DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

Water-Supply Paper 442

SURFACE WATER SUPPLY OF THE UNITED STATES

1916

PART XII. NORTH PACIFIC DRAINAGE BASINS

A. PACIFIC BASINS IN WASHINGTON AND UPPER COLUMBIA RIVER BASIN

NATHAN C. GROVER, Chief Hydraulic Engineer
G. L. PARKER and W. A. LAMB, District Engineers

Prepared in cooperation with the States of
WASHINGTON, MONTANA, and IDAHO

WASHINGTON
GOVERNMENT PRINTING OFFICE
1919

CONTENTS.

ILLUSTRATIONS.

SURFACE WATER SUPPLY OF PACIFIC SLOPE BASINS IN WASHINGTON AND UPPER COLUMBIA RIVER BASIN, 1916.

AUTHORIZATION AND SCOPE OF WORK.

This volume is one of a series of 14 reports presenting results of measurements of streams in the United States during the year ending September 30, 1916.

The data presented in these reports were collected by the United States Geological Survey under authority implied in the organic law (20 Stat. L., p. 394), which contains the following paragraph:

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

The work was begun in 1888 in connection with special studies of water supply for irrigation. Since the fiscal year ending June 30, 1895, successive sundry civil bills passed by Congress have carried the following item and appropriations:

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

Annual appropriations for the fiscal years ending June 30, 1895–1917.

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

In this work many private and State organizations have cooperated, either by furnishing records or by assisting in their collection. Acknowledgments for cooperation of the first kind are made in connection with the description of each station affected; cooperation of the second kind is acknowledged on page 13.

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

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

DEFINITION OF TERMS.

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

"Second-feet" is an abbreviation for "cubic feet per second." A second-foot is the rate of discharge of water flowing in a channel of rectangular cross-section, 1 foot wide and 1 foot deep, at an average velocity of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in the tables of convenient equivalents (pp. 9–11).

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

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

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

The following terms not in common use are here defined:

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

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

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

CONVENIENT EQUIVALENTS.

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

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

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

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

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

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

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

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

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

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

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

Discharge (second-feet).	Run-off (millions of gallons).				
	1 day.	28 days.	29 days.	30 days.	31 days.
1	0.6463	18.10	18.74	19.39	20.04
2	1.293	36.20	37.48	38.78	40.08
3	1.939	54.30	56.22	58.17	60.12
4	2.585	72.40	74.96	77.56	89.16
5	3.232	90.50	93.70	96.95	100.2
6	3.878	108.6	112.4	116.3	120.2
7	4.524	126.7	131.2	135.7	140.3
8	5.171	144.8	149.9	155.1	160.3
9	5.817	162.9	168.7	174.5	180.4

NOTE.—For part of a month multiply the run-off for 1 day by the number of days.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

EXPLANATION OF DATA.

The data presented in this report cover the year beginning October 1, 1915, and ending September 30, 1916. At the 1st of January, in most parts of the United States much of the precipitation in the preceding three months is stored as ground water, in the form of snow or ice, or in ponds, lakes, and swamps, and this stored water passes off in the streams during the spring break-up. At the end of September, on the other hand, the only stored water available for run-off is possibly a small quantity in the ground; therefore, the run-off for the year beginning October 1 is practically all derived from precipitation within that year.

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

From the discharge measurements rating tables are prepared that give the discharge for any stage. The application of the daily gage heights to these rating tables gives the daily discharge from which the monthly and yearly mean discharge are computed.

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

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

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

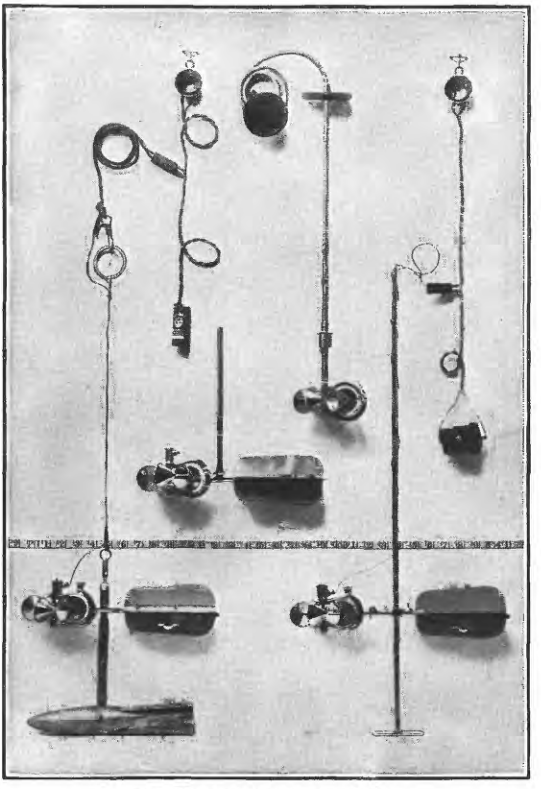
The table of daily discharge gives the discharge in second-feet corresponding to the mean of the gage heights read each day. At stations on streams subject to sudden or rapid diurnal fluctuation the discharge obtained from the rating table and the mean daily gage heights may not be the true mean discharge for the day. If such stations are equipped with water-stage recorders, the mean daily discharge may be obtained by weighting discharge for parts of the day or by use of the discharge integrator, an instrument operating on the principle of the planimeter and containing as an essential element the rating curve of the station.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height, and the corresponding discharge was consequently larger than that given in the column. Likewise, in the column headed "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" gives the average flow in cubic feet for each second during the month. On this average flow computations recorded in the remaining columns, which are defined on page 8, are based.

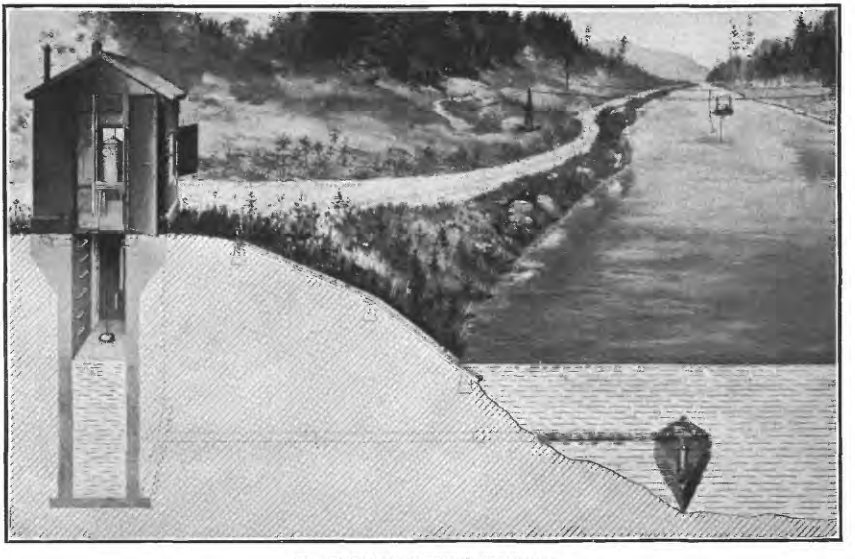
ACCURACY OF FIELD DATA AND COMPUTED RESULTS.

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

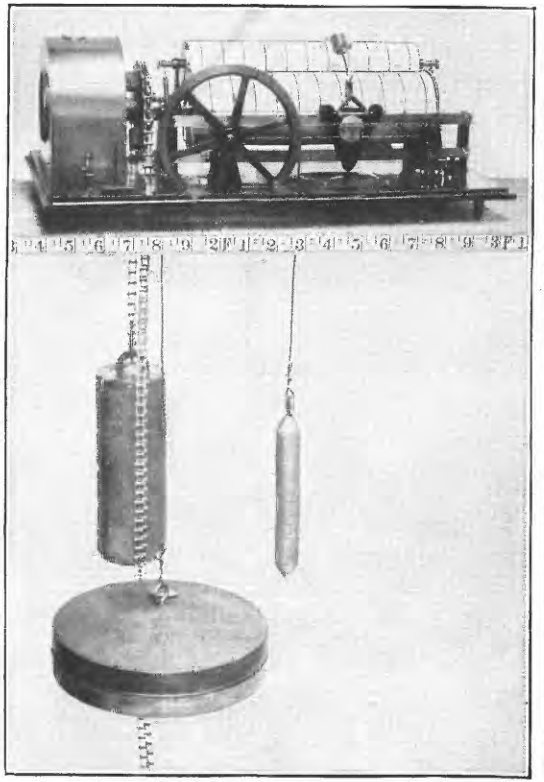
A paragraph in the description of the station or footnotes added to the tables gives information regarding the (1) permanence of the stage-discharge relation, (2) precision with which the discharge rating curve is defined, (3) refinement of gage readings, (4) frequency of



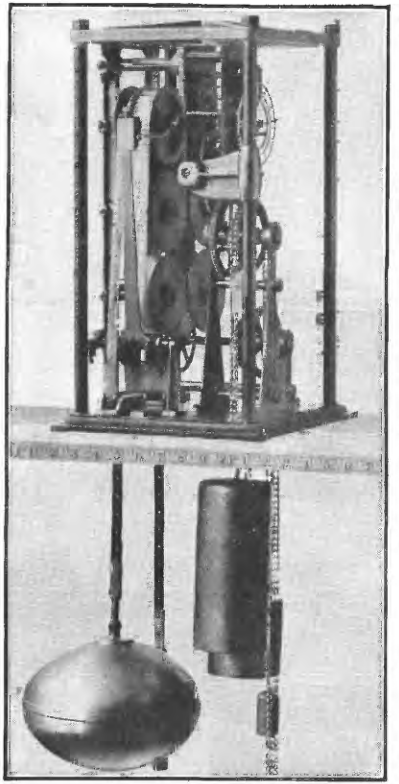
A. PRICE CURRENT METERS.



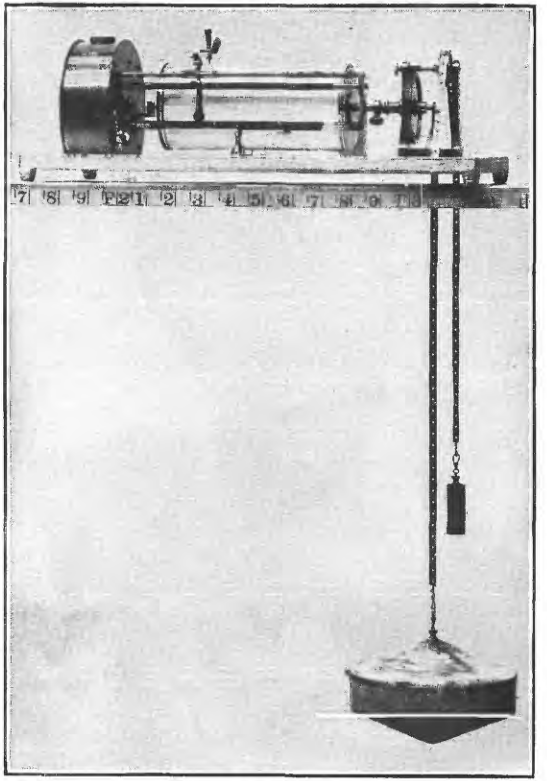
B. TYPICAL GAGING STATION.



A. STEVENS.



B. GURLEY PRINTING.



C. FRIEZ.

WATER-STAGE RECORDERS.

gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.[1]

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

The monthly means for any station may represent with high accuracy the quantity of water flowing past the gage, but the figures showing discharge per square mile and depth of run-off in inches may be subject to gross errors caused by including large noncontributing districts in the measured drainage area, by lack of information concerning water diverted for irrigation or other use, or by inability to interpret the effect of artificial regulation of the flow of the river above the station. "Second-feet per square mile" and "run-off (depth in inches)" are therefore not computed if such errors appear probable, and are also omitted for stations on streams draining areas in which the annual rainfall is less than 20 inches. All figures representing "second-feet per square mile" and "run-off (depth in inches)" previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

The table of monthly discharge gives only a general idea of the flow at the station and should not be used for other than preliminary estimates. The tables of daily discharge allow more detailed studies of the variation in flow. It should be borne in mind, however, that the observations in each succeeding year may be expected to throw new light on records previously published.

COOPERATION.

The work in Washington, Montana, and Idaho was carried on under cooperative agreements between the United States Geological Survey and the respective States.

Cooperation with the States is effected under contracts which are made between the Director of the United States Geological Survey and the State engineers or other officials, and are authorized by legislative acts appropriating moneys.

In Washington the cooperating bureau is the Board of Geological Survey, composed of Ernest Lister, governor; L. F. Hart, lieutenant governor; Edward Meath, treasurer; Henry Suzzalo, president of the University of Washington; and E. O. Holland, president of the State College. The board was efficiently represented in the investigations by Henry Landes, State geologist.

[1] For a more detailed discussion, see Grover, N. C., and Hoyt, J. C., Accuracy of stream-flow data: U. S. Geol. Survey Water-Supply Paper 400, pp. 53-59, 1916.

Acknowledgments are due to A. W. Mahon, State engineer of Montana, and to J. H. Smith, State engineer of Idaho, for the efficient manner in which they represented their States.

Acknowledgment is also due the United States Reclamation Service, the United States Forest Service, and the United States Office of Indian Affairs for assistance, suggestions, and the freest use of data gathered exclusively for them and paid for by them. The United States Weather Bureau furnished hydrographic and climatic records which were very useful in computing the daily discharge for a number of streams.

Credit is also due the British Columbia Hydrometric Survey for complete records of Columbia River at Trail, B. C., and for cooperation in the maintenance of gaging station on Clark Fork at Metaline Falls, Wash.

Acknowledgment is made in the descriptions of gaging stations for gage-height records and discharge measurements furnished by cooperating parties.

DIVISION OF WORK.

Data for stations in Washington and Idaho were collected and prepared for publication under the direction of G. L. Parker, district engineer, assisted by Lasley Lee, C. O. Brown, C. G. Paulsen, J. E. Stewart, and J. T. Hartson.

Data for stations in Montana were collected and prepared for publication under the direction of W. A. Lamb, district engineer, assisted by A. H. Tuttle, Mrs. A. H. Blom, and E. W. Kramer, district engineer for the United States Forest Service.

Data for gaging stations in the Yakima River basin, exclusive of those in the Yakima Indian Reservation, were collected and prepared for publication in cooperation with Paul Taylor, engineer in charge of hydrometric work, United States Reclamation Service, assisted by F. E. Moxley and R. S. Calland.

The manuscript was prepared by Lasley Lee, W. A. Lamb, and A. H. Tuttle, and reviewed by G. C. Stevens and Mrs. B. D. Wood.

GAGING-STATION RECORDS.

QUINAULT RIVER BASIN.

QUINAULT RIVER AT QUINAULT LAKE, WASH.

LOCATION.—In NE. ¼ sec. 8, T. 23 N., R. 9 W., at mouth of Canoe Creek, northeast shore of Quinault Lake, 35 miles north of Hoquiam, in Grays Harbor County.

DRAINAGE AREA.—264 square miles (measured on Plate I, U. S. Geol. Survey Prof. Paper 7).

RECORDS AVAILABLE.—October 29, 1911, to September 30, 1916.

GAGE.—Vertical staff in two sections on right bank of Canoe Creek 400 feet above mouth; read by Mrs. T. T. Murphy. Gage read prior to January 1, 1913, at Ingram Hotel (now Olson Hotel) on south shore of lake, at datum 1.05 feet lower than that of present gage. All gage heights corrected to datum of present gage.

DISCHARGE MEASUREMENTS.—Made from boat or from cable half a mile below outlet of lake and about 4 miles southwest of gage.

CHANNEL AND CONTROL.—Bed composed of boulders. Left bank high and wooded; not subject to overflow; right bank low, wooded, and subject to overflow at about gage height 18 feet. Stage of zero flow, according to measurements made August 18, 1915, gage height —2.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.0 feet at 7.15 p. m. December 8 (discharge, 18,700 second-feet); minimum stage recorded, 0.4 foot at 7 a. m. October 1 (discharge, 395 second-feet).

1911–1916: Maximum stage recorded, 16.3 feet at 8 a. m. January 6, 1914 (discharge, 32,500 second-feet); minimum stage recorded October 1, 1915.

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Gage-height record prior to September unreliable. Gage read to hundredths twice daily. Rating curve well defined below 12,000 second-feet. Daily discharge ascertained by applying mean gage height to rating table. Records excellent for September; good for remainder of year except for periods of considerable change in stage, for which observer's record is doubtful.

Discharge measurements of Quinault River at Quinault Lake, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 10	Tuttle and Murphy	6.93	9,440	Sept. 28	Parker and Locke	0.87	680
Mar. 3	Paulsen and Locke	2.67	2,380	29	G. L. Parker	.82	666

Daily discharge, in second-feet, of Quinault River at Quinault Lake, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	410	8,640	3,160	2,280	1,500	2,520	3,030	3,030	2,280	3,570	2,400	1,210
2	680	6,740	6,560	2,160	2,520	2,400	3,030	3,160	2,280	3,570	2,280	1,210
3	852	4,730	6,560	1,930	2,640	2,400	2,770	3,570	2,520	3,430	2,280	1,120
4	852	4,730	6,740	1,710	2,520	2,160	2,770	3,850	2,640	3,290	2,040	1,100
5	820	4,730	6,740	1,600	2,160	2,160	2,770	3,990	2,640	3,290	2,040	1,080
6	820	2,520	6,560	1,600	2,040	2,040	2,520	3,990	2,520	3,160	2,040	1,060
7	790	1,930	7,100	1,820	2,520	3,030	2,520	4,130	2,520	3,030	2,040	1,040
8	680	1,930	17,700	1,820	3,430	6,740	2,280	4,280	2,400	3,030	2,040	1,040
9	910	1,820	11,600	1,820	3,990	7,840	2,520	4,130	2,520	3,850	2,040	995
10	1,140	1,820	8,440	1,500	7,100	9,260	2,640	3,850	2,770	3,990	2,040	924
11	1,370	1,820	5,870	1,600	8,840	8,040	2,520	3,430	2,770	3,850	2,040	852
12	1,600	1,820	4,890	1,600	6,560	7,840	2,400	3,030	3,290	3,570	2,040	820
13	1,600	1,820	4,280	1,500	5,210	7,100	2,280	2,770	3,850	3,290	2,040	820
14	1,710	1,820	4,130	1,400	6,380	5,700	2,400	2,640	4,130	3,570	2,160	790
15	1,410	1,820	3,570	1,400	10,500	4,430	2,400	2,520	4,430	4,130	2,040	760
16	1,120	1,710	3,290	1,210	10,500	4,130	2,400	2,770	5,370	4,130	1,930	732
17	820	1,600	3,030	1,210	8,840	3,850	2,520	2,770	6,040	4,130	1,820	732
18	820	3,160	3,030	1,210	7,100	3,570	2,640	3,030	5,870	3,990	1,400	705
19	820	3,710	3,030	1,120	6,040	3,570	2,770	3,030	5,530	3,850	1,300	705
20	1,210	4,130	5,370	1,210	5,530	4,730	3,030	2,770	4,730	3,570	1,210	680
21	1,820	3,290	12,000	1,300	5,210	6,740	2,900	2,520	4,430	3,290	1,210	680
22	1,820	3,290	12,700	2,900	4,890	6,740	2,770	2,280	3,570	3,030	1,300	680
23	1,820	3,710	7,840	6,560	4,430	5,870	2,640	2,520	3,570	3,030	1,210	655
24	1,930	4,730	7,840	6,040	3,990	6,040	2,770	2,280	3,850	2,900	1,210	655
25	4,730	3,710	5,530	4,730	3,430	5,310	2,770	2,040	4,130	2,770	1,300	655
26	4,890	3,290	5,210	3,850	3,030	4,580	2,770	2,280	4,130	2,770	1,400	680
27	7,460	3,290	3,430	3,430	2,900	4,430	2,770	2,520	3,990	2,640	1,500	705
28	11,200	3,290	2,900	2,280	2,770	4,130	2,770	2,520	3,990	2,520	1,400	680
29	7,650	3,290	2,160	1,820	2,640	3,850	2,520	2,400	3,850	2,520	1,300	655
30	6,560	3,290	2,280	1,600	.....	3,290	3,030	2,400	3,570	2,520	1,300	632
31	8,640	.....	2,280	1,500	.....	3,030	.....	2,280	.....	2,520	1,210	.....

NOTE.—Discharge interpolated Oct. 9–11, 15–16, Mar. 25, and Sept. 4–6, because comparison with records of precipitation indicates that gage readings were unreliable. Gage not read Sept. 10; discharge interpolated.

Monthly discharge of Quinault River at Quinault Lake, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 264 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	11,200	410	2,550	9.66	11.14	157,000
November	8,640	1,600	3,270	12.4	13.83	195,000
December	17,700	2,160	5,990	22.7	26.17	368,000
January	6,560	1,120	2,180	8.26	9.52	134,000
February	10,500	1,500	4,800	18.2	19.63	276,000
March	9,260	2,040	4,760	18.0	20.75	293,000
April	3,030	2,280	2,660	10.1	11.27	158,000
May	4,280	2,040	2,990	11.3	13.03	184,000
June	6,040	2,280	3,670	13.9	15.51	218,000
July	4,130	2,520	3,320	12.6	14.53	204,000
August	2,400	1,210	1,730	6.55	7.55	106,000
September	1,210	632	835	3.16	3.53	49,700
The year	17,700	410	3,230	12.2	166.46	2,340,000

PUGET SOUND BASINS.

SKOKOMISH RIVER BASIN.

NORTH FORK OF SKOKOMISH RIVER NEAR HOODSPORT, WASH.

LOCATION.—In sec. 5, T. 22 N., R. 4 W., at footbridge on Forest Service trail to South Fork of Skokomish River, 4 miles below Lake Cushman, and 4 miles northwest of Hoodsport, in Mason County.

DRAINAGE AREA.—91 square miles (measured on Plate I, Professional Paper 7, and township plats).

RECORDS AVAILABLE.—August 17, 1910, to September 22, 1911; February 1, 1913, to to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank just below trail bridge; inspected by G. H. Moore. Fragmentary records 1910–11 obtained from vertical staff 25 feet below bridge.

DISCHARGE MEASUREMENTS.—Made from cable about a mile above bridge or by wading.

CHANNEL AND CONTROL.—Channel curved above gage; straight for 200 feet below. Banks high; not subject to overflow. Control composed of rock and gravel; practically permanent. Stage of zero flow determined October 12, 1915, gage height 4.2 feet ±0.3 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 18.26 feet at 2 p. m. December 8 (discharge, 8,000 second-feet); minimum stage recorded, 5.82 feet midnight to 9 a. m. October 1 (discharge, 102 second-feet).

1913–1916: Maximum stage estimated at 23.5 feet January 6, 1914, during part of day when recorder was not operating (discharge, as estimated, 14,000 second-feet); minimum stage recorded, 5.81 feet September 30, 1915 (discharge, 100 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed September 4, 1913, when drift lodged on control. High water of November 24, 1913, removed drift. Rating curve used before and after period when drift was lodged on control well defined. Rating curve used during that period fairly well defined. Daily discharge

ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph or, for days of considerable fluctuation, by averaging results obtained by applying gage heights for shorter intervals. Records excellent except for period when drift was lodged on control and when recorder was not operating satisfactorily. See footnote to tables of daily discharge.

COOPERATION.—Gage-height record and most of discharge measurements furnished by city of Seattle.

Discharge measurements of North Fork of Skokomish River near Hoodsport, Wash., during the years ending Sept. 30, 1913–1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1913.		*Feet.*	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 3	G. H. Moore	7.86	560	June 25	Moore and Shinkle	9.01	1,010
7	do	7.46	452	26	do	8.51	796
14	do	7.26	445	July 28	do	6.86	308
20	do	8.73	902	30	do	6.79	301
22	do	8.19	692	Sept. 2	do	6.12	159
Mar. 11	Moore and Howes	7.97	572	3	do	6.10	153
Aug. 28	G. H. Moore	6.65	288				
1913–14.				1914–15.			
Nov. 4	Parker and Moore	7.01	315	Nov. 24	do	9.69	1,280
5	do	8.76	767	June 18	Parker and Moore	7.50	452
20	G. H. Moore	9.09	918	19	G. L. Parker	7.42	458
24	do	17.65	7,540	1915–16.			
25	do	14.90	4,650	Oct. 12	C. G. Paulsen	5.85	106
Jan. 5	do	17.85	7,300	12	do	5.85	106
10	do	11.16	2,000	Sept. 1	G. L. Parker	7.06	342
16	do	10.54	1,640	2	do	7.10	351
June 5	Moore and Shinkle	8.42	841				

Daily discharge, in second-feet, of North Fork of Skokomish River near Hoodsport, Wash., for the years ending Sept. 30, 1913–1916.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913.								
1	646	434	551	551	1,490	1,400	614	235
2	614	448	491	536	1,790	1,100	614	248
3	582	448	491	521	1,790	946	598	908
4	551	434	521	521	1,690	927	598	3,190
5	521	448	713	521	1,440	1,020	551	1,900
6	492	476	730	551	1,260	1,020	506	1,140
7	462	506	646	679	1,220	1,100	491	784
8	434	582	582	854	1,220	984	476	632
9	420	614	551	965	1,180	946	462	590
10	406	630	551	1,310	1,100	1,020	434	548
11	379	630	630	1,490	1,060	946	420	495
12	379	598	764	1,400	1,100	872	406	444
13	379	566	800	1,180	1,220	836	392	418
14	434	521	764	1,020	1,060	782	366	394
15	679	491	747	1,020	984	730	340	370
16	1,400	476	713	984	965	696	327	358
17	1,790	696	679	890	908	713	340	346
18	1,360	890	747	836	890	764	340	335
19	1,060	782	927	854	1,060	854	322	324
20	908	662	984	890	1,140	946	304	312
21	782	598	1,020	908	1,180	984	292	312
22	696	536	965	964	1,400	1,020	292	301
23	646	491	818	1,100	1,260	984	302	290
24	598	462	747	1,220	1,140	946	292	280
25	551	434	696	1,220	1,100	890	280	269
26	521	406	713	1,220	1,060	800	268	259
27	491	434	713	1,590	984	713	257	259
28	462	448	679	1,490	984	679	253	301
29	.....	551	614	1,260	1,020	646	251	312
30	.....	646	582	1,180	1,310	582	248	280
31	.....	598	.....	1,260	.....	584	244	.....

Daily discharge, in second-feet, of North Fork of Skokomish River near Hoodsport, Wash; for the years ending Sept. 30, 1913–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914.												
1	269	335	1,790	1,060	927	2,250	646	764	1,020	782	285	155
2	249	312	1,400	1,140	818	1,890	696	984	1,140	800	283	150
3	241	290	1,180	1,740	713	1,400	1,060	1,100	1,060	818	283	146
4	236	353	1,060	7,840	662	1,180	1,720	984	908	782	283	144
5	228	754	984	8,920	625	965	2,490	854	764	679	271	143
6	226	1,060	984	12,000	588	836	1,690	800	679	598	266	143
7	225	940	984	7,020	550	800	1,310	836	646	582	264	159
8	225	922	927	3,940	513	836	1,140	946	782	582	251	168
9	217	1,140	836	2,490	476	854	1,100	946	800	566	242	164
10	232	1,280	782	2,010	462	800	1,220	946	713	566	231	153
11	418	922	872	1,890	507	764	1,220	927	662	566	226	146
12	1,240	721	1,140	1,740	553	782	1,140	908	713	582	224	146
13	2,370	604	1,060	1,740	598	836	1,310	984	764	566	224	143
14	1,620	548	1,220	1,590	593	1,110	1,790	1,180	800	582	222	136
15	1,100	534	1,310	1,590	585	1,310	2,250	1,180	927	506	222	153
16	752	2,310	1,140	1,640	579	1,100	1,790	1,100	1,060	476	218	208
17	632	1,760	1,060	1,400	572	1,100	1,360	984	1,060	476	212	307
18	548	1,140	927	1,360	566	1,060	1,180	965	965	491	198	964
19	521	980	818	1,310	552	1,060	1,220	927	872	491	188	2,680
20	482	904	747	1,180	536	1,140	1,220	946	764	462	184	2,180
21	444	784	696	1,100	858	1,140	1,060	1,060	696	420	186	1,100
22	418	768	679	1,140	1,180	1,100	965	1,140	646	379	184	713
23	382	1,390	630	1,020	1,180	1,020	890	1,180	598	366	180	566
24	370	6,840	598	908	1,040	908	836,	1,180	713	366	177	462
25	358	4,930	598	890	908	818	782	1,060	946	353	175	406
26	335	3,540	582	1,180	984	747	764	984	800	340	169	406
27	324	4,130	646	1,060	1,060	696	800	1,020	713	322	168	462
28	301	2,720	730	872	1,180	713	730	908	662	304	168	448
29	290	3,110	662	1,020	.....	696	679	782	679	297	166	406
30	280	2,550	646	1,060	.....	730	662	747	730	290	162	366
31	301	.....	984	984	.....	713	.....	854	.....	285	159	.....
1915.												
1	366	3,150	1,140	1,410	927	764	3,190	566	747	366	206	160
2	406	3,930	1,060	1,590	1,060	679	4,920	536	696	379	200	178
3	406	3,530	1,020	1,890	872	630	3,390	551	662	379	196	168
4	379	2,370	965	1,540	747	614	2,250	566	646	366	188	157
5	353	2,070	872	1,140	818	598	1,690	598	679	353	180	148
6	324	1,790	782	984	1,180	582	1,400	646	747	332	177	143
7	302	1,490	713	984	1,220	566	1,590	730	747	314	169	140
8	290	1,310	713	1,220	1,060	551	1,540	747	662	314	169	141
9	278	1,310	679	1,140	965	521	1,260	747	582	314	177	141
10	379	1,140	630	1,060	908	506	1,140	984	566	295	169	140
11	462	1,060	598	1,310	818	476	1,060	1,060	506	280	171	133
12	764	1,020	551	1,220	730	462	1,100	1,020	506	255	171	132
13	1,490	1,490	521	1,060	696	491	1,220	872	506	253	169	128
14	1,060	1,400	476	1,060	646	1,450	1,100	782	506	290	168	125
15	747	1,140	462	890	582	3,140	984	696	491	285	168	124
16	1,790	984	448	764	566	1,890	984	630	491	292	166	122
17	3,930	872	434	662	800	1,400	1,100	630	491	307	164	120
18	4,830	818	406	614	946	1,490	1,140	679	476	285	162	119
19	5,190	800	392	598	800	1,220	1,100	696	448	266	160	117
20	3,250	1,060	379	598	696	1,060	1,060	662	434	255	159	117
21	2,250	1,100	353	566	630	1,060	927	646	406	248	160	116
22	1,640	965	340	551	614	1,180	818	662	406	246	160	112
23	1,310	1,060	337	521	630	1,310	747	662	406	237	159	110
24	1,100	1,220	330	491	859	1,180	730	713	420	229	155	110
25	965	1,100	335	462	1,260	1,020	696	1,230	406	224	151	110
26	890	1,060	379	434	1,020	890	679	1,310	392	222	148	110
27	800	1,220	392	420	872	800	679	1,260	366	218	143	108
28	730	1,790	406	406	836	764	662	1,310	353	218	138	105
29	679	1,490	420	392	.....	872	679	1,100	353	220	140	102
30	872	1,220	434	392	.....	1,260	630	890	353	214	141	100
31	1,060	.....	566	506	.....	1,220	.....	800	.....	208	143	.....

Daily discharge, in second-feet, of North Fork of Skokomish River near Hoodsport, Wash., for the years ending Sept. 30, 1913–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1916.												
1	105	1,590	730	679	434	872	946	984	800	1,440	747	353
2	153	1,060	924	630	448	836	984	1,180	800	1,400	696	366
3	218	908	1,960	582	420	782	1,060	1,490	946	1,310	646	340
4	184	764	2,490	551	379	696	1,100	1,540	1,180	1,220	598	332
5	155	679	2,070	521	379	662	1,060	1,400	1,140	1,140	598	312
6	138	598	1,890	506	379	646	984	1,440	984	1,060	614	295
7	127	536	1,850	521	448	850	946	1,490	965	1,020	598	280
8	112	506	6,200	491	662	1,890	984	1,490	1,100	1,100	614	273
9	111	476	3,940	476	756	2,130	1,020	1,310	1,180	1,220	614	271
10	108	434	2,130	434	1,860	2,070	1,060	1,100	1,100	1,140	582	255
11	105	420	1,690	406	2,130	2,010	1,020	965	965	1,140	598	240
12	108	392	1,540	379	1,400	2,070	927	872	984	1,220	598	235
13	140	366	1,400	366	1,100	1,840	854	818	1,140	1,180	614	233
14	204	366	1,200	353	1,550	1,440	890	800	1,540	965	582	222
15	190	406	1,020	340	3,110	1,220	984	854	1,890	984	566	220
16	164	448	927	324	2,900	1,140	927	984	2,010	1,540	536	214
17	162	713	836	314	2,310	1,060	927	1,140	2,250	1,400	491	210
18	140	984	782	307	1,840	984	1,060	1,180	2,250	1,140	448	208
19	143	1,360	854	300	1,740	984	1,020	1,140	1,790	1,020	406	208
20	144	1,020	1,360	304	1,690	1,910	946	1,100	1,400	1,020	392	206
21	183	946	2,620	312	1,640	2,430	890	1,020	1,140	984	379	202
22	448	1,180	2,970	558	1,590	1,950	836	927	1,100	946	392	200
23	448	1,590	1,790	1,550	1,440	1,540	764	854	1,180	946	420	198
24	521	1,310	1,360	1,440	1,220	1,260	747	800	1,310	908	448	194
25	1,000	1,220	1,310	965	1,100	1,140	782	800	1,400	872	448	184
26	984	1,220	1,100	747	1,060	1,310	800	965	1,590	800	434	182
27	1,260	984	984	614	1,020	1,400	908	1,060	1,400	764	420	188
28	1,740	836	1,060	551	984	1,220	1,060	1,100	1,220	730	420	182
29	1,140	872	946	491	927	1,060	1,020	1,020	1,140	696	392	175
30	818	836	836	462	.....	946	946	927	1,180	713	379	168
31	1,810	.....	747	434	.....	890	.....	854	.....	782	366	.....

NOTE.—No gage heights available Feb. 2, 6, 9, Oct. 6, 1913, Feb. 5–8, 11, 12, 14–17, 19, 24, 26, 1914; discharge interpolated. Gage heights for Feb. 16–19, Oct. 11–15, 1913, Jan. 29–31, Feb. 9, 10, 13, 18, 20, 22, 23, 1914, and June 14–19, 1915, estimated from gage height chart when recorder was not operating satisfactorily; considered fairly reliable.

Monthly discharge of North Fork of Skokomish River near Hoodsport, Wash., for the years ending Sept. 30, 1913–1916.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1913.						
February	1,790	379	666	7.32	7.62	37,000
March	890	406	546	6.00	6.92	33,600
April	1,020	491	704	7.74	8.64	41,900
May	1,590	521	1,000	11.0	12.68	61,500
June	1,790	890	1,200	13.2	14.73	71,400
July	1,400	582	885	9.73	11.22	54,400
August	614	244	383	4.21	4.85	23,600
September	3,190	235	561	6.16	6.87	33,400
The period	.....	.....	.....	.....	.....	357,000
1913–14.						
October	2,370	217	511	5.62	6.48	31,400
November	6,840	290	1,620	17.8	19.86	96,400
December	1,790	582	925	10.2	11.76	56,900
January	12,000	872	2,410	26.5	30.55	148,000
February	1,180	462	727	7.99	8.32	40,400
March	2,250	696	1,010	11.1	12.80	62,100
April	2,490	646	1,190	13.1	14.62	70,800
May	1,180	747	973	10.7	12.34	59,800
June	1,140	598	809	8.89	9.92	48,100
July	818	285	506	5.56	6.41	31,100
August	285	159	215	2.36	2.72	13,200
September	2,680	136	464	5.10	5.69	27,600
The year	12,000	136	948	10.4	141.47	686,000

Monthly discharge of North Fork of Skokomish River near Hoodsport, Wash., for the years ending Sept. 30, 1913–1916—Continued.

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1914–15.						
October	5,190	278	1,270	14.0	16.14	78,100
November	3,930	800	1,500	16.5	18.41	89,300
December	1,140	330	566	6.22	7.17	34,800
January	1,890	392	867	9.53	10.99	53,300
February	1,260	566	848	9.32	9.70	47,100
March	3,140	462	989	10.9	12.57	60,800
April	4,920	630	1,350	14.8	16.51	80,300
May	1,310	536	806	8.86	10.22	49,600
June	747	353	515	5.66	6.32	30,600
July	379	208	279	3.07	3.54	17,200
August	206	138	165	1.81	2.09	10,100
September	178	100	128	1.41	1.57	7,620
The year	5,190	100	771	8.47	115.23	559,000
1915–16.						
October	1,810	105	428	4.70	5.42	26,300
November	1,590	366	834	9.16	10.22	49,600
December	6,200	730	1,660	18.2	20.98	102,000
January	1,550	300	545	5.99	6.91	33,500
February	3,110	379	1,270	14.0	15.10	73,000
March	2,430	646	1,330	14.6	16.83	81,800
April	1,100	747	948	10.4	11.60	56,400
May	1,540	800	1,080	11.9	13.72	66,400
June	2,250	800	1,300	14.3	15.95	77,400
July	1,540	696	1,060	11.6	13.37	65,200
August	747	366	517	5.68	6.55	31,800
September	366	168	238	2.62	2.92	14,200
The year	6,200	105	934	10.3	139.57	678,000

PUYALLUP RIVER BASIN.

PUYALLUP RIVER NEAR ELECTRON, WASH.

LOCATION.—In NE. ¼ NW. ¼ sec. 3, T. 16 N., R. 6 E., 1,000 feet above intake of Puget Sound Traction, Light & Power Co.'s flume, a quarter of a mile below Mowich River, and 10 miles southeast of Electron, in Pierce County.

DRAINAGE AREA.—91 square miles (measured on Plate IV, Water-Supply Paper 313).

RECORDS AVAILABLE.—January 1, 1909, to September 30, 1916.

GAGE.—Friez water-stage recorder on downstream side of left abutment of gaging bridge; inspected by H. A. Waite.

DISCHARGE MEASUREMENTS.—Made from gaging bridge at gage.

CHANNEL AND CONTROL.—Bed composed of boulders and glacial débris; shifting at all stages, owing to steep gradient.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.4 feet at 5 p. m. December 21 (discharge, 2,900 second-feet); minimum stage recorded, 0.41 foot at noon January 11 (discharge, 154 second-feet).

1909–1916: Maximum stage recorded, 4.6 feet November 10, 1910 (discharge, 3,200 second-feet); minimum discharge (estimated), 112 second-feet December 24, 1914 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation slightly affected by ice; flow estimated from observer's notes and weather records.

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed frequently; affected by ice January 12–23 and 28–30. Seven rating curves, well defined by frequent measurements and parallel to standard curve developed in 1915, were used as follows: October 1 to November 19, November 20 to December 21, December 22 to March 9, March 10 to May 21, May 22 to June 17, June 18 to July 21, and September 25–30. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph or, for days of considerable fluctuation, by applying gage height for shorter intervals; shifting-control method used July 22 to September 24. Discharge January 12–23 and 28–30 estimated from three-current-meter measurements, observer's notes, and weather records. Open-water records good; other records fair.

COOPERATION.—Puget Sound Traction, Light & Power Co. furnished gage-height record and made discharge measurements.

Discharge measurements of Puyallup River near Electron, Wash., during the year ending Sept. 30, 1916.

[Made by Barber and Waite.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Oct. 6	1.19	321	Jan. 24	1.08	395	June 10	1.48	544
24	1.21	331	Feb. 7	1.45	599	24	2.03	862
Nov. 11	.99	253	25	1.23	469	July 8	2.31	1,080
29	1.67	625	Mar. 13	2.16	1,000	21	1.89	769
Dec. 11	1.56	558	23	1.58	571	Aug. 6	1.48	593
30	.96	329	Apr. 4	1.29	410	29	2.11	990
Jan. 5	.70	233	22	1.15	340	Sept. 6	1.10	354
13	.54	190	May 6	1.98	853	25	.91	291
18	1.25	174	22	1.38	480			

Daily discharge, in second-feet, of Puyallup River near Electron, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	473	593	457	286	236	340	434	456	499	938	761	721
2	983	545	462	270	621	318	418	551	487	1,850	663	682
3	976	419	641	262	388	318	398	729	534	1,840	651	680
4	462	378	701	248	305	289	418	743	675	1,330	627	608
5	378	378	848	234	266	278	398	750	596	1,080	606	403
6	340	331	669	225	314	262	383	876	534	976	611	368
7	327	300	724	219	573	298	378	688	552	914	666	401
8	318	285	1,040	213	576	1,180	398	564	648	1,120	802	406
9	281	273	918	210	678	2,410	413	490	669	1,060	821	358
10	251	258	648	198	1,250	2,040	570	440	565	962	743	346
11	235	255	532	175	904	1,490	520	408	534	1,160	838	333
12	262	238	462	185	648	1,360	445	388	602	1,160	889	365
13	411	225	424	185	576	1,080	413	363	781	1,030	824	362
14	477	228	373	180	764	822	456	349	1,020	779	786	356
15	345	351	358	178	1,210	688	450	359	1,300	1,020	698	372
16	322	345	349	175	1,290	615	413	388	1,470	1,290	583	372
17	296	800	331	175	1,120	557	403	434	1,680	1,330	449	385
18	331	785	305	175	938	490	398	502	1,620	930	404	376
19	318	1,550	322	173	907	564	368	589	1,370	808	358	383
20	314	914	375	180	845	938	373	508	1,000	801	328	419
21	327	1,240	1,700	196	779	852	368	478	744	787	358	458
22	292	1,120	1,520	248	695	750	354	465	709	814	472	380
23	415	1,160	881	734	616	602	330	432	816	771	624	318
24	369	781	648	430	539	514	373	427	891	721	827	306
25	1,320	1,000	583	309	480	762	398	421	1,080	612	875	292
26	970	730	468	270	451	923	450	459	1,330	574	724	460
27	702	545	414	242	414	715	743	482	1,160	614	780	412
28	583	551	398	231	383	564	628	517	995	549	969	362
29	457	662	354	222	364	478	520	493	808	543	990	381
30	409	520	327	216	.....	429	467	465	801	674	908	325
31	799	.....	301	216	.....	418	.....	454	.....	792	843	.....

Monthly discharge of Puyallup River near Electron, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 91 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	1,320	235	476	5.23	6.03	29,300
November	1,550	225	592	6.51	7.26	35,200
December	1,700	301	598	6.57	7.57	36,800
January	734	173	241	2.65	3.06	14,800
February	1,290	236	660	7.25	7.82	38,000
March	2,410	262	753	8.27	9.53	46,300
April	743	330	436	4.79	5.34	25,900
May	876	349	505	5.55	6.40	31,100
June	1,680	487	882	9.69	10.81	52,500
July	1,850	543	962	10.6	12.22	59,200
August	990	328	693	7.62	8.78	42,600
September	721	292	413	4.54	5.06	24,600
The year	2,410	173	601	6.60	89.88	436,000

PUYALLUP RIVER AT ALDERTON, WASH.

LOCATION.—On township line between sec. 25, R. 4 E., and sec. 30, R. 5 E., T. 20 N., at county bridge No. 78, 1 mile north of Alderton, in Pierce County, and 1½ miles above Stuck River.

DRAINAGE AREA.—410 square miles (measured on drainage map published in Water-Supply Paper 313).

RECORDS AVAILABLE.—November 20, 1914, to September 30, 1916.

GAGE.—Vertical staff on downstream side of bridge pier on right bank; read by E. W. MacMorran and C. E. Barney.

DISCHARGE MEASUREMENTS.—Made from bridge at gage.

CHANNEL AND CONTROL.—Bed composed of silt and gravel; shifting. Right bank is overflowed at gage height about 8 feet; left bank high and not subject to overflow.

EXTREMES OF DISCHARGE.—1914–1916: Maximum stage recorded, 8.6 feet December 22, 1915 (discharge, 12,800 second-feet); minimum stage recorded, 1.90 feet December 22 and 24, 1914, September 29–30 and October 12, 1915 (discharge, 390 second-feet).

ICE.—Stage-discharge relation slightly affected by ice for a few days during severe winters.

DIVERSIONS.—None.

REGULATION.—The operation of the Puget Sound Traction, Light & Power Co.'s plant at Electron does not materially affect the natural flow, as the pondage utilized is small.

ACCURACY.—Stage-discharge relation changed at high water November 19 and March 10; slightly affected by ice January 17–19. Rating curve prior to November 19 well defined between 600 and 5,000 second-feet; November 19 to March 9, well defined between 1,800 and 9,000 second-feet; after March 9, well defined below 9,000 second-feet. Gage read to hundredths once daily but oftener during high water. Daily discharge ascertained by applying mean gage height to rating table. Records excellent except for periods of low water in January and extremely low water in October, for which rating curves were only fairly well defined.

COOPERATION.—Inter-County River Improvement Commission of King and Pierce counties furnished gage-height record and made some discharge measurements.

Discharge measurements of Puyallup River near Alderton, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 4	O. G. Murray	3.86	2,910	June 6	J. T. Hartson	2.90	1,670
Feb. 16	do	5.15	5,080	July 5	O. G. Murray	4.30	3,580
Mar. 10	Hartson and Murray	6.60	8,170	Aug. 4	J. T. Hartson	2.67	1,440
May 3	O. G. Murray	3.38	2,260				

Daily discharge, in second-feet, of Puyallup River at Alderton, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	610	1,440	2,410	1,380	760	1,270	1,790	1,790	1,680	2,030	1,570	1,460
2	2,340	1,440	2,130	1,380	3,610	1,270	1,790	1,790	1,680	5,990	1,570	1,460
3	3,990	1,320	2,000	1,270	2,690	1,380	1,680	2,030	1,570	6,820	1,360	1,260
4	1,620	1,040	2,990	1,050	2,000	1,270	1,570	2,290	1,790	4,640	1,460	1,360
5	780	930	2,550	950	1,440	1,160	1,570	2,160	1,910	3,610	1,360	1,160
6	570	780	2,990	950	1,500	1,270	1,570	2,290	1,680	2,840	1,260	890
7	650	735	2,550	950	2,550	1,160	1,460	2,420	1,570	2,420	1,360	850
8	650	690	2,990	850	4,110	4,280	1,460	2,030	1,680	2,700	1,360	850
9	570	610	4,280	850	4,110	8,820	1,460	1,910	1,910	2,840	1,460	890
10	495	610	3,140	850	5,590	9,050	1,680	1,910	1,680	2,420	1,360	850
11	460	610	2,550	850	5,590	5,990	1,790	1,790	1,460	2,420	1,460	810
12	390	610	2,130	805	3,940	4,820	1,680	1,680	1,570	2,700	1,570	773
13	530	610	2,130	670	3,140	4,640	1,460	1,460	1,790	2,420	1,680	810
14	1,380	530	1,740	670	2,990	3,290	1,460	1,360	2,160	2,030	1,680	810
15	780	530	1,620	670	3,770	2,560	1,680	1,360	2,700	1,790	1,460	773
16	650	1,440	1,380	715	5,010	2,560	1,460	1,360	3,140	2,560	1,460	810
17	610	1,200	1,620	684	4,820	2,290	1,570	1,360	3,450	3,290	1,160	810
18	610	3,050	1,500	652	3,770	2,030	1,460	1,460	3,610	2,560	975	810
19	880	9,050	1,620	621	3,290	1,790	1,360	1,790	3,450	2,030	890	810
20	570	4,460	1,740	590	2,990	2,990	1,360	1,790	2,420	1,910	850	810
21	610	4,460	7,910	670	2,840	2,990	1,460	1,680	2,030	1,910	850	850
22	690	3,770	11,400	670	2,550	3,140	1,460	1,680	1,680	1,910	850	890
23	880	4,820	5,010	2,130	2,270	2,560	1,360	1,680	1,790	1,910	1,020	736
24	1,040	3,770	3,610	1,870	1,870	2,160	1,360	1,460	2,030	1,910	1,260	702
25	2,340	3,770	3,610	1,160	1,740	2,160	1,460	1,360	2,160	1,680	1,570	668
26	2,610	4,280	2,990	950	1,620	3,770	1,460	1,360	2,840	1,460	1,360	636
27	2,750	3,140	2,410	850	1,500	4,460	2,840	1,460	2,990	1,460	1,360	810
28	1,690	2,690	2,270	760	1,500	3,290	2,700	1,460	2,840	1,570	1,570	736
29	1,440	3,290	2,270	670	1,380	2,560	2,290	1,570	2,290	1,360	1,680	736
30	1,200	2,840	1,620	670	.....	2,160	2,030	1,460	1,910	1,460	1,570	702
31	1,320	.....	1,500	670	.....	1,790	.....	1,460	.....	1,680	1,570	.....

NOTE.—Discharge interpolated Jan. 17–19, on account of ice.

Monthly discharge of Puyallup River at Alderton, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 410 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	3,990	390	1,150	2.80	3.23	70,700
November	9,050	530	2,280	5.56	6.20	136,000
December	11,400	1,380	2,920	7.12	8.21	180,000
January	2,130	590	919	2.24	2.58	56,500
February	5,590	760	2,930	7.15	7.71	169,000
March	9,050	1,160	3,060	7.46	8.60	188,000
April	2,840	1,360	1,660	4.05	4.52	98,800
May	2,420	1,360	1,700	4.15	4.78	105,000
June	3,610	1,460	2,180	5.32	5.94	130,000
July	6,820	1,360	2,530	6.17	7.11	156,000
August	1,680	850	1,350	3.29	3.79	83,000
September	1,460	636	884	2.16	2.41	52,600
The year	11,400	390	1,960	4.78	65.08	1,430,000

PUYALLUP RIVER AT PUYALLUP, WASH.

LOCATION.—In sec. 21, T. 20 N., R. 4 E., 1,000 feet upstream from Puget Sound Electric Co.'s railway bridge 1 mile north of Puyallup, in Pierce County, 2 miles below mouth of Stuck River.

DRAINAGE AREA.—914 square miles (measured on drainage map published in Water-Supply Paper 313).

RECORDS AVAILABLE.—May 1, 1914, to September 30, 1916.

GAGE.—Stevens water-stage recorder on right bank; inspected by engineers of Inter-County River Improvement Commission and United States Geological Survey.

DISCHARGE MEASUREMENTS.—Made from cable 1,200 feet below gage.

CHANNEL AND CONTROL.—Stream bed at gage and cable composed of light alluvial silt; shifting at all stages. Control formed by section of stream bed extending some distance downstream.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 31.84 feet at 3 a. m. December 22 (discharge, 22,300 second-feet); minimum stage occurred in January, when float was frozen in well.

1914–1916: Maximum stage, December 22, 1915; minimum stage, from recorder, 20.90 feet at 5 a. m. December 21, 1914 (discharge, 1,040 second-feet).

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

DIVERSIONS.—Two hydroelectric plants owned by the Puget Sound Traction, Light & Power Co., divert water above station. Water for the Electron plant is diverted from Puyallup River 10 miles above Electron into an equalizing basin having a capacity of 185 acre-feet; water used at this plant is returned directly to the river. Water for the Dieringer plant is diverted from White River near Buckley into Lake Tapps (capacity 51,000 acre-feet), and after use is discharged into Stuck River.

REGULATION.—See Diversions.

ACCURACY.—Stage-discharge relation changed continually after March 1, owing to channel-improvement work. Current-meter measurements made frequently. Rating curve used for period February 16 to December 31, 1915, well defined between 1,000 and 20,000 second-feet; and this curve and six curves parallel to it were used during rest of year. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used March 18 to April 5. Records for periods prior to March 1, good; those for periods after that date only fair, owing to numerous changes in stage-discharge relation.

COOPERATION.—Inter-County River Improvement Commission of King and Pierce counties furnished gage-height record and made some discharge measurements

Discharge measurements of Puyallup River at Puyallup, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 4	O. G. Murray	22.67	2,110	Apr. 6	Murray and Roberts	24.32	3,440
Nov. 2	J. T. Hartson	22.90	2,390	18	J. T. Hartson	24.47	3,890
18	do	24.52	4,840	May 2	O. G. Murray	25.04	4,550
19	Murray and Hunter	28.96	14,500	15	J. T. Hartson	24.04	3,320
20	Parker and Murray	25.96	7,350	June 6	O. G. Murray	24.94	4,490
Dec. 6	O. G. Murray	24.47	4,450	July 6	do	25.74	6,930
9	Parker and Murray	25.83	7,110	18	J. T. Hartson	25.24	5,780
22	J. T. Hartson	30.16	18,300	Aug. 9	O. G. Murray	23.96	3,430
22	do	29.62	16,600	22	J. T. Hartson	22.52	2,090
Jan. 14	C. G. Paulsen	22.16	1,560	Sept. 11	do	22.01	1,810
Feb. 18	J. T. Hartson	26.59	8,370	24	Brown and Mayer	21.36	1,450
Mar. 3	O. G. Murray	23.73	3,000	27	C. O. Brown	21.72	1,820
17	J. T. Hartson	24.97	5,950				

Daily discharge, in second-feet, of Puyallup River at Puyallup, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,250	3,910	3,520	2,500	1,600	3,100	4,670	4,320	4,240	5,780	3,310	3,100
2	3,800	2,340	3,170	2,240	3,910	2,910	4,500	4,580	4,070	10,500	3,100	3,240
3	5,300	2,100	3,040	2,290	3,520	2,980	4,240	5,580	4,160	15,700	2,980	2,670
4	2,150	1,830	4,240	2,190	3,040	2,730	3,830	6,160	4,850	10,700	3,240	3,040
5	1,710	1,750	4,240	2,050	2,730	2,450	3,680	6,160	3,240	8,450	3,040	2,400
6	1,520	1,710	4,410	2,000	2,620	2,670	3,380	7,160	4,410	6,860	2,790	2,100
7	1,380	1,520	4,410	1,960	4,320	2,790	3,310	6,360	4,320	6,160	2,980	2,000
8	1,280	1,520	5,680	1,960	5,870	6,160	3,380	5,780	4,760	6,560	3,170	2,190
9	1,280	1,480	7,060	1,830	5,960	14,100	3,380	5,400	5,120	6,360	3,310	2,140
10	1,190	1,480	5,300	1,830	7,900	16,500	4,160	5,120	4,760	5,580	3,100	1,830
11	1,190	1,410	4,410	1,630	7,570	13,900	4,500	4,500	3,990	5,680	3,100	1,920
12	1,190	1,440	3,600	1,550	5,300	11,800	4,070	3,990	4,070	6,160	3,310	1,870
13	1,280	1,410	3,310	1,440	4,240	10,700	3,680	3,680	4,670	5,960	3,570	1,870
14	1,790	1,250	2,980	.....	4,500	8,450	3,750	3,380	5,680	5,120	3,380	1,670
15	1,520	1,440	2,620	.....	6,460	6,460	4,070	3,310	6,860	5,580	3,380	1,670
16	1,340	2,100	2,560	.....	8,780	5,960	3,600	3,450	8,010	6,460	3,100	1,670
17	1,220	2,620	2,980	.....	8,450	5,960	3,600	3,680	8,780	7,160	2,670	1,380
18	1,280	5,210	2,670	.....	7,160	5,400	3,520	3,990	10,500	5,580	2,400	1,590
19	1,440	11,800	2,730	.....	6,660	4,670	3,310	4,500	9,620	5,030	2,190	1,630
20	1,340	7,900	3,100	.....	6,060	5,870	3,310	4,320	7,570	4,940	1,750	1,670
21	1,280	6,460	7,900	2,190	5,780	6,860	3,310	4,160	6,060	4,940	1,920	1,670
22	1,280	6,660	17,800	2,240	5,400	6,760	3,310	4,580	5,120	4,850	1,960	1,670
23	1,380	8,120	9,740	2,980	4,940	5,680	2,910	4,160	5,300	4,580	2,000	1,520
24	1,440	6,460	6,860	2,790	4,500	5,120	3,040	3,680	5,680	4,580	2,620	1,380
25	3,170	6,660	7,060	2,190	3,910	5,780	3,170	3,520	5,870	4,240	2,620	1,550
26	.....	6,460	3,990	1,870	3,830	8,230	3,380	3,680	6,960	3,680	2,340	1,670
27	.....	4,760	4,760	1,590	3,450	7,570	5,680	4,160	7,260	3,910	2,050	1,790
28	.....	4,240	4,410	1,480	3,450	6,160	6,060	4,320	6,860	3,600	2,980	1,630
29	.....	4,760	3,750	1,480	3,240	5,300	5,300	4,240	6,060	3,170	4,410	1,710
30	.....	4,070	3,240	1,480	.....	4,670	4,410	3,990	5,580	3,040	3,830	1,710
31	.....	.....	3,170	1,500	.....	4,500	.....	3,750	.....	3,520	3,240	.....

NOTE.—Gage-height graph for only parts of days Oct. 1, 4; discharge determined by applying estimated gage heights to rating table. Clock stopped Oct. 2–3, 26–31; float frozen in well Jan. 14–20 and Jan. 30 to Feb. 1; discharge estimated by hydrographic comparison with record of total discharge of Puyallup River at Alderton and White River and flume at Buckley as follows: Oct. 26–31, 3,200 second-feet; Jan. 14–20, 1,250 second-feet; Oct. 2, 3, Jan. 30, 31, and Feb. 1, as in table. Curves parallel to the well-defined curve that was used Feb. 16 to Dec. 31, 1915, were applied for short periods as follows: Jan. 1 to Feb. 24, Feb. 25 to Mar. 8, Mar. 9–17, Apr. 6 to May 5, May 6 to June 4, June 5–17, June 18 to July 9, July 10 to Aug. 12, Aug. 13–28, Aug. 29 to Sept. 24, and Sept. 25–30. Shifting-control method used Mar. 18 to Apr. 5.

Monthly discharge of Puyallup River at Puyallup, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	.....	1,190	2,040	125,000
November	11,800	1,250	3,830	228,000
December	17,800	2,560	4,800	295,000
January	2,980	.....	1,810	111,000
February	8,780	1,600	5,010	288,000
March	16,500	2,450	6,520	401,000
April	6,060	2,910	3,880	231,000
May	7,160	3,310	4,510	277,000
June	10,500	3,240	5,810	346,000
July	15,700	3,040	5,950	366,000
August	4,410	1,750	2,900	178,000
September	3,240	1,380	1,930	115,000
The year	17,800	.....	4,080	2,960,000

WHITE RIVER AT BUCKLEY, WASH.

LOCATION.—In SE. ¼ sec. 34, T. 20 N., R. 6 E., at Northern Pacific Railway bridge about a mile northeast of Buckley, in Pierce County.

DRAINAGE AREA.—424 square miles (measured on Plate XI, Water-Supply Paper 313).

RECORDS AVAILABLE.—April 22, 1899, to August 31, 1903 (gage-height record only January 1, 1902, to August 31, 1903); June 8, 1910, to December 31, 1911; January 18, 1913, to September 30, 1916.

GAGE.—Fuller water-stage recorder on left bank at downstream end of concrete wing wall protecting left abutment of railroad bridge; installed January 18, 1913. Previous gages as follows: April 22, 1899, to December 31, 1902, wire-and-weight gage on guardrail of highway bridge 500 feet above railroad bridge; January 1 to August 31, 1903, various temporary gages; June 8 to September 30, 1910, gage opposite Mud Mountain, 5 miles upstream; October 1, 1910, to December 31, 1911, inclined staff bolted to concrete wing wall about 15 feet above present gage and at datum 0.7 foot higher. Recorder inspected by O. E. Osgood.

DISCHARGE MEASUREMENTS.—Made from downstream side of railroad bridge.

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; shifting; gradient steep. One channel at all stages. Right bank low and flat; left bank protected by concrete wing wall.

EXTREMES OF DISCHARGE.—Maximum combined daily discharge of river and flume during year, 8,010 second-feet July 3; minimum combined daily discharge, 418 second-feet January 16.

1899–1901, 1911, and 1913–1916: Maximum discharge, 14,600 second-feet November 22, 1901; minimum discharge, 390 second-feet October 3–4, 19–26, 1911, including flume.

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

DIVERSIONS.—White River flume diverts water from river half a mile above gage. Total monthly discharge is computed from determinations of combined flow of river and flume.

ACCURACY.—Stage-discharge relation changed frequently. Rating curves used as follows: October 1–31, curve well defined between 300 and 9,000 second-feet, curves parallel to this curve, November 1–18, 19–27, and November 28 to December 21; December 22 to May 6, curve well defined between 300 and 9,000 second-feet and not well defined below 300 second-feet; May 7 to September 30, curve fairly well defined. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph or, for days of considerable fluctuation, by averaging results obtained by applying the gage heights for shorter intervals. Records good except for periods of extremely low water. Record of combined discharge of river and flume good.

COOPERATION.—Puget Sound Traction, Light & Power Co. furnished gage-height record and made discharge measurements.

Discharge measurements of White River at Buckley, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	Eernisse and Osgood	24.16	11.1	May 16	O. E. Osgood	26.50	1,220
Nov. 9	do	24.31	12.8	June 19	Eernisse and Osgood	27.87	5,200
19	do	28.06	5,620	19	do	27.72	4,550
Dec. 9	do	26.98	1,640	21	do	27.43	3,240
22	do	28.23	5,930	21	do	27.24	2,460
Feb. 11	do	26.49	1,080	July 24	do	27.06	2,110
Mar. 10	do	28.64	7,880	24	do	26.78	1,490
Apr. 17	Osgood and Rhodes	26.68	1,340	Sept. 13	Osgood and Ridley	25.31	254

Daily discharge, in second-feet, of White River at Buckley, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	9	742	543	285	215	713	1,510	1,660	1,510	2,410	797	526
2	73	610	379	236	377	612	1,810	2,010	1,470	5,540	710	526
3	230	380	311	232	543	558	1,490	2,670	1,540	7,520	761	486
4	18	19	702	213	535	445	1,300	2,830	2,160	5,410	1,040	412
5	12	16	803	182	343	377	1,210	2,800	2,230	4,290	912	286
6	9	15	786	179	57	360	1,110	2,920	2,130	3,370	892	238
7	8	15	838	160	120	343	1,090	2,930	2,160	2,900	932	242
8	8	13	1,260	148	255	1,740	1,200	2,460	2,390	3,030	995	362
9	8	14	1,650	142	366	6,830	1,280	2,130	2,700	2,900	995	394
10	8	13	1,230	91	1,120	7,960	1,590	1,850	2,460	2,670	932	350
11	8	13	922	10	1,010	5,340	1,740	1,530	2,160	2,670	922	268
12	8	13	673	10	521	5,000	1,540	1,310	2,040	2,790	974	264
13	8	12	564	10	343	4,300	1,360	1,200	2,410	2,760	1,030	138
14	9	12	409	8	470	3,220	1,490	1,150	2,860	2,460	952	13
15	9	170	263	223	1,640	2,230	1,590	1,130	3,580	2,580	902	12
16	9	24	269	400	2,920	2,230	1,460	1,180	4,240	3,000	834	12
17	9	731	315	478	2,890	2,490	1,360	1,310	5,120	2,860	668	12
18	9	1,590	250	521	2,670	2,050	1,250	1,440	5,790	2,110	584	13
19	10	3,510	291	514	2,590	1,520	1,130	1,570	4,930	1,810	493	13
20	9	3,580	390	485	2,440	2,050	1,100	1,560	3,980	1,810	362	13
21	9	3,110	3,090	400	2,290	2,490	1,110	1,640	2,960	1,790	350	13
22	9	2,850	6,070	142	2,160	2,230	1,060	1,730	2,410	1,710	198	13
23	9	3,170	3,520	122	1,850	1,770	980	1,450	2,410	1,590	234	12
24	10	5,470	2,670	104	1,520	1,490	970	1,260	2,580	1,610	756	12
25	307	2,740	2,640	44	1,340	1,590	1,020	1,240	2,760	1,450	356	12
26	287	2,320	2,140	22	1,300	2,070	1,190	1,370	3,070	1,130	242	12
27	112	1,740	1,580	13	1,200	2,050	2,070	1,810	3,100	1,260	316	13
28	57	1,160	1,280	42	1,070	1,660	2,180	1,890	2,830	1,170	1,120	13
39	229	864	900	413	870	1,380	1,850	1,700	2,520	944	1,380	12
20	666	657	644	543	.....	1,210	1,640	1,560	2,330	760	769	12
31	944	.....	590	244	.....	1,400	.....	1,450	.....	1,000	562	.....

Monthly discharge of White River and flume at Buckley, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 424 square miles.]

Month.	Discharge in second-feet.						Run-off—Combined.	
	Combined.		River mean.	Flume mean.	Combined.		Depth in inches on drainage area.	Total in acre-feet.
	Maximum.	Minimum.			Mean.	Per square mile.		
October	1,360	428	100	559	659	1.55	1.79	40,500
November	6,040	553	1,190	665	1,850	4.36	4.86	110,000
December	6,080	1,010	1,220	707	1,930	4.55	5.25	119,000
January	1,200	418	213	531	744	1.75	2.02	45,700
February	4,070	538	1,210	710	1,920	4.53	4.89	110,000
March	7,970	909	2,250	569	2,820	6.65	7.67	173,000
April	2,840	1,500	1,390	636	2,030	4.79	5.34	121,000
May	3,450	1,750	1,770	598	2,360	5.57	6.42	145,000
June	6,420	2,120	2,830	623	3,450	8.14	9.08	205,000
July	8,010	1,680	2,560	603	3,160	7.45	8.59	194,000
August	2,060	1,040	739	766	1,500	3.54	4.08	92,200
September	1,320	628	157	676	833	1.96	2.19	49,600
The year	8,010	418	1,300	636	1,940	4.58	62.18	1,400,000

WHITE RIVER FLUME AT BUCKLEY, WASH.

LOCATION.—In sec. 35, T. 20 N., R. 6 E., on left side of White River, 800 feet below intake, half a mile above Northern Pacific Railway crossing, and 1 mile northeast of Buckley, in Pierce County.

RECORDS AVAILABLE.—January 18, 1913, to September 30, 1916.

GAGE.—Fuller water-stage recorder on right side of flume; inspected by O. E. Osgood.

DISCHARGE MEASUREMENTS.—Made from footbridge 8 feet below gage.

CHANNEL AND CONTROL.—Control formed by long section of flume bottom below gage. Stage-discharge relation affected by variable quantity of slit deposited near end of flume about three-fourths of a mile below gage. Zero of gage at elevation of bottom of flume.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.44 feet at 5 p. m. August 24 (discharge, 1,420 second-feet); closing of gates frequently reduced discharge to about 10 second-feet; no flow in flume January 15–18.

1913–1916: Maximum stage recorded, 5.55 feet June 8, 1913 (discharge, 1,480 second-feet, revised); no flow in flume January 15–18, 1916.

ICE.—Stage-discharge relation affected by ice; flow estimated from study of gage-height graph and weather records.

DIVERSIONS.—None.

REGULATION.—Gates at intake are operated frequently to control flow.

ACCURACY.—Stage-discharge relation seriously affected by rocks washed into flume and slightly affected by cleaning of Wolslegel settling basin; affected by ice January 20–24. Rating curves used as follows: October 1–25, fairly well defined; October 26 to January 16, fairly well defined; January 17 to April 19, well defined above and fairly well defined below 300 second-feet; July 7–17, fairly well defined; July 18–29, fairly well defined; July 30 to September 30, well defined above and fairly well defined below 300 second-feet. Daily discharge ascertained by applying to rating table mean gage height obtained by inspecting gage-height graph or, for days of considerable fluctuation, by averaging results obtained by applying the gage height for shorter intervals; shifting-control method used April 20 to July 6. Records good.

COOPERATION.—Puget Sound Traction, Light & Power Co. furnished gage-height record and made discharge measurements.

Flume diverts water from left bank of White River in the SE. ¼ sec. 35, T. 20 N., R. 6 E. Water is used for power development at Dieringer and is discharged into Stuck River.

Discharge measurements of White River flume at Buckley, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	Osgood and Eernisse...	2.80	504	May 15	O. E. Osgood.....	3.71	618
Nov. 9	Eernisse and Osgood...	3.21	653	26	.....do.....	4.18	721
Dec. 6	Osgood and Eernisse...	4.49	1,020	June 12	.....do.....	3.86	607
Feb. 10	Eernisse and Osgood...	4.86	1,100	July 7	.....do.....	3.35	412
Mar. 23	Osgood and Eernisse...	4.36	910	24	.....do.....	4.32	647
Apr. 14	O. E. Osgood.....	3.56	664	Sept. 12	..... do.....	3.07	551
15	.....do.....	3.55	661	27	.....do.....	3.66	735
19	.....do.....	3.18	562				

Daily discharge, in second-feet, of White River flume at Buckley, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	497	715	759	914	350	620	332	594	662	589	1,260	799
2	714	1,040	852	821	129	606	123	629	647	573	1,170	799
3	964	945	976	821	22	593	462	564	610	493	1,050	783
4	702	852	1,010	774	20	593	764	524	595	457	675	752
5	578	821	1,040	729	195	580	720	521	547	434	752	720
6	524	774	1,040	714	620	580	705	531	536	422	736	690
7	471	729	1,040	684	924	566	690	503	534	411	752	660
8	458	684	1,070	669	1,070	620	749	490	565	472	767	560
9	446	640	1,010	654	1,110	225	764	511	586	644	767	560
10	433	611	945	684	1,110	14	890	486	551	596	752	560
11	420	597	945	759	1,110	14	890	553	572	596	752	546
12	420	583	883	744	1,070	14	824	600	604	620	783	546
13	471	541	852	669	1,060	13	749	608	637	596	783	660
14	632	541	883	626	1,150	294	705	605	668	423	767	736
15	524	626	914	297	1,130	824	662	616	663	137	752	705
16	471	790	852	18	1,150	451	634	651	699	242	720	705
17	433	945	790	20	1,040	12	620	688	693	422	645	720
18	433	945	759	23	794	367	593	713	635	795	602	720
19	524	183	774	20	620	890	566	737	1,010	742	588	690
20	471	6	729	74	606	924	564	736	540	716	690	690
21	446	164	360	104	606	856	560	607	553	691	690	736
22	446	434	12	470	593	890	545	500	594	691	898	720
23	550	584	12	832	580	924	516	579	602	666	1,010	645
24	591	566	11	878	566	794	551	665	623	531	550	630
25	959	607	11	824	553	856	665	664	630	617	1,050	630
26	1,070	966	10	734	580	996	703	692	653	798	1,130	675
27	914	828	284	690	620	960	659	379	674	577	972	736
28	852	568	667	609	593	824	656	527	647	568	220	660
29	498	852	852	150	606	720	626	720	594	735	11	645
30	157	821	833	54	.....	662	597	680	568	1,300	662	616
31	247	.....	748	400	.....	344	.....	665	.....	1,130	799	.....

Monthly discharge of White River flume at Buckley, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,070	157	559	34,400
November	1,040	6	665	39,600
December	1,070	10	707	43,500
January	914	18	531	32,600
February	1,150	20	710	40,800
March	996	12	569	35,000
April	890	123	636	37,800
May	737	379	598	36,800
June	1,010	534	623	37,100
July	1,300	137	603	37,100
August	1,260	11	766	47,100
September	799	546	676	40,200
The year	1,300	6	636	462,000

DUWAMISH RIVER BASIN.

CEDAR RIVER AT CEDAR FALLS, WASH.

LOCATION.—In sec. 4, T. 23 N., R. 8 E., below Seattle municipal power plant at Cedar Falls, in King County, 3½ miles above Taylor Creek.

DRAINAGE AREA.—83 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 9, 1914, to September 30, 1916.

GAGE.—Stevens water-stage recorder installed April 8, 1914, 0.7 mile below power plant; inspected by G. H. Moore.

DISCHARGE MEASUREMENTS.—Made from cable 90 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; shifts at extreme high water. Banks high. One channel at all stages. Stage of zero flow, according to measurements made August 27, 1916, about gage height 3.5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.51 feet at 6.30 a. m. March 11 (discharge, 1,830 second-feet); minimum stage, 4.26 feet at 5.30 p. m. February 10 (discharge, 35 second-feet).

1914–1916: Maximum stage March 11, 1916; minimum stage, 3.85 feet at 6.30 p. m. August 29, 1915 (discharge, about 3.5 second-feet).

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water in Cedar Lake reservoir to accommodate requirements of Seattle municipal power plant.

ACCURACY.—Stage-discharge relation for low water changed during high water March 11; not affected by ice. Operation of water-stage recorder affected for short periods by ice in stilling well. Rating curve used for periods before the change well defined; after the change well defined above and fairly well defined below 200 second-feet. Daily discharge October to August ascertained by use of discharge integrator; for September, by averaging results obtained by applying hourly gage height to the rating table. Records excellent.

COOPERATION.—City Engineer of Seattle furnished gage-height record and made some discharge measurements.

Discharge measurements of Cedar River at Cedar Falls, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 8	C. G. Paulsen	5.06	210	Mar. 11	Moore and Smith	7.41	1,730
Dec. 7	do	5.51	411	14	do	7.33	1,640
23	Moore and Beals	7.16	1,610	Aug. 27	Parker and Stewart	4.74	127

Daily discharge, in second-feet, of Cedar River at Cedar Falls, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	212	442	362	255	239	398	460	702	594	719	277	224
2	221	670	314	243	227	370	407	709	594	806	277	221
3	154	598	300	267	215	338	418	846	597	1,180	265	169
4	216	493	282	248	217	303	433	1,020	625	1,310	260	190
5	225	446	280	248	213	246	454	1,080	794	1,210	258	221
6	235	406	345	238	215	276	464	1,090	793	1,030	200	224
7	210	350	403	236	234	274	464	1,050	751	808	248	227
8	226	349	538	231	262	367	459	1,030	740	802	256	226
9	215	321	766	212	271	1,090	462	898	769	758	256	227
10	182	292	791	224	208	1,720	523	762	783	714	245	170
11	211	273	572	229	561	1,770	598	644	714	423	251	222
12	218	256	592	211	573	1,740	709	558	680	269	250	226
13	218	256	510	231	448	1,740	689	486	720	262	209	227
14	215	234	354	226	424	1,680	682	394	852	264	242	225
15	217	258	285	215	494	1,530	706	408	1,010	261	249	227
16	214	270	296	175	756	1,250	676	414	1,180	238	247	227
17	186	282	286	206	1,040	1,000	688	462	1,340	270	241	192
18	228	300	304	210	1,100	839	657	548	1,420	289	236	232
19	220	698	286	222	1,080	730	610	645	1,430	288	236	230
20	234	991	304	241	963	742	583	694	1,270	286	191	234
21	206	930	511	253	895	876	577	663	992	295	230	230
22	216	886	1,470	262	805	959	558	720	878	293	229	235
23	226	804	1,560	211	718	888	482	683	759	249	232	229
24	202	753	1,100	258	641	766	475	620	740	293	238	186
25	232	670	763	251	571	700	443	578	742	287	226	234
26	238	711	467	246	512	698	454	577	836	278	228	236
27	237	699	580	233	452	780	528	606	942	277	170	236
28	242	535	435	233	458	754	744	601	970	280	217	237
29	238	482	307	228	432	670	810	662	899	278	230	233
30	240	412	302	224	.....	582	724	624	790	230	223	225
31	215	.....	306	230	.....	510	.....	612	.....	267	222	.....

Monthly discharge of Cedar River at Cedar Falls, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	242	154	218	13,400
November	991	234	502	29,900
December	1,560	280	515	31,700
January	267	175	232	14,300
February	1,100	208	525	30,200
March	1,770	246	858	52,800
April	810	407	565	33,600
May	1,090	394	690	42,400
June	1,430	594	873	51,900
July	1,310	230	491	30,200
August	277	170	237	14,600
September	237	169	221	13,200
The year	1,770	154	493	358,000

CEDAR RIVER NEAR LANDSBERG, WASH.

LOCATION.—In sec. 17, T. 22 N., R. 7 E., 1¾ miles above intake of Seattle water-supply system at Landsberg, 3 miles northeast of Ravensdale, in King County, and about 5 miles below Taylor Creek.

DRAINAGE AREA.—135 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 30, 1914, to September 30, 1916. July 25, 1895, to September 30, 1898, at Clifford Bridge, 2 miles below present gage; March 24, 1901, to April 30, 1912, at intake of Seattle water supply system, 1¾ miles below present gage. Early records not exactly comparable with those at present site because of a small difference in drainage area.

GAGE.—Stevens water-stage recorder installed April 29, 1914, referred to vertical staff on left bank; inspected by G. H. Moore.

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

CHANNEL AND CONTROL.—Bed composed of large boulders and gravel. Fairly permanent control formed by section of stream bed and by a broad riffle about 1,200 feet below gage. Logs may lodge on control. One channel at all stages. Stage of zero flow, according to measurements made August 27, 1916, about gage height 2.5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.74 feet at 1 a. m. March 10 (discharge, 2,630 second-feet); minimum stage, 4.98 feet at noon October 1 (discharge, 302 second-feet).

1914–1916: Maximum stage March 10, 1916; minimum stage, 4.36 feet at 1 a. m. October 15, 1914 (discharge, 162 second-feet).

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water in Cedar Lake reservoir to accommodate requirements of Seattle municipal power plant.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 1,500 second-feet. Daily discharge ascertained by use of discharge integrator or by averaging hourly discharge. Records excellent except for periods in which recorder was not operating. See note to table of daily discharge.

COOPERATION.—City engineer of Seattle furnished gage-height record and made some discharge measurements.

Discharge measurements of Cedar River near Landsberg, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage-height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 9	C. G. Paulsen	5.07	316
Aug. 27	Stewart and Parker	5.48	429
Sept. 23	G. H. Moore	5.37	416

Daily discharge, in second-feet, of Cedar River near Landsberg, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	376	703	806	676	616	857	1,080	1,230	1,050	1,120	628	522
2	499	980	728	636	615	818	1,020	1,230	1,030	1,350	627	539
3	490	905	736	670	574	790	1,000	1,330	1,020	1,730	620	501
4	482	769	731	656	590	733	1,010	1,490	1,040	1,760	608	511
5	422	737	804	661	588	670	1,010	1,550	1,200	1,640	596	518
6	417	678	856	652	572	695	1,010	1,590	1,200	1,460	532	513
7	397	610	940	640	780	712	1,000	1,540	1,160	1,260	581	510
8	388	594	1,210	629	977	1,120	990	1,530	1,140	1,200	596	513
9	386	556	1,500	606	1,030	2,220	984	1,370	1,150	1,170	592	518
10	383	520	1,420	614	1,140	2,480	1,050	1,260	1,170	1,130	579	446
11	383	507	1,130	616	1,390	2,440	1,120	1,130	1,110	882	587	491
12	395	476	1,120	618	1,300	2,480	1,230	1,040	1,070	667	575	492
13	414	466	996	626	1,110	2,370	1,200	954	1,090	652	530	488
14	428	455	816	629	1,140	2,230	1,190	854	1,210	644	556	487
15	416	522	686	626	1,410	2,050	1,210	855	1,350	652	567	476
16	396	590	698	577	1,790	1,840	1,180	853	1,510	646	565	475
17	366	724	678	608	1,950	1,620	1,190	892	1,640	777	569	438
18	434	786	680	618	1,940	1,420	1,170	981	1,720	836	573	472
19	464	1,390	703	618	1,820	1,320	1,120	1,100	1,740	776	553	471
20	464	1,530	756	612	1,700	1,360	1,130	1,130	1,660	741	522	471
21	419	1,500	1,400	621	1,520	1,560	1,120	1,100	1,380	724	545	464
22	427	1,450	2,240	718	1,410	1,680	1,090	1,170	1,250	709	541	464
23	460	1,410	2,130	774	1,290	1,560	1,010	1,110	1,130	647	539	455
24	477	1,300	1,740	744	1,200	1,420	1,010	1,040	1,090	684	540	412
25	546	1,360	1,470	692	1,100	1,460	960	988	1,090	672	542	451
26	524	1,370	1,090	661	1,030	1,590	968	974	1,210	678	541	459
27	502	1,200	1,110	646	948	1,650	1,090	1,000	1,300	663	478	451
28	520	1,040	1,070	638	937	1,540	1,320	997	1,330	657	524	454
29	510	1,010	767	609	908	1,390	1,370	1,060	1,260	646	528	452
30	520	926	717	582	.....	1,250	1,280	1,030	1,160	593	522	443
31	550	.....	710	604	.....	1,140	.....	1,020	.....	626	518	.....

NOTE.—Recorder not operating Oct. 3–9, 17–25, Oct. 29 to Nov. 3, and Nov. 27 to Dec. 8; gage-height graph completed from records of flow at Landsberg weir and Cedar Falls. Discharge Oct. 26 interpolated. Discharge Dec. 21–25, Feb. 16–20, Mar. 9–17, 21, 22, 26, 27, June 17–20, July 2–5, Aug. 6–24, Sept. 14–30, obtained by averaging hourly discharge. Water below intake part of each day Aug. 6–27; gage-height graph for the short periods completed by comparison with record obtained at Cedar Falls.

Monthly discharge of Cedar River near Landsberg, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	550	366	447	27,500
November	1,530	455	902	53,700
December	2,240	678	1,050	64,600
January	774	577	641	39,400
February	1,950	572	1,150	66,200
March	2,480	670	1,500	92,200
April	1,370	960	1,100	65,500
May	1,590	853	1,140	70,100
June	1,740	1,020	1,250	74,400
July	1,760	593	916	56,300
August	628	478	560	34,400
September	539	412	479	28,500
The year	2,480	366	927	673,000

SNOHOMISH RIVER BASIN.

SOUTH FORK OF SKYKOMISH RIVER NEAR INDEX, WASH.

LOCATION.—In NE. ¼ sec. 29, T. 27 N., R. 10 E., 300 feet above Sunset Falls, about 2 miles above town of Index and mouth of North Fork, in Snohomish County.

DRAINAGE AREA.—351 square miles (measured on topographic and county maps).

RECORDS AVAILABLE.—October 7, 1902, to September 30, 1905; April 26, 1911, to October 21, 1912; June 14, 1913, to September 30, 1916.

GAGE.—Inclined and vertical staff gage on right bank, installed April 19, 1914; read by M. J. Gruber. October 7, 1902, to September 30, 1905, vertical staff at site of present gage, but at datum 0.39 foot higher. April 26, 1911, to February 25, 1914, vertical staff at site of present gage, but at datum 1.00 foot higher.

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

CHANNEL AND CONTROL.—Bed at measuring section composed of gravel and small boulders. Sunset Falls, 300 feet below gage forms solid rock control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 12.3 feet on October 31 (discharge, 13,500 second-feet); minumum stage recorded, 0.98 foot October 11 (discharge, 374 second-feet).

