DEPARTMENT OF THE INTERIOR
Hubert Work, Secretary

U. S. GEOLOGICAL SURVEY
George Otis Smith, Director

WATER-SUPPLY PAPER 572

SURFACE WATER SUPPLY OF THE UNITED STATES

1923

PART XII. NORTH PACIFIC SLOPE 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

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SURFACE WATER SUPPLY OF PACIFIC SLOPE BASINS IN WASHINGTON AND UPPER COLUMBIA RIVER BASIN, 1923

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 years ending September 30, 1923.

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, 1895–1924

1895	$12,500.00
1896	20,000.00
1897 to 1900, inclusive	50,000.00
1901 to 1902, inclusive	100,000.00
1903 to 1906, inclusive	200,000.00
1907	150,000.00
1908 to 1910, inclusive	100,000.00
1911 to 1917, inclusive	150,000.00
1918	175,000.00
1919	148,244.10
1920	175,000.00
1921 to 1923, inclusive	180,000.00
1924	170,000.00

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 pages 5 and 6.

Measurements of stream flow have been made at about 5,600 points in the United States and also at many points in Alaska and the Hawaiian Islands. In July, 1923, 1,590 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 inches, acre-feet, and millions of cubic feet. The principal terms used in this series of reports are second-feet, second-feet per square mile, run-off in inches, and acre-feet. They may be defined as follows:

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

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

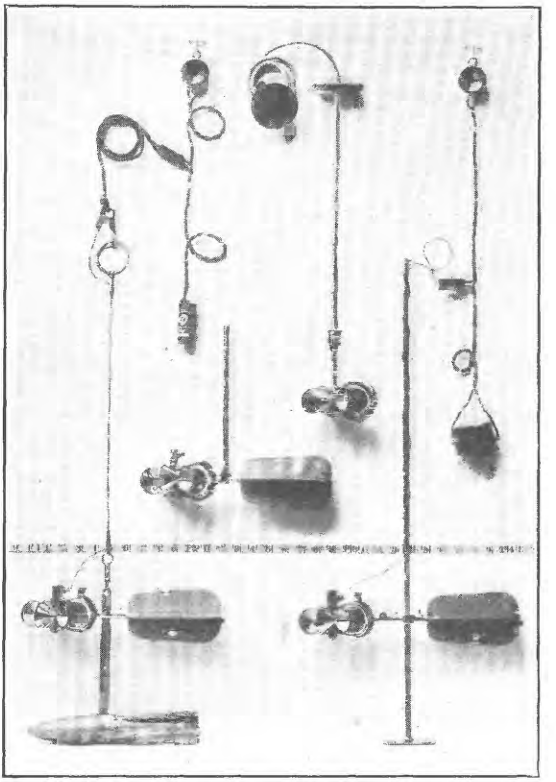
"Run-off in inches" is the depth to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

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.

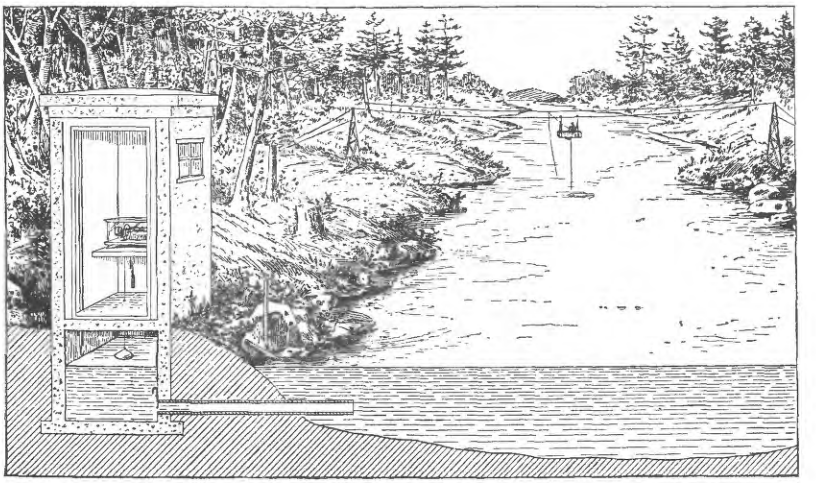
The following terms not in common use are here defined:

