	.85	.....
24	.....	2.35	4.75	2.2	1.1	1.05	.95	.75	.85	.....
25	.....	2.3	4.6	2.05	1.15	.95	.9	.75	.85	.....
26	.....	2.15	5.15	2.05	1.15	.95	.8	.75	.95	.....
27	.....	2.3	4.35	1.95	1.05	.85	.75	.75	.95	.....
28	4.85	3.2	4.45	1.95	.95	.85	.75	.75	1.05	.....
29	3.35	3.4	4.55	1.85	.95	.85	.75	.65	1.15	.....
30	2.8	3.15	4.15	1.75	.95	.75	.75	.65	1.15	.....
31	3.5	.....	2.85	.....	1.5	.75	.....	.65	.....	.....

NOTE.—River frozen January 1 to March 27; ice went out March 28 and river clear. River frozen December 16–31.

Station rating table for Dead River near The Forks, Me., from June 25, 1902, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.40	45	1.40	1,090	2.40	2,600	3.80	5,830
.50	110	1.50	1,225	2.50	2,780	4.00	6,430
.60	185	1.60	1,365	2.60	2,970	4.20	7,060
.70	270	1.70	1,505	2.70	3,160	4.40	7,730
.80	365	1.80	1,650	2.80	3,360	4.60	8,420
.90	470	1.90	1,795	2.90	3,570	4.80	9,140
1.00	580	2.00	1,945	3.00	3,790	5.00	9,890
1.10	700	2.10	2,100	3.20	4,240	5.50	11,920
1.20	825	2.20	2,260	3.40	4,730	6.00	14,080
1.30	955	2.30	2,430	3.60	5,260		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1903–1905. It is well defined between gage heights 0.7 foot and 2 feet; above 2 feet the table is subject to error of a few per cent.

Estimated monthly discharge of Dead River near The Forks, Me., for 1902–1905.

[Drainage area, 870 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1902.					
June 25–30	8,245	1,365	4,855	5.58	1.22
July	2,913	185	954	1.09	1.26
August	2,600	270	991	1.14	1.31
September	1,795	365	1,022	1.17	1.30
October	3,360	365	942	1.08	1.24
November	3,360	318	1,226	1.41	1.57
1903.					
June 4–30	9,140	470	1,748	2.01	2.02
July	1,225	470	646	.743	.857
August	1,090	470	648	.745	.859
September	470	110	222	.255	.284
October	270	110	172	.198	.228
November	580	270	357	.410	.457
1904.					
April 10–30	14,300	1,650	3,722	4.28	3.34
May	18,040	1,870	8,892	10.22	11.78
June	8,960	640	2,969	3.41	3.80
July	1,505	228	705	.810	.934
August	1,505	228	495	.569	.656
September	1,722	318	967	1.11	1.24
October	3,900	762	1,770	2.03	2.34
November	1,022	525	741	.852	.951
December 1–10	1,090	525	712	.818	.304
1905.					
April	9,700	1,795	3,352	3.85	4.30
May	13,420	3,465	7,821	8.99	10.36
June	3,065	1,295	1,955	2.25	2.51
July	2,600	525	1,180	1.36	1.57
August	1,722	318	739	.849	.979
September	890	318	475	.546	.609
October	318	228	289	.332	.383
November	762	318	470	.540	.602
December 1–16	762	640	705	.810	.482

NOTE.—Estimates for December, 1902, and December, 1903, omitted on account of ice conditions. River frozen January 1 to April 9 and December 11–31, 1904; January 1 to March 27 and December 17–31, 1905.

CARRABASSETT RIVER AT NORTH ANSON, ME.

Carrabassett 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.

The gaging station was established October 19, 1901, by N. C. Grover. It is located above Embden Brook and below Anson Brook.

The channel is straight for 500 feet above and 300 feet below the station 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, and the current is moderately rapid.

Discharge measurements are made by wading at low stages and from a boat at high stages.

Gage readings are taken once each day by N. Q. Hilton. 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. The length of the chain is 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. Elevations refer to datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, p 19; 82, p 32; 97, pp 54-55; 124, pp 67-68.
Discharge: 82, p 33; 97, p 55; 124, p 68.
Discharge, monthly: 82, p 34; 97, p 56; 124, p 70.
Gage heights: 65, p 19; 82, p 33; 97, p 55; 124, p 69.
Rating table: 82, p 34; 124, p 70.

Discharge measurements of Carrabassett River at North Anson, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet per second.*	*Feet.*	*Second-feet.*
July 20 [a]	F. E. Pressey	133	187	2.33	1.18	435
October 26 [b]	do	102	90	1.62	.40	146

[a] Log jam in left channel 500 feet below gage. [b] Wading near gage.

Daily gage height, in feet, of Carrabassett River at North Anson, Me., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.0	2.3	1.0	0.9	2.9	0.3	0.4	0.4	1.0
2	.....	2.8	2.0	.9	.9	1.5	.3	.4	.6	1.1
3	.....	2.3	1.4	.9	2.7	1.2	.3	.4	.6	.7
4	.....	2.1	3.6	1.0	1.9	.9	2.2	.4	.6	1.1
5	.....	1.9	3.1	.8	1.5	.7	1.4	.4	.7	1.4
6	.....	4.0	2.6	.8	1.2	.7	1.9	.4	.7	1.2
7	.....	3.6	2.6	1.0	1.0	.6	1.4	.4	.8	.9
8	.....	2.7	2.5	.8	.9	.9	1.2	.3	1.0	1.0
9	.....	2.2	2.0	.7	.8	.8	1.0	.4	.8	.8
10	.....	2.2	2.1	.7	.8	.7	.8	.4	.8	.8
11	.....	2.9	1.7	.6	.8	.6	.7	.3	.6	.8
12	.....	2.7	1.5	.7	.7	.5	.6	.3	.7	.6
13	.....	2.8	1.5	3.8	.6	.5	.7	1.0	.8	.6
14	.....	2.7	1.6	2.4	.5	.7	.8	.9	.8	.7
15	.....	2.8	1.5	1.8	.5	.5	.7	.7	.8	.8
16	.....	2.4	1.6	1.5	.5	.6	.6	.6	.7	.8
17	.....	2.0	2.0	1.3	.5	.9	.6	.5	.8	.8
18	.....	1.8	2.2	1.1	.6	.7	.8	.4	1.0	1.0
19	.....	1.6	3.0	1.4	1.2	.6	1.7	.4	.7	.7
20	.....	1.4	2.5	1.7	1.2	.5	1.3	.4	.7	.6
21	.....	1.3	1.9	1.8	.9	.5	1.3	.5	.8	.6
22	.....	3.4	1.7	1.5	.7	.4	1.1	.6	.7	.8
23	.....	2.6	1.5	1.4	.6	.4	1.0	.6	.5	.7
24	.....	2.1	1.3	1.2	.5	.3	1.0	.6	.6	.7
25	.....	2.0	1.2	1.0	.7	.2	.7	.5	.6	1.0
26	.....	1.9	1.1	.9	.5	.3	.6	.6	1.1	.8
27	.....	2.2	1.3	1.8	.4	.3	.7	.6	1.0	.8
28	.....	1.9	1.5	1.5	.7	.5	.5	.4	1.0	.7
29	4.0	2.1	1.3	1.2	.4	.4	.5	.4	.7	.7
30	.....	2.0	1.2	1.0	.3	.3	.5	.4	1.0	.7
31	.....	.....	1.1	.....	1.3	.3	.....	.4	.....	.8

NOTE.—River frozen January 1 to March 28. Ice broke up March 26 and went out March 28.

Station rating table for Carrabassett River at North Anson, Me., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.20	85	1.20	675	2.20	1,585	3.20	2,710
.30	120	1.30	755	2.30	1,690	3.30	2,830
.40	160	1.40	840	2.40	1,795	3.40	2,955
.50	205	1.50	925	2.50	1,900	3.50	3,080
.60	256	1.60	1,015	2.60	2,010	3.60	3,210
.70	313	1.70	1,105	2.70	2,120	3.70	3,345
.80	376	1.80	1,295	2.80	2,235	3.80	3,480
.90	445	1.90	1,290	2.90	2,350	3.90	3,615
1.00	520	2.00	1,385	3.00	2,470	4.00	3,750
1.10	595	2.10	1,485	3.10	2,590		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1902–1905. It is well defined throughout.

Estimated monthly discharge of Carrabassett River at North Anson, Me., for 1905.

[Drainage area, 340 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	3,750	755	1,814	5.34	5.96
May	3,210	595	1,316	3.87	4.46
June	3,480	256	789	2.32	2.59
July	2,120	120	459	1.35	1.56
August	2,350	120	343	1.01	1.16
September	1,585	120	490	1.44	1.61
October	520	120	205	.602	.694
November	595	160	354	1.04	1.16
December	840	256	404	1.19	1.37

SANDY RIVER NEAR MADISON, ME.

Sandy River rises near Rangeley Lake, flowing at first southeastward, then in the last third of its course northeastward into Kennebec River, which it joins 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 nearer the Madison post-office. The drainage area at this point is about 650 square miles. The dam rests on ledge rock and 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 fore 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 about 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 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.

Estimated monthly discharge of Sandy River near Madison, Me.

[Drainage area, 650 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 23–31	5,335	890	2,682	4.12	1.38
April	11,265	1,757	4,858	7.47	8.33
May	10,325	516	3,580	5.51	6.35
June	1,064	66	355	.546	.609
July	516	66	234	.360	.415
August	1,871	135	322	.495	.571
September	1,101	42	273	.420	.469
October	4,309	224	654	1.01	1.16
November	675	224	410	.631	.704
December	440	170	299	.460	.530
1905.					
January	874	224	492	.757	.873
February	645	112	313	.482	.502
March	7,908	112	1,436	2.21	2.55
April	7,026	1,046	2,558	3.94	4.40
May	2,892	477	1,336	2.06	2.37
June	3,330	224	658	1.01	1.13
July	2,653	60	292	.449	.518
August	2,078	0	224	.345	.398
September	1,601	42	350	.538	.600
October	339	37	89	.137	.158
November	388	49	215	.331	.369
December	898	165	327	.503	.580
The year	7,908	0	691	1.06	14.45

NOTE.—After August 31, 1905, wheels were run during both day and night, and estimates are based on both the flow over dam and through the wheels. Gage readings and gate openings read five times daily.

MESSALONSKEE RIVER AT WATERVILLE, ME.

Messalonskee 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. Of this lake system Messalonskee Lake is nearest to the mouth of the river. In this lower portion of the river—about 10 miles in length—there is a fall of about 210 feet, 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.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 56–57; 124, p 72.
Discharge, daily: 97, p 57; 124, p 73.

Mean daily discharge, in second-feet, of Messalonskee River at Waterville, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	432	395	383	697	336	212	64	90	90	.....	118
2	408	360	360	668	314	251	.....	90	90	118	149
3	432	351	336	587	292	273	.....	118	.....	.....	134
4	434	314	337	507	336	212	.....	118	118	.....	149
5	432	360	472	533	251	193	.....	118	90	.....	.....
6	383	292	457	587	314	230	.....	.....	90	.....	.....
7	395	292	533	533	212	177	.....	118	118	.....	.....
8	642	273	507	543	230	212	.....	118	64	.....	.....
9	482	301	577	577	251	177	.....	90	64	118	.....
10	432	336	587	432	301	159	.....	90	.....	118	.....
11	432	348	559	472	260	111	.....	90	90	149	.....
12	408	432	615	482	336	144	.....	90	90	149	.....
13	383	360	482	457	336	144	90	.....	118	118	.....
14	408	314	507	408	360	149	77	90	118	118	.....
15	408	336	432	383	383	111	90	90	118	.....	.....
16	383	336	383	383	383	144	.....	90	90	118	.....
17	408	360	432	408	432	177	90	90	.....	149	.....
18	422	336	383	383	408	212	90	118	90	118	.....
19	482	432	587	422	432	177	90	118	105	149	.....
20	472	360	587	383	533	212	105	.....	64	149	.....
21	432	336	533	432	314	193	90	90	69	118	.....
22	432	348	482	507	273	183	90	90	90	.....	.....
23	422	360	507	408	251	177	.....	90	90	134	.....
24	434	383	472	383	212	193	118	90	.....	149	.....
25	482	336	482	360	212	177	118	90	90	134	.....
26	472	383	995	383	251	177	90	90	118	118	.....
27	482	360	870	395	212	64	90	.....	118	149	.....
28	482	336	753	336	432	54	118	90	105	149	.....
29	422	.....	811	336	383	54	118	90	118	.....	.....
30	434	.....	753	360	251	26	.....	64	118	149	.....
31	395	.....	697	.....	314	.....	149	90	.....	149	.....

NOTE.—Twelve-inch flashboards on from June 27 to November 4, inclusive. Figures for discharge are probably unreliable after about June 1, owing to insufficient data.

COBBOSSEECONTEE RIVER AT GARDINER, ME.

Cobbosseecontee River drains a group of lakes lying from 5 to 15 miles west of 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 eight dams controlled by the Gardiner Water Power Company, which are in the lower 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 S. D. Warren & Co., through Joseph A. Warren. The record for 1905 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.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 82, pp 38-39; 97, pp 57-58; 124, pp 73-74.
Discharge, daily: WS 82, p 39; 97, p 58; 124, p 74.
Discharge, monthly: Ann 19, iv, pp 81-84.
Discharge, yearly: Ann 20, iv, p 46.
Hydrograph: Ann 19, iv, p 80.
Rainfall and run-off relation: Ann 19, iv, p 80.

Mean daily discharge, in second-feet, of Cobbosseecontee River at Gardiner, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10	160	160	565	280	285	280	260	220	10	115	180
2	115	160	150	605	280	285	10	260	220	220	115	180
3	115	160	140	453	280	285	280	260	10	220	115	10
4	115	160	140	330	280	10	145	260	220	220	115	180
5	115	30	60	340	285	285	135	260	220	220	10	180
6	115	160	130	568	285	285	260	10	220	220	180	195
7	115	160	130	882	10	280	260	260	220	220	180	195
8	10	160	125	703	285	280	260	260	220	10	180	195
9	160	160	115	530	285	280	10	260	220	220	180	195
10	160	160	120	400	285	280	260	260	10	220	180	10
11	160	160	125	290	285	10	260	260	220	220	180	195
12	160	20	35	290	285	280	260	260	220	220	10	195
13	160	160	125	290	285	280	260	10	220	220	180	195
14	160	160	115	290	10	280	260	260	220	220	180	195
15	10	160	110	290	285	280	260	260	220	10	180	195
16	160	160	105	113	285	280	10	260	220	220	180	195
17	160	160	105	290	285	280	260	260	10	220	180	10
18	160	160	100	290	285	10	260	260	220	220	180	195
19	160	25	20	290	285	280	260	260	220	220	10	195
20	160	160	160	290	285	280	260	10	220	220	180	195
21	160	160	170	290	10	280	260	260	220	220	180	195
22	10	160	200	290	285	280	260	260	220	10	180	195
23	160	160	210	10	285	280	10	260	220	220	180	195
24	160	160	210	290	285	280	260	260	10	220	180	10
25	160	160	210	290	285	10	260	260	220	210	180	25
26	160	20	10	290	285	280	260	260	220	190	10	195
27	160	160	260	290	285	280	260	10	220	170	180	195
28	160	160	260	280	10	280	260	220	220	160	180	195
29	20	.....	286	280	285	280	260	220	220	10	180	195
30	160	.....	484	10	10	280	10	220	220	115	10	195
31	160	.....	591	.....	285	.....	260	220	.....	115	.....	10

NOTE.—Leakage of dam taken at 10 second-feet, as determined by measurements during 1905.

Estimated monthly discharge of Cobbosseecontee River at Gardiner, Me., for 1905.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	160	10	127	0.529	0.610
February	160	20	141	.588	.612
March	591	10	166	.692	.798
April	882	10	347	1.45	1.62
May	285	10	240	1.00	1.15
June	285	10	245	1.02	1.14
July	280	10	213	.888	1.02
August	260	10	223	.929	1.07
September	220	10	192	.800	.893
October	220	10	175	.729	.840
November	180	10	143	.596	.665
December	195	10	158	.658	.759
The year	882	10	198	.823	11.18

ANDROSCOGGIN RIVER DRAINAGE BASIN.

DESCRIPTION OF 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 this being 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 Magalloway 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.
		Sq. 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 at gaging station	1,500
Do	Rumford Falls	2,090
Do	Dixfield at gaging station	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.

ANDROSCOGGIN RIVER AT ERROL DAM, N. H.

Four large storage dams are maintained in the Umbagog-Rangeley Lake system. They are located at the outlets of Rangeley, Mooselucmaguntic, 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.

In 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. No records of flow are available for 1905 at this point. The drainage area here is 1,375 square miles.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 60; 124, p 76.
Discharge, daily: 97, p 60.

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, N. H.

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 stream 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 during medium and low water conditions. The banks on both sides are subject to overflow in extreme freshets.

Discharge measurements are made at high and ordinary stages from the bridge. 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. Low-water measurements are made from

a boat at a point about 1,000 feet below the bridge, where an excellent site exists for gaging.

The gage, which is read twice each day by James Simpson, is a standard chain gage attached to the guard timber on the downstream side of the bridge. The length of the chain was 20.66 feet when the gage was established. This was changed to 20.72 feet on August 4, 1904, owing to a change in the flooring of the bridge and consequently in the position of the gage. It is referred to bench marks as follows: (1) Marked point on south edge of westernmost cylindrical pier; elevation, 17.82 feet. (2) Marked point on lower chord near gage; elevation, 18.77 feet. (3) Highest point of bowlder near easternmost pier; elevation, 7.14 feet. All elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 61; 124, p 76.
Discharge: 97, p 61; 124, p 77.
Gage heights: 97, p 62; 124, p 77.

Discharge measurements of Androscoggin River at Shelburne, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 26	F. E. Pressey	394	1,335	2.68	5.34	3,580
July 14	do	392	1,150	1.91	4.62	2,200
August 1	H. K. Barrows	394	1,760	3.11	6.11	5,480
August 1	do	394	1,850	3.38	6.39	6,240
August 2	Barrows and Norcross	394	1,470	2.63	5.37	3,860
August 3	T. W. Norcross	394	1,290	2.18	4.93	2,810
October 18[a]	Barrows and Norcross	384	1,050	1.58	4.34	1,660

[a] Measurement in third span made from upstream side of bridge.

Daily gage height, in feet, of Androscoggin River at Shelburne, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	.....	.....	5.1	6.1	4.8	4.8	6.55	4.7	4.3	4.3	4.6
2	.....	.....	.....	4.9	6.25	4.8	4.8	5.25	4.6	4.3	4.3	4.45
3	.....	.....	.....	4.75	6.7	4.75	4.8	4.9	4.8	4.2	4.3	4.75
4	.....	.....	.....	4.85	7.3	4.75	4.85	4.8	4.8	4.3	4.3	4.6
5	.....	6.6	6.3	4.8	7.45	4.8	4.7	4.8	4.6	4.3	4.3	4.55
6	.....	.....	.....	4.95	7.3	4.7	4.8	4.55	4.55	4.3	4.2	4.65
7	.....	.....	.....	5.05	7.25	4.7	4.8	4.65	4.5	4.25	4.3	4.6
8	6.05	.....	.....	5.1	7.2	4.6	4.8	4.55	4.4	4.3	4.3	4.45
9	.....	.....	.....	5.05	7.2	4.6	4.8	4.6	4.4	4.3	4.3	4.3
10	.....	.....	.....	5.3	7.2	4.6	4.9	4.5	4.3	4.3	4.3	4.2
11	.....	.....	.....	5.7	7.15	4.5	4.8	4.5	4.4	4.4	4.3	5.7
12	.....	6.5	5.2	5.6	7.0	4.5	4.75	4.5	4.4	4.8	4.1	7.35
13	.....	.....	.....	5.7	6.9	4.55	4.75	3.8	4.5	4.65	4.2	.....
14	.....	.....	.....	5.55	6.9	5.6	4.6	4.5	4.5	4.5	4.1	.....
15	6.7	.....	.....	4.95	6.7	5.45	4.5	4.6	4.4	5.0	4.1	.....
16	.....	.....	.....	4.7	6.6	5.35	4.3	4.95	4.5	4.5	4.15	.....
17	.....	.....	.....	4.65	6.4	5.05	4.4	4.95	4.5	4.15	4.2	7.1
18	.....	.....	.....	4.8	6.2	4.9	4.5	4.8	4.9	4.1	4.2	.....
19	.....	6.4	6.6	4.7	6.1	4.8	4.5	4.55	4.8	4.25	4.2	.....
20	.....	.....	.....	4.8	5.9	4.7	4.4	4.35	4.5	4.1	4.2	.....
21	.....	.....	.....	5.0	5.9	4.6	4.4	4.4	4.5	4.1	4.2	.....
22	6.4	.....	.....	5.15	5.7	4.8	4.4	4.4	4.45	4.15	4.25	.....
23	.....	.....	.....	5.0	5.7	4.85	3.65	4.4	4.4	4.35	4.2	.....
24	.....	.....	.....	5.1	5.4	4.9	4.4	4.35	4.35	4.2	4.3	7.2
25	.....	.....	.....	5.45	5.15	4.9	4.4	4.4	4.5	4.25	4.3	.....
26	.....	6.7	7.8	5.7	5.15	5.05	4.2	4.4	4.5	4.2	4.2	.....
27	.....	.....	.....	5.6	5.0	5.3	4.2	4.4	4.4	4.3	4.3	.....
28	.....	.....	.....	5.85	5.0	5.15	4.2	4.5	4.4	4.3	4.2	.....
29	5.7	.....	7.2	5.95	4.9	5.05	4.25	4.4	4.45	4.25	4.25	.....
30	.....	.....	6.1	6.15	4.95	4.9	4.0	4.55	4.4	4.4	4.25	.....
31	.....	.....	6.1	.....	4.9	.....	7.95	4.8	.....	4.35	.....	6.3

NOTE.—River frozen January 1 to March 30 and December 13–31, also ice conditions December 1–12. During the frozen period gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were made:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	6.7	7.1	1.9
January 8	6.05	6.45	1.7
January 15	6.7	6.9	2.1
January 22	6.4	6.8	2.1
January 29	5.7	6.5	2.5
February 5	6.6	6.9	3.1
February 12	6.5	6.7	3.2
February 19	6.4	6.7	3.0
February 26	6.7	6.9	3.1
March 5	6.3	6.6	3.2
March 12	5.2	6.3	2.9
March 19	6.6	6.8	2.7
March 26	7.8	7.8	2.5
December 17	7.1	7.25	.7
December 24	7.2	7.35	.6
December 31	6.3	6.4	.5

March 29, water flowing on top of ice; ice jam below gage. March 30, river clear. December 11–12, anchor ice caused rise.

Station rating table for Androscoggin River at Shelburne, N. H., from May 30, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	1,100	4.90	2,680	5.90	4,970	6.90	7,660
4.00	1,212	5.00	2,890	6.00	5,225	7.00	7,950
4.10	1,336	5.10	3,105	6.10	5,480	7.20	8,530
4.20	1,472	5.20	3,325	6.20	5,740	7.40	9,130
4.30	1,618	5.30	3,545	6.30	6,000	7.60	9,730
4.40	1,774	5.40	3,775	6.40	6,265	7.80	10,330
4.50	1,938	5.50	4,005	6.50	6,535	8.00	10,930
4.60	2,110	5.60	4,240	6.60	6,810	8.20	11,550
4.70	2,290	5.70	4,480	6.70	7,090	8.40	12,170
4.80	2,480	5.80	4,725	6.80	7,375	8.60	12,790

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1903–1905. It is well defined between gage heights 4.3 feet and 7.7 feet, and somewhat uncertain below 4.3 feet.

Estimated monthly discharge of Androscoggin River at Shelburne, N. H., for 1903–1905.