1902–1905, 1911–1916: Maximum stage recorded, 17.0 feet at 10.05 a. m. January 6, 1914 (discharge, 16,700 second-feet); minimum stage recorded, 0.54 foot September 30, 1915 (discharge, 262 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Gage read to hundredths once daily. Rating curve well defined. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

Discharge measurements of South Fork of Skykomish River near Index, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 2	C. G. Paulsen	6.59	4,040	Mar. 9	Parker and Paulsen	8.97	7,220
3	do	4.66	2,200	10	Paulsen and Parker	8.86	7,420
Nov. 20	J. T. Hartson	5.67	3,100	June 17	G. L. Parker	11.25	11,500
22	do	4.61	2,100	Sept. 29	J. E. Stewart	1.81	632
Dec. 9	Paulsen and Miller	7.40	5,020				

Daily discharge, in second-feet, of South Fork of Skykomish River near Index, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	374	5,080	1,090	1,180	622	1,870	2,370	3,940	3,200	5,800	2,460	1,000
2	3,830	3,720	1,040	1,130	622	1,660	2,630	5,220	3,720	7,180	2,280	1,040
3	3,830	3,200	1,000	1,180	622	1,520	2,630	7,180	4,180	8,340	2,110	1,000
4	1,280	2,460	1,520	1,130	622	1,400	2,820	6,710	5,360	6,400	2,030	1,090
5	840	2,820	1,950	1,090	692	1,180	3,010	6,710	4,810	5,500	2,030	1,000
6	728	2,280	1,870	958	802	1,180	2,910	7,180	5,080	4,680	1,950	1,000
7	588	2,030	1,800	840	918	1,400	2,820	5,220	5,220	5,650	1,870	1,000
8	524	1,660	3,830	764	1,040	2,190	3,200	4,420	5,500	5,950	1,870	958
9	462	1,460	5,360	692	1,180	7,180	3,200	3,940	5,950	5,950	1,800	1,000
10	374	1,340	3,200	524	2,370	7,180	3,830	3,200	5,650	6,860	1,660	1,000
11	374	1,280	2,370	524	1,950	6,250	4,180	2,730	5,360	5,800	1,730	918
12	656	1,180	1,800	524	1,660	9,220	3,400	2,540	5,220	6,560	1,800	840
13	802	1,090	1,660	524	2,540	6,100	2,910	2,540	5,950	4,940	1,870	802
14	3,400	1,040	1,400	524	3,200	4,300	3,500	2,630	8,340	4,180	1,660	692
15	1,520	1,090	1,280	524	5,650	3,400	3,400	2,820	9,580	4,180	1,590	692
16	918	2,370	1,180	524	9,040	3,300	3,010	4,060	12,100	4,420	1,460	656
17	802	2,460	1,090	524	7,020	3,610	3,100	4,180	11,600	4,680	1,340	622
18	692	2,730	1,000	622	4,680	3,200	2,910	4,550	9,940	4,300	1,230	622
19	1,230	7,020	1,040	622	4,060	3,100	2,630	4,810	7,500	3,610	1,180	588
20	918	3,100	1,090	622	3,500	4,550	2,630	4,300	5,650	3,400	1,040	556
21	840	2,460	3,610	622	3,300	4,810	2,730	3,940	4,810	3,610	1,040	556
22	802	2,110	7,830	1,660	3,100	4,060	2,370	3,610	4,550	3,610	1,040	462
23	918	2,460	7,500	3,500	2,730	3,200	2,280	3,200	5,950	3,200	1,090	402
24	1,230	2,030	4,060	2,910	2,460	2,630	2,110	3,100	6,400	2,910	1,180	432
25	3,940	2,030	3,200	1,730	2,460	2,820	2,540	3,500	6,560	2,820	1,180	462
26	2,630	2,280	3,010	622	2,280	2,730	3,010	4,060	8,170	2,730	1,090	1,280
27	4,180	1,660	1,730	622	2,110	2,630	5,950	4,810	6,860	2,460	1,040	1,060
28	4,550	1,400	2,110	622	2,110	2,370	5,080	4,680	5,950	2,460	1,000	842
29	2,910	1,280	1,590	622	1,870	2,280	3,940	3,720	5,080	2,370	1,000	622
30	2,540	1,180	1,400	622	.....	2,110	3,500	3,400	4,810	2,630	958	588
31	13,500	.....	1,340	622	.....	2,110	.....	3,300	.....	2,730	918	.....

NOTE.—Gage not read Dec. 19, Jan. 16, Sept. 27–28; discharge interpolated.

Monthly discharge of South Fork of Skykomish River near Index, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 351 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	13,500	374	2,060	5.87	6.77	127,000
November	7,000	1,040	2,280	6.50	7.25	136,000
December	7,380	1,000	2,390	6.81	7.85	147,000
January	3,500	524	941	2.68	3.09	57,900
February	9,040	622	2,590	7.38	7.96	149,000
March	9,220	1,180	3,400	9.69	11.17	209,000
April	5,950	2,110	3,150	8.97	10.01	187,000
May	7,180	2,540	4,200	12.0	13.83	258,000
June	12,100	3,200	6,300	17.9	19.97	375,000
July	8,340	2,370	4,510	12.8	14.76	277,000
August	2,460	918	1,500	4.27	4.92	92,200
September	1,280	402	793	2.26	2.52	47,200
The year	13,500	374	2,840	8.09	110.10	2,060,000

MILLER CREEK NEAR BERLIN, WASH.

LOCATION.—In NE. ¼ sec. 33, T. 26 N., R. 11 E., 1¼ miles south of Berlin and mouth of the creek, in King County.

DRAINAGE AREA.—44.2 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 24, 1911, to September 30, 1916 (fragmentary).

GAGE.—Inclined staff on left bank, 1¼ miles south of Berlin; installed August 27, 1914; read by E. J. Moore. May 24, 1911, to August 26, 1914, vertical staff 10 feet upstream from present gage at same datum.

DISCHARGE MEASUREMENTS.—Made from cable 900 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of large boulders and gravel; practically permanent. A log jam 500 feet below gage, at a water-surface elevation about 5 feet lower than at gage, may affect stage-discharge relation at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.5 feet at 11.45 a. m. October 31 (discharge, 4,220 second-feet); minimum stage recorded, 0.32 foot January 1 (discharge, 44 second-feet).

1911–1916: Maximum stage recorded, 5.5 feet November 18–19, 1911, and October 31, 1915 (discharge, 4,220 second-feet); minimum stage recorded, 0.07 foot August 31, 1915 (discharge, 24 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Gage read to hundredths when ranger passes station. Rating curve well defined below 2,000 second-feet. Daily discharge ascertained by applying daily gage height to rating table. Records good.

COOPERATION.—Gage-height record furnished by United States Forest Service.

Discharge measurements of Miller Creek near Berlin, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 4	C. G. Paulsen	1.44	279	July 29	C. O. Brown	1.64	338
June 16	G. L. Parker	3.33	1,610	29	....do	1.63	342
16	....do	3.46	1,790				

Daily discharge, in second-feet, of Miller Creek near Berlin, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	63	760	137	44	118	209	312	625	510	800	350	139
2	1,380	595	162	47	132	187	312	915	510	1,700	330	122
3	625	462	186	51	146	166	312	1,000	725	1,110	330	330
4	278	330	208	54	160	144	510	675	798	1,110	330	273
5	215	392	230	59	349	144	451	350	625	798	330	217
6	126	295	238	64	538	135	392	555	565	740	330	160
7	95	260	245	59	748	124	370	760	658	683	330	126
8	89	230	502	54	958	890	455	565	835	625	295	132
9	86	201	760	54	776	890	540	438	958	692	278	137
10	83	172	438	54	594	1,460	625	375	625	760	278	143
11	77	137	334	54	412	1,190	610	312	595	725	278	148
12	460	126	230	53	230	1,700	595	295	760	708	370	144
13	835	116	208	52	271	1,270	565	295	1,040	690	312	115
14	658	116	186	51	312	843	538	402	1,380	658	312	87
15	295	116	161	49	676	415	510	510	1,700	690	295	90
16	194	123	137	47	1,040	462	462	538	1,700	725	200	78
17	139	130	112	48	915	510	415	690	1,700	798	200	66
18	438	195	111	49	755	438	415	690	1,330	625	194	66
19	295	260	110	52	595	488	415	725	958	565	186	68
20	150	278	240	54	528	538	510	690	625	565	170	64
21	148	260	240	355	460	489	625	600	510	545	148	64
22	295	315	1,180	656	438	441	442	510	524	525	155	63
23	260	370	775	958	330	392	260	485	538	505	160	62
24	260	315	370	654	295	312	295	392	722	485	167	53
25	1,230	260	315	350	290	302	330	438	906	433	150	79
26	595	252	260	244	284	295	665	798	1,090	382	148	218
27	760	245	260	137	278	262	1,000	798	1,000	330	145	172
28	798	200	260	106	254	230	812	690	862	330	142	146
29	650	180	278	76	230	240	625	575	725	350	140	119
30	650	160	295	90	.....	250	438	460	800	350	137	93
31	4,220	.....	130	104	.....	260	.....	485	.....	460	138	.....

NOTE.—Discharge Oct. 23, 24, 29, 30, Dec. 20, 21, Mar. 8, 9, 11, June 30, July 1, 3, 4, and Sept. 26, determined by comparison with record of flow of South Fork of Skykomish River near Index. Gage read nearly every day in October and from May to August, and three to five times a week in other months; discharge interpolated for days on which gage was not read, except as noted above.

Monthly discharge of Miller Creek near Berlin, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 44.2 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	4,220	63	531	12.0	13.83	32,600
November	760	116	262	5.93	6.62	15,600
December	1,180	110	300	6.79	7.83	18,400
January	958	44	154	3.48	4.01	9,470
February	1,040	118	452	10.2	11.00	26,000
March	1,700	124	506	11.5	13.26	31,100
April	1,000	260	494	11.2	12.50	29,400
May	1,000	295	569	12.9	14.87	35,000
June	1,700	510	876	19.8	22.09	52,100
July	1,700	330	660	14.9	17.18	40,600
August	350	137	236	5.34	6.16	14,500
September	330	53	126	2.85	3.18	7,500
The year	4,220	44	430	9.73	132.53	312,000

NORTH FORK OF SKYKOMISH RIVER AT INDEX, WASH.

LOCATION.—In SE. ¼ sec. 17, T. 27 N., R. 10 E., at Index, in Snohomish County, 1¾ miles above mouth of river.

DRAINAGE AREA.—143 square miles (measured on topographic and county maps).

RECORDS AVAILABLE.—August 24, 1910, to September 30, 1916.

GAGE.—Vertical staff on wing dam on right bank, about one-third mile above highway bridge, directly back of house of observer, Lee Pickett, since November 27, 1911. August 24 to September 2, 1910, vertical staff on left bank 100 feet above tramway bridge; destroyed in course of improvements to channel. October 26, 1910, to November 26, 1911, vertical staff on right bank at lower end of wing dam and about 300 feet below site of present gage.

DISCHARGE MEASUREMENTS.—Made from cable 600 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of gravel and large boulders. Right bank high, protected by pile-and-timber wing dam, and not subject to overflow; left bank slopes back gradually. Stage of zero flow, according to measurements made August 22, 1915, gage height −1.2 feet ±0.3 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.0 feet at 9 a. m. October 31 (discharge, 6,400 second-feet); minimum stage recorded, 0.90 foot at 10 a. m. October 9 (discharge, 198 second-feet).

1911–1916: Maximum stage recorded, 9.3 feet at 11 a. m. January 6, 1914 (discharge, 10,500 second-feet); minimum stage recorded, 0.45 foot at 1 p. m. September 29, 1915 (discharge, 97 second-feet).

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

DIVERSIONS.—None.

REGULATIONS—None.

ACCURACY.—Stage-discharge relation permanent. Slight diurnal fluctuation during summer months. Gage read once daily to quarter-tenths. Rating curve well-defined. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

Discharge measurements of North Fork of Skykomish River at Index, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 3	C. G. Paulsen	2.66	1,010	June 14	G. L. Parker	5.32	3,680
Nov. 21	J. T. Hartson	2.70	1,000	15	do	5.81	4,470
Dec. 9	C. G. Paulsen	4.05	2,190	18	do	6.11	4,930
22	do	4.30	2,440	July 30	C. O. Brown	3.12	1,330

Daily discharge, in second-feet, of North Fork of Skykomish River at Index, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,640	3,150	500	546	368	742	904	1,550	1,550	3,280	1,310	523
2	1,090	2,020	348	570	368	692	963	2,220	1,550	3,020	1,090	546
3	1,020	1,640	259	477	348	642	1,160	3,150	1,820	3,410	1,020	1,640
4	594	1,730	212	454	329	594	1,020	3,020	2,440	3,150	963	1,240
5	410	1,640	904	454	329	570	848	2,900	2,220	2,550	963	1,020
6	368	1,240	848	410	293	546	742	2,780	2,330	2,550	963	692
7	311	1,020	904	410	368	546	642	2,330	2,440	2,780	904	546
8	227	963	2,780	348	642	848	642	1,920	2,660	3,020	1,020	546
9	198	848	2,440	329	594	2,220	1,390	1,390	2,330	2,660	904	642
10	198	742	1,920	329	963	2,660	1,730	1,240	2,020	2,550	848	546
11	227	692	1,090	311	1,020	2,660	1,550	1,090	1,820	2,780	963	500
12	432	594	904	311	794	4,120	1,390	1,090	2,330	2,900	963	454
13	618	523	848	329	692	2,780	1,240	1,020	2,330	2,330	963	410
14	477	570	692	329	963	1,820	1,240	1,020	3,690	2,020	904	389
15	454	570	243	329	3,280	1,550	1,240	1,090	4,580	2,020	848	348
16	389	594	227	348	4,270	1,310	1,160	1,730	5,380	2,120	742	348
17	368	794	594	329	3,550	1,470	1,090	2,220	5,550	2,780	692	348
18	1,160	1,090	570	311	2,780	1,240	1,090	2,020	4,120	2,550	742	348
19	794	1,820	500	293	2,330	1,160	1,020	2,020	3,150	1,730	618	329
20	410	1,390	546	259	2,020	2,020	963	1,920	2,550	1,640	546	311
21	410	1,020	1,390	227	1,730	1,920	963	1,920	2,330	1,640	546	293
22	594	1,020	2,000	389	1,390	1,390	848	1,730	2,550	1,730	642	348
23	794	1,090	1,640	1,240	1,240	1,310	848	1,390	2,780	1,640	642	329
24	904	794	1,550	1,090	1,160	1,090	794	1,240	2,900	1,640	642	311
25	1,920	848	1,350	794	1,090	1,090	794	1,240	3,020	1,550	642	570
26	1,920	742	1,150	594	1,020	963	2,120	1,160	3,830	1,390	642	963
27	1,920	692	944	570	963	904	2,550	1,160	2,780	1,390	642	454
28	1,920	642	742	500	848	848	2,020	1,920	2,900	1,160	618	410
29	1,730	594	642	432	848	848	1,920	1,820	2,660	1,090	618	368
30	1,240	546	594	410	.....	904	1,730	1,730	2,120	1,310	546	1,390
31	6,400	.....	570	410	.....	904	.....	1,550	.....	1,470	523	.....

Monthly discharge of North Fork of Skykomish River at Index, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 143 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	6,400	198	1,000	6.99	8.06	61,500
November	3,150	523	1,050	7.34	8.19	62,500
December	2,900	212	994	6.95	8.01	61,100
January	1,240	227	456	3.19	3.68	28,000
February	4,270	293	1,260	8.81	9.50	72,500
March	4,120	546	1,370	9.58	11.04	84,200
April	2,550	642	1,220	8.53	9.52	72,600
May	3,150	1,020	1,760	12.3	14.18	108,000
June	5,550	1,550	2,820	19.7	21.98	168,000
July	3,410	1,090	2,190	15.3	17.64	135,000
August	1,310	523	796	5.57	6.42	48,900
September	1,640	293	572	4.00	4.46	34,000
The year	6,400	198	1,290	9.02	122.68	936,000

SULTAN RIVER NEAR SULTAN, WASH.

LOCATION.—In sec. 8, T. 28 N., R. 8 E., at Horseshoe Bend, 4½ miles north of Sultan, in Snohomish County, 7 miles above mouth; prior to October 29, 1915, at Camp Habecker 2 miles upstream.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 18, 1911, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank half a mile above Horseshoe Bend; inspected by Hans Mumm and Lloyd Fairbrook. Prior to October 29, 1915, Lietz water-stage recorder at Camp Habecker, 2 miles upstream; inspected by G. D. Hite.

DISCHARGE MEASUREMENTS.—Made from cables at gages or by wading.

CHANNEL AND CONTROL.—In canyons at both sites. Controls formed by large rocks, boulders, and heavy gravel. Not likely to change except at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period, 19.6 feet at Camp Habecker, 4 p. m., November 18, 1911 (discharge about 10,700 second-feet), minimum stage recorded, 4.52 feet at Camp Habecker September 29, 1915 (discharge, 71 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice. Water in stilling-well freezes during very cold weather.

DIVERSIONS.—None.

REGULATIONS.—None.

ACCURACY.—Rating curves well defined since September, 1914; prior to that date fairly well defined at medium and high stages, but poorly defined at low stages. Gage heights prior to October, 1915, subject to some uncertainty due to possibility of intake being clogged part of time and to lack of index corrections. Daily discharge ascertained by applying mean daily gage height to rating table or after October 29, 1915, for days of considerable fluctuation in stage, by averaging results obtained by applying mean gage height for shorter intervals. Records since October, 1915, excellent; between September, 1914, and October, 1915, good; prior to September, 1914, good at medium and high stages but poor for low stages.

COOPERATION.—Gage-height record furnished by city of Everett since October 29, 1915; prior to that date by the Arnold Co., consulting engineers.

Discharge measurements of Sultan River near Sultan, Wash., during the period Aug. 18, 1911, to Sept. 30, 1916.

Date.	Made by—	Gage height.		Discharge.
		Camp Habecker.	Horseshoe Bend.	
		Feet.	*Feet.*	*Second-feet.*
1911.				
Sept. 30	W. W. Clifford	5.62		207
1914.				
Sept. 4	Robert Howes	4.51		85
1915.				
Aug. 4	C. G. Paulsen	5.12		126
4	....do	5.12		122
Sept. 26	Burns, Koon, and Fairbrook	4.66		74
Oct. 28	C. G. Paulsen	12.42	7.10	3,470
29	....do	9.73	4.93	1,580
30	....do	8.62	4.02	998
Dec. 21	....do	11.58	6.43	2,820
21	....do	13.43	7.90	4,360
1916.				
Jan. 18	....do	5.25	1.15	144
Mar. 8	Parker and Paulsen	11.57	6.42	2,770
July 25	Parker and Fairbrook	7.43	3.00	586
Aug. 30	....do	5.84	1.64	197

NOTE.—Measurements since Oct. 28, 1915, were referred to gage at Camp Habecker by curve of relation between it and gage at Horseshoe Bend.

Daily discharge, in second-feet, of Sultan River near Sultan, Wash., for the years ending Sept. 30, 1914–1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913–14.												
1	220	378	1,010	329	601	1,510	368	844	826	617	140	91
2	206	320	753	329	435	1,510	378	1,030	789	601	140	89
3	213	275	617	368	358	1,240	700	1,400	666	586	140	88
4	234	284	527	2,750	329	1,030	1,290	1,030	500	486	140	87
5	220	844	500	6,250	301	826	1,620	807	473	411	140	86
6	234	1,810	541	6,650	275	700	1,010	735	435	368	145	85
7	378	1,030	666	3,800	258	633	864	789	633	368	161	84
8	617	903	541	2,000	242	753	807	753	2,680	368	150	83
9	718	1,140	460	1,340	227	700	864	735	1,510	358	150	125
10	3,140	1,450	411	1,010	250	601	944	753	986	358	145	97
11	6,350	844	527	965	348	541	826	700	844	301	145	140
12	2,470	601	570	807	378	650	753	771	844	301	140	206
13	2,900	486	513	844	400	1,050	1,190	965	753	284	135	180
14	2,200	423	601	807	435	2,470	1,450	1,190	735	258	130	266
15	1,620	486	700	826	400	1,680	2,470	986	864	284	130	2,200
16	1,220	3,710	541	771	411	2,820	1,340	753	844	242	125	1,140
17	864	1,560	460	650	400	1,740	965	650	771	227	120	683
18	735	1,030	411	556	400	1,290	1,050	617	683	242	119	1,340
19	753	903	368	460	448	1,170	1,620	570	527	258	116	1,450
20	718	771	338	400	513	1,170	1,680	650	448	242	111	2,540
21	650	601	310	389	883	1,010	1,070	753	965	199	107	1,450
22	527	753	284	570	1,870	844	844	771	1,170	186	105	844
23	473	2,130	266	435	1,810	735	735	735	683	186	103	700
24	617	3,140	250	338	1,870	753	633	633	771	186	100	601
25	486	1,070	234	275	1,620	617	570	807	771	173	99	527
26	400	771	258	513	1,290	513	586	735	601	156	96	513
27	389	753	266	435	3,460	448	735	944	617	145	96	883
28	338	527	338	400	1,620	411	718	700	601	140	94	513
29	301	1,240	284	400	.....	435	617	541	586	140	94	389
30	275	1,450	250	666	.....	423	650	570	601	140	93	320
31	284	.....	301	666	.....	411	.....	683	.....	140	92	.....
1914–15.												
1	292	1,220	800	1,100	541	348	3,060	260	527	235	134	78
2	633	3,460	666	826	556	329	6,650	227	482	227	129	79
3	650	3,380	700	965	500	320	3,460	260	454	198	125	78
4	486	2,980	633	1,030	473	486	1,940	269	400	166	121	76
5	389	2,400	541	903	570	500	1,450	288	374	154	116	76
6	338	1,560	320	400	807	411	1,140	328	362	154	112	76
7	301	1,140	320	411	666	423	1,240	387	350	160	105	77
8	275	1,070	944	473	586	400	1,100	350	288	185	105	115
9	250	1,290	486	486	718	378	842	362	252	220	103	139
10	601	1,010	411	448	633	400	748	527	243	192	101	121
11	1,290	1,220	423	986	541	378	607	497	227	172	100	117
12	1,220	1,070	400	944	541	358	823	400	235	172	98	107
13	1,170	1,010	411	601	527	338	986	350	243	260	96	106
14	807	965	150	513	513	1,030	786	350	252	269	92	107
15	1,010	807	135	500	500	1,510	902	339	243	426	89	118
16	1,140	771	348	389	570	586	1,030	317	307	482	88	120
17	1,220	700	1,010	338	883	368	767	317	374	590	86	112
18	2,400	633	435	320	1,140	700	642	440	558	468	87	103
19	3,140	666	192	329	844	789	607	527	642	400	86	100
20	2,130	1,050	180	378	718	601	574	542	659	243	86	99
21	1,290		186	389	700	473	426	413	574	192	87	93
22	883		186	338	650	423	362	400	527	172	86	90
23	683	1,170	173	301	650	338	328	374	413	185	86	87
24	541		192	284	650	284	317	454	297	185	84	88
25	473		173	266	864	258	307	624	278	166	83	86
26	411		213	250	617	310	317	624	278	166	81	81
27	358		234	242	411	411	307	1,510	339	160	79	77
28	320	1,300	556	234	358	486	317	2,070	317	160	78	74
29	292		883	227	.....	718	339	1,070	269	160	78	71
30	527		986	242	.....	771	297	767	243	154	78	73
31	666		1,740	348	.....	617	.....	607	.....	139	77	.....

Daily discharge, in second-feet, of Sultan River near Sulton, Wash., for the years ending Sept. 30, 1914–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1915–16.												
1	160	2,470	484	297	228	518	730	1,120	860	1,000	484	179
2	1,810	1,450	518	269	210	467	770	1,520	792	1,360	418	179
3	1,050	1,170	659	252	219	434	860	1,700	930	2,500	434	1,050
4	440	842	1,340	235	210	388	1,090	1,420	1,140	1,680	388	1,480
5	297	1,220	1,350	220	202	359	955	1,320	1,060	1,340	373	662
6	243	882	1,260	219	202	332	792	1,700	838	1,030	373	403
7	198	712	1,110	210	748	501	792	1,230	860	980	345	293
8	178	558	4,650	202	915	2,760	882	1,090	1,060	955	373	654
9	166	484	1,890	202	1,220	4,480	930	1,030	1,060	905	345	484
10	154	418	1,360	188	1,980	2,780	1,230	980	815	792	318	460
11	149	388	955	158	1,540	2,340	1,390	815	750	955	359	318
12	288	373	730	156	908	4,120	1,000	710	980	1,060	373	270
13	804	345	610	150	730	1,880	838	710	1,290	955	373	238
14	1,510	359	518	141	2,200	1,290	1,260	770	1,450	770	332	219
15	659	444	450	136	4,020	1,000	1,140	930	1,660	860	318	193
16	387	630	434	136	4,480	1,360	882	1,170	1,970	1,200	270	180
17	297	2,200	418	145	2,650	1,260	930	1,290	1,930	1,290	248	171
18	400	3,380	373	129	2,010	980	905	1,140	1,660	1,000	302	165
19	1,030	3,220	467	124	1,780	1,030	770	1,060	1,060	730	293	157
20	862	1,340	770	139	1,590	2,400	1,040	930	980	860	228	152
21	882	1,220	2,980	139	1,390	1,970	860	882	750	770	210	153
22	1,010	1,240	2,680	511	1,230	1,480	670	905	690	710	219	179
23	1,220	1,400	1,220	2,610	980	1,060	573	815	955	610	238	176
24	1,290	1,080	1,050	1,190	838	838	730	770	1,000	592	259	156
25	2,470	944	944	670	770	934	860	905	1,060	610	259	314
26	1,810	862	676	484	815	1,420	1,030	1,120	1,420	670	248	1,010
27	2,200	624	558	388	750	1,230	2,250	955	1,320	592	228	568
28	3,710	497	558	318	690	930	1,660	1,030	1,140	573	219	332
29	1,600	542	440	259	610	750	1,200	905	905	501	210	259
30	980	542	362	259	.....	630	980	815	882	573	202	228
31	2,680	.....	328	238	.....	650	.....	770	.....	592	187	.....

NOTE.—Data concerning rating curve, operation of recording gage, and condition of intake pipe prior to Oct. 1, 1913, inadequate to permit accurate determinations of daily discharge during periods of low flow. For mean monthly flow see following tables.

Discharge determined from rating curves applicable; to Camp Habecker gage, Aug. 18, 1911, to Apr. 2, 1915, and Apr. 3, 1915, to Sept. 30, 1916; to Horseshoe Bend gage, Oct. 29, 1915, to Sept. 30, 1916.

Discharge determined from Camp Habecker gage heights prior to Oct. 29, 1915; Oct. 31 to Nov. 8, 1915; Nov. 17 to 30, 1915; Dec. 21, 1915, to Jan. 5, 1916; July 4 to 6, 1916. Gage heights at Horseshoe Bend used for remainder of period.

No record of gage height at Camp Habecker Nov. 21 to 30, 1914. Discharge determined by hydrograph comparison with record of flow of North Fork of Skykomish River at Index and South Fork of Stilaguamish River near Silverton.

Monthly discharge of Sultan River near Sultan, Wash., for the years ending Sept. 30, 1911–1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet.)
	Maximum.	Minimum.	Mean.	
1911.				
August 18–31	.....	.....	136	3,780
September	.....	.....	458	27,300
The period	.....	.....	.....	31,100
1911–12.				
October	.....	.....	226	13,900
November	.....	.....	1,810	108,000
December	.....	.....	923	56,800
January	.....	.....	1,050	64,600
February	.....	.....	928	53,400
March	.....	.....	263	16,200
April	.....	.....	529	31,500
May	.....	.....	936	57,600
June	.....	.....	761	45,300
July	.....	.....	458	28,200
August	.....	.....	304	18,700
September	.....	.....	328	19,500
The year	.....	.....	706	514,000

Monthly discharge of Sultan River near Sultan, Wash., for the years ending Sept. 30, 1911–1916—Continued.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1912–13.				
October			698	42,900
November			1,340	79,700
December			837	51,500
January			633	38,900
February			782	43,400
March			568	34,900
April			934	55,600
May			1,300	79,900
June			1,320	78,600
July			940	57,800
August			304	18,700
September			574	34,200
The year			850	616,000
1913–14.				
October	6,350	206	992	61,000
November	3,710	275	1,060	63,100
December	1,010	234	455	28,000
January	6,650	275	1,190	73,200
February	3,460	227	780	43,300
March	2,820	411	990	60,900
April	2,470	368	978	58,200
May	1,400	541	794	48,800
June	2,680	435	806	48,000
July	617	140	289	17,800
August	161	92	123	7,560
September	2,540	83	593	35,300
The year	6,650	83	753	545,000
1914–15.				
October	3,140	250	845	52,000
November	3,460	633	1,360	80,900
December	1,740	135	485	29,800
January	1,100	227	499	30,700
February	1,140	358	633	35,200
March	1,510	258	508	31,200
April	6,650	297	1,090	64,900
May	2,070	227	524	32,200
June	659	227	367	21,800
July	590	139	233	14,300
August	134	77	95.4	5,870
September	139	71	94.1	5,600
The year	6,650	71	558	404,000
1915–16.				
October	3,710	149	998	61,400
November	3,380	345	1,060	63,100
December	4,650	328	1,040	64,000
January	2,610	124	348	21,400
February	4,480	202	1,250	71,900
March	4,480	332	1,370	84,200
April	2,250	573	1,000	59,500
May	1,700	710	1,050	64,600
June	1,970	690	1,110	66,000
July	2,500	501	936	57,600
August	484	187	304	18,700
September	1,480	152	376	22,400
The year	4,650	124	901	655,000

MIDDLE FORK OF SNOQUALMIE RIVER NEAR NORTH BEND, WASH.

LOCATION.—In NE. ¼ SE. ¼ sec. 10, T. 23 N., R. 8 E., a mile southeast of North Bend, in King County, and 2¾ miles above junction with North Fork.

DRAINAGE AREA.—184 square miles (measured on topographic map).

RECORDS AVAILABLE.—August 10, 1907, to February 29, 1908; August 25, 1908, to September 30, 1916. All records prior to October 1, 1915, published in Water-Supply Paper 412.

GAGE.—Stevens water-stage recorder on left bank; installed August 7, 1915; inspected by R. C. McFadden and E. H. Robinson. Prior to August 7, 1915 gage was at highway bridge, 2¼ miles below present site.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge at original station.

CHANNEL AND CONTROL.—Bed composed of large boulders. Channel slightly curved above and below station. Control not likely to shift. Left bank high; right bank low and heavily wooded. Stage of zero flow, according to measurements made July 27, 1915, gage height −0.9 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.21 feet at 7 p. m. March 9 (discharge, 8,920 second-feet); minimum stage recorded, 1.57 feet at 12 a. m. October 1 (discharge, 161 second-feet).

1907–1916: Maximum stage, 13.4 feet (estimated by observer when water was above gage) November 23 and 29, 1909 (discharge not determined); stage may have been higher when water was above gage November 18, 1911 (discharge estimated by hydrographic comparison with records of flow of North and South forks at 18,000 second-feet); minimum stage recorded, 1.50 feet at 1 p. m. September 30, 1915 (discharge, 146 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting the graph or, for days of considerable fluctuation, by averaging results obtained by applying the gage heights for shorter intervals. Records excellent.

COOPERATION.—Puget Sound Traction, Light & Power Co. furnished gage-height record and made some discharge measurements.

Discharge measurements of Middle Fork of Snoqualmie River near North Bend, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Dec. 3	McFadden and Hansen	3.02	774	Apr. 1	McFadden and Hartson	3.61	1,220
Mar. 2	McFadden and Stensloff	3.05	766	Aug. 7	Hartson and Robinson.	3.04	863
Apr. 1	Hartson and McFadden.	3.61	1,240	8	Robinson and Hartson.	3.10	899
				Sept. 9	E. H. Robinson	2.56	531

Daily discharge, in second-feet, of Middle Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	277	3,520	822	721	456	921	1,250	1,690	1,480	2,410	1,170	446
2	3,420	2,410	794	647	466	843	1,300	2,440	1,390	4,040	1,060	481
3	3,050	1,870	850	623	549	815	1,390	3,150	1,690	4,860	1,020	713
4	1,250	1,430	1,210	571	517	741	1,580	2,780	2,340	3,280	980	1,570
5	815	1,720	1,380	528	481	690	1,480	2,700	2,140	2,620	921	857
6	629	1,480	1,340	501	466	690	1,300	3,000	1,740	2,070	907	617
7	506	1,250	1,420	476	1,080	754	1,300	2,270	1,800	2,070	836	512
8	428	1,090	3,070	461	1,740	2,780	1,430	1,800	2,340	2,620	850	491
9	378	980	3,040	446	1,530	7,230	1,430	1,530	2,550	2,550	829	538
10	391	871	1,870	428	2,340	5,790	1,800	1,340	1,930	2,070	788	577
11	370	829	1,430	353	1,940	4,240	1,930	1,170	1,690	2,410	822	486
12	694	781	1,170	382	1,340	4,860	1,930	1,060	2,200	2,700	893	442
13	1,150	715	1,020	382	1,090	3,450	1,870	1,020	3,140	2,410	980	432
14	3,130	684	907	342	1,850	2,340	2,000	1,090	3,470	1,690	857	391
15	1,520	747	815	330	4,290	1,740	1,690	1,250	4,110	1,740	808	357
16	1,020	980	747	315	5,410	1,930	1,530	1,630	4,950	2,000	734	342
17	788	1,850	715	370	4,030	2,140	1,480	2,000	4,860	2,350	653	334
18	763	2,560	659	349	3,000	1,690	1,390	1,870	4,340	2,450	629	330
19	1,140	5,230	721	315	2,550	1,630	1,300	2,000	2,850	2,000	571	322
20	822	2,360	893	391	2,270	2,500	1,390	1,740	2,340	1,700	517	300
21	709	1,870	4,590	387	2,070	2,780	1,390	1,630	1,690	1,600	496	293
22	653	1,690	3,920	758	1,930	2,270	1,170	1,630	1,690	1,500	496	290
23	785	1,930	2,200	2,240	1,580	1,690	1,060	1,390	2,410	1,390	560	286
24	1,040	1,580	1,580	1,680	1,340	1,430	1,090	1,250	2,700	1,390	611	268
25	2,950	1,760	1,800	1,060	1,210	1,480	1,340	1,390	2,850	1,300	623	305
26	2,180	1,800	1,390	829	1,250	1,870	1,530	1,800	3,470	1,210	577	830
27	1,930	1,340	1,130	696	1,210	2,070	2,880	1,690	3,040	1,130	543	816
28	2,270	1,090	1,250	611	1,130	1,580	2,480	1,630	2,620	1,090	533	517
29	1,800	1,020	1,020	501	1,060	1,300	1,870	1,530	2,070	1,060	543	413
30	1,480	943	850	501	.....	1,170	1,530	1,390	2,000	1,170	512	361
31	4,190	.....	788	476	.....	1,170	.....	1,340	.....	1,340	471	.....

NOTE.—No gage-height record July 17-22; discharge estimated by hydrographic comparison with record of flow of North and South forks.

Monthly discharge of Middle Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 184 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	4,190	277	1,370	7.45	8.59	84,200
November	5,230	684	1,610	8.75	9.76	95,800
December	4,590	659	1,460	7.93	9.14	89,800
January	2,240	315	602	3.27	3.77	37,000
February	5,410	456	1,730	9.40	10.14	99,500
March	7,230	690	2,150	11.7	13.49	132,000
April	2,880	1,060	1,570	8.53	9.52	93,400
May	3,150	1,020	1,750	9.51	10.96	108,000
June	4,950	1,390	2,600	14.1	15.73	155,000
July	4,860	1,060	2,070	11.2	12.91	127,000
August	1,170	471	735	3.99	4.60	45,200
September	1,570	268	497	2.70	3.01	29,600
The year	7,230	268	1,510	8.21	111.62	1,100,000

NORTH FORK OF SNOQUALMIE RIVER NEAR NORTH BEND, WASH.

LOCATION.—In sec. 34, T. 24 N., R. 8 E., at highway bridge one-eighth mile above mouth and 2 miles north of North Bend, in King County. Station removed to point 1½ miles upstream September 26, 1916.

DRAINAGE AREA.—102 square miles (measured on topographic and county maps).

RECORDS AVAILABLE.—July 4, 1907, to September 30, 1916. All records prior to October 1, 1915, published in Water-Supply Paper 412.

GAGE.—October 1–22, 1915, Fuller water-stage recorder on left abutment of highway bridge; October 23, 1915, to September 26, 1916, Friez water-stage recorder; after September 26, 1916, Friez water-stage recorder 1½ miles upstream. Gage inspected by R. C. McFadden and E. H. Robinson. See Water-Supply Paper 412 for description of earlier gages.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel; shifting at high stages. Banks fairly high; not subject to overflow. Stage-discharge relation probably affected by backwater from the Middle Fork when that stream is high.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.70 feet at 8 p. m. March 9 (discharge, 6,590 second-feet); minimum stage recorded, 1.82 feet at 1 a. m. October 1 (discharge, 71 second-feet).

1907–1916: Maximum stage, determined by leveling to high-water mark, 14.5 feet November 18, 1911 (discharge, 11,100 second-feet); water above gage November 18, 19, 23, 24, 29, and 30, 1909, and stage may have exceeded that reached in 1911. Minimum stage recorded, 2.16 feet September 5–7, 1914 (discharge, 59 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed October 25 and March 10, and probably changed slightly at other times. Rating curves applied as follows: October 1–24, well defined; October 25 to March 9, fairly well defined; March 10 to 5 p. m. September 26, well defined; September 26–30, well defined. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting graph, or, for days of considerable fluctuation, by averaging results obtained by applying gage height for shorter periods. Owing to uncertainty in regard to changes of stage-discharge relation during periods for which each rating curve was used, records are only fair.

COOPERATION.—Puget Sound Traction, Light & Power Co. furnished gage-height record and made some discharge measurements.

Discharge measurements of North Fork of Snoqualmie River near North Bend, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 2	McFadden and Norman	3.71	838	May 3	McFadden and Davidson	4.78	1,620
Dec. 2	McFadden and Robinson	3.31	550	Aug. 8	Hartson and Robinson	[a] 3.08	410
23	R. C. McFadden	4.24	1,240	9	Robinson and Hartson	[b] 3.03	343
Mar. 11	McFadden and Wilbur	5.95	3,470	Sept. 7	E. H. Robinson	2.80	257
31	Hartson and McFadden	3.76	773	21	J. T. Hartson	[c] 2.26	140
Apr. 4	McFadden and Hartson	3.99	936				

[a] Reading on new gage, 2.90 feet.
[b] Reading on new gage, 2.83 feet.
[c] Reading on new gage, 2.06 feet.

Daily discharge, in second-feet, of North Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	78	1,180	570	476	320	553	818	1,020	952	1,120	502	157
2	400	868	564	434	320	510	825	1,350	885	1,780	457	181
3	1,700	767	677	425	309	495	855	1,690	1,020	2,190	452	421
4	705	582	942	416	306	452	945	1,420	1,240	1,460	425	933
5	448	697	1,140	383	292	430	915	1,370	1,160	1,240	391	465
6	333	582	980	371	292	412	810	1,600	952	1,020	376	316
7	264	500	980	352	656	412	788	1,300	992	1,020	363	266
8	219	438	2,400	337	1,010	1,360	878	1,080	1,200	1,160	363	259
9	190	396	2,010	330	750	5,080	848	930	1,240	1,120	341	286
10	194	364	1,220	320	1,700	3,890	1,000	802	976	930	320	324
11	184	348	942	302	1,360	2,740	1,040	700	862	1,020	332	253
12	264	337	774	289	928	3,080	892	632	1,080	1,120	332	220
13	422	309	664	273	774	2,120	780	613	1,420	1,010	332	203
14	1,630	296	588	261	1,270	1,500	1,020	626	1,160	742	301	187
15	731	354	526	253	2,760	1,200	1,080	728	1,800	772	283	175
16	493	456	500	247	3,470	1,430	892	908	2,100	938	262	166
17	388	945	481	256	2,610	1,600	878	1,120	2,100	1,200	256	161
18	374	1,470	443	247	1,910	1,280	878	1,080	1,890	1,240	273	156
19	591	3,110	481	238	1,660	1,180	788	1,120	1,330	992	247	152
20	439	1,260	631	244	1,480	1,720	855	976	1,200	892	220	146
21	372	1,390	2,650	247	1,300	1,790	855	908	960	862	208	142
22	409	1,260	2,230	360	1,180	1,500	728	908	885	802	201	138
23	446	1,350	1,260	1,030	1,040	1,160	646	788	1,120	693	203	135
24	592	1,020	980	904	912	960	693	742	1,200	652	201	134
25	1,570	1,060	1,020	580	845	992	870	840	1,240	672	196	135
26	1,220	980	816	461	781	1,220	976	1,080	1,460	693	187	283
27	1,260	795	711	400	732	1,280	1,820	960	1,370	646	179	371
28	1,570	704	718	367	683	1,040	1,460	930	1,240	568	174	251
29	1,210	718	612	337	618	878	1,160	870	1,030	537	170	191
30	830	657	542	334	.....	788	992	818	968	550	166	171
31	1,800	.....	510	320	.....	772	.....	795	.....	581	161	.....

NOTE.—Gage height not recorded Oct. 22; discharge interpolated.

Monthly discharge of North Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 102 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	1,800	78	691	6.77	7.80	42,500
November	3,110	296	840	8.24	9.19	50,000
December	2,650	443	954	9.35	10.78	58,700
January	1,030	238	380	3.73	4.30	23,400
February	3,470	292	1,110	10.9	11.76	63,800
March	5,080	412	1,410	13.8	15.91	86,700
April	1,820	646	933	9.15	10.21	55,500
May	1,690	613	990	9.71	11.20	60,900
June	2,100	862	1,230	12.1	13.50	73,200
July	2,190	537	975	9.56	11.02	60,000
August	502	161	286	2.80	3.23	17,600
September	933	134	246	2.41	2.69	14,600
The year	5,080	78	837	8.21	111.59	607,000

SOUTH FORK OF SNOQUALMIE RIVER AT NORTH BEND, WASH.

LOCATION.—In NW. ¼ sec. 9, T. 23 N., R. 8 E., at Northern Pacific Railway bridge at North Bend, in King County, 2½ miles above mouth.

DRAINAGE AREA.—84 square miles (measured on topographic map).

RECORDS AVAILABLE.—July 21, 1907, to February 29, 1908, and June 26, 1908, to September 30, 1916. All records prior to October 1, 1915, published in Water Supply Paper 412.

GAGE.—Fuller water-stage gage recorder October 1–21 and Friez water-stage recorder after October 21, on right end of bridge; inspected by R. C. McFadden and E. H. Robinson. For history of gages used prior to October 1, 1915, see Water-Supply Paper 412.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 600 feet below bridge; prior to March 17, 1911, from bridge.

CHANNEL AND CONTROL.—Bed composed of small gravel; shifting at high stages. Stage of zero flow, according to measurements made September 2, 1915, gage height −0.1 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.25 feet at 4 a. m. March 10 (discharge, 3,100 second-feet); minimum stage recorded, 0.72 foot at 1 a. m. October 1 (discharge, 86 second-feet).

1907–1916: Maximum stage recorded, "Water over gage" November 3, 4, 19, 23, and 29, 1909 (gage height and discharge not determined); minimum stage recorded, 0.70 foot October 10, 11, 1908 (discharge, 68 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changing; numerous discharge measurements necessary to define rating curves, several of which have been constructed, applicable as follows: October 1 to noon October 2, well defined below 2,500 second-feet; noon October 2 to February 16, April 28 to June 17, farily well defined between 350 and 2,500 second-feet; February 17 to April 27, fairly well defined between 150 and 3,000 second-feet; June 18 to August 7, fairly well defined between 200 and 2,500 second-feet; September 7–30, fairly well defined between 150 and 3,000 second-feet. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspecting gage-height graph or, for days of considerable fluctuation, by averaging discharge for shorter periods; August 8 to September 6, by shifting-control method. Records good.

COOPERATION.—Puget Sound Traction, Light & Power Co. furnished gage-height record and made some discharge measurements.

Discharge measurements of South Fork of Snoqualmie River at North Bend, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 2	McFadden and Norman	1.82	521	Mar. 31	Hartson and McFadden	2.18	646
Nov. 3	....do	2.02	676	Apr. 2	J. T. Hartson	2.26	714
Dec. 1	R. C. McFadden	1.64	421	May 3	McFadden and Davidson	3.27	1,530
22	McFadden and Hornaday	3.58	1,760	Aug. 7	Robinson and Hartson	1.64	390
Feb. 16	McFadden and Stensloff	3.29	1,620	Sept. 7	E. H. Robinson	1.26	184
Mar. 9	McFadden and Wilbur	4.62	2,520	Sept. 27	J. T. Hartson	1.41	246

Daily discharge, in second-feet, of South Fork of Snoqualmie River at North Bend, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	115	1,450	407	456	283	459	670	970	900	911	500	178
2	545	830	391	418	283	426	700	1,180	935	1,330	472	187
3	1,270	654	376	396	305	426	730	1,480	879	1,640	455	214
4	512	618	428	381	294	384	778	1,440	1,080	1,260	438	316
5	318	581	609	371	283	364	772	1,400	1,080	1,070	422	260
6	266	544	609	356	283	369	730	1,400	935	869	412	207
7	213	508	648	337	406	395	712	1,260	935	813	391	193
8	191	439	972	328	628	892	766	1,080	1,080	960	391	190
9	177	396	1,060	323	720	1,300	778	970	1,180	995	382	196
10	184	361	758	309	970	2,630	850	865	970	834	370	199
11	170	351	622	287	893	1,860	934	778	886	869	362	190
12	180	328	520	278	668	1,950	838	713	1,000	960	357	181
13	274	309	462	269	570	1,660	736	694	1,180	918	357	172
14	517	291	412	259	609	1,200	796	700	1,370	707	330	172
15	550	314	376	250	1,000	955	844	752	1,560	681	315	167
16	341	351	361	241	1,480	934	778	858	1,800	759	295	164
17	283	548	351	231	1,420	969	760	1,000	1,880	841	283	159
18	266	724	328	249	1,200	878	760	1,000	1,760	869	278	156
19	351	1,730	346	257	1,060	838	712	1,080	1,300	720	268	153
20	300	1,040	371	257	892	1,060	736	1,000	1,030	681	242	151
21	278	865	1,400	274	796	1,310	736	935	841	681	228	148
22	257	765	2,080	418	742	1,160	682	886	953	637	223	146
23	277	830	1,160	635	658	927	634	810	960	583	228	141
24	337	732	900	616	598	802	598	758	1,030	583	232	138
25	703	823	865	473	562	820	658	778	1,070	553	228	146
26	737	829	713	376	550	934	748	935	1,180	523	213	189
27	622	622	642	323	538	990	1,100	935	1,180	500	202	294
28	752	533	674	300	533	844	1,290	900	1,030	477	191	193
29	720	508	590	296	498	736	1,110	879	904	483	191	162
30	622	456	527	318	.....	676	970	804	827	500	185	148
31	1,610	.....	491	300	.....	658	.....	752	.....	535	180	.....

NOTE.—No gage-height record Nov. 4–6; discharge interpolated. Float frozen in well Jan 12–15, 31, and Feb. 4; discharge interpolated.

Monthly discharge of South Fork of Snoqualmie River at North Bend, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 84 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	1,610	115	450	5.36	6.18	27,700
November	1,730	291	644	7.67	8.56	38,300
December	2,080	328	660	7.86	9.06	40,600
January	635	241	342	4.07	4.69	21,000
February	1,480	283	680	8.10	8.74	39,100
March	2,630	364	961	11.4	13.14	59,100
April	1,290	598	797	9.49	10.59	47,400
May	1,480	694	967	11.5	13.26	59,500
June	1,880	827	1,120	13.3	14.84	66,600
July	1,640	477	798	9.50	10.95	49,100
August	500	180	310	3.69	4.25	19,100
September	316	138	184	2.19	2.44	10,900
The year	2,630	115	659	7.85	106.70	478,000

STILAGUAMISH RIVER BASIN.

SOUTH FORK OF STILAGUAMISH RIVER NEAR SILVERTON, WASH.

LOCATION.—In SW. ¼ sec. 23, T. 30 N., R. 9 E., one-eighth mile above Silverton ranger station, one-fourth mile below Martin Creek, 2½ miles below Silverton, in Snohomish County, and 5 miles above Gold Basin.

DRAINAGE AREA.—45.4 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 1, 1910, to September 30, 1916 (fragmentary).

GAGE.—Vertical staff spiked to overhanging hemlock on right bank; read by G. E. Sawyer, A. G. Hannah, and Earl Anderson.

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

CHANNEL AND CONTROL.—Bed composed of boulders; apparently permanent. Right bank fairly high; not subject to overflow; left bank slopes back gradually and is covered by dense growth of alders. Stage of zero flow, according to measurements made in 1913 and 1916, gage height −0.5 foot ±0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6 feet December 9 (discharge, 4,440 second-feet); minimum stage recorded, 0.9 foot October 1, (discharge, 48 second-feet).

1910–1916: Maximum stage recorded, 7.0 feet November 20, 1910 (discharge 5,720 second-feet, revised determination); minimum stage recorded, 0.7 foot September 7, 23, 25, 26, 29-30, 1915 (discharge, 29 second-feet).

ICE.—Stage discharge relation affected by ice for short periods.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice January 1–3, 7-10, and 13-19. Gage read to hundredths once daily when rangers are at station. Rating curve well defined below 2,000 second-feet. Daily discharge ascertained by applying daily gage height to rating table. Records excellent except for periods of high water and periods in November and December, for which they were estimated by comparison with records of flow of nearest streams and are poor.

COOPERATION.—Gage-height record furnished by United States Forest Service.

Discharge measurements of South Fork of Stilaguamish River near Silverton, Wash., during the year ending Sept. 30, 1916.

[Made by J. T. Hartson.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 22	2.00	426
22	2.01	439

Daily discharge, in second feet, of South Fork of Stilaguamish River near Silverton, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	48	368	368	93	224	186	368	845	620	695	316	159
2	1,000	368	368	88	316	224	770	1,000	658	845	292	152
3	368	316	368	82	224	152	485	845	695	1,000	268	485
4	186	.....	425	77	182	186	550	845	770	882	264	425
5	169	.....	425	77	140	123	550	770	770	882	264	342
6	123	.....	425	77	98	98	488	770	732	882	246	205
7	88	425	425	77	845	246	425	770	770	845	233	138
8	71	.....	695	77	485	307	485	845	770	845	255	169
9	54	.....	4,440	77	485	368	620	808	770	808	233	186
10	60	.....	770	77	1,260	1,520	1,000	770	845	770	224	171
11	98	.....	.....	77	368	1,080	845	732	845	770	268	157
12	425	.....	.....	77	224	3,210	695	695	1,000	770	255	142
13	845	.....	.....	77	79	1,000	550	658	1,080	732	255	127
14	425	.....	.....	77	1,170	712	695	695	1,080	732	233	113
15	425	.....	.....	78	2,740	425	625	695	1,170	732	213	98
16	268	.....	.....	78	3,210	342	555	695	1,170	695	220	98
17	224	.....	.....	78	1,170	224	485	695	1,000	658	183	98
18	224	.....	.....	79	485	387	550	620	882	550	233	88
19	186	.....	.....	79	770	550	485	620	882	550	169	77
20	205	.....	.....	79	770	1,340	485	550	732	550	138	77
21	246	224	2,980	79	845	1,900	485	550	608	518	149	88
22	316	.....	845	79	316	1,190	550	550	485	425	169	138
23	425	.....	485	2,310	342	485	620	585	550	425	186	152
24	485	.....	620	316	283	425	695	770	550	425	186	194
25	1,000	.....	494	123	224	1,000	695	550	550	368	186	224
26	695	.....	368	98	169	550	845	620	550	368	186	485
27	620	368	268	60	60	425	1,000	620	620	326	186	342
28	695	316	186	152	110	425	770	695	620	306	186	186
29	732	316	98	98	148	368	770	658	620	306	186	138
30	770	425	98	152	.....	268	845	485	695	425	176	110
31	3,810	.....	98	224	.....	224	.....	485	.....	396	169	.....

NOTE.—Discharge estimated by hydrographic comparison with records of flow of Sauk, Sultan, and North Fork of Skykomish rivers as follows: Nov. 4–6, 460 second-feet; Nov. 8–20, 520 second-feet; Nov. 22–26, 310 second-feet; Dec. 11–20, 540 second-feet. Gage not read Oct. 8, Dec. 25, Feb. 4, 5, 24, 29, Mar. 1, 8, 14, 18, 22, Apr. 6, 15, 16, June 21, Aug. 25, 27, Sept. 10–14; discharge interpolated. Stage-discharge relation affected by ice, Jan. 1–3, 7–10, and 13–19; discharge interpolated.

Monthly discharge of South Fork of Stilaguamish River near Silverton, Wash., for the year ending September 30, 1916.

[Drainage area, 45.4 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	3,810	48	493	10.9	12.57	30,300
November	.....	.....	427	9.41	10.50	25,400
December	4,440	98	666	14.7	16.95	41,000
January	2,310	60	170	3.74	4.31	10,500
February	3,210	60	612	13.5	14.56	35,200
March	3,210	98	643	14.2	16.37	39,500
April	1,000	368	633	13.9	15.51	37,700
May	1,000	485	693	15.3	17.64	42,600
June	1,170	485	770	17.0	18.97	45,800
July	1,000	306	628	13.8	15.91	38,600
August	316	138	217	4.78	5.51	13,300
September	485	77	185	4.07	4.54	11,000
The year	4,440	48	511	11.3	153.34	371,000

SKAGIT RIVER BASIN.

SKAGIT RIVER AT REFLECTOR BAR, NEAR MARBLEMOUNT, WASH.

LOCATION.—In sec. 8, T. 36 N., R. 13 E. (unsurveyed), at Reflector Bar ranger station, just below mouth of Canyon Diablo, three-fourths mile above Stetattle Creek, 1½ miles below Thunder Creek, and 23 miles (by trail) northeast of Marblemount, in Whatcom County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—December 6, 1913, to September 30, 1916.

GAGE.—Stevens water-stage recorder on right bank, 75 feet below mouth of Canyon Diablo, installed April 13, 1914; inspected by Henry Soll, Thomas Thompson, and W. L. Stillwell. Prior to April 13, 1914, inclined staff at same site but at datum 2.00 feet higher.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet below gage.

CHANNEL AND CONTROL.—Control 200 feet below gage; composed of large boulders near right bank, clean gravel in center, and sand near left bank; may shift during floods. One channel at all stages. Banks not subject to overflow. Stage of zero flow, according to measurements made September 21, 1916, gage height −0.5 foot ±0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year 10.5 feet at 2 p. m. June 17 (discharge, 29,400 second-feet); minimum stage recorded, 2.24 feet at 8.30 a. m. January 4 (discharge, 1,170 second-feet).

1913–1916: Maximum stage recorded June 17, 1916; minimum stage recorded, 1.74 feet from 1 to 10 a. m. January 28, 1915 (discharge, 707 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Water-stage recorder not operating January 5 to May 15, May 19–23, and July 21 to September 18. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting gage-height graph or, for days of considerable fluctuation, by averaging results obtained by applying gage heights for shorter intervals. Records prior to January 5, excellent; records based on hydrographic comparison with other streams and study of weather records, when recorder was not operating, poor; records for remainder of year, fair. See note to table of daily discharge.

COOPERATION.—Station maintained in cooperation with United States Forest Service and Skagit Power Co.

Discharge measurements of Skagit River at Reflector Bar, near Marblemount, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 24	C. O. Brown	7.61	17,100	Sept. 20	J. E. Stewart	2.89	1,990
25	do	7.74	17,300	21	do	2.99	2,170

NOTE.—On June 19 a measurement was begun at gage height 8.95 feet but meter was lost when measurement was about one-third complete; discharge estimated, from measurements June 24–25, at 22,500 second-feet.

Daily discharge, in second-feet, of Skagit River at Reflector Bar, near Marblemount, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	May.	June.	July.	Aug.	Sept.
1	1,390	4,410	1,220	1,380	.....	8,840	11,800	7,020	4,410
2	1,570	3,730	1,200	1,260	.....	9,550	13,800	6,350	5,820
3	1,310	3,420	1,160	1,200	.....	11,000	14,600	5,609	5,410
4	1,100	3,210	1,240	1,170	.....	12,200	12,600	5,020	.....
5	1,270	3,210	1,310	.....	.....	11,800	11,800	5,020	.....
6	1,100	2,920	1,420	.....	.....	10,600	11,000	5,150	.....
7	973	2,640	1,450	.....	.....	10,600	11,400	5,200	.....
8	935	2,460	2,900	.....	.....	11,800	14,200	5,250	.....
9	917	2,280	3,620	.....	.....	13,400	15,400	5,310	.....
10	836	2,040	2,920	.....	.....	12,200	13,800	5,360	.....
11	794	1,960	2,550	.....	.....	11,000	14,200	5,410	.....
12	899	1,790	2,200	.....	.....	11,800	15,000	5,540	.....
13	982	1,650	2,040	.....	.....	14,200	13,800	5,960	.....
14	1,170	1,640	1,880	.....	.....	16,600	10,600	6,100	.....
15	973	1,590	1,790	.....	.....	20,100	9,910	5,410	.....
16	926	1,550	1,720	.....	5,680	26,700	11,000	4,650	.....
17	899	1,630	1,610	.....	6,860	29,000	11,400	3,950	.....
18	1,140	1,590	1,560	.....	7,490	27,600	9,910	3,420	.....
19	1,250	1,570	1,500	.....	.....	21,400	8,660	3,110	2,040
20	1,350	1,470	1,560	.....	.....	15,800	9,190	2,920	2,100
21	1,810	1,470	2,440	.....	.....	13,400	8,840	2,920	2,180
22	1,650	1,440	2,550	.....	.....	14,200	8,150	3,310	2,460
23	1,640	1,460	2,280	.....	.....	15,800	7,820	3,950	2,180
24	1,520	1,410	2,200	.....	7,660	16,600	7,330	4,180	2,100
25	2,250	1,460	2,040	.....	7,980	17,100	7,490	4,900	2,050
26	3,350	1,540	1,870	.....	9,550	19,200	6,550	4,650	2,280
27	3,740	1,440	1,750	.....	10,600	20,100	6,250	4,650	2,050
28	6,160	1,340	1,710	.....	10,600	18,300	6,100	4,490	1,720
29	4,610	1,340	1,550	.....	9,910	15,000	5,960	4,340	1,670
30	3,730	1,270	1,400	.....	9,190	12,600	6,100	4,180	1,670
31	4,630	.....	1,410	.....	8,840	.....	7,170	4,300	.....

NOTE.—Water-stage recorder not operating Jan. 5 to May 15, May 19-23, and Sept. 4-18; discharge estimated by hydrographic comparison with Skagit River near Sedro Woolley, Baker River below Anderson Creek, near Concrete, and Sauk River at Darrington, and study of weather records, as follows: May 19-23, 8,000 second-feet; Sept. 4-8, 3,650 second-feet; Sept. 9-13, 2,500 second-feet; and Sept. 14-18, 2,250 second-feet. Recorder not operating July 21 to Sept. 3. Gage read once daily July 21 to Aug. 1, Aug. 4-6, 11-27, 30, and Sept. 1-3. Discharge interpolated Aug. 2, 3, 7-10, 28, 29, and 31.

Monthly discharge of Skagit River at Reflector Bar, near Marblemount, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre feet).
	Maximum.	Minimum.	Mean.	
October	6,160	794	1,830	113,000
November	4,410	1,270	2,030	121,000
December	3,620	1,160	1,870	115,000
January	.....	.....	860	52,900
February	.....	.....	1,170	67,300
March	.....	.....	1,720	106,000
April	.....	.....	3,020	180,000
May	.....	.....	8,210	505,000
June	29,000	8,840	15,600	928,000
July	15,400	5,960	10,400	640,000
August	7,020	2,920	4,760	293,000
September	5,820	1,670	2,740	163,000
The year	29,000	.....	4,520	3,280,000

NOTE.—Monthly discharge January to April estimated by hydrographic comparison with record of flow of Skagit River near Sedro Woolley, Baker River below Anderson Creek, near Concrete, and Sauk River at Darrington, and study of weather records. Mean discharge for May based on estimate of flow for period May 1-15 determined from the hydrographic comparison.

SKAGIT RIVER NEAR SEDRO WOOLLEY, WASH.

LOCATION.—In NW. ¼ sec. 36, T. 35 N., R. 4 E., at Northern Pacific Railway bridge three-fourths mile below intake of Beatty's slough, 1½ miles south of Sedro Woolley in Skagit County, 21 miles above mouth, and 32 miles below Baker River.

DRAINAGE AREA.—2,930 square miles (measured on General Land Office map).

RECORDS AVAILABLE.—May 1, 1908, to September 30, 1916.

GAGE.—Vertical staff on upstream draw guard of Northern Pacific Railway bridge; read by E. J. Woods. Zero of gage set at elevation of extreme low water in Puget Sound. Temporary gage used when stage was below 37 feet; installed September 25, 1915, on downstream side of group of piles, 50 feet above third concrete pier from left bank of railway bridge.

DISCHARGE MEASUREMENTS.—Made from highway bridge one-third mile above gage. Beatty's slough measured from highway bridge.

CHANNEL AND CONTROL.—Gravel; shifts at high stages. Banks not subject to overflow except during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 46.5 feet at 3 p. m. June 18 (discharge, 63,800 second-feet); minimum stage recorded, 32.3 feet at 7 a. m. October 10-11 (discharge, 2,740 second-feet).

1908-1916: Maximum stage recorded, 56.1 feet November 30, 1909 (discharge, 96,100 second-feet); minimum stage recorded, 32.3 feet September 29-30 and October 10-11, 1915 (discharge 2,740 second-feet).

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

DIVERSIONS.—Beatty's slough carries from 1.5 per cent of total flow at low stages to 8 per cent at high stages. Amount determined at each visit and added to flow measured in main channel.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water in June. Rating curve used before June 18 well defined between 3,500 and 18,000 second-feet, fairly well defined above and below these limits, curve used after June 18 fairly well defined above and poorly defined below 6,000 second-feet. Gage read to half-tenths daily; crest gage heights observed or estimated. Practically no diurnal fluctuation. Records good except for a short period in January and in February, for which they are only fair, on account of ice.

Discharge measurements of Skagit River near Sedro Woolley, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.		Discharge.
		Old gage.	Temporary gage.	
		Feet.	*Feet.*	*Sec.-ft.*
Dec. 12	J. T. Hartson	36.40	36.35	15,500
13	do	35.85	35.80	12,800
June 22	C. O. Brown	40.00	.....	31,800
28	do	42.95	.....	48,800
Sept. 27	J. E. Stewart	34.97	35.49	10,900

Daily discharge, in second-feet, of Skagit River near Sedro Woolley, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,960	31,900	8,150	7,220	4,920	11,800	13,200	19,200	20,000	32,200	25,300	13,700
2	6,920	18,800	7,220	6,920	4,660	11,100	13,900	22,100	20,000	34,800	22,500	13,000
3	7,530	18,000	8,460	6,320	4,890	10,400	14,300	30,000	21,700	41,200	21,600	14,100
4	6,030	15,700	12,500	6,030	5,120	9,740	15,300	33,300	28,100	44,000	20,300	15,900
5	4,400	16,100	12,100	5,740	5,340	8,780	16,800	32,800	30,000	35,800	19,800	13,700
6	5,460	15,000	13,500	4,920	5,570	8,460	15,700	33,800	24,400	34,200	19,800	11,700
7	3,900	12,500	13,200	4,920	5,800	8,150	15,000	33,800	22,600	30,700	20,300	10,300
8	3,420	10,400	22,100	5,460	6,030	11,100	15,700	28,100	23,900	34,200	21,200	9,650
9	3,420	10,100	46,700	5,190	5,460	22,100	16,100	25,300	30,000	42,900	21,600	10,300
10	2,740	9,100	26,200	4,920	8,150	31,900	16,800	21,700	28,600	39,000	20,300	9,010
11	2,740	8,460	19,200	3,900	12,500	27,600	18,400	19,200	24,400	36,800	20,700	8,080
12	2,960	7,840	15,300	3,660	9,100	35,200	18,400	17,600	24,400	41,800	21,200	7,780
13	5,190	6,920	13,500	3,660	7,220	38,200	16,800	16,800	29,000	41,800	21,600	7,780
14	10,700	6,320	12,100	3,420	8,460	28,100	16,100	15,300	35,700	35,300	21,600	7,780
15	8,460	6,030	10,400	3,190	22,600	23,000	18,400	15,300	42,700	29,600	20,700	7,180
16	5,460	6,920	9,420	3,190	48,800	19,600	16,800	17,600	52,900	32,700	19,000	7,180
17	4,400	7,530	9,100	3,350	46,700	19,200	15,700	20,000	61,200	37,400	15,500	7,480
18	4,400	11,400	8,150	3,510	32,800	17,600	15,700	22,100	63,300	36,800	13,700	7,480
19	9,100	14,600	7,840	3,670	26,700	16,100	15,300	22,600	59,900	31,700	13,000	7,480
20	6,620	12,500	9,100	3,830	24,800	16,100	14,600	23,500	45,100	28,600	12,000	7,180
21	10,400	9,420	12,100	3,990	23,500	21,700	14,300	23,000	41,200	32,200	11,000	7,180
22	8,460	11 400	24,400	4,150	21 700	20 400	14 300	21,700	32,200	29,100	11,300	7,180
23	7,220	11,400	17,200	10,400	20,000	21,700	13,200	19 200	35,300	29,600	12,300	7,780
24	9,100	12,100	13,500	13,200	18,000	18,400	12,500	18,000	41,800	27,200	13,700	7,180
25	11,100	10,100	14,300	8,460	15,700	16,800	12,800	18,000	42,900	27,200	15,200	6,890
26	16,800	11,800	12,500	6,920	14,600	15,700	14,300	20,800	44,600	27 200	15 900	7,780
27	22,100	11,100	11,100	5,740	14,300	18,400	17,200	23,900	52,400	23,900	15,900	12,000
28	33,800	9,420	10,400	5,190	13,200	15,700	24,800	23,900	48,500	22,000	15,900	8,080
29	30,900	9,740	9,420	5,190	12,500	15,000	22,100	23,500	46,800	22,000	15,500	6,600
30	18,000	9,420	7,840	4,920	.....	13,500	19,600	21,300	34,800	22,500	15,200	6,020
31	25,300	.....	7,220	4,920	.....	12,800	.....	20,000	.....	24,800	14,100	.....

NOTE.—Stage discharge relation seriously affected by ice jam one-half mile below gage Jan. 17–31; discharge interpolated. Gage heights doubtful on account of ice at gage Feb. 3–7; discharge interpolated.

Monthly discharge of Skagit River near Sedro Woolley, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 2,930 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	33,800	2,740	9,680	3.30	3.80	595,000
November	31,900	6,030	11,700	3.99	4.45	696,000
December	46,700	7,220	13,700	4.68	5.40	842,000
January	13,200	3,190	5,360	1.83	2.11	330,000
February	48,800	4,660	16,000	5.46	5.89	920,000
March	38,200	8,150	18,200	6.21	7.16	1,120,000
April	24,800	12,500	16,100	5.49	6.12	958,000
May	33,800	15,300	22,700	7.75	8.94	1,400,000
June	63,300	20,000	36,900	12.6	14.06	2,200,000
July	44,000	22,000	32,600	11.1	12.80	2,000,000
August	25,300	11,000	17,700	6.04	6.96	1,090,000
September	15,900	6,020	9,120	3.11	3.47	543,000
The year	63,300	2,740	17,400	5.94	81.16	12,700,000

SAUK RIVER AT DARRINGTON, WASH.

LOCATION.—In SE. ¼ sec. 24, T. 32 N., R. 9 E., half a mile southeast of Darrington, in Snohomish County, 2½ miles below Clear Creek, and 23 miles above mouth of river.

DRAINAGE AREA.—293 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 15, 1914, to September 30, 1916.

GAGE.—Vertical staff attached to log crib on left bank, 700 feet above suspension footbridge; read by Paul Schmidt.

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

CHANNEL AND CONTROL.—Bed composed of gravel and large boulders. Left bank high and not subject to overflow; right bank flat and subject to overflow at extremely high stages. Stage of zero flow, according to measurements made September 7, 1915, gage height —1.70 feet±0.5 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.9 feet on December 8 (discharge, 12,500 second-feet); minimum stage recorded, 0.88 foot at 5.25 p. m. October 11 (discharge, 370 second-feet).

1914–1916: Maximum stage recorded, 8.47 feet at 4.30 p. m. April 2, 1915 (discharge, 20,400 second-feet); minimum stage recorded, 0.78 foot September 28–29, 1915 (discharge, 340 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Gage read to hundredths once daily. Rating curve well defined between 500 and 5,000 second-feet. Daily discharge ascertained by applying daily gage height to rating table. Records excellent except for periods of extremely high water.

COOPERATION.—Gage-height record furnished by United States Forest Service.

Discharge measurements of Sauk River at Darrington, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
June 21	C. O. Brown	4.45	3,740	June 27	C. O. Brown	5.16	5,660
21	do	4.42	3,730	Sept. 15	James E. Stewart	1.93	798

Daily discharge, in second-feet, of Sauk River at Darrington, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	618	4,160	975	975	418	1,420	1,590	2,540	2,390	4,690	2,870	1,260
2	1,890	3,450	1,180	910	400	1,340	1,780	3,670	2,540	5,870	2,540	1,260
3	1,180	2,700	1,340	850	418	1,260	2,000	4,420	3,050	6,520	2,250	1,260
4	790	2,120	1,780	850	435	1,180	2,000	4,420	3,670	5,260	2,250	1,420
5	690	2,250	2,250	790	435	1,110	2,000	4,420	3,240	4,160	2,000	1,420
6	550	1,890	2,250	740	490	1,110	2,000	4,690	2,870	4,160	2,000	1,260
7	470	1,590	4,970	690	740	1,340	2,000	3,670	3,240	4,690	2,250	1,110
8	452	1,420	12,500	690	1,260	2,700	2,000	3,240	3,910	4,690	2,250	975
9	435	1,340	4,690	618	1,780	4,970	2,120	2,870	3,910	5,260	2,250	975
10	400	1,180	2,870	572	3,450	4,420	2,540	2,390	3,450	5,260	2,250	850
11	370	1,040	2,120	550	3,450	3,910	2,390	2,250	3,050	5,870	2,540	850
12	510	975	1,680	550	1,590	9,460	2,120	2,120	3,910	4,690	2,250	850
13	1,780	850	1,590	530	2,540	3,910	2,000	2,000	5,260	4,160	2,250	790
14	1,590	850	1,340	530	4,160	2,870	2,120	1,890	6,860	3,670	2,250	740
15	975	910	1,180	510	7,570	2,390	2,250	2,250	7,570	4,160	2,000	850
16	740	1,260	1,180	510	9,070	2,390	2,000	2,870	9,460	5,260	1,780	850
17	640	2,250	1,040	510	5,260	2,250	2,000	2,870	9,860	4,690	1,590	850
18	690	1,780	975	490	3,910	2,120	1,890	3,050	7,930	4,160	1,590	850
19	790	3,050	1,040	490	3,450	2,120	2,120	3,240	5,870	4,160	1,260	850
20	790	1,780	1,260	510	3,240	2,250	1,890	2,870	4,420	4,160	1,180	790
21	790	2,540	6,860	530	2,870	3,670	1,680	2,700	3,670	3,670	1,110	740
22	910	1,780	3,450	550	2,540	3,050	1,500	2,390	3,910	3,240	1,340	740
23	1,500	1,680	2,250	530	2,250	2,540	2,540	2,250	5,260	3,240	1,590	690
24	1,680	1,590	2,000	510	2,000	2,250	2,250	2,250	5,560	2,870	1,780	640
25	2,540	1,780	1,780	510	1,890	2,120	1,780	2,540	5,560	2,870	1,780	850
26	2,540	1,680	1,590	490	1,780	2,700	2,250	3,050	6,190	2,540	1,780	1,260
27	2,870	1,340	1,500	452	1,680	2,390	3,670	2,870	6,190	2,250	1,590	975
28	5,560	1,180	1,420	452	1,590	2,000	2,870	2,870	5,260	2,250	1,590	1,590
29	2,390	1,340	1,180	435	1,500	1,780	2,540	2,540	4,160	2,540	1,420	690
30	2,000	1,110	1,110	435	.....	1,590	2,250	2,390	3,910	2,870	1,420	640
31	11,100	.....	1,040	418	.....	1,680	.....	2,250	.....	3,240	1,420	.....

Monthly discharge of Sauk River at Darrington, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 293 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	11,100	370	1,620	5.53	6.38	99,600
November	4,160	850	1,760	6.01	6.70	105,000
December	12,500	975	2,340	7.99	9.21	144,000
January	975	418	586	2.00	2.31	36,000
February	9,070	400	2,490	8.50	9.17	143,000
March	9,460	1,110	2,590	8.84	10.19	159,000
April	3,670	1,500	2,140	7.30	8.14	127,000
May	4,690	1,890	2,900	9.90	11.41	178,000
June	9,860	2,390	4,870	16.6	18.52	290,000
July	6,520	2,250	4,100	14.0	16.14	252,000
August	2,870	1,110	1,880	6.42	7.40	116,000
September	1,590	640	962	3.28	3.66	57,200
The year	12,500	370	2,350	8.02	109.23	1,710,000

BAKER RIVER BELOW ANDERSON CREEK, NEAR CONCRETE, WASH.

LOCATION.—In SE. ¼ sec. 30, T. 37 N., R. 9 E., 350 feet below Anderson Creek, a quarter of a mile above the Baker River ranger station, and 11 miles above Concrete, in Skagit County.

DRAINAGE AREA.—184 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 10, 1910, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank, installed September 24, 1915, inspected by G. C. Burch. Previous gages as follows: September 10 to November 19, 1910, vertical staff at trail bridge one-eighth mile above Anderson Creek; readings reduced to datum of gage installed October 22, 1910, by means of relation curve; October 22, 1910, to September 4, 1913, vertical and inclined staff gage on left bank, 30 feet above present gage; September 21, 1913, to September 23, 1915, one inclined and two vertical sections at practically the same site as the gages previously used but at different datum. Water-stage recorder referred to datum of staff gage last used, but slight change in location changed the rating.

DISCHARGE MEASUREMENTS.—Made from a cable 300 feet above gage.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel over bedrock; not likely to shift except during extremely high water. Right bank high and rocky; left bank fairly high, wooded, subject to overflow at about 11-foot stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.80 feet at 10 p. m. February 15 (discharge, 14,800 second-feet); minimum stage recorded, 2.48 feet January 18 to 21 (discharge, 525 second-feet).

1910–1916: Maximum stage recorded, 12.6 [1] feet at 3 p. m. January 6, 1914 (discharge, 24,900 second-feet, revised determination); minimum stage recorded, 2.6 feet February 27 and March 1, 1911 (discharge, 410 second-feet).

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

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined up to 10,000 second-feet. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspection of gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying heights for shorter intervals. Records excellent except for periods in which water was extremely high or water-stage recorder was not operating.

COOPERATION.—Station maintained in cooperation with United States Forest Service.

Discharge measurements of Baker River below Anderson Creek, near Concrete, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 2	Parker and Hall	5.13	2,540	Dec. 29	C. G. Paulsen	3.30	908
3	....do	4.99	2,430	June 16	C. O. Brown	7.02	7,700
Dec. 10	J. T. Hartson	5.51	3,120	16	...do	7.04	7,770
10	.....do	5.35	2,920	Sept. 16	J. E. Stewart	3.60	1,070
11	.....do	4.80	2,330				

NOTE.—The following discharge measurements made by James E. Stewart have been recomputed since publication in Water-Supply Paper 392:
Oct. 11, 1913: Gage height, 7.15 feet; discharge, 7,830 second-feet.
Oct. 12, 1913: Gage height, 6.88 feet: discharge, 6,750 second-feet.

[1] Gage height 11.1 feet used for computing discharge, 1.5 feet being difference in comparative readings of the gage read by observer at 12-foot stage and the gage rated by meter measurements.

Daily discharge, in second-feet, of Baker River below Anderson Creek, near Concrete, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	880	3,290	821	765	561	1,180	1,410	2,520	2,060	3,210	3,060	2,060
2	1,590	2,640	850	738	561	1,110	1,540	3,130	2,280	4,100	2,780	2,110
3	1,250	2,460	1,040	713	543	1,040	1,690	3,980	2,580	4,480	2,640	2,060
4	943	2,220	1,540	665	543	975	1,890	3,660	2,910	3,760	2,460	1,940
5	1,040	2,280	1,590	665	543	911	1,790	3,290	2,780	3,470	2,580	1,640
6	911	1,790	1,640	642	543	880	1,690	3,660	2,400	3,210	2,710	.....
7	738	1,500	1,780	642	665	911	1,690	3,210	2,400	3,210	3,060	.....
8	713	1,290	7,230	642	642	1,290	1,790	2,640	2,780	4,220	3,060	.....
9	665	1,180	5,760	642	621	3,010	1,890	2,220	3,210	4,350	2,780	.....
10	600	1,080	3,060	611	911	3,470	2,110	1,840	2,640	3,660	2,780	.....
11	580	1,010	2,160	580	1,040	3,660	2,110	1,590	2,460	4,350	2,980	.....
12	943	911	1,690	580	911	5,930	1,940	1,500	2,910	4,770	3,130	.....
13	1,780	850	1,460	561	880	4,220	1,740	1,410	3,760	4,220	3,130	.....
14	.....	850	1,290	561	1,740	2,840	2,060	1,500	2,780	3,130	2,980	1,010
15	.....	850	1,250	543	9,000	2,220	2,160	1,740	6,290	3,130	2,710	1,080
16	.....	911	1,220	525	12.600	1,940	1,890	2,220	7,790	4,620	2,220	1,140
17	.....	1,140	1,180	525	7,220	1,790	1,790	2,640	7,980	5,410	1,790	1,250
18	.....	1,220	1,040	525	3,980	1,590	1,690	2,640	6,840	4,350	1,540	1,220
19	.....	1,290	1,040	525	3,210	1,640	1,640	2,710	4,480	3,470	1,460	1,220
20	2,800	1,110	1,360	525	2,910	3,010	1,590	2,520	3,380	3,380	1,410	1,180
21	2,910	1,140	1,680	525	2,780	3,290	1,540	2,340	2,840	3,290	1,500	1,250
22	2,220	1,180	2,000	600	2,580	2,710	1,540	2,060	3,060	3,660	1,790	1,290
23	1,890	1,290	1,690	943	.....	2,220	1,410	1,840	4,100	3,380	2,160	1,220
24	1,890	1,220	1,500	880	.....	1,840	1,410	1,740	4,920	3,060	2,340	1,080
25	3,350	1,140	1,330	765	.....	1,640	1,590	1,840	4,770	3,210	2,710	1,180
26	5,570	1,330	1,140	713	.....	1,790	1,820	2,840	5,760	3,210	2,840	1,640
27	7,030	.....	1,040	665	1,540	1,740	3,280	2,710	5,930	2,710	2,780	1,330
28	10,400	.....	1,010	621	1,460	1,540	3,130	2,640	4,920	2,710	2,640	1,080
29	5,240	.....	911	600	1,330	1,410	2,580	2,400	3,660	2,840	2,580	975
30	2,910	911	850	580	.....	1,290	3,760	2,160	2,980	3,130	2,340	943
31	3,890	.....	821	561	.....	1,290	.....	2,110	.....	3,380	2,160	.....

NOTE.—Discharge Oct. 14–19 estimated at 1,650 second-feet by hydrographic comparison with records of flow of Skagit and Sauk rivers. Discharge Nov. 27–29, Feb. 23–26, and Sept. 6–13, estimated by interpolation at 1,120, 2,060, and 1,320 second-feet, respectively, after study of records of Skagit and Sauk rivers. No gage-height record Dec. 15, 16, 20, 21, and Jan. 10; discharge interpolated.

Monthly discharge of Baker River below Anderson Creek, near Concrete, Wash., for the year ending Sept. 30, 1916.

[Discharge area, 184 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	10,400	580	2,340	12.7	14.64	144,000
November	3,290	850	1,380	7.50	8.37	82,100
December	7,230	821	1,710	9.29	10.71	105,000
January	943	525	633	3.44	3.97	38,900
February	12,600	543	2,330	12.7	13.70	134,000
March	5,930	880	2,080	11.3	13.03	128,000
April	3,760	1,410	1,940	10.5	11.71	115,000
May	3,980	1,410	2,430	13.2	15.22	149,000
June	7,980	2,060	3,920	21.3	23.76	233,000
July	5,410	2,710	3,650	19.8	22.83	224,000
August	3,130	1,410	2,490	13.5	15.56	153,000
September	2,110	943	1,350	7.34	8.19	80,300
The year	12,600	525	2,190	11.9	161.69	1,590,000

UPPER COLUMBIA RIVER BASIN.

MAIN STREAM.

COLUMBIA RIVER AT TRAIL, B. C.

LOCATION.—At highway bridge at Trail, about 10 miles above international boundary and mouth of Clark Fork, and about 18 miles below mouth of Kootenai River.

DRAINAGE AREA.—34,000 square miles.

RECORDS AVAILABLE.—April 18, 1913, to September 30, 1916.

GAGE.—Chain gage installed on bridge in June, 1913; read by C. A. Broderick. Original gage painted on bridge pier.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Channel straight for a quarter of a mile above and below gage. Riffle control short distance below gage; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 40.6 feet June 30 (discharge, 306,000 second-feet); minimum stage recorded, 8.0 feet February 10-11 (discharge, 12,000 second-feet).

1913–1916: Maximum stage recorded, 41.6 feet June 14-15, 1913 (discharge, 312,000 second-feet); minimum stage recorded, February 10–11, 1916.

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

DIVERSIONS.—A small amount of water is diverted above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Gage read twice daily to tenths. Rating curve well defined below and fairly well defined above 150,000 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent for periods of low water and good for high water.

COOPERATION.—Complete record furnished by British Columbia Hydrometric Survey.

Discharge measurements of Columbia River at Trail, B. C., during the year ending Sept. 30, 1913–1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
1913.		*Feet.*	*Sec.-ft.*	1915.		*Feet.*	*Sec.-ft.*
May 1	Richardson and Biker	15.4	58,700	Jan. 4	Elliott and Beeston	10.0	23,800
June 11	do	40.2	297,000	Feb. 11	Elliott and Corbould	8.8	17,100
Aug. 6	Lawler and Venables	26.1	142,000	June 4	Dempster and Beeston	24.7	125,000
7	Richardson and Elliott	26.1	145,000	Aug. 9	do	25.9	144,000
Sept. 4	Lawley and Venables	21.0	97,600	Dec. 23	Richardson and Dempster	10.2	19,100
Nov. 5	Richardson and Webb	13.1	37,500				
1914.				1916.			
Jan. 15	C. E. Webb	9.5	22,300	Feb. 9	Dempster and Beeston	8.2	13,300
Apr. 17	Webb and Gill	10.5	25,000	June 6	Elliott and Patterson	24.75	126,000
June 2	Elliott and Beeston	28.3	151,000	25	T. R. Patterson	39.12	313,000
July 17	Elliott and Gill	33.7	213,000	July 20	do	37.65	262,000
Nov. 11	Elliott and Beeston	14.6	48,900	Aug. 8	do	27.67	160,000
				Sept. 6	do	22.63	109,000
				28	Elliott and Patterson	16.60	63,100

Daily discharge, in second-feet, of Columbia River at Trail, B. C., for the years ending Sept. 30, 1913–1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1913.													
1	.....	58,200	191,000	236,000	152,500	97,600	16	.....	77,600	306,000	174,000	131,000	83,200
2	.....	57,500	202,000	232,000	149,800	96,800	17	.....	82,400	298,000	170,000	129,200	80,000
3	.....	57,500	214,000	227,000	147,100	96,800	18	28,800	85,600	291,000	164,200	125,600	79,200
4	.....	57,500	226,000	222,200	144,400	96,000	19	30,000	86,400	282,000	160,600	121,100	77,600
5	.....	56,800	239,000	217,000	141,700	96,000	20	30,600	87,200	274,000	157,000	116,600	76,000
6	.....	56,800	248,000	213,000	139,000	97,600	21	33,000	88,000	266,000	153,400	111,200	74,500
7	.....	56,800	258,000	204,000	139,900	98,400	22	35,000	89,600	259,000	149,800	110,300	73,700
8	.....	58,200	258,000	200,000	139,900	98,400	23	43,500	92,800	253,000	149,800	106,700	72,200
9	.....	61,300	256,000	196,000	139,000	98,400	24	43,500	97,600	252,000	154,300	102,400	69,800
10	.....	63,700	279,000	193,000	138,200	97,600	25	45,600	106,700	250,000	156,100	100,800	67,500
11	.....	66,000	290,000	192,000	137,400	96,800	26	48,400	116,600	250,000	159,700	100,800	66,800
12	.....	68,300	295,000	191,000	137,400	94,400	27	51,200	126,500	247,000	162,400	99,200	65,300
13	.....	71,400	308,000	189,000	136,600	91,200	28	53,300	137,400	246,000	161,500	100,000	63,700
14	.....	73,000	312,000	184,000	135,000	88,800	29	54,700	146,200	244,000	158,800	100,000	62,900
15	.....	76,000	312,000	179,000	132,600	86,400	30	56,800	154,300	241,000	155,200	100,000	62,100
							31	.....	165,100	.....	153,400	98,400	.....