"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

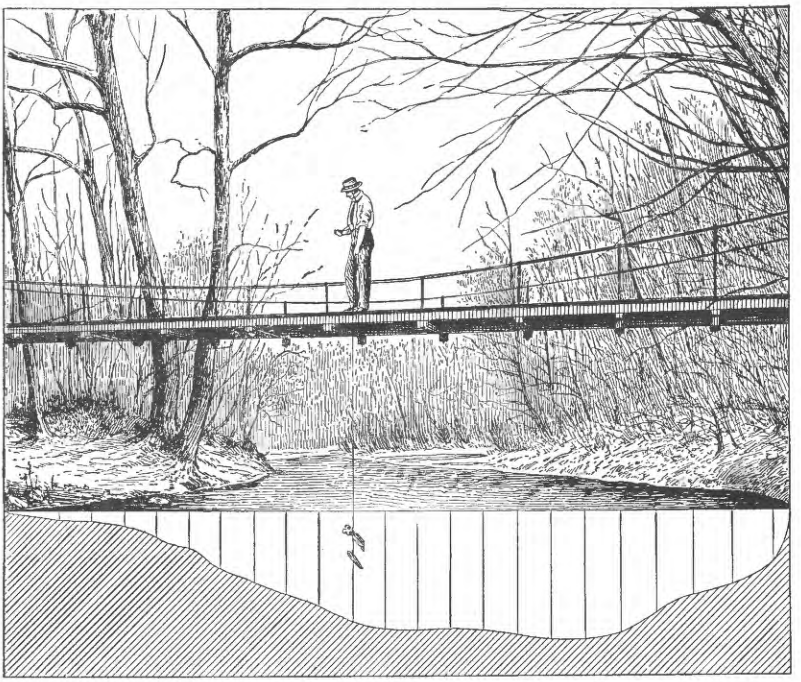


A. PRICE CURRENT METERS



B. TYPICAL GAGING STATION

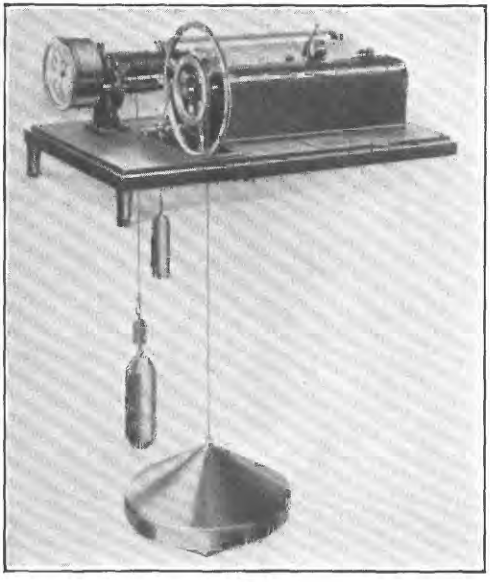
A



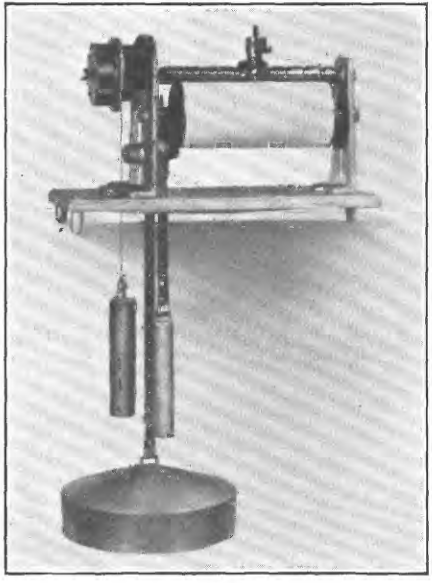
B

TYPICAL GAGING STATIONS

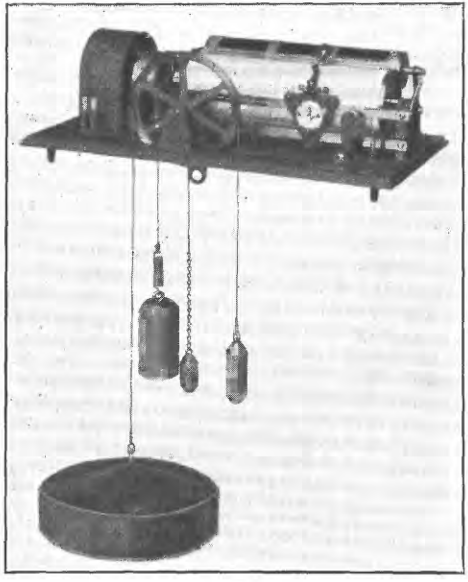
A, For wading measurement; *B*, for bridge measurement



A



B



C

WATER-STAGE RECORDERS

A, Au; *B*, Gurley; *C*, Stevens

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—at which water ceases to flow over the control.

EXPLANATION OF DATA

The data presented in this report cover the year ending September 30, 1923. At the first 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–III.)

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 comprise 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

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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 pages 2 and 3, 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 gage readings, and (5) methods of applying daily gage heights to the rating table to obtain the daily discharge.

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 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 in inches"

previously published by the Survey should be used with caution because of possible inherent sources of error not known to the Survey.

Many gaging stations on streams in the irrigated sections of the United States are located above most of the diversions from those streams, and the discharge recorded does not show the water supply available for further development, as prior appropriations below the stations must first be satisfied. To give an idea of the amount of prior appropriations, a paragraph on diversions is presented in each station description. The figures given can not be considered exact but represent the best information available.

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 act appropriating money.

Work in Washington was carried on in cooperation with the Department of Conservation and Development, Dan A. Scott, director. Cooperative relations were administered by Marvin Chase, supervisor of hydraulics, Division of Water Resources.

Acknowledgments are due to C. S. Heidel, State engineer of Montana, and to W. G. Swendsen, commissioner of reclamation of Idaho, for cooperation with their respective States.

Acknowledgments are also due to the United States Bureau of Reclamation, 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, and to the United States Weather Bureau for hydrographic and climatologic data.

The Hydrometric Survey of British Columbia furnished complete records of Columbia River at Trail, B. C.

The city of Seattle paid all costs in connection with the records for the stations on Cedar River and for all field work incident to the collection of data for Skagit River at Ruby dam site, at Reflector Bar, and at Marblemount, and for Thunder Creek at Marblemount.

The cost of field work for Nisqually River, Tacoma power conduit, Little Nisqually River, and Skokomish River was paid by the city of Tacoma.

Data pertaining to Puyallup River at Alderton and at Puyallup were gathered at the expense of the Inter-County River Improvement Commission of King and Pierce counties.