[Drainage area, 1,500 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1903.					
June	12,020	1,049	2,800	1.87	2.09
July	2,480	1,156	1,775	1.18	1.36
August	1,774	1,404	1,610	1.07	1.23
September	1,618	1,472	1,547	1.03	1.15
October	1,938	1,472	1,669	1.11	1.28
November	1,774	1,618	1,626	1.08	1.20
1904:					
April 9–30	8,095	1,774	3,563	2.37	1.94
May	12,790	3,105	8,334	5.56	6.41
June	3,105	1,938	2,426	1.62	1.81
July	3,325	1,156	2,026	1.35	1.56
August	1,774	1,212	1,426	.951	1.10
September	1,938	1,618	1,813	1.21	1.35
October	3,105	1,696	2,112	1.41	1.63
November	2,480	1,386	1,651	1.10	1.23
1905.					
April	5,610	2,200	3,359	2.24	2.50
May	9,280	2,680	5,991	3.99	4.60
June	4,240	1,938	2,641	1.76	1.96
July	10,780	862	2,296	1.53	1.76
August	6,672	998	2,235	1.49	1.72
September	2,680	1,618	1,970	1.31	1.46
October	2,890	1,336	1,677	1.12	1.29
November	1,618	1,336	1,527	1.02	1.14

NOTE.—River frozen November 28 to December 31, 1903; January 1 to April 9 and December 3–31, 1904; January 1 to March 30 and December 1–31, 1905. Estimates November 28–30, 1903, corrected to allow for influence of ice.

ANDROSCOGGIN RIVER AT RUMFORD FALLS, ME.

One of the finest water powers on 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 pulp wood and timber from the headwaters down to the mills, and the Rumford Falls and Rangeley Lakes Railroad 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.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: Ann 20, iv, p 66; WS 27, p 9; 35, p 27; 47, pp 31–32; 65, p 20; 82, p 42; 97, pp 62–63; 124, p 78.
Discharge, daily: Ann 20, iv, pp 67–69; WS 27, pp 14–16; 35, p 28; 47, p 32; 65, p 21; 82, p 43; 97, p 63.
Discharge, monthly: Ann 19, iv, pp 93–94; 20, iv, p 70; 21, iv, p 57; 22, iv, p 60; WS 75, p 22; 82, p 43.
Discharge, yearly: Ann 20, iv, pp 46, 71.
Hydrographs: Ann 19, iv, pp 94, 95; 20, iv, p 67; 21, iv, p 57; 22, iv, p 61.
Rainfall and run-off relation: Ann 19, iv, pp 96–97.
Rainfall data: Ann 21, iv, p 57.
Water powers: Ann 19, iv, pp 90–91.

Daily discharge, in second-feet, of Androscoggin River at Rumford Falls, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,027	1,720	1,500	10,288	6,486	2,889	2,904	14,784	2,492	1,755	1,855	1,665
2	2,032	1,715	1,442	6,230	5,843	2,875	3,164	6,203	2,078	1,699	1,910	2,033
3	2,134	1,697	1,398	4,988	5,867	2,791	5,049	3,882	2,523	1,863	1,855	2,511
4	1,932	1,702	1,404	4,910	8,245	2,369	4,403	3,207	6,254	1,838	1,958	3,909
5	1,709	1,659	1,366	4,182	8,435	2,631	3,963	2,804	4,735	1,696	1,897	2,648
6	1,752	1,527	1,257	5,194	7,639	2,813	3,254	2,550	3,445	1,631	2,167	2,535
7	1,793	1,709	1,318	6,217	8,651	2,939	3,107	2,385	2,976	1,614	2,165	2,636
8	1,906	1,616	1,229	4,885	8,127	2,727	2,759	2,840	2,629	1,470	2,194	2,435
9	1,982	1,546	1,210	4,127	7,924	2,531	2,512	3,085	2,389	1,599	2,095	2,344
10	2,115	1,532	1,201	4,291	8,110	2,257	2,719	2,832	2,164	1,634	2,151	2,004
11	2,100	1,570	1,220	5,994	7,924	2,093	2,716	2,454	1,947	1,709	2,064	1,534
12	2,087	1,420	1,213	5,807	7,729	2,801	2,800	2,307	1,979	2,447	2,001	1,762
13	2,009	1,490	1,087	5,799	6,817	4,412	3,034	2,059	2,595	3,081	2,098	1,816
14	2,002	1,663	1,265	5,938	5,928	5,412	2,807	2,172	2,415	2,586	2,103	2,007
15	1,918	1,546	1,124	5,845	5,528	4,180	2,195	2,231	2,104	2,310	1,686	1,785
16	1,849	1,512	1,062	5,121	5,426	3,589	2,036	3,088	2,001	2,251	2,097	1,711
17	2,016	1,494	1,045	4,504	5,139	3,448	2,135	4,036	1,865	2,152	2,245	1,734
18	1,917	1,516	1,067	3,857	4,966	3,277	2,185	2,989	3,321	2,127	1,838	1,721
19	1,931	1,481	1,330	3,582	5,313	3,389	1,927	2,534	4,767	2,177	1,710	1,890
20	1,905	1,389	2,375	3,468	4,696	3,310	1,889	2,091	3,508	2,328	1,776	1,899
21	1,960	1,629	2,020	4,853	4,955	3,012	1,910	1,986	3,311	2,334	1,794	1,870
22	1,861	1,550	1,754	9,087	4,415	3,010	1,747	1,941	3,062	2,089	1,992	1,795
23	1,865	1,578	1,665	7,070	3,838	3,000	1,544	1,772	2,865	2,083	1,974	1,925
24	1,909	1,575	1,693	5,649	3,647	2,808	1,167	1,799	2,413	2,087	2,012	1,989
25	1,844	1,585	3,145	4,615	3,606	2,535	1,660	1,799	2,421	2,034	2,270	1,790
26	1,792	1,527	7,139	4,636	3,482	3,648	1,689	1,743	2,392	1,990	2,502	1,744
27	1,726	1,460	7,135	4,600	3,736	6,541	1,540	1,975	2,239	1,978	2,548	1,870
28	1,761	1,596	7,445	4,605	3,815	4,652	1,492	2,703	2,339	1,964	1,775	1,796
29	1,791	.....	8,171	4,683	3,519	3,712	1,480	2,285	2,097	1,950	2,340	1,798
30	1,674	.....	9,295	5,470	3,325	2,915	1,747	1,988	1,979	1,861	2,664	1,934
31	1,803	.....	12,393	.....	3,099	.....	17,523	2,156	.....	1,921	.....	1,998

Estimated monthly discharge of Androscoggin River at Rumford Falls, Me., for 1905.

[Drainage area, 2,090 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	2,134	1,674	1,907	0.912	1.05
February	1,720	1,389	1,572	.752	.783
March	12,390	1,037	2,836	1.36	1.57
April	10,290	3,468	5,350	2.56	2.86
May	8,651	3,099	5,685	2.72	3.14
June	6,541	2,093	3,286	1.57	1.75
July	17,520	1,167	2,937	1.41	1.63
August	14,780	1,743	2,990	1.43	1.65
September	6,254	1,865	2,777	1.33	1.48
October	3,081	1,470	2,008	.961	1.11
November	2,664	1,686	2,058	.985	1.10
December	3,909	1,534	2,035	.974	1.12
The year	17,520	1,037	2,953	1.41	19.24

ANDROSCOGGIN RIVER AT 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 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.

Discharge measurements are made from the bridge at high and ordinary stages. The initial point for soundings is the lower end of the inclined end post of the downstream truss on the left bank. Low-water 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, this being made possible by a sandy bar separating these two parts.

A standard chain gage, which is read twice each day by S. F. Robinson, is fastened to the guard timber on the lower side of the bridge. The length of the chain is 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 August 3, 1904, probably due to settling of the post. All elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 82, p 41; 97, p 64; 124, pp 78–79.
Discharge: 82, p 41; 97, p 64; 124, p 79.
Discharge, monthly: 97, p 66.
Gage heights: 82, p 41; 97, p 65; 124, p 79.
Rating table: 97, p 65.

Discharge measurements of Androscoggin River at Dixfield, Me., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 25	F. E. Pressey	485	2,860	2.39	9.42	6,840
August 17	do	478	2,770	1.94	9.24	5,390
August 18	do	479	2,490	1.49	8.72	3,700
September 13	do	471	2,250	1.14	8.25	2,560
September 14	do	466	2,290	1.16	8.31	2,660
September 15	do	457	2,160	1.07	8.14	2,310
October 27[a]	H. K. Barrows	384	1,290	1.60	7.94	2,060

[a] Wading in two channels.

Daily gage height, in feet, of Androscoggin River at Dixfield, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	11.6	9.9	8.55	8.6	12.95	8.25	7.9	8.0	8.15
2	.....	.....	.....	10.2	9.9	8.55	8.6	10.55	8.1	7.75	7.95	8.4
3	.....	9.9	.....	9.65	9.7	8.45	9.35	9.2	8.05	8.0	7.95	8.35
4	.....	.....	9.4	9.55	10.25	8.4	9.3	8.75	9.9	7.9	7.95	9.0
5	.....	.....	.....	9.3	10.55	8.4	8.95	8.55	9.25	7.9	8.1	9.05
6	9.7	9.9	.....	9.4	10.25	8.5	8.8	8.4	8.95	7.8	7.95	8.5
7	.....	.....	.....	10.1	10.45	8.75	8.7	8.3	8.65	7.7	8.15	8.5
8	9.9	.....	.....	9.6	10.55	8.4	8.45	8.45	8.45	7.75	8.1	8.45
9	.....	.....	.....	9.25	10.35	8.35	8.35	8.6	8.3	7.85	8.1	8.3
10	.....	9.9	9.0	9.25	10.3	8.2	8.3	8.55	8.1	7.85	8.1	8.15
11	.....	.....	9.0	9.85	10.25	8.35	8.35	8.3	7.95	7.85	8.05	8.1
12	9.6	.....	8.85	9.8	10.15	8.5	8.4	8.2	8.05	8 05	8.0	8.1
13	.....	9.8	9.05	9.85	10.0	9.25	8.55	8.1	8.25	8.85	8.1	8.15
14	.....	.....	8.85	9.85	9.7	9.45	8.55	8.15	8.3	8.45	8.15	8.1
15	.....	.....	8.7	9.85	9.55	9.2	8.25	8.2	8.1	8.15	7.8	8.1
16	.....	.....	7.8	9.6	9.55	8.9	7.95	8.3	8.0	8.1	7.95	9.0
17	9.8	.....	7.6	9.4	9.55	8.7	8.05	9.15	8.0	8.15	8.25	.....
18	.....	.....	7.55	9.1	9.5	8.7	8.2	8.65	8.4	8.0	8.2	.....
19	.....	9.8	7.55	8.85	9.75	8.65	8.05	8.35	9.65	8.0	7.9	.....
20	.....	.....	8.55	8.85	9.35	8.7	8.0	8.05	9.0	8.15	8.0	.....
21	10.1	.....	8.6	9.15	9.55	8.65	8.0	7.95	8.9	8.15	8.1	.....
22	10.1	.....	8.1	10.6	9.25	8.7	7.95	7.95	8.75	8.2	8.0	8.1
23	.....	.....	8.15	10.15	9.1	8.6	7.75	7.85	8.45	8.1	8.0	8.1
24	.....	9.8	8.1	9.65	8.9	8.55	7.55	7.9	8.15	8.05	8.0	8.1
25	.....	.....	8.6	9.4	8.9	8.4	7.75	7.85	8.1	8.0	8.15	8.1
26	.....	9.8	10.85	9.35	8.9	8.45	7.9	7.8	8.2	8.0	8.45	8.1
27	.....	.....	11.25	9.5	8.95	9.95	7.8	7.8	8.15	8.0	8.35	8.7
28	10.0	.....	10.85	9.5	9.1	9.55	7.7	8.35	8.15	8.0	8.3	8.15
29	.....	.....	10.75	9.5	8.85	9.05	7.7	8.3	8.15	7.95	7.9	8.2
30	.....	.....	10.9	9.6	8.9	8.75	7.75	8.05	8.0	7.9	8.3	8.2
31	10.0	.....	11.45	.....	8.7	.....	10.45	8.0	.....	8.0	.....	8.2

NOTE.—River frozen January 1 to March 10, when it was open at the gage, and clear of ice March 30. Anchor ice during the first part of December. River frozen December 15–22, and open at gage December 22–31. During frozen season gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 6, 8, 12	.....	.....	1.3
January 17, 21	.....	.....	1.4
January 22	10.1	10.2	1.4
January 28	10.0	10.2	1.5
January 31	10.0	10.2	1.6
February 3, 6	9.9	10.1	1.8
February 10	9.9	10.2	1.8
February 13	9.8	10.3	1.9
February 19	9.8	10.1	1.8
February 24, 26	9.8	10.0	1.8
March 4	9.4	9.5	1.8

Station rating table for Androscoggin River at Dixfield, Me., from January 1, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
7.30	1,080	8.50	3,150	9.70	7,080	10.90	12,310
7.40	1,200	8.60	3,410	9.80	7,470	11.00	12,800
7.50	1,330	8.70	3,680	9.90	7,870	11.20	13,810
7.60	1,470	8.80	3,970	10.00	8,280	11.40	14,840
7.70	1,620	8.90	4,270	10.10	8,700	11.60	15,880
7.80	1,770	9.00	4,580	10.20	9,130	11.80	16,940
7.90	1,930	9.10	4,900	10.30	9,560	12.00	18,000
8.00	2,100	9.20	5,230	10.40	10,000	12.20	19,060
8.10	2,280	9.30	5,580	10.50	10,450	12.40	20,130
8.20	2,480	9.40	5,940	10.60	10,900	12.60	21,210
8.30	2,690	9.50	6,310	10.70	11,360	12.80	22,300
8.40	2,910	9.60	6,690	10.80	11,830	13.00	23,400

NOTE.—The above table is applicable only for open channel conditions. It is based on nine discharge measurements made during 1903–1905. It is fairly well defined.

Estimated monthly discharge of Androscoggin River near Dixfield, Me., for 1904–5.

[Drainage area, 2,230 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
March 26–31	19,320	3,970	10,160	4.56	1.02
April	27,000	3,150	8,210	3.68	4.11
May	23,120	4,120	13,520	6.06	6.99
June	4,425	3,030	3,584	1.61	1.80
July	4,425	1,265	2,461	1.10	1.27
August	4,740	1,330	1,792	.804	.927
September	5,065	1,080	1,911	.857	.956
October	13,050	1,545	2,962	1.33	1.53
November	2,585	1,695	2,014	.903	1.01
December 1–10	8,280	1,545	2,986	1.34	.498
1905.					
March (10–31)	15,100	1,400	5,732	2.57	2.10
April	15,880	4,120	6,971	3.13	3.49
May	10,680	3,680	6,965	3.12	3.60
June	8,075	2,480	3,838	1.72	1.92
July	10,220	1,400	2,979	1.34	1.54
August	23,120	1,770	3,646	1.63	1.88
September	7,870	2,015	3,138	1.41	1.57
October	4,120	1,620	2,160	.969	1.12
November	3,030	1,770	2,253	1.01	1.13
December 1–15, 22–31	4,740	2,280	2,728	1.22	1.13

NOTE.—River frozen January 1 to March 26 and December 11–31, 1904. Estimates for March and December, 1905, liable to some error, owing to ice conditions on the river. (See note to gage-height table, p. 83.)

PRESUMPSCOT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Presumpscot River is one of the most interesting as well 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 46 square miles; the total water surface on the drainage basin is 97 square miles; the area of the drainage basin at the outlet of the lake is 420 square miles, and at the mouth of the river 600 square miles. The northern part of the basin is mountainous and wooded; 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.

During the past few years several new developments have been made along the river, so that the only portion now unimproved is the fall of 56 feet between Great Falls and Gambo Falls.

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 during most of this time 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. In March, 1904, Messrs. S. D. Warren & Co. completed a hydro-electric plant at Eel Weir Falls, near Sebago Lake, bringing water directly from the dam at the lake by means of a canal. A head of 40 feet is thus obtained at average lake level.

The development at Eel Weir has necessitated a different method of recording the flow from the lake. The water is used through three pairs of 33-inch Hercules wheels. The water used by these wheels is recorded by three Allen meters, one on each pair. These meters were rated by the result of a test at Holyoke of one pair of these wheels.

Since the station was finished the performance of the wheels and of the recording meters has been checked by careful current-meter readings in the canal and brake tests of the wheels, combined with electrical readings of the generator output. The records of the generator output of the station are kept and the constant ratio between these readings and the Allen meter records gives a good check on the latter.

It is usually desired to keep a constant flow through the canal, and when the demands for power are not sufficient to utilize the entire flow through the wheels the excess of water is run off through a pair of regulating gates at the power station, a record of the openings of these gates being kept and the flow computed from a coefficient determined by current-meter tests.

The flow at times from the lake may be greater than it is safe to carry through the canal, though this has not as yet happened. At such times it will be necessary to draw part of the water through the old regulating gates in the main dam.

A continuous record of the Sebago Lake level has been kept since January, 1872. The lake fills rapidly after March 1, attaining its maximum height between the middle of April 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 lake level and discharge make an unusually complete and valuable series of data. These have been furnished from time to time by S. D. Warren & Co., and the data regarding the new methods of measurement, etc., is from a description furnished by Joseph A. Warren.

The records of flow from 1887 to 1901, inclusive, are assembled in Water-Supply Paper No. 69, and those for succeeding years may be found in Water-Supply Papers Nos. 82, 97, and 124.

Mean daily discharge, in second-feet, of Presumpscot River at outlet of Sebago Lake, Me., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	473	536	357	430	518	500	468	467	465	363	390	385
2	511	488	351	267	522	503	400	482	472	470	448	397
3	497	470	347	498	518	500	528	477	368	477	410	335
4	490	467	350	557	517	360	427	450	468	470	400	410
5	503	397	323	552	515	492	502	470	477	463	333	420
6	497	432	340	448	517	505	507	358	460	468	428	410
7	504	437	338	430	445	510	508	470	475	460	450	412
8	448	427	333	475	512	513	502	460	472	425	430	405
9	496	420	342	312	522	505	347	465	460	468	427	427
10	500	420	335	517	500	482	487	467	454	478	432	237
11	497	410	330	505	502	385	470	473	483	467	422	382
12	505	400	332	457	498	505	467	475	473	477	320	397
13	500	442	335	445	492	515	473	410	480	477	418	397
14	450	427	330	510	450	517	478	470	475	473	427	392
15	345	407	338	485	457	515	477	475	477	462	418	395
16	559	403	330	360	508	517	365	472	442	453	433	382
17	508	408	328	500	525	510	469	470	405	477	430	367
18	505	395	322	500	512	382	473	472	477	497	425	385
19	495	395	327	485	510	512	474	447	478	455	417	382
20	498	377	332	490	493	493	471	457	480	458	413	407
21	483	388	333	492	397	512	473	473	480	472	410	400
22	438	375	335	502	503	500	472	473	476	372	400	403
23	517	375	330	368	497	507	304	477	464	460	403	405
24	487	370	330	485	498	505	475	468	409	463	395	333
25	486	357	330	467	512	365	462	475	471	460	397	397
26	493	365	247	517	497	508	467	470	470	455	280	396
27	482	369	363	502	483	520	457	387	472	457	410	396
28	482	357	370	513	215	488	468	465	472	453	412	396
29	431	.....	400	505	573	510	463	469	470	428	412	395
30	494	.....	421	347	480	503	375	462	463	443	408	400
31	470	.....	451	.....	508	.....	490	477	.....	422	.....	278

Estimated monthly discharge of Presumpscot River at Outlet of Sebago Lake, Me., for 1905.

[Drainage area, 420 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January	559	345	485	1.15	1.33
February	536	357	411	.979	1.02
March	451	247	343	.817	.942
April	557	267	464	1.10	1.23
May	573	215	490	1.17	1.35
June	520	360	488	1.16	1.29
July	528	304	458	1.09	1.26
August	482	358	461	1.10	1.27
September	483	368	463	1.10	1.23
October	497	363	456	1.09	1.26
November	450	280	407	.969	1.08
December	420	237	385	.917	1.06
The year	559	215	443	1.05	14.32

SACO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Saco 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 portions 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, N. H., about 2 miles from each place.

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. The current is medium at high and sluggish at low stages.

Discharge measurements are usually made by wading about 400 feet above the bridge.

A standard chain gage, which is read twice each day by Albert P. Davidson, is fastened to the floor of the bridge. The length of the chain was 30.44 feet when established, but changed to 30.47 feet August 26, 1905, on account of movement of the bridge. The gage is referred to bench marks as follows: (1) Marked point on lower chord of bridge near gage; elevation, 27.72 feet when established, but changed to 27.76 feet August 26, 1905. (2) South end of top of west abutment; elevation, 25.14 feet. Elevations refer to datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 69; 124, p 82.
Discharge: 97, p 69; 124, p 82.
Discharge, monthly: 124, p 84.
Gage heights: 97, p 69; 124, p 83.
Rating table; 124, p 84.

Discharge measurements of Saco River near Center Conway, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 6	T. W. Norcross	228	786	1.91	5.71	1,500
July 5 [a]	Murphy and Barrows	160	517	1.44	4.53	742
August 26 [b]	T. W. Norcross	136	177	1.49	3.69	263

[a] Right channel, by wading a short distance below bridge.
[b] By wading 250 feet below gage; meter on rod.

Daily gage height, in feet, of Saco River near Center Conway, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	.....	.....	7.65	6.3	4.45	4.35	8.5	4.85	4.25	4.2	6.0
2	.....	.....	.....	6.5	5.75	4.45	4.35	6.4	4.45	4.2	4.2	.....
3	.....	.....	.....	6.1	5.55	4.45	5.85	5.8	7.7	4.15	4.2	7.05
4	.....	.....	.....	6.0	6.15	4.2	4.75	5.35	9.4	4.15	4.2	7.15
5	.....	4.9	4.8	5.75	6.15	4.25	4.5	4.7	7.5	4.1	4.3	6.9
6	.....	.....	.....	6.55	5.9	4.85	4.35	4.65	5.8	4.1	4.3	6.15
7	.....	.....	.....	7.05	6.4	4.95	4.25	4.55	5.8	3.95	4.3	5.7
8	5.05	.....	.....	6.35	6.0	4.6	4.05	4.45	5.5	3.95	4.4	5.15
9	.....	.....	.....	5.95	5.7	4.4	4.0	4.55	5.2	3.85	4.45	4.85
10	.....	.....	.....	6.0	5.7	4.4	3.95	4.35	4.95	3.85	4.4	4.65
11	.....	.....	.....	6.75	5.35	4.15	4.0	4.15	4.8	3.9	4.4	4.9
12	.....	4.95	4.85	6.65	5.2	4.25	3.9	4.1	5.1	6.1	4.15	5.3
13	.....	.....	.....	6.55	5.4	6.85	3.95	4.05	6.25	5.8	4.2	5.1
14	.....	.....	.....	6.4	4.9	5.85	3.8	4.05	5.6	5.0	4.5	5.05
15	4.5	.....	.....	6.45	4.95	5.35	3.85	4.0	5.05	4.65	4.35	.....
16	.....	.....	.....	6.25	5.6	4.55	3.75	4.55	4.85	4.5	4.4	.....
17	.....	.....	.....	5.75	5.35	4.45	3.7	5.3	4.75	4.5	4.3	.....
18	.....	.....	.....	5.55	5.55	4.35	3.8	4.5	6.15	4.6	4.3	.....
19	.....	5.05	5.0	5.35	5.6	4.25	3.7	4.25	7.2	4.9	3.95	.....
20	.....	.....	7.45	5.35	5.4	4.3	3.85	4.1	6.05	4.9	4.2	.....
21	.....	.....	6.65	6.0	5.0	4.25	3.85	3.95	5.65	4.7	4.2	.....
22	5.05	.....	6.1	7.75	4.95	4.45	3.7	3.85	5.4	4.45	4.1	.....
23	.....	.....	.....	6.8	4.85	4.4	3.6	3.8	5.25	4.45	4.1	.....
24	.....	.....	.....	6.05	4.7	4.2	3.55	3.75	4.9	4.35	4.15	.....
25	.....	.....	.....	6.25	4.6	4.0	3.55	3.8	4.75	4.3	4.25	.....
26	.....	5.05	11.15	5.9	4.5	4.1	3.55	3.7	5.2	4.2	4.5	.....
27	.....	.....	8.1	6.3	4.5	6.5	3.55	3.95	5.0	4.2	4.25	.....
28	.....	.....	7.75	6.3	4.45	5.8	3.55	3.85	4.45	4.2	4.3	.....
29	4.9	.....	7.45	6.4	4.3	4.55	3.55	3.9	4.25	4.2	4.45	.....
30	.....	.....	8.0	6.3	4.3	4.55	3.6	3.95	4.25	4.2	5.9	.....
31	.....	.....	8.05	.....	4.3	.....	12.55	4.8	.....	4.2	.....	4.95

Daily gage height, in feet, of Saco River near Center Conway, N. H., for 1905—Cont'd.