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1913–14.												
1	60,500	39,300	27,800	22,000	18,600	15,500	24,250	71,300	163,500	195,000	140,500	85,200
2	59,700	38,600	27,500	21,500	18,600	15,500	23,750	74,400	163,000	196,000	138,000	84,000
3	57,500	37,200	26,800	21,500	18,300	15,500	24,250	78,400	165,000	197,500	137,000	82,000
4	56,100	37,200	26,300	21,500	18,300	15,500	24,750	83,200	169,000	203,500	135,500	80,400
5	54,700	36,600	26,300	21,000	17,900	15,500	25,250	86,400	174,000	209,500	134,500	78,800
6	53,300	36,000	26,300	21,000	17,900	15,500	25,750	90,400	178,000	215,000	133,500	77,200
7	52,600	36,000	25,800	21,000	17,600	15,500	26,800	92,800	182,000	220,500	132,000	75,600
8	51,200	35,400	25,300	21,000	17,600	15,800	27,800	96,800	184,500	221,000	130,500	74,000
9	49,800	34,800	24,800	20,600	17,200	16,200	20,300	100,000	185,000	220,000	128,500	72,400
10	48,400	34,800	24,300	21,000	17,200	16,200	30,500	104,000	183,000	220,500	125,000	71,650
11	47,700	34,200	23,800	21,000	16,900	16,200	31,550	104,000	181,000	221,000	121,000	70,950
12	47,000	34,200	23,300	21,000	16,900	16,200	32,600	107,000	179,000	219,500	117,000	69,450
13	46,300	33,600	22,800	21,500	16,900	16,200	34,750	110,000	178,000	220,000	114,000	68,000
14	44,900	32,400	22,300	21,500	16,500	16,500	36,950	115,500	181,000	221,000	111,000	66,550
15	44,200	31,800	21,800	21,500	16,500	16,500	40,200	120,500	186,000	221,500	109,000	65,500
16	43,500	31,200	21,800	21,000	16,200	16,500	43,500	126,000	190,000	222,000	105,500	63,750
17	48,400	30,000	21,800	21,000	16,200	16,500	45,600	132,000	195,000	221,000	104,500	62,400
17	45,600	24,400	21,300	21,000	16,200	16,900	47,850	137,000	204,000	220,000	104,000	61,050
19	44,900	28,800	21,300	20,600	16,200	17,600	51,500	144,000	210,000	217,000	102,500	59,700
20	44,200	28,300	20,900	20,600	16,200	17,200	54,800	146,500	218,000	214,000	101,000	58,450
21	43,500	27,800	20,900	20,600	16,200	17,900	56,700	149,000	218,000	207,500	100,000	57,050
22	42,800	28,300	20,900	20,200	15,800	18,300	58,800	152,000	220,000	200,500	99,200	56,350
23	42,800	28,800	20,400	20,200	15,800	18,600	60,000	153,500	218,000	194,000	98,400	55,700
24	42,100	28,800	20,400	20,200	15,800	19,400	62,100	157,000	210,000	186,000	97,600	55,100
25	41,400	28,800	20,000	19,800	15,800	20,200	63,400	160,000	192,000	180,000	96,800	54,450
26	41,400	28,800	20,000	19,800	15,800	21,000	64,800	162,000	200,000	173,500	94,800	53,750
27	40,700	28,800	19,500	19,800	15,500	22,000	66,200	164,000	199,000	167,000	93,200	53,400
28	40,700	28,300	19,500	19,400	15,500	23,000	67,600	166,000	197,500	161,500	91,600	52,800
29	40,000	28,300	19,000	19,400	.....	23,500	68,400	167,000	195,500	155,500	90,000	52,800
30	40,000	28,300	19,000	19,000	.....	24,000	69,100	166,000	194,500	149,000	88,400	52,200
31	39,300	.....	18,600	19,000	.....	24,500	.....	165,000	.....	144,000	87,200	.....

Daily discharge, in second-feet, of Columbia River at Trail, B. C., for the years ending Sept. 30, 1913–1916—Continued.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1914–15.												
1	52,500	43,800	39,000	21,500	17,000	15,500	23,100	74,400	129,000	140,000	135,000	117,000
2	52,800	43,200	38,400	22,000	17,000	15,500	24,100	76,000	128,000	141,000	136,000	116,000
3	53,400	43,800	38,400	22,000	16,500	15,500	26,300	77,600	127,000	142,000	137,000	113,000
4	53,400	44,400	37,800	22,000	16,500	15,500	28,500	80,800	127,000	143,000	137,000	110,000
5	54,100	45,000	37,800	22,500	17,000	15,500	29,500	83,200	126,000	144,000	138,000	107,000
6	53,400	46,200	37,200	22,000	16,500	15,500	30,600	84,800	125,000	146,000	138,000	104,000
7	52,800	47,500	37,200	21,500	16,500	15,500	31,700	88,800	125,000	147,000	139,000	103,000
8	52,800	49,400	36,700	21,000	16,500	15,500	32,800	92,000	125,000	148,000	139,000	99,200
9	52,200	50,800	36,200	21,000	17,000	16,000	33,400	95,200	124,000	148,000	139,000	96,000
10	51,500	51,500	35,600	20,500	17,000	16,000	34,000	97,600	123,000	148,000	138,000	92,800
11	51,500	50,800	34,500	20,500	17,000	16,000	34,500	100,000	122,000	149,000	137,000	88,000
12	50,800	50,100	34,000	20,500	16,500	16,000	35,100	103,000	121,000	149,000	136,000	84,800
13	50,800	50,100	32,900	20,500	16,500	16,000	35,700	105,000	120,000	148,000	135,000	80,000
14	50,100	50,100	31,800	20,500	16,500	16,500	36,900	109,000	119,000	146,000	134,000	76,800
15	49,400	49,400	30,800	20,500	16,000	16,500	38,000	114,000	118,000	145,000	133,000	73,600
16	48,200	48,800	29,600	20,000	16,000	16,500	39,800	119,000	117,000	144,000	132,000	69,100
17	47,500	48,800	28,500	20,000	16,000	16,500	42,200	124,000	117,000	142,000	132,000	66,200
18	46,800	48,200	27,600	19,500	16,000	17,000	46,500	127,000	117,000	141,000	131,000	63,400
19	46,800	47,500	27,200	20,000	16,000	17,000	50,400	128,000	117,000	140,000	131,000	60,500
20	47,500	46,800	26,400	20,000	16,000	17,000	54,400	127,000	118,000	139,000	130,000	59,800
21	47,150	45,600	26,000	20,000	16,000	17,000	57,700	127,000	119,000	138,000	130,000	57,700
22	46,800	44,400	25,500	19,500	16,500	17,500	59,800	128,000	120,000	136,000	129,000	56,400
23	46,800	43,200	25,500	19,000	16,500	18,000	62,000	128,000	121,000	135,000	128,000	55,000
24	47,500	42,600	25,000	18,500	16,500	18,500	64,100	128,000	123,000	133,000	127,000	53,000
25	47,500	42,000	25,000	18,500	16,500	19,000	65,500	127,000	124,000	131,000	126,000	51,000
26	46,800	41,400	24,500	18,000	16,500	19,500	66,900	127,000	124,000	130,000	125,000	49,700
27	46,800	40,800	24,500	17,500	16,000	20,000	68,400	127,000	125,000	130,000	125,000	49,700
28	46,200	40,200	24,000	17,000	16,000	20,500	69,100	128,000	128,000	131,000	123,000	49,100
29	45,600	39,600	23,500	17,000	.....	21,000	70,600	129,000	132,000	132,000	122,000	48,400
30	45,000	39,600	23,000	17,500	.....	21,500	72,000	129,000	137,000	133,000	121,000	47,200
31	44,400	.....	22,500	17,500	.....	22,000	.....	129,000	.....	134,000	119,000	.....
1915–16.												
1	45,900	36,300	29,500	20,500	13,000	16,500	34,000	59,800	119,000	304,000	185,000	104,000
2	44,600	36,900	29,000	20,000	13,000	16,000	34,000	62,700	120,000	298,000	181,000	104,000
3	44,600	36,900	29,000	19,500	12,500	16,000	34,500	66,200	122,000	296,000	176,000	105,000
4	44,000	37,400	28,500	19,000	12,500	16,000	35,100	70,600	123,000	294,000	173,000	106,000
5	43,400	37,400	28,500	19,000	12,500	16,500	35,700	75,200	125,000	290,000	169,000	107,000
6	42,800	38,000	27,900	18,500	12,500	16,500	36,000	83,200	127,000	287,000	165,000	108,000
7	42,200	38,000	27,900	18,500	12,500	17,000	36,600	90,400	129,000	283,000	161,000	108,000
8	41,600	38,000	27,900	18,500	12,500	17,000	37,400	94,000	131,000	278,000	157,000	107,000
9	41,000	38,000	27,900	18,000	12,500	17,500	38,600	99,200	134,000	276,000	154,000	106,000
10	40,400	37,400	27,400	18,000	12,000	18,000	39,800	104,000	137,000	276,000	152,000	105,000
11	39,800	37,400	26,900	17,500	12,000	18,500	41,000	105,000	139,000	276,000	149,000	104,000
12	39,200	36,900	26,300	17,500	12,500	19,000	42,200	107,000	141,000	277,000	146,000	101,000
13	38,600	36,900	26,300	17,000	13,000	19,000	43,400	108,000	143,000	276,000	143,000	98,400
14	38,000	36,300	25,800	17,000	13,000	20,000	44,600	108,000	147,000	277,000	140,000	96,000
15	37,400	36,300	25,800	16,500	13,000	21,000	45,900	106,000	153,000	277,000	136,000	92,000
16	36,900	35,700	25,800	16,500	13,000	21,500	47,800	105,000	162,000	275,000	135,000	88,000
17	36,300	35,700	25,200	16,200	13,500	22,000	48,400	104,000	173,000	272,000	132,000	83,200
18	35,700	35,100	24,700	15,900	14,000	23,100	49,100	104,000	188,000	270,000	130,000	79,200
19	35,100	34,500	24,700	15,600	14,000	24,100	49,100	104,000	209,000	268,000	126,000	76,000
20	34,500	34,000	24,100	15,300	14,500	25,200	49,700	104,000	234,000	266,000	124,000	72,800
21	34,500	33,400	24,100	15,000	14,500	26,300	49,700	106,000	240,000	263,000	121,000	70,600
22	34,000	33,400	23,600	14,700	15,000	27,400	50,400	107,000	255,000	257,000	117,000	69,100
23	34,000	32,800	23,100	14,400	15,000	28,500	50,400	108,000	267,000	249,000	113,000	66,900
24	34,000	32,800	23,100	14,000	15,500	29,500	51,000	109,000	273,000	243,000	109,000	66,200
25	34,500	31,700	23,100	14,000	15,500	30,100	51,700	109,000	282,000	234,000	107,000	65,500
26	34,500	31,200	22,500	13,500	16,000	30,600	52,400	110,000	286,000	226,000	105,000	65,500
27	35,100	30,600	22,500	13,500	16,000	31,200	53,000	111,000	290,000	220,000	104,000	64,100
28	35,100	30,600	22,000	13,500	16,500	31,700	54,400	113,000	298,000	214,000	104,000	62,700
29	35,700	30,100	22,000	13,500	16,000	32,300	55,700	115,000	304,000	207,000	104,000	61,200
30	35,700	29,500	21,500	13,000	.....	32,800	57,700	116,000	306,000	198,000	104,000	59,100
31	36,300	.....	21,500	13,000	.....	33,400	.....	118,000	.....	192,000	104,000	.....

Monthly discharge of Columbia River at Trail, B. C., for the years ending Sept. 30, 1913–1916.

[Drainage area, 34,000 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1913.						
May	165,000	56,800	86,400	2.54	2.93	5,310,000
June	312,000	191,000	262,000	7.70	8.59	15,600,000
July	236,000	150,000	181,000	5.32	6.13	11,100,000
August	152,000	98,400	125,000	3.68	4.24	7,690,000
September	98,400	62,100	83,500	2.46	2.75	4,970,000
The period						44,700,000
1913–14.						
October	60,500	39,300	46,900	1.38	1.59	2,880,000
November	39,300	27,800	32,200	.95	1.06	1,920,000
December	27,800	18,600	22,600	.66	.76	1,390,000
January	22,000	19,000	20,700	.61	.70	1,270,000
February	18,600	15,500	16,800	.49	.51	933,000
March	24,500	15,500	17,800	.52	.60	1,090,000
April	69,100	23,700	43,900	1.24	1.38	2,610,000
May	167,000	71,300	125,000	3.68	4.24	7,690,000
June	220,000	163,000	190,000	5.60	6.25	11,300,000
July	222,000	144,000	200,000	5.89	6.79	12,300,000
August	140,000	87,200	112,000	3.29	3.79	6,890,000
September	85,200	52,200	65,700	1.93	2.15	3,910,000
The year	222,000	15,500	74,900	2.20	29.82	54,200,000
1914–15.						
October	54,100	44,400	49,300	1.45	1.67	3,030,000
November	51,500	39,600	45,900	1.35	1.51	2,730,000
December	39,000	22,500	30,500	.89	1.03	1,880,000
January	22,500	17,000	19,900	.58	.67	1,220,000
February	17,000	16,000	16,400	.48	.50	911,000
March	22,000	15,500	17,300	.51	.59	1,060,000
April	72,000	23,100	45,500	1.34	1.50	2,710,000
May	129,000	74,000	110,000	3.24	3.74	6,760,000
June	137,000	127,000	123,000	3.62	4.04	7,320,000
July	149,000	130,000	140,000	4.12	4.75	8,610,000
August	139,000	119,000	132,000	3.88	4.47	8,120,000
September	117,000	47,200	76,600	2.25	2.51	4,560,000
The year	149,000	15,500	67,600	1.99	26.98	48,900,000
1915–16.						
October	45,900	34,000	38,200	1.13	1.30	2,350,000
November	38,000	29,500	35,000	1.03	1.15	2,080,000
December	29,500	21,500	25,400	.75	.86	1,560,000
January	20,500	13,000	16,300	.48	.55	1,000,000
February	16,500	12,000	13,700	.40	.43	788,000
March	33,400	16,000	23,000	.68	.78	1,410,000
April	57,700	34,000	45,000	1.32	1.47	2,680,000
May	118,000	59,800	99,400	2.92	3.37	6,110,000
June	306,000	119,000	192,000	5.65	6.30	11,400,000
July	304,000	192,000	262,000	7.70	8.88	16,100,000
August	185,000	104,000	136,000	4.00	4.61	8,360,000
September	108,000	59,100	86,700	2.55	2.84	5,160,000
The year	306,000	12,000	81,300	2.39	32.54	59,000,000

NOTE.—All computations except yearly totals made by British Columbia Hydrometric Survey. Same records published in Water Resources Papers of British Columbia Hydrometric Survey, but with totals for calendar years.

KOOTENAI RIVER BASIN.

KOOTENAI RIVER AT LIBBY, MONT.

LOCATION.—In sec. 3, T. 30 N., R. 31 W., at highway bridge opposite Great Northern Railway station at Libby, in Lincoln County.

DRAINAGE AREA.—11,000 square miles.

RECORDS AVAILABLE.—October 13, 1910, to September 30, 1916.

GAGE.—Chain gage on left span of highway bridge; before completion of bridge, a temporary staff gage fastened to old stump on right bank at lower side of bridge. Gage datum lowered 2 feet in February, 1913; all readings prior to change reduced to new datum.

DISCHARGE MEASUREMENTS.—Made from highway bridge; before erection of bridge from ferry cable.

CHANNEL AND CONTROL.—Bed composed of small rocks; probably permanent. Current fairly swift and uniformly distributed. Channel broken by two piers.

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 19.17 feet at 3 p. m. June 21 (discharge, 130,000 second-feet); minimum stage, 1.99 feet January 2, 3 (discharge, 2,580 second-feet).

1910–1916: Maximum stage June 21, 1916; minimum, 1.4 feet February 7, 1914 (discharge, 1,690 second-feet).

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

DIVERSIONS.—None of importance.

ACCURACY.—Stage-discharge relation seriously affected by ice January 4 to March 10 (flow not computed) and possibly slightly affected for short periods in November and December. Rating curve well defined between 3,400 and 25,000 second-feet and fairly well defined above 25,000 second-feet. Gage read to hundredths twice daily; not read October 12, 31, November 13, 25, December 12, 25, 26, January 4, June 4, July 9, August 6, 24, September 3, 4, 17, 24. Daily discharge ascertained by applying daily gage height to rating table October 1 to January 2 and March 11 to September 30; interpolated for days on which gage was not read. Records considered fair.

COOPERATION.—Gage-height records furnished by United States Forest Service.

The following discharge measurement was made by W. A. Lamb:

March 2, 1916: Gage height, 2.98 feet; discharge, 3,640 second-feet. Stage-discharge relation affected by anchor ice at control.

Daily discharge, in second-feet, of Kootenai River at Libby, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	6,280	7,230	3,780	2,940	.....	8,570	18,700	24,700	70,600	19,200	12,000
2	6,280	7,230	3,780	2,600	.....	9,280	18,200	24,700	62,200	19,200	12,000
3	6,590	6,910	3,780	2,600	.....	9,280	18,700	25,200	64,100	19,800	13,000
4	6,910	6,590	3,780	.....	.....	9,650	23,500	28,300	71,500	19,800	14,000
5	6,910	6,590	4,020	.....	.....	9,650	29,500	31,400	70,600	18,700	15,000
6	6,910	6,590	4,270	.....	.....	10,000	34,700	36,800	65,000	17,600	16,800
7	6,590	6,590	4,530	.....	.....	10,000	39,000	36,100	58,600	16,400	17,300
8	6,590	6,280	4,530	.....	.....	10,800	39,700	34,000	56,000	15,900	15,000
9	6,280	6,280	4,530	.....	.....	11,600	34,000	35,400	59,100	15,900	14,600
10	5,970	5,970	4,530	.....	.....	12,800	28,800	40,400	62,200	15,900	13,700
11	5,970	5,970	4,800	.....	5,970	14,100	24,700	44,300	63,200	16,400	13,700
12	5,970	5,670	4,410	.....	7,230	14,100	21,300	41,200	61,300	15,900	13,300
13	5,970	5,240	4,020	.....	9,650	14,100	19,800	39,000	56,900	15,000	12,000
14	5,970	4,800	4,020	.....	10,400	13,700	17,800	41,200	53,400	14,600	11,200
15	5,970	4,530	4,270	.....	8,920	14,100	16,800	49,200	51,700	14,600	10,800
16	5,970	4,800	3,780	.....	7,890	14,600	16,400	61,300	42,700	14,100	10,400
17	5,670	5,080	3,780	.....	7,890	14,100	16,400	77,300	39,700	14,100	10,000
18	5,670	5,080	3,330	.....	8,570	13,700	17,300	90,100	41,200	14,100	9,650
19	5,370	5,080	3,550	.....	8,570	13,300	19,200	105,000	42,700	14,600	9,650
20	5,670	5,080	3,780	.....	8,570	12,400	22,400	117,000	39,700	15,000	8,920
21	5,970	5,080	3,780	.....	10,800	12,000	24,700	129,000	36,100	13,700	8,920
22	6,280	4,270	4,270	.....	10,800	11,200	25,200	128,000	32,700	13,300	8,920
23	5,970	4,530	4,530	.....	10,000	10,800	24,100	108,000	30,100	12,800	8,570
24	5,970	4,800	3,550	.....	9,280	10,800	22,400	86,100	28,200	13,000	8,570
25	5,970	4,800	3,470	.....	8,570	10,800	20,800	71,500	26,400	13,300	8,570
26	5,970	4,800	3,400	.....	8,230	12,400	19,800	68,700	24,700	13,700	8,230
27	6,280	4,800	3,330	.....	9,280	15,900	19,800	69,600	23,500	13,300	8,230
28	6,280	4,270	3,330	.....	10,000	19,200	21,300	72,500	23,000	13,300	8,570
29	6,280	4,020	3,120	.....	9,280	20,300	23,500	76,300	21,300	12,800	8,230
30	6,280	3,780	2,940	.....	8,920	20,300	25,200	78,200	20,800	12,800	7,890
31	6,760	.....	3,330	.....	8,570	.....	25,200	.....	19,800	12,400	.....

Monthly discharge of Kootenai River at Libby, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	6,910	5,370	6,180	380,000
November	7,230	3,780	5,420	323,000
December	4,800	2,940	3,880	239,000
March 11–31	10,800	5,970	8,920	372,000
April	20,300	8,570	12,800	762,000
May	39,700	16,400	23,500	1,440,000
June	129,000	24,700	62,400	3,710,000
July	71,500	19,800	45,800	2,820,000
August	19,800	12,400	15,200	935,000
September	17,300	7,890	11,300	672,000

CALLAHAN CREEK AT TROY, MONT.

LOCATION.—In sec. 13, T. 31 N., R. 34 W., at the highway bridge one-fourth mile southeast of Troy, in Lincoln County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 11, 1911, to September 30, 1916, fragmentary.

GAGE.—Vertical staff, attached to the right abutment of bridge; read at irregular intervals by Harry L. Baker, ranger of the United States Forest Service. On May 24, 1913, the gage was washed out and not replaced until October 12, 1913, when datum was lowered 1.60 feet to avoid minus readings.

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

CHANNEL AND CONTROL.—Bed composed of small rocks and gravel; may shift at high stages. Banks are low, but are not subject to overflow, owing to steep slope of the stream bed.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.40 feet at 5 p. m. June 15; minimum stage recorded, −0.50 foot September 21, 1916.

1911–1916: Maximum stage recorded, 3.7 feet May 9 and 15, 1912 (discharge, 1,300 second-feet); minimum discharge, October 29–31, 1911, estimated at 12 second-feet.

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

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Sufficient measurements not made to define rating curve for year. Gage read to half-tenths at irregular intervals.

COOPERATION.—Field data furnished by the United States Forest Service.

The following discharge measurement was made by E. W. Kramer:

May 19, 1916: Gage height, 2.25 feet; discharge, 761 second-feet.

Daily gage height, in feet, of Callahan Creek at Troy, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.28									
2						2.45				
3						2.80	2.45			
4						3.00		1.90		
5										
6								1.40		
7										
8						2.50	2.50			
9	.30						2.80			−0.10
10							3.00	1.30		
11		0.65								− .10
12							2.55	.90	−0.30	
13								.90		
14		.65				1.70				− .10
15		.60			2.40	1.80	3.15			
16						1.80				
17			0.60				3.20			
18						2.10				
19	.30					2.25	2.60	.60	.30	
20										
21						2.20			.10	− .50
22						2.20	2.10	.40		
23										
24				1.90			2.00		− .10	
25					2.00	1.90				
26						1.90		.30		
27					2.85					
28				2.20						
29						2.20	1.70	.20		
30										
31										

YAAK RIVER NEAR TROY, MONT.

LOCATION.—Near north line of T. 32 N., R. 34 W., at highway bridge near mouth of stream, about 10 miles north of Troy.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 15, 1910, to September 30, 1916.

GAGE.—Vertical staff on downstream side of left abutment of highway bridge; installed March 2, 1914; read at irregular intervals by R. E. Clay, forest ranger. Gages previously used as follows: October 15, 1910, to May 6, 1912, staff gage on right bank half a mile above Yaak Falls, near south line of sec. 33, T. 34 N., R. 33 W.; May 8, 1912, to June 17, 1912, staff gage at Fritz Lang's ranch near Sylvanite, 4 miles upstream; June 18, 1912, to March 2, 1914, staff gage 300 feet farther downstream and at different datum.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Gravel and boulders; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.90 feet at 5 p. m. June 21 (discharge not determined); minimum stage recorded, 1.40 feet September 28–30 (discharge not determined).

1910–1916: Maximum stage recorded, 3.69 feet May 15, 1912, at old gage (discharge, 4,240 second-feet); minimum stage recorded, 2.88 feet March 22, 1913 (discharge, 193 second-feet).

ICE.—Stage-discharge relation seriously affected by ice. Observations discontinued during the winter.

DIVERSIONS.—None.

COOPERATION.—Gage-height record furnished by U. S. Forest Service.

No discharge measurements to ascertain permanence of stage-discharge relation were made during the year. Data inadequate for determination of daily discharge.

Daily gage height, in feet, of Yaak River near Troy, Mont., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	Aug.	Sept.	Day.	Apr.	May.	June.	Aug.	Sept.
1						16		3.22			
2					1.50	17		3.42			
3						18		3.52			
4						19		3.82			
5			4.40			20		4.05			
6	3.00					21		4.15	6.90		
7	2.95	5.20			1.68	22		4.00	6.70		
8	2.9	4.90			1.65	23		3.88			
9		4.50			1.68	24			4.00		
10		4.38	4.75		1.68	25			3.95		
11	3.45	3.75			1.62	26			3.70		
12	3.60	3.55			1.60	27				1.50	
13		3.42			1.55	28				1.50	1.40
14		3.28			1.50	29					1.40
15		3.18			1.50	30					1.40
						31					

MOYIE RIVER AT SNYDER, IDAHO.

LOCATION.—In sec. 23, T. 64 N., R. 2 E. Boise meridian, at Snyder ranger station, a quarter of a mile west of Snyder station on Spokane & International Railway, 3½ miles below Round Prairie Creek, 12 miles above mouth, in Bonner County.

DRAINAGE AREA.—717 square miles (revised measurement on map of Cranbrook quadrangle, British Columbia map, and map of Priest Lake quadrangle).

RECORDS AVAILABLE.—February 21, 1912, to September 30, 1916, at present site; March 10, 1911, to February 20, 1912, at railway bridge 1 mile downstream.

GAGE.—Since February 21, 1912, vertical and inclined staff on left bank, 150 feet west of Snyder ranger station; read by J. E. Ryan. March 10, 1911, to February 20, 1912, vertical staff on left abutment of railway bridge 1 mile below present gage.

DISCHARGE MEASUREMENTS.—Made by wading at gage or from highway bridge a quarter of a mile downstream.

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; gradient, steep. Channel straight above and below gage. Banks high and not subject to overflow. Riffle control 500 feet below gage; shifting at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.0 feet at 4 p. m. June 19 (discharge, 10,800 second-feet); minimum stage recorded, 3.06 feet September 30, (discharge, 115 second-feet).

1911–1916: Maximum stage recorded in 1916; minimum stage recorded, 2.90 feet, March 9–10, 12–13, 1912 (discharge, 91 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's notes and records of precipitation and temperature.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice during winter. Gage read to hundredths twice daily when observer is at station. Rating curve well defined between 200 and 3,000 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table. Records poor for January and February because of ice and for July when gage was not read; fair for June, August, and September, as control may have shifted during high water; good for remainder of year.

COOPERATION.—Gage-height record furnished by the United States Forest Service.

Discharge measurements of Moyie River at Snyder, Idaho, during the year ending Sept. 30, 1916.

[Made by C. O. Brown.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Mar. 21	5.41	1,700
22	5.29	1,510

Daily discharge, in second-feet, of Moyie River at Snyder, Idaho, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	165	224	187	154	265	1,480	3,450	3,170	.....	412	154
2	159	224	187	154	265	1,480	4,270	3,450	.....	386	206
3	154	224	187	154	265	1,480	5,100	3,750	.....	359	206
4	154	224	187	154	224	1,290	5,920	3,900	.....	359	187
5	154	224	206	154	224	1,290	6,740	4,050	.....	310	187
6	154	224	206	154	224	1,380	6,740	4,360	.....	310	187
7	154	224	206	187	224	1,480	6,380	4,680	.....	288	187
8	154	224	206	187	224	1,680	5,350	4,840	.....	265	154
9	154	224	217	187	224	1,790	4,200	5,180	.....	265	154
10	154	224	217	187	439	2,130	3,750	5,860	.....	244	154
11	154	224	206	.....	654	2,130	3,450	5,350	.....	224	140
12	154	224	206	.....	870	2,130	3,310	5,180	.....	224	125
13	140	224	170	.....	1,580	2,130	3,030	5,010	.....	224	125
14	140	224	170	.....	1,290	2,010	2,500	5,350	.....	224	125
15	140	224	170	.....	1,070	1,900	1,900	6,230	.....	224	125
16	140	206	170	.....	950	2,010	1,680	7,120	.....	224	125
17	140	187	170	.....	870	2,130	2,130	8,000	.....	224	125
18	140	187	170	.....	870	1,900	2,370	8,180	.....	265	125
19	140	187	170	.....	1,120	1,790	2,760	10,400	.....	265	125
20	140	187	170	.....	1,290	1,790	3,450	8,550	.....	265	125
21	140	187	187	.....	1,790	1,580	3,450	7,820	.....	244	125
22	140	187	206	.....	1,680	1,480	3,450	6,380	.....	224	125
23	140	187	187	.....	1,680	.....	3,310	5,690	.....	224	125
24	150	187	187	.....	1,580	.....	3,170	5,010	.....	224	125
25	161	187	187	.....	1,580	.....	3,170	4,840	.....	224	125
26	172	187	187	.....	1,030	.....	3,170	4,840	.....	224	125
27	182	187	170	.....	1,200	.....	3,170	4,520	.....	206	120
28	192	187	170	.....	1,200	3,170	4,050	4,520	.....	154	118
29	203	187	170	.....	1,200	3,170	4,050	4,360	.....	154	115
30	214	187	170	.....	1,290	3,310	3,600	4,360	468	154	115
31	224	.....	154	.....	1,380	.....	3,310	.....	440	154	.....

NOTE.—Gage not read, discharge interpolated, Oct. 1, 2, 5–8, 18, 24–30; Nov. 1–3; Mar. 10, 11, 30, 31; May 2–4; June 15–16. Gage not read, discharge estimated by comparison with records for previous years, Apr. 23–27, 2,300 second-feet; July 1–23, 2,400 second-feet. Stage-discharge relation affected by ice Jan. 11 to Feb. 28; discharge estimated as follows: Jan. 11–15, 160 second-feet; 16–20, 140 second-feet; 21–25,170, second-feet; 26–31, 150 second-feet; Feb. 1–5, 140 second-feet; 6–10, 200 second-feet; 11–15, 260 second-feet; 16–20, 290 second-feet; 21–25, 270 second-feet; 26–30, 260 second-feet.

Monthly discharge of Moyie River at Snyder, Idaho, for the year ending Sept. 30, 1916.

[Drainage area, 717 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	224	140	158	0.220	0.25	9,720
November	224	187	206	.287	.32	12,300
December	217	154	186	.259	.30	11,400
January	.....	.....	159	.222	.26	9,780
February	.....	.....	236	.329	.35	13,600
March	1,790	224	927	1.29	1.49	57,000
April	3,310	1,290	1,990	2.78	3.10	118,000
May	6,740	1,680	3,750	5.23	6.03	231,000
June	10,400	3,170	5,500	7.67	8.56	327,000
July	.....	440	2,270	3.17	3.66	140,000
August	412	154	250	.349	.40	15,400
September	206	115	142	.198	.22	8,450
The year	10,400	115	1,310	1.83	24.94	954,000

CLARK FORK BASIN.

CLARK FORK AT ST. REGIS, MONT.

LOCATION.—In sec. 19, T. 18 N., R. 27 W., at McLeod's ferry at St. Regis, in Mineral County, half a mile below mouth of St. Regis River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 26, 1910, to September 30, 1916.

GAGE.—Vertical staff in four sections on left bank at old ferry landing; read by Archie McLeod.

DISCHARGE MEASUREMENTS.—Made from ferry cable at gage.

CHANNEL AND CONTROL.—Channel permanent above and below gage. Banks high; not subject to overflow. Control not sharply defined; formed by bed of stream for several hundred feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 17.4 feet June 21 (discharge, 52,400 second-feet); minimum stage recorded, 3.3 feet January 1 (discharge, 2,200 second-feet).

1910–1916: Maximum stage recorded, 19.1 feet May 30–31, 1913 (discharge, 62,800 second-feet); minimum stage recorded, 2.9 feet January 4, 1912 (discharge, 1,710 second-feet).

ICE.—Stage-discharge relation affected by ice.

DIVERSIONS.—Water is diverted from several of the tributaries to irrigate lands in Bitterroot Valley and in the vicinity of Missoula.

REGULATION.—Practically none.

ACCURACY.—Stage-discharge relation permanent except as affected by ice January 2 to March 7. Rating curve well defined between 3,000 and 63,000 second-feet. Gage read to tenths once daily. Daily discharge ascertained by applying gage height to rating table; not determined January 2 to March 7. Records good except for short periods during the winter, for which they are fair.

Daily discharge, in second-feet, of Clark Fork at St. Regis, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3,890	3,380	2,780	2,200	.....	9,450	24,200	21,400	48,900	9,700	5,240
2	4,030	3,380	2,880	.....	.....	9,700	13,800	21,800	44,500	9,450	5,030
3	4,030	3,550	2,880	.....	.....	9,700	21,000	22,000	42,800	9,200	5,240
4	4,060	3,380	2,880	.....	.....	10,200	21,800	23,000	42,300	8,700	5,030
5	4,060	3,380	3,100	.....	.....	10,200	25,900	26,700	39,600	7,960	4,820
6	4,060	3,380	3,230	.....	.....	10,200	29,800	27,600	36,500	7,720	4,610
7	3,890	3,380	3,380	.....	.....	10,500	34,000	29,300	35,500	7,480	4,420
8	3,890	3,380	3,380	.....	3,720	10,800	36,000	28,400	34,000	7,240	4,610
9	3,890	3,380	3,380	.....	3,720	11,100	35,000	29,300	34,000	7,240	4,610
10	3,890	3,380	3,230	.....	5,460	11,700	31,200	31,600	33,500	7,000	5,030
11	3,720	3,380	3,230	.....	7,960	12,600	28,400	32,600	33,100	7,000	5,030
12	3,890	3,380	3,230	.....	12,300	13,500	25,400	31,200	30,200	6,780	4,610
13	3,720	3,230	3,100	.....	12,600	14,200	23,400	29,500	27,200	6,560	4,610
14	3,720	3,230	2,980	.....	12,900	14,800	21,400	28,900	24,600	6,560	4,610
15	3,720	3,230	3,100	.....	11,100	14,800	28,400	30,700	22,600	6,340	4,820
16	3,720	3,230	3,100	.....	9,970	15,600	34,000	35,000	21,000	6,120	4,820
17	3,720	3,230	3,100	.....	10,200	15,900	29,300	40,100	27,500	6,340	4,820
18	3,720	3,380	3,100	.....	10,200	15,900	34,000	44,500	34,000	6,340	4,720
19	3,890	3,380	2,880	.....	10,800	15,600	39,000	48,400	29,300	6,560	4,610
20	3,720	3,380	2,780	.....	12,900	14,800	30,600	51,800	16,600	7,000	4,820
21	3,550	3,380	2,880	.....	13,800	14,200	22,200	52,400	15,900	7,240	5,030
22	3,550	3,380	3,230	.....	15,900	13,500	23,000	48,400	14,200	5,900	5,030
23	3,550	3,380	3,550	.....	14,500	12,900	22,600	41,800	13,500	5,240	5,240
24	3,380	3,380	3,380	.....	12,900	12,600	21,500	37,000	12,600	5,680	4,820
25	3,380	3,550	3,550	.....	11,700	12,900	20,000	35,000	12,000	5,460	5,030
26	3,380	3,550	3,380	.....	10,800	15,600	19,500	34,000	11,700	5,240	5,240
27	3,380	3,550	3,230	.....	11,100	29,300	19,500	36,000	11,100	5,240	5,240
28	3,380	3,380	3,230	.....	11,100	21,000	19,500	39,000	11,100	5,460	3,890
29	3,380	3,100	2,980	.....	10,500	22,600	19,000	42,300	10,800	5,680	4,230
30	3,380	2,980	2,700	.....	10,200	23,400	19,700	46,700	10,500	5,240	4,230
31	3,380	.....	2,290	.....	9,700	.....	20,200	.....	10,200	4,820	.....

NOTE.—Gage heights missing May 24–31; discharge estimated from records of flow of Clark Fork at Plains and Flathead River near Polson. Discharge for July 17 and Aug. 18 interpolated.

Monthly discharge of Clark Fork at St. Regis, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	4,060	3,380	3,710	228,000
November	3,550	2,980	3,300	200,000
December	3,550	2,290	3,100	191,000
March 8–31	15,900	3,720	10,700	509,000
April	29,300	9,450	14,300	851,000
May	39,000	13,800	25,600	1,570,000
June	52,400	21,400	34,900	2,080,000
July	48,900	10,200	25,500	1,570,000
August	9,700	4,820	6,720	414,000
September	5,240	3,890	4,800	286,000

CLARK FORK NEAR PLAINS, MONT.

LOCATION.—In lot 7, sec. 1, T. 19 N., R. 26 W., at Cooper's ferry, 3 miles above Plains, in Sanders County, and 7 miles below mouth of Flathead River.

DRAINAGE AREA.—19,900 square miles.

RECORDS AVAILABLE.—October 28, 1910, to September 30, 1916.

GAGE.—Barrett & Lawrence water-stage recorder installed November 28, 1911, 50 feet below an overhanging chain gage on right bank, 150 feet below point where old ferry crossed; datum that of chain gage, which was read before installation of recorder.

DISCHARGE MEASUREMENTS.—Made from highway bridge at Plains, 3 miles below gage. Station was rated by measurements made from a ferry cable, since removed, 150 feet above gage.

CHANNEL AND CONTROL.—River deep; current only moderately swift even at flood stages. Banks high; not subject to overflow. Channel practically permanent. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage during the year, from water-stage recorder, 17.9 feet at 2 a. m. July 2 (discharge, 115,000 second-feet); minimum stage, computed from record of flow at Thompson Falls, 3.6 feet January 1 (discharge, 5,970 second-feet).

1910–1916: Maximum stage recorded, 17.9 feet June 5, 1913, and July 2, 1916 (discharge, 115,000 second-feet); minimum stage recorded, 3.6 feet March 9–10, 1913 (discharge, 5,290 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice. Open-channel rating curve assumed applicable, except for short periods.

DIVERSIONS.—Numerous diversions are made for irrigation from the headwaters of Clark Fork and tributaries of Flathead River.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent (confirmed by measurements made during 1917). Rating curve well defined between 8,000 and 75,000 second-feet, but poorly defined for higher and lower stages. Gage-height record fragmentary, owing to faulty operation of recorder and lack of reliable observer. Daily discharge ascertained by applying to rating table gage height obtained by inspecting recorder graph or by means of a curve of relation from gage heights at Thompson Falls, or by comparison with records of flow at other stations. Records obtained from gage heights at regular station good; other records fair.

Daily discharge, in second-feet, of Clark Fork near Plains, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10,400	8,720	8,720	5,970	.....	.....	43,800	49,500	114,000	39,000	15,600
2	10,000	8,720	9,030	6,420	.....	.....	43,000	50,400	114,000	38,200	14,700
3	10,400	8,720	9,030	6,620	10,700	.....	42,200	51,300	111,000	35,900	14,400
4	10,000	8,720	9,030	6,480	11,100	.....	44,000	53,100	111,000	34,400	14,300
5	9,680	8,720	8,720	6,560	11,500	.....	48,300	55,500	109,000	32,800	14,200
6	9,680	8,420	8,720	6,730	11,500	.....	54,000	58,600	107,000	31,400	15,400
7	9,680	8,420	8,720	7,280	12,300	.....	60,700	62,400	104,000	30,600	16,400
8	9,680	8,420	8,720	7,390	13,200	.....	65,400	62,400	103,000	29,200	16,900
9	9,680	8,420	8,720	7,870	13,600	.....	67,400	63,000	105,000	27,800	16,900
10	9,680	8,420	8,720	7,630	14,600	.....	64,700	66,400	91,400	27,800	17,200
11	9,680	8,720	8,720	7,630	15,000	.....	62,700	69,400	87,400	27,100	17,200
12	9,680	8,720	8,720	7,280	15,500	.....	60,000	70,200	82,500	26,400	17,200
13	9,680	8,720	8,720	7,060	15,500	.....	56,700	68,200	79,600	25,800	17,200
14	9,350	8,420	8,720	6,730	15,500	.....	54,000	69,100	76,700	24,400	17,200
15	9,030	8,420	8,720	6,730	15,000	.....	51,600	71,000	73,800	23,800	17,200
16	9,030	8,420	8,720	6,730	14,600	.....	49,800	75,800	71,000	23,100	16,400
17	9,030	8,420	8,720	8,240	14,600	.....	48,300	83,500	67,200	22,500	16,300
18	9,030	8,130	8,420	.....	14,600	.....	48,000	89,400	.....	21,800	16,300
19	9,030	8,420	8,420	.....	15,500	.....	48,000	96,400	.....	21,800	15,100
20	9,030	8,420	8,420	.....	16,600	.....	49,800	102,000	.....	21,200	15,100
21	9,030	8,720	8,720	.....	17,700	.....	51,900	108,000	.....	21,200	14,800
22	9,350	8,720	8,720	.....	17,700	.....	53,100	107,000	.....	20,600	14,800
23	9,350	8,420	8,720	.....	17,700	.....	53,100	105,000	.....	20,600	14,600
24	9,000	8,720	8,720	.....	17,700	.....	51,600	103,000	57,100	20,000	13,800
25	9,030	8,720	8,720	.....	17,700	.....	50,500	102,000	55,200	19,400	13,800
26	9,030	8,720	8,420	.....	17,700	.....	49,200	102,000	52,500	18,800	13,600
27	8,720	8,420	8,720	.....	17,700	.....	48,600	103,000	50,800	17,700	13,400
28	8,720	8,720	8,720	.....	.....	42,000	48,000	106,000	49,000	17,100	13,400
29	8,720	8,720	8,720	.....	.....	.....	48,600	107,000	47,200	17,100	13,400
30	9,030	8,400	8,000	.....	.....	44,000	48,600	111,000	45,500	16,600	13,300
31	8,720	.....	7,700	.....	.....	.....	48,900	.....	43,800	16,000	.....

NOTE.—Discharge for periods for which gage heights were missing determined as follows: Oct. 7–10, interpolated; Dec. 25–31, by comparison with other records; Nov. 11 to Dec. 9, Dec. 20–24, Jan. 1–17, May 1 to June 12, and Sept. 1–30, from gage heights at Thompson Falls. Discharge not determined Dec. 18 to Mar. 2, Mar. 28 to Apr. 27, and July 18–23.

Monthly discharge of Clark Fork near Plains, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	10,400	8,720	9,360	576,000
November	8,720	8,130	8,500	503,000
December	9,030	7,700	8,600	532,000
January 1–17	8,240	5,970	7,020	237,000
March 3–27	17,700	10,700	15,000	744,000
May	67,400	42,200	52,100	3,200,000
June	111,000	49,500	80,700	4,800,000
August	39,000	16,000	24,800	1,520,000
September	17,200	13,300	15,300	910,000

PEND OREILLE LAKE AT SANDPOINT, IDAHO.

LOCATION.—In sec. 23, T. 57 N., R. 2 W. Boise meridian, on west side of lake, at municipal wharf at Sandpoint, in Bonner County.

DRAINAGE AREA.—23,100 square miles (measured on General Land Office maps).

RECORDS AVAILABLE.—March 18, 1914, to September 30, 1916.

GAGE.—Vertical staff in two sections on pile at municipal wharf; read to hundredths by Vera L. Chattin and Elva T. Crane.

EXTREMES OF STAGE.—Maximum stage recorded during the year, 26.0 feet July 6; minimum stage recorded, 5.80 feet October 29, and November 18 and 19.

1914–1916: Maximum stage recorded on July 6, 1916; minimum stage recorded, 5.05 feet March 3–13, 1915.

ICE.—During winter ice at gage renders observations difficult.

DIVERSIONS.—Considerable water diverted from tributaries of Clark Fork for irrigation.

REGULATION.—None.

COOPERATION.—Record furnished by United States Forest Service.

Daily gage height, in feet, of Pend Oreille Lake at Sandpoint, Idaho, for the year ending Sept. 30,1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.98				10.60		16.35	25.05	16.50	
2	5.99	5.83	5.95				16.30	25.45	16.10	9.10
3		5.85	5.93				16.30	25.65		
4	5.99		5.90			14.20		25.80	15.30	
5	5.99	5.85			10.65	14.50	16.50	25.90	14.90	8.80
6	5.95	5.85	5.90		10.70		16.70	26.00		8.70
7	5.95		5.90			15.35	17.00	25.90	14.20	
8	5.90	5.83	5.87		10.75	16.10	17.15	25.80	13.80	
9	5.90	5.85	5.87				17.40	25.60	13.50	8.60
10		5.85	5.85		10.80	16.85		25.50	13.25	8.55
11	5.90	5.85	5.90	6.40		17.00	17.90	25.35	12.90	8.50
12						17.20	18.15	25.15		
13	5.92	5.83	5.87	7.10	11.05	17.25	18.40			
14	5.93		5.87	7.50	11.10		18.65	24.60	12.20	8.40
15	5.92	5.85	5.87	7.80		17.10	18.80	24.40	11.95	
16	5.90	5.85	5.87	8.00		16.95	19.05		11.70	8.40
17			5.87	8.10	11.70	16.90	19.45	23.45	11.50	
18	5.90	5.80	5.87			16.75		23.10		
19	5.90	5.80				16.70	20.60	22.60	11.20	8.30
20	5.90	5.82	5.85		11.80	16.68	21.50	22.15	10.95	
21	5.85			8.80		16.70	21.95	21.70	10.80	8.20
22	5.87	5.93	5.85			16.75	22.50	21.25		
23	5.82	5.95	5.85	9.50	12.20	16.75	23.00	20.60		8.10
24		5.95	5.85	9.90			23.35	20.20		
25						16.65	23.80	19.70		
26	5.85	5.95			12.30	16.60	24.00	19.25		7.98
27	5.85	5.95	5.85			16.50	24.15	18.70		
28	5.85		5.85	10.40	12.50	16.45	24.35	18.25		7.85
29	5.80	5.95	5.85		12.80	16.40	24.60	17.80		
30	5.82	5.95	5.85	10.60	13.30	16.40	24.80	17.30		
31			5.85			16.35		16.90		

CLARK FORK AT METALINE FALLS, WASH.

LOCATION.—In E. ½ sec. 21, T. 39 N., R. 43 E., just below Sullivan Creek, 500 feet above Metaline Falls, opposite the town of Metaline Falls, 11 miles above the international boundary, in Pend Oreille County.

DRAINAGE AREA.—25,600 square miles (measured on General Land Office maps).

RECORDS AVAILABLE.—November 4, 1908, to September 4, 1910 (gage heights only; data insufficient for determination of discharge); October 1, 1912, to September 30, 1916.

GAGE.—Since February 12, 1914, vertical and inclined staff in 5 sections, reading from 0 to 54 feet, on right bank, 50 feet below Sullivan Creek; read by W. A. Snure and M. C. Helmer. November 4, 1908, to September 4, 1910, vertical staff in 2 sections, on right bank, three-fourths mile above present gage. October 1 to December 27, 1912, vertical staff at site of present gage but at datum 7.07 feet higher. January 16, 1913, to January 24, 1914, vertical staff at same site but at datum 5.00 feet higher than that of present gage. January 25 to February 2, 1914, temporary gage set by observer at datum different from that of previous gage, but readings were reported to a datum 5.00 feet higher than that of present gage. All readings October 1, 1912, to February 2, 1914, reduced to datum of present gage.

DISCHARGE MEASUREMENTS.—Made from a cable a quarter of a mile above gage. Discharge of Sullivan Creek added to that measured at cable.

CHANNEL AND CONTROL.—Banks high and not subject to overflow. Sensitive and permanent control formed by Metaline Falls, where water surface drops 20 feet in a distance of 1,200 feet. Elevation water surface at medium low stage, 1,970 feet above sea level.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 40.02 feet July 9 (discharge 133,000 second-feet); minimum stage recorded, 3.20 feet January 31 (discharge 6,980 second-feet).

1912–1916: Maximum stage recorded, 41.2 feet June 16, 1913 (discharge, 139,000 second-feet; revised); minimum stage recorded, January 31, 1916.

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

DIVERSIONS.—Numerous small diversions from upper tributaries for irrigation.

ACCURACY.—Stage-discharge relation permanent. Gage read to hundredths daily. No diurnal fluctuation. Rating curve well defined. Daily discharge ascertained by applying daily gage height to rating table. Records excellent. Discharge for May, June, and July, 1913, published herewith supersedes that published in Water Supply Paper 362.

COOPERATION.—Station maintained in cooperation with British Columbia Hydrometric Survey. Gage-height record furnished by Hugh L. Cooper Co.

Discharge measurements of Clark Fork at Metaline Falls, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 27	C. G. Paulsen	20.73	45,800	July 20	Bannerman and Paulsen	35.98	106,000
27	Paulsen and Smith	20.88	46,700				
28	Paulsen and Helmer	20.93	47,200	20	C. G. Paulsen	35.91	111,000
June 19	Paulsen and Bailey	31.94	89,800	Aug. 8	C. O. Brown	23.58	56,200
19	do	32.12	92,700	11	do	21.91	49,300
20	C. G. Paulsen	32.65	95,100	Sept. 11	G. H. Bannerman	12.38	23,400
July 19	Paulsen and Bannerman	36.35	117,000	13	do	12.25	22,900

Daily discharge, in second-feet, of Clark Fork at Metaline Falls, Wash., from May 1 to to July 31, 1913.

Day.	May.	June.	July.	Day.	May.	June.	July.	Day.	May.	June.	July.
1	46,400	95,800	109,000	11	49,700	137,000	80,900	21	65,100	134,000	59,000
2	46,700	101,000	107,000	12	51,300	137,000	78,500	22	65,500	132,000	56,900
3	47,000	107,000	104,000	13	53,200	138,000	73,900	23	66,300	131,000	54,900
4	47,300	112,000	101,000	14	55,900	139,000	73,900	24	67,500	127,000	53,200
5	46,700	116,000	97,800	15	57,900	139,000	71,200	25	68,300	125,000	51,600
6	47,000	119,000	94,700	16	59,600	139,000	69,100	26	69,500	122,000	49,700
7	47,000	122,000	92,100	17	61,400	138,000	67,100	27	72,100	120,000	48,200
8	47,300	126,000	89,000	18	62,900	138,000	65,100	28	76,100	117,000	46,700
9	47,600	131,000	85,900	19	64,000	138,000	62,900	29	79,900	114,000	45,200
10	48,800	135,000	83,400	20	64,400	137,000	60,700	30	84,900	112,000	44,000
								31	90,000	.....	42,900

Daily discharge, in second-feet, of Clark Fork at Metaline Falls, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12,100	11,300	12,500	9,980	7,400	13,900	36,900	51,000	67,100	124,000	70,800	28,400
2	12,000	11,300	12 500	9 680	7 860	14,100	37,500	52,200	67,100	126,000	67,900	27,600
3	11,800	11,600	12,300	9,530	8,930	14,100	37,800	53,500	67,100	128,000	65,500	26,900
4	12,000	11,800	12,100	8 650	8 790	14 100	38 000	54,900	67,100	131,000	64,000	26,400
5	12,000	11,800	12,100	8,110	9,230	13,900	38,000	55,900	67,100	132,000	61,800	25,400
6	11,600	11,400	12,100	8,110	9,530	13,900	38,000	56,900	67,900	133,000	59,600	24,700
7	11,800	11,600	12,000	8,370	9,680	13,900	38,000	59,600	68,700	133,000	57,600	24,900
8	11,800	11,600	12,300	8,650	9,830	13,900	38,000	61,800	69,500	133,000	55,500	24,900
9	11,800	11,800	12,300	8,930	9,830	14,100	38,000	64,000	71,600	133,000	53,200	24,400
10	11,800	11,800	12,300	8,880	10,100	14,500	38,300	67,100	72,500	133,000	51,900	24,400
11	11,800	11,400	12,100	8,840	10,300	15,100	38,600	68,700	74,300	132,000	50,000	24,000
12	11,800	11,400	12,100	8,790	10,500	15,900	39,400	70,400	75,700	130,000	48,500	24,000
13	11,800	11,600	12,100	8,240	10,500	16,700	39,700	71,600	77,500	130,000	46,700	23,500
14	11,800	11,600	12,300	8,110	10,600	18,000	40,800	72,100	79,400	127,000	45,800	23,500
15	11,800	11,600	12,100	8,110	10,800	20,200	41,400	72,100	81,400	126,000	44,300	23,500
16	11,800	11,800	12,300	7,920	10,800	20,900	41,700	72,100	83,400	123,000	42,900	23,200
17	11,800	11,800	12,100	7,740	11,100	22,000	42,900	71,600	85,900	121,000	41,400	23,000
18	11,800	11,800	12,000	7,620	11,400	23,000	43,700	70,400	89,500	118,000	40,300	23,000
19	11,800	11,800	12,000	7,620	11,800	23,700	44,300	70,800	91,600	115,000	39,400	23,000
20	11,600	11,800	12,000	7,620	11,800	25,400	44,300	70,800	95,200	112,000	38,300	22,800
21	11,600	11,600	11,800	7,620	12,100	26,900	44,900	70,800	99,900	110,000	36,900	22,500
22	11,600	11,600	11,800	7,860	12,300	27,900	45,500	70,400	104,000	106,000	35,800	22,500
23	11,600	11,800	11,800	9,230	12,500	29,400	46,100	69,900	107,000	101,000	35,300	22,300
24	11,600	12,300	11,800	9,230	12,800	30,200	46,100	69,500	111,000	98,900	34,500	22,000
25	11,600	12,500	11,800	9,680	13,400	31,500	46,100	70,400	114,000	94,700	33,600	21,800
26	11,800	12,300	11,800	9,980	14,300	32,600	46,400	70,400	117,000	90,600	32,800	21,600
27	11,800	12,100	11,800	9,680	14,300	34,200	46,700	69,900	118,000	87,000	32,000	21,100
28	11,800	12,100	11,800	9,380	14,300	34,700	47,000	68,700	121,000	83,400	31,500	21,100
29	11,600	12,500	11,800	8,370	14,300	35,500	47,900	67,900	122,000	79,000	30,700	20,600
30	11,600	12,500	11,600	7 290	.....	36 600	48 500	67,900	122,000	75,700	30,000	20,200
31	11,600	.....	10,800	6,980	.....	36,900	.....	67,500	.....	72,100	29,400	.....

NOTE.—Determinations of discharge for May, June, and July, 1913, revised, as later high-water measurements show that record for those months published in Water-Supply Paper 362 were more than 5 per cent in error. Discharge Dec. 31, 1915, and Jan. 10-11, 1916, interpolated, as gage readings appear to be erroneous.

Monthly discharge of Clark Fork at Metaline Falls, Wash., for the period May 1 to July 31, 1913, and the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1913.				
May	90,000	46,400	59,900	3,680,000
June	139,000	95,800	126,000	7,500,000
July	109,000	42,900	71,600	4,400,000
				15,580,000
1915–16.				
October	12,100	11,600	11,800	726,000
November	12,500	11,300	11,800	702,000
December	12,500	10,800	12,000	738,000
January	9,980	6,980	8,540	525,000
February	14,300	7,400	11,100	638,000
March	36,900	13,900	22,500	1,380,000
April	48,500	36,900	42,000	2,500,000
May	72,100	51,000	66,200	4,070,000
June	122,000	67,100	88,500	5,270,000
July	133,000	72,100	114,000	7,010,000
August	70,800	29,400	45,400	2,790,000
September	28,400	20,200	23,600	1,400,000
The year	133,000	6,980	38,200	27,700,000

NOTE.—Determination of discharge May to July, 1913, revised by means of high-water measurement made in 1916; data supersede those published in Water-Supply Paper 362.

RACETRACK CREEK NEAR ANACONDA, MONT.

LOCATION.—In sec. 13, T. 6 N., R. 11 W., opposite Racetrack Creek ranger station near Anaconda, in Powell County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 25, 1914, to September 30, 1916. July 11, 1911, to November 9, 1912, for station in sec. 15, T. 6 N., R. 11 W., above the falls.

GAGE.—Vertical staff on right bank, opposite Racetrack Creek ranger station; read to half tenths twice a day by W. E. Jackson. From July 11, 1911, to June 17, 1912, vertical staff on left bank, 2 miles above present gage; June 18 to November 9, 1912, vertical staff on left bank, 300 feet above previous gage and at different datum.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Gravel and sand; slightly shifting. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.20 feet June 19; minimum stage recorded, 1.40 feet March 29.

1911–12 and 1914–16: Maximum stage recorded, 6.8 feet June 10–14, 1912 (discharge, 515 second-feet); minimum stage recorded, 2.85 feet February 22, 24, and 26, 1912 (discharge, 16 second-feet).

WINTER FLOW.—Stage-discharge relation seriously affected by ice; record discontinued during winter.

DIVERSIONS.—One small diversion during irrigation season.

REGULATION.—None.

COOPERATION.—Gage-height record furnished by United States Forest Service.

No discharge measurements were made during the year to ascertain permanence of stage-discharge relation. Data inadequate for determination of daily discharge.

Daily gage height, in feet, Racetrack Creek near Anaconda, Mont., for the year ending Sept. 30, 1916.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.45	1.78	2.0	3.9	2.0	1.7
2	.....	1.45	1.75	2.0	4.35	2.0	2.2
3	.....	1.42	1.75	2.0	4.1	2.0	2.0
4	.....	1.4	1.92	2.3	3.85	2.0	1.85
5	.....	1.4	2.08	2.42	3.8	2.0	1.8
6	.....	1.4	2.28	2.32	3.95	1.98	1.8
7	.....	1.4	2.58	2.45	3.92	1.95	1.8
8	.....	1.42	2.38	2.85	3.95	1.95	1.8
9	.....	1.45	2.35	2.95	3.75	1.98	1.8
10	.....	1.5	2.28	2.95	3.6	1.98	1.8
11	.....	1.52	2.12	2.7	3.4	1.92	1.8
12	.....	1.5	2.02	2.6	3.15	1.9	1.8
13	.....	1.52	1.98	2.62	2.75	1.9	1.8
14	.....	1.52	1.95	2.95	2.45	1.9	1.7
15	.....	1.5	1.9	3.48	2.35	1.9	1.7
16	.....	1.52	1.9	4.1	2.45	1.9	1.7
17	.....	1.55	1.85	4.45	2.6	1.95	1.7
18	.....	1.55	1.88	4.7	2.65	1.9	1.68
19	1.55	1.5	1.95	5.2	2.55	1.85	1.65
20	1.6	1.5	2.08	4.9	2.38	1.85	1.65
21	1.5	1.5	2.05	4.15	2.32	1.85	1.62
22	1.5	1.5	2.0	3.65	2.28	1.82	1.6
23	1.48	1.48	1.95	3.3	2.25	1.8	1.6
24	1.48	1.5	1.9	3.3	2.2	1.78	1.7
25	1.45	1.55	2.0	3.25	2.3	1.75	1.7
26	1.45	1.7	2.0	3.35	2.35	1.72	1.7
27	1.45	1.8	2.0	3.8	2.35	1.7	1.7
28	1.45	1.9	2.0	3.9	2.2	1.7	1.7
29	1.4	1.8	2.02	4.42	2.15	1.7	1.7
30	1.42	1.8	2.0	4.1	2.05	1.7	1.7
31	.....	.....	2.0	.....	2.0	1.7	.....

WEST FORK OF BITTERROOT RIVER NEAR DARBY, MONT.

LOCATION.—In sec. 27, T. 2 N., R. 21 W., 500 feet downstream from the Trapper Creek ranger station, half a mile below mouth of Trapper Creek, and 10 miles south of Darby, in Ravalli County.

DRAINAGE AREA—572 square miles.

RECORDS AVAILABLE.—September 19, 1910, to September 30, 1916; fragmentary.

GAGE.—Overhanging chain gage on left bank; read by Curtis Matteson, forest ranger, when at the station.

DISCHARGE MEASUREMENTS.—Made by wading or from cable near gage.

CHANNEL AND CONTROL.—Small rock; uniform; practically permanent. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.9 feet June 18 (discharge, 5,520 second-feet); minimum stage recorded, 2 feet October 29–31 and November 1–2 and 7–10 (discharge, 150 second-feet).

1910–1916: Maximum stage recorded, 7.4 feet May 27, 1913 (discharge, 6,420 second-feet); minimum stage recorded, 1.85 feet August 28 to September 7, 1914 (discharge, 106 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined. Gage read to tenths once daily. Daily discharge ascertained by applying gage height to rating table. Records fair.

COOPERATION.—Field data furnished by United States Forest Service.

The following discharge measurement was made by E. W. Kramer:

May 10, 1916: Gage height, 5.1 feet; discharge, 2,470 second-feet.

Daily discharge, in second-feet, of West Fork of Bitterroot River near Darby, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	150	520	1,690	1,690	2,900	580	216
2	.....	150	580	1,690	1,800	3,200	520	216
3	.....	150	580	1,800	2,040	3,200	520	.....
4	.....	150	580	2,750	2,450	2,750	465	.....
5	.....	150	640	3,680	2,310	2,450	415	.....
6	.....	150	640	4,000	2,900	2,450	415	.....
7	.....	150	640	4,830	2,900	2,520	415	.....
8	.....	150	700	4,000	2,900	2,600	370	.....
9	.....	150	765	3,360	3,200	2,750	370	.....
10	.....	150	830	2,600	3,520	2,450	370	.....
11	182	.....	1,130	2,170	3,050	2,040	370	.....
12	182	.....	1,130	1,920	2,750	1,860	330	.....
13	182	.....	1,050	1,690	2,750	1,690	370	.....
14	182	.....	1,050	1,390	3,360	1,690	330	.....
15	216	.....	1,220	1,300	4,000	1,390	330	.....
16	216	.....	1,260	1,220	4,660	1,300	330	.....
17	199	.....	1,300	1,300	5,170	1,300	330	.....
18	182	.....	1,220	1,480	5,520	1,130	330	.....
19	182	.....	1,130	1,690	4,960	1,050	330	.....
20	182	.....	975	1,920	4,400	900	330	.....
21	182	.....	900	1,920	3,840	900	310	.....
22	150	.....	830	1,690	3,050	832	290	.....
23	150	.....	865	1,580	2,450	765	290	.....
24	150	.....	900	1,480	2,310	765	290	.....
25	150	.....	1,220	1,390	2,450	765	252	.....
26	182	.....	1,800	1,390	2,900	765	252	.....
27	182	.....	2,750	1,390	2,900	765	252	.....
28	182	.....	3,050	1,390	4,160	700	252	.....
29	150	.....	2,450	1,390	4,160	640	216	.....
30	150	.....	2,040	1,580	3,520	610	216	.....
31	150	.....	.....	1,690	.....	580	216	.....

NOTE.—Discharge interpolated Oct. 17, Nov. 3–6, Apr. 16, 23, May 27, June 19–20, July 7, 12, 22, 30, Aug. 9, 17–19, and 21.

Monthly discharge of West Fork of Bitterroot River near Darby, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October 11–31	216	150	175	7,290
November 1–10	150	150	150	2,980
April	3,050	520	1,160	69,000
May	4,830	1,220	2,040	125,000
June	5,520	1,690	3,270	195,000
July	3,200	580	1,600	98,400
August	580	216	344	21,200

EAST FORK OF BITTERROOT RIVER NEAR DARBY, MONT.

LOCATION.—In SE. ¼ sec. 21, T. 2 N., R. 20 W., at Joe Olsen's bridge, in front of Medicine Tree ranger station, 10 miles from Darby and 3 miles above junction of East and West forks, in Ravalli County.

DRAINAGE AREA.—340 square miles.

RECORDS AVAILABLE.—October 20, 1910, to September 30, 1916; fragmentary.

GAGE.—Vertical staff on downstream end of left abutment of the bridge; read occasionally by C. W. Shockley.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Large rocks; irregular and probably permanent. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.7 feet June 29; minimum stage recorded, 2.7 feet October 10.

1910-1916: Maximum stage recorded, 7.0 feet May 31, 1913 (discharge, 2,230 second-feet); minimum stage recorded, 2.0 feet December 10-11, 1910 (discharge, 50 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

COOPERATION.—Field data furnished by United States Forest Service.

No discharge measurements were made during the year. Data inadequate for determination of daily discharge.

Daily gage height, in feet, of East Fork of Bitterroot River near Darby, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Dec.	Apr.	May.	June.	July.	Aug.
1							
2							
3							
4							
5				4.6			
6					5.0		
7				5.4			
8				5.1	5.2		3.2
9				5.2			
10	2.7						
11				4.7		5.0	
12				4.55			
13				4.5			
14					5.65		3.0
15					6.0		
16							3.0
17							3.0
18				4.0			
19							3.0
20			3.3	4.3			3.0
21							
22		2.8					3.0
23							
24							
25				4.3			
26							
27							
28			4.4				
29					6.7		
30							
31							2.8

LOLO CREEK NEAR LOLO, MONT.

LOCATION.—In sec. 34, T. 12 N., R. 21 W., at highway bridge at Anderson's ranch, 7 miles upstream from Lolo, and junction with Bitterroot River, in Missoula County.

DRAINAGE AREA.—249 square miles.

RECORDS AVAILABLE.—April 25, 1911, to September 30, 1916, for station at present site; October 18, 1910, to March 9, 1911, for station 1 mile below Anderson's ranch. Milk Creek enters between the two sites. Records fragmentary.

GAGE.—Vertical staff, fastened to bridge abutment; read at irregular intervals by Archie N. Thayer.

DISCHARGE MEASUREMENTS.—Made by wading from bridge.

CHANNEL AND CONTROL.—Rock; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.75 feet May 6; minimum stage recorded, 1.92 feet December 3.

1911-1916: Maximum stage recorded, 5.2 feet May 28, 1913 (discharge, 2,500 second-feet); minimum stage recorded, 1.64 feet March 20, 1912 (discharge, 36 second-feet).

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

DIVERSIONS.—Water is diverted above station for irrigation on small ranches; below station water is diverted for irrigation of land adjoining this creek and Bitterroot River.

REGULATION.—None.

ACCURACY.—A discharge measurement made May 29, 1915, but omitted from Water-Supply Paper 412 indicates that stage-discharge relation is not permanent and that determinations of discharge published in that paper are considerably in error. Gage read to quarter tenths once or twice a week. Data inadequate for determination of daily discharge.

COOPERATION.—Field data furnished by United States Forest Service.

The following discharge measurement was made by E. W. Kramer:
May 29, 1915: Gage height, 3.15 feet; discharge, 424 second-feet.

Daily gage height, in feet, of Lolo Creek near Lolo, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.92				2.78		3.75			
2		2.15							2.68	2.38
3			1.92				3.82			2.35
4				2.05		4.55	3.92	4.25		
5					2.55					
6	2.05					4.75				
7					2.65					
8			2.05							
9	2.02									
10		2.18			2.95		4.15		2.45	
11	2.02			2.28		4.05				
12	2.05									2.45
13										
14										
15									2.38	
16	2.08									2.48
17							4.72	3.25		
18		2.12			3.55	3.85				
19				2.95		3.75			2.55	
20					3.75		4.55			2.35
21	2.05									
22									2.55	
23		2.15								
24					3.58					
25		2.18						3.02	2.45	
26	2.08						4.52			
27				2.85		3.62			2.42	
28										
29							4.45			
30	2.12				4.15			2.82		2.25
31										

NOTE.—Stage-discharge relation probably affected by ice Dec. 3 and 8.

FLATHEAD RIVER NEAR COLUMBIA FALLS, MONT.

LOCATION.—In sec. 7, T. 31 N., R. 19 W., at Potter's ranch, three-fourths of a mile above the junction with Middle Fork of Flathead River, and about 10 miles northeast of Columbia Falls, in Flathead County.

DRAINAGE AREA.—1,620 square miles.

RECORDS AVAILABLE.—September 22, 1910, to September 30, 1916.

GAGE.—Vertical staff, on right bank near Potter's ranch buildings; read by J. F. Potter.

DISCHARGE MEASUREMENTS.—Made from cable about three-fourths mile above gage.

CHANNEL AND CONTROL.—Bed rocky, clean and practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.8 feet June 20 (discharge, 29,500 second-feet); minimum stage recorded, 1.2 feet December 3 and 4 and 29-31 (discharge, 630 second-feet).

1910–1916: Maximum stage recorded, 9.8 feet June 20, 1916 (discharge, 29,500 second-feet); minimum stage recorded, 0.7 foot November 10, 1911, and February 5–6, 1914 (discharge, 350 second-feet).

ICE.—Stage discharge relation seriously affected by anchor ice January 1 to March 1. Data insufficient for determination of winter discharge.

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent except as affected by ice. Rating curve well defined between 500 and 26,000 second-feet. Gage read to tenths once daily. Discharge ascertained by applying mean daily gage height to rating table. Open-water records excellent.

Discharge measurements of Flathead River near Columbia Falls, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 29	8.90	[a]23,100
Sept. 29	2.17	1,460

[a] Surface velocity observed; mean velocity determined by comparison with velocities measured June 10, 1913.

Daily discharge, in second feet, of Flathead River near Columbia Falls, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,100	1,290	700	1,240	2,000	5,500	6,480	17,400	3,700	2,070
2	1,530	1,290	630	1,240	2,000	5,170	6,480	18,800	3,520	2,070
3	1,610	1,290	630	1,340	2,140	5,500	6,740	21,800	3,340	2,220
4	1,730	1,290	700	1,330	2,290	7,160	8,060	21,500	3,340	3,900
5	1,730	1,290	700	1,390	2,290	9,580	10,900	19,000	3,160	5,620
6	1,610	1,290	700	1,390	2,290	10,700	11,700	16,900	3,160	4,840
7	1,610	1,290	700	1,330	2,440	12,300	10,530	15,600	3,160	4,190
8	1,530	1,290	700	1,330	2,830	11,900	10,500	14,900	2,830	3,900
9	1,530	1,290	700	1,860	3,250	10,100	11,900	16,900	2,830	3,610
10	1,390	1,290	700	2,140	3,520	8,540	13,700	16,100	3,340	3,340
11	1,390	1,290	700	2,360	3,990	7,450	13,700	14,400	3,250	3,250
12	1,290	1,290	700	2,670	4,300	6,480	12,500	14,600	3,080	2,910
13	1,290	1,140	700	3,000	4,000	5,860	12,100	14,900	3,000	2,670
14	1,290	1,100	700	3,080	4,190	5,390	13,000	12,300	2,910	2,520
15	1,290	1,100	700	3,080	4,400	5,060	15,400	10,100	2,670	2,360
16	1,290	1,190	700	3,080	4,400	4,840	18,800	8,880	2,670	2,290
17	1,290	1,190	700	2,220	4,400	4,840	22,600	9,050	2,670	2,070
18	1,290	1,100	700	1,670	4,000	5,170	24,900	9,050	2,910	1,930
19	1,290	1,100	700	1,610	3,800	5,980	28,300	8,380	3,430	1,930
20	1,290	1,100	700	1,800	3,520	6,880	29,500	7,450	3,430	1,800
21	1,290	930	700	2,440	3,430	7,450	25,400	6,740	3,160	1,670
22	1,290	930	770	2,520	3,430	7,600	22,100	6,480	3,000	1,670
23	1,290	930	850	2,360	3,160	7,020	20,900	5,980	2,830	1,440
24	1,290	930	700	2,070	3,080	6,610	19,800	5,500	2,750	1,440
25	1,290	930	700	2,000	3,250	6,220	19,800	5,060	2,670	1,440
26	1,290	1,010	700	2,000	3,990	5,980	20,400	4,730	2,670	1,440
27	1,290	930	700	2,520	5,280	5,740	20,900	4,400	2,520	1,440
28	1,290	850	700	2,360	5,980	6,220	22,100	4,300	2,360	1,440
29	1,290	700	630	2,140	6,220	6,740	23,500	3,990	2,220	1,500
30	1,290	700	630	2,070	5,740	7,020	20,700	3,700	2,140	1,500
31	1,290	.....	630	2,000	.....	6,880	.....	3,700	2,070	.....

NOTE.—Discharge Mar. 1 estimated because of effect of ice.

Monthly discharge of Flathead River near Columbia Falls, Mont., for the year ending Sept 30, 1916.

Month.	Discharge in second-feet.			Run-off (in total acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,730	1,100	1,370	84,200
November	1,290	700	1,110	66,000
December	850	630	696	42,800
March	3,080	1,240	2,060	127,000
April	6,220	2,000	3,660	218,000
May	12,300	4,840	7,030	432,000
June	29,500	6,480	16,800	1,000,000
July	21,800	3,700	11,100	682,000
August	3,700	2,070	2,930	180.000
September	5,620	1,440	2,480	148,000

FLATHEAD LAKE AT POLSON, MONT.

LOCATION.—In SE. ¼ sec. 4, T. 22 N., R. 20 W., at s teamboat dock at Polson, in Flat head County, at south end of lake.

RECORDS AVAILABLE.—August 23, 1908, to September 30, 1916.

GAGE.—Vertical staff attached to a pile at end of pier; read daily by V. L. Holding. Datum of gage, 2,800 feet above sea level.

EXTREMES OF STAGE.—Maximum stage recorded during year, 92.7 feet July 1, 2, and 4; minimum, 79.4 feet January 22 to March 1.

1908–1916: Maximum stage recorded July, 1916; minimum, 78.5 feet February 16–22, 1913.

Daily gage height, in feet, of Flathead Lake at Polson, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	80.2	80.1	80.1	79.8	79.4	79.4	81.5	83.6	85.3	92.7	85.5	82.1
2	80.2	80.2	80.1	79.8	79.4	79.5	81.5	83.8	85.3	92.7	85.3	82.0
3	80.2	80.2	80.1	79.8	79.4	79.5	81.5	83.8	85.3	92.5	85.1	82.0
4	80.2	80.2	80.1	79.8	79.4	79.5	81.5	83.9	85.3	92.7	85.0	82.0
5	80.2	80.2	80.1	79.7	79.4	79.5	81.5	84.0	85.5	92.6	84.8	82.0
6	80.2	80.2	80.1	79.7	79.4	79.5	81.5	84.4	85.7	92.5	84.6	82.2
7	80.2	80.2	80.1	79.7	79 4	79.5	81.6	84.9	85.9	92.4	84.4	82.4
8	80.2	80.3	80.0	79.7	79.4	79.6	81.6	85.4	86.1	92.2	84.2	82.3
9	80.2	80.3	80.0	79.7	79.4	79.6	81.6	85.6	86.3	92.0	84.0	82.4
10	80.2	80.3	80.0	79.6	79.4	79.6	81.7	85.9	86.6	91.9	83.8	82.4
11	80.2	80.3	80.0	79.6	79.4	79.6	81.7	86.0	86.8	91.7	83.7	82.4
12	80.2	80.3	80.0	79.6	79.4	79.6	81.8	86.0	87.0	91.5	83.6	82.4
13	80.2	80.3	80.0	79.6	79.4	79.7	81.9	86.0	87.1	91.3	83.5	82.3
14	80.2	80.3	80.0	79.6	79.4	79.7	82.0	85.9	87.2	91.1	83.4	82.3
15	80.2	80.2	80.0	79.6	79.4	79.7	82.1	85.8	87.4	90.8	83.3	82.3
16	80.2	80.2	80.0	79.5	79.4	79.8	82.2	85.7	87.7	90.5	83.2	82.2
17	80.2	80.2	80.0	79.5	79.4	79.8	82.3	85.6	88.2	90.2	83.1	82.2
18	80.2	80.2	80.0	79.5	79.4	79.9	82.3	85.5	88.8	89.8	83.0	82.1
19	80.2	80.2	79.9	79.5	79.4	79.9	82.4	85.4	89.5	89.5	82.9	82.1
20	80.2	80.2	79.9	79.5	79.4	80.0	82.5	85.4	90.2	89.2	82.8	82.0
21	80.2	80.2	79.9	79.5	79.4	80.2	82.6	85.5	91.0	88.8	82.7	82.0
22	80.2	80.2	79.9	79.4	79.4	80.3	82.7	85.5	91.8	88.5	82.6	81.9
23	80.2	80.2	79.8	79.4	79.4	80.5	82.7	85.6	92.3	88.2	82.6	81.9
24	80.1	80.2	79.8	79.4	79.4	80.6	82.8	85.6	92.3	87.9	82.5	81.9
25	80.1	80.2	79.8	79.4	79.4	80.8	82.8	85.5	92.3	87.6	82.4	81.8
26	80.1	80.2	79.8	79.4	79.4	81.0	82.9	85.5	92.3	87.3	82.4	81.8
27	80.1	80.1	79.7	79.4	79.4	81.1	82.9	85.5	92.2	87.0	82.4	81.7
28	80.1	80.1	79.7	79.4	79.4	81.2	83.0	85.4	92.2	86.7	82.3	81.7
29	80.1	80.1	79.7	79.4	79.4	81.4	83.1	85.4	92.4	86.4	82.2	81.6
30	80.1	80.1	79.7	79.4	.....	81.4	83.4	85.4	92.6	86.1	82.2	81.6
31	80.1	.....	79.8	79.4	.....	81.5	.....	85.3	.....	85.8	82.2	.....

FLATHEAD RIVER NEAR POLSON, MONT.

LOCATION.—At Mishell's ferry at Norrisvale, 2½ miles below Newell tunnel, 15 miles northwest of Ronan, and 12 miles below Polson, in Flathead County.

DRAINAGE AREA.—7,010 square miles.

RECORDS AVAILABLE.—July 23, 1907, to September 30, 1916.

GAGE.—Vertical staff in four sections on right bank; installed April 9, 1916; prior to that date a chain gage on left bank at same datum. Gage read by J. J. Fees.

DISCHARGE MEASUREMENTS.—Made from car on ferry cable about 80 feet below gage.

CHANNEL AND CONTROL.—Bed composed of boulders; banks high and not subject to overflow. Current moderately swift. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 16.3 feet July 4 and 5 (discharge, 74,700 second-feet); minimum stage, 2.0 feet February 20 (discharge, 2,900 second-feet).

1907–1916: Maximum stage recorded, 16.4 feet June 12, 1913 (discharge, 75,400 second-feet); minimum stage recorded, 1.2 feet December 29 and 30, 1912 (discharge, 2,150 second-feet).

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

DIVERSIONS.—Several small diversions from tributaries above Flathead Lake.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; not seriously affected by ice. Rating curve well defined. Gage read to tenths once daily. Daily discharge ascertained by applying gage height to rating table. Records good.

No discharge measurements were made during the year.

Daily discharge, in second-feet, of Flathead River near Polson, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4,850	4,850	4,670	4,500	3,010	3,120	9,310	16,200	27,500	74,700	28,700	11,300
2	4,670	4,850	4,670	4,500	3,010	3,120	9,310	17,100	27,000	74,000	27,500	10,900
3	4,850	4,850	4,670	4,500	3,120	3,120	9,310	18,000	27,000	74,000	26,400	10,600
4	4,670	4,850	4,670	4,330	3,120	3,120	9,620	19,000	27,000	74,700	24,700	10,900
5	4,850	4,850	4,670	4,330	3,230	3,120	9,620	20,000	28,700	74,700	24,200	11,300
6	4,850	4,850	4,670	4,330	3,120	3,120	9,620	21,000	30,400	73,200	23,100	12,000
7	4,850	4,850	4,500	4,330	3,120	3,120	9,620	22,000	31,000	72,000	22,000	12,400
8	4,850	4,850	4,500	4,170	3,120	3,230	9,930	23,100	32,200	70,800	21,000	12,400
9	4,850	4,850	4,500	4,020	3,120	3,230	9,930	24,200	32,200	69,600	21,000	12,800
10	5,040	4,850	4,330	3,600	3,010	3,350	9,930	25,300	34,600	67,500	20,000	12,800
11	5,040	4,850	4,330	3,350	3,010	3,230	9,930	27,000	35,900	67,500	19,000	12,800
12	4,850	4,850	4,500	3,230	3,010	3,350	10,200	27,500	37,100	64,600	18,500	12,400
13	4,670	4,850	4,500	3,230	3,010	3,470	10,600	28,700	37,800	64,600	17,100	12,400
14	4,850	4,850	4,500	3,230	3,010	3,470	10,900	29,300	39,000	62,500	17,100	13,200
15	4,850	4,850	4,330	3,230	3,010	3,470	11,300	29,800	39,700	60,400	16,600	12,400
16	4,670	4,670	4,330	3,230	3,010	3,470	11,600	29,800	42,300	57,000	15,700	12,000
17	4,850	4,670	4,330	3,230	3,010	3,600	12,000	29,300	46,200	55,600	15,300	12,000
18	4,850	4,670	4,500	3,230	3,010	3,600	12,400	28,700	48,900	54,300	14,400	11,600
19	4,850	4,670	4,500	3,230	3,120	4,020	12,800	27,500	53,600	50,900	14,800	11,300
20	4,350	4,670	4,500	3,350	2,900	4,670	13,200	27,500	59,800	49,600	14,800	10,900
21	4,850	4,670	4,330	3,230	3,010	4,850	13,600	27,000	63,900	45,600	14,400	10,600
22	4,850	4,670	4,330	3,230	3,010	5,230	13,600	28,700	67,500	44,900	14,000	10,200
23	4,850	4,670	4,330	3,120	3,010	5,630	14,000	29,300	70,300	42,900	13,600	9,930
24	4,850	4,670	4,330	3,120	3,010	6,060	14,400	29,800	71,100	41,000	13,600	9,930
25	4,850	4,670	4,330	3,120	3,010	6,760	14,400	28,700	71,100	38,400	13,200	9,620
26	4,850	4,670	4,500	3,010	3,010	7,270	14,400	28,100	71,100	37,100	12,800	9,310
27	4,670	4,670	4,500	3,010	3,010	7,820	14,800	27,500	70,300	35,200	12,400	9,000
28	4,670	4,670	4,500	3,010	3,010	8,400	15,300	27,500	71,100	34,000	12,000	9,310
29	4,670	4,670	4,500	3,010	3,120	9,000	15,700	27,500	72,500	32,200	12,000	9,310
30	4,850	4,670	4,670	3,120	.....	9,620	16,200	27,500	74,000	31,000	11,600	8,700
31	4,850	.....	4,670	3,010	.....	9,310	.....	27,000	.....	29,800	11,300	.....