In accordance with provisions of the Federal Power Commission the cost of collecting data on the following streams was paid as indicated: Olney Creek, by the Sound Power Co.; Columbia River at Kettle Falls, by the Washington Water Power Co.; and Columbia River at Vernita, by the Washington Irrigation & Development Co.

The cost of analyzing and compiling data pertaining to Columbia River at Grand Coulee, Wash., and Priest River at Priest River, Idaho, was paid from Federal funds provided for the investigation of the Columbia Basin irrigation project.

DIVISION OF WORK

The data for stations in Washington were collected and prepared for publication under the direction of G. L. Parker, district engineer, assisted by D. J. F. Calkins, R. B. Kilgore, J. S. Gatewood, A. C. Baldwin, C. C. Osborne, J. M. Rogers, A. R. Haynes, and E. J. Beery.

The 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, E. L. Grant, G. H. Ellis, and Lois H. Hershner.

The data for stations in the Yakima basin, exclusive of stations in Yakima Indian Reservation, were collected and results computed and prepared for publication by Paul Taylor, engineer in charge of hydrometric work, United States Bureau of Reclamation, assisted by D. E. Ball and R. O. Crawford.

The manuscript was assembled and reviewed by J. J. Dirzulaitis.

GAGING-STATION RECORDS

QUILLAYUTE RIVER BASIN

SOLEDUCK RIVER AT SNIDER RANGER STATION, NEAR BEAVER, WASH.

LOCATION.—In sec. 28, T. 30 N., R. 11 W., at Snider ranger station, 9 miles below South Fork and 11 miles above Beaver, Clallam County.

DRAINAGE AREA.—111 square miles (measured on Pl. I, United States Geological Survey Professional Paper 7).

RECORDS AVAILABLE.—November 13, 1921, to September 30, 1923; winter records fragmentary.

GAGE.—Vertical staff in two sections on right bank a few hundred feet above ranger station; installed February 5, 1922. Gage read prior to February 5, 1922, was vertical staff on right bank about 250 feet above present gage and at different datum. All gage heights reduced to same datum. Gages read by J. H. Billingslea and H. O. Milbourn.

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

CHANNEL AND CONTROL.—Right bank high, is not overflowed; left bank subject to overflow at extremely high stages. Channel straight for several hundred feet above and below gage. Control is gravel and boulder riffle about 500 feet below gage; shifts at high stage. Stage of zero flow, according to measurements made September 14, 1922, gage height zero, ±0.25 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1923, 9.6 feet at 5 p. m. December 24 (discharge, 10,100 second-feet); minimum stage recorded, 1.19 feet at 8 a. m. September 19 (discharge, 53 second-feet).

1922–23: Maximum stage recorded, 14.7 feet at noon on December 12, 1921 (discharge, 23,500 second-feet); minimum stage recorded, that of September 19, 1923.

ICE.—Stage-discharge relation seriously affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water December 12, 1921; affected by ice February 12–14, 1923. Rating curve used prior to December 12, 1921, poorly defined; curve used since December 12, 1921, fairly well defined. Daily discharge ascertained by applying mean daily gage height to rating table. Records fair.

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

Discharge measurements of Soleduck River at Snider ranger station, near Beaver, Wash., during the years ending Sept. 30, 1922 and 1923

Date	Made by—	Gage height	Discharge
1922		*Feet*	*Sec.-ft.*
Aug. 9	R. B. Kilgore	1.65	127
Sept. 14	D. J. F. Calkins	1.43	78

Daily discharge, in second-feet, of Soleduck River at Snider ranger station, near Beaver, Wash., for the years ending Sept. 30, 1922 and 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1921–22												
1			3,340			211	238	670	1,860	470	153	113
2			1,960			224	253	840	1,760	470	148	111
3			1,490			253	321	1,410	1,670	545	144	89
4			1,170			238	402	1,960	1,580	520	139	253
5			1,030		198	224	360	1,490	1,330	448	132	174
6			960		380	211	360	1,100	1,100	448	132	126
7			840		780	211	470	900	900	425	130	162
8			780		520	211	520	720	900	402	128	139
9			840		402	211	470	620	900	360	126	111
10			4,170		340	224	425	570	900	340	139	102
11			12,300		302	211	402	520	840	340	153	94
12			18,200		285	211	360	545	840	321	162	91
13		495	2,620		253	211	340	720	840	302	155	87
14		473	1,580		238	198	321	1,030	840	285	132	83
15		461	1,100		238	198	302	1,580	695	253	124	80
16		429	900		840	186	302	2,180	645	253	119	77
17		406			780	186	285	2,070	620	238	115	75
18		384			620	224	268	1,490	620	238	111	74
19		362			495	238	268	1,170	620	238	111	73
20		340			402	224	285	1,030	620	224	126	72
21		340			360	224	360	1,100	620	211	117	77
22		2,620			321	211	380	1,030	595	186	106	186
23		1,170			285	211	360	780	570	186	102	139
24		3,470			268	198	360	900	620	186	96	102
25		2,620			253	186	380	780	645	174	91	102
26		3,470			238	186	425	695	695	174	91	211
27		5,870			224	186	495	670	695	174	91	425
28		2,510			211	186	495	780	645	174	87	321
29		2,070				198	495	1,030	595	162	87	198
30		3,740				198	570	1,490	520	160	83	198
31						224		1,670		153	87	

Daily discharge, in second-feet, of Soleduck River at Snider ranger station, near Beaver, Wash., for the years ending Sept. 30, 1922 and 1923—Continued