NOTE.—River frozen January 1 to March 26 and December 15–31. During frozen season gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*
January 1	4.5	4.55	1.2
January 8	5.05	(a)	.....
January 15	4.5	5.15	2.1
January 22	5.05	5.2	2.0
January 29	4.9	5.05	2.0
February 5	4.9	4.95	2.2
February 12	4.95	4.9	2.2
February 19	5.05	5.35	2.35
February 26	5.05	5.3	2.4
March 5	4.8	4.85	2.45
March 12	4.85	5.0	2.5

a Below water surface.

March 19, unsafe; gage height read to top of ice; March 20–22, water flowing over surface of ice; March 26, ice breaking up; March 27, river clear of ice; December 2, ice under gage 2 inches thick, but river not frozen across; December 24, gage height to top of ice, 5.1 feet; December 31, gage height to top of ice, 5.05 feet; thickness of ice, 0.95 foot at gage, but river not frozen across in left span.

Station rating table for Saco River near Center Conway, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.50	197	4.90	917	6.30	2,050	7.70	3,695
3.60	234	5.00	984	6.40	2,150	7.80	3,835
3.70	273	5.10	1,053	6.50	2,250	7.90	3,975
3.80	314	5.20	1,124	6.60	2,355	8.00	4,120
3.90	358	5.30	1,197	6.70	2,460	8.10	4,270
4.00	404	5.40	1,272	6.80	2,570	8.20	4,425
4.10	453	5.50	1,349	6.90	2,680	8.30	4,580
4.20	504	5.60	1,428	7.00	2,795	8.40	4,740
4.30	557	5.70	1,509	7.10	2,910	8.50	4,900
4.40	612	5.80	1,592	7.20	3,030	8.60	5,060
4.50	669	5.90	1,677	7.30	3,155	8.70	5,225
4.60	728	6.00	1,764	7.40	3,285	8.80	5,395
4.70	789	6.10	1.855	7.50	3,420	8.90	5,565
4.80	852	6.20	1,950	7.60	3,555	9.00	5,735

NOTE.—The above table is applicable only for open-channel conditions. It is based on fourteen discharge measurements made during 1903–1905. It is well defined between gage heights 3.4 feet and 9 feet.

Estimated monthly discharge of Saco River near Center Conway, N. H., for 1905.

[Drainage area, 385 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 26–31	10,200	3,352	4,984	12.95	2.89
April	3,765	1,234	2,088	5.42	6.05
May	2,150	557	1,214	3.15	3.63
June	2,625	404	821	2.13	2.38
July	13,600	216	835	2.17	2.50
August	4,900	273	774	2.01	2.32
September	6,450	530	1,531	3.98	4.44
October	1,855	336	646	1.68	1.94
November	1,677	381	583	1.51	1.68

MERRIMAC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Merrimac basin, which has a total drainage area of 5,015 square miles, lies in the States of New Hampshire and Massachusetts, 3,815 square miles being 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 southward 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 southward 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 for a distance of 40 miles, to Newburyport, where it enters an arm of the sea. Tide flows to Lawrence.

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

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

Drainage areas 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, at gaging station	1,460
Pemigewasset	Plymouth, at gaging station	615
Do	Junction with Winnepesaukee	1,085
Winnepesaukee	Junction with Pemigewasset	435
Contoocook	West Hopkinton, at gaging station	410
Do	Mouth	750
Suncook	East Pembroke, at gaging station	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 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 at high and medium at low stages.

Discharge measurements are made from the bridge. The initial point for soundings is at the top of the face of the right abutment at the upstream side of the bridge.

A standard chain gage, which is read twice each day by F. R. Roers, is fastened to the guard timber of the bridge. The length of the chain when established was 47.08 feet, but changed to 47.16 feet August 22, 1905, owing to movement of the gage. The gage is referred to 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. (5) Chiseled circle on outcropping ledge 50 feet north and 23 feet east of northeast corner of west abutment of the bridge, marked "B. M. 5;" elevation, 12.68 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 70–71; 124, p 86.
Discharge: 97, p 71; 124, p 87.
Discharge, monthly: 124, p 88.
Gage heights: 97, p 71; 124, p 87.
Rating table: 124, p 88

Discharge measurements of Merrimac River at Franklin Junction, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 5	F. E. Pressey	231	1,350	4.00	6.69	5,400
April 11	T. W. Norcross	231	1,370	4.61	7.19	6,320
May 2	do	226	1,100	2.77	5.76	3,040
May 24	do	220	941	2.24	4.98	2,110
July 3	Murphy and Barrows	234	1,440	4.36	7.38	6,280
August 22	T. W. Norcross	216	713	1.61	4.23	1,150

Daily gage height, in feet, of Merrimac River at Franklin Junction, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	.....	.....	12.1	6.2	4.6	5.0	6.6	6.0	4.85	4.5	5.3
2	4.1	.....	.....	8.6	5.9	4.5	.....	5.6	6.0	4.9	4.4	4.9
3	4.2	.....	.....	7.4	5.7	4.6	7.15	5.05	5.45	4.7	4.4	7.9
4	4.2	.....	.....	7.1	5.7	4.25	6.15	4.75	11.05	4.7	4.65	8.55
5	4.35	.....	.....	6.7	6.0	4.6	5.55	4.6	8.8	4.65	4.7	6.7
6	4.45	.....	.....	7.4	5.8	4.65	5.1	4.0	7.4	4.55	4.8	5.6
7	5.1	.....	.....	9.1	6.3	5.65	4.9	4.35	6.3	4.5	5.1	5.7
8	5.2	.....	.....	7.55	6.8	5.25	4.8	4.2	5.85	4.1	5.15	5.25
9	5.5	.....	.....	.....	6.0	5.0	4.25	4.2	5.5	4.7	5.1	5.3
10	5.7	.....	4.25	6.7	5.9	4.75	4.6	4.3	4.45	4.5	4.9	4.2
11	5.6	.....	4.2	7.2	5.7	4.15	4.6	4.3	4.9	4.4	4.8	.....
12	5.55	.....	4.0	8.0	5.4	4.65	4.5	.....	5.3	5.1	4.9	4.8
13	5.5	.....	4.5	7.8	5.4	.....	4.5	3.85	6.4	5.9	4.8	4.85
14	5.4	.....	4.6	7.3	4.7	5.65	4.7	4.1	5.9	5.3	4.8	4.8
15	4.7	.....	4.2	6.9	5.3	5.3	4.5	4.2	5.3	4.55	4.8	4.8
16	5.7	.....	4.0	6.45	5.6	5.0	4.1	4.4	5.1	4.8	4.7	4.8
17	5.95	.....	4.05	6.3	5.8	4.95	4.4	5.3	4.9	4.7	4.8	4.35
18	5.65	.....	4.0	5.8	5.7	.....	4.5	4.9	6.6	4.6	4.7	4.7
19	5.35	.....	3.8	5.75	5.7	4.75	4.4	4.7	11.85	4.6	4.2	4.6
20	5.05	.....	4.2	5.65	.....	4.7	4.3	.....	8.25	.....	4.4	4.75
21	4.9	.....	5.0	6.05	.....	4.65	4.6	4.2	7.6	4.85	4.4	4.7
22	.....	.....	5.05	7.95	.....	5.3	4.45	4.25	7.0	4.35	4.45	4.7
23	4.75	.....	4.9	.....	5.0	5.45	3.9	4.2	6.4	4.65	4.4	4.8
24	4.8	.....	4.85	6.6	5.0	5.1	4.1	4.1	5.3	4.7	4.5	4.2
25	5.3	.....	5.2	6.2	4.9	4.25	4.15	4.1	5.5	4.7	4.5	.....
26	5.4	.....	7.5	6.0	4.85	4.65	4.2	4.1	5.3	4.6	4.05	4.6
27	5.5	.....	9.8	6.0	4.8	6.9	4.2	.....	5.2	4.55	4.8	4.65
28	5.4	.....	11.1	6.1	4.55	6.4	4.2	4.8	5.1	4.6	4.75	4.6
29	5.5	.....	11.7	6.05	4.5	5.65	4.2	4.7	5.0	.....	4.85	4.7
30	.....	.....	13.0	.....	4.6	5.2	4.2	4.55	4.9	4.5	4.95	5.2
31	.....	.....	12.95	.....	4.6	.....	5.5	4.5	.....	4.4	.....	4.3

NOTE.—River open at gage January 1–29. River frozen January 30 to March 9.

Station rating table for Merrimac River at Franklin Junction, N. H., from July 8, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
3.90	795	5.00	2,220	6.10	4,125	7.20	6,250
4.00	910	5.10	2,380	6.20	4,310	7.40	6,660
4.10	1,030	5.20	2,540	6.30	4,500	7.60	7,075
4.20	1,150	5.30	2,705	6.40	4,690	7.80	7,500
4.30	1,270	5.40	2,875	6.50	4,880	8.00	7,930
4.40	1,395	5.50	3,045	6.60	5,070	8.20	8,370
4.50	1,520	5.60	3,220	6.70	5,265	8.40	8,815
4.60	1,645	5.70	3,395	6.80	5,460	8.60	9,265
4.70	1,775	5.80	3,575	6.90	5,655	8.80	9,715
4.80	1,915	5.90	3,755	7.00	5,850	9.00	10,170
4.90	2,065	6.00	3,940				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1903-1905. It is well defined between gage heights 4.15 feet and 8.9 feet.

Estimated monthly discharge of Merrimac River at Franklin Junction, N. H., for 1905.

[Drainage area, 1,460 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 10-31	19,830	680	5,150	3.53	2.89
April	17,580	3,308	6,006	4.11	4.59
May	5,460	1,520	2,976	2.04	2.35
June	5,655	1,090	2,397	1.64	1.83
July	6,150	795	1,824	1.25	1.44
August	5,070	738	1,586	1.09	1.26
September	16,960	1,458	4,701	3.22	3.59
October	3,755	1,030	1,785	1.22	1.41
November	2,460	970	1,763	1.21	1.35
December	9,152	1,150	2,484	1.70	1.96

NOTE.—Omitted gage heights were estimated and discharges applied as usual.

MERRIMAC RIVER AT GARVINS FALLS, N. H.

The power at Garvins Falls—4 miles below Concord—is one of the best on Merrimac River. There has been a dam at this point since 1815, first in connection with the Old Bow Canal and later to furnish power for a pulp mill. This privilege has since become the property of the Manchester Traction, Light, and Power Company, and has been more completely developed. During 1903–4 an overfall dam of the ogee type, somewhat similar in cross section to the dam at Holyoke, was completed. This is 550 feet long between abutments and about 800 feet over all, including headgates, and is substantially built of stone masonry. A canal has been completed which is about 500 feet long and 74 feet wide at the water line, and wasteways are provided from the sides of this—one 90 feet long at elevation 102 (the main crest of the dam being taken as elevation 100) and another 45 feet long at elevation 103. A waste gate 10 feet wide and capable of being lowered to elevation 93 is also provided for use especially in floating out any obstructions which lodge against the racks. The new dam and headgates to the canal are situated about 800 feet downstream

from the old dam, which was destroyed on the completion of the new structure. At present there are four triplex turbines of something over 1,000 horsepower each and one small duplex turbine of 75 horsepower used in running exciters. Provision has been made for two more large units, which will be installed later. The turbines are of the McCormick design, furnished by the Rodney Hunt Machine Company. Each large unit has three 39-inch runners, mounted on a horizontal shaft, which revolves at 180 revolutions a minute. Two of the wheels in each set discharge through a common T center and draft tube near the fore bay wall. The third wheel is set opposite a quarter turn at the downstream end of the casing and discharges through this quarter turn into a smaller draft tube. The top of the penstock opening is at elevation 95.5, while the lower ends of the draft tubes are horizontal and are about 2 feet below the level of usual tail water. The gates for the runners are of the plain cylindrical pattern without fingers and are controlled by governors. The average head on the wheels is about 29 feet. At present there are four 650-kilowatt three-phase generators direct connected with the turbines.

The power developed is transmitted at 12,000 volts tension to Manchester, about 14 miles away, where it enters a substation and is transformed to a lower voltage and through a distributing switch board utilized for light and power purposes. The Garvins Falls station is one of a system of three water-power plants and one steam-power plant operated by this company.

Careful records of the pond and tail-race levels, wheel openings, etc., have been kept by the company since the completion of the new dam in 1904, and have been furnished for computations of flow by J. Brodie Smith, manager. A number of current-meter measurements have been made from time to time by the hydrographers of the Survey for the purpose of rating turbines and to assist in computing flow over the dam. Estimates of monthly flow at this point from September 1, 1904, to December 31, 1905, are given in the following table:

Estimated monthly discharge of Merrimac River at Garvins Falls, N. H., for 1904–5.

[Drainage area, 2,340 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September	7,110	1,150	2,220	0.947	1.06
October	7,880	1,460	2,860	1.22	1.41
November	2,440	1,610	2,000	.856	.955
December	2,200	1,300	1,660	.710	.818
1905.					
January	3,440	1,490	2,190	.936	1.08
February	2,110	1,340	1,610	.690	.718
March	32,760	1,370	6,400	2.74	3.16
April	30,940	4,940	10,400	4.45	4.96
May	5,660	2,070	3,910	1.67	1.92
June	5,410	1,840	2,730	1.17	1.30
July	4,980	1,090	1,930	.824	.950
August	5,470	1,240	1,920	.823	.949
September	18,030	2,720	6,260	2.67	2.98
October	3,860	1,780	2,290	.978	1.13
November	4,030	1,810	2,560	1.10	1.23
December	9,990	2,250	3,880	1.66	1.91
The year	32,760	1,090	3,840	1.64	22.29

MERRIMAC RIVER AT LAWRENCE, MASS.

Records of flow of the Merrimac at Lawrence have been kept for more than fifty years, but have never been published in full. Data in regard to the flow are furnished by R. A. Hale, principal assistant engineer of the Essex Water Power Company.

For a portion of the year water from the drainage basins of Sudbury and Nashua rivers 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 accompanying tables give the flow of the Merrimac at Lawrence, also the quantity wasted from the Sudbury and Nashua 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.

	Square 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 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.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper; Bull = Bulletin):

Description: Ann, 19, iv, pp 111–112; Bull 140, p 33; WS 35, p 34; 47, p 32; 65, p 22; 82, pp 49–50; 97, p 72; 124, pp 89–90.
Discharge, daily: WS 35, pp 35–36; 47, p 33; 82, pp 51–52; 97, p 73; 124, pp 90–93.
Discharge, monthly: Ann 19, iv pp 113–115; 20, iv, p 73; 21, iv, p 60; Bull 140, p 34.
Discharge, yearly: Ann 20, iv, p 46.
Hydrographs: Ann 19, iv, p 112; 20, iv, p 74; 21, iv, p 60.

Mean daily discharge, in second-feet, of Merrimac River at dam at Lawrence, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	453	2,838	2,526	44,887	7,434	3,414	3,585	2,477	2,713	2,733	3,240	5,043
2	3,147	2,784	2,695	37,260	6,537	3,015	2,941	4,775	2,109	4,371	2,796	3,984
3	3,084	2,760	2,527	28,553	6,379	1,958	2,938	4,676	3,109	3,276	2,818	3,714
4	2,981	1,980	1,514	22,206	6,002	1,470	4,897	3,939	6,430	3,190	1,813	8,930
5	2,812	457	430	18,850	5,868	3,708	6,028	2,591	20,900	3,214	1,439	15,540
6	2,735	3,505	2,768	19,442	6,094	3,116	4,503	1,632	17,434	3,336	4,850	12,350
7	2,662	2,865	2,567	25,546	5,732	2,987	3,881	3,631	12,972	2,390	4,409	9,354
8	4,358	2,518	2,596	25,097	6,548	3,070	2,321	2,955	9,854	2,103	5,345	7,933
9	7,710	2,440	2,774	20,156	6,806	3,710	1,907	2,443	7,257	4,179	5,559	6,009
10	6,930	2,695	2,811	16,880	6,174	2,993	3,947	2,390	5,541	3,238	5,251	5,483
11	6,844	1,902	2,418	15,309	5,619	2,482	3,148	2,441	5,953	3,065	3,907	6,016
12	6,470	489	2,305	17,546	5,303	4,330	2,836	1,454	4,960	2,544	3,513	4,087
13	6,301	3,094	4,898	19,451	4,159	3,427	2,807	474	5,035	2,812	5,062	4,099
14	4,862	2,613	3,879	18,502	3,905	3,033	2,826	5,031	7,285	3,116	3,679	4,338
15	4,377	2,573	3,842	16,148	5,467	2,930	1,764	2,953	7,330	3,589	3,552	4,429
16	6,111	2,510	4,020	14,215	3,758	4,296	581	2,697	5,525	4,620	3,732	2,838
17	4,352	2,678	4,034	12,661	6,010	2,599	3,637	2,980	4,309	3,684	3,654	2,286
18	3,893	1,825	2,977	11,273	6,938	2,348	2,759	3,257	5,171	3,311	2,289	4,622
19	3,920	456	4,050	9,761	6,716	4,410	2,723	2,987	8,525	3,381	2,461	3,460
20	4,086	2,940	11,100	8,546	8,211	3,617	2,404	2,141	17,529	3,396	4,397	3,371
21	2,494	2,691	11,210	7,961	5,208	4,253	2,538	3,690	13,968	2,297	3,537	3,997
22	2,387	2,521	10,050	8,018	5,653	5,768	1,677	2,739	11,540	2,886	3,256	4,664
23	4,744	2,464	9,150	10,857	4,564	8,238	383	2,729	9,007	4,760	3,129	5,211
24	3,545	2,574	8,800	10,793	4,520	7,433	2,603	2,505	6,588	3,764	2,892	5,837
25	3,043	1,666	8,740	9,115	4,178	5,593	2,559	2,766	6,467	3,526	1,827	5,638
26	2,955	410	11,570	8,094	3,947	5,918	2,382	1,481	5,262	3,447	1,193	6,460
27	2,931	2,850	32,003	7,692	2,866	4,987	2,376	316	4,721	3,376	4,118	5,505
28	1,827	2,514	36,429	7,225	2,812	5,912	2,343	2,344	4,488	2,090	3,307	4,900
29	895	.....	41,219	6,856	4,343	7,300	1,403	2,458	4,133	1,851	3,212	4,890
30	3,996	.....	45,940	6,639	2,769	5,615	128	2,374	2,830	4,119	1,413	4,881
31	3,087	.....	45,617	.....	3,171	.....	2,079	2,445	.....	3,418	.....	6,432
Total	119,992	63,612	327,459	485,545	161,691	124,930	82,904	83,771	228,945	101,082	101,650	176,301
Average	3,871	2,272	10,563	16,185	5,216	4,164	2,674	2,702	7,631	3,261	3,388	5,687

Average weekly flow, arranged in order of dryness, of Merrimac River at Lawrence, Mass., for 1905.

Week ending Sunday—	Merrimac River at Lawrence (total drainage area=4,664 square miles).	Wasting into Merrimac River 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, Bannister Brook (drainage area=19 square miles).	Total waste of these watersheds (total drainage area=212 square miles).	Second-feet.	
	Second-feet for seven days.					Seven days.	Per square mile.
July 30	1,971	4	2	0	6	1,965	0.441
March 5	2,151	3	2	0	5	2,146	.482
February 26	2,181	2	4	0	6	2,175	.489
February 19	2,250	3	40	2	45	2,205	.495
August 13	2,255	3	2	0	5	2,250	.505
July 23	2,303	1	2	0	6	2,297	.516
August 27	2,318	4	2	0	6	2,312	.519
February 12	2,345	3	42	0	45	2,300	.517
September 3	2,507	4	32	0	36	2,471	.555
February 5	2,557	4	36	0	40	2,517	.565
July 16	2,558	4	2	0	6	2,552	.573
March 12	2,606	4	11	0	15	2,591	.582
November 5	2,806	3	2	0	5	2,801	.629
January 29	2,845	3	41	0	44	2,801	.629
June 4	2,877	3	3	0	6	2,871	.645
November 26	2,890	3	2	0	5	2,885	.648
January 8	3,111	5	47	0	52	3,059	.687
October 8	3,126	4	68	0	72	3,054	.686
August 20	3,149	4	2	0	6	3,143	.706
June 11	3,152	4	2	3	9	3,143	.706
August 6	3,167	4	2	0	6	3,161	.710
October 15	3,220	3	6	0	9	3,211	.721
October 29	3,259	3	2	0	5	3,254	.731
October 22	3,368	3	4	0	7	3,361	.755
June 18	3,423	3	9	11	23	3,400	.764
November 19	3,490	3	2	0	5	3,485	.783
December 3	3,542	4	2	0	6	3,536	.794
July 9	3,782	3	2	0	5	3,777	.848
January 22	3,892	3	66	0	69	3,823	.859
March 19	3,957	4	80	0	84	3,873	.870
December 17	4,013	4	2	0	6	4,007	.900
May 28	4,077	4	8	0	12	4,065	.913
October 1	4,376	4	50	0	54	4,322	.971
December 24	4,452	3	2	0	5	4,447	.999
November 12	4,691	3	2	0	5	4,686	1.053
July 2	5,180	3	7	0	10	5,170	1.161
May 14	5,502	4	6	0	10	5,492	1.234
December 31	5,529	5	44	0	49	5,480	1.231
June 25	5,616	3	23	15	41	5,575	1.252
May 21	5,758	4	24	0	28	5,730	1.287
September 17	5,771	4	2	0	6	5,765	1.295
January 15	6,213	3	109	0	112	6,101	1.370
May 7	6,292	4	2	0	6	6,286	1.412
April 30	8,060	4	23	0	27	8,033	1.804

Average weekly flow, arranged in order of dryness, of Merrimac River at Lawrence, Mass., for 1905—Continued.

Week ending Sunday—	Merrimac River at Lawrence (total drainage area=4,664 square miles).	Wasting into Merrimac River 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, Bannister Brook (drainage area=19 square miles.)	Total waste of these watersheds (total drainage area=212 square miles).	Second-feet.	
	Second-feet for seven days.					Seven days.	Per square mile.
December 10	9,371	4	2	0	6	9,365	2.104
April 23	9,868	4	55	0	59	9,809	2.203
March 26	10,089	6	171	1	178	9,911	2.226
September 24....	10,333	4	5	0	9	10,324	2.319
September 10....	11,484	3	61	0	64	11,420	2.565
April 16	16,864	4	99	12	115	16,749	3.762
April 9	22,836	4	123	24	151	22,685	5.095
April 2	40,479	5	173	40	218	40,261	9.043
Total, 52 weeks.	293,912	190	1,512	108	1,810	292,102	65.609
Weekly average.	5,652	4	29	2	35	5,617	1,262

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 given to the United States Geological Survey by the Locks and Canals Company, of Lowell, Mass. From these figures the monthly discharge of the river since that date was estimated from measurements of flow at the station during 1903 and 1904. These estimates were published in Water-Supply Paper No. 124, pp. 97–101.