NOTE.—Discharge interpolated July 7–8 and Aug. 25 because of missing gage heights.

Monthly discharge of Flathead River near Polson, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	5,040	4,670	4,820	296,000
November	4,850	4,670	4,760	283,000
December	4,670	4,360	4,490	276,000
January	4,500	3,010	3,520	216,000
February	3,200	2,900	3,000	175,000
March	9,620	3,120	4,770	293,000
April	16,200	9,310	11,900	708,000
May	29,800	16,200	25,800	1,590,000
June	74,000	27,000	48,000	2,860,000
July	74,700	29,800	55,600	3,420,000
August	28,700	11,300	17,500	1,080,000
September	13,200	8,700	11,100	660,000
The year	74,700	2,900	16,300	11,900,000

MIDDLE FORK OF FLATHEAD RIVER AT BELTON, MONT.

LOCATION.—In NW. ¼ sec. 36, T. 32 N., R. 19 W., at Hotel Belton, half a mile below highway bridge at Belton, about 2 miles above Lake McDonald outlet, in Flathead County.

DRAINAGE AREA.—900 square miles.

RECORDS AVAILABLE.—October 5, 1910, to September 30, 1916.

GAGE.—Sloping gage on left bank directly back of Hotel Belton; read by Mr. and Mrs. S. C. Brock.

DISCHARGE MEASUREMENTS.—Made from cable 200 feet below gage.

CHANNEL AND CONTROL.—Practically permanent; banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 20.0 feet at 9 a. m. June 21 (discharge determined by extension of rating curve, 49,000 second-feet); minimum stage recorded, 2.30 feet February 3–13 (discharge 535 second-feet).

1910–1916: Maximum stage recorded, 20.0 feet at 9 a. m. June 21, 1916 (discharge, determined by extension of rating curve, 49,000 second-feet); minimum stage recorded, 1.3 feet, March 29–30, 1912 (discharge 182 second-feet).

ICE.—Stream freezes over for short periods during winter, but usually remains open at control. Stage-discharge relation only slightly affected.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; possibly slightly affected by ice during January, February, and March, but no correction applied. Rating curve well defined between 325 and 20,000 second feet. Gage read to half tenths once daily; oftener during rapid changes in stage. Daily discharge ascertained by applying gage height to rating table. Records good.

The following discharge measurement was made by W. A. Lamb.

March 3, 1916: Gage height, 2.58 feet; discharge, 673 second-feet. Ice present along both banks and at control; stage-discharge relation probably slightly affected thereby.

Daily discharge, in second-feet, of Middle Fork of Flathead River at Belton, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	960	1,160	895	710	562	590	1,580	4,810	5,580	12,600	1,970	1,160
2	1,020	1,160	895	680	552	590	1,580	3,930	5,980	13,400	1,970	1,100
3	960	1,160	830	680	535	710	1,580	5,000	6,400	14,200	1,670	1,400
4	1,100	1,240	830	650	535	710	1,580	5,780	8,370	12,000	1,580	6,400
5	1,100	1,320	830	650	535	710	1,580	12,000	13,100	10,500	1,400	7,250
6	1,100	1,400	830	650	535	740	1,580	12,800	10,000	9,780	1,400	4,810
7	1,020	1,400	830	650	535	740	1,580	16,200	8,370	10,000	1,400	3,770
8	1,100	1,320	895	650	535	680	1,670	11,500	9,540	10,300	1,400	2,900
9	1,100	1,240	895	650	535	650	2,080	8,370	12,600	9,780	1,400	2,300
10	1,100	1,160	830	650	535	710	2,300	6,820	12,600	9,300	1,240	1,770
11	1,100	1,100	830	650	535	770	2,900	7,690	9,540	8,140	1,320	2,080
12	1,100	1,020	830	650	535	830	3,930	5,980	10,000	7,690	1,400	1,770
13	1,100	895	830	620	535	960	4,100	5,580	10,500	7,470	1,480	1,580
14	1,100	1,020	830	620	562	1,020	3,770	4,810	11,500	6,190	1,400	1,400
15	1,100	1,100	830	620	562	1,100	3,770	5,190	16,200	5,190	1,400	1,400
16	1,160	1,020	770	620	562	1,240	3,930	5,980	20,200	5,580	1,400	1,240
17	1,160	960	770	620	590	1,320	4,240	7,030	21,500	5,780	1,580	1,240
18	1,100	1,020	770	620	590	1,400	3,930	7,250	21,200	5,000	1,670	1,240
19	1,160	1,020	770	590	620	1,480	3,610	7,690	26,200	4,440	1,870	1,160
20	1,160	1,020	770	590	620	2,410	3,460	8,140	19,900	3,770	1,770	1,100
21	1,100	960	770	590	620	2,770	3,170	8,600	42,000	3,770	1,580	1,100
22	1,100	960	830	590	620	3,030	2,770	7,690	23,500	3,400	1,580	1,100
23	1,100	960	830	590	590	3,170	2,650	6,610	15,000	3,170	1,580	1,020
24	1,100	960	830	620	590	2,770	2,650	5,580	13,900	2,900	1,400	960
25	1,020	1,020	770	620	590	2,190	2,900	4,810	14,800	2,650	1,400	1,100
26	1,020	960	770	620	590	2,190	5,380	4,450	13,900	2,650	1,400	1,100
27	1,020	960	770	590	590	2,300	7,470	4,270	14,200	2,410	1,320	1,100
28	1,100	960	770	590	590	2,080	9,540	4,810	15,300	1,970	1,240	1,100
29	1,100	960	740	590	590	1,970	7,250	5,580	15,900	1,770	1,160	1,020
30	1,160	895	740	562	.....	1,870	5,780	5,380	12,000	1,770	1,160	895
31	1,160	.....	710	562	.....	1,670	.....	5,580	.....	1,970	1,160	.....

NOTE.—Discharge June 21 estimated by extension of rating curve.

Monthly discharge of Middle Fork of Flathead River at Belton, Mont., for the year ending September 30, 1916.

[Drainage area, 900 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	1,160	960	1,090	1.21	1.40	67,000
November	1,400	895	1,080	1.20	1.34	64,300
December	895	710	809	.899	1.04	49,700
January	710	562	624	.693	.80	38,400
February	620	535	568	.631	.68	32,700
March	3,170	590	1,460	1.62	1.87	89,800
April	9,540	1,580	3,480	3.87	4.32	207,000
May	16,200	3,930	6,960	7.73	8.91	428,000
June	42,000	5,580	14,700	16.3	18.19	875,000
July	14,200	1,770	6,440	7.16	8.26	396,000
August	1,970	1,160	1,470	1.63	1.88	90,400
September	7,250	895	1,920	2.13	2.38	114,000
The year	42,000	535	3,380	3.76	51.07	2,450,000

SOUTH FORK OF FLATHEAD RIVER NEAR COLUMBIA FALLS, MONT.

LOCATION.—In NW. ¼ SW. ¼ sec. 4, T. 30 N., R. 19 W., at highway bridge half a mile above junction with Flathead River and about 7 miles east of Columbia Falls, in Flathead County.

DRAINAGE AREA.—1,640 square miles.

RECORDS AVAILABLE.—September 20, 1910, to September 30, 1916. No gage-height record during 1910.

GAGE.—Chain on right span of bridge; read irregularly by employees of United States Forest Service.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Gravel and small rock Control probably permanent. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 16.6 feet June 19 (discharge, determined from extension of rating curve, 46,200 second-feet); minimum stage recorded, 3.8 feet September 16 (discharge, 1,300 second-feet).

1910–1916: Maximum stage recorded, 16.6 feet June 19, 1916; minimum stage recorded, 3.05 feet October 1, 1913 (discharge, 520 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—No discharge measurements to determine permanence of stage-discharge relation were made during the year; rating curve previously developed considered applicable throughout year. Gage read to tenths at irregular intervals. Daily discharge for days on which gage was read ascertained by applying gage height to rating table. Records fair below and poor above discharge 20,000 second-feet.

COOPERATION.—Gage-height record furnished by United States Forest Service.

Daily discharge, in second-feet, of South Fork of Flathead River near Columbia Falls, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.
1							
2	2,210	1,570					
3	2,570		4,290	11,600			
4							
5							3,170
6				18,300			
7				23,800			
8							
9	2,210					20,600	
10					17,500		
11					17,100		
12							
13			6,120				
14						11,600	2,570
15					24,300		
16	1,300						
17					35,400	10,200	
18					37,800		
19					46,200		
20							
21					39,000		2,390
22							
23				9,210			
24					28,200		
25			5,290				
26							
27							
28							
29							
30	1,420						
31							

ASHLEY CREEK NEAR KILA, MONT.

LOCATION.—In sec. 25, T. 28 N., R. 24 W., about 1½ miles below outlet of Ashley Lake, 7 miles northwest of Kila, in Flathead County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—July 23, 1916, to December 19, 1916.

GAGE.—Vertical staff on upstream end of the right abutment of wagon bridge 500 feet southwest of W. B. Lister's farmhouse. Read by W. B. Lister.

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

CHANNEL AND CONTROL.—Bed composed of gravel and sand, fairly permanent. No sharply defined point of control. One channel at all stages. Banks high and not subject to overflow.

WINTER FLOW.—Stage-discharge relation affected by ice.

DIVERSION.—None.

REGULATION.—Flood water stored in Ashley Lake and released during irrigation season.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.82 feet at 8.20 p. m. August 9, 1916 (discharge, 20.2 second-feet); minimum stage, 1.14 feet at 6 p. m. September 29 (discharge, 4.2 second-feet).

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined between 4 and 18 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of Ashley Creek near Kila, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 23	1.73	17.2
Aug. 25	1.62	13.9
Sept. 30	1.15	4.4

Daily discharge, in second-feet, of Ashley Creek near Kila, Mont., for the period July 23 to Dec. 19, 1916.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	18	15	18	15	17	16	.....	15	14	20	13	15
2	.....	18	15	18	15	18	17	.....	15	14	20	13	15
3	.....	18	16	18	15	18	18	.....	15	15	19	13	16
4	.....	18	16	18	15	18	19	.....	15	15	18	17	16
5	.....	17	15	17	15	18	20	.....	15	15	18	19	.....
6	.....	18	15	17	15	18	21	.....	15	14	17	18	.....
7	.....	18	15	17	15	18	22	.....	14	14	17	16	.....
8	.....	18	15	17	14	17	23	17	14	14	16	15	.....
9	.....	20	15	16	14	17	24	18	15	14	16	13	.....
10	.....	15	15	16	14	17	25	18	14	15	16	12	.....
11	.....	15	15	16	14	17	26	18	14	14	16	16	.....
12	.....	15	15	18	14	17	27	18	14	13	16	18	.....
13	.....	15	15	20	14	17	28	18	14	13	16	18	.....
14	.....	15	15	20	14	16	29	18	15	7.8	16	18	.....
15	.....	15	14	20	13	16	30	18	14	9.5	16	18	.....
							31	18	15	.....	15	.....	.....

Monthly discharge of Ashley Creek near Kila, Mont., for the period July 23 to Dec. 19, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July 23–31	18	17	17.9	320
August	20	14	15.7	965
September	16	7.8	14.2	845
October	20	15	17.4	1,070
November	19	12	15.1	898
December 1–19	18	15	16.9	637
The period				4,740

LITTLE BITTERROOT RIVER NEAR MARION, MONT.

LOCATION.—In T. 27 N., R. 24 W., at log bridge below outlet of Little Bitterroot Lake, near Marion, in Flathead County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 1, 1910, to September 30, 1916.

GAGE.—Vertical staff in middle of stream; read by Bonnell Kelsey.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Shifting. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.05 feet April 27 (discharge 53 second-feet); minimum stage recorded, 0.70 foot August 31 to September 2 (discharge 0.2 second-foot).

1910–1916: Maximum stage recorded, 3.05 feet April 27, 1916 (discharge, 53 second-feet); minimum stage recorded, 0.30 foot January 19–23, 1915 (discharge,0).

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

DIVERSIONS.—None.

REGULATION.—Some water was stored in the lake above the gage during the spring and summer of 1916.

ACCURACY.—Stage-discharge relation not permanent; affected by shifting control and backwater from fish trap below gage; not seriously affected by ice. Rating curves used applicable as follows: October 1 to April 8, fairly well defined; April 9 to May 17, May 18 to June 23, and June 24 to July 23, poorly defined. Gage read to quarter tenths about four times a week. Daily discharge ascertained by applying gage height to rating tables; shifting-control method used July 24 to Sept. 30, interpolated for days for which gage heights were missing. Records for October to March fair; those for other months poor.

Discharge measurements of Little Bitterroot River near Marion, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 11	2.09	20.3	July 24	1.04	1.8
May 10	2.94	48.2	Aug. 25	.79	.7
June 11	2.92	36.4	Sept 26	.79	1.5
30	2.57	37.0			

Daily discharge in second-feet, of Little Bitterroot River near Marion, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	3.0	0.5	0.5	0.8	5.0	10.1	13.3	44	38	40	1.5	0.2
2	3.0	.6	.6	1.2	6.0	9.8	14.2	42	38	42	1.5	.2
3	3.0	.6	.7	1.0	7.1	9.4	13.9	40	38	41	1.5	.9
4	3.3	.7	.8	.8	9.4	9.8	13.6	38	38	40	1.2	.8
5	3.6	.8	.8	.6	11.7	10.1	13.4	37	37	39	1.0	.8
6	3.3	.8	.8	.5	12.5	10.5	13.3	36	36	38	1.0	.8
7	3.0	.8	.8	.5	12.9	10.9	13.3	36	37	38	1.1	.7
8	3.0	.8	.8	.5	13.3	10.5	13.3	37	38	38	1.2	.6
9	3.0	.8	.8	.8	14.3	10.1	19	38	38	38	1.1	.5
10	3.6	.8	1.0	.8	15.3	10.1	23	50	38	40	1.0	.5
11	3.3	.8	1.2	.8	16.0	10.1	27	40	36	42	1.0	.5
12	3.0	.6	.8	.6	16.7	10.9	32	41	38	40	1.0	.5
13	3.3	.5	.6	.5	18.5	11.3	37	42	40	38	1.0	.4
14	3.6	.5	.5	.6	18.0	11.7	36	44	40	37	1.0	.3
15	3.3	.5	.5	.8	17.6	11.7	36	44	39	36	1.0	.4
16	3.0	.5	.5	1.2	16.3	11.7	42	44	40	36	.8	.5
17	2.5	.6	.5	1.4	15.0	11.0	43	39	40	35	.7	.5
18	1.8	.8	.5	1.6	15.0	10.4	44	34	39	34	.5	.4
19	1.2	.6	.5	1.6	15.0	10.9	45	36	39	32	.3	.3
20	1.2	.5	.5	1.6	14.2	11.3	46	38	39	30	1.2	.5
21	1.2	.8	.5	1.8	13.0	11.7	45	38	40	29	1.1	.7
22	1.2	.6	.5	2.0	11.7	12.1	44	36	40	28	1.0	.7
23	1.2	.5	.5	2.0	10.9	12.5	50	34	40	15	1.0	.7
24	.8	.5	.5	2.2	10.1	12.9	50	36	40	2.0	1.0	1.0
25	.8	.5	.5	2.5	10.1	13.3	51	38	38	2.0	.7	1.2
26	.8	.8	.8	2.5	10.1	14.2	52	38	38	2.0	.7	1.5
27	.6	1.2	.6	2.5	10.9	13.8	53	38	38	2.2	1.0	1.6
28	.5	.8	.5	2.6	10.6	13.3	52	34	38	2.5	.8	1.8
29	.5	.6	.5	2.8	10.3	13.3	50	35	38	2.0	.7	1.6
30	.5	.5	.5	3.6	.....	13.3	46	36	38	1.5	.4	1.5
31	.5	.....	.5	4.3	.....	13.3	.....	38	.....	1.5	.2	.....

NOTE.—Low flow July 24 due to temporary dam at lake outlet.

Monthly discharge of Little Bitterroot River near Marion, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	3.6	0.5	2.15	132
November	1.2	.5	.66	39
December	1.2	.5	.63	38
January	4.3	.5	1.52	94
February	18.5	5.0	12.7	730
March	14.2	9.4	11.5	707
April	53	13.3	34.4	2,050
May	50	34	38.7	2,380
June	40	36	38.5	2,290
July	42	1.5	27.2	1,670
August	1.5	.2	.94	58
September	1.8	.2	.75	45
The year	53	.2	14.1	10,200

LITTLE BITTERROOT RIVER NEAR HUBBART, MONT.

LOCATION.—Above canyon leading to second fall of Little Bitterroot River, 1½ miles west of ranch buildings of Hubbart Cattle Co., near Hubbart post office, 15 miles south of Marion, in Flathead County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 22, 1909, to September 30, 1916.

GAGE.—Vertical staff on left bank; read by C. A. Strodtbeck. From April 22 to October 17, 1909, the gage was in box canyon below the falls, about a mile downstream. Relation between the two gages not determined.

DISCHARGE MEASUREMENTS.—Made by wading near gage.

CHANNEL AND CONTROL.—Bed composed of gravel and silt; channel slightly obstructed by growth of moss and weeds during summer. Banks high; not subject to overflow at ordinary stages. Control shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.00 feet at 6.25 p. m. May 6 (discharge, 340 second-feet); minimum stage recorded, 1.15 feet November 2, 6, and 9 (discharge, 6.5 second-feet).

1909–1916: Maximum stage recorded, 4.0 feet May 6, 1916 (discharge, 340 second-feet); minimum stage recorded, 0.9 foot October 20–27 and November 10, 1914 (discharge, 1.4 second-feet).

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

DIVERSIONS.—None.

REGULATION.—Natural flow slightly affected by storage in Little Bitterroot Lake about 15 miles above station.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used applicable as follows: October 1 to November 13, fairly well defined; April 1 to September 30, well defined between 10 and 220 second-feet. Gage read to half tenths twice a week. Discharge ascertained by applying gage height to rating table; interpolated for days for which gage heights are missing except May 21–22, June 6–9, and June 14–16, for which it was estimated by comparison with records of flow at other stations on Little Bitterroot River. Records fair.

Discharge measurements of Little Bitterroot River near Hubbart, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 10	3.19	186	July 24	1.81	47.5
June 12	2.60	110	Aug. 25	1.21	14.3
30	2.44	95	Sept. 30	1.14	11.6

Daily discharge, in second-feet, of Little Bitterroot River near Hubbart, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	12	7.0	134	234	119	92	19	14
2	12	6.5	136	221	117	88	19	14
3	12	6.5	138	250	116	85	19	14
4	10	6.5	140	280	124	82	19	14
5	10	6.5	148	310	132	79	19	14
6	10	6.5	156	340	140	77	19	14
7	9	6.5	164	302	135	76	19	14
8	8	6.5	173	264	130	75	19	14
9	8	6.5	183	226	135	73	19	14
10	8	6.5	194	188	140	72	18	14
11	8	7.2	204	168	125	71	17	14
12	8	8.0	222	148	110	69	16	14
13	8	8.0	240	128	96	67	16	14
14	8	.....	230	124	85	65	16	14
15	8	.....	221	120	95	64	16	14
16	8	.....	210	116	103	61	16	14
17	8	.....	199	128	111	58	17	13
18	8	.....	188	140	116	56	18	13
19	8	.....	180	153	122	53	19	12
20	8	.....	173	166	128	51	18	12
21	8	.....	166	190	144	49	17	12
22	8	.....	159	165	135	47	16	12
23	8	.....	163	146	125	47	15	12
24	8	.....	168	137	116	47	15	12
25	8	.....	173	128	114	42	14	12
26	8	.....	195	119	112	37	14	12
27	8	.....	216	111	111	32	14	12
28	8	.....	238	114	106	28	14	12
29	8	.....	260	118	101	24	14	12
30	8	.....	247	122	96	22	14	12
31	8	.....	.....	120	.....	20	14	.....

Monthly discharge of Little Bitterroot River near Hubbart, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	12	8	8.61	529
November 1-13	8.0	6.5	6.82	176
April	260	134	187	11,100
May	340	111	177	10,900
June	144	96	118	7,020
July	92	20	58.4	3,590
August	19	14	16.7	1,030
September	14	12	13.1	780

LITTLE BITTERROOT RIVER NEAR NIARADA, MONT.

LOCATION.—In T. 24 N., R. 24 W., at Angus McDonald's ranch, 2 miles southwest of Niarada, in Sanders County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 8, 1908, to December 2, 1909;[1] April 12, 1916, to September 30, 1916.

GAGE.—Vertical staff on upstream end of footbridge opposite ranch house; read by Angus McDonald. April 8, 1908, to December 2, 1909, staff gage at practically same site but different datum.

DISCHARGE MEASUREMENTS.—Made from footbridge or by wading.

CHANNEL AND CONTROL.—Bed composed of silt and cobblestones; slightly shifting. Banks high and covered with a heavy growth of willows and underbrush. At high stages backwater caused by overhanging brush slightly affects stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 5.30 feet May 7 (discharge, 412 second-feet); minimum stage, 1.10 feet September 18–23 and 26–30 (discharge, 15 second-feet).

1908–1909 and 1916: Maximum discharge May 7, 1916; minimum discharge, 13 second-feet September 14, 1908.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: May 10 to June 12, fairly well defined between 140 and 300 second-feet; July 1 to September 30, fairly well defined between 12 and 140 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating tables; shifting-control method used April 12 to May 9 and June 13–30. Records fair.

Discharge measurements of Little Bitterroot River near Niarada, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
April 12	4.47	274	July 24	2.15	64
May 10	4.31	280	Aug. 26	1.21	18.1
June 12	3.23	165	Sept. 30	1.12	15.4
July 1	3.32	132			

Daily discharge, in second-feet, of Little Bitterroot River near Niarada, Mont., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	267	183	130	28	18	16	267	170	145	87	24	16
2	.....	268	179	123	26	18	17	256	161	168	81	26	16
3	.....	258	188	123	26	18	18	249	170	160	81	28	15
4	.....	309	188	123	26	18	19	241	198	176	81	26	15
5	.....	406	198	114	26	18	20	216	208	185	75	22	15
6	.....	405	224	120	26	18	21	212	242	216	69	22	15
7	.....	412	193	111	26	18	22	210	242	196	64	22	15
8	.....	380	184	111	25	18	23	193	242	185	64	22	15
9	.....	336	188	105	24	18	24	193	198	167	62	20	18
10	.....	286	193	99	24	18	25	200	179	168	59	18	18
11	.....	236	174	99	24	18	26	267	170	161	49	18	15
12	274	219	165	93	24	16	27	336	170	158	42	18	15
13	272	198	160	93	24	16	28	384	170	159	34	18	15
14	266	188	133	87	24	16	29	357	179	150	36	18	15
15	272	179	147	87	24	16	30	304	179	142	36	18	15
							31	.....	181	.....	30	18	.....

[1] Station known as Little Bitterroot River near Dayton, Mont.

Monthly discharge of Little Bitterroot River near Niarada, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 12-30	384	193	262	9,870
May	412	161	239	14,700
June	224	133	174	10,400
July	130	30	82.8	5,090
August	28	18	23.1	1,420
September	18	15	16.5	982
The period				42,500

CROW CREEK NEAR RONAN, MONT.

LOCATION.—In SW. ¼ sec. 13, T. 20 N., R. 20 W., at old highway bridge 500 feet above present bridge on stage road from St. Ignatius to Ronan, Missoula County, 3 miles south of Ronan; above all tributaries.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 21, 1906, to September 30, 1916.

GAGE.—Staff gage on upstream left corner of center pier; read by Mrs. J. A. Nordgren. Staff gage nailed to left abutment was read from September 21, 1906, to September 7, 1913; datum same as that of present gage.

DISCHARGE MEASUREMENTS.—Made by wading or from new highway bridge 500 feet below gage.

CHANNEL AND CONTROL.—Bed composed of sand and mud. Current very sluggish at gage. Sand bar about 50 feet below gage forms incomplete control; shifts slightly; partly covered with vegetation during the summer. Banks fairly high, but at extremely high stages water flows over the right bank about 100 feet above the gage into a small secondary channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 71 feet at 7 a. m. June 21 (discharge, 682 second-feet); minimum stage recorded, 0.4 foot August 8 (discharge, 5.5 second-feet).

1906–1916: Maximum stage recorded, 10.85 feet June 6, 1908 (discharge, 1,400 second-feet); minimum stage recorded August 8, 1916.

Open-water records only; flow may have been lower at times during the winter.

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

DIVERSIONS.—Water is diverted above station by the Pablo feeder canal to irrigate about 12,000 acres.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve fairly well defined between 20 and 600 second-feet. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

Discharge measurements of Crow Creek near Ronan, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 11	1.25	29	July 1	6.20	535
Apr. 8	1.70	50	25	2.60	115
May 9	3.95	212	Aug. 26	2.03	69
June 9	4.82	275			

Daily discharge, in second-feet, of Crow Creek near Ronan, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	64	46	41	.....	56	76	170	544	13.0	36
2	56	46	41	.....	58	82	188	449	11.0	36
3	56	46	36	.....	61	122	179	389	9.5	58
4	56	46	36	.....	67	188	138	332	9.5	100
5	58	46	36	61	61	207	138	306	9.5	179
6	56	46	36	61	56	248	146	294	7.5	188
7	56	41	36	58	54	294	170	560	6.5	122
8	56	44	36	56	48	282	207	560	5.5	122
9	56	41	36	58	51	227	294	528	6.5	138
10	58	41	36	58	48	207	404	512	7.5	138
11	61	41	36	61	46	188	496	496	8.5	107
12	61	41	36	61	46	154	480	464	8.5	96
13	56	41	32	61	46	107	480	404	9.5	90
14	56	41	32	58	46	107	464	360	12.0	79
15	56	41	32	70	46	96	496	319	13.0	70
16	56	41	32	73	46	86	560	319	16.0	61
17	56	41	32	79	46	90	592	294	18.0	61
18	56	41	32	79	46	107	560	270	30.0	61
19	51	41	32	79	46	122	646	270	58.0	56
20	51	41	32	86	46	154	664	319	9.5	56
21	46	41	32	110	48	138	664	259	12.0	54
22	46	41	32	170	51	130	628	227	13.0	51
23	46	41	32	122	51	122	576	207	16.0	51
24	46	41	32	90	56	138	528	207	18.0	51
25	46	41	32	79	61	138	496	114	30.0	48
26	46	41	32	73	96	138	464	70	58.0	46
27	46	41	32	64	114	138	496	61	54.0	46
28	46	41	32	61	93	138	528	54	51.0	51
29	46	41	32	56	70	138	592	34	46.0	48
30	46	41	32	61	70	138	610	26	44.0	46
31	46	.....	32	58	.....	154	.....	18	41.0	.....

NOTE.—Discharge Aug. 6–13 appears unusually low; probably due to diversion above station; figures should be used with caution.

Monthly discharge of Crow Creek near Ronan, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	64	46	52.8	3,250
November	46	41	42.1	2,510
December	41	32	33.9	2,080
March 5–31	170	56	74.2	3,970
April	114	46	57.7	3,430
May	294	76	150.	9,220
June	664	138	435.	25,900
July	560	18	299.	18,400
August	58	5.5	21.0	1,290
September	188	36	78.2	4,650

CROW CREEK AT LOZEAU'S RANCH, NEAR RONAN, MONT.

LOCATION.—In E. ½ sec. 15, T. 20 N., R. 21 E., at Louis Lozeau's ranch, about a mile below mouth of Mud Creek, 2½ miles above junction of Crow Creek with Flathead River, and 8 miles southwest of Ronan, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 21, 1911, to September 30, 1916.

GAGE.—Overhanging chain gage installed July 26, 1916, at site of private bridge of Louis Lozeau; new datum. April 21, 1911, to May 9, 1915, staff gage 100 feet farther upstream; May 10, 1915, to June 17, 1916, vertical staff with cast-iron face at site of present gage but at different datum.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed at gage and control composed of gravel and cobblestones; shifts at high stages, when current is swift.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.00 feet (new gage) July 8 and 9 (discharge, 717 second-feet); minimum stage recorded, 2.50 feet February 29, March 1–2 (discharge, 40 second-feet).

1911–1916: Maximum stage recorded, 3.4 feet June 29, 1911 (discharge, 960 second-feet); minimum stage recorded, 0.8 foot March 21, 1913 (discharge, 4 second-feet).

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

DIVERSIONS.—Water is diverted from the various tributaries of Crow Creek by the Pablo feeder canal supplying Pablo reservoir. Another canal heads just below mouth of Mud Creek, about a mile above the gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used applicable as follows: October 1 to March 10 (open water), well defined; March 11 to June 16, poorly defined; July 8 to September 30, fairly well defined between 70 and 200 second-feet. No records obtained June 17 to July 7. Gage read to quarter-tenths once daily; temporary gage used July 8–25. Daily discharge ascertained by applying gage height to rating table. Records good except those for high-water periods.

Discharge measurements of Crow Creek at Lozeau's ranch, near Ronan, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 12	2.82	60	July 26	[a] 2.60	161
Apr. 8	3.05	85	Aug. 26	2.32	93
June 9	3.80	216	Oct. 1	2.26	86

[a] New gage at new datum.

Daily discharge, in second-feet, of Crow Creek at Lozeau's ranch, near Ronan, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	102	116	61	50	.....	40	74	87	120	.....	92	86
2	102	116	61	50	.....	40	102	87	130	.....	77	100
3	102	75	59	50	.....	42	87	94	140	.....	75	133
4	102	75	59	50	.....	42	80	120	140	.....	75	161
5	102	75	59	48	.....	45	80	140	216	.....	71	223
6	102	75	59	48	.....	48	87	188	319	.....	66	296
7	102	75	59	.....	.....	233	80	188	300	.....	66	296
8	87	75	59	.....	.....	249	74	216	282	717	66	277
9	87	70	59	.....	.....	283	74	282	216	717	68	133
10	87	70	57	.....	.....	520	74	188	319	671	71	133
11	75	65	57	.....	.....	282	80	163	357	627	71	147
12	75	65	57	.....	.....	216	120	140	282	627	71	139
13	75	65	57	.....	.....	202	102	120	216	583	68	133
14	75	65	57	.....	.....	130	94	120	300	539	68	121
15	70	65	57	.....	.....	102	87	102	514	497	67	109
16	70	61	57	.....	.....	102	87	74	640	375	67	109
17	75	61	57	.....	.....	102	87	87	.....	335	66	109
18	75	61	54	.....	.....	94	80	94	.....	335	68	109
19	75	61	50	.....	.....	87	80	120	.....	375	68	95
20	75	61	50	.....	.....	111	80	140	.....	497	79	95
21	75	57	54	.....	.....	216	74	152	.....	395	92	95
22	75	57	57	.....	.....	264	68	140	.....	335	100	92
23	116	57	57	.....	.....	202	63	120	.....	335	109	92
24	116	57	61	.....	.....	188	63	111	.....	296	109	92
25	110	57	63	.....	.....	140	63	102	.....	258	100	92
26	110	57	65	.....	.....	130	80	102	.....	161	100	92
27	110	57	65	.....	.....	130	87	102	.....	161	92	92
28	110	57	65	.....	.....	130	120	111	.....	114	92	92
29	110	57	54	.....	40	94	120	111	.....	106	86	92
30	110	61	50	.....	.....	80	120	120	.....	100	86	86
31	110	.....	50	.....	.....	74	.....	120	.....	92	86	.....

Monthly discharge of Crow Creek at Lozeau's ranch, near Ronan, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	116	70	92.5	5,690
November	116	57	67.5	4,020
December	65	50	57.6	3,540
January 1–6	50	48	49.3	587
March	520	40	149	9,160
April	120	63	85.6	5,090
May	282	74	130	7,990
June 1–16	640	120	281	8,920
July 8–31	717	92	385	18,300
August	109	66	79.7	4,900
September	296	86	131	7,800

MISSION CREEK NEAR ST. IGNATIUS, MONT.

LOCATION.—In SW. ¼ sec. 10, T. 18 N., R. 20 W., about a mile downstream from St. Ignatius, Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 21, 1908, to September 30, 1916.

GAGE.—Vertical staff on left bank 500 feet below house of T. L. Cope; installed May 19, 1913; read by Mrs. T. L. Cope. Original gage was destroyed July 5, 1907, and a new gage was installed July 24 of that year, a short distance downstream and at a datum 0.30 foot lower; January 25, 1908, this gage was lowered 0.39 foot. The gage was again destroyed June 7, 1908, and on June 26 a vertical staff was installed 20 feet farther downstream and at a different datum. January 29, 1912, a chain gage was installed on the left bank about 200 feet above last gage and at different datum. Site and datum of present gage same as those of chain gage.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge 2 miles below gage.

CHANNEL AND CONTROL.—Bed composed of gravel; shifts slightly at high water. Current swift. No definite point of control. Left bank high and not subject to overflow; right bank low but subject to overflow only at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.7 feet June 19 (discharge, 590 second-feet); minimum stage recorded, 1.65 feet March 16–29 (discharge, 14 second-feet).

1906–1916: Maximum discharge estimated at 2,000 second-feet (gage washed out) June 7–25, 1908; minimum stage recorded 0.2 foot January 30 to February 4, February 17–25, and March 9–12, 1908, and February 28, 1911 (discharge, 8 second-feet).

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

DIVERSIONS.—Mission canal of the United States Reclamation Service and several private ditches divert water above the gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to March 4, well defined between 16 and 360 second-feet; April 3 to June 19, well defined between 20 and 140 second-feet; June 20 to September 30, fairly well defined between 222 and 320 second-feet. Gage read to half-tenths two or three times a week. Snow melting in the mountains causes some diurnal fluctuations during the spring months. Daily discharge ascertained by applying daily gage height to rating table; interpolated for days for which gage heights are missing; shifting-control method used March 5–31.

Discharge measurements of Mission Creek near St. Ignatius, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 7	1.92	27.9	July 1 [a]	3.65	310
May 9	2.52	94	July 26	3.30	222
June 9	2.70	121			

[a] Made from highway bridge 2 miles below gage.

Daily discharge, in second-feet, of Mission Creek near St. Ignatius, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	29	48	38	29	16	14	22	59	78	309	284	62
2	29	48	38	29	16	14	21	62	84	354	245	80
3	45	48	38	29	16	14	20	65	91	400	221	98
4	61	48	38	29	16	14	23	72	91	348	198	135
5	61	48	38	29	16	15	26	78	98	322	183	128
6	61	46	38	29	16	16	27	88	98	361	169	122
7	61	43	38	29	16	17	27	98	101	400	155	116
8	61	43	38	29	16	18	30	108	105	392	145	110
9	61	43	38	29	16	18	30	94	121	385	135	104
10	61	40	38	29	16	18	30	73	147	377	128	98
11	61	38	37	29	16	18	32	53	138	370	122	92
12	61	38	36	29	16	18	33	55	142	363	116	86
13	61	38	35	29	16	18	33	57	147	357	107	80
14	61	38	34	25	18	17	33	59	156	350	98	74
15	61	38	34	22	20	17	33	62	253	343	107	68
16	61	38	33	19	22	17	33	65	365	336	107	68
17	61	38	32	19	20	17	33	65	440	329	107	68
18	61	38	31	19	18	17	33	72	478	322	102	68
19	58	38	30	19	16	16	33	78	590	296	98	68
20	54	38	29	19	16	16	33	84	426	296	90	68
21	54	38	29	19	16	16	35	91	322	296	82	66
22	54	38	29	19	16	16	38	65	270	270	78	65
23	54	38	29	26	16	16	46	65	245	374	75	64
24	51	38	29	22	16	16	53	65	233	361	76	63
25	48	38	29	19	16	17	53	65	239	348	77	62
26	48	38	29	16	16	18	53	65	245	221	78	62
27	48	38	29	16	16	18	53	65	270	241	80	62
28	48	38	29	16	16	18	59	65	279	261	82	62
29	48	38	29	16	18	20	59	65	289	281	75	62
30	48	38	29	16	.....	22	59	68	299	301	72	62
31	48	.....	29	16	.....	24	.....	72	.....	322	68	.....

Monthly discharge of Mission Creek near St. Ignatius, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	61	29	54.2	3,330
November	48	38	40.5	2,410
December	38	29	33.2	2,040
January	29	16	23.2	1,430
February	22	16	16.7	961
March	24	14	17.1	1,050
April	59	20	36.4	2,170
May	108	53	70.9	4,360
June	590	78	228	13,600
July	400	221	332	20,400
August	284	68	121	7,440
September	135	62	80.8	4,810
The year	590	14	88.1	64,000

DRY CREEK NEAR ST. IGNATIUS, MONT.

LOCATION.—At Felsman's ranch, 1½ miles below St. Mary Lake, above the only tributary, and about 5 miles southeast of St. Ignatius, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 16, 1908, to September 30, 1916.

GAGE.—Staff nailed to tree on left bank opposite Henry Felsman's house; read by Theresa Felsman.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and boulders; shifts occasionally. Control not well defined. Banks low but not subject to overflow as slope of channel is great.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 2.80 feet June 19 (discharge, determined from extension of rating curve, 220 second-feet); minimum stage recorded, 0.4 foot October 26–30 (discharge, 4.0 second-feet).

1908–1916: Maximum stage recorded, water over gage June 6–7, 1908 (discharge estimated at 250 second-feet); channel reported dry November 30, 1908, May 15, 18–21, October 24, November 1–4, 11–15, 17, 20–30, 1909, April 23, 1910, May 3–7, 1913, April 1–11, 1914.

ICE.—Observations discontinued during winter; very little flow during winter and early spring.

DIVERSIONS.—One small ditch diverts water above station.

REGULATION.—Flow regulated by St. Mary Lake, Dry Creek carrying only the overflow, which is small during the winter and early spring.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to June 16, well defined; June 20 to September 30, well defined below 100 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying gage height to rating table; shifting-control method used June 17–19. Records fair.

Discharge measurements of Dry Creek near St. Ignatius, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

	Gage height.	Discharge.		Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 11	0.35	3.2	July 1	1.95	79
Apr. 7	.48	6.2	Aug. 26	1.15	12.2
June 9	.90	29.2			

Daily discharge, in second-feet, of Dry Creek near St. Ignatius, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	17	6.0	.....	6.0	17	20	88	8.2	6.8
2	17	6.0	.....	6.0	19	22	98	8.2	7.2
3	17	6.0	.....	4.0	19	22	111	8.2	15
4	17	6.0	.....	4.0	22	24	111	8.2	15
5	17	6.0	.....	6.0	24	26	98	8.2	15
6	17	6.0	.....	6.0	26	27	98	8.2	15
7	16	6.0	.....	6.0	27	29	98	7.9	21
8	16	6.0	.....	6.0	29	33	98	7.9	21
9	16	6.0	.....	6.8	32	33	98	7.9	21
10	10	6.0	.....	6.8	32	40	98	7.9	21
11	10	5.0	.....	7.6	33	40	95	7.9	15
12	10	5.0	.....	7.6	33	44	95	7.9	15
13	10	5.0	.....	6.8	33	47	95	7.9	15
14	10	.....	.....	6.8	33	56	90	7.9	10
15	10	.....	.....	6.8	32	78	88	7.9	10
16	10	.....	.....	6.8	27	114	88	7.9	10
17	10	.....	.....	6.8	26	150	85	7.9	10
18	10	.....	.....	8.4	19	160	85	7.9	10
19	10	.....	.....	9.2	19	220	85	7.9	6.5
20	10	.....	.....	9.2	20	125	6.5	7.9	6.5
21	6.0	.....	.....	9.2	20	62	10	7.9	10
22	6.0	.....	.....	9.2	20	52	10	7.9	6.5
23	6.0	.....	.....	11	20	52	9.3	7.9	6.5
24	6.0	.....	.....	12	20	52	9.3	7.9	6.5
25	6.0	.....	.....	17	19	73	9.0	7.6	6.5
26	4.0	.....	.....	19	19	111	8.6	9.3	6.5
27	4.0	.....	.....	22	19	111	8.6	7.2	6.5
28	4.0	.....	.....	22	19	125	8.2	7.2	6.5
29	4.0	.....	.....	24	19	118	8.2	6.8	6.5
30	4.0	.....	.....	17	20	111	8.2	6.8	6.5
31	6.0	.....	5.0	.....	20	.....	8.2	6.8	.....

NOTE.—Sudden drop in discharge July 19–20 was due to storage in St. Mary Lake above station.

Monthly discharge of Dry Creek near St. Ignatius, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	17	4.0	10.2	627
November 1–13	6.0	5.0	5.77	149
April	24	4.0	9.87	587
May	33	17	23.8	1,460
June	220	20	72.6	4,320
July	111	6.5	61.5	3,780
August	9.3	6.8	7.84	482
September	21	6.5	11.2	666

POST CREEK NEAR ST. IGNATIUS, MONT.

LOCATION.—On line between SW. ¼ sec. 24 and SE. ¼ sec. 23, T. 19 N., R. 20 W., at new highway bridge on stage road between St. Ignatius and Ronan, about a mile below North Fork of Post Creek and 5 miles north of St. Ignatius, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—September 19, 1911, to September 30, 1916. For station at Fitzpatrick's ranch, 3 miles above, September 1, 1906, to May 9, 1911; for station at Deschamp's ranch, 1½ miles above, April 20 to November 11, 1911. Considerable inflow from springs between present and former sites. North Fork of Post Creek also enters between the sites.

GAGE.—Chain gage on downstream side of highway bridge; read by I. H. Lee.

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

CHANNEL AND CONTROL.—Bed composed of small boulders; free from vegetation; shifting at high stages. Banks fairly high; not subject to overflow except at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.20 feet at 5 a. m. June 29 (discharge, 680 second-feet); minimum stage recorded, 2.20 feet October 13–26 (discharge, 32 second-feet).

1906–1916: Maximum stage recorded, 8.48 at station at Fitzpatrick's ranch about June 10, 1908 (gage washed out; discharge estimated at 2,200 second-feet); minimum stage recorded, 2.0 feet September 3, 1914 (discharge, 20 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice except for short periods.

DIVERSIONS.—Two small ditches divert water above old station at Fitzpatrick's ranch. The United States Reclamation Service diverts water for irrigation and for storage in Ninepipe reservoir.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by backwater from drift on control during parts of year. Rating curves used as follows: October 1 to April 30, fairly well defined; June 21 to September 30, well defined between 50 and 480 second-feet. Gage read to tenths twice daily; not read October 27–30, January 16–30, May 31 to June 3, and July 9–11. Daily discharge ascertained by applying daily gage height to rating table; shifting-control method used May 1 to June 30; discharge estimated October 27–30 and interpolated May 31 to June 3 and July 9–11; not determined January 16–29. Records fair.

Discharge measurements of Post Creek near St. Ignatius, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 11	2.53	58	July 1	4.30	420
Apr. 8	2.57	62	26	3.64	249
May 9	3.19	123	Aug. 26	2.94	114
June 9	3.44	182			

Daily discharge, in second-feet, of Post Creek near St. Ignatius, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	95	63	63	55	39	47	63	95	117	448	206	104
2	83	63	55	47	39	39	63	81	124	504	195	120
3	68	63	55	47	39	39	63	80	131	560	206	174
4	51	63	55	47	39	39	63	84	139	590	195	206
5	47	63	55	47	39	39	89	94	187	448	206	195
6	39	63	55	47	39	39	68	112	209	420	174	184
7	39	63	55	47	39	39	63	127	176	448	184	174
8	39	63	55	47	39	43	63	125	166	532	155	155
9	39	63	55	47	39	63	63	125	176	504	195	155
10	39	63	55	47	95	72	63	109	209	476	195	164
11	36	63	55	47	151	72	72	95	200	448	184	128
12	36	63	55	47	63	63	95	89	180	420	155	120
13	32	63	55	47	43	63	83	84	180	448	164	112
14	32	63	55	47	55	63	72	73	180	476	155	104
15	32	59	55	47	95	63	72	64	276	448	164	112
16	32	55	55	.....	83	55	72	65	436	420	137	90
17	32	55	55	.....	68	55	72	65	548	420	155	97
18	32	55	55	.....	59	55	72	69	579	420	174	90
19	32	55	55	.....	63	55	72	93	612	340	164	97
20	32	59	55	.....	55	83	68	106	615	289	137	90
21	32	63	59	.....	55	102	63	114	448	240	128	84
22	32	63	55	.....	47	109	63	115	340	276	104	77
23	32	63	55	.....	47	102	63	115	302	264	112	84
24	32	63	55	.....	47	83	63	108	289	252	104	77
25	32	63	55	.....	47	72	63	95	340	240	112	84
26	32	63	55	.....	47	72	63	95	420	252	112	77
27	32	63	55	.....	47	68	72	102	448	240	112	84
28	63	63	55	.....	47	63	78	103	560	252	104	77
29	63	63	55	.....	47	63	95	103	680	217	112	84
30	63	63	55	39	.....	63	95	103	560	228	104	77
31	63	.....	55	39	.....	63	.....	110	.....	206	112	.....

Monthly discharge of Post Creek near St. Ignatius, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	95	32	43.3	2,660
November	63	55	61.7	3,670
December	63	55	55.4	3,410
January 1-15	55	47	47.5	1,410
February	151	39	55.6	3,200
March	109	39	62.8	3,860
April	95	63	71.0	4,220
May	127	64	96.7	5,950
June	680	117	328	19,500
July	590	206	378	23,200
August	206	104	152	9,350
September	206	77	116	6,900

SOUTH FORK OF JOCKO RIVER NEAR JOCKO, MONT.

LOCATION.—In NE. ¼ sec. 35, T. 17 N., R. 18 W., 300 feet below junction with Middle Fork and about 10 miles northeast of Jocko, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 11, 1912, to September 30, 1916.

GAGE.—Vertical staff nailed to tree on right bank; read by Tony Delaware to October 30 and by Jos. R. Blodgett thereafter.

DISCHARGE MEASUREMENTS.—Made by wading or from a foot log about 200 feet below gage.

CHANNEL AND CONTROL.—Bed composed of boulders and cobblestones; shifts slightly. Current swift at all stages. Banks not very high but not subject to overflow, as slope of channel is steep.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.50 feet June 17 (discharge, 733 second-feet); minimum stage recorded, 2.00 feet October 22 (discharge, 37 second-feet).

1912–1916: Maximum stage recorded, 4.15 feet May 13, 1913 (discharge, 782 second-feet); minimum stage recorded, 1.93 feet December 7, 1912 (discharge, 28 second-feet).

ICE.—Stage-discharge relation probably not seriously affected by ice, but gage readings are discontinued during winter as gage is difficult to reach on account of snow.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to November 27, fairly well defined; March 15 to September 30, fairly well defined between 100 and 500 second-feet. Gage read to hundredths once a week. Melting snow in the mountains causes diurnal fluctuation during the spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; monthly discharge not determined. Records fair.

Discharge measurements of South Fork of Jocko River near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 8	3.65	400
June 14	3.81	435
Aug. 27	2.51	[a] 109

[a] Measured above mouth of Middle Fork and discharge of Middle Fork, 43.7 second-feet, included.

Daily discharge, in second-feet, of South Fork of Jocko River near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1							605		
2									106
3	59					386			
4									
5								187	
6		45			370				
7									
8				106	402		508		
9	55								98
10						412			
11									
12								144	
13		43			223				
14						458			
15			74	132			250		
16	55								82
17						733			
18									
19								134	71
20		41			308				
21				111					
22	37		89				236		
23									71
24						454			
25									
26								111	
27		41			250			108	
28									
29			86	278			203		
30	50								68
31									

JOCKO RIVER NEAR JOCKO, MONT.

LOCATION.—At highway bridge about 1¼ miles north of Jocko agency and 3½ miles east of Arlee, in Missoula, County. Below Big Knife Creek and above Finley, Agency, and Valley creeks.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 20, 1908, to September 30, 1916.

GAGE.—Vertical staff attached to middle pier of highway bridge, on downstream side; read by Tony Delaware to October 30 and by Jos. R. Blodgett thereafter.

DISCHARGE MEASUREMENTS.—Made by wading or from highway bridge. Previous to 1914 high-water measurements were made at a foot log about a mile above the gage, where the measuring section was better.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel; shifts occasionally; very rough at gage. Current swift. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.55 feet June 20 (discharge, 1,630 second-feet); minimum stage recorded, 7.26 feet October 2 (discharge, 106 second-feet).

1906–1916: Open-season records: Maximum stage, from high-water mark, 12.25 feet June 6, 1908 (discharge, estimated from floats, 6,200 second-feet); minimum stage recorded, 6.86 feet July 31, 1914 (discharge, 53 second-feet). Minimum flow July 31, 1914, was due to diversion of water above station.

ICE.—Stage-discharge relation not seriously affected by ice. Gage readings discontinued during winter as water is used only for irrigation and winter flow is not considered important.

DIVERSIONS.—Jocko canal diverts water about 2 miles above station and Big Knife canal diverts from Big Knife Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to June 20, fairly well defined; June 21 to September 30, poorly defined. Gage read to hundredths twice a week; snow melting in the mountains causes diurnal fluctuations during the spring. Daily discharge ascertained by applying gage height to rating table; interpolated for days on which gage was not read. Records fair October to June and poor thereafter.

Discharge measurements of Jocko River near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
Dec. 9[a]	7.14	96
June 13	8.86	902

[a] Measured above mouth of Big Knife Creek; flow of Big Knife Creek, estimated at 9 second-feet, added.

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

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	114	122	.....	207	450	518	1,500	275	174
2	106	122	.....	211	405	550	1,410	266	197
3	114	122	.....	215	507	590	1,320	257	220
4	122	122	.....	219	609	630	1,250	248	243
5	129	122	.....	223	712	671	1,180	248	266
6	136	.....	.....	227	700	712	1,120	248	239
7	144	.....	.....	231	688	786	1,060	248	213
8	152	.....	.....	235	676	860	1,060	248	187
9	152	.....	.....	245	665	935	1,060	254	183
10	152	.....	.....	255	595	905	1,060	260	180
11	153	.....	.....	265	525	875	1,030	266	177
12	154	.....	.....	277	455	845	1,000	266	174
13	155	.....	.....	288	448	815	970	266	169
14	156	.....	.....	298	442	945	940	266	165
15	156	.....	144	298	436	1,180	845	266	161
16	154	.....	153	298	430	1,320	750	279	158
17	152	.....	162	298	470	1,400	655	292	155
18	151	.....	171	298	510	1,480	598	306	152
19	150	.....	180	287	550	1,560	541	296	150
20	149	.....	189	276	533	1,630	485	286	146
21	148	.....	198	265	517	1,400	429	276	142
22	146	.....	208	287	501	1,170	403	266	138
23	144	.....	206	309	485	940	377	244	138
24	142	.....	204	332	466	1,070	351	223	138
25	140	.....	202	355	448	1,200	339	202	138
26	136	.....	200	431	430	1,320	328	198	138
27	132	.....	198	508	436	1,460	317	194	134
28	128	.....	196	585	442	1,500	306	190	131
29	124	.....	195	540	448	1,540	299	187	128
30	124	.....	199	495	455	1,590	292	182	128
31	122	.....	203	.....	486	.....	285	178	.....

Monthly discharge of Jocko River near Jocko, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	156	106	140	8,610
November 1-5	122	122	122	1,210
March 15-31	208	144	189	4,370
April	585	207	309	18,400
May	712	405	514	31,600
June	1,630	518	1,080	64,300
July	1,500	285	760	46,700
August	306	178	248	15,200
September	266	128	169	10,100

MIDDLE FORK OF JOCKO RIVER NEAR JOCKO, MONT.

LOCATION.—Near north line of sec. 35, T. 17 N., R. 18 W., 300 feet above junction with South Fork and about 10 miles northeast of Jocko, in Missoula County.

DRAINAGE AREA.—Not measured.

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

GAGE.—Vertical staff nailed to a log on the right bank; read by Tony Delaware to October 30 and by Jos. R. Blodgett thereafter.

DISCHARGE MEASUREMENTS.—Made by wading or from foot log at gage.

CHANNEL AND CONTROL.—Bed composed of gravel and cobblestones; shifting. Banks fairly high; not subject to overflow. Growth of moss along bottom during summer probably has little effect on stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.53 feet June 17 (discharge, 112 second-feet); minimum stage recorded, 0.47 foot November 20 (discharge, 12 second-feet).

1912-1916: Open-season records only: Maximum stage recorded, 1.4 feet June 1, 1912 (discharge, 134 second-feet); minimum stage recorded, 0.45 foot December 13, 1913 (discharge, 8 second-feet).

ICE.—Stage-discharge relation probably not seriously affected by ice, but gage readings are discontinued during winter as gage is difficult to reach on account of snow.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curve used fairly well defined October 1 to November 27. Gage read to hundredths once a week. Snow melting in mountains causes diurnal fluctuation during spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; shifting control method used March 15 to September 30. Monthly discharge not determined. Records for October and November fair; other records poor.

Discharge measurements of Middle Fork of Jocko River near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 8	1.23	74	July 27	1.07	71
June 14	1.22	80	Aug. 27	.88	44

Daily discharge, in second-feet, of Middle Fork of Jocko River near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1							107		
2									42
3	17					75			
4									
5								62	
6		14			94				
7									
8				43			98		
9	16								40
10						81			
11									
12								58	
13		13			51				
14									
15			40	49			66		
16	17								37
17						112			
18									
19								51	
20		12			63				
21									
22	16		43	40			65		
23									35
24						78			
25									
26								45	
27		13			60				
28									
29			40	69			68		
30	14								33
31									

NORTH FORK OF JOCKO RIVER NEAR JOCKO, MONT.

LOCATION.—In NW. ¼ sec. 23, T. 17 N., R. 18 W., three-quarters of a mile above junction with Falls Creek and about 11 miles northeast of Jocko, in Missoula County.

DRAINAGE AREA.—Not measured.

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

GAGE.—Vertical staff nailed to a tree on the left bank; read by Tony Delaware to October 30, and by Jos. R. Blodgett thereafter.

DISCHARGE MEASUREMENTS.—Made from a foot log about 100 feet above gage, or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders and cobblestones; shifts slightly. Current swift at all stages, but gage is set in a deep quiet pool. Banks fairly high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.60 feet June 17 (discharge, 483 second-feet); minimum stage recorded, 0.75 foot September 30 (discharge 14 second-feet).

1912–1916: Maximum stage recorded, 3.4 feet May 31, 1913 (discharge, 492 second-feet); minimum stage recorded, 0.55 foot December 13, 1913 (discharge 6 second-feet). Open-season records only.

ICE.—Stage-discharge relation probably not seriously affected by ice, but observations are discontinued during the winter as it is very difficult to reach the gage on account of snow.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to November 27, well defined above 10 second-feet; March 15 to June 17, fairly well defined between 40 and 320 second-feet; June 18 to September 30, fairly well defined below 80 second-feet. Gage read to hundredths once a week. Snow melting in the mountains causes some diurnal fluctuation during the spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; monthly discharge not determined. Records fair.

Discharge measurements of North Fork of Jocko River near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 8	2.60	221	July 27	1.36	62
June 14	2.95	312	Aug. 27	.93	25

Daily discharge, in second-feet, of North Fork of Jocko River near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	26						390		
2									26
3						566			
4								42	
5									
6		21			179				
7									
8				45	231		342		
9	19								38
10						320			
11									
12								38	
13		22			86				
14						312			
15			30	52			116		
16	28								30
17						483			
18									
19								34	
20		20			125				
21									
22	25		39	46			98		
23									23
24						252			
25									
26								25	
27		19			114		61	25	
28									
29			36	119			50		
30	23								14
31									

FALLS CREEK NEAR JOCKO, MONT.

LOCATION.—In NE. ¼ sec. 22, T. 17 N., R. 18 W., a quarter of a mile above junction with North Fork of Jocko River and 10 miles northeast of Jocko, Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 11, 1912, to September 30, 1916.

GAGE.—Staff nailed to tree on right bank; read by Tony Delaware and Jos. R. Blodgett.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders. Stream flows through a succession of pools, waterfalls, and rapids. Gage is in pool above a small fall. Control is an irregular rocky ledge strewn with rocks and gravel; shifts slightly.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.45 feet June 17 (discharge, 110 second-feet); minimum stage recorded 0.1 foot March 15 (discharge 3.2 second-feet).

1912–1916: Maximum stage recorded, 1.45 feet June 17, 1916 (discharge, 110 second-feet); minimum stage recorded, 0.0 November 29 and December 6, 1913 (discharge, 1.0 second-foot).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to November 27, fairly well defined below 23 second-feet; March 15 to September 30, fairly well defined below 70 second-feet. Gage read to hundredths once a week. Snow melting in the mountains causes diurnal fluctuations during spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; monthly discharge not determined. Records fair.

Discharge measurements of Falls Creek near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 14	1.19	70
July 27	.60	15.4
Aug. 27	.25	5.6

Daily discharge, in second-feet, of Falls Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1							102		
2									8.8
3	11					52			
4									
5								12	
6		6.0			18				
7									
8				5.6			71		
9	6.5								9.1
10						46			
11									
12								12	
13		4.1			12				
14						70			
15			3.2	7.2			27		
16	7.4								8.3
17						110			
18									
19								11	
20		3.8			16				
21									
22	6.5		4.5	5.6			20		
23									7.2
24						41			
25									
26								9.6	
27		3.6			13		15	5.6	
28									
29			3.9	10			13		
30	6.5								5.9
31									

BIG KNIFE CREEK NEAR JOCKO, MONT.

LOCATION.—In NW. ¼ sec. 14, T. 16 N., R. 19 W., just above head gates of Big Knife canal, about 2½ miles northeast of Jocko, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 19, 1908, to December 31, 1910; August 5, 1910, to September 30, 1916 (present site).

GAGE.—Staff gage on right bank 200 feet above head gate of Big Knife canal; read by Tony Delaware and Jos. R. Blodgett. August 19, 1908, to December 31, 1910, prior to construction of Big Knife canal, which was put in operation August 1, 1910, a staff gage about a mile below present site was used.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; shifts slightly. Channel slightly obstructed during summer by growth of moss at control. Stream gradient steep and current swift, but there is a pool at the gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.65 feet June 30 (discharge, 78 second-feet); minimum stage recorded, 2.08 feet December 9 (discharge, 7.0 second-feet).

Maximum stage recorded 1910–1916: 3.65 feet June 30, 1916 (discharge, 78 second-feet); minimum stage recorded, 1.83 feet April 17, 1911 (discharge, 4.3 second-feet). Open-season records only.

ICE.—Stage-discharge relation not seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—None above station. Big Knife canal takes out just below.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to December 9, fairly well defined; April 14 to September 30, well defined between 7 and 45 second-feet. Gage read to hundredths twice a week. Snow melting in the mountains causes slight diurnal fluctuation during spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; interpolated for other days except November 9–30 (estimated at 7.5 second-feet), December 1–8 (estimated at 7.2 second-feet), and December 9–31 (estimated at 7 second-feet). Records fair.

Discharge measurements of Big Knife Creek near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Dec. 9	2.08	7.0	June 13	2.81	33.3
Apr. 14	2.11	8.8	July 27	2.92	37.6
May 7	2.63	25.4			

Daily discharge, in second-feet, of Big Knife Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1	13	8.2	.....	.....	12	20	74	37	20
2	14	8.1	.....	.....	12	20	70	37	20
3	13	8.0	.....	.....	14	21	66	36	20
4	13	7.9	.....	.....	17	22	66	36	21
5	13	7.8	.....	.....	20	23	67	36	21
6	12	7.8	.....	.....	22	24	68	34	21
7	11	7.8	.....	.....	25	27	69	33	20
8	11	7.8	7.0	.....	22	30	53	33	20
9	11	.....	.....	.....	20	34	37	31	20
10	10	.....	.....	.....	19	34	23	29	20
11	10	.....	.....	.....	17	34	32	28	19
12	10	.....	.....	.....	16	34	41	28	19
13	10	.....	.....	.....	16	34	50	28	19
14	10	.....	.....	8.9	16	41	60	27	18
15	10	.....	.....	9.2	15	48	57	27	18
16	10	.....	.....	9.5	15	56	55	27	18
17	10	.....	.....	9.5	15	60	53	27	18
18	10	.....	.....	9.5	14	64	51	27	17
19	9.9	.....	.....	9.3	14	68	49	26	17
20	9.9	.....	.....	9.1	15	72	47	26	17
21	9.8	.....	.....	8.9	16	65	46	25	16
22	9.7	.....	.....	8.9	17	57	45	24	16
23	9.5	.....	.....	8.9	19	50	43	24	16
24	9.3	.....	.....	8.9	18	54	42	22	16
25	9.2	.....	.....	8.9	17	59	41	22	15
26	9.1	.....	.....	10.2	16	64	40	22	15
27	9.0	.....	.....	11.5	16	69	39	22	15
28	8.9	.....	.....	13.0	17	72	38	21	14
29	8.8	.....	.....	13.0	18	75	38	21	14
30	8.6	.....	.....	12.0	19	78	38	21	14
31	8.4	.....	.....	.....	20	.....	38	20	.....

Monthly discharge of Big Knife Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	14	8.4	10.4	640
November	8.2	.....	7.61	453
December	.....	.....	7.05	433
April 14–30	13	8.9	9.95	336
May	25	12	17.1	1,050
June	78	20	47.0	2,800
July	74	23	49.5	3,040
August	37	20	27.6	1,700
September	21	14	17.8	1,060

NOTE.—See "Accuracy," in station description.

AGENCY CREEK NEAR JOCKO, MONT.

LOCATION.—Just above intake of Matt ditch, about 2 miles east of Jocko, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 19, 1908, to September 30, 1916.

GAGE.—Staff gage bolted to large boulder on left bank about 300 feet above intake of Matt ditch; used since April 1, 1913; read by Tony Delaware and Jos. R. Blodgett. August 19, 1908, to March 31, 1913, staff gage about 100 feet below present site and at different datum; discharge is the same at both points.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel; shifts slightly. Fall is so great that the stream is a succession of small waterfalls. Gage is in a pool just above a small fall. Banks not subject to overflow as stream flows in a ravine.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 3.30 feet June 20 (discharge, 228 second-feet); minimum stage recorded, 1.59 feet September 29 (discharge, 5.8 second-feet).

1908–1916: Maximum stage recorded, 3.30 feet June 20, 1916 (discharge, 228 second-feet); minimum stage recorded, 1.38 feet December 12, 1913 (discharge, 2.0 second-feet). See "Gage." Open-season records only.

ICE.—Stage-discharge relation not seriously affected by ice. Observations discontinued during winter.

DIVERSIONS.—None above station. Matt ditch is the largest taking water from the stream; smaller ditches also take water below the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to June 20, well defined; June 21 to September 30, fairly well defined. Gage read to hundredths twice a week. Snow melting in the mountains causes diurnal fluctuations during the spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; interpolated for other days. Records poor.

Discharge measurements of Agency Creek near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
May 7	2.35	48.8
July 2	2.61	106
28	1.99	22.7

Daily discharge, in second-feet, of Agency Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	38	7.0	.....	13	21	110	20	8.4
2	46	6.8	.....	19	21	106	18	8.5
3	40	6.7	.....	25	23	100	16	8.6
4	35	6.6	.....	31	26	99	14	8.8
5	28	6.4	.....	38	29	98	14	9.0
6	22	.....	.....	44	32	96	14	8.9
7	16	.....	.....	49	39	94	14	8.8
8	10.2	.....	.....	37	47	94	14	8.7
9	9.7	.....	.....	24	55	94	13	8.7
10	9.5	.....	.....	21	55	94	12	8.8
11	9.3	.....	.....	18	55	84	12	8.9
12	9.0	.....	.....	15	55	74	12	9.0
13	8.9	.....	.....	14	55	64	12	9.0
14	8.7	.....	7.5	13	86	55	12	9.0
15	8.5	.....	7.4	12	117	53	12	9.0
16	8.7	.....	7.2	11	148	51	12	8.8
17	8.7	.....	7.1	11	168	48	12	8.6
18	8.9	.....	6.9	13	188	43	12	8.5
19	8.7	.....	6.6	13	208	39	11.6	8.4
20	8.5	.....	6.3	14	228	35	11.2	8.2
21	8.2	.....	6.0	15	180	31	10.8	8.0
22	8.2	.....	6.0	16	132	30	10.5	7.8
23	7.9	.....	6.0	18	85	28	10.2	7.5
24	7.6	.....	6.0	16	94	27	9.9	7.2
25	7.6	.....	6.0	15	103	26	9.6	6.9
26	7.5	.....	9.3	14	113	25	9.3	6.6
27	7.3	.....	12.7	15	123	24	9.2	6.3
28	7.1	.....	16	16	120	23	9.1	6.0
29	7.0	.....	15	18	117	23	9.0	5.8
30	7.0	.....	14	20	114	22	8.8	5.8
31	7.0	.....	.....	20	.....	22	8.6	.....

Monthly discharge of Agency Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	46	7.0	13.7	842
November 1-5	7.0	6.4	6.70	66
April 14-30	16	6.0	8.59	290
May	49	11	19.9	1,220
June	228	21	94.6	5,630
July	110	22	58.5	3,600
August	20	8.6	12.0	738
September	9.0	5.8	8.08	481

FINLEY CREEK NEAR JOCKO, MONT.

LOCATION.—In sec. 31, T. 16 N., R. 19 W., at a ford about 200 feet above a highway bridge, about one-eighth mile below the junction of East and West forks, 4 miles southwest of Jocko and 5 miles southeast of Arlee, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 19, 1908, to September 30, 1916.

GAGE.—Vertical staff nailed to tree on right bank 100 feet above highway bridge; read by Tony Delaware to October 23 and by Jos. R. Blodgett thereafter.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; shifts slightly. Current swift. Control not well defined. Banks moderately high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.96 feet June 23 (discharge, determined from extension of rating curve, 518 second-feet); minimum stage recorded, 1.31 feet November 5 (discharge, 9.2 second-feet).

1909–1916: Maximum stage recorded, 2.96 feet June 23, 1916 (discharge, 518 second-feet); minumum stage recorded, 1.12 feet December 12, 1913 (discharge, 4.4 second-feet).

ICE.—Stage-discharge relation not seriously affected by ice. Gage readings discontinued during winter. Water is used only for irrigation, and as there is no storage the winter flow is not important.

DIVERSIONS.—Indian ditch diverts water from East Finley Creek just below station on that stream. A ditch of the United States Reclamation Service also diverts water from both branches.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Rating curves used as follows: October 1 to November 5, fairly well defined; April 14 to September 30, well defined between 7 and 100 second-feet and fairly well defined above 100 second-feet. Gage read to hundredths once a week. Snow melting in the mountains causes a small diurnal fluctuation during spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; discharge June 16 and 20 estimated from extension of rating curve; monthly discharge not determined. Records fair.

Discharge measurements of Finley Creek near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 14	1.90	65	June 14	2.12	110
May 7	2.20	170	July 28	1.68	33.3

Daily discharge, in second-feet, of Finley Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1		9.8						14
2	16			57	67			
3						190		
4	15						24	
5		9.2		132				18
6					94			
7				150		170		
8	17						23	17
9				108	121			
10						132		
11	14						22	
12				76				20
13					108			
14			65		121	86		
15	12						22	22
16				23	303			
17						82		
18	12		63				22	
19				14				19
20					518			
21	10		60			49		
22							20	17
23				65	190			
24						36		
25	10		49				18	
26				57				17
27					263			
28			80			34		
29	9.8						15	17
30				65	238			
31						30		

EAST FINLEY CREEK NEAR JOCKO, MONT.

LOCATION.—Near south line of sec. 32, T. 16 N., R. 19 W., just above intake of Indian ditch, and about 200 feet below crossing of United States Reclamation Service canal; 4 miles southwest of Jocko, and 6 miles southeast of Arlee, in Missoula County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 18, 1908, to July 31, 1911; January 31, 1912, to September 30, 1916.

GAGE.—Vertical staff nailed to tree on left bank about 100 feet above head of Indian ditch; read by Tony Delaware and Jos. R. Blodgett.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; shifts slightly Banks high; not subject to overflow. Current swift at all stages. On account of the fall, the dam at the head of Indian ditch has little or no effect.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.35 feet at 4 p. m. June 20 (discharge, 165 second-feet); minimum stage recorded, 1.50 feet November 5 (discharge, 7.0 second-feet).

1909–1916: Maximum stage recorded, 3.35 feet June 20, 1916 (discharge, 165 second-feet); minimum stage recorded, 1.23 feet April 2, 1912 (discharge, 2.5 second-feet). Open-season records.

ICE.—Stage discharge relation not seriously affected by ice. Gage readings discontinued during winter.

DIVERSIONS.—Indian ditch, heading below the station, takes practically the entire low-water flow. The United States Reclamation Service canal, which crosses above the station, can divert the entire flow, but was not operated during the season of 1916. No record was kept at this station in 1911 after July 31, as practically the entire flow was being diverted by the Reclamation Service canal.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent. Two fairly well defined rating curves used, one applicable October 1 to April 25, the other July 17 to September 30. Gage read to hundredths twice a week. Snow melting in the mountains causes a small diurnal fluctuation in the spring. Discharge for days on which gage was read ascertained by applying gage height to rating table; shifting control method used April 28 to July 14; monthly discharge not determined. Records fair.

Discharge measurements of East Finley Creek near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

	Gage height.	Discharge.		Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 14	1.63	10.7	June 14	2.48	63
May 7	2.10	62	July 28	1.57	16.0

Daily discharge, in second-feet, of East Finley Creek near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1								12
2	14	7.3		25	26			
3						75		
4	13						10	
5		7		58				11
6					47			
7				62		69		
8	10						8.8	11
9				63	68			
10						28		
11	11						7.5	
12				52				11
13					43			
14			11		63	27		
15	12						7.5	11
16				27	111			
17						38		
18	11		11				7.5	
19				7				11
20					165			
21	9.7		10			33		
22							7.5	10
23				35	44			
24						19		
25	8.5		10				14	
26				26				9.2
27					79			
28			24			16		
29	7.3						12	8.2
30				28	72			
31						15		

INDIAN DITCH NEAR JOCKO, MONT.

LOCATION.—Near south line of sec. 32, T. 16 N., R. 19 W., 200 feet below intake on East Finley Creek, 4 miles southwest of Jocko and 6 miles southeast of Arlee, in Missoula County. The intake is 100 feet below gage on East Finley Creek and 300 feet below crossing of United States Reclamation Service canal on East Finley Creek.

RECORDS AVAILABLE.—August 18, 1908, to July 31, 1911; January 31, 1912, to September 30, 1916.

GAGE.—Vertical staff nailed to tree on left bank; installed May 14, 1913; read by Tony Delaware and Jos. R. Blodgett. August 18, 1908, to May 13, 1913, vertical staff nailed to headworks, 200 feet above present site, at different datum.

DISCHARGE MEASUREMENTS.—Made by wading.

REGULATION.—Flow regulated by height of diversion dam; no head gate.

ACCURACY.—Stage-discharge relation not permanent. Two well-defined rating curves used, one applicable October 1 to November 5, the other April 14 to September 30. Gage read to hundredths twice a week. Daily discharge ascertained by applying gage height to rating table; interpolated for days on which gage was not read. Records fair.

Indian ditch diverts water from East Finley Creek, chiefly for use of stock, and is therefore in operation most of the year. Water is also used during the summer to irrigate hay lands. Water not used returns to Finley Creek below station on that stream.

Discharge measurements of Indian ditch near Jocko, Mont., during the year ending Sept. 30, 1916.

[Made by W. A. Lamb.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Apr. 14	0.84	1.1	June 14	1.38	9.8
May 7	1.19	6.2	July 28	1.22	6.4

Daily discharge, in second-feet, of Indian ditch near Jocko, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	7.6	6.0	.....	1.2	1.0	5.2	22	3.8
2	6.6	6.0	.....	1.3	1.2	4.1	15	4.2
3	6.2	5.8	.....	1.4	2.5	3.0	9.4	4.6
4	5.9	5.5	.....	1.5	3.8	3.0	3.8	5.0
5	4.9	5.5	.....	1.7	5.2	3.0	3.6	5.4
6	3.8	.....	.....	1.4	6.6	3.0	3.4	5.8
7	2.7	.....	.....	1.1	6.9	3.0	3.2	6.2
8	1.7	.....	.....	.8	7.3	3.0	3.0	6.6
9	1.7	.....	.....	.4	7.7	3.0	2.9	6.9
10	2.4	.....	.....	.4	8.2	3.0	2.8	5.5
11	2.4	.....	.....	.4	8.8	3.0	2.7	5.0
12	2.9	.....	.....	.4	9.4	3.0	2.7	4.5
13	3.4	.....	.....	.7	10	3.0	2.6	4.0
14	3.9	.....	0.7	1.0	10	3.0	2.5	3.5
15	4.3	.....	.7	1.3	12	4.7	2.4	3.0
16	3.9	.....	.7	1.7	12	6.4	2.6	3.0
17	3.6	.....	.7	1.7	13	8.1	2.8	2.9
18	3.3	.....	.7	1.7	14	8.5	3.0	2.8
19	3.0	.....	.7	1.7	15	9.0	3.0	2.7
20	2.7	.....	.7	1.5	16	9.5	3.0	2.7
21	2.4	.....	.7	1.4	11	10	3.0	2.6
22	3.1	.....	.9	1.3	5.5	9.0	3.0	2.6
23	3.8	.....	1.1	1.2	.0	8.0	3.0	2.6
24	4.5	.....	1.4	.9	2.0	7.0	3.0	2.5
25	5.1	.....	1.7	.6	4.0	12	3.0	2.4
26	5.3	.....	2.1	.4	6.0	17	3.0	2.4
27	5.6	.....	2.5	.4	8.1	23	3.0	2.1
28	5.8	.....	3.0	.5	7.5	29	3.0	1.9
29	6.0	.....	2.4	.6	6.9	29	3.0	1.7
30	6.0	.....	1.8	.7	6.4	29	3.3	1.7
31	6.0	.....	.....	.8	.....	29	3.6	.....

NOTE.—No records Nov. 6 to Apr. 13. Water shut off at intake June 23.

Monthly discharge of Indian ditch near Jocko, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off total in acre feet
	Maximum.	Minimum.	Mean.	
October	7.6	1.7	4.21	259
November 1–5	6.0	5.5	5.76	57
April 14–30	3.0	.7	1.32	45
May	1.7	.4	1.04	64
June	16	0	7.60	452
July	29	3.0	9.47	582
August	22	2.4	4.20	258
September	6.6	1.7	3.66	218

REVAIS CREEK NEAR DIXON, MONT.

LOCATION.—In T. 18 N., R. 22 W., below highway bridge near residence of A. Bishop, 4 miles southwest of Dixon, in Sanders County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 30, 1911, to September 30, 1916.

GAGE.—Staff gage attached to tree on right bank about 100 feet below a log highway bridge; read by A. Bishop.

DISCHARGE MEASUREMENTS.—Made by wading or from bridge.

CHANNEL AND CONTROL.—Steam narrow; banks high; not subject to overflow. Bed composed of small boulders; fairly permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.70 feet at 7 a. m. June 19 (discharge, 512 second-feet); minimum stage recorded, 1.33 feet December 5–19 and 24–31, January 1–22 and 26–31, February 1–9, March 1–5 (discharge, 6.6 second-feet).

1911–1916: Maximum stage recorded, 3.7 feet June 19, 1916 (discharge, 512 second-feet); minimum stage recorded, 1.3 feet several times during January, February, August, September, and October, 1914; also twice during March, 1914 and 1915 (discharge, 6 second-feet).

ICE.—Stage-discharge relation apparently little if any affected by ice.

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined below 200 second-feet. Gage read to half tenths twice daily. Melting snow causes small diurnal fluctuations during the spring. Daily discharge ascertained by applying daily gage height to rating table. Records good except for extremely high stages and for the winter, for which they are fair.

The following discharge measurement was made by W. A. Lamb:

June 13, 1916: Gage height, 2.75 feet; discharge, 156 second-feet.

Daily discharge, in second-feet, of Revais Creek near Dixon, Mont., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10.4	7.6	7.6	6.6	6.6	6.6	37	113	100	228	24	10.1
2	10.4	7.6	7.6	6.6	6.6	6.6	38	83	111	228	22	10.1
3	10.4	7.6	7.6	6.6	6.6	6.6	38	113	111	228	22	12.5
4	10.4	7.6	7.6	6.6	6.6	6.6	38	182	178	188	22	13.1
5	8.9	7.6	6.6	6.6	6.6	6.6	38	214	238	163	22	13.1
6	8.9	7.6	6.6	6.6	6.6	7.6	38	256	194	134	22	12.5
7	8.9	7.6	6.6	6.6	6.6	8.9	38	274	194	122	20	11.6
8	8.9	7.6	6.6	6.6	6.6	12.5	38	178	228	111	19.0	10.1
9	8.9	7.6	6.6	6.6	6.6	28	38	134	256	100	19.0	10.1
10	8.9	7.6	6.6	6.6	7.0	42	40	100	228	91	16.8	10.1
11	8.9	7.6	6.6	6.6	8.9	47	47	91	194	87	16.8	10.1
12	8.9	7.6	6.6	6.6	8.3	47	62	74	194	77	16.8	10.1
13	8.9	7.6	6.6	6.6	7.6	38	68	74	166	71	16.8	10.1
14	8.9	7.6	6.6	6.6	7.6	35	83	61	211	61	16.8	10.1
15	8.9	7.6	6.6	6.6	8.9	35	83	61	274	61	16.0	10.1
16	8.9	7.6	6.6	6.6	9.5	37	83	61	332	50	14.8	10.1
17	8.9	7.6	6.6	6.6	10.4	38	75	61	372	50	14.8	10.1
18	8.9	7.6	6.6	6.6	8.9	38	68	82	392	46	16.8	10.1
19	8.9	7.6	6.6	6.6	8.9	42	62	100	472	43	16.8	10.1
20	8.9	7.6	7.0	6.6	8.9	62	56	148	352	42	16.8	10.1
21	8.9	7.6	8.9	6.6	8.9	102	47	163	274	38	14.8	8.6
22	8.9	8.9	8.9	6.6	8.9	102	47	134	228	34	14.8	8.6
23	8.9	8.9	8.3	7.0	8.9	75	51	111	194	34	13.7	8.6
24	7.6	8.9	6.6	8.3	8.9	51	71	91	194	34	13.1	8.6
25	7.6	7.6	6.6	7.0	8.9	47	87	87	194	32	13.1	8.6
26	7.6	7.6	6.6	6.6	8.9	47	124	74	211	30	12.5	8.6
27	7.6	7.6	6.6	6.6	8.3	38	214	74	238	28	11.6	7.4
28	7.6	7.6	6.6	6.6	7.6	37	214	74	312	27	11.6	7.4
29	7.6	7.6	6.6	6.6	7.0	31	166	77	274	27	10.1	7.4
30	7.6	7.6	6.6	6.6	.....	31	124	87	228	27	10.1	7.4
31	7.6	.....	6.6	6.6	.....	31	.....	91	.....	26	10.1	.....

Monthly discharge of Revais Creek near Dixon, Mont., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	10.4	7.6	8.76	539
November	8.9	7.6	7.73	460
December	8.9	6.6	6.95	427
January	8.3	6.6	6.68	411
February	10.4	6.6	7.95	457
March	102	6.6	36.9	2,270
April	214	37	73.8	4,390
May	271	61	114	7,010
June	472	100	238	14,200
July	228	26	81.2	4,990
August	24	10.1	16.4	1,010
September	13.1	7.4	9.85	586
The year	472	6.6	50.5	36,800

THOMPSON RIVER NEAR THOMPSON FALLS, MONT.

LOCATION.—In SE. ¼ sec. 7, T. 21 N., R. 28 W., at second highway bridge 1 mile above mouth and 8 miles east of Thompson Falls, in Sanders County.

DRAINAGE AREA.—601 square miles.

RECORDS AVAILABLE.—February 12, 1911, to September 30, 1916, fragmentary.

GAGE.—Vertical staff attached to the right-hand downstream side of the center pier.

DISCHARGE MEASUREMENTS.—Made from the highway bridge or by wading at the ford 50 feet above bridge.

CHANNEL AND CONTROL.—Bed composed of gravel and small rock; practically permanent. Current broken by one pier. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.7 feet April 14 (discharge, 3,090 second-feet); minimum stage recorded, 3.77 feet October 27 (discharge, 142 second-feet).

1911–1916: Maximum stage recorded, 7.8 feet May 29, 1913 (discharge, 3,180 second-feet); minimum stage recorded, 3.7 feet August 22, 26, 27, and 28 (discharge, 115 second-feet).

Records fragmentary and for open-season only; flow may have been lower at times during winter.

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

DIVERSIONS.—A flume takes water from river half a mile above the gage for use in irrigating bench lands adjoining Clark Fork between mouth of Thompson River and Thompson Falls.

ACCURACY.—No discharge measurements to determine permanence of stage-discharge relation made durlng year. Old rating curve fairly well defined. Gage read to tenths at irregular intervals. Discharge for days on which gage was read ascertained by applying gage height to old rating table. Records fair.

COOPERATION.—Gage-height record furnished by United States Forest Service.

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

Date.	Discharge.	Date.	Discharge.	Date.	Discharge.
Oct. 6	162	May 12	1,660	Aug. 9	480
15	183	June 9	2,070	19	419
27	142	16	2,490	Sept. 1	307
Mar. 28	1,330	28	2,240	11	254
Apr. 7	1,900	July 24	800	15	254
14	3,090	30	677	22	254
May 6	2,920				

PROSPECT CREEK NEAR THOMPSON FALLS, MONT.

LOCATION.—In NE. ¼ NE. ¼ sec. 18, T. 21 N., R. 29 W., at first highway bridge over Prospect Creek above mouth of Dry Creek, about a mile from Thompson Falls, in Sanders County.

DRAINAGE AREA.—139 square miles.

RECORDS AVAILABLE.—February 12, 1911, to September 30, 1916.

GAGE.—Vertical staff attached to a bridge pier; read by F. E. Brown.

DISCHARGE MEASUREMENTS.—Made by wading 200 feet below the bridge or from bridge.

CHANNEL AND CONTROL.—Bed covered with large rocks; very rough; probably permanent. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.0 feet April 28 (discharge, 1,610 second-feet); minimum stage recorded, 1.9 feet October 27 (discharge, 14 second-feet).

1911–1916: Maximum stage recorded, 7.5 feet May 29, 1913 (discharge, 1,860 second-feet); minimum stage recorded, 1.9 feet October 27, 1916 (discharge, 4 second-feet), open season records only.

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

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—No discharge measurements to test permanence of stage-discharge relation were made during year. Old rating curve fairly well defined. Gage read to tenths at irregular intervals. Discharge for days on which gage was read ascertained by applying gage height to old rating table. Records fair.

COOPERATION.—Field data furnished by United States Forest Service.

Daily discharge, in second-feet, of Prospect Creek near Thompson Falls, Mont., for the year ending Sept. 30, 1916.

Date.	Discharge.	Date.	Discharge.	Date.	Discharge.
Oct. 14	6	June 12	904	Aug. 16	71
27	4	28	881	19	71
Apr. 2	586	July 12	363	23	60
9	881	13	363	26	49
16	972	14	331	Sept. 1	49
19	793	31	111	8	39
28	1,610	Aug. 4	96	9	39
May 25	667	5	96	16	39
June 3	881	6	96	22	23
8	1,110	8	83		

PRIEST RIVER AT OUTLET OF PRIEST LAKE, NEAR COOLIN, IDAHO.