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1922–23												
1	253			2,070	360	470	780	520	545	545	157	73
2	186			5,870	321	425	695	425	545	495	155	77
3	162			3,470	302	402	645	402	595	545	148	96
4	153			2,070	285	380	595	448	695	448	144	78
5	144			1,860	285	360	570	620	840	470	141	74
6	135			7,030	268	645	595	670	840	495	137	70
7	126			7,230	268	620	545	695	780	448	135	68
8				3,470	253	545	495	840	780	425	130	67
9				5,870	253	470	470	960	720	380	128	65
10				3,880	238	520	470	900	695	380	124	63
11				2,400	238	570	495	720	595	380	121	62
12				1,670		495	545	620	520	360	119	61
13				1,330	280	448	495	570	470	340	117	58
14				1,170		402	448	595	425	340	113	58
15				1,960	1,170	360	470	670	402	340	113	58
16				1,860	780	360	570	780	425	321	109	56
17				2,970	840	340	570	645	402	268	106	55
18				1,760	1,960	321	570	570	402	253	104	54
19			2,070	1,250	1,100	321	595	520	402	238	99	56
20			960	1,030	840	321	595	470	380	238	100	238
21			900	840	670	302	570	495	380	224	96	150
22			1,580	750	670	302	495	545	380	224	124	96
23			3,340	670	720	285	470	495	380	224	121	103
24			9,840	620	645	340	470	448	380	224	100	186
25			3,210	570	570	321	545	495	380	198	94	135
26			3,210	520	520	302	670	545	402	186	90	92
27			7,030	495	470	340	645	495	402	186	85	85
28			4,640	448	448	471	570	425	448	186	81	75
29			2,290	425		645	495	780	520	186	77	72
30			1,760	380		840	470	695	570	174	77	68
31			3,740	360		840		595		162	75	

NOTE.—Gage not read Nov. 14–19, 1921, Aug. 19, 22, 26, 28, Sept. 7, 8, 23, 29, and 30, 1923; discharge Aug. 19, 22, and Sept. 23 estimated after comparison with records of Elwha River; for other days noted, estimates made by interpolation.

Monthly discharge of Soleduck River at Snider ranger station, near Beaver, Wash., for the period Nov. 13, 1921, to Sept. 30, 1923

[Drainage area, 111 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1921–22						
November 13–30	5,870	340	1,730	15.6	10.44	61,800
December 1–16	18,200	780	3,330	30.0	17.85	106,000
February 5–28	840	198	385	3.47	3.10	18,300
March	253	186	210	1.89	2.18	12,900
April	570	238	376	3.39	3.78	22,400
May	2,180	520	1,080	9.73	11.22	66,400
June	1,860	520	876	7.89	8.80	52,100
July	545	153	292	2.63	3.03	18,000
August	162	83	120	1.08	1.24	7,380
September	425	72	138	1.24	1.38	8,210
1922–23						
October	253	126	166	1.50	.39	2,300
December 19–31	9,840	900	3,430	30.9	14.94	88,400
January	7,230	360	2,140	19.3	22.25	132,000
February	1,960		547	4.93	5.13	30,400
March	840	285	444	4.00	4.61	27,300
April	780	448	554	4.99	5.57	33,000
May	960	402	602	5.42	6.25	37,000
June	840	380	523	4.71	5.26	31,100
July	545	162	319	2.87	3.31	19,600
August	157	75	114	1.03	1.19	7,010
September	238	54	85	.766	.85	5,060

LYRE RIVER BASIN

CRESCENT LAKE AT PIEDMONT, WASH.

LOCATION.—In sec. 14, T. 30 N., R. 9 W., on dock at Log Cabin Hotel, at Piedmont, Clallam County.

DRAINAGE AREA.—49.1 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 1, 1919, to September 30, 1923.

GAGE.—Vertical staff on dock; read by J. A. Martin.

EXTREMES OF STAGE.—Maximum stage recorded during year, 3.42 feet January 11; minimum stage recorded, 0.16 foot September 17–19.

1919–1923: Maximum stage recorded, 5.46 feet December 13 and 14, 1921; minimum stage recorded, that of September 17–19, 1923.

ACCURACY.—Gage read to hundredths once daily. Records excellent.

COOPERATION.—Gage-height record furnished by Washington Pulp & Paper Co.