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 fairly permanent near the gage, but evidences of change in conditions below and consequent change in control as regards velocity have been observed during 1905. The bed is rocky in the right half and gravelly in the left. The velocity is rapid in the right and sluggish in the left half.

Discharge measurements at ordinary and high stages are made from the bridge. The initial point for soundings is at the top of the face of the right abutment on the upstream side. At low water the discharge of the left channel is measured by wading.

A standard chain gage, which is read twice each day by Frank Morton, is attached to the guard rail of the sidewalk of the bridge on the upstream side. The length of the chain is 34.69 feet. The gage is referred to bench marks as follows: (1) Marked point on rail of bridge near gage; elevation, 34.00 feet when established, but changed to 33.96 feet August 23, 1905. (2) North corner of intermediate cast-iron gage set by the 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.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 73–74; 124, pp 93–94.
Discharge: 97, p 74; 124, p 94.
Discharge, monthly: 124, pp 97–101.
Gage heights: 97, p 75; 124, p 95.
Rating table: 124, p 96.

Discharge measurements of Pemigewasset River at Plymouth, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
July 4	Murphy and Barrows	202	777	2.65	3.94	2,060
August 3[a]	H. K. Barrows	178	387	2.14	2.75	826
August 23[b]	T. W. Norcross	124	257	1.44	1.80	370
September 5	do	224	1,400	4.17	6.88	5,840
October 7[a]	do	142	282	1.65	2.01	466
October 28[a]	do	113	208	1.15	1.51	240
October 28[a]	do	113	208	1.31	1.57	272

[a] In left channel by wading. [b] In left channel by wading; meter fastened to rod.

Daily gage height, in feet, of Pemigewasset River at Plymouth, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	.....	.....	7.55	4.4	2.6	2.8	4.35	3.6	2.35	2.0	2.65
2	2.22	3.1	3.1	5.6	3.9	2.4	2.8	3.3	3.3	2.2	2.2	2.8
3	2.32	.....	.....	4.6	3.6	2.35	6.0	2.8	4.8	2.3	2.0	3.6
4	2.42	.....	.....	4.4	4.2	2.4	4.05	2.5	8.8	2.25	2.15	6.3
5	2.5	.....	.....	4.2	4.3	2.35	3.3	2.3	7.15	2.2	2.4	4.15
6	.....	.....	.....	5.7	4.0	3.3	2.95	2.15	5.2	2.15	2.45	3.75
7	.....	.....	.....	6.3	5.15	3.6	2.8	2.1	4.25	2.0	2.5	3.3
8	3.4	.....	.....	5.05	4.75	3.05	2.6	2.1	3.6	2.0	2.6	3.1
9	4.1	2.85	2.85	4.6	4.1	2.9	2.4	2.0	3.25	2.05	2.55	2.9
10	4.25	.....	.....	4.6	4.0	2.6	2.4	2.1	2.9	2.0	2.4	2.65
11	4.02	.....	.....	5.65	3.6	2.4	2.2	1.9	2.6	1.9	2.3	1.8
12	.....	.....	.....	5.8	3.4	2.7	2.15	1.9	3.0	3.1	2.25	3.45
13	.....	.....	.....	5.6	3.3	4.55	2.5	1.8	4.3	3.65	2.25	3.45
14	.....	.....	.....	5.1	3.2	3.6	2.25	1.9	3.4	3.9	2.3	3.0
15	3.7	.....	.....	5.0	3.2	3.1	2.25	1.8	2.9	3.4	2.2	3.1
16	.....	3.25	2.65	4.35	3.7	2.8	2.1	2.25	2.7	2.7	2.2	3.4
17	.....	.....	.....	4.0	3.55	2.6	2.0	3.3	2.6	2.3	2.1	3.6
18	.....	.....	.....	3.65	3.8	2.5	2.3	2.5	6.2	2.15	1.95	3.5
19	3.2	.....	.....	3.4	3.85	2.4	2.1	2.2	8.15	2.3	1.85	3.4
20	.....	.....	.....	3.35	3.6	2.3	2.5	1.9	5.1	2.65	1.8	3.3
21	.....	.....	4.85	4.05	3.3	2.35	2.2	1.9	5.65	2.9	2.05	3.1
22	3.2	.....	.....	6.9	3.1	3.35	2.05	1.75	4.35	2.65	2.2	3.1
23	.....	2.95	4.15	5.2	2.9	3.1	1.85	1.8	3.6	2.4	1.95	3.1
24	.....	.....	.....	4.4	2.8	2.7	1.85	1.7	3.3	2.35	1.95	3.0
25	.....	.....	3.9	4.3	2.65	2.45	1.9	1.7	3.05	2.15	2.0	2.8
26	3.25	.....	8.6	4.15	2.6	2.95	1.75	1.7	3.0	2.15	2.4	2.9
27	.....	.....	9.15	4.5	2.85	6.3	1.8	2.2	2.85	2.2	2.45	2.75
28	.....	.....	13.1	4.7	2.9	4.25	1.8	2.8	2.7	1.85	2.2	2.7
29	.....	.....	11.85	4.7	2.75	3.6	1.8	2.35	2.6	1.95	2.4	2.7
30	.....	.....	8.65	4.5	2.7	3.1	1.7	2.0	2.5	1.9	5.0	4.0
31	.....	.....	9.25	.....	2.7	.....	5.3	4.0	.....	2.05	.....	3.75

NOTE.—River frozen January 5 to March 28. Ice jam in latter part of March affected gage heights. Ice went out March 28. During frozen season gage heights were read to the surface of the water in a hole cut in the ice, except January 15 and March 21, when readings were taken to the top of the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 19	3.2	3.3	0.6	February 16	3.25	3.5	1.3
January 22	3.2	3.3	.7	February 23	2.95	3.15	1.3
January 26	3.25	3.4	1.0	March 2	3.1	3.3	1.3
February 2	3.1	3.3	1.1	March 9	2.85	3.0	1.4
February 9	2.85	3.0	1.2	March 16	2.65	2.85	1.0

January 8, water on top of ice.

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 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, and the current is rapid.

Discharge measurements are made from the bridge. The initial point for soundings is at the downstream side of the left abutment at the top.

A standard chain gage, which is read twice each day by Frank H. Carr, is attached to the downstream side of the board covering of the bridge. The length of the chain was 26.11 feet when established, but changed to 26.04 feet August 29, 1905, owing to settling of the bridge. The gage is referred to bench marks as follows: (1) Point on the railing of bridge near the gage; elevation, 25.35 feet above gage datum. (2) The highest point of the large rock on the south side of the road, 15 feet northwest of the left abutment; elevation, 21.55 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 75; 124, pp 101–102.
Discharge: 97, p 75; 124, p 102.
Discharge, monthly: 124, p 104.
Gage heights: 97, p 75; 124, p 103.
Rating table: 124, p 104.

Discharge measurements of Contoocook River at West Hopkinton, N. H., for 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 1	F. E. Pressey	152	109	8.05	9.08	8,770
April 3	do	142	657	6.64	6.42	4,360
April 3	do	142	643	6.51	6.31	4,190
April 6	do	139	602	6.36	6.08	3,830
April 6	do	139	584	6.15	5.93	3,590
April 10	T. W. Norcross	133	472	5.09	5.08	2,400
April 12	do	139	574	5.85	5.80	3,360
April 12	do	139	574	5.84	5.80	3,350
August 29[a]	do	109	138	1.36	2.40	187
November 22[a]	do	110	163	1.56	2.64	254

[a] Partly by wading—same section.

Daily gage height, in feet, of Contoocook River at West Hopkinton, N. H., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	9.3	3.5	2.8	2.9	3.4	2.6	2.9	2.7	3.3
2	.....	7.7	3.4	2.9	2.9	3.15	2.7	2.7	2.6	3.4
3	.....	6.7	3.4	2.85	2.8	3.0	3.0	2.7	2.7	4.0
4	.....	6.15	3.6	2.8	2.7	2.85	5.05	2.8	2.85	5.55
5	.....	5.8	3.8	2.8	2.7	2.7	5.3	2.75	2.9	5.4
6	.....	6.3	3.7	2.65	2.65	2.6	5.0	2.7	3.0	4.4
7	.....	6.7	3.6	2.8	2.65	2.75	4.25	2.6	3.25	3.8
8	.....	6.3	3.5	2.95	2.7	2.85	3.65	2.6	3.7	3.75
9	.....	5.65	3.4	2.95	2.65	2.9	3.35	2.5	3.55	3.7
10	.....	5.3	3.3	3.0	2.7	2.8	3.15	2.45	3.3	3.6
11	.....	5.5	3.25	2.9	2.6	2.8	2.9	2.6	3.2	3.75
12	.....	5.9	3.25	2.8	2.6	2.75	3.2	2.8	3.05	3.9
13	.....	5.9	3.2	2.8	2.5	3.05	3.95	3.05	2.8	3.75
14	.....	5.5	3.15	2.85	2.5	3.15	4.1	3.0	2.8	3.85
15	.....	5.25	3.1	2.8	2.55	3.1	3.75	2.9	2.7	4.2
16	.....	5.0	3.35	2.85	2.5	3.15	3.4	2.9	2.7	4.5
17	.....	4.7	3.8	2.8	2.55	3.25	3.3	2.75	2.8	4.4
18	.....	4.45	3.8	2.7	2.45	3.45	3.45	2.7	2.8	4.15
19	.....	4.3	3.7	2.8	2.55	3.2	5.5	2.85	2.7	3.95
20	.....	4.2	3.6	2.8	2.55	3.0	5.1	2.95	2.7	3.65
21	.....	4.1	3.5	3.0	2.55	2.7	4.6	3.1	2.7	3.7
22	.....	4.1	3.3	3.6	2.5	2.8	4.3	3.0	2.7	3.7
23	.....	4.05	3.25	4.15	2.35	2.7	3.95	2.85	2.6	3.75
24	.....	3.9	3.2	3.8	2.4	2.7	3.65	2.8	2.7	3.8
25	.....	3.9	3.15	3.3	2.45	2.65	3.45	2.8	2.65	3.85
26	8.3	3.8	3.1	3.15	2.55	2.6	3.3	2.75	2.65	3.6
27	10.2	3.7	3.0	3.25	2.5	2.55	3.2	2.7	2.6	3.4
28	11.0	3.6	3.0	3.45	2.5	2.6	3.1	2.7	2.65	3.4
29	11.2	3.6	2.9	3.25	2.6	2.65	3.0	2.7	2.8	3.25
30	11.5	3.6	2.8	3.15	2.45	2.6	3.0	2.65	3.3	3.65
31	10.9	.....	2.85	.....	2.85	2.6	.....	2.6	.....	3.7

NOTE.—Ice January 1 to April 1 and December 11–31.
March 27, back water from ice jam below bridge. April 1, river clear of ice. Anchor ice in river December 11–17 and probably more or less after that time.

Station rating table for Contoocook River at West Hopkinton, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.30	165	3.30	582	4.30	1,465	5.30	2,685
2.40	185	3.40	651	4.40	1,575	5.40	2,820
2.50	209	3.50	724	4.50	1,690	5.50	2,960
2.60	237	3.60	801	4.60	1,805	5.60	3,100
2.70	270	3.70	882	4.70	1,925	5.70	3,245
2.80	308	3.80	967	4.80	2,045	5.80	3,395
2.90	352	3.90	1,056	4.90	2,165	5.90	3,550
3.00	402	4.00	1,150	5.00	2,290	6.00	3,710
3.10	457	4.10	1,250	5.10	2,420		
3.20	517	4.20	1,355	5.20	2,550		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 2.4 feet and 9 feet. Above gage height 6 feet the rating curve is a tangent, the difference being 164 per tenth.

Estimated monthly discharge of Contoocook River at West Hopkinton, N. H., for 1905.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	9,122	801	2,711	6.61	7.38
May	967	308	624	1.52	1.75
June	1,302	254	442	1.08	1.20
July	352	175	240	.585	.674
August	688	223	357	.871	1.00
September	2,960	237	1,043	2.54	2.83
October	457	197	303	.739	.852
November	882	237	361	.880	.982

SUNCOOK RIVER AT EAST PEMBROKE, N. H.

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

A temporary gaging station was established at East Pembroke November 3, 1904, by H. K. Barrows. This was discontinued June 30, 1905. The drainage area at this point is about 250 square miles. A wooden staff gage, which was read twice each day by George P. Cass, was fastened to the abutment of the highway bridge over the canal channel to a mill near this point, which was recently destroyed by fire. It is near the Allenstown station, on the Boston and Maine Railroad. When the gaging station was first established and for some little time afterwards all of the water, except a slight amount which leaked through the dam, was flowing through this canal channel. During the high water which occurred about March 26, 1905, a portion of the dam was carried away, so that after this date a considerable part of the flow passed through the channel in which the dam was located. Current-meter measurements made before March 26 will not apply in considering data subsequent to that time.

Discharge measurements of Suncook River at East Pembroke, N. H., in 1904 and 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
November 3 [a]	H. K. Barrows	40	61	1.77	1.68	108
December 21 [b]	T. W. Norcross	25	34	1.41	1.26	48
1905.						
March 20 [c]	F. E. Pressey	60	102	2.74	2.54	280
April 4 [d]	do	121	480	3.73	4.63	1,790
April 7 [e]	do	121	525	3.87	4.95	2,030
August 28 [f]	T. W. Norcross	113	193	1.56	1.97	302

[a] Includes 3 second-feet in right channel.
[b] No flow in right channel.
[c] Includes 30 second-feet (estimated) in right channel.
[d] Includes 700 second-feet (estimated) in right channel.
[e] Includes 851 second-feet in right channel.
[f] Includes 74 second-feet in right channel.

Daily gage height, in feet, of Suncook River at East Pembroke, N. H., for 1904 and 1905.

Day.	1904.		1905.					
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	.....	1.8	1.65	1.5	1.15	6.65	2.3	1.75
2	.....	1.8	1.65	1.8	1.05	.....	2.0	1.65
3	1.7	1.85	1.65	1.5	1.05	5.3	1.95	1.9
4	1.8	1.65	1.6	1.5	1.05	4.75	1.95	.....
5	1.8	1.6	1.55	.....	.....	4.65	2.05	1.2
6	1.7	1.85	1.55	1.35	1.05	5.4	2.0	1.75
7	.9	1.8	1.75	1.45	1.05	5.15	.....	1.95
8	1.8	1.8	.....	1.45	1.15	4.7	2.05	2.05
9	1.8	1.5	2.7	1.55	1.15	.....	1.9	1.8
10	1.8	1.45	3.0	1.55	1.25	3.8	1.8	1.75
11	1.75	1.15	2.85	1.45	1.25	4.0	1.8	.....
12	1.75	1.2	2.75	.....	.....	4.25	1.8	1.05
13	1.3	1.35	2.55	1.4	1.15	4.05	1.75	1.8
14	1.2	1.3	2.55	1.45	1.15	3.7	.....	1.85
15	1.95	1.35	.....	1.45	1.25	3.45	1.3	1.7
16	1.95	1.4	1.45	1.35	1.25	.....	2.95	1.65
17	1.9	1.4	2.15	1.35	1.35	3.0	3.0	1.55
18	1.85	.....	2.15	1.4	1.4	2.75	2.6	.....
19	1.75	1.2	2.1	.....	.....	2.8	2.55	1.8
20	1.25	1.0	2.15	1.25	2.6	2.8	2.05	2.45
21	1.3	1.0	1.9	1.25	2.8	2.8	.....	2.05
22	1.8	.....	.....	1.15	2.75	2.8	2.15	3.15
23	1.65	.....	1.45	1.15	2.7	.....	2.1	2.85
24	1.9	.....	1.45	1.05	2.6	2.65	2.1	2.4
25	1.65	.....	1.4	1.05	2.9	2.6	2.1	.....
26	1.7	.....	1.65	.....	.....	2.4	1.95	2.0
27	1.55	1.0	1.95	1.0	6.15	2.35	1.95	3.15
28	1.55	1.5	1.95	1.15	6.75	2.15	.....	2.7
29	1.8	1.7	.....	.....	7.1	2.1	1.15	2.25
30	1.85	1.75	1.3	.....	7.2	.....	1.5	1.95
31	.....	1.6	1.3	.....	7.05	.....	1.55	.....

NOTE.—Water below gage December 22–27, 1904; reading December 27 taken in the afternoon. After March 26, 1905, conditions changed, owing to a portion of the dam in the right channel being carried away. Station discontinued June 30, 1905.

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 northward, 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 waterworks.

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 accompanying tables, furnished by Frederic P. Stearns, give the results for 1905, also the averages for thirty-one years for Sudbury River and for forty-three years for Lake Cochituate:

Information in regard to this basin is contained in the following publications of the United States Geological Survey. (Ann=Annual Report; WS=Water-Supply Paper; Bull=Bulletin.)

SUDBURY RIVER.

Description: Ann 20, iv, pp 74–75; WS 47, p 33.
Discharge, weekly: Bull 140, pp 36–37.
Discharge, monthly: WS 35, p 37.
Discharge, yearly: Ann 20, iv, p 46.

SUDBURY RIVER NEAR FRAMINGHAM.

Description: WS 82, p 52; 97, p 76; 124, p 105.
Discharge, monthly: WS 82, p 53; 97, p 77; 124, p 106.
Rainfall data: WS 82, p 52; 97, p 77.

SUDBURY RIVER BASIN.

Description: Ann 21, iv, p 61; Bull 140, pp 35–36; WS 65, p 26.
Discharge: WS 47, p 34.
Discharge, monthly: Ann 20, iv, p 75; WS 35, p 37; WS 65, p 26; 82, pp 50–51.
Discharge, monthly and yearly: Ann 20, iv, p 75.
Map: Ann 21, iv, p 61.
Rainfall data: WS 65, p 26.

LAKE COCHITUATE.

Description: WS 35, pp 37–38; 47 p 33.
Discharge, monthly: WS 35, pp 37, 38.

LAKE COCHITUATE NEAR COCHITUATE.

Description: WS 82, p 52; 97, p 76; 124, p 105.
Discharge: WS 82, p 54.
Discharge, monthly: WS 82, p 54; 97, p 78; 124, p 107.
Rainfall data: WS 82, p 54; 97, p 78; 124, p 107.

LAKE COCHITUATE WATERSHED.

Description: WS 65, p 26.
Discharge: WS 47, p 34.
Discharge, monthly: WS 65, p 26; 82, pp 50–51.
Rainfall data: WS 65, p 26.

Yield and rainfall in Sudbury River watershed at Framingham, Mass.

[Drainage area, 75.2 square miles.]

Month.	Total yield, in million gallons.	Average yield of 1 square mile.		Rainfall in inches.[a]	Rainfall collected, in inches.[a]	Per cent collected.
		Million gallons per day.	Second-feet.			
1905.						
January	3,288.0	1.410	2.182	5.26	2.516	47.8
February	694.2	.330	.510	2.20	.531	24.2
March	5,822.1	2.497	3.864	3.15	4.456	141.5
April	3,707.4	1.643	2.543	2.72	2.837	104.2
May	693.4	.297	.460	1.31	.530	40.4
June	1,054.0	.467	.723	5.00	.806	16.1
July	413.6	.177	.275	5.47	.316	5.8
August	266.6	.114	.177	2.70	.204	7.6
September	2,811.6	1.246	1.928	6.88	2.152	31.3
October	369.0	.158	.245	1.54	.282	18.3
November	629.0	.279	.431	2.07	.481	23.3
December	2,068.8	.887	1.373	4.01	1.583	39.5
The year	21,817.7	.795	1.230	42.31	16.694	39.5
1875–1905.						
January	88,385.2	1.223	1.892	4.24	2.182	51.5
February	119,212.5	1.812	2.803	4.27	2.942	68.9
March	214,677.9	2.971	4.596	4.55	5.299	116.6
April	146,900.8	2.100	3.249	3.58	3.626	101.3
May	80,518.0	1.114	1.724	3.28	1.987	60.6
June	36,381.4	.520	.805	3.15	.898	28.5
July	13,926.9	.193	.298	3.73	.344	9.2
August	20,605.6	.285	.441	4.01	.509	12.7
September	18,927.8	.271	.419	3.43	.467	13.6
October	35,762.9	.495	.766	4.14	.883	21.3
November	59,406.4	.849	1.314	3.89	1.466	37.6
December	77,764.9	1.076	1.665	3.82	1.920	50.2
The period	912,470.3	1.072	1.658	46.09	22.523	48.9

[a] Total for month for 1905; average of totals per calendar month, 1875 to 1905.

Yield and rainfall in Cochituate Lake watershed at Cochituate, Mass.

[Drainage area, 18.87 square miles.]

Month.	Total yield, in million gallons.	Average yield of 1 square mile.		Rainfall in inches.[a]	Rainfall collected in inches.[a]	Per cent collected.
		Million gallons per day.	Second-feet.			
1905.						
January	689.6	1.179	1.824	5.40	2.10	38.9
February	144.1	.273	.422	2.00	.44	22.0
March	1,182.1	2.021	3.127	3.28	3.60	109.9
April	755.2	1.334	2.064	2.87	2.30	80.2
May	200.6	.343	.531	1.57	.61	39.0
June	235.4	.416	.643	5.46	.72	13.2
July	68.0	.116	.180	3.24	.21	6.4
August	216.0	.369	.571	2.89	.66	22.8
September	602.7	1.065	1.647	7.00	1.84	26.3
October	258.9	.443	.685	1.35	.79	58.5
November	321.2	.567	.878	2.07	.98	47.3
December	528.4	.903	1.398	4.07	1.61	39.6
The year	5,202.2	.755	1.169	41.20	15.86	38.5
1863–1905.						
January	28,311.6	1.126	1.741	3.97	2.01	50.5
February	36,072.0	1.575	2.436	3.98	2.56	64.2
March	56,066.2	2.228	3.448	4.42	3.98	89.9
April	42,068.0	1.728	2.674	3.68	2.98	81.1
May	24,696.5	.982	1.519	3.68	1.75	47.6
June	11,360.2	.467	.722	3.07	.81	26.3
July	7,397.6	.294	.455	4.11	.53	12.8
August	10,685.7	.425	.657	4.37	.76	17.3
September	10,634.6	.437	.676	3.59	.75	21.0
October	14,557.2	.579	.895	4.33	1.03	23.8
November	19,806.4	.814	1.259	4.12	1.40	34.1
December	24,180.2	.961	1.487	3.56	1.71	48.2
The period	285,836.2	.965	1.492	46.87	20.27	43.2

[a] Total per month for 1905; average of totals per calendar month 1863 to 1905.

SOUTH BRANCH NASHUA RIVER AT CLINTON, MASS.

Since July, 1896, the flow of 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 has been 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 accompanying tables give the results for 1905, also the average for the years 1897–1905, inclusive.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 65, pp 22–24; 82, pp 54–55; 97, pp 78–79; 124, p 108.
Discharge, monthly: 65, pp 24–25; 82, p 55; 97, p 79; 124, pp 108–109.
Rainfall data: 65, pp 24–25; 82, p 55; 97, p 79; 124, p 108.

Yield and rainfall in South Branch, Nashua River watershed, at Clinton, Mass.

[Drainage area, 119 square miles.]