LOCATION.—In SW. ¼ sec. 5, T. 59 N., R. 4 W., at south end of Priest Lake, 2 miles northwest of Coolin, in Bonner County.

DRAINAGE AREA.—572 square miles.

RECORDS AVAILABLE.—June 18, 1911, to September 30, 1916; fragmentary.

GAGE.—Stevens water-stage recorder on right bank 600 feet below outlet; installed November 24, 1914; inspected by Henry Gable. June 18, 1911, to April 6, 1912, and July 13, 1912, to January 8, 1913, two vertical staff gages on wharf at Coolin (not accurately referred to bench marks before being destroyed by ice); April 18, 1913, to November 23, 1914, and August 26 to October 9, 1915 (when water-stage recorder was not operating), inclined staff about 200 feet east of wharf at Coolin.

DISCHARGE MEASUREMENTS.—Prior to September 17, 1913, made from a boat at outlet; after that date, made from a cable about 300 feet above gage.

CHANNEL AND CONTROL.—Bed rough; banks high; control probably permanent. Many large boulders and angular rocks at control catch logs and cause backwater.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.88 feet from 2 to 8 p. m. June 20 (discharge, 5,770 second-feet); minimum stage, 0.57 foot October 11 (discharge, 280 second-feet).

1911–1916: Maximum stage recorded, 7.42 feet June 4–6, 1913 (discharge, 5,970 second-feet); minimum stage recorded, 1.54 feet at 6.30 p. m. September 13, 1914 (discharge, 276 second-feet).

ICE.—Ice forms on lake and occasionally in river just below outlet. Stage-discharge relation not affected by ice except possibly for short periods when ice, running out of lake, jams on rocks at control.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by log jam in April and May; not affected by ice. Rating curve for river gage well defined; rating curve for lake gage, developed by means of a curve of relation between the two gages, fairly well defined. Daily discharge for October ascertained by applying daily gage height to rating table and for rest of year by applying to rating table mean daily gage height determined by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying heights for shorter intervals. Records excellent except for the period from April 9 to May 10, for which, on account of uncertainty as to amount of backwater, they are only fair.

COOPERATION.—Gage height record furnished by United States Forest Service.

Discharge measurements of Priest River at outlet of Priest Lake, near Coolin, Idaho, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 16	C. G. Paulsen	5.28	5,040
16	....do	5.34	4,960
Aug. 22	C. O. Brown	1.67	840

Daily discharge, in second-feet, of Priest River at outlet of Priest Lake, near Coolin, Idaho, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	303	329	397	436	436	464	1,160	1,720	4,280	4,730	1,540	655
2	298	333	397	436	418	459	1,200	1,770	4,280	4,730	1,500	633
3	293	333	401	436	401	472	1,200	1,870	4,280	4,730	1,400	633
4	293	341	401	432	397	472	1,240	2,020	4,280	4,730	1,360	638
5	293	337	410	428	389	477	1,280	2,230	4,430	4,580	1,320	650
6	293	341	414	423	389	482	1,280	2,550	4,430	4,430	1,280	644
7	293	345	427	423	389	482	1,320	3,000	4,430	4,430	1,240	644
8	293	349	441	428	393	495	1,360	3,290	4,280	4,280	1,200	628
9	293	357	454	432	401	525	1,400	3,450	4,430	4,140	*1,160	622
10	286	365	454	441	423	530	1,320	4,170	4,430	4,000	1,120	611
11	280	365	454	450	428	535	1,280	4,730	4,430	3,860	1,080	600
12	.....	361	459	428	428	540	1,240	4,580	4,430	3,720	1,050	584
13	.....	349	454	423	428	562	1,200	4,580	4,430	3,450	1,020	578
14	.....	353	454	393	432	589	1,120	4,430	4,580	3,320	980	562
15	.....	361	450	393	436	611	1,080	4,280	4,730	3,190	945	545
16	.....	381	459	389	441	628	1,160	4,140	4,880	3,060	910	540
17	.....	389	459	397	450	633	1,160	4,140	5,030	2,930	878	530
18	.....	393	454	397	454	650	1,200	4,140	5,330	2,870	878	515
19	.....	393	454	397	446	667	1,240	4,140	5,480	2,810	878	500
20	.....	389	459	397	459	709	1,240	4,280	5,640	2,690	878	495
21	.....	397	464	405	464	767	1,280	4,280	5,640	2,510	845	486
22	.....	405	468	418	464	845	1,280	4,430	5,480	2,450	878	486
23	.....	418	468	454	464	878	1,280	4,280	5,330	2,340	812	482
24	.....	418	464	477	464	910	1,240	4,280	5,180	2,230	812	477
25	.....	418	472	472	464	980	1,240	4,280	5,030	2,120	767	472
26	.....	410	472	477	468	1,020	1,280	4,140	5,030	2,020	767	472
27	.....	410	468	472	464	1,050	1,360	4,140	5,030	1,920	741	477
28	.....	410	468	468	464	1,080	1,500	4,280	5,030	1,820	722	468
29	.....	410	464	450	468	1,120	1,580	4,280	5,030	1,770	703	464
30	294	405	454	450	.....	1,120	1,680	4,280	4,880	1,680	685	454
31	312	.....	446	441	.....	1,160	.....	4,280	.....	1,630	661	.....

NOTE.—Oct. 3–9, readings on lake gage; Oct. 11, 30, readings on staff gage at outlet. Water-stage recorder not operating in October. No record Oct. 1, 2, 10, 31, and Dec. 7–8; discharge interpolated. Discharge Oct. 12–20 and 21–29 estimated, by comparison with records of flow of other streams, at 280 and 290 second-feet, respectively.

Monthly discharge of Priest River at outlet of Priest Lake, near Coolin, Idaho, for year ending Sept. 30, 1916.

[Drainage area, 572 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	.....	.....	289	0.505	0.58	17,800
November	418	329	375	.656	.73	22,300
December	472	397	447	.781	.90	27,500
January	477	389	431	.753	.87	26,500
February	468	389	435	.760	.82	25,000
March	1,160	459	707	1.24	1.43	43,500
April	1,680	1,080	1,280	2.24	2.50	76 200
May	4,730	1,720	3,760	6.57	7.57	231,000
June	5,640	4,280	4,810	8.41	9.38	286,000
July	4,730	1,630	3,200	5.59	6.44	197,000
August	1,540	661	999	1.75	2.02	61,400
September	655	454	552	.965	1.08	32,800
The period	5.640	.....	1,440	2.52	34.32	1,050,000

SULLIVAN LAKE NEAR METALINE FALLS, WASH.

LOCATION.—Approximately in sec. 31, T. 39 N., R. 44 E. (unsurveyed), near the forest ranger station at north end of Sullivan Lake, about 4¼ miles east of Metaline Falls, in Pend Oreille County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1916.

GAGE.—Since May 9, 1913, float gage on dam at outlet of lake; read once daily to half-tenths by A. J. McDougall; prior to May 9, 1913, a vertical staff at same site.

EXTREMES OF STAGE.—1912–1916: Maximum stage recorded, 26.6 feet June 17–20, 1916; minimum stage recorded, 8.85 feet April 13, 1916.

REGULATION.—Most of the surplus flow of Sullivan Creek is diverted into the lake. Sufficient water is stored in the lake to afford a continuous flow of about 60 second-feet in flume of Inland Portland Cement Co. Zero of gage at elevation of gate sills; crest of log chute is 22 feet and crest of spillway 25 feet above gate sills.

COOPERATION.—Gage-height record furnished by Inland Portland Cement Co.

Daily gage height, in feet, of Sullivan Lake near Metaline Falls, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	20.5	18.1	16.4	14.55	12.3	10.7	9.2	9.65	19.6	26.1	24.15	22.05
2	20.45	18.05	16.3	14.5	12.2	10.65	9.2	9.75	19.8	26.0	24.1	22.05
3	20.3	18.0	16.2	14.45	12.1	10.5	9.2	9.95	20.0	26.0	23.95	22.0
4	20.25	17.95	16.1	14.35	12.0	10.45	9.05	10.8	20.6	25.8	23.9	21.95
5	20.2	17.8	16.0	14.35	11.95	10.4	8.95	11.3	20.9	25.6	23.85	21.9
6	20.1	17.8	16.0	14.25	11.9	10.3	8.9	11.9	21.6	25.4	23.7	21.75
7	20.0	17.7	15.95	14.2	11.8	10.3	8.9	12.4	21.95	25.5	23.6	21.65
8	19 9	17.65	15.9	14.15	11.7	10.3	8.9	12.9	22.6	25.3	23.5	21.5
9	19 8	17.6	15.8	14.1	11.6	10.2	8.9	13.4	22.95	25.25	22.5	21.45
10	19.7	17.55	15.7	14.05	11.6	10.15	8.9	13.6	23.75	25.2	23.5	21.4
11	19.65	17.5	15.65	13.95	11.6	10.1	8.9	13.75	24.2	25.1	23.45	21.3
12	19.6	17.5	15.6	13.9	11.6	10.0	8.9	13.8	24.7	25.1	23.4	21.2
13	19.5	17.4	15.55	13.8	11.5	10.0	8.85	13.9	25.1	25.1	23.4	21.2
14	19.4	17.35	15.5	13.75	11.5	9.95	8.9	13.95	25.45	25.1	23.2	21.2
15	19.25	17.3	15.45	13.7	11.5	9.9	8.9	14.1	25.8	25.1	23.15	21.15
16	19.2	17.25	15.4	13.6	11.5	9.8	8.9	14.4	26.4	25.1	23.1	21.1
17	19.1	17.2	15.35	13.5	11.5	9.8	8.9	.....	26.6	25.1	23.0	21.1
18	19.05	17.15	15.3	13.45	11.5	9.75	8.9	.....	26.6	25.0	22.95	21.05
19	19.0	17.1	15.25	13.4	11.45	9.65	8.95	.....	26.6	25.0	22.95	21.1
20	18.9	17.05	15.2	13.3	11.35	9.45	9.0	15.9	26.6	24.9	22.9	20.95
21	18.85	17.0	15.1	13.15	11.3	9.4	9.0	16.3	26.4	24.85	22 8	20.85
22	18.8	16.95	15.0	12.95	11.25	9.45	9.0	16.4	26.2	24.8	22.8	20.7
23	18.75	16.85	14.9	12.9	11.2	9.45	9.0	16.4	26.1	24.8	22.7	20.65
24	18.7	16.8	14.85	12.9	11.15	9.4	9.0	16.6	26.2	24.75	22.6	20.55
25	18.5	16.75	.....	12.8	11.1	9.4	9.1	16.75	26.2	24.7	22.5	20.5
26	18.4	16.7	14.8	12.7	11.0	9.35	9.2	16.9	26.1	24.7	22.45	20.4
27	18.35	16.55	14.8	12.65	11.0	9.3	9.3	17.6	26.0	24.6	22.4	20.3
28	18.3	16.5	14.8	12.6	10.9	9.3	9.4	18.1	26.2	24.4	22.3	20.25
29	18.25	16.45	14.7	12.5	10.8	9.3	9.5	18.6	26.2	24.3	22.2	20.1
30	18.2	16.4	14.7	12.4	.....	9.3	9.55	18.8	26.2	24.2	22.15	20.1
31	18.15	.....	14.6	12.35	.....	9.2	.....	19.2	.....	24.2	22.1	.....

NOTE.—Mean height for year, 17.00 feet.

SULLIVAN CREEK NEAR METALINE FALLS, WASH.

LOCATION.—In sec. 30, T. 39 N., R. 44 E., one-eighth mile below Outlet Creek, one-half mile below Sullivan Lake, and about 4 miles east of Metaline Falls, in Pend Oreille County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1916.

GAGE.—Vertical staff on right bank; read by A. J. McDougall.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 40 feet downstream.

CHANNEL AND CONTROL.—Stream bed of cobblestones and coarse gravel; likely to shift. Banks high and not subject to overflow. Gradient steep.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.6 feet at 4 p. m. June 17 (discharge, 1,540 second-feet); minimum stage recorded, 1.4 feet January 7–10, 31, and February 1–10 (discharge, 75 second-feet).

1912–1916: Maximum stage recorded, 4.2 feet June 2, 1913 (discharge, 1,650 second-feet); minimum stage recorded, 1.10 feet February 1, 1913 (discharge, 53 second-feet).

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

DIVERSIONS.—Water is diverted from Sullivan Creek for storage in Sullivan Lake about a mile above station, but entire run-off of drainage basin passes gage.

REGULATION.—Storage in Sullivan Lake is used by Inland Portland Cement Co. to increase low-water flow.

ACCURACY.—Stage-discharge relation changed during high water June 17; not affected by ice. Rating curve used prior to change well defined below and fairly well defined above 250 second-feet; curve used after change well defined below and fairly well defined above 500 second-feet. Gage read once daily to half-tenths. Daily discharge ascertained by applying daily gage height to rating table. Records excellent except for periods of high water.

COOPERATION.—Station maintained in cooperation with United States Forest Service and Inland Portland Cement Co.

Discharge measurements of Sullivan Creek near Metaline Falls, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 29	C. O. Brown	1.44	81.8	July 21	C. G. Paulsen	1.88	274
Apr. 23	Paulsen and Helwig	1.81	173	Aug. 10	C. O. Brown	1.57	157
June 18	C. G. Paulsen	4.34	1,480				

Daily discharge, in second-feet, of Sullivan Creek near Metaline Falls, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	106	117	84	84	75	84	144	316	430	940	180	108
2	106	117	84	84	75	84	144	316	430	840	163	108
3	106	117	84	84	75	94	144	338	430	840	163	108
4	106	117	106	84	75	94	160	430	476	790	163	133
5	106	130	117	84	75	94	160	476	524	694	163	133
6	106	106	117	84	75	84	176	548	524	694	148	133
7	106	117	117	75	75	94	176	572	548	622	133	120
8	106	106	117	75	75	106	176	572	572	574	133	120
9	106	106	117	75	75	117	194	476	620	526	197	133
10	106	117	117	75	75	130	194	384	716	502	160	133
11	106	94	117	84	94	130	212	361	716	479	163	120
12	106	94	117	84	94	117	212	476	716	456	148	120
13	106	94	117	84	94	117	212	524	764	456	148	120
14	117	117	117	84	106	117	212	548	812	387	148	120
15	117	117	117	84	106	117	212	548	1,010	364	133	120
16	106	117	117	84	117	117	212	572	1,310	342	120	108
17	117	117	106	84	130	117	212	572	1,480	320	133	108
18	106	106	106	84	106	117	232	572	1,460	299	133	120
19	106	106	106	84	94	130	232	572	1,400	299	148	108
20	94	106	106	84	94	130	212	668	1,340	278	133	108
21	94	106	106	84	94	160	176	524	1,040	278	133	108
22	94	106	117	84	94	160	176	430	890	278	133	108
23	94	94	106	84	94	160	176	384	840	258	133	108
24	117	94	94	84	84	160	176	430	890	258	133	108
25	117	94	94	94	94	160	194	384	890	234	120	120
26	106	94	94	94	94	176	212	361	890	215	120	133
27	117	94	94	84	94	176	232	384	790	215	120	120
28	117	84	94	84	94	144	252	407	840	197	120	120
29	117	84	84	83	84	144	294	476	1,040	180	120	120
30	117	84	84	84	.....	144	316	476	990	180	120	120
31	117	.....	84	75	.....	144	.....	430	.....	180	120	.....

NOTE.—Gage not read Dec. 25 and May 17 and 18; discharge interpolated.

Monthly discharge of Sullivan Creek near Metaline Falls, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	117	94	108	6,640
November	30	84	105	6,250
December	117	84	104	6,400
January	194	75	83.2	5,120
February	130	75	90.0	5,180
March	176	84	126	7,750
April	316	144	201	12,000
May	668	316	469	28,800
June	1,480	430	846	50,300
July	940	180	425	26,100
August	197	120	141	8,670
September	133	108	118	7,020
The year	148	75	235	170,000

HALL CREEK BASIN.

HALL CREEK NEAR INCHELIUM, WASH.

LOCATION.—In NW. ¼ sec. 6, T. 32 N., R. 37 E., three-fourths mile above highway bridge, a mile above mouth of creek, and 1½ miles northwest of Inchelium, Ferry County.

DRAINAGE AREA.—163 square miles; at Wires bridge, 3 miles above mouth, 160 square miles (measured on map of Colville Indian Reservation).

RECORDS AVAILABLE.—December 18, 1912, to September 30, 1916.

GAGE.—Stevens water-stage recorder on right bank three-fourths mile above bridge; installed August 27, 1916; December 18, 1912, to May 15, 1913, and August 1, 1915, to January 27, 1916, vertical staff on right bank about one-fourth mile above highway bridge; May 16, 1913, to July 31, 1915, gage was at Wires bridge, one-fourth mile from Gwen mine, about 3 miles above mouth. During the year ending September 30, 1916, the vertical staff a quarter of a mile above the highway bridge was read from October 1 to November 20 and also on days in November, December, and January when backwater from ice existed at the upper gage. Gage observer, Walter Johnson.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed of stream at site of water-stage recorder composed of gravel and boulders; permanent except at extremely high stages. Channel straight above and below gage. Banks high. Control for gage a quarter of a mile above highway bridge not stable and both banks are overflowed at stages above gage height 3.0 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.72 feet May 5 (discharge, 649 second-feet); minimum discharge, 13.8 second-feet (current-meter measurement) January 19, 1916.

1912-1916: Maximum stage recorded, 3.10 feet at 6.20 a. m. April 16, 1914 (discharge, 965 second-feet); minimum discharge, 13.8 second-feet January 19, 1916.

ICE.—Stage-discharge relation seriously affected by ice for short periods; flow estimated from observer's notes, weather records, and current-meter measurements.

DIVERSIONS.—Water is diverted for use in Gwen mine power plant but is returned to creek above gage.

REGULATION.—Effect of operation of power plant negligible.

ACCURACY.—Stage-discharge relation permanent; affected by anchor ice January 5-18. Gage read once daily to hundredths prior to installation of water-stage recorder. Rating curve for lower gage fairly well defined; for upper gage, well defined. Daily discharge ascertained by applying to rating table mean daily gage height reported by observer or obtained by inspecting gage-height graph. Records for period prior to January, good; those for January, fair; after January, excellent.

Discharge measurements of Hall Creek near Inchelium, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height, upper.	Gage height, lower.	Discharge.
		Feet.	*Feet.*	*Sec-ft.*
Nov. 21	C. O. Brown	1.52	0.27	22.2
Jan. 19	do	[a]1.70	0.27	13.8
Apr. 11	C. G. Paulsen	3.31	1.80	428
June 13	do	2.88	1.32	242
Aug. 28	do	1.72	.....	35.6

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Hall Creek near Inchelium, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	20	20	18	15	16	30	142	502	324	176	60	33
2	20	20	19	15	18	30	202	559	304	176	60	32
3	20	21	17	15	18	31	248	589	304	164	58	33
4	20	21	20	15	17	31	284	649	304	164	54	34
5	20	21	20	.....	17	30	266	649	304	164	54	35
6	20	20	23	.....	17	30	266	649	304	153	54	35
7	20	20	23	.....	17	30	284	649	284	142	53	33
8	20	20	22	.....	17	30	304	589	284	136	55	33
9	20	21	23	.....	17	31	394	529	284	132	66	33
10	20	21	21	.....	21	33	419	502	284	132	62	33
11	20	20	22	.....	21	37	419	446	284	126	57	32
12	20	20	21	.....	20	42	419	419	266	122	56	31
13	20	20	20	.....	20	55	394	419	248	153	49	30
14	20	20	21	.....	20	63	394	324	232	104	49	30
15	20	20	18	.....	21	66	446	284	216	99	46	29
16	20	20	18	.....	22	68	346	284	216	96	44	29
17	20	20	20	.....	22	67	346	284	202	104	44	28
18	20	20	20	.....	22	67	394	284	202	118	44	28
19	20	20	20	16	22	74	369	304	202	104	47	28
20	20	20	17	16	22	90	369	324	216	91	47	28
21	20	22	17	18	23	122	324	324	248	88	47	28
22	20	22	18	18	23	128	304	324	232	85	41	27
23	20	21	18	20	23	122	284	324	188	81	41	26
24	20	21	20	20	23	109	266	324	188	78	39	26
25	21	21	20	18	23	106	304	284	188	74	38	27
26	21	21	18	18	28	104	394	284	216	73	36	29
27	21	20	17	18	30	164	529	284	216	72	36	28
28	21	17	17	17	30	153	559	284	216	70	36	27
29	20	18	16	17	30	142	559	284	202	64	35	26
30	20	18	16	17	.....	142	529	324	188	63	33	26
31	20	.....	15	16	.....	153	.....	324	.....	62	33	.....

NOTE.—Stage-discharge relation at upper gage affected by ice for periods in November, December and January, but at lower gage, readings on which were used at such periods, only from Jan. 5-18. Discharge Jan. 5-18 estimated from observer's notes, weather records, and one discharge measurement, at 15 second-feet. No record Nov. 22, Sept. 3, 11-15; discharge interpolated.

Monthly discharge of Hall Creek near Inchelium, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	21	20	20.1	1,240
November	22	17	20.2	1,200
December	23	15	19.2	1,180
January	20	.....	16.1	990
February	30	16	21.4	1,230
March	164	30	76.8	4,720
April	559	142	359	21,400
May	649	284	406	25,000
June	324	188	245	14,600
July	176	62	112	6,890
August	66	33	47.5	2,920
September	35	26	29.9	1,780
The year	649	.....	114	83,200

STRANGER CREEK BASIN.

STRANGER CREEK AT INCHELIUM, WASH.

LOCATION.—In sec. 5, T. 32 N., R. 37 E., about half a mile above mouth and half a mile south of Inchelium, in Ferry County, below all tributaries.

DRAINAGE AREA.—74 square miles (measured on Colville Indian Reservation map, edition of 1913).

RECORDS AVAILABLE.—March 18, 1914, to September 30, 1916.

GAGE.—Vertical staff on right bank, read by Walter Johnson.

DISCHARGE MEASUREMENTS.—Made from highway bridge 50 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of sand and gravel; overhanging brush partly obstructs flow at high stages. One channel at all stages. Timber artificial control built November 21, 1915. Stage of zero flow, according to measurements made November 22, 1915, and August 29, 1916, gage height 0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.35 feet May 7–10 (discharge, 195 second-feet); minimum stage recorded, 0.41 foot November 13–16 (discharge, 4.9 second-feet).

1914–1916: Maximum stage recorded, 3.80 feet April 18, 1914, (discharge, 209 second-feet). Minimum discharge estimated 3.2 second-feet in December, 1914, when stage-discharge relation was affected by ice.

ICE.—Stage-discharge relation affected by ice for short periods; flow estimated from observer's notes and weather records.

DIVERSIONS.—Several small ditches divert water for irrigation above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed when timber control was built November 21; permanent thereafter; affected by ice for two short periods. Gage read once daily to hundredths. Rating curve for old control fairly well defined; for new control, well defined. Daily discharge ascertained by applying daily mean gage height to rating table. Records for periods prior to February 5, good; after that date excellent.

Discharge measurements of Stranger Creek at Inchelium, Wash., during the year ending Sept. 30, 1916.

Date.	Made by	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 22	C. O. Brown	0.50	7.0	June 13	C. G. Paulsen	1.16	50.7
Jan. 19	do	0.48	6.64	Aug. 29	do	.60	11.0
Apr. 11	C. G. Paulsen	2.12	157				

Daily discharge, in second-feet, of Stranger Creek at Inchelium, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	5.1	5.5	7.0	.....	.....	14	56	155	78	40	16	12
2	5.1	5.5	7.0	.....	.....	16	58	142	73	40	16	12
3	5.3	5.8	7.5	.....	.....	17	63	162	73	40	16	12
4	5.3	5.8	9.5	9.5	.....	17	73	162	68	39	14	12
5	5.3	5.8	10	9.5	9.5	16	73	168	63	38	16	11
6	5.3	5.5	10	9.5	10	15	84	168	63	38	16	11
7	5.3	5.3	9.5	9.5	9.5	15	90	195	60	34	16	11
8	5.3	5.3	9.5	9.5	9.5	16	100	195	58	34	19	10
9	5.3	5.5	10	9.5	9.5	16	112	195	54	33	20	10
10	5.3	5.5	7.0	9.5	10	19	118	168	50	33	18	10
11	5.3	5.3	7.0	9.5	10	21	155	155	50	33	15	10
12	5.3	5.1	7.0	9.5	9.5	26	162	142	50	32	16	10
13	5.3	4.9	7.5	10	9.5	26	162	142	51	32	15	10
14	5.3	4.9	8.0	9.5	9.5	33	168	130	49	32	15	9.5
15	5.3	4.9	8.0	9.5	10	27	168	118	46	30	14	9.0
16	5.3	4.9	7.5	9.5	12	32	168	118	42	29	14	9.0
17	5.1	5.1	7.0	8.0	12	32	168	106	38	29	14	9.0
18	5.1	5.1	7.0	8.0	12	33	181	106	38	30	15	9.0
19	5.1	5.1	8.5	6.7	12	34	181	100	38	28	15	8.5
20	5.1	5.1	8.5	6.7	12	37	168	100	42	26	14	8.5
21	5.1	5.1	9.5	6.7	12	42	168	100	46	25	14	8.0
22	5.1	7.0	9.5	7.0	12	42	162	95	46	25	14	8.0
23	5.1	7.0	9.5	9.5	12	38	142	90	42	24	13	8.0
24	5.3	7.0	7.5	10	11	38	136	90	42	24	13	8.0
25	6.0	7.5	9.5	10	12	40	124	84	38	23	12	8.5
26	6.0	7.5	4.6	12	12	43	118	84	46	22	12	8.5
27	5.8	6.1	.....	.....	14	44	118	84	42	21	12	8.0
28	5.8	5.5	.....	.....	13	43	124	78	54	20	12	8.0
29	5.5	5.8	.....	.....	13	41	136	73	50	19	12	7.5
30	5.5	7.0	.....	.....	.....	41	142	84	42	18	12	7.5
31	5.5	.....	.....	.....	.....	42	.....	78	.....	17	12	.....

NOTE.—Discharge estimated, on account of ice, as follows: Dec. 8 to Jan. 3, 8 second-feet; Jan. 27–31, 10 second-feet; and Feb. 1–4, 9 second-feet.

Monthly discharge of Stranger Creek at Inchelium, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	6.0	5.1	5.34	328
November	7.5	4.9	5.71	340
December	10	.....	8.16	502
January	.....	.....	9.12	561
February	14	.....	10.8	621
March	44	14	29.5	1,810
April	181	56	129	7,680
May	195	73	125	7,690
June	78	38	51.1	3,040
July	40	17	29.3	1,800
August	20	12	14.6	898
September	12	7.5	9.45	562
The year	195	.....	35.6	25,800

SPOKANE RIVER BASIN.

COEUR D'ALENE LAKE AT COEUR D'ALENE, IDAHO.

LOCATION.—In SW. ¼ SW. ¼ sec. 13, T. 50 N., R. 4 W., at Johnson's wharf, 800 feet southeast of railroad station at Coeur d'Alene, in Kootenai County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—February 11, 1905, to September 30, 1916. April 25, 1903, to February 10, 1905, St. Joe Boom Co.'s gage, at mouth of St. Joe River.

GAGE.—Vertical staff on pile at wharf; read to hundredths daily by Henry Kloppenburg. Gage datum is 2,100 feet above mean sea level.

EXTREMES OF STAGE.—Maximum stage recorded during year, 32.80 feet May 9, 10; minimum stage recorded, 21.24 feet November 15.

1903–1916: Maximum stage recorded, 34.45 feet May 30–31, 1913; minimum stage recorded, 19.9 feet on October 10–12, 1904, September 24–25, 1905, October 14 to November 3, 1906.

DIVERSIONS.—None.

REGULATION.—Considerable storage is used by the Washington Water Power Co. to increase summer flow of Spokane River; regulation is effected by tainter gates and bear-trap dam at Post Falls.

COOPERATION.—Gage-height record furnished by the Washington Water Power Co.

Daily gage height, in feet, of Coeur d'Alene Lake at Coeur d'Alene, Idaho, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	22.80	21.64	21.70	23.72	22.70	24.10	31.18	31.46	29.32	28.86	25.12	25.48
2	22.78	21.60	21.66	23.70	22.60	24.00	30.96	31.36	29.20	28.68	25.14	25.46
3	22.72	21.56	21.60	23.70	22.50	23.96	30.86	31.30	29.12	28.62	25.20	25.46
4	22.66	21.54	21.58	23.70	22.46	23.86	30.66	31.30	29.02	28.50	25.20	25.50
5	22.62	21.52	21.56	23.68	22.40	23.78	30.56	31.54	29.04	28.46	25.22	25.52
6	22.58	21.48	21.58	23.66	22.36	23.70	30.44	31.90	29.20	28.36	25.26	25.52
7	22.54	21.46	21.60	23.64	22.30	23.60	30.28	32.30	29.32	28.26	25.26	25.48
8	22.48	21.44	21.64	23.62	22.20	23.50	30.12	32.60	29.34	28.16	25.30	25.50
9	22.46	21.46	21.74	23.64	22.20	23.64	30.00	32.80	29.36	28.04	25.34	25.50
10	22.40	21.46	21.84	23.62	22.30	23.76	30.00	32.80	29.42	27.86	25.36	25.48
11	22.36	21.44	21.96	23.60	22.36	25.26	30.12	32.56	29.56	27.66	25.38	25.48
12	22.32	21.38	22.06	23.56	22.50	25.92	30.46	32.20	29.60	27.46	25.38	25.46
13	22.28	21.34	22.12	23.52	22.60	26.66	30.72	31.82	29.54	27.26	25.42	25.40
14	22.26	21.28	22.18	23.48	22.74	27.20	30.82	31.46	29.46	27.06	25.46	25.40
15	22.22	21.24	22.20	23.40	22.80	27.50	30.82	31.04	29.40	26.80	25.48	25.38
16	22.20	21.30	22.22	23.30	22.90	27.62	30.82	30.70	29.46	26.56	25.48	25.38
17	22.18	21.28	22.24	23.22	23.08	27.68	30.82	30.42	29.56	26.34	25.46	25.34
18	22.16	21.28	22.22	23.18	23.36	27.52	30.76	30.22	29.70	26.24	25.50	25.34
19	22.12	21.30	22.22	23.14	23.66	27.52	30.72	30.22	29.86	26.04	25.58	25.32
20	22.10	21.32	22.20	23.04	23.86	27.70	30.62	30.22	30.00	25.86	25.60	25.28
21	22.04	21.36	22.24	23.06	24.04	28.56	30.48	30.32	30.02	25.66	25.62	25.24
22	22.00	21.40	22.32	23.02	24.12	29.50	30.36	30.40	30.02	25.44	25.62	25.22
23	21.96	21.50	22.80	23.08	24.22	30.36	30.16	30.34	29.82	25.26	25.62	25.20
24	21.90	21.58	23.18	23.08	24.28	30.70	29.98	30.20	29.60	25.08	25.62	25.22
25	21.88	21.64	23.46	23.18	24.28	30.72	29.82	30.08	29.38	24.96	25.62	25.22
26	21.84	21.74	23.54	23.22	24.28	30.80	29.78	29.84	29.20	24.90	25.58	25.22
27	21.80	21.76	23.64	23.18	24.26	31.10	29.90	29.70	29.10	24.90	25.58	25.20
28	21.78	21.72	23.78	23.08	24.24	31.50	30.50	29.68	29.08	24.96	25.56	25.18
29	21.76	21.74	23.78	22.98	24.20	31.70	31.10	29.42	29.00	25.02	25.52	25.18
30	21.74	21.72	23.78	22.88	.....	31.66	31.38	29.40	28.96	25.04	25.52	25.18
31	21.70	.....	23.76	22.78	.....	31.44	.....	29.40	.....	25.08	25.50	.....

NOTE.—Mean height for year, 25.70 feet.

SPOKANE RIVER AT POST FALLS, IDAHO.

LOCATION.—In sec. 4, T. 50 N., R. 5 W. Boise meridian, a quarter of a mile below power plant of Washington Water Power Co., three-fourths mile below intake of Spokane Valley Land & Water Co.'s canal, and a mile west of Post Falls, in Kootenai County.

DRAINAGE AREA.—3,890 square miles (measured on General Land Office map).

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

GAGE.—Vertical staff in 3 sections on left bank; read by Nils Lindberg. Elevation of zero of gage, 2,000 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable 300 feet below gage.

CHANNEL AND CONTROL.—River bed at and below gage composed of large gravel and boulders; may shift during floods. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 76.7 feet May 9 (discharge, 27,900 second-feet); minimum stage recorded, 66.82 feet October 29 (discharge, 1,220 second-feet).

1911–1916: Maximum stage recorded, 77.8 feet at 8 a. m. May 30 and June 1, 1913 (discharge, 31,500 second-feet); minimum stage recorded, 66.20 feet October 25, 1914 (discharge, 875 second-feet).

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

DIVERSIONS.—Spokane Valley Land & Water Co.'s canal diverts above gage for irrigation. Mean diversion during year, 65 second-feet. Storage in Coeur d'Alene Lake partly regulated by operation of gates in dam at Post Falls.

REGULATION.—Varying load on power plant causes fluctuation in stage.

ACCURACY.—Stage-discharge relation permanent. Gage read once daily to hundredths When discharge is less than 5,000 second-feet stage is variable, owing to changing load at power plant, and one reading daily may not indicate true mean stage. Rating curve well defined between 1,000 and 20,000 second-feet. Daily discharge ascertained by applying daily gage height to rating table. Records for discharge below 5,000 second-feet, good; between 5,000 and 20,000 second-feet, excellent.

COOPERATION.—Gage-height record furnished by the Washington Water Power Co.

Discharge measurements of Spokane River at Post Falls, Idaho, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 18	C. O. Brown	70.05	6,000	Aug. 20	C. O. Brown	67.22	1,500
May 26	C. G. Paulsen	74.45	18,900	28	do	67.29	1,650

Daily discharge, in second-feet, of Spokane River at Post Falls, Idaho, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,470	1,560	2,240	2,120	3,670	7,010	23,600	23,600	18,000	16,600	2,240	1,560
2	1,560	1,380	2,370	2,120	3,830	6,780	22,900	23,200	17,600	16,200	2,000	1,560
3	1,560	1,530	2,240	2,120	3,350	6,780	22,500	23,200	17,300	16,200	1,880	1,470
4	1,470	1,470	2,240	2,120	2,770	6,330	22,100	23,200	17,300	15,900	1,770	1,470
5	1,470	1,380	2,240	2,240	2,910	6,110	21,700	24,000	17,600	15,900	1,660	1,470
6	1,470	1,470	2,370	2,120	2,910	6,110	21,300	24,800	17,600	15,900	1,770	1,560
7	1,470	1,560	2,120	2,240	2,910	5,900	21,000	26,000	18,000	15,500	1,660	1,470
8	1,470	1,380	2,000	2,120	3,510	5,900	20,600	26,800	18,000	15,500	1,560	1,560
9	1,470	1,470	2,000	2,120	3,050	5,900	20,200	27,900	18,400	14,800	1,560	1,560
10	1,560	1,470	2,000	2,120	3,350	7,010	20,200	27,500	18,400	14,500	1,660	1,560
11	1,560	1,560	2,240	2,120	3,830	9,020	20,600	27,200	18,700	14,200	1,560	1,560
12	1,470	1,380	2,120	2,120	4,000	10,700	21,000	25,600	18,700	13,500	1,560	1,470
13	1,470	1,660	2,120	2,120	4,170	12,500	21,700	24,800	19,100	13,200	1,660	1,560
14	1,470	1,470	2,120	2,120	4,530	13,500	22,100	23,600	18,400	12,500	1,660	1,560
15	1,380	1,770	2,120	2,120	4,530	14,500	22,500	22,500	18,400	11,900	1,560	1,560
16	1,380	1,560	2,120	2,120	4,710	14,500	22,100	21,700	18,400	11,600	1,660	1,560
17	1,380	1,380	2,120	2,240	5,090	14,500	22,100	21,000	18,700	11,000	1,660	1,470
18	1,560	1,470	3,050	2,120	5,490	14,500	22,500	20,200	19,100	10,700	1,660	1,560
19	1,300	1,470	2,120	2,120	5,900	14,200	22,100	20,200	19,100	10,400	1,660	1,470
20	1,380	1,660	2,000	2,120	7,490	14,800	21,700	20,200	19,500	9,840	1,560	1,470
21	1,380	1,470	2,240	2,240	6,780	16,600	21,300	20,600	19,800	9,560	1,660	1,560
22	1,380	1,380	2,240	2,240	7,010	19,500	21,000	20,600	19,500	8,760	1,660	1,560
23	1,380	1,470	2,120	2,120	7,010	21,300	20,600	20,600	19,500	8,240	1,660	1,560
24	1,470	1,470	2,120	2,120	7,010	22,500	20,200	20,200	18,700	7,250	1,660	1,470
25	1,380	1,380	2,000	2,120	7,250	22,500	19,500	19,500	18,000	5,490	1,660	1,560
26	1,470	1,380	2,240	3,830	7,250	22,500	19,500	19,500	17,600	4,900	1,660	1,470
27	1,380	1,380	2,240	4,710	7,250	23,200	19,800	19,100	17,600	2,500	1,560	1,560
28	1,380	1,470	2,120	4,530	7,250	24,400	21,300	18,700	17,300	2,500	1,660	1,470
29	1,220	1,770	2,120	4,530	7,010	25,200	22,500	18,400	16,900	2,370	1,660	1,560
30	1,470	2,370	2,000	4,350	.....	25,200	23,200	18,400	16,900	2,500	1,560	1,560
31	1,560	.....	2,240	4,170	.....	24,400	.....	18,000	.....	2,370	1,660	.....

Monthly discharge of Spokane River and Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.					Run-off (total in acre-feet).
	River.			Canal [a] (mean).	Total (mean).	
	Maximum.	Minimum.	Mean.			
October	1,560	1,220	1,440	37	1,480	91,000
November	2,370	1,380	1,520	47	1,570	93,400
December	3,050	2,000	2,180	42	2,220	136,000
January	4,710	2,120	2,570	24	2,590	159,000
February	7,490	2,770	5,030	28	5,060	291,000
March	25,200	5,900	14,300	58	14,400	885,000
April	23,600	19,500	21,400	72	21,500	1,280,000
May	27,900	18,000	22,300	93	22,400	1,380,000
June	19,800	16,900	18,300	101	18,400	1,090,000
July	16,600	2,370	10,700	96	10,800	664,000
August	2,240	1,560	1,680	106	1,790	110,000
September	1,560	1,470	1,530	79	1,610	95,800
The year	27,900	1,220	8,580	65	8,640	6,280,000

[a] Complete data regarding diversion in canal given on p. 134.

SPOKANE RIVER AT SPOKANE, WASH.

LOCATION.—In sec. 9, T. 25 N., R. 43 E., above Washington Water Power Co.'s steam plant in Spokane, 2.8 miles above Spokane Falls and about 4 miles above Latah Creek in Spokane County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—March 22, 1891, to September 30, 1916.

GAGE.—Stevens water-stage recorder on right bank 500 feet above Washington Water Power Co.'s stream plant; installed July 31, 1915; inspected daily by A. E. Sawin. For description of earlier gages see Water-Supply Paper 412. Approximate elevation of gage datum, 1,800 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet upstream from gage.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders. One channel at all stages. Control is stretch of channel contracted by bridge structures and embankments between station and crest of Spokane Falls.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 80.25 feet from 5 to 6 p. m. May 9 (discharge, 28,400 second-feet); minimum stage from recorder, 68.96 feet at 3 p. m. October 27 (discharge, 1,720 second-feet).

1891–1916: Maximum stage recorded, 12.42 feet (Washington Water Power Co.'s gage at Spokane Falls dam) May 31, 1894 (discharge, 35,200 second-feet); minimum stage recorded, 1.3 feet (Martha Street gage) September 28 and 30, 1905 (discharge, 1,240 second-feet).

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

DIVERSIONS.—Water is diverted above the station for irrigation by the Spokane Valley Land & Water Co. Mean diversion during year, 65 second-feet.

REGULATION.—Flow is partly regulated by storage in Coeur d'Alene Lake.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Daily discharge ascertained by applying to rating table daily mean gage height obtained by inspecting gage-height graph or, for days of considerable fluctuation, by applying gage height for shorter intervals. Records excellent.

COOPERATION.—Gage-height record furnished by the Washington Water Power Co.

Discharge measurements of Spokane River at Spokane, Wash., during the year ending Sept. 30, 1916.

[Made by C. O. Brown.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Feb. 21	72.04	6,300	Mar. 23	77.88	20,000
22	72.16	6,440	Aug. 15	69.45	2,290

Daily discharge, in second-feet, of Spokane River at Spokane, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,940	1,940	2,450	2,450	3,610	6,430	23,400	23,800	18,100	17,000	3,190	2,160
2	1,890	1,890	2,510	2,450	3,610	6,430	23,100	23,800	17,800	16,400	2,870	2,110
3	1,940	1,940	2,570	2,450	3,260	6,240	22,400	23,400	17,500	16,400	2,750	2,160
4	1,940	1,940	2,570	2,450	3,060	6,240	22,100	23,400	17,500	16,100	2,690	2,220
5	1,940	1,940	2,630	2,450	3,060	6,060	21,800	24,100	17,500	15,800	2,570	2,160
6	1,890	1,940	2,570	2,450	3,060	5,880	21,400	25,100	17,800	15,600	2,570	2,160
7	1,890	1,940	2,450	2,450	3,260	5,700	20,800	26,500	18,100	15,300	2,450	2,160
8	1,890	1,940	2,450	2,450	3,610	5,700	20,500	27,500	18,400	15,000	2,450	2,110
9	1,890	1,940	2,390	2,450	3,400	5,880	20,200	28,200	18,400	14,800	2,390	2,110
10	1,890	1,890	2,450	2,450	3,610	6,810	20,200	28,200	18,400	14,500	2,390	2,160
11	1,890	1,890	2,450	2,450	3,610	8,190	20,500	27,800	18,700	14,000	2,330	2,160
12	1,890	1,940	2,450	2,450	3,750	9,680	21,100	26,800	18,700	13,500	2,330	2,110
13	1,890	1,940	2,450	2,450	3,890	11,000	21,800	25,500	18,700	13,000	2,330	2,110
14	1,940	2,000	2,450	2,450	4,180	12,500	22,400	24,400	18,400	12,500	2,570	2,160
15	1,840	2,160	2,450	2,450	4,180	13,200	22,400	23,100	18,400	12,200	2,330	2,110
16	1,840	2,060	2,450	2,450	4,330	13,500	22,400	22,100	18,400	11,800	2,280	2,110
17	1,890	2,000	2,450	2,450	4,650	13,500	22,400	21,400	18,700	11,300	2,280	2,110
18	1,890	2,000	2,510	2,450	4,990	13,500	22,100	20,800	18,700	11,000	2,330	2,110
19	1,940	2,060	2,450	2,450	5,520	13,500	22,100	20,800	19,300	10,600	2,280	2,110
20	1,890	2,220	2,450	2,510	5,880	14,000	21,800	20,800	19,600	10,100	2,280	2,110
21	1,890	2,060	2,450	2,450	6,060	15,600	21,400	20,800	19,900	9,900	2,220	2,110
22	1,890	2,000	2,450	2,510	6,430	18,100	21,100	20,800	19,900	9,240	2,220	2,110
23	1,890	2,000	2,450	2,510	6,430	20,500	20,500	20,800	19,300	8,810	2,220	2,110
24	2,000	1,890	2,450	2,510	6,620	21,400	20,200	20,200	18,700	7,690	2,220	2,110
25	1,890	2,000	2,450	2,630	6,620	21,800	19,600	20,200	18,400	6,240	2,220	2,110
26	1,890	1,890	2,450	3,750	6,620	22,100	19,600	19,900	17,800	6,000	2,220	2,110
27	1,840	2,000	2,450	4,180	6,620	22,700	19,900	19,300	17,500	3,750	2,160	2,110
28	2,000	2,160	2,510	4,030	6,810	24,100	21,100	19,000	17,500	3,610	2,160	2,110
29	2,060	2,110	2,450	4,030	6,620	25,100	22,400	18,700	17,200	3,470	2,160	2,110
30	1,890	2,450	2,450	3,890	.....	24,800	23,400	18,400	17,000	3,400	2,160	2,110
31	2,000	.....	2,450	3,750	.....	24,100	.....	18,400	.....	3,330	2,160	.....

Monthly discharge of Spokane River at Spokane, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	2,060	1,840	1,910	117,000
November	2,450	1,890	2,000	119,000
December	2,630	2,390	2,470	152,000
January	4,180	2,450	2,750	169,000
February	6,810	3,060	4,740	273,000
March	25,100	5,700	13,700	842,000
April	23,400	19,600	21,500	1,280,000
May	28,200	18,400	22,700	1,400,000
June	19,900	17,000	18,300	1,090,000
July	17,000	3,330	11,000	676,000
August	3,190	2,160	2,380	146,000
September	2,220	2,110	2,130	127,000
The year	28,200	1,840	8,800	6,390,000

SPOKANE RIVER BELOW LITTLE FALLS, NEAR LONG LAKE, WASH.

LOCATION.—In NW. ¼ sec. 19, T. 27 N., R. 39 E., just above Chamokane Ferry 1½ miles below Little Falls power plant of Washington Water Power Co., 4 miles below Chamokane Creek and about 5 miles below Long Lake, in Lincoln County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—November 5, 1912, to September 30, 1916.

GAGE—Stevens water-stage recorder on left bank. Gage datum, 1,200 feet above mean sea level.

DISCHARGE MEASUREMENTS.—Made from cable 50 feet below gage.

CHANNEL AND CONTROL.—Bed composed of heavy boulders; practically permanent. Both banks high; one channel at all stages. No noticeable riffle control below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 87.94 feet at 9 a. m. March 28 (discharge, 29,800 second-feet); minimum mean daily discharge, 1,820 second-feet November 14 (water below intake, which is at elevation 75.05 feet, for 20 hours during day).

1912–1916: Maximum stage recorded, 88.7 feet at 11 a. m. and 7 p. m. June 1, 1913 (discharge, 31,900 second-feet); minimum mean daily discharge November 14, 1915.

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

DIVERSIONS.—Spokane Valley Land & Water Co. diverts water for irrigation above the station. Mean diversion during year, 65 second-feet.

REGULATION.—Flow affected considerably by power regulation at Little Falls and Long Lake, and slightly by power regulation at Ninemile, Spokane, and Post Falls. Low-water flow is affected by regulation of storage in Coeur d'Alene Lake.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Water fell below intake 3 to 6 hours on 25 days in October, November, and December, and for 20 and 10 hours, respectively, November 14 and 15; range in stage when below intake estimated on gage-height graph. Daily discharge ascertained by use of discharge integrator October 1 to January 1 and by applying mean daily gage heights to rating table for rest of year, except for days of considerable fluctuation, for which mean gage heights for shorter intervals were applied to rating table. Records excellent except for periods in which water was below intake or recorder not operating, for which they are good. See note to daily-discharge table.

COOPERATION.—Gage-height record furnished by Washington Water Power Co.

Discharge measurements of Spokane River below Little Falls, near Long Lake, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec-ft.*
Nov. 26	C. O. Brown	76.20	3,010
Mar. 24	Brown and Daniels	86.46	25,400
Aug. 29	....do	76.27	3,300

Daily discharge, in second-feet, of Spokane River below Little Falls, near Long Lake, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2,420	2,980	2,840	3,150	4,630	8,350	27,000	24,800	20,000	18,700	4,490	2,940
2	2,680	2,960	3,070	3,140	4,490	8,150	26,200	24,800	19,700	18,400	4,210	2,840
3	2,360	2,810	3,240	3,240	4,350	7,950	25,600	24,800	19,700	18,200	3,950	2,840
4	2,500	2,740	3,380	3,240	4,080	7,750	25,400	24,500	19,200	17,900	3,820	2,840
5	2,590	2,630	2,940	3,140	3,950	7,550	24,800	24,800	19,200	17,900	3,700	2,840
6	2,660	2,470	3,920	3,240	3,820	7,550	24,300	25,400	19,200	17,600	3,580	2,840
7	2,600	2,740	3,680	3,240	3,820	7,350	24,000	26,200	19,400	17,400	3,580	2,840
8	2,890	2,700	3,130	3,240	4,080	7,150	23,500	26,700	19,700	17,100	3,460	2,840
9	2,570	2,620	3,210	3,140	4,210	7,550	22,900	27,500	19,700	16,800	3,460	2,840
10	2,180	2,480	3,460	3,140	4,210	11,800	22,900	27,800	19,700	16,600	3,460	2,740
11	2,650	2,390	3,070	3,140	4,780	15,300	22,600	27,800	20,000	16,300	3,350	2,840
12	2,650	2,210	2,660	3,140	5,910	15,300	23,200	27,200	19,400	16,100	3,350	2,840
13	2,640	2,060	3,070	3,140	6,430	15,600	23,700	26,700	19,900	15,600	3,240	2,740
14	2,530	1,820	3,240	3,140	6,610	15,800	24,300	25,600	20,200	15,000	3,350	2,740
15	2,600	2,490	3,230	3,140	7,150	16,300	24,500	25,100	19,700	14,500	3,350	2,840
16	2,630	2,780	3,260	3,040	8,550	16,600	24,500	24,000	19,500	14,000	3,240	2,840
17	2,320	2,860	3,240	3,090	9,430	16,600	24,500	23,500	19,700	13,500	3,140	2,740
18	2,570	2,790	3,230	3,140	9,430	16,300	24,500	22,600	19,700	13,000	3,040	2,740
19	2,620	2,740	3,180	3,140	9,210	16,300	24,500	22,400	20,200	12,700	2,940	2,840
20	2,650	2,720	3,280	3,140	8,990	16,600	24,300	22,100	.....	12,400	3,040	2,840
21	2,590	2,520	3,170	3,140	8,770	18,200	24,000	22,100	.....	12,000	3,140	2,840
22	2,540	2,990	3,280	3,240	8,770	21,000	24,000	22,400	.....	11,500	3,140	2,840
23	2,690	.....	3,500	3,240	8,550	24,300	23,500	22,400	.....	10,600	3,040	2,840
24	2,260	.....	3,810	3,350	8,550	25,600	22,900	22,100	.....	10,300	3,040	2,840
25	2,740	.....	3,640	3,460	8,550	25,600	22,400	22,800	.....	.....	3,040	2,840
26	2,690	.....	3,480	3,820	8,550	26,400	22,100	22,600	.....	.....	3,040	2,840
27	2,630	.....	3,420	4,490	8,550	28,600	21,800	22,300	19,400	.....	2,940	2,840
28	3,180	.....	3,270	4,780	8,550	29,400	22,400	21,000	19,200	.....	3,040	2,840
29	3,480	.....	3,270	4,930	8,550	28,900	23,500	20,500	19,200	.....	2,940	2,840
30	3,240	2,810	3,220	4,930	.....	28,300	24,300	20,200	18,900	.....	3,040	2,840
31	2,870	.....	3,160	4,780	.....	27,500	.....	20,200	.....	.....	3,040	.....

NOTE.—Operation of water-stage recorder not satisfactory: discharge estimated by comparison with record at Spokane, as follows: Nov. 23–29, 2,900 second-feet: June 20–26, 20,200 second-feet: July 25–31, 6,400 second-feet.

Monthly discharge of Spokane River below Little Falls, near Long Lake, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	3,480	2,180	2,650	163,000
November	.....	1,820	2,690	160,000
December	3,920	2,660	3,280	202,000
January	4,930	3,040	3,460	213,000
February	9,430	3,820	6,740	388,000
March	29,400	7,150	17,000	1,050,000
April	27,000	21,800	23,900	1,420,000
May	27,800	20,200	24,000	1,480,000
June	.....	18,900	19,700	1,170,000
July	18,700	.....	13,200	812,000
August	4,490	2,940	3,330	205,000
September	2,940	2,740	2,830	168,000
The year	29,400	1,820	10,200	7,430,000

ST. JOE RIVER AT AVERY, IDAHO.

LOCATION.—In sec. 15, T. 45 N., R. 5 E., at Avery, in Shoshone County, half a mile below junction of the North and South forks.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—January 1, 1911, to September 30, 1916.

GAGE.—Vertical and inclined staff, installed September 18, 1912, on left bank 20 feet above suspension bridge, about 500 feet below Chicago, Milwaukee & St. Paul Railway depot; read by W. H. Daugs. January 1 to July 2, 1911, and May 13 to September 16, 1912, gage on old bridge pier a short distance below the Mountain View hotel, about 700 feet below present site; July 11, 1911, to May 10, 1912, gage in front of post office and about 100 feet below present site.

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

CHANNEL AND CONTROL.—Channel wide and shallow, with steep gradient; bed composed of gravel and small boulders; shifting during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.4 feet at 9 a. m. May 5 (discharge, 12,600 second-feet); minimum stage recorded, 0.30 foot November 29 (discharge, 270 second-feet).

1911–1916: Maximum stage recorded, 7.3 feet at 5 a. m. May 28, 1913 (discharge 17,900 second-feet). Minimum flow possibly occurs during winter, when discharge relation is seriously affected by ice. Data insufficient for estimating flow during January and February, 1911, or December, 1911, and January, 1912.

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's notes and weather records.

DIVERSIONS.—Above all important diversions.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water May 5; affected by ice December 29 to January 9 and January 11 to March 4. Rating curves used before and after change, well defined below and fairly well defined above 3,000 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records for ice season and high water poor; medium water, good; low water, excellent.

COOPERATION.—Gage-height record furnished by the United States Forest Service.

Discharge measurements of St. Joe River at Avery, Idaho, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 24	C. G. Paulsen	2.56	4,620
Aug. 16	C. O. Brown	.75	651

Daily discharge, in second-feet, of St. Joe River at Avery, Idaho, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	350	340	330	.....	.....	2,100	4,640	5,220	4,440	1,080	411
2	350	393	350	.....	.....	2,530	4,640	5,760	4,960	1,050	422
3	370	393	439	.....	.....	2,640	3,850	6,030	4,960	1,060	518
4	360	350	439	.....	.....	2,760	9,230	7,650	4,440	934	608
5	350	393	498	.....	650	2,420	11,400	8,740	4,180	678	492
6	350	428	560	.....	745	2,640	8,740	6,840	4,180	765	455
7	310	350	535	.....	793	2,760	10,400	6,570	3,920	795	444
8	300	350	474	.....	842	2,870	7,920	7,650	3,920	678	444
9	310	330	485	.....	890	3,350	6,310	9,020	3,920	678	505
10	310	350	474	510	1,130	3,600	4,700	8,190	3,410	636	542
11	330	340	439	.....	1,990	4,370	4,440	7,110	2,910	622	480
12	330	330	382	.....	1,880	4,370	3,660	6,300	2,670	518	444
13	340	320	330	.....	2,100	3,600	3,540	6,840	2,670	825	422
14	350	340	310	.....	1,880	3,850	3,410	7,380	2,200	678	400
15	370	310	290	.....	1,880	3,850	4,180	9,020	2,090	518	400
16	370	404	330	.....	1,780	3,850	4,180	10,100	2,090	706	389
17	370	370	310	.....	1,880	3,850	5,220	10,400	2,090	678	389
18	350	404	310	.....	2,100	3,850	6,160	10,400	2,090	825	389
19	330	585	330	.....	2,200	3,600	7,110	9,860	1,770	780	389
20	330	585	350	.....	4,910	3,350	7,380	7,920	1,480	636	378
21	330	510	393	.....	4,910	3,110	6,840	6,030	1,480	568	378
22	330	474	598	.....	4,370	2,870	6,300	5,220	1,290	530	378
23	350	585	718	.....	2,870	2,990	5,220	4,700	1,180	444	378
24	350	610	585	.....	2,310	3,110	4,700	4,700	1,290	518	389
25	350	485	572	.....	2,310	4,640	4,440	5,220	1,150	518	389
26	393	393	535	.....	2,100	4,370	4,180	5,760	1,080	518	400
27	370	360	462	.....	2,100	8,960	4,180	6,030	1,150	492	444
28	350	310	450	.....	2,530	7,610	4,700	6,300	1,130	480	455
29	330	270	455	.....	2,530	5,990	5,220	5,490	1,100	468	400
30	320	350	460	.....	2,200	5,720	5,220	4,700	1,050	455	400
31	330	.....	465	.....	2,100	.....	4,960	.....	1,080	433	.....

NOTE.—Gage not read Mar. 7, 8, Apr. 23, May 9, 13, 18; discharge interpolated. Discharge estimated because of ice, Dec. 29–31 as in table; Jan. 1–9, 485 second-feet; Jan. 11–20, 375 second-feet; Jan. 21–31, 455 second-feet; Feb. 1–5, 400 second-feet; Feb. 6–29, 600 second-feet; Mar. 1–4, 600 second-feet.

Monthly discharge of St. Joe River at Avery, Idaho, for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	393	300	343	21,100
November	610	270	400	23,800
December	718	290	441	27,100
January	.....	.....	440	27,100
February	.....	.....	566	32,600
March	4,910	.....	1,950	120,000
April	8,960	2,100	3,850	229,000
May	11,400	3,410	5,710	351,000
June	10,400	4,700	7,040	419,000
July	4,960	1,050	2,500	154,000
August	1,080	433	663	40,800
September	608	378	431	25,600
The year	11,400	270	2,030	1,470,000

SPOKANE VALLEY LAND & WATER CO.'S CANAL AT POST FALLS, IDAHO.

LOCATION.—In NE. ¼ sec. 4, T. 50 N., R. 5 W. Boise meridian, on right bank of Spokane River, 1,200 feet below canal head gates, and half a mile west of Post Falls, in Kootenai County.

RECORDS AVAILABLE.—May 20, 1911, to September 30, 1916.

GAGE.—Vertical staff on left side of flume; read by Emil Johnson. Prior to April 21, 1915, a vertical staff at end of flume, about 1,200 feet below present gage.

DISCHARGE MEASUREMENTS.—Made from crossties on top of flume, or from footbridge across flume one-fourth mile below gage.

CHANNEL AND CONTROL.—Flume and canal section below gage; shifts occasionally, owing to effect of gravel bar at end of flume and growth of aquatic plants.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.65 feet August 4–5 (discharge, 113 second-feet). No water in canal January 16–23 and January 28 to February 8.

1911–1916: Maximum stage recorded, 3.20 feet June 18–22, 1911 (discharge, 170 second-feet). No water in canal June 23–28, 1911, January 7–9, 1912, January 16–23, 1916, and January 28 to February 8, 1916.

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

ACCURACY.—Stage-discharge relation gradually changed from May 28 to August 19. Two fairly well-defined rating curves used before and after the shift. Gage read once daily to half-tenths. Daily discharge ascertained by applying daily gage height to rating table, except from May 28 to August 19, for which period shifting-control method was used. Records good.

COOPERATION.—Gage-height record furnished by Spokane Valley Land & Water Co.

Canal diverts water from right bank of Spokane River in the SE. ¼ sec. 3, T. 50 N., R. 5 W. Water is used for irrigation.

Discharge measurements of Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 27	C. G. Paulsen	2.26	90.1
Aug. 20	C. O. Brown	2.40	92.1
28	....do	2.42	91.7

Daily discharge, in second-feet, of Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	31	52	44	44	0	52	67	80	93	101	93	91
2	31	52	44	44	0	52	70	90	93	97	101	91
3	31	52	44	44	0	52	70	90	93	97	101	88
4	31	52	44	44	0	52	70	90	93	97	113	88
5	31	52	42	44	0	52	70	90	97	97	113	88
6	31	52	42	44	0	52	70	90	97	97	109	88
7	31	46	39	44	0	52	70	94	97	97	109	88
8	31	46	39	44	0	52	70	94	101	96	108	88
9	31	46	39	39	24	52	70	94	100	96	108	88
10	31	46	39	39	24	52	70	94	100	96	108	88
11	31	46	39	39	24	52	70	94	100	96	108	88
12	31	46	42	39	24	55	73	94	104	96	108	88
13	31	46	42	39	29	55	73	94	104	96	108	88
14	31	44	42	39	29	55	73	94	104	96	108	88
15	31	44	42	39	29	58	73	94	104	96	108	88
16	31	44	42	0	37	58	73	94	103	95	107	70
17	31	44	42	0	37	58	73	94	103	95	107	70
18	31	44	42	0	37	58	73	94	103	95	95	70
19	31	44	42	0	37	58	73	94	103	95	95	70
20	31	44	44	0	39	61	73	94	103	95	91	70
21	31	44	44	0	39	61	73	94	103	95	91	70
22	31	46	44	0	44	61	73	94	103	95	91	70
23	31	46	44	0	44	61	73	94	102	94	91	70
24	55	46	44	33	49	61	73	94	102	94	91	70
25	55	46	44	33	49	61	73	94	102	94	91	67
26	55	46	44	33	49	61	73	94	102	94	91	67
27	55	46	44	33	52	64	73	94	102	94	95	67
28	55	46	44	0	52	67	73	94	102	94	95	67
29	55	46	44	0	52	67	73	94	102	94	95	67
30	55	46	44	0	.....	67	73	94	102	94	95	67
31	55	.....	44	0	.....	67	.....	94	.....	93	95	.....

Monthly discharge of Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	55	31	37.2	2,290
November	52	44	46.7	2,780
December	44	39	42.5	2,610
January	44	0	24.4	1,500
February	52	0	27.6	1,590
March	67	52	57.5	3,540
April	73	67	71.8	4,270
May	94	80	92.9	5,710
June	104	93	101	6,010
July	101	93	95.5	5,870
August	113	91	106	6,520
September	91	67	78.6	4,680
The year	113	0	64.8	47,400

SANPOIL RIVER BASIN.

SANPOIL RIVER AT KELLER, WASH.

LOCATION.—In NW. ¼ NW. ¼ sec. 9, T. 29 N., R. 33 E., just below highway bridge at Keller, in Ferry County, three-fourths mile below Silver Creek, and about 22 miles north of Wilbur.

DRAINAGE AREA.—971 square miles (measured on map of Colville Indian Reservation).

RECORDS AVAILABLE.—April 29, 1911, to September 30, 1916.

GAGE.—Vertical staff on right bank 100 feet below bridge; read by Mrs. C. A. Sovereign.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of rock and gravel; likely to shift at extremely high water. Some water carried through slough on left side during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.78 feet at 7.30 a. m. April 12 (discharge 1,920 second-feet); minimum discharge estimated at 44 second-feet in January during period in which stage-discharge relation was affected by ice.

1911–1916: Maximum stage recorded, 4.2 feet at 6.30 a. m. April 17, 1914 (discharge, 1,650 second-feet); minimum stage recorded, 0.45 foot at 7 a. m. and 4 p. m. September 1, 1914 (discharge, 26 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's notes, discharge measurements, and weather records.

DIVERSIONS.—A small quantity of water diverted occasionally above gage for use in a cyanide plant.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed on March 13, on account of widening of channel at bridge and removal of gravel under bridge; affected by ice December 17 to February 26. Rating curves used before and after the change fairly well defined. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records good; winter records poor.

Discharge measurements of Sanpoil River at Keller, Wash., during the year ending Sept. 30, 1916.

[Made by C. G. Paulsen.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Feb. 10	[a]1.78	55.8	July 26	1.52	240
Apr. 6	3.32	1,450	27	1.50	232
6	3.31	1,450			

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Sanpoil River at Keller, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May,	June.	July.	Aug.	Sept.
1	57	64	69	.....	194	1,090	1,620	930	572	186	71
2	57	64	102	.....	186	1,260	1,620	970	572	176	67
3	57	64	78	.....	183	1,350	1,620	970	572	167	67
4	57	65	78	.....	178	1,440	1,720	930	572	159	71
5	57	64	82	.....	183	1,530	1,720	891	604	151	71
6	57	64	88	.....	165	1,440	1,720	852	572	151	71
7	57	65	86	.....	160	1,440	1,720	814	512	145	74
8	57	65	85	.....	158	1,440	1,720	776	512	140	74
9	57	64	85	.....	158	1,530	1,620	740	484	143	72
10	57	64	85	.....	189	1,620	1,530	704	456	145	72
11	57	64	82	.....	288	1,720	1,440	670	456	138	71
12	57	62	78	.....	450	1,920	1,260	636	404	130	71
13	58	59	78	.....	670	1,820	1,170	636	404	121	71
14	59	56	71	.....	740	1,820	1,090	636	356	116	67
15	59	58	69	.....	636	1,820	1,010	572	356	114	66
16	59	66	69	.....	604	1,820	1,010	542	356	112	64
17	59	66	.....	.....	572	1,820	970	542	356	110	64
18	58	66	.....	.....	572	1,720	970	512	380	110	61
19	58	65	.....	.....	636	1,720	970	484	380	108	61
20	58	65	.....	.....	704	1,620	970	542	380	110	58
21	58	66	.....	.....	930	1,440	970	604	334	110	58
22	58	68	.....	.....	1,170	1,440	970	636	311	103	58
23	62	65	.....	.....	1,090	1,350	930	636	290	99	58
24	64	64	.....	.....	1,010	1,350	891	572	270	95	58
25	64	68	.....	.....	930	1,260	852	572	266	91	58
26	64	66	.....	.....	852	1,350	814	572	247	88	58
27	59	69	.....	180	891	1,530	776	604	232	84	58
28	58	85	.....	192	1,010	1,720	776	604	229	81	55
29	62	92	.....	197	1,010	1,820	740	636	218	77	53
30	64	64	.....	.....	1,010	1,720	776	636	205	77	54
31	68	.....	.....	.....	1,010	.....	852	.....	195	74	.....

NOTE.—About 2 per cent of the total flow is carried around the gage through the slough at high stages but is included in the results of discharge measurements and determinations of daily discharge. The flume (5 feet wide) to the cyanide plant carried less than half a foot of water Sept. 3–6, and 24–30, and none the rest of the year. Discharge estimated because of ice as follows: Dec. 17–31, 68 second-feet; Jan. 1–10, 58 second-feet; Jan. 11–20, 52 second-feet; Jan. 21–31, 71 second-feet; Feb. 1–10, 54 second-feet; Feb. 11–26, 118 second-feet.

Monthly discharge of Sanpoil River at Keller, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	68	57	59.2	3,640
November	92	56	65.9	3,920
December	102	.....	74.4	4,570
January	.....	.....	60.7	3,730
February	197	.....	103	5,920
March	1,170	158	598	36,800
April	1,920	1,090	1,560	92,800
May	1,720	740	1,190	73,200
June	970	484	681	40,500
July	604	195	389	23,900
August	186	74	120	7,380
September	74	53	64.4	3,830
The year	1,920	.....	414	300,000

NESPELEM RIVER BASIN.

NESPELEM RIVER AT NESPELEM, WASH.

LOCATION.—In SE. ¼ sec. 24, T. 31 N., R. 30 E., about half a mile above Nespelem, in Okanogan County, about 5 miles above Little Nespelem River and 6 miles above the mouth.

DRAINAGE AREA.—122 square miles (measured on map Colville Indian Reservation, edition of 1911).

RECORDS AVAILABLE.—May 1, 1911, to September 30, 1916.

GAGE.—Vertical staff attached to overhanging tree on left bank at gaging bridge; read by Mrs. C. T. Kronk and Erwin Lynch. Prior to July 30, 1913, gage was about 1,000 feet farther upstream at different datum.

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

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; overgrown with aquatic plants during summer months. Concrete control built in November, 1915. Right bank flat; subject to overflow at gage height 4.0 feet; left bank high; not subject to overflow. Stage of zero flow, determined by mean of two observations in 1916, gage height 0.5 foot ±0.1 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.50 feet April 11, (discharge, 379 second-feet); minimum stage recorded, 0.90 foot January 16–18 (discharge, 7.5 second-feet).

1911–1916: Maximum stage recorded, 4.75 feet at 9 a. m. April 16, 1914 (discharge, 442 second-feet); minimum stage recorded, 1.00 foot August 6–7, August 13 to September 28, 1913, and October 1–5, 1913 (discharge, 7.0 second-feet).

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

DIVERSIONS.—Above all diversions.

ACCURACY.—Stage-discharge relation changed when concrete control was built in November, 1915. Rating curve used October 1 to November 4, is defined at prevailing stage by a good discharge measurement; rating curve for new control well defined above and fairly well defined below 50 second-feet. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records excellent except for periods of extremely low water, for which they are good.

Discharge measurements of Nespelem River at Nespelem, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Jan. 5	C. O. Brown	1.02	11.8	Apr. 25	C. L. Marble	3.30	238
5	do	1.02	11.6	July 25	C. G. Paulsen	1.29	33.5
Apr. 4	C. G. Paulsen	3.70	282	26	Paulsen and Marble	1.29	33.7
4	do	3.71	283	26	do	1.29	32.4

Daily discharge, in second-feet, of Nespelem River at Nespelem, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	12	12	15	15	12	15	202	295	169	76	26	13
2	12	12	15	15	12	15	213	295	169	76	25	13
3	12	12	15	15	12	17	271	307	169	76	24	13
4	12	12	17	15	12	17	283	295	158	72	24	14
5	12	.....	22	13	12	17	307	307	147	67	24	13
6	12	.....	18	13	18	17	295	319	147	62	24	13
7	12	.....	18	12	15	18	283	331	136	62	22	13
8	12	.....	18	12	12	18	307	319	136	58	22	13
9	12	.....	18	13	12	21	331	319	126	52	29	13
10	12	.....	18	13	15	20	343	295	126	51	29	13
11	12	.....	18	12	13	24	379	271	121	46	22	13
12	12	.....	18	12	18	37	355	235	111	43	19	13
13	12	.....	15	12	16	46	343	224	111	41	18	13
14	12	.....	15	12	13	41	343	202	96	41	18	13
15	12	.....	15	12	13	41	331	191	96	41	18	12
16	12	.....	15	7.5	24	62	331	180	96	42	18	12
17	12	.....	17	7.5	15	67	319	180	96	45	18	12
18	12	.....	17	7.5	13	106	319	180	96	49	18	12
19	12	.....	17	8.3	13	106	307	180	96	45	22	12
20	12	.....	16	9.5	13	106	295	180	106	42	18	12
21	12	.....	16	12	13	111	283	180	126	39	17	12
22	12	.....	17	12	13	126	271	180	106	36	17	12
23	12	.....	17	25	18	271	259	158	96	34	17	12
24	12	15	18	12	15	191	247	158	91	33	17	12
25	12	15	18	12	15	202	247	147	81	33	17	12
26	12	15	17	12	15	169	235	147	86	33	15	12
27	12	15	17	12	15	158	271	147	96	31	15	12
28	12	15	16	12	15	169	295	147	91	29	15	12
29	12	15	15	12	14	158	295	147	86	28	15	12
30	12	15	15	12	.....	169	295	158	76	27	14	12
31	12	15	15	12	.....	180	.....	169	.....	26	14	12

NOTE.—No gage-height record Nov. 5–23; concrete control being built; discharge estimated at 14 second-feet, as record of flow of Sanpoil River at Keller shows only a few hundredths of a foot variation during period.

Monthly discharge of Nespelem River at Nespelem, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	12	12	12.0	738
November	15	12	14.0	833
December	22	15	16.7	1,030
January	25	7.5	12.3	756
February	24	12	14.3	822
March	271	15	87.6	5,390
April	379	202	295	17,600
May	331	147	221	13,600
June	169	76	115	6,840
July	76	26	46.3	2,850
August	29	14	19.7	1,210
September	14	12	12.5	744
The year	379	7.5	72.1	52,400

OKANOGAN RIVER BASIN.

OKANOGAN RIVER AT OKANOGAN, WASH.

LOCATION.—In sec. 16, T. 33 N., R. 26 E., at Okanogan, in Okanogan County, a quarter of a mile above Salmon Creek.

DRAINAGE AREA.—7,740 square miles (measured on topographic maps and maps of Okanogan National Forest, Colville Indian Reservation, and Canadian Railway belt).

RECORDS AVAILABLE.—May 10, 1911, to September 30, 1916.

GAGE.—Vertical staff attached to steamboat dock on left bank at Okanogan; October 21, 1915, to April 27, 1916, and August 28 to September 30, 1916, inclined staff for low water 300 feet above old gage; read by J. B. Gordon.

DISCHARGE MEASUREMENTS.—Made from boat at gage or from highway bridge at Omak, 4 miles upstream.

CHANNEL AND CONTROL.—Bed composed of boulders and cobblestones; likely to shift at extremely high water. Banks fairly high. One channel at all stages.

EXTREMES OF DISCHARGE.—1911–1916: Maximum stage recorded, 12.21 feet June 20, 1916 (discharge, 22,200 second-feet); minimum discharge estimated at 630 second-feet January 12, 1916 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's notes, discharge measurements, and weather records.

DIVERSIONS.—Numerous small ditches divert water for irrigation above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed slightly during high water in June; affected by ice December 17 to February 22. Rating curves well defined except for extremely high water. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records excellent except for periods during which stage was extremely high or stage-discharge relation was affected by ice.

COOPERATION.—Gage-height record furnished by United States Forest Service.

Discharge measurements of Okanogan River at Okanogan, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.		Discharge.
		Old gage.	New gage.	
		Feet.	*Feet.*	*Sec.-ft.*
Oct. 18	J. T. Hartson	2.50	.....	1,070
20	....do	2.49	.....	1,080
Jan. 25	C. G. Paulsen	.....	[a] 2.78	973
29	....do	.....	[a] 2.62	890
June 4	Paulsen and Sherer	8.84	.....	11,700
9	C. G. Paulsen	9.30	.....	12,900
Aug. 3	C. O. Brown	5.05	.....	4,040

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Okanogan River at Okanogan, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,110	1,840	1,130	.....	1,460	1,840	5,480	10,800	15,900	4,270	2,000
2	1,110	1,740	1,130	.....	1,370	1,840	5,800	10,500	14,000	4,270	2,000
3	1,080	1,940	1,130	.....	1,460	1,840	9,300	10,800	14,300	3,990	1,950
4	1,040	1,840	1,130	.....	1,460	1,940	12,800	11,600	13,800	3,990	1,900
5	1,110	1,740	1,210	.....	1,380	2,050	12,800	12,800	13,400	3,850	2,000
6	1,110	1,740	1,210	.....	1,290	2,050	13,100	13,100	12,500	3,710	2,220
7	1,110	1,640	1,210	.....	1,350	2,160	13,700	12,500	11,900	3,570	2,110
8	1,110	1,640	1,210	.....	1,400	2,220	14,000	11,900	10,800	3,430	2,000
9	1,110	1,640	1,210	.....	1,460	2,270	12,500	12,800	10,800	3,430	1,900
10	1,110	1,550	1,210	.....	1,740	2,380	10,800	13,700	11,000	3,430	1,850
11	1,110	1,500	1,210	.....	1,840	2,600	9,300	13,700	10,500	3,290	1,800
12	1,110	1,460	1,210	.....	1,940	2,720	8,640	12,800	9,780	3,160	1,800
13	1,110	1,370	1,130	.....	2,050	2,720	8,000	12,500	9,300	3,030	1,800
14	1,040	1,370	1,130	.....	2,490	2,840	7,410	13,400	8,860	2,900	1,800
15	1,040	1,290	1,130	.....	2,270	2,840	7,220	14,600	8,000	2,900	1,700
16	1,040	1,290	1,130	.....	2,270	2,960	7,030	15,900	7,700	2,900	1,600
17	1,110	1,290	1,130	.....	2,270	3,080	6,840	17,500	7,410	2,780	1,600
18	1,110	1,290	.....	.....	2,160	3,200	7,600	19,500	7,030	2,650	1,600
19	1,110	1,290	.....	.....	2,050	3,200	8,420	21,500	7,800	2,650	1,510
20	1,110	1,290	.....	.....	2,160	3,200	9,080	22,200	7,030	2,650	1,510
21	1,060	1,290	.....	.....	2,160	3,080	10,000	20,500	6,660	2,650	1,510
22	1,060	1,290	.....	.....	2,160	3,020	10,000	18,400	6,230	2,650	1,510
23	1,130	1,210	.....	1,370	2,050	2,960	9,780	18,100	5,800	2,650	1,510
24	1,170	1,210	.....	1,370	2,050	2,960	8,860	17,500	5,640	2,490	1,420
25	1,210	1,250	.....	1,370	2,000	2,960	8,420	17,100	5,170	2,340	1,420
26	1,210	1,290	.....	1,460	1,940	2,960	9,300	17,100	5,170	2,180	1,510
27	1,210	1,210	.....	1,550	1,940	3,080	9,780	17,500	5,020	2,200	1,420
28	1,290	1,170	.....	1,550	1,940	3,850	10,300	18,800	4,870	2,220	1,420
29	1,740	1,130	.....	1,460	1,940	5,170	11,000	18,400	4,870	2,000	1,420
30	2,050	1,130	.....	.....	1,840	5,480	11,000	17,800	4,720	2,000	1,420
31	1,940	.....	.....	.....	1,840	.....	10,500	.....	4,570	2,000	.....

NOTE.—Gage not read Oct. 3, 24, 31; Nov. 11, 17, 25, 28; Mar. 5, 7, 8, 25, 31; Apr. 1, 8, 22; May 3, 16; July 1, 4. 16, 22, 30; Aug. 5, 13, 15, 17, 20, 24, 25, 27; Sept. 3, 10, 13, 17, discharge interpolated. Discharge estimated, because of ice, as follows: Dec. 18–31, 910 second-feet; Jan. 1–10, 680 second-feet; Jan. 11–20, 665 second-feet; Jan. 21–31, 950 second-feet; Feb. 1–15, 880 second-feet; Feb. 16–22, 1,300 second-feet.

Monthly discharge of Okanogan River at Okanogan, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	2,050	1,040	1,190	73,200
November	1,940	1,130	1,430	85,100
December	1,210	.....	1,050	64,600
January	.....	.....	771	47,400
February	1,550	.....	1,120	64,400
March	2,490	1,290	1,860	114,000
April	5,480	1,840	2,850	170,000
May	14,000	5,480	9,640	593,000
June	22,200	10,500	15,500	922,000
July	15,900	4,570	8,730	537,000
August	4,270	2,180	2,980	183,000
September	2,220	1,420	1,710	102,000
The year	22,200	.....	4,070	2,960,000

SIMILKAMEEN RIVER NEAR OROVILLE, WASH.

LOCATION.—In SE. ¼ sec. 13, T. 40 N., R. 25 E., at the Okanogan Valley Power Co.'s plant, 4 miles above Oroville, in Okanogan County, 5 miles above mouth; below all tributaries.

DRAINAGE AREA.—3,450 square miles (measured on topographic maps and Canadian railway belt maps).

RECORDS AVAILABLE.—May 14, 1911, to September 30, 1916.

GAGE.—Vertical staff in seven sections on left bank—three sections 15 feet above tailrace and four sections nailed to power house; read by G. M. Rayburn.

DISCHARGE MEASUREMENTS.—Made from highway bridge at Oroville, 4 miles below gage.

CHANNEL AND CONTROL.—Narrow canyon at gage and control; fairly permanent. Banks high, not subject to overflow. Lower falls (25 feet high) 150 feet above gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 18.3 feet at 7 a. m. June 19 (discharge, 20,600 second-feet); minimum uncertain, but estimated at 280 second-feet December 29 (stage-discharge relation affected by ice).

1911–1916: Maximum stage recorded, 18.3 feet during 1916. Minimum discharge uncertain, but estimated at 280 second-feet January 20–21, 1915, and December 29, 1916 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's notes, weather records, and discharge measurements.

DIVERSIONS.—Some water is diverted for irrigation from tributaries above the station. The diversion by the West Okanogan irrigation district was measured, as follows: May 30, 94 second-feet; June 10, 50 second-feet; and August 4, 61 second-feet.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water May 7. Rating curve used before change well defined below 13,000 second-feet; curve used after change well defined below 15,000 second-feet. Stage-discharge relation affected by ice December 4 to February 13. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records excellent; other records fair.

COOPERATION.—Gage-height record furnished by the Okanogan Valley Power Co.

Discharge measurements of Similkameen River near Oroville, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 22	J. T. Hartson	1.88	640	June 11	C. G. Paulsen	12.57	11,500
Jan. 28	C. G. Paulsen	[a] 1.61	396	Aug. 5	C. O. Brown	4.48	2,380
May 31	....do	11.21	9,720				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Similkameen River near Oroville, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	454	1,110	526	.....	775	1,060	4,950	9,720	11,400	2,830	970
2	437	1,270	526	.....	730	1,160	6,610	9,860	10,800	2,670	915
3	437	1,210	526	.....	642	1,160	8,060	10,300	11,600	2,590	970
4	437	1,160	.....	.....	685	820	10,300	11,400	11,000	2,510	1,140
5	454	1,110	.....	.....	685	1,010	12,100	11,900	10,300	2,270	1,260
6	490	1,060	.....	.....	685	1,390	12,600	11,200	9,860	2,270	1,140
7	526	1,060	.....	.....	642	1,450	12,800	10,700	9,040	2,130	1,020
8	490	1,010	.....	.....	642	1,510	11,800	10,800	9,040	2,130	970
9	490	960	.....	.....	685	1,630	9,860	12,000	8,910	2,130	915
10	490	910	.....	.....	685	1,930	9,040	12,500	9,170	2,060	915
11	490	865	.....	.....	730	1,930	8,260	11,300	8,260	1,990	915
12	490	820	.....	.....	1,110	2,000	7,480	11,000	8,900	1,850	862
13	454	775	.....	.....	1,570	2,000	6,740	11,300	7,740	1,710	862
14	490	685	.....	564	1,690	2,000	6,500	12,800	7,100	1,710	809
15	490	730	.....	730	1,570	2,140	6,150	14,500	6,150	1,640	809
16	526	775	.....	775	1,570	2,280	6,260	16,900	5,930	1,640	758
17	526	730	.....	730	1,450	2,280	6,980	18,800	6,500	1,520	758
18	490	730	.....	720	1,330	2,350	7,740	20,400	6,500	1,520	709
19	490	730	.....	775	1,390	2,350	8,520	19,900	5,820	1,520	709
20	490	685	.....	775	1,390	2,280	9,170	17,200	5,270	1,520	709
21	526	685	.....	775	1,390	2,210	9,300	14,500	5,050	1,380	662
22	642	642	.....	775	1,390	2,210	8,910	14,200	4,640	1,320	662
23	642	642	.....	775	1,330	2,140	8,260	14,300	4,540	1,260	617
24	642	642	.....	775	1,330	2,070	8,000	14,000	4,140	1,200	662
25	642	685	.....	775	1,270	2,070	7,610	14,000	3,870	1,140	758
26	685	685	.....	865	1,270	2,210	7,870	14,300	3,690	1,140	709
27	775	642	.....	960	1,210	2,830	9,300	15,800	3,510	1,140	709
28	1,160	602	.....	820	1,210	4,250	10,000	15,600	3,420	1,080	662
29	1,630	564	.....	775	1,160	4,750	10,400	14,700	3,420	1,080	662
30	1,390	564	.....	.....	1,060	4,750	9,720	13,100	3,150	1,020	662
31	1,210	.....	.....	.....	1,060	.....	9,580	.....	2,990	970	.....

NOTE.—Discharge estimated, on account of ice, as follows: Dec. 3–10, 530 second-feet; Dec. 11–20, 470 second-feet; Dec. 21–31, 390 second-feet; Jan. 1–10, 410 second-feet; Jan. 11–20, 390 second-feet; Jan. 21–31, 410 second-feet; Feb. 1–7, 420 second-feet; and Feb. 8–13, 490 second-feet.