Daily gage height, in feet, of Crescent Lake at Piedmont, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.52	0.58	0.42	2.90	1.60	1.26	0.90	0.95	0.92	0.74	0.38	0.26
2	.50	.58	.42	3.00	1.52	1.20	.92	.95	.90	.74	.36	.26
3	.48	.56	.42	3.14	1.48	1.22	.92	.93	.85	.72	.34	.24
4	.46	.56	.40	3.04	1.42	1.18	.92	.92	.90	.72	.34	.24
5	.44	.54	.40	3.00	1.36	1.16	.94	.90	.90	.72	.32	.24
6	.42	.54	.42	3.20	1.32	1.24	.94	.90	.90	.74	.32	.24
7	.40	.52	.42	3.24	1.30	1.28	.94	.90	.90	.76	.32	.24
8	.40	.52	.42	3.24	1.26	1.28	.94	.90	.90	.74	.30	.22
9	.38	.50	.42	3.34	1.22	1.28	.94	.92	.92	.72	.30	.22
10	.36	.50	.40	3.40	1.18	1.30	.94	.94	.92	.70	.28	.22
11	.34	.50	.40	3.42	1.14	1.30	.94	.94	.95	.70	.28	.20
12	.32	.46	.40	3.30	1.12	1.32	.94	.95	.95	.68	.28	.20
13	.30	.44	.42	3.15	1.14	1.32	.94	.96	.94	.68	.28	.20
14	.30	.42	.42	3.04	1.20	1.26	.94	.98	.92	.66	.26	.18
15	.30	.42	.42	2.98	1.40	1.24	.94	1.00	.90	.64	.26	.18
16	.30	.48	.42	2.76	1.46	1.22	.94	1.00	.88	.62	.26	.18
17	.30	.50	.42	2.54	1.48	1.18	.94	.95	.84	.60	.26	.16
18	.28	.52	.44	2.48	1.52	1.12	.95	1.00	.84	.58	.26	.16
19	.28	.52	.50	2.42	1.56	1.10	.96	1.00	.82	.58	.26	.16
20	.28	.52	.56	2.35	1.52	1.06	.98	.95	.80	.56	.26	.20
21	.28	.50	.78	2.32	1.48	1.06	1.00	.95	.78	.54	.26	.24
22	.26	.50	.90	2.28	1.44	1.04	.96	.95	.78	.54	.32	.26
23	.26	.48	1.20	2.26	1.42	1.02	.94	.92	.78	.52	.36	.28
24	.30	.48	1.50	2.14	1.40	1.00	.92	.90	.76	.50	.36	.28
25	.50	.48	1.68	2.00	1.36	1.16	.90	.92	.76	.50	.34	.26
26	.58	.46	1.78	1.90	1.34	1.06	.88	.95	.75	.48	.32	.26
27	.60	.46	2.00	1.86	1.30	1.00	.88	.92	.75	.46	.32	.26
28	.62	.46	2.42	1.82	1.28	.96	.90	.92	.74	.42	.30	.26
29	.60	.44	2.50	1.80	-------	.94	.90	.95	-------	.40	.30	.26
30	.60	.44	2.52	1.76	-------	.90	.92	.95	.74	.40	.28	.24
31	.58	-------	2.70	1.68	-------	.90	-------	.95	-------	.38	.28	-------

ELWHA RIVER BASIN

ELWHA RIVER AT McDONALD BRIDGE, NEAR PORT ANGELES, WASH.

LOCATION.—In NE. ¼ NW. ¼ sec. 33, T. 30 N., R. 7 W., at McDonald Bridge, 6½ miles above mouth and 8 miles southwest of Port Angeles, Clallam County.

DRAINAGE AREA.—262 square miles (measured on Pl. I, United States Geological Survey Professional Paper 7).

RECORDS AVAILABLE.—October 8, 1897, to December 31, 1901; October 1, 1918, to September 30, 1923.

GAGE.—Since October 17, 1918, Stevens water-stage recorder on left bank; inspected by A. J. Hooper. Gage datum 206.29 feet above mean sea level. A wire gage on bridge at same site, but different datum, was used 1897–1901.

DISCHARGE MEASUREMENTS.—Made from bridge.

CHANNEL AND CONTROL.—Bed composed of gravel; shifting; banks high.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 6.3 feet at 4.30 a. m. December 24 (discharge, 8,900 second-feet); minimum stage from water-stage recorder, 0.06 foot from 3 to 9 p. m. December 16 (discharge, 368 second-feet).

1897–1901; 1918–1923: Maximum stage recorded, 10.6 feet November 27, 1901 (discharge, 23,800 second-feet); minimum discharge, 170 second-feet October 18, 1897.

ICE.—Stage-discharge relation only slightly affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed gradually over the periods January 10–22, March 29 to July 9, and on February 15; slightly affected by ice February 14 and 15. Rating curve developed in 1922 and well defined below 5,000 second-feet used as standard form of curve to which changes in control prior to July 9, indicated by frequent discharge measurements, have been assumed to yield curves parallel. Rating curve used subsequent to July 9 is well defined. Shifting-control method used over periods of gradual change. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean gage heights obtained by inspecting gage-height graph, or, for days of considerable fluctuation, by averaging results obtained by applying gage heights for shorter intervals. Records good.

COOPERATION.—Gage-height record and some discharge measurements furnished by Northwestern Power & Manufacturing Co.

Discharge measurements of Elwha River at McDonald Bridge, near Port Angeles, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft*			*Feet*	*Sec.-ft*
Oct. 5	A. J. Hooper	0.47	546	May 7	A. J. Hooper	2.10	1,850
Nov. 13	do	.38	457	June 4	do	2.46	2,240
Jan. 1	do	2.94	3,000	July 9	do	2.24	1,770
Feb. 5	do	1.00	762	Aug. 21	do	1.02	695
Mar. 6	do	1.20	1,100	Sept. 13	do	.68	476
Apr. 10	do	1.24	1,050	30	Kilgore and Hooper	.53	392