Month.	Total yield in million gallons.	Average yield of 1 square mile.		Rainfall in inches. [a]	Rainfall collected in inches. [a]	Per cent collected.
		Million gallons per day.	Second-feet.			
1905.						
January	4,669.6	1.266	1.959	6.10	2.258	37.0
February	1,507.2	.452	.700	1.72	.729	42.3
March	11,081.1	3.004	4.648	3.95	5.358	135.7
April	5,774.1	1.617	2.502	2.60	2.792	107.6
May	1,641.3	.445	.688	.83	.794	99.2
June	1,933.8	.542	.838	4.88	.935	19.2
July	1,347.2	.365	.565	5.39	.651	12.1
August	1,184.5	.321	.497	3.09	.573	18.5
September	4,383.5	1.228	1.900	6.90	2.119	30.7
October	1,352.6	.367	.567	1.81	.654	36.0
November	1,579.0	.442	.684	2.52	.763	30.4
December	3,754.5	1.018	1.575	3.79	1.816	47.9
The year	40,208.4	.926	1.432	43.58	19.442	44.6
1897–1905.						
January	39,223.7	1.181	1.827	3.89	2.107	54.1
February	43,361.1	1.440	2.228	3.87	2.330	60.2
March	105,107.7	3.165	4.897	4.92	5.647	114.9
April	80,680.5	2.511	3.885	4.29	4.335	101.1
May	40,833.1	1.230	1.902	3.16	2.194	69.5
June	28,481.3	.887	1.372	4.45	1.530	34.4
July	16,972.4	.511	.791	4.54	.912	20.1
August	17,013.4	.512	.793	4.40	.914	20.8
September	14,601.5	.454	.703	3.90	.785	20.1
October	19,477.2	.587	.907	3.54	1.046	29.6
November	26,160.8	.814	1.260	3.63	1.406	38.7
December	50,752.5	1.529	2.365	4.76	2.727	57.4
The period	482,665.2	1.234	1.910	49.35	25.933	52.6

[a] Total per month for 1905; average of totals per calendar month 1897 to 1905.

BLACKSTONE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Blackstone River rises in Worcester County, near the city of Worcester, Mass., flowing in a southeasterly course and emptying into Providence River at Providence, below Pawtucket, R. I., 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 are used for storage and the flow of the river is fairly constant. It has numerous tributaries, all of which, though small, are utilized for power purposes.

BLACKSTONE RIVER NEAR 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 railway station at Woonsocket, R. I., and that at Blackstone, Mass., being 1½ miles from either of these two points. It is about 1 mile below the dam at Blackstone and three-fourths of a mile above the dam at Woonsocket. The drainage area at this point is 360 square miles.

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. During 1905 it has been found that this station is considerably influenced by backwater effect from the dam at Woonsocket, and consequently that gage readings probably do not give a true index of the flow during medium and low stages.

Discharge measurements are made from the two-span bridge. The initial point for soundings is the face of the right abutment on the downstream side.

A standard chain gage, which is read twice each day by Gerald Fitzgerald, is attached to the upstream side of the steel highway bridge. The length of the chain is 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. (2) A marked point on the bridge near the gage; elevation, 20.26 feet. (3) On the upstream face of left abutment; elevation, 18.46 feet. Elevations refer to gage datum.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 109–110.

Discharge measurements of Blackstone River near Woonsocket, R. I., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per. sec.*	*Feet.*	*Sec.-feet.*
March 29	T. W. Norcross	127	884	2.32	4.91	2,050
March 31	do	127	774	1.95	4.13	1,510
March 31	do	127	763	1.94	4.08	1,480
May 27	do	126	478	.36	1.86	174
July 26	do	126	553	.66	2.49	366

Daily gage height, in feet, of Blackstone River near Woonsocket, R. I., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.6	2.6	2.2	2.1	2.2	2.2	2.4	2.3	2.5
2	.....	3.5	2.7	2.0	a1.8	a1.8	2.4	2.4	2.3	2.2
3	.....	3.6	2.7	2.4	a1.9	2.2	2.4	2.6	2.2	2.6
4	.....	3.2	2.6	2.6	2.2	2.2	3.6	2.6	1.9	2.8
5	.....	3.2	2.6	2.4	2.3	2.2	4.0	2.4	2.4	2.8
6	.....	5.0	2.6	2.4	2.2	a1.8	3.6	2.4	2.5	2.6
7	.....	5.5	2.6	2.6	2.5	2.2	3.2	2.5	2.5	2.5
8	.....	4.6	2.8	2.8	2.4	2.2	2.8	2.4	2.4	2.6
9	.....	4.0	2.7	2.8	2.3	2.3	3.0	2.4	2.4	2.3
10	.....	3.8	2.6	2.8	2.2	2.2	2.7	2.3	2.4	2.6
11	.....	3.6	2.6	2.5	2.2	2.4	2.8	2.4	2.0	2.6
12	.....	4.1	2.8	2.4	2.1	2.0	2.4	2.5	2.0	2.6
13	.....	4.2	2.5	3.6	2.0	2.1	2.8	2.4	2.6	2.5
14	.....	3.7	2.6	2.9	2.0	2.4	2.6	2.4	2.1	2.5
15	.....	3.6	2.4	2.6	2.4	2.4	2.8	2.2	2.1	2.4
16	.....	3.3	2.6	2.4	2.6	2.4	2.7	2.4	2.0	2.2
17	.....	3.2	2.6	2.6	2.4	2.4	2.6	2.4	2.0	2.5
18	.....	3.0	2.7	2.5	2.4	2.4	2.6	2.4	2.0	2.4
19	.....	2.9	2.8	2.3	2.2	2.2	2.6	2.4	2.3	2.4
20	.....	3.2	2.9	2.4	2.2	a1.8	2.8	2.6	2.2	2.4
21	.....	3.3	2.6	2.4	2.4	2.2	2.6	2.4	2.4	2.4
22	.....	3.4	2.6	2.8	2.2	2.2	2.2	2.5	2.2	2.8
23	3.7	3.2	2.6	2.9	a1.9	2.1	2.2	2.5	2.2	2.8
24	3.8	3.2	2.6	3.1	2.4	2.3	2.4	2.6	2.2	2.8
25	4.8	3.0	2.6	2.9	2.0	2.4	2.6	2.5	1.8	2.8
26	5.8	3.1	2.5	2.8	2.4	2.4	2.4	2.6	2.1	2.7
27	5.7	2.9	2.1	2.6	2.1	2.4	2.4	2.5	2.1	2.6
28	5.3	2.8	2.5	2.8	2.0	2.3	2.6	2.4	2.3	2.6
29	5.0	2.7	2.6	2.6	2.2	2.2	2.4	2.4	2.2	3.0
30	4.2	2.8	2.6	2.4	1.6	2.1	2.4	2.4	2.4	3.5
31	3.9	.....	2.6	.....	2.4	2.2	.....	2.3	.....	3.1

a Gage heights not true indications of flow, as water was drawn down at dam, one-half mile below.

NOTE.—River frozen January 1 to March 22. Gage heights are affected by backwater from Woonsocket dam and are unreliable.

THAMES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Thames River 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 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 town of Brimfield, in the southern part of Massachusetts, and has a total length of about 60 miles. At Willimantic the Shetucket divides into Willimantic and Nachaug rivers, which are, especially the former, important water-power streams.

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

Drainage areas of Thames River and principal tributaries.

River.	Locality.	Area.
		Sq. miles.
Thames	Norwich	1,300
Do	New London	1,400
Willimantic	Mouth	223
Nachaug	do	169
Quinnebaug	do	688
Shetucket	do	1,200
Do	Willimantic at gaging station	396
Yantic	Mouth	98

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 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. The current is swift at high stages, but medium and rather poorly distributed at low water. Owing to pondage at the Willimantic dam it is difficult to obtain gage readings which correctly represent the daily flow at this point.

Discharge measurements are made from the two-span steel bridge, total length 200 feet. The initial point for soundings is the extreme outer edge of the end column of the downstream truss at the left bank.

A standard chain gage, which is read twice each day by David Martin, is attached to the downstream side of the bridge near the center of the left span. The length of the chain is 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 when established, but changed to 21.39 feet September 6, 1905. (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 refer to gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pages 112–113.

Discharge measurements of Shetucket River near Willimantic, Conn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 29	T. W. Norcross	154	896	3.19	6.10	2,860
March 31	do	154	746	2.60	5.16	1,940
April 7	do	154	917	3.32	6.33	3,050
May 16	do	143	519	1.58	3.62	822
May 27	do	135	405	1.08	2.85	439
July 28	do	131	364	.87	2.51	316
July 28	do	124	296	.45	2.01	133
September 6	do	135	563	1.95	4.15	1,100

Daily gage height, in feet, of Shetucket River near Willimantic, Conn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			3.2	4.4	3.2	2.4					2.5	3.1
2			2.8	4.2	3.0	2.4					2.3	3.1
3			2.4	4.2	2.8	1.8					2.5	3.4
4			2.7	4.1	3.0	1.6					2.4	6.2
5			2.5	5.2	2.9	2.2					2.2	5.1
6			3.3	7.4	2.8	2.9					3.1	4.3
7			3.4	6.8	2.9	3.1					2.5	3.4
8			3.6	5.2	2.8	3.2					2.5	3.4
9			4.2	4.6	2.8	3.2					3.0	3.4
10			5.4	4.2	2.8	2.6					2.7	3.3
11			5.6	5.0	2.8	2.6					2.5	3.3
12			5.0	5.2	2.8	3.1					2.7	3.1
13			4.4	4.7	3.0	3.0					3.0	3.3
14			4.0	4.2	2.6	3.2					2.8	3.3
15			3.8	3.8	3.4	3.9					2.6	3.2
16			4.2	3.0	3.0	3.5					2.6	3.3
17			4.0	3.5	3.0	3.1					2.7	3.2
18			4.3	3.9	2.9	3.2					3.1	3.3
19			5.8	3.4	3.0	3.1					2.7	3.3
20			6.8	3.4	2.8	4.7					2.6	3.2
21			6.6	3.6	2.8	4.4					2.6	3.4
22			6.8	4.0	3.2	3.7					2.5	3.8
23			6.0	3.8	2.9	3.2					2.4	4.0
24			5.1	3.6	3.0	3.3					2.8	4.3
25			6.9	3.4	2.8	3.2					3.0	3.8
26			7.1	3.0	2.9	3.1					2.5	3.4
27			7.0	3.2	2.5	2.8					2.5	3.4
28			6.8	3.4	2.4	3.0					2.5	3.5
29			7.0	3.1	2.8	2.9					2.6	3.7
30			6.5	3.2	2.4	2.6					2.7	5.1
31			5.4		2.8							4.2

NOTE.—No gage heights during frozen season. Gage heights omitted from July 1 to October 31, inclusive, not being well determined.

Station rating table for Shetucket River near Willimantic, Conn., from April 4, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	310	3.70	870	4.90	1,720	6.00	2,730
2.60	345	3.80	930	5.00	1,805	6.10	2,830
2.70	385	3.90	990	5.10	1,890	6.20	2,930
2.80	425	4.00	1,055	5.20	1,980	6.30	3,030
2.90	465	4.10	1,120	5.30	2,070	6.40	3,130
3.00	510	4.20	1,190	5.40	2,160	6.50	3,230
3.10	555	4.30	1,260	5.50	2,255	6.60	3,335
3.20	603	4.40	1,330	5.60	2,350	6.70	3,440
3.30	654	4.50	1,405	5.70	2,445	6.80	3,545
3.40	706	4.60	1,480	5.80	2,540	6.90	3,650
3.50	758	4.70	1,560	5.90	2,635	7.00	3,755
3.60	814	4.80	1,640				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1904-5. It is well defined between gage heights 2.5 feet and 6.5 feet. Estimates below gage height 2.5 feet are somewhat uncertain.

Estimated monthly discharge of Shetucket River near Willimantic, Conn., for 1904–5.

[Drainage area, 396 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
April 4–30	4,420	758	1,784	4.50	4.51
May	2,350	385	920	2.32	2.68
June	555	84	326	.823	.918
July	345	84	221	.558	.643
August	930	126	373	.942	1.09
September	2,930	66	428	1.08	1.20
October	930	207	396	1.00	1.15
November	990	150	381	.962	1.07
December 1–17, 28–31	3,755	126	831	2.10	1.64
1905.					
March	3,865	275	1,937	4.89	5.64
April	4,195	510	1,254	3.17	3.54
May	706	275	455	1.15	1.33
June	1,560	66	565	1.43	1.60
November	555	207	364	.919	1.03
December	2,930	555	902	2.28	2.63

NOTE.—River frozen December 18–27, 1904.

CONNECTICUT RIVER DRAINAGE BASIN.

DESCRIPTION OF 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, Conn.; Holyoke and Turners Falls, Mass.; and Bellows Falls and Wilder, Vt. 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.

The drainage areas of the river and of several of its tributaries are given in the following table:

Drainage areas of Connecticut River and tributaries.

River.	Locality.	Area.
		Sq. miles.
Connecticut	In Canada	155
Do	Orford, N. H., at gaging station	3,305
Do	Sunderland, Mass., at gaging station	7,700
Do	Hartford, Conn	10,235
Do	Mouth	11,085
Israel	Above South Branch, at gaging station	8.7
Do	Below South Branch, at gaging station	21.2
Ammonoosuc	Bretton Woods, N. H., at gaging station	34
Zealand	Mouth and at gaging station	14
Little	At gaging station	11
Do	Mouth	12
White	Sharon, Vt	680
Ashuelot	Winchester, N. H	385
Deerfield	Mouth	667
Do	Deerfield, Mass., at gaging station	550
Chicopee	Mouth	730
Ware	.....do	223
Do	Gilbertville, Mass	160
Do	Ware, Mass., at gaging station	162
Quaboag	Mouth	213
Do	West Warren, Mass., at gaging station	144
Swift	Mouth	218
Do	West Ware, Mass., at gaging station	188
Westfield	Mouth	518
Do	Russell, Mass., at gaging station	331
Westfield Little	Mouth	83.6
Do	At gaging station, near Blandford, Mass	43.2
Salmon	Mouth	152
Do	At gaging station, Leesville, Conn	115

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 channel is straight for at least 1,000 feet above and 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.

Discharge measurements are made from the bridge.

A standard chain gage, which is read once each day by Frank H. Gardner, is attached to the inside timbers of the upper side of the bridge, 125 feet from the left abutment. The length of the chain is 42.95 feet. The gage is referred to bench marks as follows: (1) Top of downstream corner of right abutment at face; elevation, 30.34 feet. (2) Chisel draft marked "B. M." in base of downstream corner of left abutment at face; elevation, 30.04 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, 39.06 feet. Elevations are above datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 47, p 34; 65, p 29; 82, p 46; 97, p 81; 124, p 115.
Discharge: 65, p 29; 82, p 47; 97, p 81; 124, p 116.
Discharge, monthly: 75, p 23; 82, p 48; 97, p 84; 124, p 119.
Gage heights: 47, p 34; 65, p 30; 82, p 47; 97, p 82; 124, p 117.
Rating tables: 65, p 318; 97, pp 82–84; 124, pp 118–119.

Discharge measurements of Connecticut River, near Orford, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
February 28[a]	T. W. Norcross	235	775	0.88	4.07	686
March 1[b]	do	235	794	.96	4.26	766
March 1[c]	do	235	794	.93	4.25	739
April 5	A. D. Butterfield	313	3,650	3.15	11.90	11,500
April 6	do	313	3,590	3.04	11.70	10,900
August 30	T. W. Norcross	282	1,770	1.68	5.62	2,980

[a] Gage height to top of ice, 4.22 feet. Ice, 2.05 feet thick at gage. Average distance from bottom of ice to water surface, 1.77 feet. Average thickness of ice, 2.01 feet.
[b] Gage height to top of ice, 4.40 feet. Ice, 2.1 feet thick at gage. Average distance from bottom of ice to water surface, 1.86 feet. Average thickness of ice, 2.09 feet.
[c] Gage height to top of ice, 4.40 feet. Ice, 2.1 feet thick at gage.

Daily gage height, in feet, of Connecticut River near Orford, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	.....	.....	23.0	12.8	6.9	8.7	6.2	8.8	5.8	4.4	9.0
2	.....	.....	.....	22.0	12.5	6.7	9.1	7.4	7.8	5.7	4.5	10.1
3	.....	.....	.....	18.4	10.9	6.2	11.4	9.3	6.6	5.4	4.4	10.9
4	.....	.....	.....	14.2	11.2	6.3	15.5	7.7	8.7	5.4	4.5	11.4
5	.....	4.2	4.2	12.0	12.4	6.5	14.2	6.8	9.6	5.2	4.7	12.0
6	.....	.....	.....	11.8	12.8	6.6	11.1	5.6	9.2	5.1	5.6	11.2
7	.....	.....	.....	13.2	13.0	7.6	7.2	5.1	8.4	5.0	6.1	11.0
8	3.9	.....	.....	13.0	12.8	7.0	6.4	5.1	7.8	4.8	6.5	10.8
9	.....	.....	.....	12.4	12.3	6.8	6.0	5.6	7.1	4.7	6.3	10.2
10	.....	.....	.....	11.0	11.2	6.2	5.8	5.9	6.5	4.6	6.2	8.4
11	.....	.....	.....	11.3	11.6	5.8	5.5	5.1	5.8	4.5	6.0	7.8
12	.....	4.5	4.3	12.7	11.3	5.4	5.2	5.3	5.5	4.5	5.9	6.6
13	.....	.....	.....	13.3	10.0	6.0	5.3	4.9	5.7	5.4	5.6	6.5
14	.....	.....	.....	13.2	9.7	7.6	5.2	5.0	5.6	5.7	5.6	6.4
15	4.7	.....	.....	13.0	9.5	8.1	5.0	5.1	5.4	5.7	5.5	6.4
16	.....	.....	.....	12.6	9.2	7.4	5.1	5.9	5.1	5.5	5.3	6.4
17	.....	.....	.....	11.6	9.0	7.0	5.2	8.3	5.0	5.2	5.5	6.6
18	.....	.....	.....	10.6	9.2	5.7	5.1	8.4	6.6	4.9	5.6	6.1
19	.....	4.4	5.0	9.6	9.1	5.8	5.1	7.5	10.6	4.9	5.4	5.6
20	.....	.....	6.4	9.1	9.0	6.1	6.4	6.4	11.4	5.0	5.5	5.8
21	.....	.....	7.6	11.8	9.0	5.9	6.5	5.6	11.4	5.3	5.6	6.1
22	4.4	.....	8.1	13.6	8.9	6.0	6.1	5.1	11.0	5.6	5.7	6.6
23	.....	.....	8.2	14.2	8.6	6.0	5.0	4.8	9.8	5.5	5.9	7.0
24	.....	.....	8.3	13.4	8.0	5.9	4.6	4.4	8.4	5.6	5.3	7.1
25	.....	.....	9.9	12.0	7.4	5.5	4.3	3.9	8.0	5.4	4.9	7.0
26	.....	4.3	16.4	11.0	7.1	5.1	3.9	3.6	7.0	5.0	5.1	7.0
27	.....	.....	19.0	10.9	6.6	5.9	3.9	3.6	6.9	4.6	5.4	6.9
28	.....	.....	22.4	11.5	8.7	9.2	3.8	4.6	6.5	4.6	5.5	6.8
29	4.3	.....	24.8	12.2	9.1	9.4	3.8	6.2	6.2	4.6	6.2	7.0
30	.....	.....	24.8	12.8	8.4	8.2	3.7	5.9	6.0	4.6	8.1	7.1
31	.....	.....	24.0	.....	7.1	.....	6.0	6.9	.....	4.2	.....	8.4

NOTE.—River frozen January 1 to March 25 and November 30 to December 5. During frozen season gage heights were read to the surface of the water in a hole cut in the ice, except March 19–25, when readings were taken to top of ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 1	4.1	4.2	1.3	February 12	4.5	4.5	2.1
January 8	3.9	4.0	1.5	February 19	4.4	4.5	1.9
January 15	4.7	4.8	1.5	February 26	4.3	4.6	2.2
January 22	4.4	4.6	1.6	March 5	4.2	4.4	2.2
January 29	4.3	4.5	1.7	March 12	4.3	4.4	2.1
February 5	4.2	4.4	2.1	March 19–25	.....	.....	1.6

March 26, river clear of ice. November 30, river frozen over; ice 0.1 foot thick. December 5, river clear of ice.

Station rating table for Connecticut River near Orford, N. H., from March 29 to November 16, 1904, and from March 26 to November 30, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	640	3.80	1,600	5.60	3,070	8.80	6,640
2.10	680	3.90	1,670	5.70	3,170	9.00	6,900
2.20	725	4.00	1,740	5.80	3,270	9.20	7,160
2.30	770	4.10	1,810	5.90	3,370	9.40	7,420
2.40	815	4.20	1,880	6.00	3,470	9.60	7,690
2.50	860	4.30	1,950	6.20	3,680	9.80	7,970
2.60	905	4.40	2,030	6.40	3,900	10.00	8,250
2.70	950	4.50	2,110	6.60	4,120	10.20	8,530
2.80	1,000	4.60	2,190	6.80	4,340	10.40	8,810
2.90	1,050	4.70	2,270	7.00	4,560	10.60	9,100
3.00	1,100	4.80	2,350	7.20	4,780	10.80	9,400
3.10	1,160	4.90	2,430	7.40	5,000	11.00	9,700
3.20	1,220	5.00	2,520	7.60	5,220	11.20	10,000
3.30	1,280	5.10	2,610	7.80	5,440	11.40	10,300
3.40	1,340	5.20	2,700	8.00	5,660	11.60	10,600
3.50	1,400	5.30	2,790	8.20	5,900	11.80	10,900
3.60	1,460	5.40	2,880	8.40	6,140	12.00	11,200
3.70	1,530	5.50	2,970	8.60	6,380		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900–1905. It is well defined between gage heights 2 feet and 12 feet. Above gage height 12 feet the rating curve is a tangent, the difference being 157 per tenth. Two estimated and one measured discharges are used as the basis for extending the curve above gage height 12 feet.

Estimated monthly discharge of Connecticut River near Orford, N. H., for 1905.

[Drainage area, 3,305 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	28,470	7,030	12,880	3.90	4.35
May	12,770	4,120	8,340	2.52	2.90
June	7,420	2,610	4,179	1.26	1.41
July	16,700	1,530	4,334	1.31	1.51
August	7,290	1,460	3,426	1.04	1.20
September	10,300	2,520	5,392	1.63	1.82
October	3,270	1,880	2,622	.793	.914
November[a]	5,780	2,030	3,068	.928	1.04

[a] No correction made in discharge November 30 for ice conditions.

CONNECTICUT RIVER AT SUNDERLAND, MASS.

This station was established March 31, 1904, by N. C. Grover. It is located at a five-span steel highway bridge, with a total length of about 830 feet, at Sunderland. The nearest railway station is at South Deerfield. The gaging station is about 18 miles above the dam at Holyoke and about 5 miles below that at Turners Falls.

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 five channels at all stages. The current is swift at high and medium at low stages.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the left abutment at the top on the downstream side.

A standard chain gage, which is read twice each day by V. Lawer, is attached to the downstream side of the bridge near the left bank. The length of the chain was 42.79 feet when established, but changed to 42.93 feet September 1, 1905, owing to movement of bridge. The gage is referred to bench marks as follows: (1) On the bottom chord of the bridge directly under the downspout of gage; elevation, 37.81 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 the bridge; elevation, 32.91 feet. All elevations are above the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 120–121.