Monthly discharge of Similkameen River near Oroville, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,630	437	632	38,900
November	1,270	564	825	49,100
December	.....	.....	461	28,300
January	.....	.....	404	24,800
February	960	.....	629	36,200
March	1,690	642	1,110	68,200
April	4,750	820	2,140	127,000
May	12,800	4,950	8,740	537,000
June	20,400	9,720	13,600	809,000
July	11,600	2,990	6,800	418,000
August	2,830	970	1,710	105,000
September	1,260	617	829	49,300
The year	20,400	.....	3,160	2,290.000

SALMON CREEK NEAR CONCONULLY,[1] WASH.

LOCATION.—In sec. 18, T. 35 N., R. 25 E., half a mile below Conconully reservoir, Okanogan project of United States Reclamation Service, 2 miles south of Conconully, and about 14 miles above Okanogan, in Okanogan County.

DRAINAGE AREA.—121 square miles (revised measurement); 152 square miles at Jones ranch.

RECORDS AVAILABLE.—July 6, 1910, to September 30, 1916. From May 27, 1903, to March 31, 1912, records were obtained at Jones ranch in sec. 31, T. 34 N., R. 26 E., about 6 miles above Okanogan.

GAGE.—Vertical staff half a mile below reservoir indicates head on weir; read by Allen Honey.

DISCHARGE MEASUREMENTS.—Made from footbridge near gage.

CHANNEL AND CONTROL.—20-foot rectangular sharp-crested weir with two end contractions; prior to October 1, 1912, a 20-foot Cippoletti weir.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.00 feet July 3 (discharge, 410 second-feet); minimum stage recorded, 0.11 foot October 1–6 (discharge, 2.5 second-feet).

1903–1916: Maximum stage recorded, 3.63 feet, April 29, 1904 (discharge, 577 second-feet). No flow 4 p. m. October 3 to 6 p. m. October 11, 1910, when water was being stored in Salmon Lake and Conconully reservoirs.

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

DIVERSIONS.—None.

REGULATION.—Flow controlled by storage in Salmon Lake reservoir, (capacity 2,600 acre-feet) and Conconully reservoir (capacity 13,000 acre-feet). Monthly summaries of flow for 1912–1916 have been corrected for storage.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read to hundredths once daily; oftener when head was changed. Daily discharge ascertained by applying gage height to rating table, or, for days when head was changed, by weighing the results obtained by subdividing days and ascertaining discharge for periods by applying gage heights to rating table. Records excellent.

COOPERATION.—Gage-height record and storage determinations furnished by United States Reclamation Service.

Discharge measurements of Salmon Creek near Conconully, Wash., during the year ending Sept. 30, 1916.

[Made by C. G. Paulsen.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 2	1.74	166	June 3	0.87	56.5
2	1.52	135	3	.58	29.8
2	1.19	91.9			

[1] Formerly discribed as near Okanogan.

Daily discharge, in second-feet, of Salmon Creek near Conconully, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.5	23	3.6	3.6	3.6	3.6	4.0	62	166	254	112	114
2	2.5	22	3.6	3.6	3.6	3.6	4.3	93	145	251	117	118
3	2.5	19	3.6	3.6	3.6	3 6	4.3	122	120	410	122	121
4	2.5	20	3.6	3.6	3.6	3 6	4.3	171	166	282	122	120
5	2.5	20	3.6	3.6	3.6	3.6	4.3	195	166	262	128	115
6	2.5	20	3.6	3.6	3.6	3.6	4.3	216	166	232	125	115
7	2.8	4.0	3.6	3.6	3.6	3.6	4 3	223	168	170	125	116
8	2.8	3.6	3.6	3.6	4.0	3.6	4.3	225	168	110	124	112
9	2.8	3.6	3.6	3.6	4.0	3.6	4.3	225	168	207	124	109
10	2.8	3.6	3.6	3.6	4.0	3.6	4.3	225	169	181	124	110
11	2.8	3.6	3.6	3.6	4.0	3.6	4.3	223	190	166	124	105
12	2.8	3.6	3.6	3.6	3.6	3.6	4.3	223	210	152	124	80
13	2.8	3.6	3.6	3.6	3.6	4.0	4.3	223	216	142	124	4.0
14	2.8	3.2	3.6	3.6	3.6	4.0	4.3	221	219	142	124	4.0
15	2.8	3.2	3.6	3.6	3.6	3.6	4.3	202	252	119	123	4.0
16	2.8	3.2	3.6	3.6	3.6	3.6	4.3	220	286	122	121	3.6
17	2.8	3.2	3.6	3.6	3.6	3.6	4.3	223	337	176	121	3.6
18	2.8	3.2	3.6	3.6	3.6	4.0	4.3	223	366	170	119	3.6
19	2.8	3.2	3.6	3.6	3.6	4.0	4.3	221	366	136	118	6.4
20	2.8	3.2	3.6	3.6	3.6	4.0	4.3	221	347	118	118	14
21	2.8	3.2	3.6	3.6	3.6	4.0	4.7	220	334	106	118	22
22	2.8	3.2	3.6	3.6	3 6	4.0	4.3	220	334	95	114	32
23	2.8	3.2	3.6	3.6	3.6	4.0	4.3	212	286	101	115	44
24	2.8	3.2	3.6	3.6	3.6	4.0	4 3	176	234	98	115	63
25	2.8	3.6	3.6	3.6	3.6	4.0	4.3	163	234	98	113	68
26	2.8	3.6	3.6	3.6	3.6	4.0	4.3	163	271	95	110	14
27	5.7	3.6	3.6	3.6	3.6	4.0	4.7	163	302	95	110	4.0
28	9.0	3.6	3.6	3.6	3.6	4.0	5.4	164	316	98	110	3.6
29	16	3.6	3.6	3.6	3.6	4.0	32	164	272	99	110	3.6
30	18	3.6	3.6	3.6	.....	4.0	46	166	256	101	113	3.6
31	19	.....	3.6	3.6	.....	4.0	.....	166	.....	105	113	.....

Monthly discharge of Salmon Creek near Conconully, Wash., for the year ending Sept. 30, 1916.

Month.	Observed discharge in second-feet.			Run-off in acre-feet.			Mean discharge without storage in second-feet.
	Maximum.	Minimum.	Mean.	Observed.	Stored.	Without storage.	
October	19	2.5	4.47	275	+265	540	8.78
November	23	3.2	6.88	409	+262	671	11.3
December	3.6	3.6	3.60	221	+349	570	9.27
January	3.6	3.6	3.60	221	+855	1,110	18.1
February	4.0	3.6	3.66	211	+389	600	10.4
March	4.0	3.6	3.81	234	+820	1,050	17.1
April	46	4.0	6.67	397	+3,640	4,040	67.9
May	225	62	191	11,700	+2,090	13,800	224
June	366	120	241	14,300	+2,030	16,300	274
July	410	95	158	9,720	— 583	9,140	149
August	128	110	119	7,320	−5,280	2,040	33.2
September	121	3.6	54.5	3,240	−2,680	560	9.41
The year	410	2.5	66.6	48,200	+2,160	50,400	69.4

89351°—19—WSP 442——10

METHOW RIVER BASIN.

METHOW RIVER AT PATEROS, WASH.

LOCATION.—In sec. 2, T. 29 N., R. 23 E., three-fourths mile above highway bridge at Pateros, in Okanogan County, 1 mile above mouth.

DRAINAGE AREA.—1,850 square miles (measured on topographic and Forest Service maps).

RECORDS AVAILABLE.—May 3, 1903, to September 30, 1916.

GAGE.—Inclined and vertical staff gage on left bank 500 feet below observer's house; read by F. W. Robinson. Prior to June 17, 1903, gage was half a mile farther downstream.

DISCHARGE MEASUREMENTS.—Made from cable 1,000 feet upstream or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of large boulders and gravel; shifts at extremely high stages. One channel at all stages. Right bank high and not subject to overflow; left bank not subject to overflow below gage height 12 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.95 feet, at peaks, June 17 and 18 (discharge, 14,600 second-feet); minimum stage occurred either January 30 or 31 (discharge, 317 second-feet from discharge measurement January 31).

1903–1916: Maximum stage recorded June 17 and 18, 1916. Minimum discharge estimated at 230 second-feet February 5 and 6, 1914 (stage-discharge relation affected by ice).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Many small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Rating curve well defined. Gage read to hundredths twice daily; oftener during high water. Stage-discharge relation permanent; affected by ice January 2 to March 6; observer's ice record excellent. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water record excellent; record January 2 to March 6, fair.

Discharge measurements of Methow River at Pateros, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 16	J. T. Hartson	3.91	403	June 5	C. G. Paulsen	9.00	7,430
Jan. 24	C. G. Paulsen	5.16[a]	405	Aug. 2	C. O. Brown	6.13	2,280
31	....do	4.73[a]	317				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Methow River at Pateros, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	372	466	448	386	.....	910	5,080	5,910	8,350	2,290	870
2	372	486	448	.....	.....	1,080	6,120	5,910	8,120	2,170	832
3	372	466	486	.....	.....	1,300	7,660	6,330	8,820	2,050	870
4	386	466	506	.....	.....	1,600	9,060	7,660	8,350	2,050	992
5	386	448	486	.....	.....	1,930	9,540	7,430	8,120	2,050	950
6	386	448	486	.....	.....	2,050	9,300	6,770	7,890	1,930	870
7	386	448	466	.....	416	2,170	8,820	6,990	7,430	1,820	870
8	386	466	466	.....	416	2,290	7,660	7,430	7,430	1,820	832
9	386	466	448	.....	416	2,550	6,550	8,350	8,120	1,930	795
10	400	448	431	.....	431	2,980	6,120	8,120	7,890	1,930	760
11	400	448	431	.....	466	2,980	5,280	7,210	7,210	1,820	760
12	400	448	431	.....	506	2,980	4,880	7,430	6,990	1,710	725
13	400	431	431	.....	604	2,830	4,490	7,890	6,990	1,710	694
14	400	431	416	.....	604	3,130	4,120	9,300	5,910	1,710	694
15	400	448	400	.....	604	3,130	3,940	11,200	5,280	1,600	662
16	400	448	431	.....	604	3,280	4,120	13,800	5,280	1,500	633
17	400	431	416	.....	604	3,130	4,490	14,200	6,120	1,400	633
18	386	448	400	.....	662	3,130	4,880	14,200	5,280	1,400	604
19	400	448	400	.....	760	2,830	5,490	12,800	4,680	1,300	604
20	400	448	431	.....	795	2,690	6,120	10,500	4,300	1,210	578
21	400	448	486	.....	870	2,690	6,330	9,060	4,120	1,120	578
22	386	466	486	.....	870	2,550	6,120	8,820	3,770	1,080	552
23	400	466	431	.....	870	2,550	5,700	8,820	3,600	1,040	552
24	431	466	416	.....	870	2,550	5,280	9,540	3,280	1,040	552
25	448	448	431	.....	870	2,550	5,280	9,780	3,130	992	552
26	448	448	416	.....	870	2,980	5,280	11,200	2,830	992	529
27	448	448	400	.....	870	4,120	6,120	11,800	2,550	992	529
28	448	400	466	.....	832	4,880	6,990	10,800	2,420	992	506
29	448	431	448	.....	832	4,680	6,550	9,780	2,290	950	506
30	448	448	400	.....	795	4,680	6,330	8,820	2,290	870	506
31	448	.....	386	.....	795	.....	6,120	.....	2,290	870	.....

NOTE.—Discharge estimated, because of ice, as follows: Jan. 2–10, 400 second-feet; Jan. 11–20, 400 second-feet; Jan. 21–31, 385 second-feet; Feb. 1–10, 380 second-feet; Feb. 11–20, 440 second-feet; Feb. 21–29, 450 second-feet; Mar. 1–6, 415 second-feet.

Monthly discharge of Methow River at Pateros, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	448	372	406	25,000
November	486	400	450	26,800
December	506	386	439	27,200
January	.....	.....	394	24,200
February	.....	.....	422	24,300
March	870	.....	636	39,100
April	4,880	910	2,770	165,000
May	9,540	3,940	6,120	376,000
June	14,200	5,910	9,260	551,000
July	8,820	2,290	5,520	339,000
August	2,290	870	1,490	91,600
September	992	506	686	40,800
The year	14,200	.....	2,380	1,730,000

CHELAN RIVER BASIN.

LAKE CHELAN AT CHELAN, WASH.

LOCATION.—In sec. 13, T. 27 N., R. 22 E., at Forest Service boat landing at Chelan, in Chelan County, a quarter of a mile above highway bridge at outlet.

DRAINAGE AREA.—951 square miles.

RECORDS AVAILABLE.—September 1 to October 15, 1897; January 1, 1898, to December 31, 1899; January 1 to June 30, 1905; December 5, 1910, to September 30, 1916,

GAGE.—Vertical staff on pile at landing; installed December 5, 1910; datum, 1,076.15 feet above sea level. Gage used from 1897 to 1899 was at Lakeside, about a mile west of Chelan; datum, 1,070.18 feet above sea level. In 1905 gage was on a bent of the upper bridge at Chelan; elevation not determined. Gage read by W. E. Naylor.

EXTREMES OF STAGE.—Maximum stage recorded during year, 7.2 feet June 18; minimum, 2.12 feet April 2.

1898–99 and 1911–16: Maximum stage recorded June 18, 1916; minimum stage recorded, 6.60 feet January 27–28, and December 2–5, 1898.

REGULATION.—The height of water in the lake is controlled by operation of gates in the dam at outlet.

COOPERATION.—Gage-height record since December, 1910, furnished by United States Forest Service.

Daily gage height, in feet, of Lake Chelan at Chelan, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		3.03										
2							2.12	3.30		6.63		
3						2.90						3.66
4	2.72			3.05					4.80			
5			3.20									
6						2.75						
7		3.02			2.55						2.95	
8						2.75		4.52				
9										6.45		
10				2.90			2.55					3.50
11									5.04			
12			3.20									
13						3.15					3.78	
14		3.08			2.80							
15						3.00		4.15				
16				2.88						6.18		
17							2.85					3.20
18									7.20			
19												
20						2.67						
21		3.25						4.35			3.22	
22					2.72							
23							2.70					
24				2.72						5.39		3.07
25	2.72								6.98			
26						2.65						
27					2.78							
28		3.18						4.45				
29												
30										4.62	3.40	
31				2.60								

CHELAN RIVER AT CHELAN, WASH.

LOCATION.—In sec. 13, T. 27 N., R. 22 E., at lower highway bridge at Chelan, in Chelan County, 800 feet below the flashboard dam at outlet of Chelan Lake, and 4 miles northwest of Chelan Falls.

DRAINAGE AREA.—950 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 6, 1903, to September 30, 1916.

GAGE.—Vertical staff on fourth bent of left approach to lower highway bridge; read by W. E. Naylor.

DISCHARGE MEASUREMENTS.—Made from upper highway bridge 1,000 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel; shifting at extremely high water. Channel curved above gage but practically straight below. Banks high; not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.48 feet June 20 (discharge, 9,780 second-feet); minimum stage recorded, 4.10 feet January 5 (discharge, 303 second-feet).

1903–1916: Maximum stage recorded June 20, 1916; minimum stage recorded, 4.35 feet December 17, 1910 (discharge, 245 second-feet).

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

DIVERSIONS.—Several irrigation ditches divert from tributaries a very small proportion of the run-off.

REGULATION.—Flashboard dam 800 feet above gage controls lake level at low water in the interest of navigation.

ACCURACY.—Stage-discharge relation for low water changed June 20. Rating curves used before and after the change well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

COOPERATION.—Gage-height record furnished by United States Forest Service.

Discharge measurements of Chelan River at Chelan, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 7	J. T. Hartson	4.50	407	June 6	C. G. Paulsen	9.19	5,870
15	do	4.40	380	8	do	9.22	5,960

Daily discharge, in second-feet, of Chelan River at Chelan, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	418	482	579	500	465	558	2,070	3,280	5,180	8,880	5,340	1,820
2	418	538	538	500	500	519	2,070	3,580	5,180	8,790	5,180	1,940
3	410	519	558	500	500	579	2,070	3,740	5,340	8,700	5,020	1,940
4	403	500	648	449	500	558	2,200	4,220	5,420	8,520	4,860	1,940
5	418	538	660	303	500	568	2,200	4,700	5,500	8,350	4,860	1,940
6	403	519	673	519	519	579	2,200	5,340	5,660	8,180	4,700	1,940
7	389	510	727	500	538	538	2,200	5,420	5,820	8,010	4,540	1,940
8	389	500	700	449	538	1,470	2,200	5,500	5,820	8,350	4,380	1,940
9	403	538	727	406	500	1,470	2,330	5,500	6,140	8,260	4,540	1,820
10	396	538	624	362	538	500	2,460	5,500	6,140	8,180	4,380	1,760
11	389	500	624	500	538	1,700	2,460	5,340	6,140	8,180	4,380	1,700
12	375	500	624	624	500	2,140	2,720	5,180	6,140	8,180	4,220	1,580
13	375	500	624	579	500	2,590	2,720	5,020	6,310	8,520	4,060	1,470
14	375	500	579	579	500	2,990	2,720	4,940	6,480	8,350	3,900	571
15	375	500	558	579	500	2,990	2,850	4,860	6,990	8,180	3,900	571
16	362	538	519	558	500	2,990	2,850	4,700	7,670	7,920	3,900	1,260
17	.....	579	519	538	500	2,990	2,850	4,700	8,520	7,670	3,740	1,240
18	.....	558	519	538	482	2,850	2,850	4,700	9,600	7,670	3,280	1,210
19	.....	624	519	500	500	2,780	2,850	4,860	9,600	7,500	3,130	1,210
20	.....	579	519	482	519	2,720	2,850	4,860	9,780	7,160	2,990	1,160
21	.....	568	558	500	538	2,720	2,720	5,020	9,600	7,160	2,850	1,160
22	.....	558	673	538	538	2,720	2,720	5,180	9,240	6,990	2,720	1,260
23	362	673	700	528	500	2,590	2,720	5,020	9,240	6,820	2,720	1,120
24	356	673	624	519	500	2,460	2,720	5,020	9,240	6,650	2,720	1,160
25	349	673	632	558	538	2,460	2,720	4,860	9,240	6,480	2,720	1,210
26	403	673	640	519	519	2,460	2,720	5,020	9,240	6,140	1,580	1,030
27	375	624	648	500	528	2,460	2,850	5,020	9,600	5,980	1,640	990
28	389	613	727	465	538	2,330	2,990	5,100	9,600	5,820	1,700	990
29	418	602	624	482	538	2,330	3,130	5,180	9,600	5,500	1,700	990
30	449	579	465	474	.....	2,070	3,200	5,260	9,420	5,420	1,820	955
31	466	.....	500	465	.....	2,070	.....	5,340	.....	5,340	1,820	.....

NOTE.—Gage not read Sundays (except June 18) and a few other days; discharge interpolated. Discharge October 17–22, when gage was not read, estimated at 360 second-feet. Low discharge March 10 due to backing of water in lake while bridge was being repaired. Decrease in discharge August 26 due to inserting flashboards to raise the lake surface for navigation.

Monthly discharge of Chelan River at Chelan, Wash., for the year ending Sept. 3, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	466	349	388	23,900
November	673	482	560	33,300
December	727	465	607	37,300
January	624	303	500	30,700
February	538	465	513	29,500
March	2,990	500	1,960	121,000
April	3,200	2,070	2,610	155,000
May	5,500	3,280	4,900	301,000
June	9,780	5,180	7,580	451,000
July	8,880	5,340	7,480	460,000
August	5,340	1,580	3,530	217,000
September	1,940	571	1,390	82,700
The year	9,780	303	2,680	1,940,000

ENTIAT RIVER BASIN.

ENTIAT RIVER AT ENTIAT, WASH.

LOCATION.—In sec. 18, T. 25 N., R. 21 E., one-eighth mile below power house of Wenatchee Valley Gas & Electric Co., three-fourths mile above Entiat, in Chelan County, and about a mile above the mouth.

DRAINAGE AREA.—419 square miles (measured on topographic map).

RECORDS AVAILABLE.—October 5, 1910, to September, 30, 1916.

GAGE.—Inclined staff on left bank one-eighth mile below power house; read by L. C. Asher.

DISCHARGE MEASUREMENTS.—Made from private bridge 200 feet below power house or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; shifting at extremely high water. One channel at all stages. Left bank high; not subject to overflow; right bank slopes gradually.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.00 feet June 17 (discharge, 5,150 second-feet); minimum stage recorded, 0.71 foot November 29 (discharge, 73 second-feet).

1910–1916: Maximum stage recorded, June 17, 1916. Minimum discharge estimated at 65 second-feet February 7, 1914, from temperature record and observer's notes of effect of ice.

ICE.—Stage-discharge relation seriously affected by ice, flow estimated from observer's notes, discharge measurements, and temperature record.

DIVERSIONS.—Entiat Irrigation Co.'s high line canal (capacity about 20 second-feet) diverts water above station.

REGULATION.—Flow affected by changes in load at power plant.

ACCURACY.—Stage-discharge relation changed at high water June 17; affected by ice December 15 to February 16. Rating curves used before and after the change fairly well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Some fluctuation at extremely low water due to regulation at power house. Open water records good; others fair.

COOPERATION.—Gage-height record furnished by Wenatchee Valley Gas & Electric Co.

Discharge measurements of Entiat River at Entiat, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 6	J. T. Hartson	0.81	88.2	Feb. 1	C. G. Paulsen	a 1.35	83.4
Jan. 13	C. O. Brown	a 2.32	95.3	June 7	do	3.68	2,480
22	Paulsen and Winter	a 1.96	92.1	Aug. 1	C. O. Brown	2.53	1,030

a Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Entiat River at Entiat, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	83	199	114	.....	83	158	415	1,390	2,060	2,690	1,000	388
2	85	171	114	.....	.....	158	545	1,770	2,210	2,520	1,000	388
3	86	142	124	.....	.....	156	582	2,210	2,210	2,520	912	388
4	88	128	124	.....	.....	144	700	2,700	2,210	2,520	912	342
5	88	124	124	.....	.....	142	740	2,700	2,700	2,520	828	300
6	88	124	124	.....	.....	144	780	2,700	2,530	2,520	828	300
7	86	120	118	.....	.....	137	780	2,370	2,530	2,520	789	281
8	86	116	114	.....	.....	142	870	2,060	2,700	2,690	789	245
9	86	114	104	.....	.....	171	870	1,910	2,870	2,690	750	222
10	83	112	86	.....	.....	446	915	1,770	3,050	3,240	750	212
11	83	114	104	.....	.....	582	915	1,390	2,870	3,050	750	212
12	83	114	114	.....	.....	582	960	1,270	2,700	3,050	714	209
13	86	100	108	95	.....	620	915	1,220	2,700	3,050	678	209
14	86	99	95	.....	.....	545	915	1,110	3,050	2,690	678	206
15	86	106	86	.....	.....	477	1,010	1,110	3,440	2,360	678	196
16	86	104	.....	.....	.....	446	1,060	1,220	4,710	2,200	612	193
17	86	112	.....	.....	108	415	960	1,330	5,150	2,200	612	193
18	90	110	.....	.....	126	415	870	1,510	5,150	2,050	492	193
19	90	108	.....	.....	124	415	870	1,510	4,270	1,910	438	190
20	90	97	.....	.....	135	446	870	1,700	4,060	1,770	413	184
21	85	95	.....	.....	137	446	780	1,700	3,440	1,640	388	178
22	83	97	.....	92	146	446	740	1,770	2,690	1,640	388	178
23	90	104	.....	.....	144	446	700	1,770	2,520	1,640	388	175
24	124	106	.....	.....	142	446	700	1,700	3,050	1,460	388	175
25	120	114	.....	.....	146	415	700	1,640	3,050	1,290	388	172
26	120	114	.....	.....	156	415	740	1,700	3,240	1,190	388	172
27	171	108	.....	.....	158	415	870	2,060	3,640	1,090	388	169
28	120	86	.....	.....	161	415	1,220	2,530	3,640	1,000	388	169
29	120	73	.....	.....	164	415	1,270	2,370	3,240	1,000	388	172
30	122	104	.....	.....	.....	388	1,330	2,370	3,050	1,000	388	175
31	171	.....	.....	.....	.....	388	.....	2,060	.....	1,000	388	.....

NOTE.—Discharge estimated, on account of ice, from current-meter measurements, observer's notes, and temperature record as follows: Dec. 15–31, 88 second-feet; Jan. 1–12, 93 second-feet; Jan. 14–21, 94 second-feet; Jan. 23–31, 88 second-feet; Feb. 2–16, 95 second-feet.

Monthly discharge of Entiat River at Entiat, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	171	83	98.4	6,050
November	199	73	114	6,780
December	124	.....	98.7	6,070
January	.....	.....	91.8	5,640
February	164	.....	116	6,670
March	620	137	367	22,600
April	1,330	415	853	50,800
May	2,700	1,110	1,830	113,000
June	5,150	2,060	3,160	188,000
July	3,240	1,000	2,090	129,000
August	1,000	388	609	37,400
September	388	169	226	13,400
The year	5,150	73	804	585,000

WENATCHEE RIVER BASIN.

WENATCHEE RIVER NEAR LEAVENWORTH, WASH.

LOCATION.—In SW. ¼ sec. 12, T. 26 N., R. 17 E., 1,500 feet below highway bridge, half a mile below Beaver Creek, and about 14 miles north of Leavenworth, in Chelan County.

DRAINAGE AREA.—591 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 28, 1910, to September 30, 1916.

GAGE.—Vertical and inclined staff gage on left bank 1,500 feet below highway bridge since September 6, 1913; read by R. E. Nickles. November 28, 1910, to September 5, 1913, vertical staff 15 feet downstream at same datum.

DISCHARGE MEASUREMENTS.—Made from cable three-eighths mile above gage.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; likely to shift during extremely high water. One channel at all stages. Banks high and not subject to overflow. Stage of zero flow, according to measurements made February 8 and October 3, 1915, gage height 1.5 and ±0.2 foot.

EXTREMES OF DISCHARGE.—1910–1916: Maximum stage recorded, 10.25 feet at 6 p. m. June 18, 1916 (discharge, 16,500 second-feet); minimum stage recorded, 2.53 feet October 11 and 12, 1915 (discharge, 316 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from observer's notes, discharge measurements, and weather records.

DIVERSIONS.—The Wenatchee Park Land & Irrigation Co. diverted a maximum of about 10 second-feet from Chiwawa Creek for short periods during irrigation season.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice January 1, 2, 4, 5, 11–31, and February 1–16. Rating curve well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Open-water records excellent.

COOPERATION.—Gage-height record furnished by Quincy Valley Irrigation District.

Discharge measurements of Wenatchee River near Leavenworth, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 3	J. T. Hartson	2.95	561	June 19	G. L. Parker	9.67	14,500
Jan. 19	C. G. Paulsen	[a] 3.19	518	20	do	8.82	12,200

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Wenatchee River near Leavenworth, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	344	2,260	550	515	.....	880	1,630	5,100	5,540	7,000	3,960	1,750
2	480	2,000	550	515	.....	835	1,750	6,020	5,780	8,030	3,780	1,630
3	550	1 630	569	515	.....	835	1 870	7 510	6,020	8,570	3,610	1,630
4	515	1,510	588	503	.....	835	2,130	8,840	7,510	8,300	3,440	1,630
5	480	1,390	588	492	.....	790	2,400	9,680	7,260	7,510	3,280	1,450
6	438	1,280	588	480	.....	790	2,400	9,400	7,000	7,130	3,280	1,340
7	397	1,170	588	515	.....	790	2,540	8,570	7,250	6,750	2,970	1,220
8	379	1,070	588	515	.....	925	2,680	7,250	7,510	7,770	3,440	1,070
9	367	970	606	515	.....	1,170	2,970	6,020	8,300	8,440	3,280	1,040
10	344	925	625	515	.....	1,630	3,280	5,540	8,030	9,120	3,120	1,020
11	316	880	625	.....	.....	2,000	3,360	4,930	7,510	8,570	2,970	925
12	316	790	588	.....	.....	2,260	3,440	4,320	7,510	8,840	3,120	925
13	385	790	588	.....	.....	2,470	3,440	4,140	8,570	9,120	3,070	925
14	1,280	769	550	.....	.....	2,680	3,610	3,960	9,970	7,510	3,020	880
15	448	748	515	.....	.....	2,400	3,610	4,320	11,700	6,750	2,970	835
16	415	705	515	.....	.....	2,260	3,610	4,700	13,900	7,000	2,680	835
17	403	790	515	.....	748	2,130	3,440	5,320	16,000	6,880	2,260	835
18	397	748	515	.....	880	2,000	3,280	5,540	16,400	6,750	2,000	835
19	397	748	515	.....	925	1,870	2,970	6,260	15,100	6,020	1,870	790
20	415	705	515	.....	925	1,870	2,970	6,380	13,000	5,540	1,630	790
21	412	705	570	.....	880	2,130	2,820	6,500	8,840	5,780	1,630	790
22	409	665	625	.....	880	2,130	2,680	6,020	8,030	5,100	1,630	748
23	480	665	748	.....	880	2,130	2,680	5,540	8,570	4,900	1,750	748
24	588	665	705	.....	880	1,870	2,820	5,100	9,120	4,900	1,870	748
25	734	665	705	.....	880	1,870	2,820	5,100	9,400	4,510	2,000	705
26	880	665	665	.....	880	1,750	3,280	5,780	9,970	4,140	2,000	705
27	1,070	588	625	.....	925	1,750	4,320	6,500	10,800	3,780	2,000	685
28	1,220	515	705	.....	625	1,630	4,510	7,000	10,300	3,610	2,000	665
29	1,390	588	588	.....	880	1,630	4,700	7,000	8,570	3,440	2,000	665
30	1,280	588	515	.....	.....	1,510	4,700	6,500	7,510	3,780	1,870	625
31	1,630	.....	515	.....	.....	1,570	.....	6,020	.....	3,960	1,750	.....

NOTE.—Discharge estimated, because of ice, as follows: Jan. 1, 2, 4, 5, as in table; Jan. 11–20, 510 second-feet; Jan. 21–31, 620 second-feet; Feb. 1–10, 600 second-feet; Feb. 11–16, 700 second-feet. Discharge interpolated for days on which gage was not read—31 days scattered throughout year.

Monthly discharge of Wenatchee River near Leavenworth, Wash., for the year ending Sept. 30, 1916.

[Drainage area, 591 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
October	1,630	316	618	1.05	1.21	38,000
November	2,260	515	940	1.59	1.77	55,900
December	748	515	589	.997	1.15	36,200
January	.....	.....	547	.928	1.07	33,700
February	925	.....	738	1.25	1.35	42,400
March	2,680	790	1,660	2.81	3.24	102,000
April	4,700	1,630	3,090	5.23	5.84	184,000
May	9,680	3,960	6,160	10.40	11.99	379,000
June	16,400	5,540	9,370	15.90	17.74	558,000
July	9,120	3,440	6,440	10.90	12.57	396,000
August	3,960	1,630	2,590	4.38	5.05	159,000
September	1,750	625	981	1.66	1.85	58,400
The year	16,400	316	2,810	4.75	64.83	2,040,000

WENATCHEE RIVER AT DRYDEN, WASH.

LOCATION.—In SW. ¼ sec. 26, T. 24 N., R. 18 E., at Wenatchee Valley Gas & Electric Co.'s plant, a quarter of a mile north of Dryden, in Chelan County, 1 mile below intake of Wenatchee Valley canal, 2 miles below Peshastin Creek, and 4 miles above Cashmere.

DRAINAGE AREA.—1,200 square miles (measured on topographic maps).

RECORDS AVAILABLE.—October 1, 1911, to September 30, 1916.

GAGE.—Vertical staff on cribbing at upstream side of tailrace; read by Percy Burrow. An inclined gage, installed October 24, 1915, on left bank 80 feet below power plant was used to June 17, 1916 (except May 5–7), when it was destroyed.

DISCHARGE MEASUREMENTS.—Made from highway bridge 3 miles below gage.

CHANNEL AND CONTROL.—Bed composed of solid rock and boulders. High-water control permanent; low-water control shifting. Left bank high; right bank, which is fairly high, slopes back gradually. Channel curved above and below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.85 feet (old gage in tailrace) at 6 p. m. June 17 and 6 a. m. June 18 (discharge, 24,500 second-feet); minimum discharge estimated at 600 second-feet October 1–10, by comparison with record obtained at Leavenworth.

1904 [1]–1916: Maximum stage recorded June 17 and 18, 1916; minimum stage recorded, −0.3 foot September 14–16, 1915 (discharge, 470 second-feet); stage may have been lower during the period from September 17 to October 28, for which gage heights are not available.

ICE.—Stage-discharge relation seriously affected by ice for short periods; flow estimated from discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Wenatchee Valley canal is the most important diversion above station. Records of flow in canal are combined with those of river to give total flow.

REGULATION.—By storage in mill pond at Leavenworth.

ACCURACY.—Stage-discharge relation changed during October as a result of an earth slide through the power plant; permanent after October; affected by ice January 16–21. Gage read to hundredths twice daily. Rating curve for gage used October 29 to June 17 (except May 5–7) fairly well defined below 4,000 second-feet; for gage used May 5–7 and after June 17 well defined. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair for October and April to June; good for November to March; excellent for July to September.

COOPERATION.—Gage-height record furnished by Wenatchee Valley Gas & Electric Co.

Discharge measurements of Wenatchee River at Dryden, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 29	J. T. Hartson	[a] 2.52	1,850	June 21	G. L. Parker	[b] 6.37	13,000
Dec. 1	C. O. Brown	[a] 1.58	879	22	do	[b] 6.05	12,100
Jan. 21	C. G. Paulsen	[a] 1.68	734	July 31	C. O. Brown	[b] 3.80	6,000
Feb. 5	do	[a] 1.52	734				

[a] Gage 80 feet below power house.
[b] Old gage in tailrace.
[1] Gaging station called "Wenatchee River at Cashmere," 1904–1910.

Daily discharge, in second-feet, of Wenatchee River at Dryden, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	3,300	860	770	730	1,520	3,820	9,190	8,960	10,800	6,130	2,370
2	.....	2,810	860	815	690	1,460	4,370	10,600	8,730	12,000	5,890	2,240
3	.....	2,360	860	860	690	1,460	4,940	12,500	9,650	13,200	5,190	2,370
4	.....	1,950	860	860	770	1,400	5,330	13,700	11,500	12,600	4,970	2,370
5	.....	1,950	860	815	770	1,350	5,530	15,000	11,800	11,400	4,550	2,110
6	.....	1,700	860	860	770	1,300	5,530	14,700	12,000	10,800	4,550	1,870
7	.....	1,580	905	860	770	1,300	5,530	13,200	11,300	10,500	4,350	1,760
8	.....	1,520	905	860	770	1,520	6,130	11,500	11,800	11,400	4,550	1,650
9	.....	1,400	950	905	770	2,220	6,760	10,600	13,000	13,800	4,970	1,550
10	.....	1,400	950	860	815	3,640	7,400	8,730	12,300	13,800	4,550	1,360
11	.....	1,240	995	730	815	4,560	7,400	7,840	12,000	13,500	4,350	1,270
12	.....	1,240	995	770	815	5,330	7,180	6,970	11,500	13,500	4,350	1,270
13	.....	1,040	950	815	770	5,930	6,970	6,760	12,500	13,500	4,350	1,360
14	.....	1,090	955	860	770	5,330	7,400	6,550	14,200	11,700	4,350	1,270
15	.....	1,090	860	770	815	4,180	7,400	6,970	16,500	10,500	4,350	1,270
16	.....	1,040	860	.....	905	4,560	6,970	7,400	19,200	11,100	3,790	1,190
17	.....	1,090	770	.....	1,140	4,000	6,550	8,500	22,900	11,100	3,270	1,190
18	.....	1,090	1,040	.....	1,350	4,000	6,130	8,960	24,400	9,900	2,950	1,190
19	.....	1,140	1,090	.....	1,580	3,820	5,930	9,650	21,300	8,780	2,650	1,190
20	.....	1,040	1,090	.....	1,580	4,180	5,530	10,600	17,600	8,500	2,240	1,190
21	.....	995	1,140	734	1,580	4,560	5,330	10,600	13,800	8,780	2,110	1,110
22	.....	995	1,240	950	1,700	4,750	4,940	9,420	12,300	8,500	2,240	1,110
23	.....	1,040	1,240	905	1,580	4,000	4,750	8,730	12,900	7,410	2,370	1,110
24	.....	995	1,140	905	1,580	3,470	4,750	7,840	13,800	7,150	2,510	1,040
25	.....	995	1,140	905	1,580	3,470	5,330	7,840	14,400	7,150	2,650	1,040
26	.....	950	1,090	950	1,580	3,300	6,550	8,500	14,700	6,380	2,800	1,110
27	.....	905	1,090	905	1,520	3,130	7,840	9,880	16,000	5,890	2,650	1,110
28	.....	905	1,090	860	1,520	3,470	8,960	10,600	15,000	5,420	2,510	1,110
29	1,820	860	950	815	1,520	2,970	8,730	10,100	13,200	5,190	2,510	1,040
30	1,700	860	815	770	.....	2,970	8,730	9,650	11,400	5,190	2,510	1,040
31	1,950	.....	815	730	.....	3,300	.....	9,190	.....	5,650	2,370	.....

NOTE.—Discharge estimated as follows, on account of changes in stage-discharge relation due to washing of earth slide through power house, by comparison with records obtained at Leavenworth: Oct. 1–10, 600 second-feet; Oct. 11–20, 660 second-feet; Oct. 21–28, 870 second-feet. Stage-discharge relation affected by ice Jan. 16–21; discharge Jan. 16–20 estimated at 610 second-feet; Jan. 21, from current-meter measurement.

Combined monthly discharge of Wenatchee River and Wenatchee Valley canal at Dryden, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.					Combined run-off (total in acre-feet)
	Combined.		River (mean).	Canal (mean).	Total (mean.)	
	Maximum.	Minimum.				
October	1,950	.....	807	43.9	851	52,300
November	3,300	860	1,350	.0	1,350	80,300
December	1,240	770	975	.0	975	60,000
Jauuary	950	.....	803	.0	803	49,400
February	1,700	690	1,110	.0	1,110	63,800
March	5,930	1,300	3,300	.0	3,300	203,000
April	8,960	3,820	6,290	.0	6,290	374,000
May	15,000	6,610	9,750	70.0	9,820	604,000
June	24,500	8,850	14,000	125	14,100	839,000
July	13,900	5,310	9,840	121	9,960	612,000
August	6,250	2,230	3,660	125	3,780	232,000
September	2,500	1,050	1,430	103	1,530	91,000
The year	24,500	.....	4,450	49.2	4,500	3,260,000

WENATCHEE VALLEY CANAL AT DRYDEN, WASH.

LOCATION.—In sec. 26, T. 24 N., R. 18 E., directly across river from Dryden, in Chelan County, 1,300 feet below Dryden power house, and 1½ miles below canal intake.

RECORDS AVAILABLE.—Irrigation seasons 1911–1916.

GAGE.—Enameled gage on left side of flume; installed April 29, 1915; read by employees of Wenatchee Valley Gas & Electric Co. Prior to April 29, 1915, gage was 300 feet above present site.

DISCHARGE MEASUREMENTS.—Made from foot plank near gage.

CHANNEL AND CONTROL.—Control is section of flume extending some distance below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.05 feet from 10 a. m. August 23, to 9 a. m. September 17 (discharge, 129 second-feet); no flow October 17 to May 2.

1911–1916: Maximum stage recorded, 2.85 feet 1 p. m. July 15 to July 17, 1915 (discharge, 131 second-feet); no flow during nonirrigating seasons.

ACCURACY.—Stage-discharge relation changed during winter. Rating curves fairly well defined. Gage read twice daily to hundredths and time of changing gates also noted. Daily discharge ascertained by applying mean daily gage height to rating table or, for days when gates were changed, by subdividing days and applying gage height for intervals. Records good.

COOPERATION.—Gage-height records furnished by Wenatchee Valley Gas & Electric Co.

Canal diverts water from left bank of Wenatchee River in sec. 27, T. 24 N., R. 18 E. Water is used for irrigation and power. Water used by power plant is diverted above gage. Records show flow used for irrigation.

Discharge measurements of Wenatchee Valley canal at Dryden, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 5	J. T. Hartson	2.08	83.7
June 22	G. L. Parker	2.97	124
July 31	C. O. Brown	2.98	124

Daily discharge, in second-feet, of Wenatchee Valley canal at Dryden, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	May.	June.	July.	Aug.	Sept.	Day.	Oct.	May.	June.	July.	Aug.	Sept.
1	85	.....	120	124	124	129	16	85	62	127	118	124	129
2	85	.....	120	124	124	129	17	.....	79	125	118	124	121
3	85	10	120	124	124	129	18	.....	84	124	118	124	117
4	85	21	120	124	124	129	19	.....	91	124	118	124	117
5	85	28	123	124	124	129	20	.....	99	124	118	124	117
6	85	38	127	124	124	129	21	.....	99	124	118	124	117
7	85	38	127	124	124	129	22	.....	99	124	118	124	117
8	85	38	127	124	124	129	23	.....	99	124	118	127	116
9	85	44	127	124	124	129	24	.....	99	124	118	129	114
10	85	50	127	124	124	129	25	.....	106	124	118	129	44
11	85	50	127	124	124	129	26	.....	114	124	118	129	12
12	85	56	127	124	124	129	27	.....	114	124	118	129	12
13	85	62	127	119	124	129	28	.....	114	124	118	129	12
14	85	62	127	118	124	129	29	.....	114	124	121	120	12
15	85	62	127	118	124	129	30	.....	119	124	124	129	12
							31	.....	120	.....	124	129	.....

Monthly discharge of Wenatchee Valley canal at Dryden, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	85	0	43.9	2,700
May	120	0	70.0	4,300
June	127	120	125	7,440
July	124	118	121	7,440
August	129	124	125	7,690
September	129	12	103	6,130

YAKIMA RIVER BASIN.

KEECHELUS LAKE NEAR MARTIN, WASH.

LOCATION.—At outlet of lake, 1¼ miles northeast of Meadow Creek station on Chicago, Milwaukee & St. Paul Railway, 3½ miles northwest of Martin, in Kittitas County, 9½ miles northwest of Easton.

DRAINAGE AREA.—55 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 12, 1906, to September 30, 1916.

GAGE.—Vertical staff; position changed frequently during 1914 and 1915 to accommodate work on construction of new dam; read to hundredths twice daily by employees of the United States Reclamation Service. Since August 19, 1914, gages have been set to sea-level datum; prior to that date at height of gate sill in temporary crib dam—elevation, 2,457 feet.

EXTREMES OF STAGE.—Maximum stage recorded during the year, 2,450.39 feet June 19 (capacity, 32,780 acre-feet); minimum stage recorded, 2,432.62 feet January 20 (capacity, 9,580 acre-feet).

1906–1916: Maximum stage recorded, 2,471.38 feet November 23, 1909 (capacity, storage plane new reservoir, 62,910 acre-feet); minimum stage recorded January 20, 1916.

STORAGE.—Capacity of new reservoir, 152,000 acre-feet; elevation of gate sill and spillway crest, 2,425 feet and 2,515 feet, respectively. Record of storage or release each month used to determine discharge without storage for gaging station below dam.

COOPERATION.—Capacities computed by United States Reclamation Service.

Storage, in acre-feet, of Keechelus Lake near Martin, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	19,450	26,480	10,950	11,410	9,790	10,590	15,130	23,900	18,760	30,600	19,630	24,690
2	19,790	26,020	10,800	11,250	9,970	10,560	15,640	24,290	18,670	30,930	19,180	24,980
3	20,360	25,350	10,660	11,050	9,920	10,640	16,170	25,000	18,750	32,070	18,700	25,210
4	20,860	24,660	10,560	10,950	9,880	10,530	16,830	25,770	19,370	32,640	18,230	25,540
5	20,870	24,240	10,590	11,820	9,830	10,450	17,450	25,420	20,100	32,620	17,770	25,820
6	20,960	23,820	10,540	10,670	9,880	10,440	18,100	24,730	20,440	32,180	17,320	26,060
7	20,910	23,370	10,540	10,540	9,880	10,450	18,720	24,050	20,670	31,550	16,880	26,280
8	20,900	23,010	10,570	10,390	9,950	10,750	19,420	23,080	21,150	31,260	16,510	26,480
9	20,870	21,740	10,590	10,330	10,040	11,560	20,150	22,170	21,960	31,280	16,140	26,690
10	20,880	19,870	10,610	10,240	10,060	13,310	20,840	21,250	22,380	31,110	16,470	26,900
11	21,030	18,320	10,580	10,140	9,980	14,650	21,530	20,330	22,460	30,920	17,020	27,120
12	21,250	17,000	10,520	10,060	9,860	15,540	21,980	19,550	22,590	30,960	17,600	27,300
13	21,500	15,880	10,440	10,000	9,860	16,390	22,250	18,880	23,140	30,970	18,200	27,450
14	22,020	14,920	10,360	9,920	9,780	16,430	22,500	18,440	23,560	30,630	18,740	27,600
15	22,380	14,210	10,300	9,830	9,780	16,160	22,770	17,920	25,720	30,040	19,240	27,760
16	22,770	13,710	10,260	9,730	9,790	15,810	22,850	17,440	27,780	29,590	19,700	27,910
17	23,050	13,250	10,250	9,680	10,040	15,480	22,920	16,990	29,960	29,220	20,110	28,070
18	23,360	12,870	10,140	9,650	10,390	15,120	22,970	17,940	32,000	28,720	20,520	28,230
19	23,730	12,940	10,140	9,590	10,640	14,770	22,860	18,280	32,780	28,100	20,950	28,370
20	23,990	12,760	10,210	9,580	10,770	14,560	22,820	18,600	32,660	27,420	21,220	28,500
21	24,320	12,530	10,560	9,720	10,820	14,620	22,680	18,770	32,050	26,800	21,540	28,630
22	24,530	12,480	11,790	9,960	10,840	14,640	22,560	18,810	31,310	26,150	21,850	28,760
23	24,790	12,380	12,460	10,040	10,840	14,430	22,430	18,640	30,970	25,370	22,170	28,900
24	25,080	12,120	12,560	9,980	10,820	14,160	22,250	18,380	30,930	24,750	22,510	29,030
25	25,800	11,970	12,660	9,960	10,770	14,020	22,190	18,180	31,030	24,090	22,820	29,160
26	26,590	11,920	12,520	9,880	10,700	13,840	22,320	18,250	31,350	23,360	23,150	29,390
27	26,230	11,660	12,350	9,830	10,630	13,580	22,730	18,460	31,700	22,560	23,420	29,660
28	25,930	11,460	12,350	9,780	10,620	13,390	23,350	18,770	31,700	21,830	23,690	29,860
29	25,370	11,410	10,080	9,720	10,640	13,840	23,690	18,930	31,470	21,150	23,950	30,020
30	24,820	11,180	11,870	9,680	.....	14,280	23,800	18,960	30,950	20,520	24,210	30,150
31	25,250	.....	11,650	9,680	.....	14,640	.....	18,840	.....	20,100	24,480	.....

YAKIMA RIVER NEAR MARTIN, WASH.

LOCATION.—Below dam at outlet of Keechelus Lake, 1½ miles east of Meadow Creek station on Chicago, Milwaukee & St. Paul Railway, 3½ miles northwest of Martin and 9½ miles northwest of Easton, in Kittitas County.

DRAINAGE AREA.—55 square miles (measured on topographic maps).

RECORDS AVAILABLE.—October 18, to November 14, 1903; January 28, 1904, to September 30, 1916.

GAGES.—Three vertical staff gages, differing in location and datum, used during year as follows: October 1–5, gage installed July 7, 1915, on pier 60 feet below end of flume; October 6, to November 24, 1915, and March 15, to September 30, 1916, gage installed May 4, 1915, just above cable, 1¼ miles below dam; November 25, 1915, to March 14, 1916, gage three-fourths mile above cable. Gage read during year by R. I. Thomas, R. Keltner, C. L. Albertson, F. D. Mack, and A. L. Flint.

Gages in use prior to October 1, 1915, as follows: October 18, to November 14, 1903, on right bank 800 feet below crib dam; January 28, 1904, to October 7, 1912, vertical staff on right bank 75 feet above site of original gage and at datum 0.07 foot lower (previous gage heights corrected to new datum); October 8, 1912, to September 11, 1914, vertical staff on right bank anchored to bent of highway bridge at same site and datum as previous gage; September 12 to December 7, 1914, vertical staff half a mile below previous gage, at different datum; December 7, 1914, to March 26, 1915, inclined staff just above cable, half a mile below previous gage; January 25 to March 26, 1915, Stevens water-stage recorder at same site; March 29, to May 3, 1915, vertical staff at same site but different datum; May 4 to July 19, vertical staff at same site and datum as previous gage; July 20, to October 5, 1915, gage installed July 7, 1915, on pier 60 feet below end of flume.

DISCHARGE MEASUREMENTS.—Made from cable 1¼ miles below dam or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel; shifts at high stages. Logs and brush sometimes lodge on riffle control below gage and cause backwater, affecting stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.79 feet at 1.30 p. m. May 5 (discharge, 1,650 second-feet); no flow October 18–24.

1904–1916: Maximum discharge, 7,370 second-feet at 10.45 a. m. March 26, 1915, when temporary crib dam was washed out (gage destroyed; discharge computed from hourly gage readings of lake surface and estimated natural inflow to lake); practically no flow when gates in Keechelus reservoir dam are closed.

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water at Keechelus reservoir. Monthly discharge, without storage, determined from records of stage at reservoir.

ACCURACY.—Stage-discharge relation changed, probably at high water November 9 but possibly at some other time in November or later. Rating curves prior to change fairly well defined; after change well defined above 40 second-feet. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for periods of extremely low water, for which the rating curves are poorly defined, and for period from middle of November to middle of March, for which they are only fair owing to uncertainty as to applicability of rating curve and the difference between the rating curves at the prevailing stages.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Yakima River near Martin, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 4	F. E. Moxley	6.69	868	June 21	F. E. Moxley	7.32	1,310
16	Taylor and Parker	6.29	684	Aug. 4	do	6.12	606
June 17	R. I. Thomas	7.31	1,320				

Daily discharge, in second-feet, of Yakima River near Martin, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	34	921	275	309	170	246	22	645	692	1,230	692	4
2	41	985	256	298	180	237	25	692	742	1,230	645	4
3	63	860	246	286	180	246	26	795	742	1,300	645	5
4	73	746	237	265	170	237	28	1,040	742	1,300	600	5
5	78	692	237	256	161	227	29	1,650	795	1,300	600	5
6	94	615	227	246	170	227	30	1,510	851	1,300	557	4
7	94	566	227	237	170	227	31	1,440	851	1,230	557	4
8	94	496	237	227	189	256	43	1,230	851	1,230	536	4
9	91	1,260	237	218	189	332	141	1,100	910	1,230	499	4
10	87	1,160	237	208	189	508	271	971	910	1,230	8	4
11	3	1,030	237	199	180	627	352	910	910	1,230	7	4
12	3	910	237	189	170	692	404	795	971	1,230	7	4
13	5	742	227	189	170	759	422	742	971	1,230	7	4
14	45	645	227	170	170	759	440	742	1,030	1,160	6	4
15	62	557	218	170	161	742	477	692	1,160	1,160	6	4
16	2	516	218	152	170	742	477	692	1,230	1,160	6	4
17	1	497	208	152	189	692	497	692	1,300	1,100	6	4
18	0	458	199	152	227	645	497	692	1,370	1,100	6	4
19	0	458	199	144	246	645	497	692	1,370	1,100	6	4
20	0	440	199	144	256	600	477	692	1,370	1,030	6	4
21	0	440	237	161	265	600	477	742	1,300	1,030	5	4
22	0	404	355	180	265	600	440	742	1,300	1,030	5	4
23	0	404	404	189	265	600	440	742	1,230	971	5	4
24	0	369	429	180	265	557	422	742	1,230	910	5	4
25	14	379	429	180	256	557	422	692	1,300	910	5	4
26	104	355	404	170	246	536	440	742	1,300	910	5	4
27	692	332	404	170	246	516	497	742	1,300	851	5	4
28	746	309	404	170	246	192	557	742	1,300	795	5	4
29	746	309	379	161	246	22	600	742	1,300	795	5	3
30	692	286	355	152	.....	21	645	742	1,230	742	5	3
31	352	.....	332	152	.....	21	.....	742	.....	742	5	.....

Monthly discharge of Yakima River near Martin, Wash., for year ending Sept. 30, 1916.

[Drainage area, 55 square miles.]

Month.	Observed discharge (second-feet).			Run-off (total in acre-feet).			Discharge without storage (second-feet).		Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Observed.	Stored.	Without storage.	Mean.	Per square mile.	
October	746	0	136	8,360	+ 5,830	14,200	231	4.20	4.84
November	1,260	286	605	36,000	−14,100	21,900	368	6.69	7.46
December	429	199	281	17,300	+ 472	17,800	290	5.27	6.08
January	309	144	196	12,000	− 1,970	10,000	163	2.96	3.41
February	265	161	207	11,900	+ 965	12,900	224	4.07	4.39
March	759	21	447	27,500	+ 3,990	31,500	512	9.31	10.73
April	645	22	338	20,100	+ 9,170	29,300	492	8.95	9.99
May	1,650	645	856	52,600	− 4,970	47,600	774	14.1	16.26
June	1,370	692	1,090	64,600	+12,100	76,700	1,290	23.5	26.22
July	1,300	742	1,090	67,000	−10,800	56,200	914	16.6	19.14
August	692	5	176	10,800	+ 4,380	15,200	247	4.49	5.18
September	5	3	4.03	240	+ 5,670	5,910	99.3	1.80	2.02
The year	1,650	0	452	328,000	+10,700	339,000	467	8.49	115.72

YAKIMA RIVER AT CLE ELUM, WASH.

LOCATION.—In sec. 27, T. 20 N., R. 15 E., at highway bridge at Cle Elum, in Kittitas County, just above Roslyn Creek, 3 miles below mouth of Cle Elum River, and 6½ miles above Teanaway River.

DRAINAGE AREA.—500 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 24, 1906, to September 30, 1916.

GAGE.—Friez water-stage recorder on right bank under highway bridge; installed July 12, 1911; inspected by T. J. Denny. Since June 27, 1916, vertical staff on recorder wall. August 12, 1910, to June 27, 1916, vertical and inclined staff on right bank 30 feet below bridge; prior to August 12, 1910, chain gage on bridge, at datum varying from 0.14 foot higher to 0.12 foot lower than that of present gage.

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

CHANNEL AND CONTROL.—Bed composed of gravel and cobblestones; permanent except during floods. One channel at all stages. Control at low water formed by broad riffle about 1,200 feet below gage; at high water by a section of stream bed extending about one-fourth mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 8.02 feet at 1 p. m. June 18 (discharge, 10,800 second-feet); minimum stage, from recorder, 1.14 feet 3 to 12 p. m. October 1 (discharge, 202 second-feet).

1906–1916: Maximum stage, measured from high-water marks, 12.5 feet November 14, 1906 (discharge, about 25,600 second-feet); minimum stage recorded, 1.11 feet at 6 p. m. September 30, 1915 (discharge, 192 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; flow estimated from discharge measurements and weather records.

DIVERSIONS.—None.

REGULATION.—Flow partly regulated by storage and release of water at Keechelus, Kachess, and Cle Elum reservoirs. Monthly discharge without storage determined from records of stage at reservoirs.

ACCURACY.—Stage-discharge relation permanent; affected by ice January 1–24, 31, February 1–15, 18–29, and March 1–7. Rating curve well defined. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage height to rating table. Open-water records excellent; others fair.

COOPERATION.—United States Reclamation Service made current meter measurements and computed discharge.

Discharge measurements of Yakima River at Cle Elum, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 1	Calland and Moxley...	1.13	200	May 15	Taylor and Parker.....	4.74	3,570
Jan. 14	F. E. Moxley.....	2.18	663	June 22	Moxley and Taylor....	5.99	5,920
27	.....do.....	2.11	684	Aug. 4	F. E. Moxley.....	4.00	2,390
Feb. 29	.....do.....	2.38	751	Sept. 27	.....do.....	2.99	1,300
May 3	.....do.....	6.49	6,720				

Daily discharge, in second-feet of Yakima River at Cle Elum, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	202	1,340	771	.....	.....	.....	2,420	4,830	4,360	5,210	2,630	1,720
2	218	1,420	752	.....	.....	.....	2,700	5,610	4,450	5,610	2,780	1,760
3	267	1,420	738	.....	.....	.....	2,780	6,690	4,740	6,470	2,420	1,760
4	335	1,300	745	.....	.....	.....	3,080	7,870	5,610	6,470	2,780	1,760
5	366	1,220	758	.....	.....	.....	3,240	8,620	6,030	6,030	2,560	1,720
6	384	1,180	745	.....	.....	.....	3,320	8,370	5,610	5,610	2,090	1,760
7	426	1,140	765	.....	.....	.....	3,400	7,630	5,410	5,020	2,030	1,760
8	412	1,020	765	.....	.....	992	3,570	6,470	5,610	4,920	1,970	1,720
9	403	1,260	778	.....	.....	1,620	3,910	5,410	6,250	5,410	2,030	1,240
10	393	1,590	771	.....	.....	2,700	4,360	4,740	6,250	5,410	2,220	1,580
11	357	1,500	758	.....	.....	3,240	4,450	4,090	5,610	5,210	2,030	1,670
12	310	1,380	738	.....	.....	4,450	4,270	3,660	5,410	5,210	1,970	1,620
13	353	1,260	732	.....	.....	5,210	4,090	3,480	5,820	5,610	1,400	1,360
14	431	1,180	712	.....	.....	4,740	4,000	3,400	6,690	5,210	1,280	853
15	522	1,100	706	.....	.....	4,180	4,180	3,480	7,630	4,920	1,240	1,360
16	529	1,020	694	.....	584	3,740	4,000	3,820	8,880	4,830	1,200	1,490
17	487	1,020	681	.....	594	3,570	3,740	4,450	9,670	4,920	1,160	1,490
18	471	984	675	.....	.....	3,400	3,660	4,740	10,800	4,740	1,400	1,440
19	393	1,100	675	.....	.....	3,240	3,320	5,020	9,940	4,450	1,400	1,400
20	348	1,100	681	.....	.....	3,320	3,160	5,410	8,370	4,180	1,400	1,360
21	335	1,020	874	.....	.....	3,660	3,000	5,410	6,920	4,000	1,490	1,360
22	323	984	1,260	.....	.....	3,570	2,860	4,920	5,820	3,910	1,760	1,320
23	327	947	1,220	.....	.....	3,400	2,700	4,450	5,820	3,660	1,760	1,360
24	335	910	1,180	.....	.....	3,080	2,630	4,000	6,250	3,240	1,760	1,360
25	370	947	1,140	695	.....	2,930	2,780	3,820	6,470	3,320	1,760	1,320
26	441	910	1,100	688	.....	2,700	3,320	4,180	6,690	3,400	1,760	1,320
27	745	875	1,060	664	.....	2,490	4,540	4,830	6,920	3,160	1,720	1,320
28	1,100	832	1,100	652	.....	2,220	5,020	5,410	6,690	2,930	1,720	1,320
29	1,180	825	1,060	658	.....	1,810	5,020	5,210	6,030	2,780	1,720	1,240
30	1,260	812	984	664	.....	2,090	4,830	4,830	5,410	2,630	1,720	860
31	1,300	.....	910	660	.....	2,160	.....	4,540	.....	2,630	1,670	.....

NOTE.—Discharge estimated, on account of ice, from current-meter measurements, observer's notes, and records of precipitation and temperature, as follows: Jan. 1–5, 860 second-feet; Jan. 6–10, 750 second-feet; Jan. 11–15, 650 second-feet; Jan. 16–20, 670 second-feet; Jan. 21–24, 710 second-feet; Jan. 31 and Feb. 1–10, 660 second-feet; Feb. 11–15, 620 second-feet; Feb. 18–23, 650 second-feet; Feb. 24–29, 740 second-feet; and Mar. 1–7, 760 second-feet.

Monthly discharge of Yakima River at Cle Elum, Wash., for year ending Sept. 30, 1916.

[Drainage area, 500 square miles.]

Month.	Observed discharge (second-feet).			Run-off (total in acre-feet).			Discharge without storage (second-feet).		Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Observed	Stored.	Without storage.	Mean.	Per square mile.	
October	1,300	202	494	30,400	+18,500	48,900	795	1.59	1.83
November	1,590	812	1,120	66,600	+12,200	78,800	1,320	2.64	2.94
December	1,260	675	856	52,600	+12,200	64,800	1,050	2.10	2.42
January	.....	.....	715	44,000	− 2,590	41,400	673	1.35	1.56
February	.....	.....	663	38,100	+ 9,550	48,600	845	1.69	1.82
March	5,210	.....	2,580	159,000	+38,700	198,000	3,220	6.44	7.42
April	5,020	2,420	3,610	215,000	+32,100	247,000	4,150	8.30	9.26
May	8,620	3,400	5,140	316,000	+45,000	361,000	5,870	11.7	13.49
June	10,800	4,860	6,540	389,000	+62,000	451,000	7,580	15.2	16.96
July	6,470	2,630	4,850	280,000	+ 973	281,000	4,570	9.14	10.54
August	2,780	1,160	1,830	113,000	−23,900	89,100	1,450	2.90	3.34
September	1,760	853	1,450	86,500	−48,800	37,700	634	1.27	1.42
The year	10,800	202	2,460	1,790,000	+156,000	1,950,000	2,690	5.38	73.00

YAKIMA RIVER AT UMTANUM, WASH.

LOCATION.—In sec. 30, T. 16 N., R. 19 E., at Umtanum, in Kittitas County, half a mile above Umtanum Creek and 10 miles south of Ellensburg.

DRAINAGE AREA.—1,620 square miles (measured on topographic maps and Plate I, Water-Supply Paper 369).

RECORDS AVAILABLE.—August 25, 1906, to May 20, 1907; August 10, 1907, to September 30, 1916.

GAGE.—Stevens water-stage recorder on right bank 100 feet east of Northern Pacific Railway section house at Umtanum, installed July 10, 1914; Barrett & Lawrence water-stage recorder September 28, 1911, to July 9, 1914; vertical-staff gage at same site as present gage but at datum 0.16 foot higher, prior to June 26, 1908; June 26, 1908, to July 9, 1914, cantilever chain gage at datum 0.13 foot higher than present gage until January 1, 1911, and at approximately the same datum as present gage thereafter. Gage inspected by Tom Letos.

DISCHARGE MEASUREMENTS.—Made from cable 100 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of rocks and gravel; slightly shifting. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.78 feet at 10 p. m. May 5 (discharge, 14,000 second-feet); minimum stage, 2.86 feet at 7 p. m. October 3 (discharge, 138 second-feet).

1906–1916: Maximum stage, 14.2 feet November 15 or 16, 1906 (estimated from high-water marks; discharge, about 41,000 second-feet); minimum stage recorded October 3, 1915.

ICE.—Record discontinued during winter.

DIVERSIONS.—Water diverted above gage for irrigation of about 40,000 acres in Kittitas Valley.

REGULATION.—Flow partly regulated by storage and release of water at Keechelus, Kachess, and Cle Elum reservoirs.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Water-stage recorder inspected twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Yakima River at Umtanum, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	R. S. Calland	3.21	291	May 17	Parker and Taylor	6.44	5,970
Nov. 15	F. E. Moxley	4.26	1,330	June 23	Taylor and Moxley	6.77	7,140
Mar. 28	do	5.85	4,500	Aug. 9	F. E. Moxley	4.65	1,960
Apr. 25	do	6.13	5,240	Sept. 30	do	4.04	1,080
May 5	do	8.73	13,800				

Daily discharge, in second-feet, of Yakima River at Umtanum, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	154	1,640	4,900	8,380	6,170	6,940	2,510	1,610
2	142	1,630	5,880	9,370	6,170	7,260	2,600	1,640
3	139	1,630	6,170	10,800	6,320	8,380	2,420	1,780
4	150	1,430	6,780	12,500	7,420	8,710	2,420	1,850
5	165	1,380	6,940	13,700	8,380	8,380	2,240	1,810
6	210	1,320	6,780	13,700	8,060	7,420	2,090	1,860
7	240	1,300	6,940	12,200	7,420	6,940	2,010	1,810
8	271	1,240	7,260	10,800	7,580	6,170	1,990	1,720
9	299	1,180	7,900	9,040	8,060	6,320	1,930	1,580
10	299	1,200	8,380	7,420	8,380	6,780	1,970	1,330
11	299	1,230	8,380	6,470	7,740	6,320	1,970	1,620
12	291	1,250	8,060	5,590	7,260	6,170	1,910	1,640
13	314	1,270	7,740	5,170	7,420	6,320	1,730	1,490
14	343	1,300	7,900	5,030	8,060	6,170	1,440	1,190
15	434	1,320	8,380	5,170	9,040	5,880	1,290	977
16	606	.....	8,060	5,450	10,400	5,740	1,190	1,340
17	624	.....	7,260	6,170	11,800	5,740	1,110	1,480
18	615	.....	6,780	6,780	12,500	5,590	1,070	1,420
19	615	.....	6,170	7,260	12,500	5,310	1,210	1,330
20	550	.....	5,740	7,740	10,800	4,900	1,240	1,290
21	496	.....	5,310	7,740	9,370	4,500	1,250	1,300
22	434	.....	5,170	7,420	7,580	4,380	1,350	1,320
23	451	.....	5,030	6,470	7,100	4,250	1,620	1,340
24	460	.....	4,760	6,020	7,420	3,760	1,640	1,390
25	505	.....	5,170	5,590	8,060	3,420	1,640	1,330
26	560	.....	6,470	5,590	8,380	3,420	1,660	1,310
27	606	.....	8,060	6,620	9,040	3,420	1,670	1,240
28	985	.....	9,370	7,580	9,040	3,100	1,670	1,260
29	1,180	.....	9,040	7,900	8,380	2,800	1,660	1,250
30	1,300	.....	8,710	7,100	7,420	2,700	1,580	1,130
31	1,340	.....	.....	6,470	.....	2,600	1,620	.....

NOTE.—Gage not read Nov. 10–14; discharge interpolated.

Monthly discharge of Yakima River at Umtanum, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,340	139	486	29,900
November 1–15	1,640	1,180	1,350	40,300
April	9,370	4,760	6,980	415,000
May	13,700	5,030	7,850	482,000
June	12,500	6,170	8,440	502,000
July	8,710	2,600	5,480	337,000
August	2,600	1,070	1,730	106,000
September	1,860	977	1,450	86,500

YAKIMA RIVER NEAR WAPATO, WASH.

LOCATION.—In sec. 28, T. 12 N., R. 19 E., below Sunnyside diversion dam, 2 miles below Union Gap, 3 miles north of Wapato, in Yakima County, and 11 miles below mouth of Naches River.

DRAINAGE AREA.—3,560 square miles (measured on topographic maps and Plate I of Water-Supply Paper 369).

RECORDS AVAILABLE.—April 25, 1908, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank about 600 feet below Sunnyside diversion dam; installed August 17, 1915. Gages previously used as follows: September 25, 1908, to February 17, 1909, hook gage in stilling well anchored to retaining wall on left bank 25 feet above head gate of Sunnyside canal, datum of this gage at same elevation as crest of diversion dam; February 18, 1909, to October 23, 1914, cantilever chain gage; datum lowered 2.00 feet January 1, 1914; after October 23, 1914, inclined staff at same site and datum. Recorder inspected by Henry Hansen.

DISCHARGE MEASUREMENTS.—Made from cable 80 feet above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of solid rock, large boulders, and gravel. One channel at all stages. Control formed by diagonal riffle just below Oregon-Washington Railroad & Navigation Co.'s bridge and about 250 feet below gage; may shift slightly during extremely high floods; supports of railway bridge form part control at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 11.32 feet at 8 a. m. June 19 (discharge, 24,800 second-feet); minimum stage recorded, 1.53 feet at 10 a. m. October 6 (discharge, 8.4 second-feet).

1908–1916: Maximum stage recorded, 9.82 feet November 25, 1909 (discharge, 33,400 second-feet); minimum stage recorded, −0.65 foot October 26, 1911, and 1.23 feet August 25 and 28, 1915 (discharge practically zero).

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

DIVERSIONS.—Water diverted above gage for irrigation of about 250,000 acres.

REGULATION.—Flow partly regulated by diversions and by storage and release of water at Keechelus, Kachess, Cle Elum, and Bumping reservoirs.

ACCURACY.—Stage-discharge relation changed slightly during high water May 6; possibly slightly affected by ice in January. Rating curves used before and after change well defined. Water-stage recorder inspected twice daily. Daily discharge ascertained by applying mean daily gage height to rating table or, for days of considerable fluctuation, by averaging results obtained by applying the gage height for shorter periods. Records excellent except for periods of extremely low water in October and for January, for which they are good.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Yakima River near Wapato, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Feb. 15	F. E. Moxley	5.09	2,510	Apr. 24	F. E. Moxley	7.03	6,470
17	do	5.88	3,800	May 6	Taylor and Moxley	10.91	22,200
18	do	6.15	4,430	12	F. E. Moxley	7.37	7,750
Mar. 10	Moxley and Taylor	9.55	15,500	16	do	7.28	7,340
11	Moxley and Calland	10.58	21,500	19	Parker and Taylor	8.14	10,000
15	F. E. Moxley	8.93	12,800	Aug. 12	F. E. Moxley	4.39	1,740
18	do	8.48	10,900	28	do	3.52	869
Apr. 14	Moxley and Hall	8.77	12,400	Sept. 15	Moxley and Taylor	3.26	657
20	F. E. Moxley	7.58	8,090				

Daily discharge, in second-feet, of Yakima River near Wapato, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	18	1,930	1,560	1,800	1,500	3,660	8,280	12,400	8,900	11,000	3,400	959
2	16	2,340	1,560	1,620	1,160	3,300	9,660	14,800	8,580	12,600	3,310	941
3	23	2,340	1,680	1,800	1,080	3,220	10,800	17,800	9,230	13,400	3,140	1,120
4	22	2,200	1,680	1,740	1,250	3,040	11,600	21,400	11,400	17,100	2,760	1,150
5	30	2,060	1,800	1,620	1,500	2,880	11,600	23,800	12,600	15,100	2,540	1,230
6	19	1,930	1,800	1,450	1,560	2,800	11,200	23,200	12,200	13,000	2,260	1,250
7	15	1,800	1,800	1,450	1,740	2,720	11,200	20,600	12,200	11,800	2,130	1,250
8	23	1,800	1,800	1,450	1,930	3,050	12,000	17,100	12,600	11,400	2,000	1,180
9	24	1,560	1,800	1,510	1,990	6,510	13,300	14,200	13,800	12,600	2,060	1,090
10	39	1,800	1,800	1,510	3,570	15,300	14,300	11,000	14,200	12,600	2,000	703
11	37	2,200	1,800	1,230	3,130	19,800	14,300	8,900	12,600	11,800	2,000	995
12	30	2,060	1,680	958	2,640	18,300	13,300	7,650	11,800	11,400	1,760	1,130
13	34	1,930	1,680	940	2,200	19,300	12,000	7,080	11,800	11,800	1,760	1,160
14	35	1,930	1,680	1,220	2,130	15,800	12,400	6,550	13,400	11,000	1,530	1,000
15	48	1,980	1,560	1,390	2,800	12,800	13,300	6,550	15,600	9,570	1,280	694
16	150	1,800	1,560	1,300	4,140	11,200	12,800	7,080	18,600	9,570	907	810
17	258	1,800	1,560	1,210	4,440	11,200	11,600	7,950	21,100	10,300	702	968
18	197	1,930	1,450	1,200	4,760	10,800	10,000	9,230	22,600	9,570	484	977
19	156	1,930	1,340	1,160	5,080	10,800	9,300	10,300	24,100	8,580	496	968
20	166	2,340	1,340	1,450	4,440	13,300	7,960	11,000	20,100	7,950	456	890
21	76	2,200	1,560	1,740	4,140	16,300	7,650	11,400	20,600	7,650	323	907
22	29	2,200	3,300	2,030	3,850	15,300	7,200	10,600	16,600	7,080	384	890
23	35	2,060	3,660	3,040	3,660	12,800	6,640	9,230	16,100	6,810	610	933
24	124	1,930	3,130	2,270	3,660	10,800	6,380	8,260	13,000	6,160	769	924
25	169	1,930	2,800	1,990	3,660	9,660	7,060	7,650	13,400	5,560	848	995
26	246	1,930	2,640	1,740	3,660	9,300	9,300	7,950	14,200	5,210	916	995
27	360	1,800	2,340	1,680	3,850	9,300	12,000	9,230	15,600	4,880	890	968
28	528	1,680	2,340	1,620	4,040	7,960	14,800	11,000	15,600	4,450	890	986
29	823	1,800	2,340	1,450	3,940	7,350	13,800	11,400	13,400	3,760	951	924
30	940	1,680	1,800	1,400	.....	6,780	12,800	10,300	11,800	3,490	995	848
31	1,180	.....	1,560	1,450	.....	7,060	.....	9,230	.....	3,400	995	.....

Monthly discharge of Yakima River near Wapato, Wash. for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,180	15	189	11,600
November	2,340	1,560	1,960	117,000
December	3,660	1,340	1,950	120,000
January	3,040	940	1,560	96,100
February	5,080	1,080	3,020	174,000
March	19,800	2,720	9,750	600,000
April	14,800	6,380	11,000	651,000
May	23,800	6,550	11,800	723,000
June	24,100	8,580	14,600	868,000
July	17,100	3,400	9,370	576,000
August	3,400	323	1,470	90,300
September	1,250	694	994	59,200
The year	24,100	15	5,640	4,090,000

Combined monthly discharge of Yakima River near Wapato, Wash., New Reservation and Old Reservation canals near Parker, Wash., and Sunnyside canal near Wapato, Wash., for the year ending Sept. 30, 1916.

Month.	Combined mean discharge in second-feet.	Run-off (total in acre-feet).	Month.	Combined mean discharge in second-feet.	Run-off (total in acre-feet).
October	800	49,200	May	13,700	842,000
November	2,040	121,000	June	16,500	982,000
December	1,950	120,000	July	11,000	676,000
January	1,560	95,900	August	3,270	201,000
February	3,020	174,000	September	2,220	132,000
March	9,880	608,000			
April	12,000	714,000	The year	6,500	4,720,000

YAKIMA RIVER NEAR PROSSER, WASH.

LOCATION.—In SE. ¼ sec. 36, T. 9 N., R. 24 E., 1¼ miles northeast of Prosser, in Benton County, 40 miles above mouth.

DRAINAGE AREA.—5 340 square miles (measured on project map of United States Reclamation Service).

RECORDS AVAILABLE.—June 1 to October 10, 1904; June 8 to December 30, 1905; February 1 to October 12, 1906; August 4, 1913, to September 30, 1916.

GAGE.—Stevens water-stage recorder referred to vertical and inclined staff on right bank, 1¼ miles below Prosser Falls; installed August 4, 1913. June 1, 1904, to December 30, 1905, chain gage on highway bridge 600 feet below Prosser Falls. February 1 to October 12, 1906, inclined staff at approximately same site as present gage but at different datum. Recorder inspected by T. Martinson.

DISCHARGE MEASUREMENTS.—Made from cable 1,000 feet above gage or from a boat.

CHANNEL AND CONTROL.—Bed composed of rock and large boulders; changes only during floods. Control formed by broad riffle about 800 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.65 feet at 5 p. m. May 7 (discharge, 24,000 second-feet); minimum stage recorded, 0.82 foot at 6 p. m. October 10 (discharge, 310 second-feet).

1904–1906 and 1914–1916: Maximum flow measured by floats (not referred to gage) at 3 p. m. November 17, 1906 (discharge, 62,800 second-feet); maximum stage occurred at 9 a. m. on same date at stage three-fourths inch above that of measurement; minimum stage recorded, 2.60 feet August 19, 26, 30, 31, and September 30, 1906 (discharge about 40 second-feet).

ICE.—Record discontinued during winter.

DIVERSIONS.—Water diverted above gage for irrigation of about 250,000 acres.

REGULATION.—Flow partly regulated by diversions and by storage and release of water of Keechelus, Kachess. Cle Elum, and Bumping reservoirs.

ACCURACY.—Stage-discharge relation changed slightly during period in which record was discontinued—probably during high water in March. Rating curve used for October fairly well defined; that for rest of year well defined. Water-stage recorder inspected once daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good for October and excellent for rest of year.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Yakima River near Prosser, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 13	F. E. Moxley	3.53	2,290	May 18	Taylor and Parker	7.34	9,500
Mar. 29	do	7.81	10,900	June 19	Moxley and Taylor	11.07	21,700
May 10	Moxley and Taylor	9.72	16,500				

Daily discharge, in second-feet, of Yakima River near Prosser, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Apr.	May.	June.	July.	Aug.	Sept.
1	358	9,640	13,700	10,700	12,800	4,030	1,470
2	340	10,700	13,700	10,200	12,500	4,030	1,470
3	319	11,900	15,200	10,200	14,000	3,940	1,430
4	348	12,500	17,200	11,000	16,600	3,620	1,570
5	351	13,100	19,900	12,800	18,000	3,390	1,620
6	351	13,100	22,600	13,700	15,900	3,120	1,720
7	348	13,100	23,800	13,400	14,300	2,940	1,720
8	361	13,100	23,000	13,100	12,800	2,820	1,770
9	353	13,700	19,900	13,400	12,500	2,700	1,670
10	317	14,600	16,200	14,300	13,100	2,640	1,620
11	351	15,600	13,400	14,600	13,100	2,520	1,380
12	356	15,900	11,000	13,400	12,500	2,520	1,520
13	346	15,200	9,390	12,500	12,200	2,340	1,620
14	351	14,300	8,660	12,800	12,500	2,280	1,670
15	372	14,300	8,200	14,000	11,600	2,100	1,570
16	367	14,900	8,200	15,600	10,400	1,830	1,380
17	328	14,300	8,660	17,600	10,700	1,620	1,340
18	380	13,400	9,640	19,900	10,700	1,430	1,520
19	457	11,900	10,400	21,400	9,900	1,200	1,520
20	476	10,700	11,300	23,000	9,140	1,160	1,570
21	484	9,900	12,200	22,200	8,660	1,200	1,470
22	480	9,390	12,200	17,600	8,430	1,160	1,470
23	435	8,900	11,600	14,000	7,970	1,080	1 430
24	407	8,200	10,400	13,100	7,510	1,160	1,470
25	449	7,970	9,640	13,700	6,840	1,290	1,520
26	453	8,660	9,140	14,300	6,190	1,430	1,570
27	417	10,700	9,640	14,900	5,770	1,430	1,520
28	533	13,100	11,000	15,900	5,370	1,430	1,570
29	643	14,600	12,500	15,600	4,870	1,430	1,570
30	926	14,600	12,500	14,000	4,400	1,470	1,570
31	1,110	.....	11,600	.....	4,120	1,520	.....

Monthly discharge of Yakima River near Prosser, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	1,110	317	438	26,900
April	15,900	7,970	12,400	737,000
May	23,800	8,200	13,100	806,000
June	23,000	10,200	14,800	878,000
July	18,000	4,120	10,500	646,000
August	4,030	1,080	2,160	133,000
September	1,770	1,340	1,540	91,800

KACHESS LAKE NEAR EASTON, WASH.

LOCATION.—In sec. 24, T. 21 N., R. 13 E. (unsurveyed), at lake outlet, 2½ miles northwest of Easton, in Kittitas County.

DRAINAGE AREA.—63 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 20, 1905, to September 30, 1916.

GAGE.—Stevens water-gage recorder installed in gate tower November 25, 1915, for use when gates are closed, and staff gage in three sections (datum, mean sea level) as follows: Highest section, installed October 6, 1914, is inclined and is anchored to rock paving on upstream face of storage dam between outlet conduit and east end of dam; middle section, installed October 31, 1914, is inclined and is anchored to rock paving on upstream face of back-fill dam at former outlet of lake; lowest section installed September 28, 1915, is set vertically in dredged channel about half way between back-fill dam and open water in lake. Original gage, used until September 5, 1911, was a vertical staff on east side of lake, at boat landing, 400 feet above temporary crib dam at outlet; zero at elevation 2,226.02 feet. September 6, 1911, until installation of present sections, a vertical staff on face of gate tower at outlet through new storage dam. Gage read by I. Pennington.

EXTREMES OF CAPACITY.—Maximum stage recorded during year, 2,258.1 feet July 25 (capacity, 221,480 acre-feet); minimum stage recorded, 2,197.85 feet October 1 (capacity, 14,060 acre-feet).

1906–1916: Maximum stage recorded July 25, 1916; mimimum stage recorded, 2,197.73 feet September 26–27, 1915 (capacity, 13,730 acre-feet).

STORAGE.—Capacity of reservoir at crest of spillway, 221,000 acre-feet (revised determination). Elevation of gate sill and spillway crest, 2,192.75 feet and 2,258 feet, respectively. Record of storage or release each month used for determining discharge without storage at gaging station below dam.

COOPERATION.—Capacities computed by United States Reclamation Service.

Daily capacity, in acre-feet, of Kachess Lake near Easton, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	14,060	20,860	34,960	46,000	53,250	62,480	87,630	108,000	157,820	206,320	220,370	198,920
2	14,340	21,640	35,150	46,280	53,900	62,770	87,250	109,250	159,140	207,370	220,200	197,370
3	14,750	22,250	35,400	46,310	54,240	63,190	86,910	111,400	160,740	208,980	220,330	195,820
4	15,030	22,920	35,660	46,390	54,440	63,620	86,620	113,940	162,760	210,120	220,110	194,360
5	15,080	23,840	35,940	46,820	54,610	64,050	86,330	117,020	164,780	210,950	220,240	192,740
6	15,170	24,310	36,240	47,240	55,030	64,330	86,040	120,120	166,620	211,470	220,240	191,180
7	15,170	24,900	36,550	47,490	55,460	64,900	85,750	122,510	168,460	211,780	220,330	189,420
8	15,170	25,480	36,920	48,030	55,740	65,680	85,460	124,550	170,100	213,190	220,280	187,800
9	15,170	25,930	37,170	48,250	56,310	66,480	85,460	126,210	172,570	215,120	220,110	187,120
10	15,200	26,270	37,450	48,510	56,790	67,330	85,600	127,810	174,640	216,620	219,270	185,520
11	15,220	26,660	37,790	48,700	57,220	68,450	85,890	128,620	176,500	218,030	218,290	183,910
12	15,200	27,050	38,040	48,870	57,470	69,920	86,330	129,370	178,170	219,620	217,540	182,320
13	15,140	27,490	38,260	49,040	57,730	71,610	87,110	130,310	180,260	220,600	217,720	180,470
14	14,700	27,880	38,490	49,160	57,930	73,070	88,120	131,250	182,990	220,770	217,850	180,260
15	14,480	28,270	38,690	49,300	58,100	74,390	89,230	132,190	185,940	220,820	218,250	179,220
16	14,340	28,830	38,970	49,380	58,350	75,660	90,310	133,320	189,540	221,040	218,600	177,550
17	14,200	29,280	39,160	49,490	58,490	76,720	91,490	134,820	193,810	221,040	218,690	175,550
18	14,490	29,720	39,330	49,610	58,780	77,730	92,740	136,340	195,950	221,040	218,160	174,220
19	14,790	30,280	39,590	49,720	59,060	78,680	93,920	138,060	196,810	220,680	217,500	172,650
20	15,080	30,780	40,060	48,860	59,350	79,770	95,060	139,970	197,330	220,460	216,620	170,960
21	15,470	31,400	41,050	50,200	59,630	80,950	96,180	141,700	197,280	220,600	216,000	169,280
22	15,700	31,740	41,810	50,680	59,920	82,100	97,090	143,230	197,800	220,640	214,420	167,600
23	15,920	32,070	42,340	51,130	60,200	83,110	98,030	144,580	198,700	220,770	212,970	166,010
24	16,190	32,380	42,850	51,550	60,570	83,920	98,980	145,750	199,820	221,400	211,390	164,380
25	16,360	33,000	43,380	51,840	60,940	84,820	99,890	146,910	200,990	221,480	209,850	162,960
26	16,640	33,420	43,770	51,980	61,230	85,750	100,870	148,470	202,420	221,130	208,280	161,550
27	17,080	33,860	44,190	52,170	61,480	86,560	102,110	150,220	203,930	220,510	206,760	160,020
28	17,580	34,120	44,780	52,260	61,770	87,220	103,630	151,990	204,890	220,370	205,240	158,500
29	18,030	34,540	45,210	52,400	62,050	87,860	105,150	153,570	205,540	220,240	203,670	157,020
30	18,580	34,820	45,490	52,540	.....	87,960	106,580	155,150	205,930	220,280	202,070	156,260
31	19,970	.....	45,770	52,830	.....	88,070	.....	156,540	.....	220,370	200,470	.....