Daily discharge, in second-feet, of Elwha River at McDonald Bridge, near Port Angeles, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	600	770	474	2,840	864	1,080	1,450	1,260	1,660	2,760	898	615
2	535	714	470	4,310	829	1,020	1,400	1,120	1,760	2,550	869	654
3	550	668	454	4,180	802	952	1,300	1,040	2,040	2,340	869	615
4	526	679	446	3,060	770	930	1,260	1,080	2,410	2,040	862	550
5	522	630	443	2,840	763	907	1,210	1,350	2,920	1,980	820	520
6	499	610	436	5,660	756	1,040	1,210	1,660	3,220	1,980	799	496
7	490	620	418	6,200	750	1,020	1,210	1,930	3,360	1,980	757	502
8	482	585	418	4,940	714	945	1,080	2,410	3,520	1,980	750	544
9	482	560	418	5,660	702	871	1,020	3,140	3,360	1,880	757	532
10	478	555	412	5,480	696	836	1,040	2,990	3,220	1,980	750	496
11	478	550	398	4,090	679	890	1,080	2,550	2,760	1,920	757	485
12	454	535	408	3,290	673	945	1,080	2,280	2,410	1,860	778	496
13	443	486	412	2,690	652	908	1,040	2,220	2,220	1,860	785	496
14	436	478	394	2,410	1,580	843	1,010	2,340	1,980	1,860	778	479
15	432	478	380	2,480	1,800	802	1,080	2,550	1,880	1,740	771	446
16	429	1,010	374	2,760	1,210	789	1,350	2,920	1,980	1,630	771	430
17	422	696	377	3,520	1,500	756	1,350	2,690	1,930	1,530	799	390
18	415	635	861	2,760	2,340	732	1,350	2,480	1,820	1,310	743	400
19	415	600	1,290	2,340	1,820	756	1,260	2,220	1,820	1,240	722	425
20	415	590	857	2,040	1,500	744	1,160	2,160	1,820	1,150	750	933
21	412	565	850	1,820	1,350	732	1,080	2,220	1,760	1,180	708	556
22	401	550	1,160	1,600	1,300	726	1,010	2,340	1,820	1,230	834	446
23	404	535	2,440	1,500	1,300	714	1,000	2,220	1,710	1,220	750	405
24	529	526	7,330	1,350	1,260	708	1,010	2,040	1,710	1,190	674	668
25	3,280	555	3,820	1,260	1,160	696	1,160	2,100	1,710	1,120	660	514
26	2,100	560	2,920	1,210	1,080	690	1,450	1,980	1,820	1,080	654	435
27	1,300	595	7,140	1,120	1,040	738	1,660	1,760	2,040	1,100	635	405
28	960	555	5,660	1,080	1,020	857	1,550	1,660	2,220	1,140	654	400
29	789	499	3,750	984	-------	1,020	1,350	1,930	2,620	1,140	667	405
30	935	490	2,990	930	-------	1,260	1,300	1,760	2,840	1,070	660	410
31	938	-------	3,590	900	-------	1,500	-------	1,660	-------	970	622	-------

NOTE.—Recorder not operating Mar. 11. Discharge determined by interpolation.

Monthly discharge of Elwha River at McDonald Bridge, near Port Angeles, Wash., for the year ending Sept. 30, 1923

[Drainage area, 262 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	3,280	401	695	2.65	3.06	42,700
November	1,010	478	596	2.27	2.53	35,500
December	7,330	374	1,670	6.37	7.34	103,000
January	6,200	900	2,820	10.8	12.45	173,000
February	2,340	652	1,100	4.20	4.37	61,100
March	1,500	690	884	3.37	3.88	54,400
April	1,660	1,000	1,210	4.62	5.16	72,000
May	3,140	1,040	2,070	7.90	9.11	127,000
June	3,520	1,660	2,280	8.70	9.71	136,000
July	2,760	970	1,610	6.15	7.09	99,000
August	898	622	752	2.87	3.31	46,200
September	933	390	505	1.93	2.15	30,000
The year	7,330	374	1,350	5.15	70.16	980,000

PUGET SOUND BASINS

SKOKOMISH RIVER BASIN

NORTH FORK OF SKOKOMISH NEAR HOODSPORT, WASH.

LOCATION.—In SW. ¼ 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, Mason County.

DRAINAGE AREA.—91 square miles (measured on Pl. I, United States Geological Survey Professional Paper 7, and township plats).

RECORDS AVAILABLE.—August 17, 1910, to September 22, 1911; February 1, 1913, to September 30, 1923.

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

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

CHANNEL AND CONTROL.—Channel curved above gage, straight below gage for 200 feet. Banks high, not subject to overflow. Control composed of rock and gravel; slightly shifting at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 13.1 feet from 2 to 5 p. m. December 27 (discharge, 7,860 second-feet); minimum stage from recorder, 0.87 foot from 11 a. m. to 8 p. m. September 18 (discharge, 100 second-feet).

1913–1923: Maximum stage estimated at 23.5 feet January 6, 1914, during part of day when recorder was not operating (discharge, estimated at 14,000 second-feet); minimum stage recorded, 0.77 foot September 28, 1918 (discharge, 89 second-feet).

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

DIVERSIONS.—None.

REGULATION.—Flow regulated by natural storage at Lake Cushman.

ACCURACY.—Stage-discharge relation changed frequently as a result of clearing site for construction work. Rating curves used October 1–25 and May 12–26 poorly defined; curve used October 26 to April 30 well defined; that used May 27 to September 30 fairly well defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating tables mean daily gage height determined from recorder graph by inspection, or, for days when variation in stage was considerable, by averaging results obtained by applying mean gage heights for shorter intervals. Shifting-control method used May 1–11. Records fair October and May; otherwise good.