Discharge measurements of Connecticut River at Sunderland, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 3	T. W. Norcross	787	15,400	3.94	20.11	60,600
April 6	do	777	11,600	3.84	15.26	44,600
April 14	do	775	11,100	3.75	14.57	41,600
April 27	do	744	6,970	3.27	9.28	22,800
May 18	do	736	5,510	2.92	7.67	16,100
August 18	do	731	5,410	2.72	7.46	14,700
September 1	do	697	3,390	2.14	4.75	7,240
September 9	do	738	5,620	2.77	8.01	15,600

Daily gage height, in feet, of Connecticut River at Sunderland, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	27.25	9.3	5.3	6.35	10.55	4.7	5.4	4.2	7.45
2	.....	.....	.....	23.75	9.35	4.9	5.6	9.1	5.85	5.1	4.2	6.35
3	.....	.....	.....	19.95	9.1	4.55	4.8	7.95	7.7	5.2	4.2	6.8
4	.....	4.35	4.75	17.35	8.85	4.35	6.9	7.5	12.4	5.0	4.4	13.3
5	.....	.....	.....	15.45	8.6	4.3	9.3	6.55	14.55	4.9	4.7	11.6
6	.....	.....	.....	15.45	8.75	4.6	9.2	5.45	12.7	4.7	4.9	9.9
7	.....	.....	.....	16.45	9.0	4.7	7.9	4.95	10.8	4.5	5.55	8.75
8	.....	.....	.....	15.05	9.05	5.4	6.55	4.9	9.35	4.3	6.5	7.9
9	.....	.....	.....	13.35	8.9	5.7	5.55	4.55	8.2	4.05	6.3	7.35
10	.....	.....	.....	12.45	8.6	5.4	4.9	4.3	7.15	4.2	5.9	6.85
11	.....	4.85	.....	13.65	8.4	4.95	4.7	4.5	6.4	4.15	5.6	6.6
12	.....	.....	.....	16.3	8.05	4.5	4.3	5.25	6.6	4.3	5.4	5.95
13	.....	.....	.....	15.95	7.8	4.5	4.1	5.25	8.0	5.2	5.1	6.0
14	6.75	.....	.....	14.55	7.55	4.8	4.0	5.0	7.8	5.45	5.2	5.65
15	.....	.....	.....	13.55	7.2	5.15	3.8	4.75	6.85	5.3	5.15	6.2
16	.....	.....	.....	12.55	7.3	5.4	3.65	4.9	6.1	4.95	5.1	7.05
17	.....	.....	.....	11.65	7.8	5.35	3.5	6.55	5.65	4.95	5.0	6.85
18	.....	4.9	.....	10.7	7.8	4.9	3.7	7.55	5.7	4.7	4.9	6.7
19	.....	.....	.....	9.8	7.65	4.5	3.7	7.0	13.75	4.6	4.85	6.55
20	.....	.....	.....	9.05	7.25	4.6	3.9	6.15	13.8	4.8	4.7	6.7
21	5.4	.....	.....	8.7	6.9	4.95	4.1	5.45	12.5	5.45	4.5	6.7
22	.....	.....	.....	9.4	6.6	7.3	4.1	4.95	12.2	5.65	4.2	7.3
23	.....	.....	.....	10.55	6.55	7.75	4.0	4.45	10.55	5.3	4.1	7.6
24	.....	.....	.....	11.0	6.3	6.75	3.6	4.05	9.2	5.35	4.1	7.5
25	.....	4.7	.....	10.7	6.0	5.7	3.6	3.9	8.0	5.15	4.2	6.95
26	.....	.....	.....	10.0	5.4	5.25	3.4	3.65	7.25	4.9	4.1	6.55
27	.....	.....	19.45	9.35	5.15	5.65	3.3	3.55	6.65	4.8	4.1	6.5
28	5.1	.....	22.5	9.0	4.9	5.65	3.3	3.4	6.3	4.55	4.35	6.3
29	.....	.....	22.45	8.85	5.3	6.2	3.2	3.3	6.0	4.3	4.6	6.35
30	.....	.....	25.05	9.0	5.95	6.7	3.2	3.65	5.75	4.1	7.45	7.5
31	.....	.....	26.95	.....	5.7	.....	6.0	4.55	.....	4.1	.....	8.05

NOTE.—River frozen January 1 to March 26. During this period gage heights were read to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 7	.....	6.6	(a)	February 25	4.7	4.8	1.5
January 14	6.75	6.6	1.0	March 4	4.75	4.85	1.7
January 21	5.4	5.5	1.15	March 11	.....	5.45	(b)
January 28	5.1	5.2	1.05	March 18	.....	5.5	(a)
February 4	4.35	4.4	1.4	March 25	.....	9.75	(c)
February 11	4.85	4.75	1.55	March 26	.....	14.75	.....
February 18	4.9	5.0	1.65				

a Ice broken up along banks. *b* Ice thin near banks. *c* Ice beginning to break up.

March 27, river clear of ice. Highest point April 1 in morning was 27.7 feet.

Station rating table for Connecticut River at Sunderland, Mass., from April 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.*
1.70	2,250	3.50	5,380	5.30	9,670	7.10	15,030
1.80	2,370	3.60	5,610	5.40	9,930	7.20	15,370
1.90	2,500	3.70	5,840	5.50	10,200	7.30	15,710
2.00	2,630	3.80	6,070	5.60	10,470	7.40	16,060
2.10	2,770	3.90	6,300	5.70	10,750	7.50	16,410
2.20	2,910	4.00	6,530	5.80	11,030	7.60	16,760
2.30	3,060	4.10	6,760	5.90	11,310	7.70	17,110
2.40	3,210	4.20	6,990	6.00	11,600	7.80	17,470
2.50	3,370	4.30	7,220	6.10	11,890	7.90	17,830
2.60	3,540	4.40	7,460	6.20	12,190	8.00	18,190
2.70	3,720	4.50	7,700	6.30	12,490	8.10	18,550
2.80	3,900	4.60	7,940	6.40	12,790	8.20	18,920
2.90	4,080	4.70	8,180	6.50	13,100	8.30	19,290
3.00	4,280	4.80	8,420	6.60	13,410	8.40	19,660
3.10	4,490	4.90	8,660	6.70	13,730	8.50	20,030
3.20	4,710	5.00	8,910	6.80	14,050		
3.30	4,930	5.10	9,160	6.90	14,370		
3.40	5,150	5.20	9,410	7.00	14,700		

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 2.3 feet and 18 feet. Above gage height 8.5 feet the rating curve is a tangent, the difference being 380 per tenth.

Station rating table for Connecticut River at Sunderland, Mass., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.70	3,110	4.50	6,670	6.30	11,480	8.10	17,280
2.80	3,270	4.60	6,900	6.40	11,780	8.20	17,630
2.90	3,430	4.70	7,140	6.50	12,080	8.30	17,980
3.00	3,600	4.80	7,380	6.60	12,380	8.40	18,330
3.10	3,770	4.90	7,630	6.70	12,690	8.50	18,680
3.20	3,950	5.00	7,880	6.80	13,000	8.60	19,030
3.30	4,130	5.10	8,140	6.90	13,310	8.70	19,390
3.40	4,320	5.20	8,400	7.00	13,620	8.80	19,750
3.50	4,520	5.30	8,660	7.10	13,940	8.90	20,110
3.60	4,720	5.40	8,930	7.20	14,260	9.00	20,470
3.70	4,920	5.50	9,200	7.30	14,580	9.10	20,830
3.80	5,130	5.60	9,470	7.40	14,910	9.20	21,190
3.90	5,340	5.70	9,750	7.50	15,240	9.30	21,550
4.00	5,550	5.80	10,030	7.60	15,570	9.40	21,910
4.10	5,770	5.90	10,310	7.70	15,910	9.50	22,270
4.20	5,990	6.00	10,600	7.80	16,250	9.60	22,630
4.30	6,210	6.10	10,890	7.90	16,590	9.70	22,990
4.40	6,440	6.20	11,180	8.00	16,930	9.80	23,360

The above table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1905. It is fairly well defined. Above gage height 9.8 feet the rating curve is a tangent, the difference being 370 per tenth.

Estimated monthly discharge of Connecticut River at Sunderland, Mass., for 1904.

[Drainage area, 7,700 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
April	69,050	22,880	38,730	5.03	5.61
May	62,210	14,210	31,600	4.10	4.73
June	18,190	4,080	8,102	1.05	1.17
July	7,820	2,500	4,528	.588	.678
August	9,285	2,310	5,124	.665	.767
September	20,790	3,135	8,546	1.11	1.24
October	26,490	8,180	13,400	1.74	2.01
November	10,610	5,725	7,506	.975	1.09
December 1–10[a]	10,200	7,700	8,468	1.10	.409

[a] River frozen December 11 to 31.

Estimated monthly discharge of Connecticut River near Sunderland, Mass., for 1905.

[Drainage area, 7,700 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
March 27–31	86,820	59,060	73,240	9.51	1.77
April	87,920	19,390	36,540	4.75	5.30
May	21,730	7,630	15,330	1.99	2.29
June	16,080	6,210	8,852	1.15	1.28
July	21,550	3,950	7,814	1.01	1.16
August	26,140	4,130	9,397	1.22	1.41
September	40,940	7,140	19,580	2.54	2.83
October	9,610	5,660	7,475	.971	1.12
November	15,080	5,770	7,797	1.01	1.13
December	36,310	9,610	14,960	1.94	2.24

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 of the 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 toll-house gage, the zero of which is set at the low-water mark of 1801.[a] The highest water ever known in the river (29 feet 10 inches) was in May, 1854; the lowest (1½ inches below zero) in 1858.

This datum was used in the various surveys of the river below Hartford in 1866–67;[a] also in the survey above Hartford in 1871–1878,[b] and in the survey of 1897.[c] It has

[a] See report of Theodore G. Ellis, 1867 (H. R. Ex. Doc. No. 153, 40th Cong., 2d sess.).
[b] Engineers Report, 1878, pp. 348–391.
[c] Engineers' Report, 1898, pp. 976–988.

again been used, 1902–1905, in a further survey by the Secretary of War to study the problem of river improvements above Hartford.

During low-water periods the tidal wave comes up the river to Hartford. The visible effect of this wave is dependent on 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 as per references below.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: Ann 20, iv, pp 77–78; WS 35, p 42; 47, p 35; 65, p 30; 82, pp 48–49; 97, pp 84–85; 124, pp 121–122.

Discharge, monthly: Ann 14, ii, pp 141–144.

Discharge, yearly: Ann 20, iv, p 47.

Gage heights: WS 35, pp 43–44; 47, p 35; 65, p 31; 82, p 49; 97, p 85; 124, p 122.

Daily gage height, in feet, of Connecticut River at Hartford, Conn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	3.7	3.3	24.0	7.1	3.8	4.2	4.6	2.5	3.8	2.9	5.5
2	4.0	3.4	3.2	24.1	7.2	3.4	4.0	7.1	2.9	3.5	2.3	5.3
3	4.9	3.1	3.0	22.2	7.2	3.0	3.3	6.0	4.0	3.4	2.6	4.3
4	4.7	3.2	3.1	19.5	7.0	2.5	2.8	5.2	8.6	3.4	3.0	9.0
5	4.0	2.4	2.5	17.1	6.7	2.6	4.6	4.8	13.7	3.4	2.5	11.1
6	3.4	2.2	1.8	15.9	6.5	3.0	6.2	4.0	13.4	3.1	3.3	9.4
7	5.0	3.6	3.0	16.2	6.6	2.9	6.0	3.4	11.4	3.0	3.4	7.9
8	10.6	3.0	3.3	15.8	6.6	3.0	5.2	3.1	9.2	3.0	4.6	6.8
9	11.7	3.2	3.4	14.3	7.0	3.8	4.0	3.0	7.5	2.6	4.4	6.0
10	10.0	3.6	4.1	12.6	6.5	3.9	3.6	2.9	6.0	3.3	4.0	5.6
11	8.0	3.0	5.3	11.7	6.3	3.5	3.2	2.9	5.2	3.1	3.6	4.5
12	7.0	2.6	5.0	13.5	6.1	3.6	3.1	2.8	5.1	3.3	3.5	4.6
13	7.0	3.1	4.9	14.8	6.0	3.8	3.0	2.6	5.5	2.9	3.1	4.4
14	6.8	3.5	5.2	14.4	5.8	3.4	2.6	2.8	6.3	3.1	3.0	4.1
15	5.7	3.2	5.0	13.1	5.6	3.1	2.7	3.0	5.7	3.2	3.1	3.0
16	5.0	3.1	4.4	12.0	5.6	3.3	1.6	3.0	5.0	3.1	3.3	3.8
17	4.8	3.0	4.1	11.0	5.6	3.3	1.7	3.2	4.1	3.0	3.2	4.2
18	4.4	3.0	4.3	10.0	5.9	3.1	2.1	4.2	4.0	2.9	3.0	4.4
19	4.6	2.3	5.1	9.1	6.0	2.9	2.2	4.8	4.5	3.0	2.5	4.7
20	4.6	1.5	8.2	8.4	5.8	3.3	2.3	4.3	10.6	3.1	2.8	4.5
21	4.4	3.2	9.6	7.7	5.3	3.0	2.0	3.7	10.6	3.2	2.9	5.0
22	3.9	3.4	7.6	7.6	4.9	3.6	2.3	3.3	9.9	3.4	2.9	5.5
23	3.8	3.8	7.5	8.0	5.0	5.7	2.0	3.0	9.2	4.0	2.7	5.6
24	4.3	3.8	7.4	8.7	4.8	5.7	2.4	2.7	7.8	4.0	3.2	5.2
25	4.3	3.6	7.4	9.1	4.5	4.6	2.5	2.9	6.5	3.8	3.2	4.5
26	3.9	3.4	10.6	8.8	4.1	4.0	2.3	3.0	5.6	3.6	2.1	4.4
27	3.4	2.2	13.2	8.2	3.7	3.7	2.3	2.4	5.0	3.7	2.2	4.2
28	3.6	3.2	16.7	7.6	3.4	3.6	2.3	2.5	4.5	3.1	2.3	3.8
29	3.3	.....	19.5	7.2	3.3	3.5	1.4	2.7	4.2	2.3	3.0	4.4
30	3.3	.....	20.9	7.0	3.4	4.0	2.5	2.5	4.0	2.4	3.0	4.8
31	3.9	.....	22.6	.....	4.0	.....	3.4	2.3	.....	2.8	.....	4.5

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, 2½ miles from either place. 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.

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 freshets. The current is strong at high and medium at low stages. The bed is gravelly and permanent.

Discharge measurements at high and ordinary stages are made from the bridge. Low-water measurements are made by wading about 20 feet above the bridge.

A standard chain gage, which is read once each day by E. A. Crawford, is attached to the upstream truss of the bridge. The length of the chain is 15.43 feet. The gage 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, 12.10 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 86; 124, p 123.
Discharge: 97, p 86; 124, p. 123.
Discharge, monthly: 124, p 125.
Gage heights: 97, p 87; 124, p 124.
Rating table: 124, p 124.

Discharge measurements of Israel River (above South Branch) near Jefferson Highlands, N. H., in 1905.

Date.	Hydrograper.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 5	T. W. Norcross	22	35	1.69	1.92	60
August 3	do	23	29	1.34	1.73	39
August 24[a]	do	21.5	12	.87	1.27	10.5
October 26[b]	do	21	11.6	1.09	1.29	12.7

[a] By wading; meter on a rod.

[b] By wading.

Daily gage height, in feet, of Israel River (above South Branch) near Jefferson Highlands, N. H., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.9	1.4	1.4	1.75	1.5	1.2	1.25
2	1.35	1.85	2.25	1.45	1.75	1.45	1.2	1.25
3	1.3	1.7	1.85	3.3	1.7	1.45	1.2	1.25
4	2.7	1.6	1.65	2.7	1.6	1.45	1.2	1.25
5	1.9	1.5	1.55	2.4	1.85	1.45	1.3	2.15
6	1.85	1.6	1.5	2.0	1.8	1.4	1.3	2.1
7	1.9	1.5	1.45	1.8	1.75	1.4	1.3	1.85
8	1.6	1.7	1.4	1.8	1.75	1.4	1.3	1.8
9	1.55	1.65	1.35	2.3	1.8	1.4	1.3	1.75
10	1.85	1.55	1.3	1.7	1.7	1.35	1.3	1.65
11	1.7	1.7	1.25	1.5	1.6	1.35	1.35	1.55
12	1.6	1.95	1.25	1.5	1.55	1.55	1.3	1.6
13	1.7	1.75	1.45	1.7	1.55	1.5	1.25	1.55
14	1.65	1.65	1.4	1.5	1.65	1.5	1.25	1.5
15	1.65	1.55	1.4	1.45	1.65	1.45	1.25	1.4
16	1.9	1.5	1.35	1.4	1.6	1.45	1.2	1.35
17	1.6	1.45	1.45	1.4	1.55	1.4	1.2	.....
18	1.85	1.45	1.4	1.35	2.5	1.4	1.55	.....
19	1.8	1.65	1.35	1.3	2.1	1.65	1.5	.....
20	1.75	1.5	1.3	1.25	1.95	1.6	1.4	.....
21	1.7	1.45	1.25	1.25	1.7	1.5	1.4	.....
22	1.75	1.4	1.2	1.35	1.65	1.4	1.35	.....
23	1.65	1.35	1.2	1.4	1.6	1.35	1.35	.....
24	1.5	1.3	1.2	1.45	1.55	1.35	1.3	.....
25	1.5	1.3	1.2	1.4	1.8	1.35	1.3	.....
26	1.95	1.9	1.35	1.35	1.75	1.3	1.3	.....
27	2.3	1.75	1.3	1.4	1.7	.....	1.25	.....
28	2.45	1.65	1.35	1.45	1.6	.....	1.3	.....
29	2.05	1.5	1.3	1.4	1.55	.....	1.3	.....
30	1.8	1.45	1.3	1.35	1.55	.....	1.25	.....
31	1.65	.....	1.35	1.3	.....	.....	.....	.....

NOTE.—River frozen January 1 to April 30 and December 17-31. Gage heights are somewhat unreliable owing to carelessness of gage reader.

Station rating table for Israel River (above South Branch) near Jefferson Highlands, N. H., from September 2, 1903, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
0.80	1.0	1.30	13	1.80	46	2.20	93
0.90	1.6	1.40	18	1.90	55	2.30	108
1.00	3.0	1.50	24	2.00	67	2.40	124
1.10	5.3	1.60	30	2.10	79	2.50	140
1.20	8.6	1.70	38				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-5. It is fairly well defined between gage heights 1.04 feet and 2.4 feet. Above 2.5 feet the 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 1905.

[Drainage area, 8.7 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	176	13	48.4	5.56	6.41
June	61	13	31.1	3.57	3.98
July	100	8.6	19.6	2.25	2.59
August	284	10.5	42.5	4.89	5.64
September	140	27	41.5	4.77	5.32
October[a]	34	8.6	18.7	2.15	2.48
November	27	8.6	13.1	1.51	1.68
December 1–16	86	10.5	32.5	3.74	2.22

[a] Discharge interpolated October 27–31.

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. South Branch of Israel River has its mouth above this station and below the station previously described (p. 123). 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.

The channel is straight for 100 feet above and 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. The current is strong at high and well sustained at low stages.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the right abutment of the bridge.

A standard chain gage, which is read once each day by E. A. Crawford, is attached to the downstream truss of the bridge; length of chain, 12.99 feet. The gage 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 the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 87; 124, pp 125–126.
Discharge: 97, p 88; 124, p 126.
Discharge, monthly: 124, p 128.
Gage heights: 97, p 88; 124, p 127.
Rating table: 124, p 127.

Discharge measurements of Israel River (below South Branch) near Jefferson Highlands, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 5[a]	T. W. Norcross	41	43.9	3.01	1.94	132
August 3	do	19	23.1	2.81	1.60	65
August 23	do	15	15.8	1.30	1.20	20.6
August 24[b]	do	20	18.0	1.18	1.20	21.3
October 26	do	16	16.4	1.36	1.23	22.3

[a] Measurement made from downstream side of bridge.
[b] By wading about 40 feet above bridge; meter on a rod.

Daily gage height, in feet, of Israel River (below South Branch) near Jefferson Highlands, N. H., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.9	1.4	1.45	1.7	1.45	1.15	1.2
2	1.35	1.8	2.15	1.45	1.7	1.4	1.15	1.2
3	1.3	1.7	1.8	2.9	1.6	1.4	1.15	1.2
4	2.7	1.6	1.6	2.7	1.5	1.4	1.15	1.2
5	1.95	1.5	1.55	2.4	1.8	1.4	1.25	2.0
6	1.85	1.6	1.5	2.4	1.8	1.35	1.25	2.1
7	1.95	1.5	1.45	2.2	1.7	1.35	1.2	1.8
8	1.6	1.7	1.4	2.0	1.65	1.35	1.2	1.7
9	1.5	1.6	1.35	2.5	1.7	1.3	1.2	1.6
10	1.85	1.5	1.35	2.0	1.6	1.3	1.2	1.5
11	1.75	1.7	1.3	1.8	1.55	1.3	1.25	1.5
12	1.65	1.9	1.25	1.7	1.5	1.5	1.25	1.6
13	1.75	1.75	1.5	1.6	1.5	1.45	1.2	1.5
14	1.7	1.65	1.45	1.6	1.6	1.45	1.2	1.45
15	1.7	1.55	1.45	1.55	1.6	1.4	1.2	1.4
16	1.95	1.45	1.4	1.5	1.5	1.4	1.15	1.35
17	1.75	1.45	1.45	1.45	1.5	1.35	1.15	.....
18	1.85	1.5	1.4	1.4	2.3	1.35	1.35	.....
19	1.8	1.6	1.35	1.35	2.0	1.55	1.35	.....
20	1.75	1.5	1.3	1.3	1.8	1.5	1.35	.....
21	1.7	1.45	1.25	1.3	1.65	1.5	1.35	.....
22	1.75	1.45	1.25	1.35	1.6	1.4	1.3	.....
23	1.65	1.4	1.2	1.45	1.55	1.3	1.3	.....
24	1.5	1.35	1.2	1.4	1.5	1.3	1.25	.....
25	1.5	1.35	1.2	1.35	1.7	1.3	1.25	.....
26	1.9	1.95	1.4	1.3	1.7	1.25	1.25	.....
27	2.2	1.8	1.35	1.35	1.6	.....	1.2	.....
28	2.45	1.65	1.35	1.4	1.55	.....	1.25	.....
29	2.0	1.55	1.3	1.35	1.5	.....	1.25	.....
30	1.8	1.45	1.3	1.3	1.5	.....	1.2	.....
31	1.7	.....	1.35	1.25	.....	.....	.....	.....

NOTE.—River frozen January 1 to April 30 and December 17–31. Gage heights are somewhat unreliable, owing to carelessness of gage reader.

Station rating table for Israel River (below South Branch) near Jefferson Highlands, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.00	10	1.50	51	2.00	154	2.50	298
1.10	15	1.60	66	2.10	182	2.60	327
1.20	21	1.70	84	2.20	211	2.70	356
1.30	29	1.80	105	2.30	240	2.80	385
1.40	39	1.90	128	2.40	269	2.90	414

NOTE.—The above table is applicable only for open-channel conditions. It is based on 21 discharge measurements made during 1903–1905. It is well defined between gage heights 0.9 foot and 2.6 feet.

Estimated monthly discharge of Israel River (below South Branch) near Jefferson Highlands, N. H., for 1905.

[Drainage area, 21.2 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	356	29	109	5.14	5.93
June	141	34	69.0	3.25	3.63
July	196	21	43.9	2.07	2.39
August	414	25	102	4.81	5.54
September	240	51	78 0	3.68	4.11
October[a]	58	18	35.3	1.67	1.92
November	34	18	33.7	1.59	1.77
December 1-16	182	21	63.2	2.98	1.77

[a] Discharge interpolated October 27-31.

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.

The channel is straight for 300 feet above and 200 feet below the measuring section, 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. The current is medium at ordinary and sluggish at low stages.

Discharge measurements at high and ordinary stages are made from a footbridge located about 300 feet downstream from the highway bridge. Low-water measurements are made by wading at various sections in the vicinity where better velocities are found.

A standard chain gage, which is read twice each day by John Paige, is attached to the floor on the downstream side of the highway bridge; length of chain, 18.86 feet. The gage is referred to the following bench marks: (1) Marked point on bridge near gage; elevation, 17.36 feet when established, but changed to 17.33 feet August 24, 1905. (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 when established, but found to be 17.04 feet August 24, 1905. Elevations are above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, pp 89–90; 124, pp 129.
Discharge: 97, p 90; 124, p 129.
Discharge, monthly: 124, p 131.
Gage heights: 97, p 90; 124, p 130.
Rating table: 124, p 130.