KACHESS RIVER NEAR EASTON, WASH.

LOCATION.—In sec. 3, T. 20 N., R. 13 E., three-fourths mile below Kachess storage dam, one-fourth mile above mouth, and 2 miles northwest of Easton, in Kittitas County.

DRAINAGE AREA.—64 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 20, 1903, to September 30, 1916.

GAGE.—Stevens water-stage recorder at highway bridge a quarter of a mile above mouth, installed August 15, 1916; original staff gage on left bank a quarter of a mile below Kachess storage dam was replaced by water-stage recorder at same site and datum July 22, 1913. Gage inspected by I. Pennington.

DISCHARGE MEASUREMENTS.—Made from cable 20 feet below site of old gage or by wading.

CHANNEL AND CONTROL.—Bed at old station composed of light gravel and sand; shifting frequently. One channel at all stages. Control formed by broad riffle 125 feet below gage. At new station conditions of channel and control are better.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 7.12 feet at 12 m. August 3 (discharge, 1,080 second-feet); channel practically dry October 1–5, and October 20 to March 28.

1904–1916: Maximum stage recorded, 8.0 feet at 8.30 a. m. November 16, 1906 (discharge, 1,760 [1] second-feet); minimum flow when gates in dam are closed (discharge practically zero).

ICE.—No flow during winter; gates closed.

DIVERSIONS.—None.

REGULATION.—Flow controlled by storage and release of water in Kachess reservoir. Monthly discharge, without storage, determined from records of stage of reservoir.

ACCURACY.—Stage-discharge relation changed June 17 and August 1. Rating curve used prior to June 17 poorly defined; curves used June 17 to August 1 and August 1–15 fairly well defined; curve used for new gage, after August 15, well defined. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage height to rating table or, for days of considerable fluctuation, by averaging results obtained by applying the gage heights for shorter intervals. Records prior to June 17, fair; June 17 to August 15, good; August 15 to September 30, excellent.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Kachess River near Easton, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.		Discharge.
		New gage.	Old gage.	
		Feet.	*Feet.*	*Sec.-ft.*
Oct. 7	Calland and Moxley	.....	3.70	36.2
June 20	Taylor and Moxley	.....	6.67	945
Aug. 1	F. E. Moxley	4.13	4.75	326
2	.....do	5.10	6.00	681
2	.....do	3.71	4.47	168
2	.....do	2.98	4.07	63.2
3	.....do	5.89	7.10	1,070
3	.....do	4.21	4.96	332
Sept. 26	Pennington and Moxley	5.40	.....	826

[1] Revised from original data. The river reached a stage of 7.5 feet November 25, 1909, and the discharge of 1,790 second-feet published for that date in Water-Supply Paper 272, p. 174, and Water-Supply Paper 369, p. 62, is probably too large.

Daily discharge, in second-feet, of Kachess River near Easton, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	.....	535	21.0	18.6	569	414	845
2	.....	.....	535	21.0	18.6	585	297	845
3	.....	.....	535	21.0	18.6	569	344	845
4	.....	.....	535	22.5	18.6	585	252	845
5	.....	.....	535	24.0	18.6	585	223	845
6	17	.....	535	24.0	18.6	553	213	845
7	36	.....	535	24.0	18.6	313	216	845
8	36	.....	535	24.0	18.6	199	155	703
9	36	.....	535	24.0	18.6	199	486	691
10	34	.....	460	22.5	18.6	199	749	870
11	34	.....	300	22.5	17.4	199	749	870
12	61	.....	223	21.0	17.4	344	438	870
13	115	.....	71	19.8	16.2	585	19.2	435
14	131	.....	7.4	18.6	16.2	585	19.2	280
15	121	.....	7.4	17.4	16.2	585	19.2	821
16	118	.....	9.0	17.4	16.2	665	19.2	845
17	118	.....	11.4	18.6	535	715	251	845
18	90	.....	13.8	18.6	1,020	731	416	845
19	12	.....	16.2	19.8	1,020	649	419	821
20	.....	.....	18.6	19.8	920	485	419	821
21	.....	.....	18.6	21.0	522	476	658	821
22	.....	.....	17.4	21.0	522	491	845	821
23	.....	.....	16.2	21.0	522	314	845	821
24	.....	.....	16.2	19.8	522	293	845	821
25	.....	.....	16.2	19.8	522	469	845	821
26	.....	.....	16.2	19.8	522	649	845	821
27	.....	.....	17.4	18.6	553	491	845	821
28	.....	.....	18.6	18.6	569	400	845	797
29	.....	118	19.8	18.6	569	308	845	553
30	.....	540	21.0	18.6	569	325	845	312
31	.....	518	.....	18.6	.....	323	845	.....

NOTE.—Gates closed, practically no flow Oct. 1–5 and Oct. 20 to Mar. 28.

Monthly discharge of Kachess River near Easton, Wash., for year ending Sept. 30, 1916.

[Drainage area, 63 square miles to Aug. 15, 1916; 64 square miles after that date.]

Month.	Observed discharge (second-feet).			Run-off (total in acre-feet).			Discharge without storage (second-feet).		Run-off (depth in inches on Drainage area).
	Maximum.	Minimum.	Mean.	Observed	Stored.	Without storage.	Mean.	Per square mile.	
October	131	0.0	30.9	1,900	+ 6,000	7,900	128	2.03	2.34
November	0	.0	.0	0	+ 14,800	14,800	259	3.95	4.41
December	0	.0	.0	0	+ 11,000	11,000	179	2.84	3.27
January	0	.0	.0	0	+ 7,060	7,060	115	1.82	2.10
February	0	.0	.0	0	+ 9,230	9,230	160	2.54	2.74
March	540	.0	37.9	2,330	+ 26,300	28,300	460	7.30	8.42
April	535	7.4	204	12,200	+ 18,500	30,700	516	8.19	9.14
May	24	17.4	20.5	1,260	+ 50,000	51,300	834	13.24	15.26
June	1,020	16.2	306	18,200	+ 49,400	67,600	1,140	18.09	20.18
July	731	199	466	28,600	+ 14,400	43,000	699	11.10	12.80
August	845	19.2	491	30,200	− 19,900	10,300	168	2.64	3.04
September	870	280	768	45,700	− 44,200	1,500	25.2	.394	.44
The year	1,020	.0	193	140,000	+143,000	283,000	390	6.18	84.14

CLE ELUM LAKE NEAR ROSLYN, WASH.

LOCATION.—In sec. 10, T. 20 N., R. 14 E., at lake outlet, 4 miles northwest of Roslyn, in Kittitas County, and about 7½ miles northwest of Cle Elum.

DRAINAGE AREA.—202 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 4 to June 9, 1906; October 1, 1906, to September 30, 1916.

GAGE.—Vertical staff on left abutment of temporary crib dam, installed June 17, 1907; zero at elevation of gate sills, 2,122.75 feet. Considerable fall between lake and dam for stages below 5.0 feet; auxiliary gages, at same datum, about 200 feet above dam, installed October, 1907, and July 16, 1915, used to obtain true elevation of lake at low stages; prior to June 17, 1907, vertical staff in lake above outlet at datum 0.45 foot lower than that of present gage; simultaneous readings on this gage and present gage July 7 to October 31, 1907. Gage read to hundredths twice daily by A. D. Nichols.

EXTREMES OF CAPACITY.—Maximum stage recorded during year, 15.4 feet June 17 at 6 a. m. and June 18 at 6 a. m. and 6 p. m. (capacity, 33,810 acre-feet); minimum stage recorded, 2.10 feet at 7 a. m. October 1 (capacity, 4,360 acre-feet).

1907–1916: Maximum stage recorded, 16.70 feet November 24, 1909 (capacity, 37,050 acre-feet); minimum stage estimated at 1.15 feet August 31, 1906 (capacity, 2,380 acre-feet).

STORAGE.—Capacity of reservoir at crest of spillway (gage height, 11.3 feet), 24,100 acre-feet. Storage or release each month used for determining discharge without storage for gaging station below dam.

COOPERATION.—Capacities computed by United States Reclamation Service.

Daily capacity, in acre-feet, of Cle Elum Lake near Roslyn, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4,720	13,660	22,160	24,020	15,840	15,820	24,470	28,830	28,740	29,020	26,960	17,140
2	5,140	15,970	22,110	23,630	15,370	16,060	24,620	29,590	28,830	29,540	26,980	16,770
3	5,090	17,390	22,020	23,450	14,840	16,450	24,920	30,520	29,210	30,310	26,590	16,400
4	5,700	18,300	21,980	23,400	14,470	16,580	25,370	31,730	30,260	30,260	26,470	15,910
5	5,890	19,220	21,960	23,270	13,870	16,700	25,740	31,850	30,520	29,830	26,360	15,500
6	6,100	20,000	21,960	23,090	13,280	16,770	25,810	31,490	30,020	29,420	26,270	15,110
7	6,250	20,530	21,980	22,870	12,700	17,140	25,850	30,600	29,850	29,020	26,170	14,840
8	6,160	20,880	21,980	22,690	12,270	17,350	26,040	29,710	30,160	29,260	26,080	15,590
9	6,080	21,270	21,960	22,530	11,700	18,610	26,290	28,830	30,760	29,950	26,080	15,590
10	6,000	21,400	21,960	22,310	11,020	20,970	26,870	28,220	30,550	30,040	26,080	12,490
11	5,910	21,470	21,980	22,180	10,360	24,350	27,380	27,590	29,920	29,780	26,060	12,060
12	5,760	21,710	21,960	21,890	9,920	26,220	27,520	27,260	29,760	29,930	26,060	11,780
13	5,760	21,710	21,960	21,740	9,370	28,150	27,330	27,100	30,190	29,950	26,040	11,360
14	5,760	21,710	21,930	21,430	10,430	27,980	27,380	27,190	31,080	29,420	25,970	11,210
15	6,070	21,690	21,890	21,320	11,060	27,450	27,610	27,470	31,920	28,880	25,920	10,470
16	6,370	21,690	21,620	20,970	11,360	27,010	27,610	27,980	33,120	28,780	25,850	9,660
17	6,630	21,910	21,400	20,660	11,570	26,680	27,520	28,640	33,780	28,970	25,670	9,450
18	6,670	22,090	21,380	20,400	11,660	26,500	27,360	29,070	33,810	28,710	25,440	9,410
19	6,690	22,380	21,270	20,400	11,850	25,990	27,100	29,590	32,820	28,170	25,140	9,200
20	6,670	22,380	21,270	18,930	12,230	25,940	26,940	29,970	31,240	28,030	24,620	8,880
21	6,630	22,400	21,490	18,430	12,810	26,430	26,750	29,640	29,920	27,980	24,220	8,460
22	6,670	22,560	22,200	18,110	13,190	26,540	26,590	29,120	29,260	27,890	23,790	8,750
23	6,670	22,690	22,690	17,930	13,660	26,380	26,400	28,550	29,470	27,660	23,220	9,620
24	6,670	22,780	22,840	17,740	14,040	25,990	26,340	28,120	30,020	27,420	21,890	9,360
25	7,050	22,870	23,320	17,650	14,470	25,830	26,500	27,940	30,350	27,210	21,120	9,090
26	7,730	22,780	23,630	17,610	14,770	25,530	27,190	28,360	30,640	27,080	20,680	8,830
27	8,420	22,710	23,830	17,480	15,030	25,300	28,270	29,300	31,030	26,820	20,240	8,560
28	9,070	22,640	24,130	17,260	15,330	24,990	29,260	29,830	30,550	26,640	19,920	8,400
29	9,730	22,670	24,020	17,090	15,670	24,760	29,260	29,610	29,880	26,500	19,260	8,310
30	10,420	22,510	24,020	16,790	.....	24,540	28,830	29,070	29,260	26,520	18,930	8,040
31	11,100	.....	23,990	16,320	.....	24,400	.....	28,810	.....	26,640	18,260	.....

CLE ELUM RIVER NEAR ROSLYN, WASH.

LOCATION.—In sec. 10, T. 20 N., R. 14 E., below temporary crib dam at outlet of Cle Elum Lake, 4 miles northwest of Roslyn, in Kittitas County, and 7½ miles northwest of Cle Elum.

DRAINAGE AREA.—202 square miles (measured on topographic maps).

RECORDS AVAILABLE.—October 10, 1903, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank 800 feet below temporary crib dam; installed October 14, 1913. Previous gages as follows: Prior to August 28, 1905, inclined gage at same site and datum as present gage; August 28, 1905, to March 16, 1906, inclined staff at same site but at datum 0.56 higher than that of present gage, gage heights corrected to true datum; May 17, 1906, to October 14, 1913, vertical and inclined staff at site of present gage. Gage inspected by A. D. Nichols.

DISCHARGE MEASUREMENTS.—Made from cable about 350 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and boulders; shifting at high water. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.60 feet from 6 to 9 a. m. June 18 (discharge, 6,650 second-feet); minimum stage, 1.10 feet at 7 p. m. October 2 (discharge, 104 second-feet).

1904–1916: Maximum stage recorded, 14.05 feet at 2 p. m. November 15, 1906 (discharge, 18,700 second-feet); minimum stage recorded, zero at 6 p. m. September 28, 1914 (discharge practically zero).

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water at Cle Elum reservoir. Monthly discharge without storage determined from records of stage at reservoir.

ACCURACY.—Stage-discharge relation changed at high water May 5. Rating curves used before and after change well defined below 4,500 second-feet. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent except for extremely high water.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Cle Elum River near Roslyn, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 4	R. S. Calland	1.54	207.	May 15	Parker and Taylor	4.39	1,810
Dec. 1	F. E. Moxley	2.07	347	June 21	Taylor and Moxley	5.88	3,070
Jan. 15	do	1.98	328	Aug. 5	F. E. Moxley	3.60	1,180
May 3	do	6.34	3,700	Sept. 28	do	2.01	364

Daily discharge, in second-feet, of Cle Elum River near Roslyn, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	117	329	346	356	488	297	758	2,450	2,530	2,680	1,360	822
2	118	349	346	349	488	297	813	2,970	2,580	3,080	1,400	822
3	157	353	346	349	488	300	895	2,650	2,880	3,630	1,320	822
4	196	353	346	353	488	303	1,000	4,540	3,630	3,630	1,250	822
5	211	353	346	353	488	307	1,120	4,810	3,750	3,190	1,180	822
6	211	360	346	346	488	310	1,180	4,470	3,410	2,880	1,150	822
7	213	363	346	346	492	313	1,220	3,870	3,300	2,680	1,120	822
8	213	367	346	346	488	316	1,280	3,190	3,520	2,880	1,090	737
9	213	370	346	339	488	329	1,390	2,680	3,990	3,300	1,060	583
10	196	370	346	336	488	346	1,500	2,170	3,750	3,410	1,060	693
11	190	367	346	329	484	519	1,660	1,880	3,300	3,300	1,060	737
12	188	367	346	329	488	1,460	1,740	1,680	3,190	3,300	1,060	637
13	190	367	346	329	492	2,100	1,620	1,600	3,520	3,410	1,060	465
14	198	367	343	326	501	2,000	1,620	1,640	4,230	2,980	1,030	509
15	223	367	343	326	316	1,740	1,740	1,800	4,990	2,580	1,030	627
16	245	356	339	326	221	1,460	1,740	2,120	5,950	2,580	970	593
17	247	349	329	323	223	1,320	1,580	2,530	6,510	2,680	910	541
18	250	349	329	323	236	1,280	1,500	2,780	6,510	2,530	851	495
19	245	349	329	400	245	1,280	1,390	3,080	5,670	2,260	822	465
20	245	349	329	532	250	1,250	1,280	3,300	4,350	2,120	822	440
21	239	349	329	532	259	1,390	1,220	3,080	3,300	2,040	822	424
22	239	349	332	578	270	1,460	1,120	2,780	2,880	1,960	822	398
23	239	353	339	532	276	1,360	1,060	2,440	2,980	1,840	822	432
24	239	356	343	400	279	1,280	1,030	2,170	3,410	1,760	851	440
25	256	356	346	367	285	1,180	1,090	2,080	3,630	1,680	822	409
26	302	349	349	363	285	1,090	1,390	2,350	3,870	1,600	822	379
27	374	353	356	363	288	1,000	1,950	2,880	4,230	1,440	822	362
28	400	353	374	360	291	912	2,550	3,300	3,870	1,320	822	366
29	431	349	370	353	291	868	2,650	3,080	3,300	1,250	822	355
30	484	349	367	418	.....	785	2,500	2,780	2,880	1,250	822	348
31	457	.....	356	488	.....	732	.....	2,580	.....	1,290	822	.....

Monthly discharge of Cle Elum River near Roslyn, Wash., for year ending Sept. 30, 1916.

[Drainage area, 202 square miles.]

Month.	Observed discharge (second-feet).			Run-off (total in acre-feet).			Discharge without storage (second-feet).		Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Observed	Stored.	Without storage	Mean.	Per square mile.	
October	484	117	249	15,300	+ 6,720	22,000	358	1.77	2.04
November	370	329	356	21,200	+11,400	32,600	548	2.71	3.02
December	374	329	345	21,200	+ 1,480	22,700	369	1.83	2.11
January	578	323	380	23,300	− 7,680	15,600	254	1.26	1.45
February	501	221	375	21,800	− 645	20,900	362	1.79	1.93
March	2,100	297	954	58,700	+ 8,730	67,400	1,100	5.45	6.28
April	2,650	758	1,450	86,400	+ 4,430	90,800	1,530	7.57	8.45
May	4,810	1,600	2,760	170,000	− 24	170,000	2,760	13.7	15.79
June	6,510	2,530	3,860	230,000	+ 450	230,000	3,870	19.2	21.42
July	3,630	1,250	2,470	152,000	− 2,620	149,000	2,420	12.0	13.83
August	1,400	822	990	60,800	− 8,380	52,400	852	4.22	4.86
September	822	348	573	34,100	−10,200	23,900	402	1.99	2.22
The year	6,510	117	1,230	894,000	+ 3,660	897,000	1,240	6.14	83.40

NACHES RIVER AT OAK FLAT, NEAR NILE, WASH.

LOCATION.—In sec. 34, T. 15 N., R. 16 E., just above Oak Flat, three-fourths mile above intake of Selah Valley canal, 2 miles above Tieton River, and 8 miles southeast of Nile, in Yakima County.

DRAINAGE AREA.—640 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 25, 1904, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank, installed November 29, 1914; referred to inclined staff installed September 22, 1914. Previous gages as follows: Prior to flood of November 15, 1906, inclined staff on left bank 800 feet below site of present gage and at different datum; November 16, 1906, to January 27, 1907, temporary inclined gage at same location (gage heights corrected to datum of original gage); January 28, 1907, to April 12, 1909, vertical and inclined staff at same site and datum as original gage; April 13, 1909, to September 14, 1914, cantilever chain gage at same site and datum as present gage; September 20, 1911, to September 14, 1914, Barrett and Lawrence water-stage recorder referred to chain gage. Recorder inspected by Lafe Little and D. A. Noble.

DISCHARGE MEASUREMENTS.—Made from cable 75 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; shifting at medium and high water; gradient steep. One channel at all stages. Stage of zero flow, about gage height 1.65 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.80 feet at 4.30 a. m. July 3 (discharge, 8,070 second-feet); minimum stage, 3.44 feet from 8 a. m. to 6 p. m. October 1 (discharge, 138 second-feet).

1904–1916: Maximum stage, 10.3 feet during morning of November 15, 1906; water over gage; determined from high-water marks (discharge, 21,900 second-feet); minimum stage recorded, 3.47 feet at 2 a. m. September 25, 1915 (discharge, 141 second-feet).[1]

ICE.—Record discontinued during winter.

DIVERSIONS.—Numerous small tracts irrigated above station; aggregate depletion less than 5 per cent of flow.

REGULATION.—Flow partly controlled by storage and release of water at Bumping reservoir. Monthly discharge without storage determined from records of stage at reservoir.

ACCURACY.—Stage-discharge relation shifting from November 16 to May 8. Rating curve used October 1 to November 15, fairly well defined; curve used after May 8 failry well defined. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage height to rating table; shifting-control method used April 1 to May 8. Records good except for periods of shifting control, for which they are fair.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

---

[1] Minimum stage of 3.0 feet recorded Sept. 18–21, 1904, not considered reliable; discharge of 139 second feet, published in Water-Supply Paper 135, p. 97, too small. Correct discharge Sept. 18–21, 1904, probably 180 second-feet.

Discharge measurements of Naches River at Oak Flat, near Nile, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 16	F. E. Moxley	3.98	323	May 13	F. E. Moxley	6.55	2,810
Mar. 30	do	5.97	1,690	20	Taylor and Parker	7.32	4,520
Apr. 18	do	7.04	2,800	June 10	Taylor and Moxley	7.71	5,190
26	do	7.45	3,620	16	Moxley and Taylor	8.50	7,270
May 8	Paul Taylor	7.62	4,990	Aug. 10	F. E. Moxley	5.53	1,610

Daily discharge, in second-feet, of Naches River at Oak Flat, near Nile, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	138	542	2,150	4,820	4,040	3,840	2,080	928
2	147	559	2,580	6,000	4,150	6,000	1,950	920
3	170	553	2,740	6,750	4,480	7,530	1,890	928
4	182	525	2,820	7,270	5,220	6,210	1,770	944
5	182	509	2,740	7,270	5,400	5,400	1,660	904
6	179	493	2,740	6,750	4,820	4,700	1,600	865
7	176	457	2,900	5,880	4,940	4,370	1,550	842
8	176	432	3,350	5,050	5,400	4,940	1,550	820
9	164	389	3,740	4,260	5,880	5,640	1,550	535
10	161	323	4,040	3,640	5,280	5,280	1,500	760
11	155	306	3,940	3,260	4,700	5,050	1,450	752
12	155	271	3,440	2,990	4,590	5,280	1,450	730
13	155	267	3,170	2,900	5,050	5,280	1,450	716
14	152	267	3,640	2,820	5,880	4,590	1,450	695
15	155	302	3,640	2,990	6,750	4,040	1,350	695
16	164	.....	3,350	3,260	7,530	4,150	1,300	681
17	170	.....	2,990	3,640	7,270	4,040	1,260	660
18	167	.....	2,740	3,940	7,010	3,440	1,260	647
19	167	.....	2,440	4,370	7,010	3,170	1,210	615
20	167	.....	2,290	4,590	6,750	3,170	1,210	608
21	164	.....	2,290	4,590	5,400	3,260	1,210	595
22	164	.....	2,080	4,150	4,260	3,170	1,160	571
23	191	.....	2,020	3,740	4,370	2,900	1,160	445
24	235	.....	2,150	3,440	5,050	2,740	1,160	445
25	238	.....	2,820	3,440	3,280	2,510	1,080	455
26	298	.....	3,740	3,940	5,640	2,290	984	470
27	323	.....	4,700	4,700	5,640	2,150	952	480
28	327	.....	4,590	5,050	5,050	2,020	920	475
29	331	.....	4,260	4,700	4,370	1,950	960	426
30	331	.....	4,260	4,260	3,940	1,830	960	426
31	340	.....	.....	4,040	.....	2,020	952	.....

Monthly discharge of Naches River at Oak Flat, near Nile, Wash., for year ending Sept. 30, 1916.

[Drainage area, 640 square miles].

Month.	Observed discharge (second-feet).			Run-off (total in acre-feet).			Discharge without storage (second-feet).		Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Observed	Stored.	Without storage.	Mean.	Per square mile.	
October	340	138	201	12,300	+ 902	13,200	215	0.336	0.39
November 1-15	559	267	413	12,300	− 195	12,100	407	.636	.35
April	4,700	2,020	3,150	187,000	− 248	187,000	3,140	4.91	5.48
May	7,270	2,820	4,470	275,000	+ 4,810	280,000	4,550	7.11	8.20
June	7,530	3,940	5,380	320,000	+25,500	346,000	5,810	9.08	10.13
July	7,530	1,830	3,970	244,000	− 532	243,000	3,950	6.17	7.11
August	2,080	920	1,350	83,300	− 6,110	77,200	1,260	1.97	2.27
September	944	426	668	39,700	−17,600	22,100	371	.58	.65

BUMPING LAKE NEAR NILE, WASH.

LOCATION.—At storage dam at outlet of Bumping Lake, 12 miles above American River and 19 miles west of Nile, in Yakima County.

DRAINAGE AREA.—68 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 27 to November 22, 1909; November 3, 1910, to September 30, 1916.

GAGE.—Vertical staff on face of gate tower; datum, mean sea level. Prior to November 3, 1910, vertical staff on north shore of lake, one-fourth mile above outlet, at different datum. Gage read to hundredths twice daily by J. H. Nelson.

EXTREMES OF CAPACITY.—Maximum stage recorded during year, 3,428.10 feet July 3 (capacity, 36,490 acre-feet); minimum stage recorded, 3,391 feet from 4.30 p. m. February 12 to 9 a. m. February 15 (capacity, 1,260 acre-feet).

1911–1916: Maximum stage recorded, 3,428 feet July 9, 1915 (capacity, 36,730 acre-feet); minimum stage recorded, 3,392.50 feet March 7, 1911 (capacity, 775 acre-feet).

STORAGE.—Capacity of reservoir at crest of spillway, 33,700 acre-feet. Elevation of gate sill and spillway crest, 3,389 feet and 3,426 feet, respectively. Storage or release each month used for determining discharge without storage for gaging station below dam.

COOPERATION.—Capacities computed by United States Reclamation Service.

Daily capacity, in acre-feet, of Bumping Lake near Nile, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1,770	3,260	2,750	4,040	2,800	3,460	5,320	5,410	10,080	35,850	35,020	28,300
2	1,800	3,360	2,740	4,170	2,660	3,420	5,150	5,770	10,190	36,160	35,000	27,700
3	1,870	3,390	2,720	4,270	2,610	3,390	4,960	6,440	10,970	36,420	34,890	27,040
4	1,900	3,360	2,700	4,320	2,540	3,360	4,810	6,940	11,800	35,950	34,760	26,300
5	1,900	3,310	2,680	4,400	2,480	3,320	4,640	7,840	12,700	35,750	34,760	25,630
6	1,870	3,200	2,700	4,510	2,480	3,320	4,660	8,780	13,560	35,620	34,690	24,940
7	1,870	3,190	2,700	4,600	2,420	3,260	4,720	9,530	14,740	35,530	34,620	24,170
8	1,900	3,060	2,720	4,710	2,360	3,200	4,590	9,930	15,960	35,820	34,620	23,400
9	1,870	2,940	2,740	4,810	2,310	3,200	4,620	10,200	17,630	36,090	34,620	23,400
10	1,870	2,880	2,740	4,910	2,410	3,460	4,660	10,190	18,770	35,930	34,620	22,710
11	1,870	2,750	2,750	4,960	1,370	3,720	4,740	10,060	19,730	35,790	34,560	21,980
12	1,830	2,660	2,720	4,890	1,270	4,050	4,790	9,890	20,750	36,160	34,560	21,310
13	1,830	2,590	2,700	4,670	1,260	4,400	4,830	9,650	21,910	36,090	34,560	20,560
14	1,910	2,510	2,700	4,510	1,260	4,600	4,860	9,300	23,460	35,930	34,560	19,840
15	1,930	2,480	2,700	4,370	1,340	4,810	4,890	9,010	25,690	35,750	34,490	19,130
16	1,930	2,510	2,660	4,240	4,150	5,200	4,960	8,810	28,810	35,750	34,490	18,360
17	1,900	2,620	2,640	4,060	4,190	5,770	4,960	8,650	32,870	35,690	34,470	17,650
18	1,900	2,790	2,640	3,860	4,190	6,470	4,960	8,650	36,200	35,550	34,260	16,840
19	1,900	2,900	2,540	3,710	4,170	6,870	4,930	8,740	36,250	35,420	34,100	16,030
20	1,870	3,190	2,540	3,640	4,150	7,400	4,890	8,910	36,060	35,290	34,030	15,270
21	1,870	3,270	2,740	3,540	4,110	7,380	4,850	8,950	35,790	35,490	33,900	14,480
22	1,830	3,320	2,980	3,520	4,050	7,240	4,710	8,910	35,490	35,490	33,420	13,800
23	1,950	3,340	3,110	3,510	3,980	7,080	4,590	8,950	35,450	35,260	32,930	13,420
24	2,010	3,320	3,320	3,490	3,930	6,870	4,560	8,950	35,690	35,180	32,480	13,030
25	2,150	3,190	3,490	3,490	3,840	6,660	4,520	8,950	35,850	35,160	31,970	12,660
26	2,230	3,140	3,470	3,470	3,710	6,440	4,530	8,990	36,020	35,090	31,460	12,310
27	2,280	3,080	3,400	3,460	3,640	6,230	4,620	9,090	35,980	35,020	30,990	11,970
28	2,350	2,940	3,540	3,390	3,560	6,000	4,850	9,510	35,820	34,890	30,490	11,580
29	2,350	2,880	3,640	3,270	3,470	5,810	5,080	9,770	35,690	34,890	29,960	11,440
30	2,350	2,870	3,730	3,050	.....	5,600	5,210	9,870	35,490	34,890	29,400	11,280
31	2,670	.....	3,840	2,770	.....	5,460	.....	10,030	.....	34,960	28,850	.....

BUMPING RIVER NEAR NILE, WASH.

LOCATION.—A quarter of a mile below spillway of Bumping Lake dam, half a mile below outlet conduit through storage dam, 11½ miles above American River, and 19 miles west of Nile, in Yakima County.

DRAINAGE AREA.—68 square miles (measured on topographic maps).

RECORDS AVAILABLE.—June 13 to July 31, 1906; April 27, 1909, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank one-fourth mile below spillway of storage dam; installed June 17, 1913. Previous gages as follows: During 1906, vertical staff on left bank at dam site, half a mile above site of present gage and at different datum; April 27 to September 16, 1909, and June 26, 1912, to June 13, 1913, vertical staff near downstream end of right pier of highway bridge, about three-eighths mile above site of present gage and at different datum (readings on this gage April 27 to August 6, 1909, reduced to datum of succeeding gage by relation curve); August 7, 1909, to June 25, 1912, vertical and inclined staff on right bank about 1,300 feet above site of present gage and at different datum. Discharge over spillway crest June 24, to July 30, 1912, computed and added to flow past gage. Recorder inspected by J. H. Nelson.

DISCHARGE MEASUREMENTS.—Made from cable about 40 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of large angular rocks and gravel; fairly permanent. Riffle control 60 feet below gage. Stage of zero flow, about gage height 0.6 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.44 feet at 6.30 a. m. July 3 (discharge, 1,830 second-feet); minimum stage recorded, 1.20 feet at 8 a. m. February 12 (discharge, 6.0 second-feet).

1906 and 1909–1916: Maximum stage recorded, 7.0 feet November 14, 1906 (discharge about 4,300 second-feet); practically no flow when gates in outlet conduit are closed.

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water at Bumping reservoir. Monthly discharge without storage determined from records of stage at reservoir.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined below 800 second-feet. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage heights to rating table or, for days of considerable fluctuation, by averaging the results obtained by applying the gage height for shorter intervals. Records excellent except for periods of high water in June and July.

COOPERATION.—United States Reclamation Service made current meter measurements and computed discharge.

Discharge measurements of Bumping River near Nile, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Oct. 8	Paul Taylor	1.71	42.7
July 28	F. E. Moxley	3.78	798
29	....do	4.07	963

Daily discharge, in second-feet, of Bumping River near Nile, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	33	228	152	50.7	145	206	355	452	682	1,120	840	536
2	38	244	142	50.7	140	203	347	496	640	1,480	781	536
3	46	244	135	50.7	137	197	336	556	456	1,800	752	571
4	47	244	133	50.7	133	188	332	656	478	1,570	723	597
5	47	228	133	51.8	109	182	325	746	505	1,410	689	597
6	46	228	131	52.9	131	180	318	802	510	1,280	656	592
7	45	213	133	54.0	128	174	300	831	519	1,220	597	587
8	43	194	137	54.0	131	177	362	719	542	1,340	592	480
9	43	177	142	52.9	135	182	359	719	561	1,570	582	366
10	42	160	145	54.0	107	194	366	719	576	1,570	566	571
11	41	145	147	52.9	11.2	219	374	692	580	1,540	556	577
12	40	131	142	114	6.4	244	382	687	585	1,640	551	571
13	42	121	140	152	8.4	275	382	682	590	1,670	546	561
14	46	115	135	152	8.8	296	390	676	580	1,410	531	551
15	49	111	131	150	27.1	307	398	645	477	1,380	497	571
16	49	111	126	142	233	128	406	640	427	1,340	473	587
17	46	119	126	137	268	14.2	402	630	461	1,340	426	577
18	46	126	117	140	261	13.6	398	615	1,490	1,180	391	561
19	46	168	111	137	268	13.6	394	620	1,740	1,060	348	566
20	46	213	111	137	271	185	390	630	1,540	1,090	324	577
21	45	228	147	135	271	561	378	640	1,280	1,150	444	571
22	45	228	182	133	265	542	366	645	1,150	1,120	531	418
23	50	228	197	135	251	542	359	645	1,220	1,020	541	336
24	58	213	182	137	244	524	347	640	1,340	992	556	332
25	69	213	197	133	238	514	347	635	1,440	930	556	324
26	90	213	197	133	238	505	359	635	1,510	870	551	317
27	103	194	174	126	228	492	382	640	1,540	811	551	317
28	119	182	155	131	222	456	410	650	1,380	781	551	239
29	117	171	128	133	213	410	427	661	1,250	761	546	177
30	119	158	113	152	.....	386	435	661	1,150	717	541	167
31	145	.....	82	150	.....	370	.....	666	.....	811	536	.....

Monthly discharge of Bumping River near Nile, Wash., for year ending Sept. 30, 1916.

[Drainage area, 68 square miles.]

Month.	Observed discharge (second-feet).			Run-off (total in acre-feet).			Discharge without storage (second-feet).		Run-off (depth in inches on drainage area).
	Maximum.	Minimum.	Mean.	Observed	Stored.	Without storage.	Mean.	Per square mile.	
October	145	33	59.4	3,650	+ 902	4,550	74.1	1.09	1.26
November	244	111	185	11,000	+ 195	11,200	188	2.76	3.08
December	197	82	143	8,770	+ 972	9,740	158	2.32	2.68
January	152	50.7	108	6,610	− 1,070	5,540	90.1	1.32	1.52
February	271	6.4	167	9,570	+ 700	10,300	179	2.63	2.84
March	561	13.6	286	17,600	+ 1,990	19,600	319	4.69	5.41
April	435	300	371	22,100	− 248	21,900	368	5.41	6.04
May	831	452	656	40,300	+ 4,810	45,100	733	10.78	12.43
June	1,740	427	907	53,900	+25,500	79,400	1,330	19.56	21.82
July	1,800	717	1,220	75,300	− 532	74,800	1,220	17.94	20.68
August	840	324	559	34,400	− 6,110	28,300	460	6.76	7.79
September	597	167	478	28,400	−17,600	10,800	182	2.68	2.99
The year	1,800	6.4	429	312,000	+ 9,510	321,000	442	6.50	88.54

TIETON RIVER AT HEADWORKS OF TIETON CANAL, NEAR NACHES, WASH.

LOCATION.—In sec. 30, T. 14 N., R. 15 E. (unsurveyed), below intake of Tieton canal, 15 miles above mouth and about 16 miles southwest of Naches, in Yakima County.

DRAINAGE AREA.—240 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 17 to September 17, 1906 (fragmentary gage heights); July 5, 1907, to September 30, 1916.

GAGE.—Friez water-stage recorder on right bank about 1,000 feet below intake of Tieton canal; substituted July 8, 1911, for Bristol water-stage recorder used from July 28, 1909, to July 7, 1911. Previous gages as follows: April 17 to September 17, 1906, vertical staff on left bank about three-fourths mile below site of present gage; July 5 to October 26, 1907, vertical staff at present site; October 27, 1907, to April 8, 1909, cantilever arm and graduated sticks for measuring down to water surface at Weisberger's power plant, about 1½ miles below site of present gage; August 26 to December 12, 1908, and since April 9, 1909, vertical staff at present site. Gage heights January 1 to April 8, 1909, referred to datum of present gage by curve of relation. All published gage heights at approximately the same datum and records at all sites comparable. Gage inspected by employees of United States Reclamation Service.

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

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; shifts slightly at high water; gradient steep. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 6.42 feet at 12 m. June 18 (discharge, 3,530 second-feet); minimum stage, from recorder, 2.08 feet at 4 p. m. November 13 (discharge, 68 second-feet).

1907–1916: Maximum stage, from water-stage recorder, 7.15 feet at 4 a. m. November 24, 1909 (discharge about 5,400 second-feet); minimum stage, from water-stage recorder, 1.30 feet at 8 p. m. July 15, 1915 (discharge, 19 second-feet).

ICE.—Stage-discharge relation seriously affected by ice; discharge for January and February, 1916, not determined.

DIVERSIONS.—Tieton canal has diverted water above the gage since 1910. Diversions through canal added to mean monthly flow to determine natural monthly discharge.

REGULATION.—Flow slightly regulated by storage and release of water at Clear Creek reservoir about 15 miles above gage. Purpose of regulation to obviate diurnal fluctuation during irrigation season.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 100 and 1,600 second-feet. Water-stage recorder inspected twice daily during irrigation season and once or twice a week during rest of year. Daily discharge ascertained by applying mean daily gage height to rating table. Records for October excellent; those for rest of year good.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Discharge measurements of Tieton River at headworks of Tieton canal, near Naches, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 30	F. E. Moxley	*4.43	1,180
May 22	Parker and Taylor	4.22	1,070
Aug. 15	Moxley and Calland	3.62	617

Daily discharge, in second-feet, of Tieton River at headworks of Tieton canal, near Naches, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	219	368	123	367	898	1,340	1,100	1,380	758	390
2	256	290	123	345	950	1,670	1,180	2,300	676	316
3	270	284	131	333	990	2,180	1,380	2,550	650	296
4	227	273	224	320	1,020	2,420	1,670	2,060	625	289
5	192	255	251	312	990	2,420	1,520	1,670	570	270
6	187	209	239	300	990	2,300	1,480	1,480	541	225
7	176	112	233	292	1,020	1,940	1,570	1,430	502	156
8	173	101	245	454	1,140	1,620	1,780	1,670	513	136
9	176	93	264	928	1,300	1,380	1,830	2,000	570	121
10	151	84	239	1,380	1,380	1,180	1,520	1,830	524	112
11	149	85	236	1,380	1,380	1,020	1,430	1,720	519	104
12	149	79	230	1,380	1,300	942	1,430	1,940	530	107
13	159	76	218	1,340	1,300	860	1,570	2,000	625	109
14	187	78	201	1,140	1,430	765	1,940	1,570	619	102
15	170	107	206	990	1,430	744	2,300	1,480	588	96
16	146	95	195	950	1,300	801	2,740	1,620	565	97
17	138	112	212	990	1,220	898	3,150	1,570	475	120
18	144	168	221	942	1,140	950	3,430	1,300	367	112
19	154	360	201	990	1,020	1,100	2,810	1,180	292	69
20	157	270	203	1,520	990	1,180	2,060	1,220	266	76
21	165	233	462	1,520	990	1,180	1,570	1,260	273	83
22	168	230	774	1,300	890	1,060	1,340	1,140	285	85
23	230	206	522	1,100	780	990	1,520	1,060	316	85
24	242	168	415	990	831	890	1,780	950	359	77
25	261	157	398	935	1,060	875	1,780	942	359	320
26	315	141	329	912	1,260	990	1,940	808	354	312
27	280	123	322	875	1,340	1,140	1,940	723	304	367
28	230	133	315	808	1,260	1,260	1,620	676	329	316
29	255	151	284	758	1,220	1,220	1,340	670	354	292
30	224	128	285	737	1,260	1,100	1,260	676	345	289
31	253	.....	286	766	.....	1,060	.....	758	341	.....

Combined monthly discharge of Tieton River and canal at headworks of Tieton canal, near Naches, Wash., for year ending Sept. 30, 1916.

[Drainage area, 240 square miles.]

Month.	Discharge in second-feet.						Combined run-off.	
	Combined.		River (mean).	Canal (mean).	Combined.		Depth in inches on drainage area.	Total in acre-feet.
	Maximum.	Minimum.			Mean.	Per square mile.		
October	315	138	200	.....	200	0.833	0.96	12,300
November	370	76	172	35.1	207	.862	.96	12,300
December	774	175	277	5.03	282	1.18	1.36	17,300
March	1,520	292	882	.....	882	3.68	4.24	54,200
April	1,510	880	1,140	39.1	1,180	4.92	5.49	70,200
May	2,630	969	1,270	225	1,500	6.25	7.21	92,200
June	3,700	1,360	1,800	265	2,060	8.58	9.57	123,000
July	2,550	942	1,410	249	1,660	6.92	7.98	102,000
August	1,040	550	464	284	748	3.12	3.60	46,000
September	674	176	184	210	395	1.65	1.84	23,500

TIETON CANAL NEAR NACHES, WASH.

LOCATION.—In sec. 30, T. 14 N., R. 15 E. (unsurveyed), below canal intake and about 16 miles southwest of Naches, in Yakima County.

RECORDS AVAILABLE.—Irrigation seasons 1910 to 1916.

GAGE.—Float gage installed in a stilling well about 500 feet below canal intake; read by S. H. Stimson.

DISCHARGE MEASUREMENTS.—Made from a gaging bridge 30 feet below gage or by wading.

CHANNEL AND CONTROL.—Earth section merging into concrete-lined section 1,000 feet below gage.

EXTREMES OF DISCHARGE.—Irrigation seasons 1910–1916: Maximum stage recorded, 4.61 feet July 14–16, 1916 (discharge, 289 second-feet); no water in canal during nonirrigating season.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Canal diverts water from right bank of Tieton River in sec. 30, T. 14 N., R. 15 E. Water is used for irrigation.

Discharge measurements of Tieton canal near Naches, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 30	F. E. Moxley	2.81	144	July 13	A. Philpott	4.53	278
May 16	A. Philpott	3.84	229	13	do	4.52	275
22	Taylor and Parker	4.27	259	Aug. 14	Moxley and Colland	4.52	278

Daily discharge, in second-feet, of Tieton canal near Naches, Wash., for the year ending Sept. 30, 1916.

Day.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.
1		52		152	260	253	280	284
2		52		154	260	242	284	284
3		52		150	260	0	284	284
4				171	260	0	284	284
5				212	264	177	284	284
6				211	264	253	284	284
7				208	267	253	284	284
8				206	267	262	284	284
9				210	267	262	284	284
10				211	267	262	284	284
11				211	267	272	284	284
12				211	267	272	284	284
13				211	267	280	284	284
14				210	267	289	284	284
15				225	267	289	284	284
16				226	272	289	284	284
17				222	272	283	284	264
18				240	272	283	284	107
19				247	267	288	284	107
20	100			248	267	284	284	242
21	100			250	267	284	284	242
22	100			262	267	242	284	242
23	100		100	262	267	242	284	242
24	100		150	261	267	251	284	240
25	100		150	261	267	267	284	80
26	100		150	271	267	267	284	
27	100		174	258	258	267	284	
28	100		150	259	253	267	284	
29	100		150	256	253	272	284	
30	52		150	253	253	277	284	
31				259		277	284	

Monthly discharge of Tieton canal near Naches, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (in acre-feet).
	Maximum.	Minimum.	Mean.	
November 20–30	100	52	95.6	2,090
December 1–3	52	52	52.0	310
April 23–30	174	100	147	2,330
May	271	150	225	13,900
June	272	253	265	15,800
July	289	0	249	15,300
August	284	280	284	17,500
September 1–25	284	80	252	12,500

NORTH FORK OF AHTANUM CREEK NEAR TAMPICO, WASH.

LOCATION.—In NW. ¼ sec. 2, T. 12 N., R. 15 E., at George Prior's ranch, 100 feet below Nasty Creek and about 3½ miles northwest of Tampico, in Yakima County.

DRAINAGE AREA.—69 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 26, 1907, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank about 300 feet southeast of ranch house; installed September 6, 1916. Previous gages as follows: August 26, 1907, to April 1, 1913, and August 20, 1915, to September 5, 1916, vertical staff at same site and datum as present gage (read during year by F. W. and Clifford Schott and J. C. Holm); April 2, 1913, to August 19, 1915, Stevens water-stage recorder at same site and datum. Recorder inspected once a week by F. W. Schott.

DISCHARGE MEASUREMENTS.—Made from gaging bridge 40 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders. Banks high; not subject to overflow. Concrete control installed in November, 1915. Stage of zero flow since construction of control, gage height 1.45 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 4.6 feet June 18 (discharge, 728 second-feet); minimum stage recorded, 1.42 feet October 1 and 9 (discharge, 15 second-feet).

1907–1916: Maximum stage recorded June 18, 1916; minimum stage recorded 1.32 feet at 3 p. m. December 25, 1914 (discharge, 11.8 second-feet).

ICE.—Record discontinued during the winter.

DIVERSIONS.—Station is above all diversions.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed in November, 1915, by construction of artificial control. Rating curves used before and after change in control well defined. Gage read to hundredths one to three times a week prior to installation of water-stage recorder; after September 5, 1916, mean daily stage determined by inspecting graph. Daily discharge ascertained by applying mean daily gage height to rating tables. Accuracy of records depends largely on frequency of gage readings. Records for May, fair; for October, June, and July, good; for August and September, excellent.

Discharge measurements of North Fork of Ahtanum Creek near Tampico, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
May 8	C. G. Paulsen	3.31	329	Sept. 6	C. G. Paulsen	2.03	39.0
Aug. 2	....do	2.40	94.3	Sept. 6	R. S. Skillin [a]	2.03	36.8

[a] Engineer, United States Indian Service.

Daily discharge, in second-feet, of North Fork of Ahtanum Creek near Tampico, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	May.	June.	July.	Aug.	Sept.	Day.	Oct.	May.	June.	July.	Aug.	Sept.
1	15				98	34	16						35
2					94	35	17		233				34
3				358		36	18			728	207	55	32
4					90	37	19						32
5						38	20						32
6			442			39	21			364	179		32
7				277		39	22					45	31
8		325			74	40	23	27	260				31
9	15					39	24						32
10						39	25				138	42	32
11				280	70	38	26			294			32
12			373			37	27						32
13						35	28				122		31
14				269		36	29	17				36	30
15	16				60	36	30						30
							31		311				

NOTE.—Gage not read Sept. 2–5; discharge interpolated.

Monthly discharge of North Fork of Ahtanum Creek near Tampico, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October			16.5	1,010
May			286	17,600
June			418	24,900
July			226	13,900
August	98		60.7	3,730
September	40	30	34.5	2,050

NOTE.—To obtain monthly mean discharge for October and May to August the daily discharge was interpolated on days when gage was not read.

SOUTH FORK OF AHTANUM CREEK AT CONRAD RANCH, NEAR TAMPICO, WASH.

LOCATION.—In W. ½ sec. 23, T. 12 N., R. 15 E., at Conrad ranch, 2½ miles above mouth of North Fork and 2¾ miles southwest of Tampico, in Yakima County.

DRAINAGE AREA.—26 square miles (measured on topographic maps).

RECORDS AVAILABLE.—March 15, 1915, to September 30, 1916.

GAGE.—Vertical staff on left bank about 75 feet from observer's house; read by Mrs. W. B. Conrad.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand; shifting at high stages. Banks high and wooded. Concrete control built 7 feet below gage September 6, 1916. Stage of zero flow, according to measurements made September 6, 1916, gage height, 1.2 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year, 3.10 feet June 19 (discharge, 216 second-feet); minimum stage recorded, 0.62 foot October 1–11 (discharge, 5.1 second-feet).

1915–16: Maximum stage recorded June 19, 1916; minimum stage recorded, 0.60 foot September 25–26, 1915 (discharge, 4.3 second-feet).

ICE.—Record discontinued during winter.

DIVERSIONS.—Small ditch diverting above gage supplies water to Conrad's hop fields.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water of 1916 and when concrete control was built in September. Three rating curves used, well defined for low water, applicable October 1–31, May 8 to September 2, and September 6–30. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent for periods in which discharge was less than 100 second-feet and good for those in which it was higher.

Discharge measurements of South Fork of Ahtanum Creek at Conrad ranch, near Tampico, Wash., during the year ending Sept. 30, 1916.

[Made by C. G. Paulsen.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 13	0.62	5.1	Aug. 2	1.36	25.2
May 8	2.04	84.7	Sept. 6	1.68	[a] 14.5

[a] Discharge was same on Sept. 2, before concrete control was built, at gage height 1.17 feet.

Daily discharge, in second-feet, of South Fork of Ahtanum Creek at Conrad ranch, near Tampico, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	May.	June.	July.	Aug.	Sept.	Day.	Oct.	May.	June.	July.	Aug.	Sept.
1	5.1	.....	76	81	25	14	16	6.0	49	151	60	17	13
2	5.1	.....	76	92	24	15	17	6.0	60	164	56	17	12
3	5.1	.....	81	81	23	15	18	6.0	65	203	51	17	12
4	5.1	.....	86	76	23	14	19	6.4	70	203	47	16	12
5	5.1	.....	92	70	22	14	20	6.4	70	151	46	16	12
6	5.1	.....	98	70	22	14	21	6.4	70	115	44	16	12
7	5.1	.....	103	70	22	14	22	6.4	70	103	42	16	12
8	5.1	86	103	70	22	14	23	10.	65	103	39	16	12
9	5.1	.....	103	70	22	14	24	6.4	60	103	36	15	12
10	5.1	.....	103	70	21	13	25	6.4	60	98	34	15	12
11	5.1	.....	103	70	21	13	26	6.4	65	103	33	15	12
12	5.6	.....	103	70	21	13	27	6.4	70	103	32	15	11
13	6.0	.....	115	65	20	13	28	6.4	81	92	30	14	11
14	6.0	.....	127	60	20	13	29	6.4	81	81	29	14	11
15	6.0	46	139	60	18	13	30	6.4	81	81	28	15	11
							31	6.8	76	.....	26	15	.....

NOTE.—No gage-height record July 26 to Aug. 1 and Sept. 3–5; discharge interpolated.

Monthly discharge of South Fork of Ahtanum Creek at Conrad ranch, near Tampico, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	10	5.1	5.96	366
June	203	76	112	6,660
July	92	26	55.1	3,390
August	25	14	18.5	1,140
September	15	11	12.8	762

NEW RESERVATION CANAL NEAR PARKER, WASH.

LOCATION.—In sec. 20, T. 12 N., R. 19 E., about a mile below intake of canal, three-fourths mile northwest of Parker, in Yakima County, and 5½ miles northwest of Wapato.

RECORDS AVAILABLE.—Irrigation seasons 1904 to 1916.

GAGE.—Vertical staff on left side at highway bridge about a mile below intake; installed April 27, 1916. Gages previously used as follows: Prior to April 1, 1911, gage at about present site; April 1, 1911, to April 26, 1916, about a quarter of a mile above present site.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed composed of gravel and small stones. Channel at times obstructed by growth of aquatic plants. Operation of checks below gage renders control unstable.

EXTREMES OF DISCHARGE.—1904–1916: Maximum stage recorded, 5.74 feet May 26–28, 1916 (discharge, 746 second-feet); canal dry during nonirrigating seasons.

ACCURACY.—Stage-discharge relation changed during winter, when record was discontinued, and about August 15, at new gaging station. Rating curves fairly well defined. Gage read twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge. Some discharge measurements were also made by United States Office of Indian Affairs.

Canal diverts from right bank of Yakima River in sec. 20, T. 12 N., R. 19 E., about 1¾ miles above intake of Old Reservation canal. Water is used for irrigation.

Discharge measurements of New Reservation canal near Parker, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 11	F. E. Moxley	[a] 2.89	201	July 3	R. S. Skillin	4.85	548
15	do	[b] 3.89	362	3	F. E. Moxley	4.85	557
21	do	4.82	549	10	R. S. Skillin	4.58	503
24	R. S. Skillin	4.78	530	21	do	4.37	454
29	do	5.30	663	24	do	4.33	457
May 8	do	5.46	681	Aug. 9	do	5.00	576
15	do	5.30	655	11	F. E. Moxley	5.08	588
18	Parker and Taylor	5.52	728	14	R. S. Skillin	5.39	657
20	R. S. Skillin	5.59	728	22	do	4.86	523
24	do	5.68	727	28	F. E. Moxley	4.42	423
25	do	5.71	751	28	R. S. Skillin	4.49	439
June 8	do	5.13	601	Sept. 5	do	4.27	393
12	do	4.82	539	12	do	4.11	356
15	F. E. Moxley	4.98	607	18	do	3.98	344
22	R. S. Skillin	5.70	770	25	do	3.62	273
28	do	2.81	200				

[a] Old gage, 1.92 feet.

[b] Old gage, 2.90 feet.

Daily discharge, in second-feet, of New Reservation canal near Parker, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Apr.	May.	June.	July.	Aug.	Sept.
1	117	248	14	693	653	649	508	416
2	117	253	14	649	625	636	504	427
3	117	231	25	671	645	554	516	440
4	120	222	38	682	662	541	533	414
5	118	231	53	682	682	541	549	390
6	120	227	97	700	575	526	558	370
7	120	129	97	693	541	504	570	368
8	121	117	121	697	609	500	581	362
9	121	135	121	702	601	605	583	360
10	122	129	121	700	585	498	596	338
11	122	130	153	691	564	508	603	354
12	122	127	198	680	543	541	603	358
13	123	128	229	667	583	530	607	306
14	127	.....	317	649	603	522	656	288
15	127	.....	353	667	693	530	649	295
16	127	.....	362	697	697	549	613	316
17	189	.....	400	706	706	549	605	331
18	198	.....	446	704	700	498	615	334
19	196	.....	491	702	702	461	579	318
20	198	.....	528	706	715	457	569	307
21	244	.....	542	711	728	453	544	302
22	244	.....	568	702	730	452	511	302
23	227	.....	570	708	308	450	521	302
24	227	.....	577	735	461	450	504	300
25	224	.....	643	737	724	450	472	264
26	226	.....	667	746	726	442	472	262
27	222	.....	627	746	728	438	458	262
28	214	.....	653	746	383	442	438	266
29	234	.....	680	737	631	448	422	266
30	231	.....	675	697	658	450	416	266
31	240	.....	.....	671	.....	480	416	.....

Monthly discharge of New Reservation canal near Parker, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off total (in acre-feet).
	Maximum.	Minimum.	Mean.	
October	244	117	170	10,400
November 1–13	253	117	177	4,570
April	680	14	346	20,600
May	746	649	699	43,000
June	730	308	625	37,200
July	649	438	505	31,000
August	656	416	541	33,200
September	440	262	329	19,600

OLD RESERVATION CANAL NEAR PARKER, WASH.

LOCATION.—In sec. 28, T. 12 N., R. 19 E., about 300 feet below intake and about 500 feet above controlling waste of first lateral, a mile east of Parker, in Yakima County, and 3½ miles northwest of Wapato.

RECORDS AVAILABLE.—Irrigation seasons 1904 to 1916.

GAGE.—Vertical staff on left side about 10 feet upstream from private farm bridge; read by Frank Sutton. Prior to June 23, 1908, vertical staff on downstream end of right retaining wall of Northern Pacific Railway bridge, about half a mile below site of present gage and at different datum.

DISCHARGE MEASUREMENTS.—Made from gaging bridge at gage.

CHANNEL AND CONTROL.—Bed of old slough. Velocities high. No obstruction from growth of aquatic plants. Fairly permanent for each irrigation season.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.00 feet May 27 (discharge, 316 second-feet); canal dry October 1 to March 31.

1904-1916: Maximum stage recorded, 4.20 feet June 17, 1914 (discharge, 332 second-feet). No water diverted during nonirrigating seasons.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Gage read twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge. Some discharge measurements were also made by United States Office of Indian Affairs.

Canal diverts from right bank of Yakima River in sec. 28, T. 12 N., R. 19 E., about half a mile above intake of Sunnyside canal. Water is used for irrigation.

Discharge measurements of Old Reservation canal near Parker, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Apr. 11	F. E. Moxley	2.88	129	July 3	R. Skillin	3.12	153
15	do	4.00	228	3	F. E. Moxley	3.12	153
20	R. Skillin	3.94	228	7	R. Skillin	3.29	160
21	F. E. Moxley	4.03	231	17	do	3.85	210
29	R. Skillin	4.20	244	24	do	2.95	132
May 8	do	4.33	258	Aug. 9	do	4.00	232
15	do	4.68	288	11	F. E. Moxley	3.98	227
19	Parker and Taylor	4.86	302	14	R. Skillin	3.84	217
20	R. Skillin	4.90	310	22	do	3.39	165
24	do	4.83	298	28	do	3.40	173
27	do	5.01	316	28	F. E. Moxley	3.38	170
June 9	do	4.46	265	Sept. 5	R. Skillin	3.05	140
12	do	3.80	207	12	do	2.12	66.3
15	F. E. Moxley	4.70	290	12	do	2.61	104
22	R. Skillin	4.80	310	18	do	2.04	60.2
28	do	3.30	165	25	do	2.04	61.8

Daily discharge, in second-feet, of Old Reservation canal near Parker, Wash., for the year ending Sept. 30, 1916.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	15.5	244	298	217	219	147	16	208	291	311	217	194	57.8
2	15.5	253	298	208	221	145	17	208	302	293	212	185	59.0
3	47.0	266	298	153	219	150	18	203	314	307	163	174	61.8
4	47.0	253	302	149	221	149	19	208	302	311	136	176	62.5
5	47.0	271	298	136	230	136	20	221	307	293	132	172	59.0
6	47.0	266	275	127	235	127	21	221	309	289	131	165	62.5
7	48.2	257	262	134	235	111	22	226	307	284	131	174	60.4
8	59.0	244	266	134	226	100	23	222	302	296	131	185	62.5
9	69.5	253	269	144	226	99.0	24	221	296	298	131	190	61.8
10	91.0	266	253	154	226	91.0	25	222	302	289	138	181	61.8
11	111	267	226	172	226	99.0	26	242	308	289	167	181	61.8
12	127	271	212	190	226	85.6	27	239	316	280	167	172	61.8
13	154	275	212	203	221	67.4	28	253	311	257	163	169	65.3
14	190	282	235	208	221	62.5	29	246	311	253	176	156	69.5
15	217	284	282	212	210	56.0	30	237	298	226	199	145	69.5
							31	.....	293	.....	217	145	.....

Monthly discharge of Old Reservation canal near Parker, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April	253	15.5	155	9,250
May	316	244	285	17,500
June	311	212	275	16,400
July	217	127	166	10,200
August	235	145	198	12,200
September	150	56	85.4	5,080
The period				70,600

SUNNYSIDE CANAL NEAR PARKER,[1] WASH.

LOCATION.—In sec. 28, T. 12 N., R. 19 E., about 600 feet below intake, 1½ miles east of Parker, and 3½ miles northwest of Wapato, in Yakima County.

RECORDS AVAILABLE.—Irrigation seasons 1904–1916.

GAGE.—Lietz water-stage recorder on right side; installed April 20, 1909; referred to vertical staff gage installed April 6, 1908. Prior to April 6, 1908, vertical staff on left side about 200 feet above site of present gage and at different datum. An inclined staff gage, installed April 6, 1907, at about same site as present gage, was in use during 1907, but gage heights were referred to datum of original gage. Recorder inspected daily by Henry Hanson.

DISCHARGE MEASUREMENTS.—Made from gaging bridge 30 feet below gage.

CHANNEL AND CONTROL.—Bottom of canal gravel; fairly permanent. Operation of flash board at drop No. 1 makes control changeable.

EXTREMES OF DISCHARGE.—1904–1916: Maximum stage recorded, 5.31 feet August 23, 1916 (discharge, 1,160 second-feet); no water in canal during nonirrigating seasons.

ACCURACY.—Stage-discharge relation affected by variable velocity of approach due to different gate openings at headworks and by operation of flash boards at drop No. 1. Daily discharge ascertained by shifting-control method except June 12 to July 16, for which period mean daily gage height was applied directly to rating curve. As discharge measurements were made frequently records are excellent.

COOPERATION.—United States Reclamation Service made current-meter measurements and computed discharge.

Canal diverts water from left bank of Yakima River in sec. 28, T. 12 N., R. 19 E., about half a mile below intake of Old Reservation canal. Water is used for irrigation.

Discharge measurements of Sunnyside canal near Parker, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 13	G. D. Hall	3.23	465	June 7	G. D. Hall	4.57	929
21	do	3.52	543	17	do	4.71	972
28	do	3.42	523	28	do	4.775	996
Mar. 14	do	1.35	103	July 8	do	4.50	901
21	do	1.78	184	19	do	4.81	1,004
30	do	2.11	253	28	do	4.69	949
Apr. 7	do	2.41	289	Aug. 9	do	4.96	1,043
14	do	3.53	616	18	Hall and Moore	5.06	1,066
21	do	4.12	801	Sept. 2	G. D. Hall	4.95	1,037
28	do	4.40	890	11	do	4.42	856
May 8	do	4.49	926	19	do	4.13	750
17	do	4.61	954	29	do	3.81	645
27	do	4.58	925				

[1] Described in previous reports as "near Wapato."

Daily discharge, in second-feet, of Sunnyside canal near Parker, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	217	.....	253	893	932	984	1,000	1,030
2	230	.....	269	893	945	945	998	1,040
3	255	.....	273	897	935	935	1,000	1,030
4	295	.....	278	925	893	925	1,020	1,010
5	303	.....	292	942	897	907	1,020	984
6	312	.....	290	942	911	900	1,030	949
7	335	.....	308	939	893	900	1,040	935
8	347	.....	349	932	942	900	1,030	935
9	381	11	400	917	938	917	1,040	914
10	400	56	415	893	935	921	1,040	859
11	422	71	441	904	935	939	1,060	859
12	449	72	502	900	925	970	1,060	829
13	464	90	574	911	938	1,010	1,080	799
14	482	103	602	911	938	1,010	1,070	770
15	484	133	629	914	932	1,030	1,070	755
16	487	168	649	925	942	1,010	1,070	758
17	505	170	663	945	973	970	1,060	774
18	508	175	669	956	984	952	1,070	763
19	508	173	693	952	991	984	1,080	755
20	516	180	745	967	977	1,000	1,100	745
21	527	184	780	977	980	991	1,110	730
22	516	184	789	977	956	974	1,130	711
23	524	180	793	967	998	967	1,160	693
24	524	184	796	942	1,030	952	1,150	678
25	529	211	819	921	1,030	945	1,130	663
26	532	213	852	914	1,020	932	1,090	660
27	529	228	880	917	1,010	949	1,070	658
28	529	239	890	921	1,000	956	1,050	652
29	540	253	890	914	1,000	980	1,040	643
30	532	253	886	932	998	1,000	1,040	643
31	521	253	.....	917	.....	998	1,040	.....

NOTE.—No water in canal Nov. 1 to Mar. 8.

Monthly discharge of Sunnyside canal near Parker, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	540	217	442	27,200
March	253	0	122	7,500
April	890	253	589	35,000
May	977	893	928	57,100
June	1,030	893	959	57,100
July	1,030	900	960	59,000
August	1,160	998	1,060	65,200
September	1,040	643	807	48,000

TOPPENISH CREEK NEAR FORT SIMCOE, WASH.

LOCATION.—In sec. 26, T. 10 N., R. 16 E., at Olney's ranch, 1½ miles below the highway bridge, 3½ miles southeast of Fort Simcoe, and about 5 miles southwest of White Swan, in Yakima County.

DRAINAGE AREA.—124 square miles (measured on Plate I, Water-Supply Paper 369).

RECORDS AVAILABLE.—February 27, 1909, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank half a mile east of Olney ranch house; installed August 19, 1915. February 27, 1909, to July 22, 1913, chain gage on left bank a quarter of a mile above site of present gage; July 23, 1913, to August 18, 1915, vertical staff attached to cottonwood tree on right bank 150 feet above site of present gage.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders; shifting at high stages. Concrete control built in August, 1915, was buried under gravel during high water of February, 1916. New concrete control installed September 10–13, 1916. Both banks covered with brush; subject to overflow at extremely high water.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.46 feet at noon May 4 (discharge, 1,650 second-feet); minimum stage recorded, 0.60 foot October 1 (discharge, 9.3 second-feet).

1909–1916: Maximum stage recorded May 4, 1916; minimum stage recorded, 0.95 foot January 17, 1915 (discharge, 3.5 second-feet).

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

DIVERSIONS.—A small irrigating ditch diverts water above station. Diversion of spring run-off into a reservoir on Simcoe Creek for use in irrigating Indian lands is proposed.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed February 10 and May 4, when control shifted at high water, and September 13, when new concrete control was built. Rating curves not well defined except for low stages. Daily discharge ascertained by applying a rating table mean daily gage heights obtained by inspecting gage height graph or, for days of considerable fluctuation, by averaging results obtained by applying the gage heights for shorter intervals. Records excellent for low water, except when record was broken, and fair for higher stages. See note to table of daily discharge.

Discharge measurements of Toppenish Creek near Fort Simcoe, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 20	Paulsen and Schuler	0.76	24.3	July 30	C. G. Paulsen	2.10	35.4
Jan. 23	G. L. Parker	1.87	250	31	do	2.09	36.0
Feb. 19	C. G. Paulsen	2.67	362	Sept. 9	do	1.30	21.8
May 5	do	5.16	1,060	13	do	2.36	20.2

Daily discharge, in second-feet, of Toppenish Creek near Fort Simcoe, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10.0	21	.....	53	.....	164	424	1,020	308	136	35	20
2	10.0	21	.....	50	.....	143	480	1,170	292	136	34	20
3	10.8	19.7	.....	48	66	153	562	1,320	277	136	33	22
4	11.5	19.7	.....	48	.....	143	646	1,570	292	136	32	23
5	12.2	22	.....	46	.....	133	646	1,020	277	136	31	23
6	12.2	21	.....	46	.....	133	646	860	235	136	31	22
7	12.9	21	.....	46	.....	143	646	755	222	136	31	22
8	12.9	21	.....	46	.....	250	731	610	210	109	32	22
9	12.9	21	.....	46	.....	480	871	474	198	80	32	22
10	12.2	21	.....	43	734	970	970	394	176	87	31	21
11	12.9	21	.....	34	688	920	920	324	165	80	30	21
12	12.9	21	50	.....	372	920	823	292	145	74	29	21
13	13.8	21	48	.....	264	871	776	262	145	74	28	20
14	14.7	21	43	.....	210	688	920	248	136	68	28	20
15	14.7	22	38	.....	279	562	1,020	235	136	68	26	20
16	15.7	27	38	.....	406	480	920	248	136	68	26	20
17	15.7	24	37	.....	480	521	823	292	136	.....	26	20
18	14.7	28	34	.....	406	521	731	341	126	.....	26	18.8
19	14.7	28	33	.....	372	562	646	394	126	.....	26	18.8
20	15.7	24	39	.....	324	1,020	604	413	126	.....	25	18.8
21	15.7	24	717	.....	264	1,120	562	432	126	.....	24	18.1
22	15.7	26	804	.....	236	823	562	413	126	.....	23	18.1
23	22	33	271	288	223	604	480	376	126	.....	22	18.1
24	24	30	162	367	210	442	480	341	126	.....	22	18.8
25	21	34	127	199	198	442	604	341	126	.....	22	18.1
26	19.7	34	101	161	198	646	823	358	126	.....	21	17.4
27	19.7	30	85	.....	186	688	1,070	394	136	.....	21	17.4
28	19.7	28	76	.....	175	562	1,070	432	136	.....	21	17.4
29	19.7	28	68	.....	175	480	920	394	136	.....	20	17.4
30	19.7	28	56	.....	.....	406	920	341	136	37	20	17.4
31	19.7	.....	58	.....	.....	372	.....	308	.....	35	20	.....

NOTE.—Discharge determined as follows: Oct. 1 to Feb. 10, from rating curve well defined below, poorly defined above, and fairly well defined between 75 and 500 second-feet; Feb. 11 to May 4, from poorly defined rating curve; May 5 to Sept. 9 from curve well defined below and fairly well defined above 75 second-feet; Sept. 13–30, from well-defined rating curve. Weight chain caught Nov. 30 to Dec. 11; discharge estimated by hydrographic comparison with records of flow of Simcoe and Satus creeks as follows: Nov. 30, 28 second-feet; Dec. 1–11, 43 second-feet. Well frozen over Jan. 12–22, Jan. 27 to Feb. 2, and Feb. 4–9; discharge estimated by hydrographic comparison as follows: Jan. 12–20, 34 second-feet; Jan. 21, 50 second-feet; Jan. 22, 65 second-feet; Jan. 27–31, 125 second-feet; Feb. 1–2, 85 second-feet; Feb. 4–8, 66 second-feet; Feb. 9, 90 second-feet. July 17–29, supply of record paper exhausted; discharge estimated at 52 second-feet. Sept. 10–12 concrete control being built; discharge interpolated.

Monthly discharge of Toppenish Creek near Fort Simcoe, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	24	10.0	15.5	953
November	34	19.7	24.7	1,470
December	804	.....	108	6,640
January	367	.....	82.8	5,090
February	734	.....	243	14,000
March	1,120	133	528	32,500
April	1,070	424	743	44,200
May	1,570	235	528	32,500
June	308	126	172	10,200
July	136	35	77.7	4,780
August	35	20	26.7	1,640
September	23	17.4	19.8	1,180
The year	1,570	10.0	214	155,000

SIMCOE CREEK BELOW SPRING CREEK, NEAR FORT SIMCOE, WASH.

LOCATION.—In sec. 34, T. 11 N., R. 16 E., at site of proposed reservoir, 4 miles northeast of Fort Simcoe, in Yakima County.

DRAINAGE AREA.—77 square miles (measured on Plate I, Water-Supply Paper 369).

RECORDS AVAILABLE.—November 20, 1915, to September 30, 1916. For a station just above Spring Creek, February 28, 1909, to November 20, 1915.

GAGE.—Stevens water-stage recorder on left bank just below Spring Creek; inspected twice a month by Martin Schuler.

DISCHARGE MEASUREMENTS.—Made from foot bridge at gage or by wading.

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Concrete control 16 feet below gage. Banks fairly high: not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.14 feet at 5 p. m. February 10 (discharge, 731 second-feet); minimum stage recorded, 0.17 foot November 20 (discharge, 0.2 second-foot).

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

ACCURACY.—Stage-discharge relation changed February 10, when foot bridge was washed onto control; it remained there until September 11. Rating curves used before and after the change well defined below and fairly well defined above 50 second-feet. Daily discharge ascertained by applying mean daily gage height to rating table except that for December 21 and February 10–16, which was found by averaging results obtained by applying gage heights for regular intervals. Records good for low and medium stages and fair for higher stages. See note to table of daily discharge.

Discharge measurements of Simcoe Creek, below Spring Creek, near Fort Simcoe, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Nov. 21	C. G. Paulsen	0.22	0.9	July 31	C. G. Paulsen	0.49	7.7
Jan. 23	G. L. Parker	2.06	172	Aug. 6	Paulsen and Freeman	.42	5.1
Feb. 20	Paulsen and Schuler	2.60	208	Sept. 11	C. G. Paulsen	.33	3.1
May 5	C. G. Paulsen	2.99	260				

Daily discharge, in second-feet, of Simcoe Creek below Spring Creek, near Fort Simcoe, Wash., for the year ending Sept. 30, 1916.

Day.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	2.3	.....	20	85	144	115	62	24	7.8	3.2
2	.....	2.3	.....	19	75	162	135	58	26	7.3	3.2
3	.....	3.4	.....	19	75	180	168	57	25	6.8	3.2
4	.....	4.6	.....	20	69	192	222	59	23	6.3	4.0
5	.....	5.3	.....	19	65	186	254	60	21	5.8	4.3
6	.....	4.3	.....	19	109	180	247	58	20	5.3	4.3
7	.....	9.7	.....	20	152	180	204	57	20	5.7	3.4
8	.....	10	.....	29	196	186	162	55	18	5.3	2.9
9	.....	8.8	.....	42	240	204	119	53	17	5.3	2.6
10	.....	7.6	.....	598	338	222	90	51	17	5.0	2.0
11	.....	6.8	.....	426	435	222	75	47	16	4.6	2.6
12	.....	6.4	.....	234	435	192	64	45	14	4.6	2.6
13	.....	6.4	.....	164	421	168	57	42	13	4.3	2.6
14	.....	6.1	.....	175	351	174	54	41	13	4.3	2.6
15	.....	5.7	.....	211	280	198	52	40	13	4.3	2.6
16	.....	5.3	.....	378	234	192	53	38	14	4.0	2.6
17	.....	5.0	.....	306	228	162	57	37	15	4.3	2.6
18	.....	3.7	.....	312	222	136	62	34	14	4.3	2.3
19	.....	4.0	.....	266	254	105	66	34	13	4.3	2.3
20	0.2	5.3	.....	216	379	88	69	34	12	4.0	2.3
21	.3	293	.....	174	393	78	69	32	12	4.0	2.3
22	.7	.....	.....	144	351	73	68	31	10	4.0	1.7
23	1.4	.....	117	126	280	67	64	28	11	4.0	2.0
24	1.6	.....	46	115	228	64	60	28	9.2	4.0	1.7
25	1.7	.....	38	106	210	65	58	27	8.8	3.7	2.0
26	2.3	.....	32	105	204	80	56	26	9.2	3.7	2.0
27	2.0	.....	30	98	204	112	59	26	9.7	4.0	2.0
28	2.6	.....	27	93	192	125	68	26	9.7	3.7	2.0
29	2.9	.....	22	85	174	107	71	25	9.7	3.7	2.0
30	2.6	.....	22	.....	150	101	64	24	9.2	3.7	2.0
31	.....	.....	20	.....	136	.....	60	.....	8.3	3.4	.....

NOTE.—No gage-height record Dec. 22 to Jan. 22; discharge estimated by hydrographic comparison with Toppenish and Satus creeks as follows: Dec. 22–26, 85 second-feet; Dec. 27–31, 18 second-feet; Jan. 1–5, 9 second-feet; Jan. 6–10, 8 second-feet; Jan. 11–16, 5 second-feet; and Jan. 17–22, 8 second-feet. No gage height record Mar. 6–8 and Aug. 1–5, discharge interpolated.

Monthly discharge of Simcoe Creek below Spring Creek, near Fort Simcoe, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
November 20–31	2.9	0.2	1.66	36.2
December	293	2.3	29.7	1,830
January	.....	.....	16.7	1,030
February	598	19	157	9,030
March	435	65	231	14,200
April	222	64	145	8,630
May	254	52	97.5	6,000
June	62	24	41.2	2,450
July	26	8.3	14.7	904
August	7.8	3.4	4.69	288
September	4.3	1.7	2.60	155
The period	.....	.....	.....	44,600

RESERVATION DRAIN AT ALFALFA, WASH.

LOCATION.—In sec. 29, T. 10 N., R. 21 E., at highway bridge a quarter of a mile southeast of Alfalfa, in Yakima County, about 2 miles above mouth of drain.

RECORDS AVAILABLE.—December 5, 1912, to September 30, 1916; miscellaneous measurements 1911 and 1912.

GAGE.—Vertical staff on right bank under highway bridge; read by Miss Nellie Ide.

DISCHARGE MEASUREMENTS.—Made from footbridge 1,000 feet below gage; prior to August, 1916, made from highway bridge at gage, highway bridge 2 miles below gage, or from gaging footbridge (washed out in February, 1916), 2 miles below gage.

CHANNEL AND CONTROL.—Bed composed of gravel. Control prior to highwater of 1916 was formed largely by the loose rock piled at railroad bridge 150 feet below gage; shifting frequently; present control is gravel bar which was deposited 250 feet below gage by high water of 1916 and is likely to shift at high water. Banks high. Current swift at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, about 4.8 feet (determined by levels) during period in which water was over gage (discharge, 590 second-feet); minimum stage recorded, 1.88 feet October 1, 4, and 7 (discharge, 156, second-feet).

1913–1916: Maximum stage recorded, about 4.8 feet in 1916; minimum stage recorded, 1.8 feet July 3, August 12, 15-31, September 1-14, 19, 1915 (discharge, 145 second-feet).

ICE.—Ice does not form at this station.

DIVERSION.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed gradually from October 27 to December 17 and during the spring high water. Rating curve October 1–26 well defined; December 18 to March 10 well defined below 200 second-feet; May 1 to September 30 well defined. Gage read to quarter-tenths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records excellent except for periods of high water in February and March, for which rating curve is not well defined and gage-height record is uncertain as gage was in poor condition.

Reservation drain carries the return water from irrigation by the reservation canals and the under flow of Toppenish Valley. During the low-water period practically the whole flow of Toppenish Creek is carried into this channel by seepage underground.

Discharge measurements of Reservation drain at Alfalfa, Wash., during the year ending Sept. 30, 1916.

Date.	Made by—	Gage height.	Discharge.	Date.	Made by—	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 9	R. S. Skillen [a]	1.90	156	July 18	R. S. Skillen	3.30	280
26	do	2.05	173	22	do	3.16	255
Nov. 2	do	2.14	185	29	do	3.06	235
Jan. 5	C. G. Paulsen	2.00	181	Aug. 5	C. G. Paulsen	2.93	218
25	R. S. Skillen	2.08	184	12	R. S. Skillen	2.95	218
Feb. 23	C. G. Paulsen	3.88	472	21	do	3.06	235
May 3	do	4.25	478	Sept. 1	do	3.02	237
June 16	R. S. Skillen	3.42	310	9	do	3.16	259
24	do	3.48	326	15	C. G. Paulsen	3.12	255
July 1	do	3.56	336	16	R. S. Skillen	3.13	255
8	do	3.60	352	23	do	3.18	265
15	do	3.08	246	29	do	3.12	254

[a] Engineer, United States Indian Service.

Daily discharge, in second-feet, of Reservation drain at Alfalfa, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	May.	June.	July.	Aug.	Sept.
1	156	183	184	178	178	363	468	348	348	249	230
2	156	185	185	178	178	345	468	328	348	249	230
3	156	183	187	178	178	328	468	348	368	230	230
4	156	183	185	178	178	328	488	328	388	220	249
5	156	183	187	178	178	328	508	328	388	220	268
6	156	183	185	178	178	328	548	348	348	220	249
7	156	183	187	178	178	311	548	348	348	230	249
8	156	181	187	178	178	311	548	348	348	230	249
9	156	178	187	178	200	345	528	348	328	230	268
10	156	182	185	178	235	495	488	348	328	230	268
11	156	182	186	178	418	.....	468	348	328	220	268
12	156	182	186	178	.....	.....	428	348	268	220	268
13	156	182	186	178	.....	.....	388	348	268	220	268
14	156	182	186	178	.....	.....	368	328	268	230	249
15	167	182	186	178	.....	.....	348	328	249	230	249
16	167	182	182	178	.....	.....	328	308	268	230	249
17	167	183	177	178	.....	.....	328	308	288	230	268
18	167	183	178	167	.....	.....	308	328	288	230	268
19	167	183	178	167	.....	.....	328	328	288	230	268
20	178	179	178	167	.....	.....	328	348	268	230	268
21	167	183	178	167	.....	.....	348	348	268	249	268
22	178	179	178	178	.....	.....	348	348	268	230	268
23	167	183	178	178	475	.....	348	348	268	249	268
24	167	184	178	189	418	.....	348	328	268	249	268
25	167	186	189	189	399	.....	368	328	249	249	268
26	172	186	189	189	399	.....	368	348	249	249	268
27	177	184	189	189	381	.....	348	348	230	230	288
28	180	184	189	178	381	.....	348	348	249	230	268
29	180	184	189	178	363	.....	348	348	249	230	249
30	181	184	178	178	.....	.....	348	348	230	230	249
31	182	.....	178	178	.....	.....	348	.....	230	230	.....

NOTE.—Discharge Oct. 27 to Dec. 17 determined by shifting-control method. Water over gage February 12–22; discharge estimated from observer's notes at 450 second-feet. Water over gage Mar. 11 to Apr. 30; discharge not estimated. Gage repaired and extended for high-water readings May 2.

Monthly discharge of Reservation drain at Alfalfa, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	182	156	178	10,900
November	186	178	183	10,900
December	189	177	184	11,300
January	189	167	178	10,900
February	.....	178	346	19,900
May	548	308	405	24,900
June	348	308	339	20,200
July	388	230	293	18,000
August	249	220	232	14,300
September	288	230	259	15,400

SATUS CREEK BELOW DRY CREEK, NEAR TOPPENISH, WASH.

LOCATION.—In sec. 24, T. 9 N., R. 19 E., at dam site about a mile below mouth of Dry Creek and 9 miles southwest of Toppenish, in Yakima County.

DRAINAGE AREA.—427 square miles (measured on topographic maps and map of Yakima Indian Reservation).

RECORDS AVAILABLE.—June 22, 1913, to September 30, 1916.

GAGE.—Stevens water-stage recorder on left bank.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; shifting at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 9.15 feet December 22 (from high-water marks in well; discharge, 3,870 second-feet); minimum stage recorded, 0.43 foot October 1 (discharge, 10 second-feet).

1913–1916: Maximum stage December 22, 1915; minimum stage recorded, 0.28 foot at 10 p. m. August 28 and 4 a. m. August 30, 1915 (discharge, 6.6 second-feet).

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

DIVERSIONS.—Entire flow of Satus Creek above Lazy Creek is diverted for irrigation during July and August; records for low-water summer months show run-off of Lazy and Dry creeks and seepage return from upper Satus Creek.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water December 22 and March 21. Rating curve used October 1 to December 21, well defined; December 22 to March 10, well defined up to 1,400 second-feet; March 25 to September 15, fairly well defined below 1,000 second-feet. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting graph or for days of considerable fluctuation by applying gage heights for shorter intervals; shifting-control method used September 16–30. Records excellent for low and medium stages, before high water in March, except when gage-height record is broken; good for low and medium stages after high water; those for higher stages fair. See note to table of daily discharge.

Discharge measurements of Satus Creek below Dry Creek, near Toppenish, Wash., during the year ending Sept. 30, 1916.