Discharge measurements of North Fork of Skokomish River near Hoodsport, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 22	R. B. Kilgore	2.10	388	June 6	Gatewood and Dautoff	4.55	936
Dec. 19	do	4.22	1,090	Aug. 14	R. B. Kilgore	1.26	162
Mar. 20	Parker and Gatewood	2.16	398	31	D. J. F. Calkins	1.13	134
20	do	2.16	389	Sept. 26	R. B. Kilgore	2.02	307

Daily discharge, in second-feet, of North Fork of Skokomish River near Hoodsport, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	338	553	271	2,100	467	524	872		600	600	218	133
2	272	495	262	2,430	453	510	800		588	575	209	128
3	252	439	253	2,940	426	495	782	550	625	542	205	127
4	245	412	246	2,100	412	467	747		700	498	194	126
5	378	386	242	1,770	399	467	765		820	476	194	121
6	506	373	249	3,460	386	538	872		910	487	190	117
7	420	426	240	3,970	386	614	818		945	476	180	115
8	350	495	234	3,360	373	598	747	900	980	454	177	115
9	305	467	232	3,640	358	538	696		945	432	173	117
10	272	426	221	4,290	348	553	662		880	432	166	117
11	243	386	215	2,870	338	646	646		820	432	163	114
12	225	352	203	2,100	330	598	646		688	422	161	114
13	213	330	197	1,620	313	553	614	700	625	412	163	114
14	199	313	195	1,420	333	510	568		575	401	163	114
15	192	299	190	1,820		467	568		542	390	161	112
16	182	404	184	1,820		439	630		542	370	159	111
17	177	481	180	2,520		426	679		542	349	158	108
18	169	481	308	2,160		412	679	700	509	329	154	105
19	161	453	1,000	1,620		399	679		487	309	149	105
20	159	439	890	1,240		399	646		476	299	147	222
21	156	412	713	1,080	750	399	630		465	289	149	299
22	152	386	837	946		386	583		465	289	180	228
23	149	360	1,670	836		386	553	600	454	279	211	188
24	190	345	5,020	765		386	553		454	279	182	360
25	1,770	330	3,780	713		373	614		443	260	161	412
26	2,870	325	2,940	662		373	747		465	250	146	309
27	1,620	318	6,610	646	538	386	836		487	250	141	250
28	983	318	5,760	598	524	467	782	650	509	241	136	205
29	713	304	2,900	553	-------	583	679		564	241	132	179
30	598	287	1,920	524	-------	730	614		612	237	135	161
31	614	-------	2,220	495	-------	854	-------		-------	228	136	-------

NOTE.—Water-stage recorder not operating satisfactorily Feb. 15–26; discharge estimated from recorded range of stage. Braced figures show mean discharge for periods indicated.

Monthly discharge of North Fork of Skokomish River near Hoodsport, Wash., for the year ending Sept. 30, 1923

[Drainage area, 91 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	2,870	149	486	5.34	6.16	29,900
November	553	287	393	4.32	4.82	23,400
December	6,610	180	1,300	14.3	16.49	79,900
January	4,290	495	1,840	20.2	23.29	113,000
February	-------	313	549	6.03	6.28	30,500
March	854	373	499	5.48	6.32	30,700
April	872	553	690	7.58	8.46	41,100
May	-------	-------	682	7.49	8.64	41,900
June	980	443	624	6.86	7.65	37,100
July	600	228	372	4.09	4.72	22,900
August	218	132	168	1.85	2.13	10,300
September	412	105	168	1.85	2.06	10,000
The year	6,610	105	651	7.15	97.02	471,000

NISQUALLY RIVER BASIN

NISQUALLY RIVER NEAR LA GRANDE, WASH.

LOCATION.—In sec. 9, T. 15 N., R. 4 E., 1,200 feet below diversion dam of city of Tacoma municipal power plant and 2½ miles southeast of La Grande, Pierce County.

DRAINAGE AREA.—287 square miles (measured on topographic map of Rainier National Park, map of Rainier National Forest, edition of 1918, and Pl. IV, Water-Supply Paper 313).

RECORDS AVAILABLE.—October 1, 1919, to September 30, 1923; September 5, 1906, to October 31, 1911, fragmentary records showing total flow.

GAGE.—Stevens long-distance recorder on left bank 1,200 feet below dam; also vertical staff on left bank at head of low-water control for use during periods of low water when silt interferes with normal stage-discharge relation. Recorder inspected and gage read by headgate attendants. Previous gages as follows: From September 5, 1906, to September 8, 1910, vertical staff in two sections on right bank near site of present gage; January 1, 1910, to December 31, 1911, vertical staff on right wall of canyon at power-house site.

DISCHARGE MEASUREMENTS.—Made from cable 250 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of bedrock and boulders. Banks high. A considerable amount of glacial silt is deposited during summer, causing control to change temporarily.

EXTREMES OF DISCHARGE.—Maximum stage during year from water-stage recorder, 14.2 feet at 11 p. m. January 7 (discharge, 16,100 second-feet). Possibly no flow at gage for parts of several days during October, November, December, and September when entire flow was diverted into power conduit.

1920–1923: Maximum stage, from recorder, 15.6 feet from 3.30 to 6 a. m. December 12, 1921 (discharge, 19,200 second-feet). Possibly no flow at gage for parts of days when entire flow is diverted into power conduit.

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

DIVERSION.—City of Tacoma diverts water 1,200 feet above gage for power purposes. Total monthly discharge is computed from determinations of combined flow of river and power conduit.

ACCURACY.—Stage-discharge relation changed at high water January 7; affected by silt washed from settling basin and behind dam October 1 to December 18 and as noted in footnote to table of daily discharge. Rating curves for normal-control conditions well defined. Operation of water-stage recorder satisfactory. Daily discharge ascertained by use of discharge integrator except for extreme high water when discharge was determined by applying mean daily gage height to rating table or, for days of considerable variation in gage height, by averaging results obtained by applying mean gage height for shorter intervals. Records good except for extreme low water when amount of backwater effect is doubtful.