Discharge measurements of Ammonoosuc River at Bretton Woods, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 4	T. W. Norcross	40	157	3.40	3.61	534
July 5	Murphy and Barrows	38	83	.65	1.80	54
August 1[a]	T. W. Norcross	40	106	1.22	2.40	129
August 4	do	39	89	.70	1.93	62
August 24[b]	do	30	27.6	1.14	1.58	31.6
October 27[c]	do	24	28.5	1.07	1.57	30.4

[a] Meter in poor condition.
[b] By wading 150 feet above gage, meter on a rod.
[c] From upstream side of highway bridge.

Daily gage height, in feet, of Ammonoosuc River at Bretton Woods, N. H., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	2.72	2.52	1.92	1.75	2.48	2.1	1.72	1.62	1.95
2	.....	.....	.....	2.28	2.38	1.85	2.18	2.0	2.0	1.7	1.6	1.9
3	.....	.....	.....	2.15	2.35	2.28	2.2	2.1	2.5	1.68	1.5	2.4
4	.....	1.5	.7	2.02	3.55	2.02	1.88	1.98	2.7	1.65	1.52	2.65
5	.....	.....	.....	2.0	2.88	1.95	1.75	1.9	2.65	1.65	1.58	2.15
6	.....	.....	.....	2.92	3.2	2.55	1.68	1.88	2.5	1.62	1.5	1.75
7	3.1	.....	.....	2.68	3.45	2.2	1.62	1.82	2.25	1.6	1.52	1.58
8	.....	.....	.....	2.22	3.02	2.0	1.6	1.85	2.12	1.6	1.55	1.55
9	.....	.....	.....	2.12	2.8	1.98	1.6	2.02	1.98	1.58	1.55	1.55
10	.....	.....	.....	2.28	2.75	1.85	1.55	1.85	1.88	1.55	1.52	1.55
11	.....	1.6	.5	2.45	2.55	1.98	1.55	1.72	1.85	1.55	1.5	1.55
12	.....	.....	.....	2.62	2.52	2.35	1.52	1.68	2.12	2.25	1.5	1.55
13	.....	.....	.....	2.62	2.4	2.6	1.5	1.7	1.98	1.98	1.5	1.55
14	1.85	.....	.....	2.55	2.42	2.75	1.5	1.68	1.92	1.92	1.4	1.5
15	.....	.....	.....	2.42	2.75	2.25	1.5	1.75	1.82	1.78	1.42	1.5
16	.....	.....	.....	2.28	2.7	2.05	1.5	2.75	1.8	1.72	1.48	.....
17	.....	.....	.....	2.12	2.7	1.98	1.78	2.15	1.8	1.7	1.5	.....
18	.....	.9	.6	2.0	2.7	2.0	1.7	1.8	2.4	1.7	1.42	.....
19	.....	.....	.....	1.88	2.72	1.98	1.65	1.68	2.3	1.8	1.4	1.5
20	.....	.....	.....	1.58	2.55	1.88	1.88	1.65	2.08	1.72	1.35	1.5
21	1.5	.....	2.2	2.6	2.42	1.88	1.65	1.65	2.02	1.7	1.35	1.5
22	.....	.....	2.3	2.9	2.35	1.9	1.52	1.65	1.9	1.68	1.35	1.48
23	.....	.....	1.68	2.42	2.18	1.82	1.48	1.65	1.85	1.62	1.4	1.45
24	.....	.....	1.5	2.2	2.08	1.7	1.45	1.65	1.8	1.6	1.5	1.45
25	.....	.8	2.3	2.28	2.0	1.62	1.5	1.6	1.88	1.58	1.65	1.45
26	.....	.....	3.4	2.45	2.0	2.12	1.5	1.6	1.9	1.55	1.65	1.45
27	.....	.....	3.0	2.55	2.5	2.3	1.48	2.55	1.82	1.55	1.6	1.45
28	1.4	.....	2.88	2.68	2.28	2.0	1.42	2.05	1.82	1.55	1.6	1.45
29	.....	.....	2.98	2.65	2.22	1.85	1.4	1.75	1.8	1.55	1.7	1.62
30	.....	.....	3.58	2.8	2.15	1.75	1.65	1.98	1.75	1.55	2.1	2.0
31	.....	.....	3.58	.....	2.02	.....	3.05	2.15	.....	1.55	.....	1.7

NOTE.—River frozen January 1 to March 20 and December 16–18. During frozen season gage heights are to the surface of the water in a hole cut in the ice. The following comparative readings were taken:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 7[a]	.....	.....	.....	February 18	.9	1.5	1.9
January 14	.....	.....	1.8	February 25	.8	1.4	1.9
January 21	.....	.....	1.9	March 4	.7	1.2	1.9
January 28	1.4	2.1	1.9	March 11	.5	1.15	1.9
February 4, 11	.....	.....	1.9	March 18	.6	1.5	1.9

[a] Water flowing over the ice.

ZEALAND RIVER NEAR TWIN MOUNTAIN, N. H.

This 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, about 2½ miles from either place. 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. The elevation at the mouth 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, consisting 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.

The bed is rough and rocky, but permanent. The current is swift at high and medium at low stages. The banks are high and subject to overflow only in extreme freshets.

Discharge measurements at high stages are made from a highway bridge near the gage. At medium and low water measurements are made by wading close by.

A standard chain gage, which is read once each day by Charles Cote, is attached to trees on the bank just above the highway bridge; length of chain 13.40 feet when established, but changed to 13.24 feet May 3, 1905, and to 13.12 feet August 25, 1905, on account of settling of one of the trees to which the gage is fastened. The gage 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 when established, but found to be 11.30 feet August 25, 1905. Elevations are above datum of gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey reports as follows:

Description: 97, pp 90–91; 124, pp 131–132.
Discharge: 97, p 91; 124, p 132.
Discharge, monthly: 124, p 134.
Gage heights: 97, p 91; 124, p 133.
Rating table: 124, p 133.

Discharge measurements of Zealand River near Twin Mountain, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 3[a]	T. W. Norcross	44	35	1.99	2.67	70
August 4[a]	do	17	13	1.13	2.08	14.7
August 25[b]	do	13	9.8	.95	1.99	9.3

[a] By wading. [b] By wading; meter on a rod.

Daily gage height, in feet, of Zealand River near Twin Mountain, N. H., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.85	2.35	2.3	2.6	2.9	2.3	3.0	2.6
2	.....	3.25	2.4	2.9	2.35	2.7	2.3	3.5	2.5
3	.....	3.1	2.7	2.6	2.3	3.0	2.3	2.3	3.0
4	.....	3.0	2.5	2.4	2.2	3.2	2.3	2.5	3.2
5	.....	3.2	2.4	2.3	2.2	2.85	2.3	2.35	3.0
6	.....	3.4	3.0	2.3	2.2	3.0	2.3	2.3	.....
7	.....	3.4	2.7	2.3	2.2	2.65	2.3	2.35	.....
8	.....	3.3	2.6	2.2	2.3	2.5	2.25	2.35	.....
9	.....	3.3	2.5	2.2	2.3	2.4	2.25	2.3	.....
10	.....	3.1	2.45	2.2	2.25	2.35	2.25	2.3	.....
11	.....	3.0	2.3	2.2	2.2	2.3	2.2	2.3	.....
12	.....	3.0	2.7	2.2	2.2	2.3	2.7	2.2	.....
13	.....	2.9	2.8	2.2	2.4	2.5	2.8	2.2	.....
14	.....	2.9	2.7	2.2	2.25	2.45	2.7	2.2	.....
15	.....	2.7	2.5	2.3	2.3	2.35	2.45	2.2	.....
16	.....	2.7	2.4	2.0	2.6	2.3	2.4	2.2	.....
17	.....	2.6	2.4	2.3	2.55	2.3	2.4	2.15	.....
18	.....	2.75	2.3	2.3	2.35	3.2	2.4	2.15	.....
19	.....	2.7	2.3	2.4	2.2	2.65	2.7	2.1	.....
20	.....	2.65	2.3	2.3	2.2	2.5	2.5	2.1	.....
21	.....	2.7	2.4	2.2	2.2	2.5	2.5	2.1	.....
22	.....	2.5	2.55	2.1	2.2	2.5	4.5	2.2	.....
23	.....	2.5	2.3	2.1	2.15	2.45	4.5	2.2	.....
24	.....	2.45	2.3	2.15	2.15	2.35	4.0	2.3	.....
25	.....	2.4	2.2	2.2	2.0	2.45	4.0	2.4	.....
26	.....	2.4	2.5	2.2	2.0	2.4	4.0	2.4	.....
27	3.15	2.6	2.6	2.2	2.75	2.4	3.5	2.4	.....
28	3.05	2.5	2.4	2.15	2.4	2.35	2.5	2.4	.....
29	2.95	2.45	2.35	2.1	2.4	2.3	2.5	2.4	.....
30	2.85	2.4	2.3	2.1	2.9	2.3	2.5	2.6	.....
31	.....	2.35	.....	2.9	3.2	.....	2.5	.....	.....

NOTE.—River frozen January 1 to April 26 and December 6–31.

Station rating table for Zealand River, near Twin Mountain, N. H., from January 1 to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.00	10	2.70	78	3.40	293	4.10	567
2.10	14	2.80	100	3.50	330	4.20	609
2.20	20	2.90	127	3.60	368	4.30	652
2.30	27	3.00	156	3.70	406	4.40	696
2.40	35	3.10	188	3.80	445	4.50	740
2.50	46	3.20	222	3.90	485		
2.60	60	3.30	257	4.00	526		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1903–1905. It is well defined between gage heights 1.9 feet and 2.6 feet.

Estimated monthly discharge of Zealand River near Twin Mountain, N. H., for 1905.

[Drainage area, 14 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
May	293	31	120	8.57	9.88
June	156	20	48.2	3.44	3.84
July	127	10	29.7	2.12	2.44
August	222	10	38.3	2.74	3.16
September	222	27	65.1	4.65	5.19
October	740	20	143	10.21	11.77
November	330	14	41.3	2.95	3.29
December 1–5	222	46	128	9.14	1.70

LITTLE RIVER NEAR TWIN MOUNTAIN, N. H.

This station was established January 21, 1904, by F. E. Pressey, and discontinued September 15, 1905. It is located at the rough wooden highway bridge about 2 miles southwest of Twin Mountain, and about 2 miles above the entrance of Little River into the Ammonoosuc. The area of the drainage basin 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 and 1905, but it is not intended to make any estimates of discharge for this point.

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.

A standard chain gage, which is read twice each day by Edward Lynch, is attached to the floor on the downstream side of the bridge; length of chain, 12.92 feet when established, but changed to 12.32 feet August 25, 1905, owing to settling of the gage. The gage 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 when established, but found to be 10.73 feet August 25, 1905. (2) A cross on a bowlder on right bank, about 32 feet from end of gage box; elevation, 9.05 feet. Elevations refer to gage datum.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 134–135.

Discharge measurements of Little River near Twin Mountain, N. H., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
May 3 *a*	T. W. Norcross	28	32.7	2.20	5.80	72.
August 25 *b*	do	24	18.3	.72	4.86	13.2

a From bridge. *b* By wading; meter fastened to a rod.

Daily gage height, in feet, of Little River near Twin Mountain, N. H., for 1905.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	5.75	5.25	5.0	5.0	5.55	17	.....	6.25	5.3	5.1	5.05	.....
2	.....	5.65	5.2	5.45	4.8	5.5	18	.....	6.45	5.3	5.0	4.9	.....
3	.....	5.75	5.45	5.5	4.8	6.1	19	.....	6.35	5.4	4.95	4.85	.....
4	.....	6.35	5.4	5.35	4.75	5.8	20	.....	6.05	5.2	4.9	4.8	.....
5	.....	6.3	5.25	5.15	4.7	5.5	21	.....	6.0	5.2	4.9	4.75	.....
6	.....	6.5	5.85	5.05	4.7	5.4	22	.....	5.85	5.15	4.8	4.7	.....
7	.....	6.85	5.45	5.0	4.7	5.4	23	.....	5.6	5.05	4.8	4.8	.....
8	.....	6.45	5.45	5.0	4.95	.....	24	.....	5.55	5.0	4.8	4.7	.....
9	.....	6.5	5.3	4.9	4.95	.....	25	6.05	5.5	5.0	4.8	4.55	.....
10	.....	6.3	5.25	4.9	4.75	.....	26	6.05	5.6	5.3	4.8	4.4	.....
11	.....	6.3	5.2	4.9	4.7	.....	27	6.0	6.15	5.55	4.8	5.4	.....
12	.....	6.25	5.6	4.9	4.7	.....	28	6.0	5.9	5.4	4.7	4.95	.....
13	.....	6.1	5.55	4.9	4.75	.....	29	6.15	5.75	5.25	4.7	4.9	.....
14	.....	6.05	5.65	5.0	4.7	.....	30	6.25	5.75	5.15	4.9	5.7	.....
15	.....	6.1	5.4	4.95	4.75	.....	31	.....	5.55	.....	5.35	5.85	.....
16	.....	6.15	5.3	4.9	5.5	.....							

NOTE.—River frozen January 1 to April 24.

WHITE RIVER AT SHARON, VT.

This station was established July 30, 1903, by H. K. Barrows. It was discontinued April 7, 1905, and no data are available after the year 1904.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 92; 124, p 136.
Discharge: 97, p 92; 124, p 136.
Discharge, monthly: 124, p 138.
Gage heights: 97, p 92; 124, p 137.
Rating table: 124, p 137.

ASHUELOT RIVER AT WINCHESTER, N. H.

This station was established July 10, 1903, by H. K. Barrows. Owing to probable backwater effect from the dam at Ashuelot, about 2½ miles below, and unsatisfactory results, it was discontinued April 7, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 97, p 93; 124, p 138.
Discharge: 97, p 93; 124, p 139.
Gage heights: 97, p 93; 124, p 139.

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 and is 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 the 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, which is reached by back water from Connecticut River.

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.

Discharge measurements are made from the downstream side of the bridge, the initial point for soundings being the left end of the top chord of the stiffening truss at the downstream side. Low-water measurements are made by wading at a point about one-half mile downstream.

A standard chain gage, which is read twice each day by Mrs. Carrie I. Wellman, 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, 31.35 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 refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 140–141.

Discharge measurements of Deerfield River at Deerfield, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 4	T. W. Norcross	319	2,270	1.63	3.97	3,710
August 16	do	315	2,040	.82	3.29	1,680
August 16	do	318	2,120	1.08	3.56	2,290
August 16	do	318	2,140	1.18	3.69	2,520
August 17	do	318	2,130	1.11	3.68	2,380
August 17	do	318	2,110	.95	3.51	2,000
August 17	do	318	2,100	.88	3.42	1,840
August 31	do	314	2,020	.65	3.12	1,310

Daily gage height, in feet, of Deerfield River at Deerfield, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	5.65	3.1	2.45	2.6	3.05	2.95	2.5	2.45	3.45
2	.....	.....	.....	4.35	3.0	2.5	2.55	2.75	2.8	2.5	2.5	3.25
3	.....	.....	.....	4.05	2.8	2.4	2.5	2.55	5.5	2.5	2.5	6.2
4	.....	.....	.....	3.95	2.8	2.5	2.5	2.5	5.05	2.55	2.6	4.6
5	.....	.....	.....	4.2	2.95	2.5	2.6	2.4	4.5	2.6	2.5	3.65
6	.....	.....	.....	5.4	.....	2.5	2.65	2.35	3.65	2.5	2.85	3.2
7	7.2	.....	.....	4.4	2.9	2.5	2.65	2.5	3.35	2.5	3.15	3.1
8	4.5	.....	.....	3.8	2.85	2.7	2.5	2.4	3.2	2.55	3.0	3.0
9	3.75	.....	.....	3.55	2.8	2.6	2.45	2.4	3.1	2.55	2.9	2.9
10	3.35	.....	.....	3.8	2.75	2.6	2.4	2.4	3.0	2.5	2.7	3.0
11	3.35	.....	.....	5.3	2.75	2.55	2.45	2.4	2.7	2.5	2.6	3.05
12	4.05	.....	.....	5.3	2.5	2.5	2.45	3.05	4.1	3.25	2.55	3.0
13	3.95	.....	.....	4.5	2.7	2.5	2.45	2.9	3.5	3.05	2.55	2.9
14	.....	.....	.....	4.15	2.7	2.5	2.4	2.75	3.2	2.9	2.5	2.85
15	.....	.....	.....	3.95	2.7	2.45	2.35	2.5	3.0	2.85	2.5	2.8
16	.....	.....	.....	3.65	3.05	2.4	2.3	3.5	2.9	2.65	2.65	.....
17	.....	.....	.....	3.4	3.2	2.4	2.3	3.6	3.0	2.5	2.7	.....
18	.....	.....	.....	3.3	3.1	2.4	2.2	2.9	3.9	2.55	2.65	.....
19	.....	.....	.....	3.15	3.0	2.3	2.4	2.65	4.75	2.65	2.5	.....
20	.....	.....	.....	3.1	2.65	2.55	2.4	2.3	3.9	3.05	2.45	.....
21	.....	.....	.....	3.5	2.7	2.9	2.4	2.2	3.7	3.4	2.6	.....
22	.....	.....	.....	4.2	2.7	4.3	2.35	2.45	3.4	2.9	2.5	.....
23	.....	.....	.....	3.95	2.6	3.5	2.3	2.5	3.15	2.85	2.6	.....
24	.....	.....	.....	3.35	2.6	3.0	2.2	2.4	2.95	2.8	2.4	.....
25	.....	.....	.....	3.2	2.5	2.8	2.3	2.4	2.8	2.75	2.45	.....
26	.....	.....	.....	3.25	2.5	2.75	2.35	2.45	2.8	2.7	2.5	.....
27	.....	.....	6.6	3.4	2.45	3.1	2.35	2.45	2.75	2.6	2.45	.....
28	.....	.....	5.45	3.3	2.5	2.85	2.35	2.4	2.7	2.55	2.4	.....
29	.....	.....	5.5	3.3	2.5	2.7	2.4	2.35	2.65	2.5	3.05	.....
30	.....	.....	5.9	3.2	2.5	2.7	3.4	2.5	2.6	2.45	4.7	.....
31	.....	.....	6.35	.....	2.5	.....	3.5	3.15	.....	2.45	.....	.....

NOTE.—River clear of ice January 7-13, frozen January 1-6 and January 14 to March 26. Ice went out of river on night of March 26. River frozen December 16-31.

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 162 square miles and is tributary to Chicopee River, which drains a large section of central Massachusetts and is the largest tributary of the Connecticut in respect of drainage area, its basin containing 730 square miles. Chicopee River is formed at Three Rivers by the union in that vicinity of Ware, Swift, and Quaboag rivers; thence runs westward 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 on them.

A gaging station was established September 15, 1904, by H. K. Barrows, at the steel highway bridge about 2 miles above the village of Ware, Mass. The bridge has a span of about 85 feet.

The channel is curved for some distance above 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.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the left abutment at the top.

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. The gage is read wice each day by M. N. Richards, the expense of such readings being borne equally by the Otis Company and the George H. Gilbert Manufacturing Company, both of Ware. The gage 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 elevations refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pp. 142–143.

Discharge measurements of Ware River near Ware, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
March 28	T. W. Norcross	83	459	5.56	6.92	2,550
March 28	do	83	465	5.59	6.96	2,600
April 1	do	83	370	4.59	5.75	1,690
April 7	do	83	303	4.09	5.06	1,240
April 13	do	83	212	3.58	4.00	758
April 29	do	79	108	1.98	2.74	214
May 17	do	80	120	2.27	2.89	272
July 29	do	68	87	1.56	2.46	136
August 11	do	66	78	1.56	2.37	122
August 11	do	58	52	.83	1.94	43
September 7	do	83	315	3.48	5.20	1,100
September 26	do	80	108	2.08	2.77	225

Daily gage height, in feet, of Ware River near Ware, Mass., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				5.9	2.9	2.4	2.3	2.5	2.5	2.05	2.7	3.1
2				5.1	2.8	2.4	2.7	2.75	2.3	2.75	2.6	2.75
3				4.7	2.85	2.0	1.95	2.55	3.3	2.9	2.6	3.4
4			3.8	4.3	2.9	1.65	2.1	2.8	6.3	2.8	2.4	4.7
5		4.3		4.0	2.8	2.1	2.0	2.7	6.65	2.9	2.4	3.9
6				4.8	2.4	2.55	2.4	2.65	6.1	2.65	2.8	4.0
7				5.0	2.25	3.15	1.7	2.45	4.6	2.3	2.85	3.5
8				4.6	2.6	2.5	1.75	2.6	3.8	2.1	2.65	3.4
9			3.7	4.0	2.45	2.75	2.25	2.75	4.0	2.55	2.6	3.0
10				4.0	2.5	2.5	2.4	2.5	3.25	2.8	2.7	2.8
11	6.3			4.05	2.4	2.1	2.6	2.2	3.2	2.5	2.2	2.9
12				4.45	2.6	2.6	2.3	2.5	3.3	2.85	2.25	3.15
13				4.15	2.3	2.9	2.05	2.8	3.55	2.8	2.7	3.1
14		3.3	4.1	3.9	2.3	2.5	2.55	2.7	3.1	2.8	2.5	2.9
15			3.55	3.8	2.6	2.7	2.5	2.65	3.1	2.95	2.8	3.2
16	5.4		3.35	3.65	2.95	2.6	2.7	3.3	3.15	2.8	2.65	3.35
17			3.0	3.4	2.7	2.2	2.2	3.5	2.7	2.75	2.65	2.6
18			3.05	3.35	3.0	2.2	2.5	3.4	3.1	2.7	2.3	4.05
19			5.25	3.25	2.7	2.15	2.4	3.15	2.8	2.8	2.15	3.3
20			5.35	3.45	2.6	2.5	2.5	2.4	3.0	2.85	2.65	2.8
21			4.5	3.35	2.3	2.8	2.65	2.5	3.05	3.1	2.6	2.8
22	4.85		3.95	3.35	2.45	3.2	1.9	2.6	3.15	2.6	2.75	3.15
23			3.8	3.1	2.6	3.45	2.3	2.7	2.85	2.9	2.65	3.4
24		4.2	3.75	3.6	2.5	3.1	2.4	2.6	2.55	2.75	2.8	3.1
25			5.65	3.3	2.8	3.0	2.5	2.7	3.0	2.8	2.35	3.05
26			7.1	3.3	2.7	2.7	2.5		2.85	2.7	2.8	3.1
27			7.3	3.1	2.6	2.5	2.5	2.5	2.8	2.7	2.6	3.05
28			7.05	3.05	2.4	2.5	2.6	2.9	2.8	2.4	2.7	3.1
29			6.6	3.0	2.35	2.5	1.7	2.6	2.8	2.35	2.8	3.0
30	4.4		6.4	2.8	2.25	2.5	2.3	2.95	2.55	2.6	3.25	3.3
31			6.1		2.3		2.6	2.5		2.8		2.8

NOTE.—River frozen January 1 to March 15, when ice went out. During this period the readings were taken to the top of the ice. The thickness of the ice was measured, as follows:

	Feet.		Feet.
Jannary 11	1.2	February 24	1.9
Jannary 16, 22	1.7	March 4	2.5
January 30	1.8	March 9	1.6
February 5, 14	2.1		

Station rating table for Ware River near Ware, Mass., from September 15, 1904, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
1.90	42	3.00	294	4.10	718	5.20	1,332
2.00	55	3.10	325	4.20	768	5.40	1,460
2.10	71	3.20	357	4.30	820	5.60	1,590
2.20	89	3.30	390	4.40	873	5.80	1,725
2.30	109	3.40	424	4.50	927	6.00	1,865
2.40	131	3.50	460	4.60	982	6.20	2,005
2.50	155	3.60	498	4.70	1,038	6.40	2,155
2.60	180	3.70	538	4.80	1,095	6.60	2,305
2.70	207	3.80	580	4.90	1,153	6.80	2,460
2.80	235	3.90	624	5.00	1,212	7.00	2,620
2.90	264	4.00	670				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1904–5. It is well defined between gage heights 1.9 feet and 7 feet.