[Made by C. G. Paulsen.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
Nov. 7	0.67	18.8	Feb. 17	5.10	1,230	May 9	3.10	367
Jan. 4	1.76	103	Feb. 22	3.72	641	Aug. 4	1.62	42.7
Jan. 6	1.64	89.2	May 2	3.00	328	Sept. 15	1.40	23.6

Daily discharge, in second-feet, of Satus Creek below Dry Creek, near Toppenish, Wash., for the year ending Sept. 30, 1916.

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	10	16	31	.....	.....	393	735	321	250	193	54	23
2	.....	17	30	.....	.....	356	715	329	250	229	51	24
3	.....	18	31	.....	.....	362	695	347	253	201	46	27
4	.....	19	40	105	.....	353	675	383	276	179	43	28
5	.....	18	57	93	.....	335	615	408	273	163	42	29
6	.....	18	114	88	.....	312	578	439	268	156	41	29
7	.....	19	186	82	.....	298	560	423	271	146	41	27
8	.....	19	284	88	90	500	560	392	282	144	40	26
9	.....	20	294	91	468	1,180	560	365	296	142	41	27
10	.....	19	171	91	1,890	1,350	578	329	279	136	39	26
11	.....	19	129	81	.....	1,170	595	301	255	132	37	27
12	.....	19	109	73	.....	1,040	542	276	255	124	36	25
13	.....	19	95	72	.....	978	508	258	255	120	39	25
14	.....	19	81	71	.....	692	508	240	263	114	38	25
15	.....	20	.....	71	.....	524	508	224	271	108	35	23
16	.....	22	.....	71	.....	456	472	216	282	132	34	23
17	.....	22	.....	71	1,280	472	472	216	298	150	33	23
18	.....	23	.....	71	1,280	456	439	219	312	118	33	22
19	.....	24	.....	71	1,040	456	408	232	301	105	32	22
20	.....	23	.....	71	870	827	383	234	260	98	31	22
21	.....	23	.....	71	750	.....	392	240	224	91	29	22
22	14	26	3,230	71	673	.....	374	234	201	84	29	21
23	14	34	.....	.....	692	.....	335	229	196	80	27	22
24	15	31	.....	.....	616	.....	315	224	188	77	26	23
25	15	33	.....	.....	597	990	307	234	193	75	25	22
26	15	44	.....	.....	597	1,800	310	234	229	74	25	22
27	14	37	251	.....	506	1,620	326	245	227	71	24	22
28	14	34	.....	.....	472	1,140	344	260	214	68	23	23
29	15	34	.....	.....	424	938	335	258	184	64	23	23
30	15	31	.....	.....	.....	795	324	245	174	60	25	22
31	15	.....	.....	.....	.....	755	.....	250	.....	57	24	.....

NOTE.—No gage-height record Oct. 2–21; discharge estimated by interpolation at 12 second-feet, as chart shows no change in stage, except the slight rise indicated by gage height of Oct. 22. Discharge estimated by hydrographic comparison with records of flow of Toppenish and Simcoe creeks when recorder was stopped as follows: Dec. 15–21, 400 second-feet; Dec. 23–26, 720 second-feet; Dec. 28–31, 190 second-feet; Jan. 1–3, 130 second-feet; Jan. 23–31, 540 second-feet; Feb. 1–7, 130 second-feet; Feb. 11–16, 1,260 second-feet. No gage-height record Mar. 21–24; discharge estimated by interpolation at 910 second-feet.

Monthly discharge of Satus Creek below Dry Creek, near Toppenish, Wash., for the year ending Sept. 30, 1916.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
October	15	10	12.8	787
November	44	16	24.0	1,430
December	3,230	30	373	22,900
January	.....	71	218	13,400
February	1,890	.....	714	41,100
March	1,800	298	780	48,000
April	735	307	482	28,700
May	439	216	284	17,500
June	312	174	249	14,800
July	229	57	119	7,320
August	54	23	34.4	2,120
September	29	21	24.2	1,440
The year	3,230	10	275	199,000

MISCELLANEOUS MEASUREMENTS.

In addition to the records of stream flow obtained at gaging stations and reported in the preceding pages, measurements of flows were made at a number of other points, as shown by the following table:

Miscellaneous discharge measurements in drainage basins in Washington during the year ending Sept. 30, 1916.

Snohomish River basin.

Date.	Stream.	Tributary to or diverting from—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
Apr. 3	North Fork Snoqualmie River.	Snoqualmie River.....	Gaging station at cable bridge near North Bend, Wash.	2.21	722
3	.....do.....	.....do.....	.....do.....	2.20	743
10	.....do.....	.....do.....	.....do.....	1.41	315

Stilaguamish River basin.

Oct. 5	South Fork, Stilaguamish River.	Stilaguamish River....	Gaging station at Granite Falls, Wash.	2.42	395
5	Canyon Creek.....	South Fork Stilaguamish River.	Mouth near Granite Falls, Wash.	.....	82

Stranger Creek basin.

Apr. 12	Stranger Creek.....	Columbia River.....	Sec. 21, T. 22 N., R. 36 E., at Meteor, Wash.	.....	153
Aug. 29	.....do.....	.....do.....	.....do.....	0.50	10.0

Okanogan River basin.

Oct. 24	Okanogan River.....	Columbia River.....	Above Similkameen River at Oroville, Wash.	.....	508
June 1	.....do.....	.....do.....	.....do.....	.....	1,120
11	.....do.....	.....do.....	.....do.....	.....	1,250
Aug. 5	.....do.....	.....do.....	.....do.....	.....	1,110
Oct. 25	Similkameen River....	Okanogan River.....	1½ miles below gage at bridge at Nighthawk, Wash.	1.86	664
Jan. 27	.....do.....	.....do.....	.....do.....	1.20	395
May 30	.....do.....	.....do.....	.....do.....	9.20	9,960
June 10	.....do.....	.....do.....	.....do.....	10.77	12,700
Aug. 4	.....do.....	.....do.....	.....do.....	4.18	2,610
May 30	West Okanogan Valley irrigation district canal.	Similkameen River...	Near intake, 2 miles below Nighthawk, Wash.	.....	94
June 10	.....do.....	.....do.....	.....do.....	.....	96
Aug. 4	.....do.....	.....do.....	.....do.....	.....	61

Chelan River basin.

Oct. 11	Stehekin River.....	Lake Chelan.....	100 yards above mouth of Bridge Creek.	.....	93
11	Bridge Creek.....	Stehekin River.....	Half a mile above mouth..	.....	40.6
13	Agnes Creek.....	.....do.....	300 feet above mouth.....	.....	98

Wenatchee River basin.

Oct. 4	Wenatchee Park, Land & Irr. Co.'s canal.	Chiwawa Creek.....	Half a mile below intake, 17 miles from Leavenworth, Wash.	.....	2.2

Yakima River basin.

Nov. 20	Abe Lincoln ditch [a]....	Toppenish Creek.....	1½ miles above gage on Toppenish Creek.	1.17	3.4
July 31	.....do.....	.....do.....	.....do.....	1.05	5.0
Sept. 13	.....do.....	.....do.....	.....do.....	.92	4.7
Nov. 21	Spring Creek.....	Simcoe Creek.....	Point where branch of Spring Creek empties into Wappat ditch.[b]	.....	.6

[a] Formerly called Nicol ditch.

[b] Wappat ditch diverts from Simcoe Creek below mouth of one branch of Spring Creek. This measurement shows quantity emptied into ditch by other branch of Spring Creek.

INDEX.

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART XII.—NORTH PACIFIC SLOPE BASINS

STREAM-GAGING STATIONS AND PUBLICATIONS RELATING TO WATER RESOURCES.

INTRODUCTION.

Investigation of water resources by the United States Geological Survey has consisted in large part of measurements of the volume of flow of streams and studies of the conditions affecting that flow, but it has comprised also investigation of such closely allied subjects as irrigation, water storage, water powers, underground waters, and quality of waters. Most of the results of these investigations have been published in the series of water-supply papers, but some have appeared in the bulletins, monographs, professional papers, and annual reports.

The results of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage features as indicated below:

Part I. North Atlantic slope basins.
II. South Atlantic slope and eastern Gulf of Mexico basins.
III. Ohio River basin.
IV. St. Lawrence River basin.
V. Upper Mississippi River and Hudson Bay basins.
VI. Missouri River basin.
VII. Lower Mississippi River basin.
VIII. Western Gulf of Mexico basins.
IX. Colorado River basin.
X. Great Basin.
XI. Pacific slope basins in California.
XII. North Pacific slope basins, in three volumes:
A, Pacific slope basins in Washington and upper Columbia River basin.
B, Snake River basin.
C, Lower Columbia River basin and Pacific slope basins in Oregon.

HOW GOVERNMENT REPORTS MAY BE OBTAINED OR CONSULTED.

Water-supply papers and other publications of the United States Geological Survey containing data in regard to the water resources of the United States may be obtained or consulted as indicated below.

1. Copies may be obtained free of charge by applying to the Director of the Geological Survey, Washington, D. C. The edition printed for free distribution is, however, small and is soon exhausted.

2. Copies may be purchased at nominal cost from the Superin-

tendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.

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

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

Boston, Mass., 2500 Customhouse.
Albany, N. Y., 704, Journal Building.
Atlanta, Ga., Post Office Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Topeka, Kans., 25 Federal Building.
Helena, Mont., Montana National Bank Building.
Denver, Colo., 403 New Post Office Building.
Salt Lake City, Utah, 421 Federal Building.
Boise, Idaho, 615 Idaho Building.
Portland, Oreg., 606 Post Office Building.
Tacoma, Wash., 406 Federal Building.
San Francisco, Cal., 328 Customhouse.
Los Angeles, Cal., 619 Federal Building.
Austin, Tex., Capitol Building.
Honolulu, Hawaii, 14 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director of the United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS.

Stream-flow records have been obtained at more than 4,100 points in the United States, and the data obtained have been published in the reports tabulated below:

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

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

Report.	Character of data.	Year.
10th A, pt. 2	Descriptive information only	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to September, 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th A, pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th A, pt. 2	Descriptive information only	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W 11	Gage heights (also gage heights for earlier years)	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for some earlier years).	1895 and 1896.
W 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th A, pt. 2	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.

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

Report.	Character of data.	Year.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	do	1903.
W 124 to 135	do	1904.
W 165 to 178	do	1905.
W 201 to 214	do	1906.
W 241 to 252	do	1907–8.
W 261 to 272	do	1809.
W 281 to 292	do	1910.
W 301 to 312	do	1911.
W 321 to 332	do	1912.
W 351 to 362	do	1913.
W 381 to 394	do	1914.
W 401 to 414	do	1915.
W 431 to 444	do	1916.

The records at most of the stations discussed in these reports extend over a series of years, and miscellaneous measurements at many points other than regular gaging stations have been made each year. An index of the reports containing records obtained prior to 1904 has been published in Water-Supply Paper 119.

The table following gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1916. The data for any particular station will, as a rule, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Me., 1903 to 1916, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, and 431, which contain records for the New England streams from 1903 to 1916. Results of miscellaneous measurements are published by drainage basins.

In these papers and in the following lists the stations are arranged in downstream order. The main stem of any river is determined by measuring or estimating its drainage area—that is, the headwater stream having the largest drainage area is considered the continuation of the main stream, and local changes in name and lake surface are disregarded. All stations from the source to the mouth of the main stem of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

In exception to this rule the records for Mississippi River are given in four parts, as indicated on page III, and the records for large lakes are presented in order of the streams around the rim of the lake.

89351°—19—WSP 442——14

Numbers of water-supply papers containing results of stream measurements, 1899–1916.

Year.	I North Atlantic slope basins (St. John River to York River).	II South Atlantic slope and eastern Gulf of Mexico basins (James River to the Mississippi).	III Ohio River. basin.	IV St. Lawrence River basin.	V Hudson Bay and upper Mississippi River basins.	VI Missouri River basin.	VII Lower Mississippi River basin.	VIII Western Gulf of Mexico basins.	IX Colorado River basin.	X Great Basin.	XI Pacific slope basins in California.	XII North Pacific slope basins.		
												Pacific slope basins in Washington and upper Columbia. River.	Snake River basin.	Lower Columbia River and Pacific slope basins in Oregon.
1899 [a]	35	[b] 35,36	36	36	36	[c] 36,37	37	37	[d] 37,38	38, [e] 39	38, [f] 39	38	38	38
1900 [g]	47, [h] 48	48	48, [i] 49	49	49	49, [j] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 83, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[h] 98, 99, [m] 100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 169, 173	174	175, [s] 177	176, [r] 177	177	178	178	[t] 177, 178
1906	[n] 201, [o] 202, [p] 203	[p] 203, 204	205	206	207	208	[k] 205, 209	210	211	212, [r] 213	213	214	214	214
1907–8	241	242	243	244	245	246	247	248	249	250, [r] 251	251	252	252	252
1909	261	262	263	264	265	266	267	268	269	270, [r] 271	271	272	272	272
1910	281	282	283	284	285	286	287	288	289	290	291	292	292	292
1911	301	302	303	304	305	306	307	308	309	310	311	312	312	312
1912	321	322	323	324	325	26	327	328	329	330	331	332–A	332–B	332–C
1913	351	352	353	354	355	356	357	358	359	360	361	362–A	362–B	362–C
1914	381	382	383	384	385	386	387	388	389	390	391	392	393	394
1915	401	402	403	404	405	406	407	408	409	410	411	412	413	414
1916	431	432	433	434	435	436	437	438	439	440	441	442	443	444

[a] Rating tables and index to Water-Supply Papers 35-39 contained in Water-Supply Paper 39. Tables fos monthly discharge for 1899 in Twenty-first Annual Report, Part IV.
[b] James River only.
[c] Gallatin River.
[d] Green and Gunnison rivers and Grand River above junction with Gunnison.
[e] Mohave River only.
[f] Kings and Kern rivers and south Pacific slope drainage basins.
[g] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52. Tables for monthly charge for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

NORTH PACIFIC SLOPE DRAINAGE BASINS.

PRINCIPAL STREAMS.

The largest rivers discharging into the Pacific Ocean in Oregon and Washington are Rogue, Umpqua, and Columbia rivers and streams that reach the ocean through Puget Sound. The principal tributaries of the Columbia are Kootenai, Clark Fork, Spokane, Wenatchee, Yakima, Snake, Walla Walla, Umatilla, John Day, Deschutes, Klickitat, Willamette, and Lewis rivers. Nisqually, Puyallup, White, Snohomish, and Skagit rivers flow into Puget Sound. The streams of this division drain wholly or in part the States of Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.

In addition to the list of gaging stations and the annotated list of publications relating specifically to the section, these pages contain a similar list of reports that are of general interest in many sections and cover a wide range of hydrologic subjects, and also brief references to reports published by State and other organizations (p. xxxii).

GAGING STATIONS.

NOTE.—Date after a date indicates that station was being maintained September 30, 1916. Period after a date indicates discontinuance.

BETWEEN COLUMBIA RIVER AND PUGET SOUND.

Chehalis River at Centralia, Wash., 1910–11.
Quinault River at Quinault Lake, Wash., 1911–
Soleduck River near Quillayute, Wash., 1897–1901.
Kalawa River near Forks, Wash., 1897–1901.

PUGET SOUND DRAINAGE BASINS.

Elwha River at McDonald, Wash., 1897–1901.
Elwha River near Port Angeles, Wash., 1911–12.
Dungeness River at Sequin, Wash., 1897–98.
Dungeness River at Dungeness, Wash., 1898–1901.
Dosewallips River at Brinnon, Wash., 1910–11.
Duckabush River near Duckabush, Wash., 1910–11.
Skokomish River, North Fork (head of Skokomish River), nead Hoodsport, Wash., 1910–11; 1913.
Nisqually River near Ashford, Wash., 1910–1914.
Nisqually River near La Grande, Wash., 1906–1911.
Puyallup River near Electron, Wash., 1909–
Puyallup River near Alderton, Wash., 1914–
Puyallup River at Puyallup, Wash., 1914–
Carbon River at Fairfax, Wash., 1910–1912.
White River below Forks, near Enumclaw, Wash., 1911–12.

Nooksack River,[1] North Fork (head of Nooksack River), near Glacier, Wash., 1910–11.
Nooksack River near Deming, Wash., 1910–11.
Middle Fork of Nooksack River at ranger station near Deming, Wash., 1910–11.
Middle Fork of Nooksack River near Deming, Wash., 1910–11.

COLUMBIA RIVER BASIN.

Columbia River at Trail, British Columbia, 1913–
Columbia River at Wenatchee, Wash., 1910.
Columbia River near Julia, Wash., 1905.
Columbia River at Hanford, Wash., 1910.
Columbia River at Pasco, Wash., 1904–1910.
Columbia River at Cascade Locks and The Dalles, Oreg., 1878–
Kootenai River at Libby, Mont., 1910–
Kootenai River at Crossport, Idaho, 1904.
Kootenai River near Bonners Ferry, Idaho, 1904.
Kootenai River near Porthill, Idaho, 1904.
Callahan Creek at Troy, Mont., 1911–
Yaak River near Troy, Mont., 1910–
Moyie River at Snyder, Idaho, 1911–
Clark Fork at Missoula, Mont., 1898–1907.
Clark Fork at St. Regis, Mont., 1910–
Clark Fork near Plains, Mont., 1910–
Pend Oreille Lake at Sandpoint, Idaho, 1914–
Clark Fork at Priest River, Idaho, 1903–1905.
Clark Fork at Newport, Wash., 1904–1910.
Clark Fork at Metaline Falls, Wash., 1908–1910; 1912–
Racetrack Creek near Anaconda, Mont., 1911–12; 1914–
Little Blackfoot River and ditch near Elliston, Mont., 1910–1915.
Rock Creek near Quigley, Mont., 1910–1912.
Big Blackfoot River at Bonner, Mont., 1898–1905.
Rattlesnake Creek at Missoula, Mont., 1898–1900.
Bitterroot River, West Fork (head of Bitterroot River), near Darby, Mont., 1910—
Bitterroot River near Grantsdale, Mont., 1902–1907.
Bitterroot River near Missoula, Mont., 1898–1901; 1903–4.
East Fork of Bitterroot River near Darby, Mont., 1910–
Lolo Creek near Lolo, Mont., 1910–
St. Regis River near St. Regis, Mont., 1910–1915.
Flathead River near Columbia Falls, Mont., 1910–
Flathead River at Demersville, near Kalispell, Mont., 1910–1912.
Flathead River at Damon's ranch, near Kalispell, Mont., 1910–1912.
Flathead River at Keller's ranch, near Holt, Mont., 1910–1912.
Flathead Lake (on Flathead River) near Holt, Mont., 1900.
Flathead Lake at Polson, Mont., 1908–
Flathead River near Polson, Mont., 1907–
Middle Fork of Flathead River at Belton, Mont., 1910–
Lake McDonald outlet at Lake McDonald, Mont., 1912–1914.
South Fork of Flathead River near Columbia Falls, Mont., 1910–
Stillwater River near Kalispell, Mont., 1906–7.
Whitefish River near Kalispell, Mont., 1906.
Ashley Creek, Kila, Mont., 1916–
Swan River near Big Fork, Mont., 1910–11.
Little Bitterroot River near Marion, Mont., 1910–

[1] Revised decision of United States Geographic Board rendered Oct. 3, 1917.

Columbia River tributaries—Continued.
Yakima River tributaries—Continued.
New Reservation canal near Parker (Yakima City), Wash., 1904–
Old Reservation canal near Parker (Wapato), Wash., 1904–
Sunnyside canal near Parker (Wapato), Wash., 1904–
Toppenish Creek near Fort Simcoe, Wash., 1909–
Toppenish Creek near White Swan (Wapato), Wash., 1909–1912.
Toppenish Creek at railway bridge, near Toppenish, Wash., 1894–1896.
Toppenish Creek near Toppenish, Wash., 1908–9.
Toppenish Creek at Alfalfa, Wash., 1909–1912.
Simcoe Creek near Fort Simcoe, Wash., 1909–
Reservation drain at Alfalfa, Wash., 1912–
Satus Creek near Toppenish, Wash., 1908–1913.
Satus Creek below mouth of Dry Creek, near Toppenish, Wash., 1913–
Satus Creek near Alfalfa, Wash., 1905.
Satus Creek near Satus, Wash., 1894–1896.
Kiona canal near Kiona, Wash., 1904–1906; 1908–1911.
Kennewick canal near Richland (Kennewick), Wash., 1904–5; 1910–11.
Lower Yakima canal near Kiona, Wash., 1905; 1910–11.
Snake River at south boundary of Yellowstone National Park, 1913–
Jackson Lake (Snake River) at Moran, Wyo., 1909–10 (fragmentary); 1911–
Snake River [1] near Moran, Wyo., 1903–
Snake River [1] at Grovont, Wyo., 1899.
Snake River at Alpine, Idaho, 1916–
Snake River [1] near Lyon, Idaho, 1903–1911.
Snake River [1] near Heise, Idaho, 1910–
Snake River at Idaho Falls, Idaho, 1889–1890; 1892–1894.
Snake River near Shelley, Idaho, 1915–
Snake River near Firth, Idaho, 1915.
Snake River at Porterville Bridge near Blackfoot, Idaho, 1916–
Snake River near Blackfoot, Idaho, 1910–
Snake River at Neeley, Idaho, 1906–
Snake River at Howells Ferry, near Minidoka, Idaho, 1910–
Snake River at Montgomery Ferry, near Minidoka, Idaho, 1895–1899; 1901–1910.
Lake Milner (on Snake River) at Milner, Idaho, 1911–
Snake River at Milner, Idaho, 1909–
Snake River near Twin Falls, Idaho, 1911–
Snake River near Hagerman, Idaho, 1912–
Snake River at King Hill, Idaho, 1909–
Snake River near Murphy, Idaho, 1912; 1913–
Snake River at Weiser, Idaho, 1910–
Snake River at Lewiston, Idaho, 1910.
Snake River at Riparia, Wash., 1916–
Snake River near Burbank, Wash., 1907–
Pacific Creek near Moran, Wyo., 1906.
Buffalo River near Elk, Wyo., 1906.
Henrys Fork [2] at Warm River, Idaho, 1910–1915.
Henrys Fork near Ora, Idaho, 1902–1909.
Henrys Fork in canyon above Fall River, Idaho, 1890–91.
Henrys Fork near Rexburg, Idaho, 1909–
Warm River at Warm River, Idaho, 1912–1915.
Robinson Creek at Warm River, Idaho, 1912–1915.

[1] Decision of United States Geographic Board; formerly called South Fork of Snake River.
[2] Decision of United States Geographic Board; formerly called North Fork of Snake River.

Columbia River tributaries—Continued.
Deschutes River tributaries—Continued.
Crooked River tributaries—Continued.
Ochoco Creek tributaries—Continued.
Tableland ditch near Prineville, Oreg., 1915–
Elliot ditch near Prineville, Oreg., 1908–1910; 1914–
McKay Creek near Prineville, Oreg., 1915–
Metolius River at Allingham ranger station, near Sisters, Oreg., 1910–1913; 1915–
Metolius River at Hubbard's ranch, near Grandview, Oreg., 1910–1913.
Metolius River at Rigg's ranch, near Sisters, Oreg., 1908–1912.
Lake Creek near Sisters, Oreg., 1911–1913; 1915–
First Creek near Sisters, Oreg., 1915–
Jack Creek near Sisters, Oreg., 1915–
Canyon Creek near Sisters, Oreg., 1915–
Whitewater River near Grandview, Oreg., 1911–1913.
Shitike Creek at Warmspring, Oreg., 1911–
Trout Creek near Antelope, Oreg., 1915; 1916–
Trout Creek near Gateway, Oreg., 1915; 1916.
Hay Creek near Hay Creek, Oreg., 1915; 1916.
Warm Springs River near Warmspring, Oreg., 1911–
Mill Creek near Warmspring, Oreg., 1915.
White River near Tygh Valley, Oreg., 1911–
Tygh Creek at Tygh Valley, Oreg., 1911–1913.
Klickitat River above Pearl Creek, near Glenwood, Wash., 1910; 1916–
Klickitat River above Big Muddy Creek, Wash., 1905.
Klickitat River below Big Muddy Creek, Wash., 1905; 1907–8.
Klickitat River at Camp Klickitat, Wash., 1907–1908.
Klickitat River near Glenwood, Wash., 1909–
Klickitat River below Glenwood, Wash., 1914.
Klickitat River at Hanson's cable, near Klickitat, Wash., 1908–9.
Klickitat River at Klickitat (Wright), Wash., 1909–1912.
Klickitat River at Wols Ferry, near Lyle, Wash., 1907–1910.
Klickitat River at Lyle, Wash., 1912.
Pearl Creek near Glenwood, Wash., 1916.
Swamp Creek near Glenwood, Wash., 1916.
West Fork of Klickitat River near Glenwood, Wash., 1910; 1916–
Surveyors Creek near Glenwood, Wash., 1916.
Cunningham Creek near Glenwood, Wash., 1916.
Big Muddy Creek near Glenwood, Wash., 1916–
Big Muddy River above mouth of Cougar Creek, near Wright, Wash., 1905; 1908.
Cougar Creek near Glenwood, Wash., 1916.
Little Klickitat River near Goldendale, Wash., 1910–1912.
Hood River at Dee, Oreg., 1913–
Hood River at Winans, Oreg., 1905–1907; 1910–1912; 1913.
Hood River at Tucker Bridge, Oreg., 1897–1899; 1913–
Hood River at Powerdale, near Hood River, Oreg., 1913–
East Fork of Hood River near Mount Hood, Oreg., 1913–
East Fork Irrigation District canal near Mount Hood, Oreg., 1913–
West Fork of Hood River near Dee, Oreg., 1913–
Pacific Light & Power Co.'s tailrace near Hood River, Oreg., 1914; 1916–
White Salmon River at splash dam near Trout Lake, Wash., 1912–
White Salmon River at Husum, Wash., 1909–

Columbia River tributaries—Continued.
White Salmon River at Condit dam, near Underwood, Wash., 1912–13.
Trout Creek at Guler, Wash., 1909–1911.
Little White Salmon River below Lava Creek, near Cook, Wash., 1903–1906.[1]
Little White Salmon River near Cooks, Wash., 1909.
Latourell Creek at Latourell, Oreg., 1912–13.
Sandy River above Salmon River, at Brightwood, Oreg., 1910–1914.
Sandy River below Salmon River, near Brightwood, Oreg., 1907–1911.
Sandy River near Marmot, Oreg., 1911–1916.
Sandy River above Bull Run River, near Bull Run, Oreg., 1910–1912.
Sandy River below Bull Run River, near Bull Run, Oreg., 1910–1914.
Clear Fork of Sandy River near Welches, Oreg., 1913; 1914–15.
Lost Creek near Brightwood, Oreg., 1913–
Sandy River canal near Marmot, Oreg., 1916–
Still Creek near Rowe, Oreg., 1910–1912.
Salmon River near Rowe, Oreg., 1910–1912.
Salmon River at Welches, Oreg., 1913–14.
Salmon River at Fish Hatchery, near Brightwood, Oreg., 1912–13.
Bull Run River near Bull Run, Oreg., 1895–
Little Sandy River near Marmot, Oreg., 1913–
Little Sandy River near Bull Run, Oreg., 1911–1913.
Little Sandy flume near Bull Run, Oreg., 1912–13.
Willamette River, Middle Fork (head of Willamette River), above Salt Creek, near Oakridge, Oreg., 1913–14.
Willamette River, Middle Fork, below North Fork, near Oakridge, Oreg., 1911–12.
Willamette River, Middle Fork, at Jasper, Oreg., 1905–1912. 1913–
Willamette River at Springfield, Oreg., 1911–1913.
Willamette River at Albany, Oreg., 1878–1880; 1892–
Willamette River at Salem, Oreg., 1909–
Willamette River at Oregon City, Oreg., 1909–1912.
Salt Creek near Oakridge, Oreg., 1913–14.
Salmon Creek near Oakridge, Oreg., 1913–
North Fork of Middle Fork of Willamette River near Oakridge (Hazeldell), Oreg., 1909–1912; 1913–
Fall Creek near Fall Creek, Oreg., 1911.
Coast Fork of Willamette River near Goshen, Oreg., 1905–1912.
Row River near Disston, Oreg., 1910–1913.
McKenzie River at Clear Lake, Oreg., 1912–1915.
McKenzie River at McKenzie Bridge, Oreg., 1910–
McKenzie River at Martins Rapids, Oreg., 1910–11.
McKenzie River near Springfield, Oreg., 1905–1915.
Eugene power canal near Walterville, Oreg., 1912–1915.
North Santiam River near Hoover, Oreg., 1910–13.
North Santiam River at Detroit, Oreg., 1907–1909.
North Santiam River at Niagara, Oreg., 1908–
North Santiam River at Mehama, Oreg., 1905–1907; 1910–1914.
Santiam River at Jefferson, Oreg., 1905–6; 1908–
Marion Fork of Santiam River at Marion Lake, near Hoover, Oreg., 1907; 1909–1912.
Puzzle Creek near Detroit (Hoover), Oreg., 1907; 1909.
North Fork of Puzzle Creek near Hoover, Oreg., 1909–1912.
South Fork of Puzzle Creek near Hoover, Oreg., 1909–1912.
Pamelia Creek near Detroit, Oreg., 1907; 1909; 1913.

[1] Records published in U. S. Geol. Survey Water-Supply Paper 272, pp. 428–429.

Columbia River tributaries—Continued.
Williamette River tributaries—Continued.
Santiam River tributaries—Continued.
Whitewater Creek near Detroit, Oreg., 1907; 1913.
Breitenbush Creek near Detroit, Oreg., 1910–1913.
South Santiam River near Cascadia, Oreg., 1910–1913.
South Santiam River near Foster, Oreg., 1911.
South Santiam River at Waterloo, Oreg., 1905–1907; 1910–11.
Middle Santiam River near Foster, Oreg , 1911.
Luckiamute River near Suver, Oreg., 1905–1911.
Yamhill River, South Fork (head of Yamhill River), at Sheridan, Oreg., 1906–1913.
Yamhill River at La Fayette, Oreg., 1908–1914.
Molalla River near Molalla, Oreg., 1905; 1909–
Clackamas River near Cazadero, Oreg., 1909; 1916–
Clackamas River at Estacada, Oreg., 1908–1911.
Clackamas River near Barton, Oreg. (replaced by Estacada station), 1905–1908.
Clackamas River at Park Place, Oreg., 1911–12.
Oak Grove Fork of Clackamas River at Timothy Meadows, near Cazadero, Oreg., 1913–14; 1916.
Oak Grove Fork of Clackamas River at intake, near Cazadero, Oreg., 1909–1914; 1916–
Lewis River above Muddy River near Cougar, Wash., 1909.
Lewis River near Cougar, Wash., 1909–1912.
Lewis River near Amboy, Wash., 1911–
Lewis River at Ariel, Wash., 1909.
Muddy River at mouth, near Cougar, Wash., 1909.
Pine Creek at mouth, near Cougar, Wash., 1909.
Swift Creek at mouth, near Cougar, Wash., 1909.
Kalama River near Kalama, Wash., 1911–1913; 1916–
Ohanapecosh River near Lewis, Wash., 1907–
Cowlitz River at Lewis, Wash., 1911–1916.
Cowlitz River at Mossy Rock, Wash., 1912–
Cowlitz River at Randle, Wash., 1910–1912.
Cowlitz River at Mayfield, Wash., 1910–11.
Clear Fork near Lewis, Wash., 1907–
Coal Creek near Lewis, Wash., 1911–1915.
Lake Creek at outlet of Packwood Lake, near Lewis, Wash., 1911–
Lake Creek at mouth, near Lewis, Wash., 1907–1915.
Johnson Creek below West Fork, near Lewis, Wash., 1911; 1913–14.
Johnson Creek at mouth, near Lewis, Wash., 1907–1914.
Glacier Creek near Lewis, Wash., 1911.
Hagar Creek near Lewis, Wash., 1911–12; 1913–14.
North Fork of Hagar Creek near Lewis, Wash., 1911–12; 1913–14.
Cispus River near Randle, Wash., 1910–1912.
Toutle River at St. Helen, Wash., 1909.
Toutle River near Castle Rock, Wash., 1909–1912.
Youngs River near Astoria, Oreg., 1916–

STREAMS BETWEEN COLUMBIA RIVER AND KLAMATH RIVER.

Rogue River near Prospect, Oreg., 1907–1912.
Rogue River below Prospect, Oreg., 1913–
Rogue River near Trail, Oreg., 1910–1913.

REPORTS ON WATER RESOURCES OF THE NORTH PACIFIC SLOPE DRAINAGE BASINS.

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

WATER-SUPPLY PAPERS.

Water-supply papers are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers marked in this way may, however, be purchased (at price noted) from the SUPERINTENDENT OF DOCUMENTS, Washington, D. C. Omission of the price indicates that the report is not obtainable from Goverrment sources. Water-supply papers are of octavo size.

*4. A reconnaissance in Southeastern Washington, by I. C. Russell, 1897. 96 pp., 7 pls. 15c.

Describes an area "bordered on the south by Oregon, on the east by Idaho, on the north by Snake River, and on the west by the Columbia," and "briefly designated as lying south of Snake River;" discusses climate, vegetation, topography and drainage, geologic formations—including the river terraces and soils—irrigation, and the artesian water supply, and gives an outline of the geological history of the region.

*44. Profiles of rivers in the United States, by Henry Gannett. 1901. 100 pp. 11 pls. 15c.

Gives elevations and distances along Columbia, Willamette, Flathead, and Snake rivers.

*53. Geology and water resources of Nez Perce County, Idaho, Part I, by I. C. Russell. 1901. 85 pp., 10 pls. 10c.

*54. Geology and water resources of Nez Perce County, Idaho, Part II, by I. C. Russell. 1901. 55 pp. (87–141).

Nos. 53 and 54 relate to an area "in western Idaho, bordered on the west by portions of Washington and Oregon," drained through Snake River to the Columbia; they describe the topography, geology, and soils of the region, discuss the relation of the surface features—plateaus, canyons, streams, etc.—to the geology and the climate, the source and quantity of the water supply, including springs and artesian wells, and refer briefly to the occurrence of building stones, lignite, gold, silver, and copper. They include also a short bibliography of artesian waters and two appendixes—one giving list of elevations, and the other notes concerning Portland cement.

55. Geology and water resources of a portion of Yakima County, Wash., by G. O. Smith. 1901. 68 pp., 7 pls. 10c.

Describes topography, climate, soil, agriculture, geology, and surface and ground waters of an area comprising about 50 square miles in the vicinity of North Yakima; discusses in some detail the artesian basins and wells.

*57. Preliminary list of deep borings in the United States, Part I (Alabama-Montana), by N. H. Darton. 1902. 60 pp. 5c.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp. 5c.

Nos. 57 and 61 contain information as to depth, diameter, yield, and head of water in borings more than 400 feet deep; under head "Remarks" gives information concerning temperature, quality of water, purposes of boring, etc. The lists are arranged by States, and the States are arranged alphabetically. A second, revised, edition was published in 1905 as Water-Supply Paper 149 (q. v.). 5c.

*78. Preliminary report on artesian basins in southwestern Idaho and southeastern Oregon, by I. C. Russell. 1903. 53 pp., 2 pls. 5c.

Discusses briefly the rocks and geologic structure of a part of the Snake River Plains in Canyon and Owyhee counties, Idaho, and Malheur and Harney counties, Oreg.; describes briefly the conditions on which artesian flow depends, and in some detail the springs and drilled wells in the Lewis, Otis, Harney, and Whitehorse artesian basins; also describes artesian wells in alluvial deposits and discusses the size of drill holes, casings, etc., the preservation of well records, and the importance of laws to control the use of artesian waters; gives list of publications bearing on artesian waters.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer, 1904. 361 pp. 25c. [Inquiries concerning this report should be addressed to the Reclamation Service.] Contains:

Investigations in Idaho, by D. W. Ross. Describes the irrigable lands in the area drained by Snake River.

Investigations in Oregon, by J. T. Whistler. Mentions the Umatilla, Malheur, and Harnei projects.

Work in Washington, by T. A. Noble. Describes the plains of Columbia River.

96. Destructive floods in the United States in 1903, by E. C. Murphy. 1904. 81 pp., 13 pls. 15c.

Gives an account of a flood (commonly spoken of as the "Heppner disaster") on Willow Creek, a tributary of Columbia River, in Morrow County, Oreg.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. [Superseded by No. 152, q. v.]

Cites statutory restrictions of water pollution in Idaho, Nevada, Oregon, Utah, Washington, and Wyoming.

111. Preliminary report on the underground waters of Washington, by Henry Landes. 1905. 85 pp., 1 pl. 10c.

Describes, by counties, the municipal water supplies, deep wells, and springs in the State, giving also for each county a brief account of the climate, rainfall, topography, drainage, and geology.

118. Geology and water resources of a portion of east-central Washington, by F. C. Calkins. 1905. 96 pp., 4 pls. 5c.

Describes briefly the topography, geology, climate, vegetation, grazing, and agriculture on the Columbia Plains and in Kittitas Valley; discusses the streams, springs, and shallow and deep wells.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Cites legislative acts relating to ground waters in Idaho, Nevada, Oregon, Utah, Washington, and Wyoming.

149. Preliminary list of deep borings in the United States, second edition, with additions, by N. H. Darton. 1905. 175 pp. 10c.

Gives, by States (and within the States by counties), location, depth, diameter, yield, height of water, and other available information, concerning wells 400 feet or more in depth; includes all wells listed in Water-Supply Papers 57 and 61; mentions also principal publications relating to deep borings.

152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Cites statutory restrictions of water pollution in Idaho, Nevada, Oregon, Utah, Washington, and Wyoming.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

Gives estimates (p. 85) of flood discharge and frequency for Boise River at Boise and Weiser River at Weiser, Idaho.

*231. Geology and water resources of the Harney Basin region, Oregon, by G. A. Waring. 1909. 93 pp., 5 pls. 25c.

The greater part of the area covered by this report is in the Great Basin, but a small tract in the northeastern corner is drained by a number of small streams that are tributary to Malheur River.

253. Water powers of the Cascade Range, Part I, Southern Washington, by J. C. Stevens. 1910. 94 pp., 21 pls. 40c.

Discusses conditions governing hydraulic development, water laws of Washington, and variations in streams; describes the drainage basins of Klickitat, White Salmon, Little White Salmon, Lewis, and Toutle rivers; gives results of observations at gaging stations, and estimates of average minimum discharge and of the available horsepower at the power sites.

274. Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses, by Herman Stabler. 1911. 188 pp. 15c

Describes collection of samples, plan of analytical work, and methods of analyses; discusses soap-consuming power of waters, water softening, boiler waters, and water for irrigation; gives results of analyses of waters of Boise, Malheur, Payette, and Palouse rivers, and Salmon Creek.

313. Water powers of the Cascade Range, Part II, Cowlitz, Nisqually, Puyallup, White, Green, and Cedar drainage basins, by F. F. Henshaw and G. L. Parker. 1913. 170 pp., 16 pls. 55c.

Describes the geological features and history of the drainage basins, topography and drainage, soils and vegetation, and precipitation; gives stream-flow records and discusses water powers, storage, and power sites; discusses also natural resources and harbors of the Pacific coast, central electric stations, and power utilization, and gives commercial and residential rates. See also 253.

316. Geology and water resources of a portion of south-central Washington, by G. A. Waring. 1913. 46 pp., 1 pl. 5c.

Describes settlements, climate and vegetation, agriculture, grazing, geographic provinces, relation of surface features and structure, and geology; discusses shallow and artesian waters and irrigation enterprises in Sunnyside and Reservation valleys, Horse Heaven Plateau, and the Columbia River Plains, and irrigation along lower Yakima River; gives tabulated data concerning wells and springs.

339. Quality of the surface waters of Washington, by Walton Van Winkle. 1914. 105 pp., 2 pls. 15c.

Discusses briefly the natural and economic features of the State, the constituents and uses of the natural waters, purification of water, methods of analysis, and industrial and geochemical interpretation of the results of analysis; describes the general features of the principal drainage basins and gives the results of an investigation of the character of the river waters; treats briefly of the average chemical composition of river water, the economic value of the rivers, denudation, and the influence of natural features on the character of the waters.

344. Deschutes River, Oregon, and its utilization, by F. F. Henshaw, John H. Lewis, and E. J. McCaustland. 1914. 200 pp., 28 pls. 50c.

A report, prepared in cooperation with the State of Oregon, containing the results of measurements of stream flow, a discussion of the economic distribution of the water, and chapters on the quality of the water, the availability of the water supply, the developed water powers undeveloped power sites, water rights and appropriations, the relation of the Federal Government to the development of water power, and Government permits for power and reservoir sites.

346. Profile surveys in the basin of Clark Fork of Columbia River, Montana-Idaho-Washington, prepared under the direction of R. B. Marshall, chief geographer. 1914. 6 pp., 3 pls. (22 sheets). 50c.

347. Profile surveys in Snake River basin, Idaho, prepared under the direction of R. B. Marshall, chief geographer. 1914. 12 pp., 3 pls. (37 sheets). 55c.

348. Profile surveys in Hood and Sandy River basins, Oregon, prepared under the direction of R. B. Marshall, chief geographer. 1914. 8 pp., 2 pls. (6 sheets), 30c.

349. Profile surveys in Willamette River basin, Oregon, prepared under the direction of R. B. Marshall, chief geographer. 1914. 8 pp., 3 pls. (16 sheets). 30c.

363. Quality of the surface waters of Oregon, by W. Van Winkle. 1914. 137 pp., 2 pls. 20c.

Describes the topography, drainage, rocks and soils, climate, population, and industries of the State, the constituents of natural waters, water for domestic and industrial uses, and purification of water, methods of analysis, and interpretation of results of analysis; describes the general features of the river basins and the character of the river waters, discusses the conditions influencing the quality of the surface waters, average chemical composition, geochemical character, denudation, industrial value, and value for irrigation.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of Soap and Omak lakes, Wash., and of mine waters from Butte, Mont.

366. Profile surveys of Snoqualmie, Sultan, and Skykomish rivers, Washington, prepared under the direction of R. B. Marshall, chief geographer. 1914. 7 pp., 3 pls. (12 sheets). 20c.

368. Profile surveys in Wenatchee River basin, Washington, prepared under the direction of R. B. Marshall, chief geographer. 1914. 7 pp., 1 pl. (8 sheets). 20c.

369. Water powers of the Cascade Range, Part III, Yakima River basin, by G. L. Parker and F. B. Storey, 1916. 169 pp., 20 pls. 45c.

Describes the geography of the basin, the geologic history, physiography and river history, climate, settlement, and development, population, and transportation; gives steam-flow records and discusses natural conditions affecting stream flow; storage reservoirs, developed and undeveloped power sites; treats also of the industrial development of the region, discussing irrigation by gravity systems and by pumping, the production of coal and other minerals, and manufacturing; presents a scheme of development and utilization of stored water. The report was prepared under the direction of the Washington State Board of Geological Survey, and is based on data consisting of "stream-flow records, river plans and profiles, reservoir surveys, and field reconnaissance of the rivers and their various tributaries," obtained by the United States Geological Survey and the United States Reclamation Service, supplemented by a large amount of information furnished by private parties.

370. Surface water supply of Oregon, 1878–1910, by F. F. Henshaw and H. J. Dean. 1915. 829 pp., 1 pl. 45c.

Describes briefly the natural features of Oregon and in greater detail the general features of the river basins; consists principally of records of stream flow that have been carefully studied and recomputed when necessary to insure their best possible interpretation.

376. Profile surveys in Chelan and Methow River basins, Washington, prepared under the direction of R. B. Marshall, chief geographer. 1915. 8 pp., 5 pls. 15c.

377. Profile surveys in Spokane River basin, Washington, and John Day River basin, Oregon, prepared under the direction of R. B. Marshall, chief geographer. 1915. 7 pp., 10 pls. 15c.

378. Profile surveys in 1914 on Middle Fork of Willamette River and White River, Oregon, prepared under the direction of R. B. Marshall, chief geographer. 1915. 8 pp., 6 pls. 15c.

379. Profile surveys in 1914 in Umpqua River basin, Oregon, prepared under the direction of R. B. Marshall, chief geographer. 1915. 7 pp., 13 pls. 20c.

*400. Contributions to the hydrology of the United States, 1916, Nathan C. Grover, chief hydraulic engineer, 1917. 108 pp., 7 pls. 15c. Contains:

(*b*) Artesian water for irrigation in Little Bitterroot Valley, Mont., by O. E. Meinzer.

419. Profile surveys in 1915 in Skagit River basin, Washington, prepared under the direction of W. H. Herron, acting chief geographer. 1916. 8 pp., 12 pls. 15c.

420. Profile surveys along Henrys Fork, Idaho, and Logan River and Blacksmith Fork, Utah, prepared under the direction of W. H. Herron. acting chief geographer. 1916. 8 pp., 10 pls. 10c.

425. Contributions to the hydrology of the United States, 1917, N. C. Grover, chief hydraulic engineer, 1918. Contains:

(*e*) Ground water in Quincy Valley, Wash., by A. T. Schwennesen and O. E. Meinzer.

BULLETINS

An asterisk (*) indicates that the Geological Survey's stock of the paper is exhausted. Many of the papers so marked may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Bulletins are of octavo size.

*199. Geology and water resources of the Snake River Plains of Idaho, by I. C. Russell. 1902. 192 pp., 25 pls. 25c.

Describes the topography, geology, climate, vegetation, fauna, and soils of an area extending entirely across the southern part of Idaho; discusses streams, springs, water powers, irrigation and agriculture, industries, and routes of transportation and highways; treats of the origin of surface and subsurface waters, the requisite conditions for artesian wells and the quantity of water available.

252. Preliminary report on the geology and water resources of central Oregon, by I. C. Russell. 1905. 138 pp., 24 pls. 15c.

Describes a portion of the extreme northern part of the Great Basin and a part of the drainage area of Deschutes River and its principal tributary, Crooked River; gives an account of the topography, drainage, rainfall and temperature, winds, and forests; describes the volcanic sedimentary rock formations, and discusses by counties the geology and topography, the surface and ground waters; treats of artesian conditions in the Deschutes basin and makes suggestions concerning artesian-well records.

*264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

Bulletins 264 and 298 give an account of progress in the collection of well records and samples, and contain tabulated records of wells in Idaho, Montana, Nevada, Oregon, Washington, and Wyoming. No. 298 gives detailed records of wells in Flathead County, Mont., and Benton, Jefferson, and Walla Walla counties, Wash. The wells of which detailed sections are given were selected because they afford valuable stratigraphic information.

ANNUAL REPORTS.

Each of the papers contained in the annual reports was also issued in separate form.

Annual reports are distributed free by the Geological Survey as long as its stock lasts. An asterisk (*) indicates that this stock has been exhausted. Many of the papers so marked, however, may be purchased from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C.

*Tenth Annual Report of the Director of the United States Geological Survey, 1888–89, J. W. Powell, Director. 1890. 2 parts. *Pt. II. Irrigation, viii, 123 pp. 35c.

Makes a preliminary report on the organization and prosecution of the survey of the arid lands for purposes of irrigation; includes an account of the methods of topographic and hydraulic work, the segregation work on reservoir sites and irrigable lands, field and office methods, and brief descriptions of the topography of some of the river basins.

Eleventh Annual Report of the United States Geological Survey, 1889–90, J. W. Powell, Director. 1891. 2 parts. Pt. II. Irrigation, xiv, 395 pp. 30 pls. and maps. $1.25. Contains:

*Hydrography, pp. 1–110. Discusses scope of work, methods of stream measurement, rainfall and evaporation, and describes the more important streams.

*Engineering, pp. 111–200. Defines the scope of the work and gives an account of the survey in the Sun River basin and in the Arkansas, Rio Grande, California, Lahontan, Utah, and Snake River divisions.

*Topography, pp. 291–343. Comprises reports of the topographic surveys in California, Nevada, Colorado, Idaho, Montana, and New Mexico, and a report on reservoir sites.

*Irrigation literature, pp. 345–388. Gives a list of books and pamphlets on irrigation and allied subjects, mainly contained in the library of the United States Geological Survey

Twelfth Annual Report of the Director of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp. 93 pls. $2. Contains:

*Hydrography of the arid regions, by F. H. Newell, pp. 213–361, Pls. 58–106. Discusses the available water supply of the arid regions, the duty of water, flood waters, relation of rainfall to river flow; classifies the drainage basins; and describes the rivers of the Missouri, Arkansas, Rio Grande, Colorado, Sacramento, and San Joaquin basins, and the principal streams of the Great Basin in Nevada and Utah and the Snake River basin.

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III. Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*Engineering results of irrigation survey, by H. M. Wilson, pp. 351–427, Pls. 147–182. Describes structures on the Pocatello canal, Idaho.

Sixteenth Annual Report of the United States Geological Survey, 1894–95, Charles D. Walcott, Director. 1896. (Pts. II, III, and IV, 1895.) 4 parts. *Pt. II. Papers of an economic character, xix, 598 pp., 43 pls. $1.25. Contains:

The public lands and their water supply, by F. H. Newell, pp. 457–533, Pls. 35–39. Describes general character of the public lands, the lands disposed of (railroad, grant, and swamp lands, and private miscellaneous entries), lands reserved (Indian, forest, and military reservations), the vacant lands, and the rate of disposal of vacant lands; discusses the streams, wells, and reservoirs as sources of water supply; gives details for each State.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Pts. II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. V, Forest reserves, xvii, 400 pp., 110 pls. $1.25. 16 maps in separate case, 75c. Contains:

*Priest River Forest Reserve, by J. B. Leiberg, pp. 217–252, Pls. 48–61.

*Bitterroot Forest Reserve, by J. B. Leiberg, pp. 253–282, Pls. 62–73.

*Washington Forest Reserve, by H. B. Ayres, pp. 283–313, Pls. 76–100.

*Eastern part of Washington Forest Reserve, by M. W. Gorman, pp. 315–350, Pl. 101.

*Forest conditions of northern Idaho, by J. B. Leiberg, pp. 373–386, Pls. 109–110.

These reports describe the topography and the streams of the forest reserves.

Twentieth Annual Report of the United States Geological Survey, 1898–99, Charles D. Walcott, Director. 1899. (Pts. II, III, IV, V, and VII, 1900.) 7 parts in 8 vols. and separate case for maps with Pt. V. *Pt. V, Forest reserves, xix, 498 pp., 159 pls., 8 maps in separate case. $2.80. Contains:

*The Flathead Forest Reserve, by H. B. Ayres, pp. 245–316, Pls. 77–113.

*Bitterroot Forest Reserve, by J. B. Leiberg, pp. 317–409, Pls. 115–142. Contains brief descriptions of the streams and lakes in the reserves.

Twenty-first Annual Report of the United States Geological Survey, 1899–1900, Charles D. Walcott, Director. 1900. (Pts. III, IV, VI, VI continued, and VII, 1901.) 7 parts in 8 vols. and separate case for maps with Pt. V. *Pt. V, Forest reserves, 711 pp., 143 pls., 39 maps in separate case. $3.85. Contains:

*Mount Rainier Forest Reserve, Washington, by F. G. Plummer, pp. 81–143, Pls. 33–50.

*Olympic Forest Reserve, Washington, from field notes by Arthur Dodwell and T. F. Rixon, pp. 145–208, Pls. 51–70.

*Cascade Range Forest Reserve, Oregon, from T. 28 S. to T. 37 S., inclusive, together with the Ashland Forest Reserve and adjacent forest regions from T. 28 S. to T. 41 S., inclusive, and from R. 2 W. to R. 14 E., Willamette meridian, inclusive, by J. B. Leiberg, pp. 209–498, Pls. 71–84. Contains descriptions of many of the streams flowing through the forest reserves.

GEOLOGIC FOLIOS.

Under the plan adopted for the preparation of a geologic map of the United States the entire area is divided into small quadrangles, bounded by certain meridians and parallels, and these quadrangles, which number several thousand, are separately surveyed and mapped.[1] The unit of survey is also the unit of publication, and the maps and description of each quadrangle are issued in the form of a folio. When all the folios are completed they will constitute the Geologic Atlas of the United States.

A folio is designated by the name of the principal town or of a prominent natural feature within the quadrangle. Each folio includes maps showing the topography, geology, underground structure, and mineral deposits of the area mapped and several pages of descriptive text. The text explains the maps and describes the topographic and geologic features of the country and its mineral products. The topographic map shows roads, railroads, waterways, and, by contour lines, the shapes of the hills and valleys and the height above sea level of all points in the quadrangle. The areal-geology map shows the distribution of the various rocks at the surface. The structural-geology map shows the relations of the rocks to one another underground. The economic-geology map indicates the location of mineral deposits that are commercially valuable. The artesian-water map shows the depth to underground-water horizons. Economic-geology and artesian-water maps are included in folios if the conditions in the areas mapped warrant their publication. The folios are of special interest to students of geography and geology and are valuable as guides in the development and utilization of mineral resources.

The folios numbered from 1 to 163, inclusive, are published in only one form (18 by 22 inches), called the library edition. Some of the folios that bear numbers higher than 163 are published also in an octavo edition (6 by 9 inches). Owing to a fire in the Geological Survey Building May 18, 1913, the stock of geologic folios was more or less damaged by fire and water, but the folios are usable and are sold at the uniform price of 5 cents each, with no reduction for wholesale orders. This rate applies to folios in stock from 1 to 184, inclusive (except reprints), also the library edition of folio 186. The library edition of folios 185, 187, and higher numbers sells for 25 cents a copy, except that some folios which contain an unusually large amount of matter sell at higher prices. The octavo edition of folio 185 and higher numbers sells for 50 cents a copy except folio 193, which sells for 75 cents a copy. If 34 folios selling at 25 cents each (or their equivalent in higher-priced folios) are ordered at one time a discount of 40 per cent is allowed; $5.10 is the minimum amount accepted at this rate.

All the folios contain descriptions of the drainage of the quadrangles. The folios in the following list contain also brief discussions of the underground waters in connection with the economic resources of the areas and more or less information concerning the utilization of the water resources.

An asterisk (*) indicates that the stock of the folio is exhausted.

*45. Boise, Idaho.

86. Ellensburg, Wash. 5c.

103. Nampa, Idaho-Oregon. 5c.

Describes the relief, drainage, climate, and vegetation of the area; discusses the geologic history and geologic formations, and, under "Economic geology," the surface waters available for irrigation, the springs and shallow wells, and the artesian wells; indicates areas of possible artesian flow.

104. Silver City, Idaho. 5c.

106. Mount Stuart, Wash.

*139. Snoqualmie, Washington.

[1] Index maps showing areas in the North Pacific slope basins covered by topographic maps and by geologic folios will be mailed on receipt of request addressed to the Director, U. S. Geological Survey, Washington, D. C.

MISCELLANEOUS REPORTS.

Other Federal bureaus and State and other organizations have from time to time published reports relating to the water resources of various sections of the country. Notable among those pertaining to the northern Pacific coast drainage basins are the reports of the commissioner of conservation of the State of Montana; the State land commission; the State engineer of Idaho; the Bureau of Industry, Agriculture, and Irrigation of Nevada; the State engineers of Nevada, Oregon, Utah, and Washington; the annual reports of the United States Reclamation Service; and the reports of the Chief of Engineers, U. S. Army. The following reports deserve special mention:

The Oregon system of water titles, by John H. Lewis: Oregon State Engineer Bull. 2, 1912.

State and National water laws, with a detailed statement of the Oregon system of water titles, by John H. Lewis, with a discussion by Clarence T. Johnston and L. J. Le Conte: Am. Soc. Civil Eng. Trans., vol. 76, pp. 637–758, 1913.

Report of the commission on conservation [State of Montana] on bills relating to public lands, water rights, and the protection and preservation of the forests: Helena, 1911; also report of the governor of the State of Montana on the same subject.

How to appropriate the public waters of the State of Nevada, compiled by W. M. Kearney, State engineer, 1911.

Requirements and regulations, including suggestions and instructions in relation to the appropriation, use, and measurement of water in the State of Nevada: State engineer of Nevada, 1912.

Irrigation pumping in Nevada, etc., by Charles Norcross: Nevada Bur. of Industry, Agr., and Irr. Bull. 8, 1913.

The water resources of Washington: Potable and mineral water, by H. G. Byers; artesian water, by C. A. Ruddy; water power, by R. E. Heine: Washington Geol. Survey Ann. Rept. for 1901, vol. 1, pt. 5, 1902.

Preliminary report on the Quincy Valley irrigation project, by Henry Landes and others: Washington Geol. Survey Bull. 14, 1912.

Biennial Report of the State Commissioner of Arid Lands [Washington], 1895–96 and 1897–98.

The irrigated lands of the State of Washington, by George M. Allen, deputy commissioner: State Bureau of Statistics and Immigration, 1910.

Irrigation laws of the State of Wyoming, prepared for publication in the office of the State engineer, 1909.

GEOLOGICAL SURVEY HYDROLOGIC REPORTS OF GENERAL INTEREST.

The following list comprises reports not readily calssifiable by drainage basins and covering a wide range of hydrologic investigations:

WATER-SUPPLY PAPERS.

*1. Pumping water for irrigation, by H. M. Wilson. 1896. 56 pp., 9 pls.

Describes pumps and motive powers, windmills, water wheels, and various kinds of engines; also storage reservoirs to retain pumped water until needed for irrigation.

*3. Sewage irrigation, by G. W. Rafter. 1897. 100 pp., 4 pls. (See Water-Supply Paper 22.) 10c.

Discusses methods of sewage disposal by intermittent filtration and by irrigation; describes utilization of sewage in Germany, England, and France, and sewage purification in the United States.

*8. Windmills for irrigation, by E. C. Murphy. 1897. 49 pp., 8 pls. 10c.

Gives results of experimental tests of windmills during the summer of 1896 in the vicinity of Garden, Kans.; describes instruments and methods and draws conclusions.

*14. New tests of certain pumps and water lifts used in irrigation, by O. P. Hood. 1898. 91 pp., 1 pl.

Discusses efficiency of pumps and water lifts of various types.

*20. Experiments with windmills, by T. O. Perry. 1899. 97 pp., 12 pls. 15c.

Includes tables and descriptions of wind wheels, compares wheels of several types, and discusses results.

*22. Sewage irrigation, Part II, by G. W. Rafter. 1899. 100 pp., 7 pls. 15c.

Gives résumé of Water-Supply Paper 3; discusses pollution of certain streams, experiments on purification of factory wastes in Massachusetts, value of commercial fertilizers, and describes American sewage-disposal plants by States; contains bibliography of publications relating to sewage utilization and disposal.

*41. The windmill, its efficiency and economic use, Part I, by E. C. Murphy. 1901. 72 pp., 14 pls. 5c.

*42. The windmill, its efficiency and economic use, Part II, by E. C. Murphy. 1901. 75 pp. (73–147), 2 pls. (15–16). 10c.

Nos. 41 and 42 give details of results of experimental tests with windmills of various types.

*43. Conveyance of water in irrigation canals, flumes, and pipes, by Samuel Fortier. 1901. 86 pp., 15 pls. 15c.

*56. Methods of stream measurement. 1901. 51 pp., 12 pls. 15c.

Describes the methods used by the Survey in 1901–2. See also Nos. 64, 94, and 95.

*64. Accuracy of stream measurements, by E. C. Murphy. 1902. 99 pp., 4 pls. (See No. 95.) 10c.

Describes methods of measuring velocity of water and of measuring and computing stream flow and compares results obtained with the different instruments and methods; describes also experiments and results at the Cornell University hydraulic laboratory. A second, enlarged, edition published as Water-Supply Paper 95.

*67. The motions of underground waters, by C. S. Slichter. 1902. 106 pp., 8 pls. 15c.

Discusses origin, depth, and amount of ground waters; permeability of rocks and porosity of soils; causes, rates, and laws of motions of ground water; surface and deep zones of flow, and recovery of waters by open wells and artesian and deep wells; treats of the shape and position of the water table; gives simple methods of measuring yield of flowing well; describes artesian wells at Savannah, Ga.

72. Sewage pollution in the metropolitan area near New York City and its effect on inland water resources, by M. O. Leighton. 1902. 75 pp., 8 pls. 10c.

Defines "normal" and "polluted" waters and discusses the damage resulting from pollution.

*80. The relation of rainfall to run-off, by G. W. Rafter. 1903. 104 pp. 10c.

Treats of measurements of rainfall and laws and measurements of stream flow; gives rainfall, run-off, and evaporation formulas; discusses effects of forests on rainfall and run-off.

87. Irrigation in India (second edition), by H. M. Wilson. 1903. 238 pp., 27 pls. 25c.

First edition was published in Part II of the Twelfth Annual Report.

93. Proceedings of first conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1904. 361 pp. 25c. [Requests for this paper should be addressed to the U. S. Reclamation Service.]

Contains, in addition to an account of the organization of the hydrographic [water-resources] branch of the United States Geological Survey and the reports of the conference, the following papers of more or less general interest:

Limits of an irrigation project, by D. W. Ross.

Relation of Federal and State laws to irrigation, by Morris Bien.

Electrical transmission of power for pumping, by H. A. Storrs.

Correct design and stability of high masonry dams, by Geo. Y. Wisner.

Irrigation surveys and the use of the plane table, by J. B. Lippincott.

The use of akaline waters for irrigation, by Thomas H. Means.

*94. Hydrographic manual of the United States Geological Survey, prepared by E. C. Murphy, J. C. Hoyt, and G. B. Hollister. 1904. 76 pp., 3 pls. 10c.

Gives instruction for field and office work relating to measurements of stream flow by current meters. See also No. 95.

*95. Accuracy of stream measurements (second, enlarged edition), by E. C. Murphy. 1904. 169 pp., 6 pls.

Describes methods of measuring and computing stream flow and compares results derived from different instruments and methods. See also No. 94.

*103. A review of the laws forbidding pollution of inland waters in the United States, by E. B. Goodell. 1904. 120 pp. (See No. 152.)

Explains the legal principles under which antipollution statutes become operative, quotes court decisions to show authority for various deductions, and classifies according to scope the statutes enacted in the different States.

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

Contains the following reports of general interest. The scope of each paper is indicated by its title.

Description of underflow meter used in measuring the velocity and direction of underground water, by Charles S. Slichter.

The California or "stovepipe" method of well construction, by Charles S. Slichter.

Approximate methods of measuring the yield of flowing wells, by Charles S. Slichter.

Corrections necessary in accurate determinations of flow from vertical well casings, from notes furnished by A. N. Talbot.

Experiments relating to problems of well contamination at Quitman, Ga., by S. W. McCallie.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls. 5c.

The first paper discusses the pollution of streams by sewage and by trade wastes, describes the manufacture of strawboard, and gives results of various experiments in disposing of the waste. The second paper describes briefly the topography, drainage, and geology of the region about Marion, Ind., the contamination of rock wells and of streams by waste oil and brine.

*114. Underground waters of eastern United States; M. L. Fuller, geologist in charge. 1905. 285 pp., 18 pls. 25c.

Contains report on "Occurrence of underground waters," by M. L. Fuller, discussing sources, amount, and temperature of waters, permeability and storage capacity of rocks, water-bearing formations, recovery of water by springs, wells, and pumps, essential conditions of artesian flows, and general conditions affecting ground waters in eastern United States.

119. Index to the hydrographic progress reports of the United States Geological Survey, 1888 to 1903, by J. C. Hoyt and B. D. Wood. 1905. 253 pp. 15c.

120. Bibliographic review and index of papers relating to underground waters published by the United States Geological Survey, 1879–1904, by M. L. Fuller. 1905. 128 pp. 10c.

*122. Relation of the law to underground waters, by D. W. Johnson. 1905. 55 pp. 5c.

Defines and classifies underground waters, gives common-law rules relating to their use, and cites State legislative acts affecting them.

140. Field measurements of the rate of movement of underground waters, by C. S. Slichter. 1905. 122 pp., 15 pls. 15c.

Discusses the capacity of sand to transmit water, describes measurements of underflow in Rio Hondo, San Gabriel, and Mohave River valleys, Cal., and on Long Island, N. Y., gives results of tests of wells and pumping plants, and describes stovepipe method of well construction.

143. Experiments on steel-concrete pipes on a working scale, by J. H. Quinton. 1905. 61 pp., 4 pls. 5c.

Scope indicated by title.

145. Contributions to the hydrology of eastern United States, 1905; M. L. Fuller, geologist in charge. 1905. 220 pp., 6 pls. 10c.

Contains brief reports of general interest as follows:

Drainage of ponds into drilled wells, by Robert E. Horton. Discusses efficiency, cost, and capacity of drainage wells, and gives statistics of such wells in southern Michigan.

Construction of so-called fountain and geyser springs, by Myron L. Fuller.

A convenient gage for determining low artesian heads, by Myron L. Fuller.

146. Proceedings of second conference of engineers of the Reclamation Service, with accompanying papers, compiled by F. H. Newell, chief engineer. 1905. 267 pp. 15c. [Inquiries concerning this report should be addressed to the U. S. Reclamation Service.]

Contains brief account of the organization of the hydrographic [water-resources] branch and the Reclamation Service, reports of conferences and committees, circulars of instruction, and many brief reports on subjects closely related to reclamation, and a bibliography of technical papers by members of the service. Of the papers read at the conference those listed below (scope indicated by title) are of more or less general interest:

Proposed State code of water laws, by Morris Bien.

Power engineering applied to irrigation problems, by O. H. Ensign.

Estimates on tunneling in irrigation projects, by A. L. Fellows.

Collection of stream-gaging data, by N. C. Grover.

Diamond-drill methods, by G. A. Hammond.

Mean-velocity and area curves, by F. W. Hanna.

Importance of general hydrographic data concerning basins of streams gaged by R. E. Horton.

Effect of aquatic vegetation on stream flow, by R. E. Horton.

Sanitary regulations governing construction camps, by M. O. Leighton.

Necessity of draining irrigated land, by Thos. H. Means.

Alkali soils, by Thos. H. Means.

Cost of stream-gaging work, by E. C. Murphy.
Equipment of a cable gaging station, by E. C. Murphy.
Silting of reservoirs, by W. M. Reed.
Farm-unit classification, by D. W. Ross.
Cost of power for pumping irrigating water, by H. A. Storrs.
Records of flow at current-meter gaging stations during the frozen season, by F. H. Tillinghast.

147. Destructive floods in the United States in 1904, by E. C. Murphy and others. 1905. 206 pp., 18 pls. 15c.

Contains a brief account of "A method of computing cross-section area of waterways," including formulas for maximum discharge and area of cross section.

*150. Weir experiments, coefficients, and formulas, by R. E. Horton. 1906. 189 pp. 38 pls. (See Water-Supply Paper 200.) 15c.

Scope indicated by title.

151. Field assay of water, by M. O. Leighton. 1905. 77 pp., 4 pls.

Discusses methods, instruments, and reagents used in determining turbidity, color, iron, chlorides, and hardness in connection with the studies of the quality of water in various parts of the United States.

152. A review of the laws forbidding pollution of inland waters in the United States (second edition), by E. B. Goodell. 1905. 149 pp. 10c.

Scope indicated by title.

*155. Fluctuations of the water level in wells, with special reference to Long Island, N. Y., by A. C. Veatch. 1906. 83 pp., 9 pls. 25c.

Includes general discussion of fluctuation changes due to rainfall and evaporation, barometric changes, temperature changes, changes in rivers, changes in lake level, tidal changes, effects of settlement, irrigation, dams, underground-water developments, and to indeterminate causes.

*160. Underground-water papers, 1906; M. L. Fuller, geologist in charge. 1906. 104 pp., 1 pl.

Gives account of work in 1905; lists publications relating to ground waters, and contains the following brief reports of general interest:
Significance of the term "artesian," by Myron L. Fuller.
Representation of wells and springs on maps, by Myron L. Fuller.
Total amount of free water in the earth's crust, by Myron L. Fuller.
Use of fluorescein in the study of underground waters, by R. B. Dole.
Problems of water contamination, by Isaiah Bowman.
Instances of improvement of water in wells, by Myron L. Fuller.

*162. Destructive floods in the United States in 1905, with a discussion of flood discharge and frequency and an index to flood literature, by E. C. Murphy and others. 1906. 105 pp., 4 pls. 15c.

*163. Bibliographic review and index of underground-water literature published in the United States in 1905, by M. L. Fuller, F. G. Clapp, and B. L. Johnson. 1906. 130 pp. 15c.

Scope indicated by title.

*179. Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906. 34 pp., 1 pl. 10c.

Describes grain distillation; treatment of slop; sources, character, and effects of effluents on streams; discusses filtration, precipitation, fermentation, and evaporation methods of disposal of wastes without pollution.

*180. Turbine water-wheel tests and power tables, by R. E. Horton. 1906. 134 pp., 2 pls. 20c.

Scope indicated by title.

*185. Investigations on the purification of Boston sewage, by C.-E. A. Winslow and E. B. Phelps. 1906. 163 pp. 25c.

Discusses composition, disposal, purification, and treatment of sewages and tendencies in sewage-disposal practice in England, Germany, and the United States; describes character of crude sewage at Boston, removal of suspended matter, treatment in septic tanks, and purification in intermittent sand filtration and coarse material; gives bibliography.

*186. Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906. 36 pp., 1 pl.

Gives history of pollution by acid-iron wastes at Shelby, Ohio, and resulting litigation; discusses effect of acid-iron liquors on sewage-purification processes, recovery of copperas from acid-iron wastes, and other processes for removal of pickling liquor.

*187. Determination of stream flow during the frozen season, by H. K. Barrows and R. E. Horton. 1907. 93 pp., 1 pl. 15c.

Scope indicated by title.

*189. The prevention of stream pollution by strawboard waste, by E. B. Phelps. 1906. 29 pp., 2 pls.

Describes manufacture of strawboard, present and proposed methods of disposal of wast liquors, laboratory investigations of precipitation and sedimentation, and field studies of amount and character of water used, raw material and finished product, and mechanical filtration.

*194. Pollution of Illinois and Mississippi rivers by Chicago sewage (a digest of the testimony taken in the case of the State of Missouri *v.* the State of Illinois and the Sanitary District of Chicago), by M. O. Leighton. 1907. 369 pp., 2 pls.

Scope indicated by amplification of title.

*200. Weir experiments, coefficients, and formulas (revision of paper No. 150), by R. E. Horton. 1907. 195 pp., 38 pls. 35c.

Scope indicated by title.

*226. The pollution of streams by sulphite-pulp waste, a study of possible remedies, by E. B. Phelps. 1909. 37 pp., 1 pl. 10c.

Describes manufacture of sulphite pulp, the waste liquors, and the experimental work leading to suggestions as to methods of preventing stream pollution.

*229. The disinfection of sewage and sewage filter effluents, with a chapter on the putrescibility and stability of sewage effluents, by E. B. Phelps. 1909. 91 pp., 1 pl. 15c.

Scope indicated by title.

*234. Papers on the conservation of water resources. 1909. 96 pp., 2 pls. 15c.

Contains the following papers, whose scope is indicated by their titles: Distribution of rainfall, by Henry Gannett; Floods, by M. O. Leighton; Developed water powers, compiled under the direction of W. M. Steuart, with discussion by M. O. Leighton; Undeveloped water powers, by M. O. Leighton; Irrigation, by F. H. Newell; Underground waters, by W. C. Mendenhall; Denudation, by R. B. Dole and Herman Stabler; Control of catchment areas, by H. N. Parker.

*235. The purification of some textile and other factory wastes, by Herman Stabler and G. H. Pratt. 1909. 76 pp. 10c.

Discusses waste waters from wool scouring, bleaching and dyeing cotton yarn, bleaching cotton piece goods, and manufacture of oleomargarine, fertilizer, and glue.

236. The quality of surface waters in the United States, Part I, Analyses of waters east of the one hundredth meridian, by R. B. Dole. 1909. 123 pp. 10c.

Describes collection of samples, methods of examination, preparation of solutions, accuracy of estimates, and expression of analytical results.

89351°—19—WSP 442——16

238. The public utility of water powers and their governmental regulation, by René Tavernier and M. O. Leighton. 1910. 161 pp. 15c.

Discusses hydraulic power and irrigation, French, Italian, and Swiss legislation relative to the development of water powers, and laws proposed in the French Parliament; reviews work of bureau of hydraulics and agricultural improvements of the French department of agriculture, and gives résumé of Federal and State water-power legislation in the United States.

*255. Underground waters for farm use, by M. L. Fuller. 1910. 58 pp., 17 pls. 15c.

Discusses rocks as sources of water supply and the relative safety of supplies from different materials; springs and their protection; open or dug and deep wells, their location, yield, relative cost, protection, and safety; advantages and disadvantages of cisterns and combination wells and cisterns.

*257. Well-drilling methods, by Isaiah Bowman. 1911. 139 pp., 4 pls. 15c.

Discusses amount, distribution, and disposal of rainfall; water-bearing rocks; amount of ground water; artesian conditions; oil and gas bearing formations; gives history of well drilling in Asia, Europe, and the United States; describes in detail the various methods and the machinery used; discusses loss of tools and geologic difficulties, contamination of well waters and methods of prevention, tests of capacity and measurement of depth, and costs of sinking wells.

*258. Underground-water papers, 1910, by M. L. Fuller, F. G. Clapp, G. C. Matson, Samuel Sanford, and H. C. Wolff. 1911. 123 pp., 2 pls. 15c.

Contains the following papers (scope indicated by titles) of general interest:
Drainage by wells, by M. L. Fuller.
Freezing of wells and related phenomena, by M. L. Fuller.
Pollution of underground waters in limestone, by G. C. Matson.
Protection of shallow wells in sandy deposits, by M. L. Fuller.
Magnetic wells, by M. L. Fuller.

*315. The purification of public water supplies, by G. A. Johnson. 1913. 84 pp., 8 pls. 10c.

Discusses ground, lake, and river waters as public supplies, development of water-works systems in the United States, water consumption, and typhoid fever; describes methods of filtration and sterilization of water and municipal water softening.

334. The Ohio Valley flood of March-April, 1913 (including comparisons with some earlier floods), by A. H. Horton and H. J. Jackson. 1913. 96 pp., 22 pls. 20c.

Although relating specifically to floods in the Ohio Valley, this report discusses also the causes of floods and the prevention of damage by floods.

337. The effects of ice on stream flow, by William Glenn Hoyt. 1913. 77 pp., 7 pls. 15c.

Discusses methods of measuring the winter flow of streams.

*345. Contributions to the hydrology of the United States, 1914; N. C. Grover, chief hydraulic engineer. 1915. 225 pp., 17 pls. 30c. Contains:

(e) A method of determining the daily discharge of rivers of variable slope, by M. R. Hall, W. E. Hall, and C. H. Pierce, pp. 53–65.

364. Water analyses from the laboratory of the United States Geological Survey, tabulated by F. W. Clarke, chief chemist. 1914. 40 pp. 5c.

Contains analyses of waters from rivers, lakes, wells, and springs in various parts of the United States, including analyses of the geyser water of Yellowstone National Park, hot springs in Montana, brines from Death Valley, water from the Gulf of Mexico, and mine waters from Tennessee, Michigan, Missouri and Oklahoma, Montana, Colorado and Utah, Nevada and Arizona, and California.

371 Equipment for current-meter gaging stations, by G. J. Lyon. 1915. 64 pp., 37 pls. 20c.

Describes methods of installing automatic and other gages and of constructing gage wells shelters, and structures for making discharge measurements and artificial controls.

*375. Contributions to the hydrology of the United States, 1915; N. C. Grover, chief hydraulic engineer. 1916. 181 pp., 9 pls. 15c. Contains:

(c) The relation of stream gaging to the science of hydraulics, by C. H. Pierce and R. W. Davenport, pp. 77–84.

(e) A method of correcting river discharge for a changing stage, by B. E. Jones, pp. 117–130.

(f) Conditions requiring the use of automatic gages in obtaining records of stream flow, by C. H. Pierce, pp. 131–139.

Three papers presented at the conference of engineers of the water-resources branch in December, 1914.

*400. Contributions to the hydrology of the United States, 1916; N. C. Grover, chief hydraulic engineer. 108 pp., 7 pls. Contains:

(a) The people's interest in water-power resources, by G. O. Smith, pp. 1–8.

(c) The measurement of silt-laden streams, by R. C. Pierce, pp. 39–51.

(d) Accuracy of stream-flow data, by N. C. Grover and J. C. Hoyt, pp. 53–59.

416. The divining rod, a history of water witching, with a bibliography, by Arthur J. Ellis. 1917. 59 pp. 10c.

A brief paper published "merely to furnish a reply to the numerous inquiries that are continually being received from all parts of the country" as to the efficacy of the divining rod for locating underground water.

425. Contributions to the hydrology of the United States, 1917; N. C. Grover, chief hydraulic engineer. 1918. Contains:

*(c) Hydraulic conversion tables and convenient equivalents, pp. 71–94. 1917.

427. Bibliography and index of the publications of the United States Geological Survey relating to ground water, by O. E. Meinzer. 1918. 169 pp., 1 pl.

Includes publications prepared, in whole or in part, by the Geological Survey that treat any phase of the subject of ground water or any subject directly applicable to ground water. Illustrated by map showing reports that cover specific areas more or less thoroughly.

ANNUAL REPORTS.

*Fifth Annual Report of the United States Geological Survey, 1883–84, J. W. Powell, Director. 1885. xxxvi, 469 pp., 58 pls. $2.25. Contains:

*The requisite and qualifying conditions of artesian wells, by T. C. Chamberlin, pp. 125–173 pl. 21. Scope indicated by title.

Twelfth Annual Report of the United States Geological Survey, 1890–91, J. W. Powell, Director. 1891. 2 parts. Pt. II, Irrigation, xviii, 576 pp., 93 pls. $2. Contains:

*Irrigation in India, by H. M. Wilson, pp. 363–561, pls. 107 to 146. See Water-Supply Paper 87.

Thirteenth Annual Report of the United States Geological Survey, 1891–92, J. W. Powell, Director. 1892. (Pts. II and III, 1893.) 3 parts. *Pt. III, Irrigation, xi, 486 pp., 77 pls. $1.85. Contains:

*American irrigation engineering, by H. M. Wilson, pp. 101–349, pls. 111 to 146. Discusses the economical aspects of irrigation, alkaline drainage, silt, and sedimentation; gives brief history of legislation; describes perennial canals in Idaho, California, Wyoming, and Arizona; discusses water storage at reservoirs of the California and other projects, subsurface sources of supply, pumping, and subirrigation.

Fourteenth Annual Report of the United States Geological Survey, 1892–93, J. W. Powell, Director. 1893. (Pt. II, 1894.) 2 parts. *Pt. II, Accompanying papers, xx, 597 pp., 73 pls. $2.10. Contains:

*The potable waters of eastern United States, by W. J. McGee, pp. 1–47. Discusses cistern water, stream waters, and ground waters, including mineral springs and artesian wells.

*Natural mineral waters of the United States, by A. C. Peale, pp. 49–88, pls. 3 and 4. Discusses the origin and flow of mineral springs, the source of mineralization, thermal springs, the chemical composition and analysis of spring waters, geographic distribution, and the utilization of mineral waters; gives a list of American mineral-spring resorts; contains also some analyses.

Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director. 1898. (Parts II, III, and V, 1899.) 6 parts in 7 vols. and separate case for maps with Pt. V. *Pt. II, Papers chiefly of a theoretic nature, v, 958 pp., 172 pls. $2.65. Contains:

*Principles and conditions of the movements of ground water, by F. H. King, pp. 59–294, pls. 6 to 16. Discusses the amount of waters stored in sandstone, in soil, and in other rocks, and the depth to which ground water penetrates; gravitational, thermal, and capillary movements of ground waters, and the configuration of the ground-water surface; gives the results of experimental investigations on the flow of air and water through a rigid, porous medium, and through sand, sandstones, and silts; discusses results obtained by other investigators, and summarizes results of observations; discusses also rate of flow of water through sand and rock, the growth of rivers, rate of filtration through soil, interference of wells, etc.

*Theoretical investigation of the motion of ground waters, by C. S. Slichter, pp. 295–384, pl. 17. Scope indicated by title.

PROFESSIONAL PAPERS.

*72. Denudation and erosion in the southern Appalachian region and the Monongahela basin, by L. C. Glenn. 1911. 137 pp., 21 pls. 35c.

Describes the topography, geology, drainage, forests, climate, and population, and transportation facilities of the region, the relation of agriculture, lumbering, mining, and power development to erosion and denudation, and the nature, effects, and remedies of erosion; gives details of conditions in Holston, Nolichucky, French Broad, Little Tennessee, and Hiwassee River basins, along Tennessee River proper, and in the basins of the Coosa-Alabama system, Chattahoochee, Savannah, Saluda, Broad, Catawba, Yadkin, New, and Monongahela rivers.

86. The transportation of débris by running water, by G. K. Gilbert, based on experiments made with the assistance of E. C. Murphy. 1914. 263 pp., 3 pls. 70c.

The results of an investigation which was carried on in a specially equipped laboratory at Berkeley, Cal., and was undertaken for the purpose of learning "the laws which control the movement of bed load and especially to determine how the quantity of load is related to the stream slope and discharge and to the degree of comminution of the débris."

105. Hydraulic-mining débris in the Sierra Nevada, by G. K. Gilbert. 154 pp., 34 pls. 1917. 50c.

Presents the results of an investigation undertaken by the United States Geological Survey in response to a memorial from the California Miners' Association asking that a particular study be made of portions of the Sacramento and San Joaquin valleys affected by detritus from torrential streams. The report deals largely with geologic and physiographic aspects of the subject, traces the physical effects, past and future, of the hydraulic mining of earlier decades, the similar effects which certain other industries induce through stimulation of the erosion of the soil, and the influence of the restriction of the area of inundation by the construction of levees. Suggests cooperation by several interests for the control of the streams now carrying heavy loads of débris.

BULLETINS.

*32. Lists and analyses of the mineral springs of the United States (a preliminary study), by A. C. Peale. 1886. 235 pp.

Defines mineral waters, lists the springs by States, and gives tables of analyses so far as available.

*319. Summary of the controlling factors of artesian flows, by Myron L. Fuller. 1908. 44 pp., 7 pls. 10c.

Describes underground reservoirs, the sources of ground waters, the confining agents, the primary and modifying factors of artesian circulation, the essential and modifying factors of artesian flow, and typical artesian systems.

*479. The geochemical interpretation of water analyses, by Chase Palmer. 1911. 31 pp. 5c.

Discusses the expression of chemical analyses, the chemical character of water and the properties of natural waters; gives a classification of waters based on property values and reacting values, and discusses the character of the waters of certain rivers as interpreted directly from the results of analyses; discusses also the relation of water properties to geologic formations, silica in river water, and the character of the water of the Mississippi and the Great Lakes and St. Lawrence River as indicated by chemical analyses.

616. The data of geochemistry (third edition), by F. W. Clarke. 1916. 821 pp. 45c.

Earlier editions were published as Bulletins 330 and 491. Contains a discussion of the statement and interpretation of water analyses and a chapter on "Mineral wells and springs" (pp. 179–216). Discusses the definition and classification of mineral waters, changes in the composition of water, deposits of calcareous, ocherous, and siliceous materials made by water, vadose and juvenile waters, and thermal springs in relation to volcanism. Describes the different kinds of ground water and gives typical analyses. Includes a brief bibliography of papers containing water analyses.

INDEX BY AREAS AND SUBJECTS.

[A=Annual Reports; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper; G F=Geologic folio.]

[1] Many of the reports contain brief subject bibliographies. See abstracts.

[2] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

INDEX OF STREAMS.