Estimated monthly discharge of Ware River near Ware, Mass., for 1904–5.

[Drainage area, 162 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
September 15–30	846	109	293	1.81	1.08
October	294	80	192	1.19	1.37
November	357	55	182	1.12	1.25
December 1–9	221	71	172	1.06	.355
1905.					
March 15–31	2,860	294	1,367	8.44	5.34
April	1,795	235	650	4.01	4.47
May	294	99	177	1.09	1.26
June	442	16	180	1.11	1.24
July	207	20	121	.747	.861
August	460	89	214	1.32	1.52
September	2,342	109	513	3.17	3.54
October	325	63	207	1.28	1.48
November	374	80	188	1.16	1.29
December	1,038	180	377	2.33	2.69

NOTE.—River frozen December 10–31, 1904; January 1 to March 15, 1905. Discharge interpolated August 26, 1905.

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 1904–5 are withheld, awaiting confirmation of data.

QUABOAG RIVER AT WEST WARREN, MASS.

Quaboag River is about 25 miles in length, and has 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 Quaboag 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 a 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.

Mean daily discharge, in second-feet, of Quaboag River at West Warren, Mass., from July to October, 1903.[a]

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	[b]213	127	116	[b]52	17	.....	.....	233	151
2	233	129	124	81	18	.....	.....	208	202
3	207	130	[b]131	78	19	.....	.....	178	.....
4	192	115	[b]73	105	20	[b]158	.....	164	.....
5	[b]174	239	112	90	21	219	[b]109	151	.....
6	.....	241	121	82	22	225	111	125	.....
7	.....	224	118	95	23	228	106	133	.....
8	.....	196	116	99	24	209	101	123	.....
9	.....	191	114	144	25	182	120	115	.....
10	[b]93	[b]214	117	145	26	172	113	110	.....
11	128	.....	123	140	27	160	116	129	.....
12	170	.....	116	158	28	150	119	[b]158	.....
13	270	.....	106	148	29	145	136	.....	.....
14	217	.....	112	118	30	136	146	.....	.....
15	211	.....	127	108	31	150	136	.....	.....
16	[b]197	.....	151	102					

[a] From automatic gage records kept by Massachusetts State Board of Health.
[b] Average of less than 24 hourly readings.

Estimated monthly discharge of Quaboag River at West Warren, Mass., for 1904 and 1905.

[Drainage area, 144 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
1904.					
October 25–31	182	106	153	1.06	0.276
November	182	30	82	.569	.635
December	229	10	76	.528	.609
1905.					
January	605	123	267	1.85	2.13
February	161	89	120	.833	.867
March	1,206	106	525	3.65	4.21
April	931	226	556	3.86	4.31
May	229	106	148	1.03	1.19
June	106	55	88	.611	.682
July	106	20	59	.410	.473
August	72	30	50	.347	.400
September	476	72	104	1.42	1.58
October	106	72	90	.625	.721
November	89	55	83	.576	.643
December	306	89	187	1.30	1.50
The year	1,206	20	198	1.38	18.71

NOTE.—Estimates are based on one gage reading per day, taken at about 6.15 a. m. (before mill upstream starts up) on week days, and on Sundays at about 4 p. m.

SWIFT RIVER AT WEST WARE, MASS.

Swift River is about 30 miles long and has a total drainage 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 Dwight Holland, manager, since October 21, 1904. The drainage area at this point is 188 square miles. The dam at West Ware is a timber crib, and 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 the 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.

April 14, 1905, this mill was totally destroyed by fire, so that records here have been interrupted.

WESTFIELD RIVER AT RUSSELL, MASS.

The main branch of Westfield River rises in the northeastern part of Berkshire County, entering Connecticut River at Springfield, with a total length of about 55 miles. Its principal tributaries are West Branch and Middle Branch, respectively; the length of West Branch from the mouth is 22 miles and that of 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, and consequently rapid fluctuations in the flow.

A gaging station was established April 1, 1904, by N. C. Grover. It is located at the steel highway bridge near the railway station at Russell, Mass. This bridge has two spans, which are about 250 feet long. The drainage area at this point is 331 square miles.

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; the current is swift at all times.

Discharge measurements are made from the bridge. The initial point for soundings is the face of the left abutment, on the downstream side, at the top.

A standard chain gage, which is read twice each day by B. A. Silliman, 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 refer to the datum of the gage.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper of the United States Geological Survey No. 124, pages 145–146.

Discharge measurements of Westfield River at Russell, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height	Discharge.
		Feet.	*Sq. feet.*	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
April 5	T. W. Norcross	214	524	5.11	2.81	2,680
April 15	do	196	376	4.23	2.12	1,590
April 25	do	186	233	3.15	1.32	735
May 19	do	187	230	2.09	1.20	480
July 15[a]	Barrows and Norcross	129	151	1.10	.75	167

[a] By wading one-half mile above gage.

Daily gage height, in feet, of Westfield River, at Russell, Mass., for 1905.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.9	1.3	0.8	0.8	1.3	1.2	0.85	0.95	1.5
2	.....	2.9	1.25	.8	.75	1.0	1.0	.9	1.0	1.3
3	.....	2.3	1.2	.85	.7	.9	4.4	.9	.95	.....
4	.....	2.25	1.15	.8	.7	.8	6.5	1.0	1.05	.....
5	.....	2.85	1.1	.8	.6	.8	3.05	.95	1.1	.....
6	.....	4.3	1.1	.85	.7	.6	2.0	.9	1.1	.....
7	.....	2.7	1.1	1.1	.7	.7	1.55	.8	1.65	1.5
8	.....	2.3	1.1	1.05	.7	.85	1.4	.85	1.4	1.55
9	.....	2.2	1.05	.9	.6	.8	1.2	.8	1.25	1.4
10	.....	2.3	1.1	.85	.6	.7	1.1	.8	1.1	1.4
11	.....	2.9	1.0	.8	.7	.7	1.1	.8	1.1	1.6
12	.....	3.05	1.1	.8	.95	1.1	2.3	1.9	1.05	1.9
13	.....	2.3	1.1	.9	.8	1.05	2.35	1.5	1.0	1.3
14	.....	2.15	1.15	.9	.8	.9	1.55	1.2	1.0	1.1
15	.....	2.1	1.25	.9	.6	.9	1.35	1.1	.9	1.05
16	.....	1.9	1.45	.9	.6	1.4	1.3	1.1	1.0	1.25
17	.....	1.8	1.4	.8	.6	1.5	1.3	1.0	1.05	.....
18	.....	1.65	1.3	.75	.6	1.1	1.4	.95	1.0	.....
19	4.0	1.6	1.2	.7	.6	.9	1.75	1.1	1.0	.....
20	3.25	1.55	1.1	.95	.7	.8	1.4	1.8	1.4	.....
21	2.25	1.8	1.0	.95	.6	.8	1.6	1.7	1.4	.....
22	2.1	1.75	1.0	1.85	.6	.85	1.4	1.3	1.4	.....
23	2.0	1.5	1.0	1.65	.6	.8	1.2	1.2	1.0	.....
24	1.8	1.4	.95	1.15	.5	.85	1.1	1.1	1.0	.....
25	3.1	1.35	.9	.95	.55	.8	1.1	1.0	1.0	.....
26	3.5	1.3	.9	.9	.7	1.0	1.0	1.0	1.0	.....
27	4.4	1.3	.9	1.0	.65	.85	.9	1.0	1.0	.....
28	3.95	1.35	.85	.9	.6	.85	.95	1.0	1.0	.....
29	4.1	1.3	.8	.8	.6	.9	.9	.95	1.3	.....
30	4.45	1.3	.85	.8	2.2	.9	.85	1.0	2.95	.....
31	4.5	.....	.8	.....	1.85	1.3	.....	.95	.....	.....

NOTE.—River frozen January 1 to March 18 and December 17–31. River clear of ice March 20.

WESTFIELD LITTLE RIVER NEAR BLANDFORD, MASS.

Westfield Little River is formed by the union of Peebles and Borden brooks in the southern part of the town of Blandford. The headwaters of Peebles Brook are in North Blandford, at an elevation of about 1,400 feet, while at its junction with Borden Brook it has an elevation of about 850 feet, a fall of 550 feet in a distance of about 8 miles. Below Borden Brook the fall is also very rapid, reaching an elevation of 200 feet in the vicinity of West Parish, a distance of 6 miles from Borden Brook. The drainage area at the junction of Peebles and Borden brooks is about 43 square miles; at the mouth of the river, 83.6 miles. The slopes are very steep, and in places precipitous. The greater part of the basin above West Parish is in forest. It is expected that Westfield Little River will be used as the municipal water supply for the city of Springfield, for which a dam and reservoir are being planned in the vicinity of Cobble Mountain.

A gaging station was established July 13, 1905, by H. K. Barrows, at Cobble Mountain, near Blandford, Mass. It is located a short distance below Borden Brook, and is maintained in cooperation with the water board of the city of Springfield, through their engineer, E. E. Lochridge.

The channel is straight for 100 feet above and 200 feet below the station. The bed is very rough and rocky, though it has been improved somewhat by the aid of dynamite. The left bank is high and steep, but the right bank is liable to overflow in

extreme high water. The channel is fairly permanent, but in extreme freshets is liable to change, this having occurred during the present season, as noted in connection with the list of discharge measurements. The current is swift at high and medium at low stages. The flow is free and very little affected by artificial conditions.

Discharge measurements at medium and high stages are made from a car suspended from a cable of 140-foot span. The initial point for soundings is a 6-inch maple tree on the left bank in the line of the cable. All low-water measurements are made by wading at various sections.

A staff gage is bolted to a large rock on the left bank of the river. A standard chain gage is also attached to a tree on the left bank a short distance above the staff gage. The length of the chain is 11.43 feet. Gage readings are made twice each day by S. H. Bodurtha. Both gages have the same datum, and are referred to bench marks as follows: (1) Circular chisel draft in highest point of stone to which the staff gage is attached; elevation, 5.00 feet. (2) Chiseled T near the gage on the same stone, for measurement to water surface; elevation, 3.51 feet. (3) Center of head of nail in largest tree on right bank opposite the gage; elevation, 8.55 feet. All elevations refer to datum of the gage.

Discharge measurements of Westfield Little River near Blandford, Mass., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Ft.per.sec.*	*Feet.*	*Sec-feet.*
July 14 [a]	Barrows and Norcross	34	44	0.73	2.32	32.4
August 10 [a]	Norcross and Lockridge	32	51	.47	2.30	23.8
September 8 [a]	do	46	73	1.12	2.98	82.
September 27 [a]	T. W. Norcross	39	54	.49	2.40	26.5
September 28 [a]	do	39	53	.48	2.39	25.7
October 13 [b]	do	44	77	1.10	2.94	85.
October 14 [b]	do	42	71	.83	2.76	59.
November 9 [b]	Norcross and Lockridge	39	59	.68	2.57	40.1

[a] By wading; meter on a rod. [b] From cable car.

NOTE.—The measurement of July 14 is not comparable with the measurements which follow, on account of changed conditions of bed of river, caused by freshet of July 30.

Daily gage height, in feet, of Westfield Little River near Blandford, Mass., for 1905.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.5	2.47	2.32	2.38	3.28	17	1.98	2.8	2.8	2.5	2.47	a2.9
2	.....	3.05	2.5	2.32	2.38	a3.3	18	1.92	2.53	3.0	2.48	2.45	a3.0
3	.....	2.84	4.08	2.58	2.35	4.18	19	2.25	2.34	3.01	2.46	2.4	a3.0
4	.....	2.68	5.25	2.46	2.75	3.88	20	2.26	2.26	2.9	3.2	a2.5	a3.0
5	.....	2.46	4.35	2.39	2.58	a3.4	21	2.13	2.19	2.98	2.95	a2.6	b4.0
6	.....	2.32	3.6	2.34	2.68	3.3	22	2.0	2.16	2.84	2.73	a2.6	3.45
7	.....	2.46	3.25	2.3	2.78	3.15	23	1.94	2.1	2.68	2.59	a2.6	3.3
8	.....	2.41	3.0	2.28	2.68	3.0	24	1.9	2.08	2.58	2.6	2.5	3.18
9	.....	2.4	2.84	2.28	2.59	2.95	25	1.93	2.8	2.52	2.6	2.5	3.0
10	.....	2.3	2.68	2.25	2.55	3.0	26	1.88	2.58	2.44	2.53	2.48	3.0
11	.....	2.38	2.6	2.24	2.48	a3.1	27	1.86	2.42	2.44	2.46	2.48	2.9
12	.....	2.36	3.66	3.45	2.46	a3.1	28	1.84	2.37	2.42	2.43	3.32	2.9
13	2.58	2.24	3.65	2.98	2.44	a3.1	29	1.9	2.49	2.36	2.4	3.52	3.85
14	2.37	2.14	3.3	2.76	2.44	a3.0	30	7.75	2.68	2.36	2.4	3.38	3.48
15	2.25	2.44	2.95	2.6	a2.52	a2.9	31	4.3	2.57	.....	2.37	.....	3.05
16	2.06	2.95	2.82	2.51	a2.49	2.9							

[a] Anchor ice in river. [b] River clear of ice.

NOTE.—Gage heights during freshet of July 30 estimated. Crest of flood was at gage height, 8 feet at 8.30 a. m., as determined afterwards with a level, using marks on trees. Relation of gage heights to discharge changed by this flood.

SALMON RIVER AT LEESVILLE, CONN.

This station was established March 28, 1905, by H. K. Barrows. It is located at the plant of the East Haddam Electric Light Company at Leesville, a short distance above the bridge on the highway leading from Leesville to Easthampton. The drainage area at this point is 115 square miles. The station is maintained through the cooperation of Messrs. Ransom & Hoadley, of Providence, R. I., who are expecting to build at this point a dam about 72 feet in height for developing light and power, which will probably be used in Hartford.

The channel is curved more or less above and below the station. The bed is rather rough and rocky; banks in the vicinity of the gage are high and steep, but a short distance below the bridge they become of medium height. The current is good at the places used for measurement by wading, but is apt to be small and poorly distributed in the vicinity of the bridge during ordinary stages. This station may be influenced for a time during the spring by backwater effect from Connecticut River, into which it flows about 5 miles below this point. The effect of the tide is experienced nearly up to the highway bridge, but it is believed that gage readings are not affected by it. During the low-water season no water is allowed to flow by the dam during the daytime, consequently it has been necessary to get a number of gage readings, most of which were in the night, to determine the mean flow for the day.

Discharge measurements at ordinary and low stages are made by wading at various sections in the vicinity. At high water they are made from the bridge, where there is a clear span of about 100 feet.

A vertical staff gage is fastened to the side wall of the tailrace near its entrance into the river. An additional staff gage is fastened to the foundation wall of the electric-light station for high-water observations. Gage readings are taken by E. W. Crocker, superintendent of the electric-light plant. The two gages are referred to bench marks, as follows: (1) Circular chisel draft on stone near staff gage in tailrace; elevation, 2.98 feet. (2) Circular chisel draft on bowlder, 36 feet south and 8 feet west of southeast corner of electric-light station; elevation, 4.51 feet. (3) Chiseled cross on ledge 20 feet east and 5 feet north of southeast corner of old power-house foundation; elevation, 9.27 feet. All elevations are above datum of the gage.

Discharge measurements of Salmon River at Leesville, Conn., in 1905.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
April 28[a]	Barrows and Norcross	120	112	1.48	1.34	166
May 16[a]	T. W. Norcross	122	121	1.46	1.38	177
May 26[a]	do	98	82	.89	.70	73
December 5[b]	do	102	400	.82	1.97	330

[a] By wading; meter on a rod.
[b] From downstream side of highway bridge; about one-eighth of discharge is estimated.

HOUSATONIC RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Housatonic River has its source in Berkshire County, Mass. It flows southward across Massachusetts and the west 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.

HOUSATONIC RIVER AT GAYLORDSVILLE, CONN.

This station was established October 24, 1900, by E. G. Paul. It is located at the covered wooden highway bridge at Gaylordsville, 2 miles below the mouth of Tenmile River.

The channel is straight for about 500 feet above and below the measuring section, and there is sufficient velocity at all stages to permit of accurate measurement. At high water the current is swift and rough. Both banks are subject to overflow only during extreme freshets; both 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.

On account of the poor cross section of the bridge discharge measurements are made by means of a cable and car 1¼ miles below. The cable has a span of 200 feet. The initial point for soundings is the zero of the tagged wire at the sycamore tree which supports the cable on the left bank.

A standard chain gage, which is read twice each day by G. H. Monroe, is fastened to the woodwork of the inside of the bridge; length of chain, 30.45 feet. No bench marks have been established. The center of the gage pulley is 29.35 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 47, pp 35–36; 65, pp 87–88; 82, p 121; 97, p 94; 124, p 147.
Discharge: 47, p 36; 65, p 88; 82, p 122; 97, p 95; 124, p 148.
Discharge, daily: 97, pp 98–101; 124, p 151.
Discharge, low-water: 65, pp 89–90.
Discharge, monthly: 75, p 24; 97, pp 102–103; 124, p 152.
Gage heights: 47, p 36; 65, p 89; 82, p 122; 97, p 96; 124, p 149.
Hydrographs: 75, p 24.
Rating tables: 65, p 318; 97, p 97; 124, p 150.

Daily gage height, in feet, of Housatonic River at Gaylordsville, Conn., for 1905.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	4.4	4.2	8.4	4.8	4.0	3.4	4.65	4.0	4.05	4.05	5.05
2	4.3	4.45	4.3	7.95	4.8	3.65	3.4	4.4	3.8	4.0	4.0	5.0
3	4.45	4.5	4.25	7.7	4.8	3.9	3.55	4.2	4.8	4.1	3.95	5.55
4	4.5	4.4	4.2	7.0	4.75	3.9	3.4	3.95	6.35	4.3	4.0	6.5
5	4.4	4.45	4.1	6.8	4.65	3.7	3.35	3.8	6.85	4.15	4.0	6.3
6	4.4	4.4	4.1	7.3	4.5	3.75	3.2	3.45	6.35	4.15	4.2	5.65
7	8.4	4.4	4.15	7.15	4.4	4.35	3.3	3.5	5.7	4.2	4.2	5.45
8	8.0	4.5	4.15	6.8	4.45	4.2	3.4	3.5	5.45	4.1	4.4	5.1
9	6.65	4.3	4.3	6.75	4.3	4.1	3.25	3.45	5.05	4.0	4.3	5.15
10	6.5	4.3	4.7	6.6	4.3	4.2	3.25	3.65	4.7	3.95	4.35	5.2
11	6.25	4.4	5.65	6.55	4.45	4.05	3.25	3.7	4.6	3.9	4.3	5.2
12	6.1	4.4	5.3	6.65	4.4	4.0	3.35	3.8	5.0	4.4	4.2	4.8
13	6.4	4.25	5.1	6.55	4.55	4.05	3.35	3.75	5.1	4.7	4.1	4.95
14	5.65	4.2	5.0	6.2	4.15	4.2	3.3	3.5	5.2	4.5	4.05	4.75
15	5.45	4.35	4.95	5.75	4.45	4.05	3.45	3.6	5.1	4.4	4.0	4.6
16	5.4	4.4	4.7	5.8	4.45	3.95	3.7	3.9	5.15	4.3	3.6	4.6
17	5.2	4.3	4.8	5.8	4.5	4.0	3.6	4.1	4.7	4.1	4.0	4.2
18	5.1	4.2	4.75	5.45	4.55	3.55	3.45	3.9	4.55	4.15	4.0	4.35
19	5.05	4.2	6.6	5.45	4.55	3.4	3.25	3.9	4.8	4.15	3.95	4.4
20	5.1	4.1	7.3	5.35	4.5	3.45	3.25	3.8	4.95	4.3	3.8	4.5
21	5.1	4.1	6.65	5.5	4.3	3.8	3.3	3.75	4.95	4.5	3.8	4.85
22	5.1	4.15	6.6	5.55	3.85	3.95	3.25	3.5	5.0	4.65	3.75	5.5
23	5.0	4.0	6.55	5.3	4.25	4.15	3.15	3.35	4.8	4.4	3.7	5.5
24	4.65	4.0	6.65	5.1	4.25	4.3	3.4	3.55	4.55	4.1	3.9	5.15
25	4.6	4.1	8.15	5.1	4.0	3.5	3.4	4.1	4.4	4.3	4.0	4.95
26	4.6	4.2	8.1	5.05	4.05	4.0	3.25	4.0	4.3	4.3	3.7	4.7
27	4.6	4.2	9.1	5.0	4.0	4.0	3.5	3.7	4.2	4.25	3.75	4.7
28	4.5	4.2	9.05	5.0	4.1	3.7	3.35	3.8	4.25	4.2	3.85	4.7
29	4.7	.....	8.8	5.0	3.85	3.5	3.15	3.6	4.15	4.25	4.3	4.9
30	4.6	.....	8.8	4.8	3.8	3.6	3.35	3.65	4.0	4.35	5.0	4.8
31	4.5	.....	8.65	.....	4.0	.....	4.05	4.3	.....	4.4	.....	4.85

NOTE.—January 1, ice 1 foot thick along edges. January 7, ice went out. January 7–25, river open. January 26, observer notes river open at gage, but frozen across 5 inches thick about 35 rods below the gage. Ice along banks above gage; no anchor ice. This condition held nearly constant with slight increase of ice along banks until March 11, when ice began to melt. River clear March 18.

Station rating table for Housatonic River at Gaylordsville, Conn., from October 23, 1900, to December 31, 1905.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*	*Feet.*	*Second-feet.*
2.50	120	4.60	1,506	6.60	5,204	8.60	10,430
2.60	157	4.70	1,642	6.70	5,448	8.70	10,700
2.70	193	4.80	1,778	6.80	5,692	8.80	10,980
2.80	230	4.90	1,914	6.90	5,936	8.90	11,250
2.90	266	5.00	2,050	7.00	6,180	9.00	11,530
3.00	303	5.10	2,216	7.10	6,440	9.10	11,800
3.10	352	5.20	2,382	7.20	6,700	9.20	12,080
3.20	402	5.30	2,548	7.30	6,960	9.30	12,350
3.30	451	5.40	2,714	7.40	7,220	9.40	12,630
3.40	501	5.50	2,880	7.50	7,480	9.50	12,900
3.50	550	5.60	3,076	7.60	7,744	9.60	13,180
3.60	618	5.70	3,272	7.70	8,008	9.70	13,460
3.70	686	5.80	3,468	7.80	8,272	9.80	13,740
3.80	754	5.90	3,664	7.90	8,536	9.90	14,020
3.90	822	6.00	3,860	8.00	8,800	10.00	14,300
4.00	890	6.10	4,080	8.10	9,070	10.10	14,600
4.10	986	6.20	4,300	8.20	9,340	10.20	14,900
4.20	1,082	6.30	4,520	8.30	9,610	10.30	15,200
4.30	1,178	6.40	4,740	8.40	9,880	10.40	15,500
4.40	1,274	6.50	4,960	8.50	10,150	10.50	15,800
4.50	1,370						

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

Estimated monthly discharge of Housatonic River at Gaylordsville, Conn., for 1905.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
January 7–25	9,880	1,506	3,652	3.58	2.53
March 18–31	11,800	1,710	7,791	7.64	3.98
April	9,880	1,778	4,321	4.24	4.73
May	1,778	754	1,246	1.22	1.41
June	1,226	501	837	.821	.916
July	938	377	494	.484	.558
August	1,574	476	773	.758	.874
September	5,814	754	2,056	2.02	2.25
October	1,642	822	1,131	1.11	1.28
November	2,050	618	956	.937	1.05
December	4,960	1,082	2,183	2.14	2.47

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 165.]

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.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.

2. A certain number are delivered to Senators and Representatives in Congress, for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.

4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

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 (1888–1903) is published as 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, 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.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Union Trust Building; Phœnix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Huntley, Mont.; Hazen, Nev.; Boise, Idaho; North Yakima, Wash.; Portland, Oreg., 351 Washington street.

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