COOPERATION.—Gage-height record furnished by city of Tacoma.

Discharge measurements of Nisqually River near La Grande, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Apr. 17	Calkins and Gatewood	4.81	1,100	June 2	J. S. Gatewood	4.44	910
17	do	4.90	1,130	Sept. 12	R. B. Kilgore	.38	3.2
June 1	J. S. Gatewood	3.87	654				

Daily discharge, in second-feet, of Nisqually River near La Grande, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		256		2,990		298	1,410	590	692	1,150	103	40
2				3,640		308	1,180	526	906	946	86	152
3				4,730		276	1,220	380	1,040	765	76	132
4				2,950		360	1,130	400	1,020	598	60	
5	5	35	5	2,760	25	249	1,020	680	1,270	412	154	
6				9,800		530	918	978	1,640	370	40	15
7				13,500		797	1,030	1,020	1,570	631	46	
8				9,940		518	951	1,400	1,540	604	62	
9				7,350		358	751	1,980	1,600	526	65	
10				9,880		284	657	2,440	1,640	611	66	
11		5		6,220		544	701	2,030	1,300	644	118	
12				3,800		348	882	1,480	1,030	681	336	
13	5			2,500	15	365	817	1,250	829	654	276	
14			5	1,990		250	664	991	687	756	334	
15				1,870		174	744	1,040	596	905	320	
16				1,730		179	1,070	1,410	617	620	342	5
17		213		3,180	210	254	1,210	1,420	652	428	437	
18		245		2,640	462	241	1,060	1,090	473	239	396	
19		169	1,030	2,140	912	150	1,000	897	460	246	490	
20	5		626	1,580	832	182	912	854	501	208	311	
21			494	1,290	638	100	816	668	474	281	335	
22			564	1,040	658	116	690	635	494	546	716	
23			2,110	908	662	101	492	720	435	450	176	
24			7,240	756	634	134	552	626	614	386	116	
25	910	15	4,930	762	590	182	664	716	446	310	90	3
26	993		3,710	510	447	174	903	726	510	234	212	
27	700		5,840	435	359	211	1,090	680	476	239	153	
28	420		4,200	384	311	480	1,000	478	609	256	189	
29	293		2,770	243	-------	886	798	761	925	376	266	
30	70		2,140	151	-------	1,330	586	954	1,180	268	203	
31	408	-------	3,610	157	-------	1,530	-------	742	-------	158	164	-------

NOTE.—Braced figures show mean discharge for periods indicated. Stage-discharge relation affected by deposition of silt. Flow for these periods and for Oct. 30 and Sept. 1 estimated from gage-height graph constructed from gage-height records at regular and auxiliary gages and from notes of visiting engineers and of power-plant attendants.

Monthly discharge of Nisqually River and Tacoma power conduit near La Grande, Wash., for the year ending Sept. 30, 1923

[Drainage area, 287 square miles]

Month	Discharge in second-feet						Combined run-off	
	River (mean)	Conduit (mean)	Combined		Mean	Per square mile	Inches	Acre-feet
			Maximum	Minimum				
October	126	388	1,500	----------	514	1.79	2.06	31,600
November	42	472	822	----------	514	1.79	2.00	30,600
December	1,270	448	7,750	----------	1,720	5.99	6.91	106,000
January	3,280	591	13,900	800	3,870	13.5	15.56	238,000
February	251	584	1,550	----------	835	2.91	3.03	46,400
March	384	600	2,090	709	984	3.43	3.95	60,500
April	897	573	1,930	1,110	1,470	5.12	5.71	87,500
May	986	577	3,010	964	1,560	5.44	6.27	95,900
June	874	459	2,150	850	1,330	4.63	5.17	79,100
July	500	498	1,560	714	998	3.48	4.01	61,400
August	217	515	1,240	532	732	2.55	2.94	45,000
September	17	480	----------	----------	497	1.73	1.93	29,600
The year	745	515	13,900	----------	1,260	4.39	59.54	912,000

NOTE.—Combined records are comparable with records previously published for Nisqually River below Little Nisqually River, near La Grande, Wash.; also for Nisqually River near and at La Grande, Wash.

LITTLE NISQUALLY RIVER NEAR ALDER, WASH.

LOCATION.—In NW. ¼ sec. 16, T. 15 N., R. 4 E., in Thurston County, 1,500 feet above mouth, 3,000 feet from diversion dam of city of Tacoma's power plant, and 1½ miles southwest of Alder, Pierce County.

DRAINAGE AREA.—28.5 square miles (measured on Forest Service map).

RECORDS AVAILABLE.—August 1, 1920, to September 30, 1923.

GAGE.—Stevens water-stage recorder on left bank; installed April 16, 1921; inspected by employees of city of Tacoma. Previous gages as follows: August 6 to September 20, 1920, gage heights obtained from reference point in rock at site of present gage and same datum; September 30 to December 30, 1920, staff gage at same site but at datum 17.0 feet lower than that of present gage; January 1–27, 1921, staff gage at practically same site and at datum 0.22 foot lower than that of present gage; January 28 to April 19, 1921, staff gage at present site but at datum 0.12 foot lower than present gage. All gage readings referred to present datum.

DISCHARGE MEASUREMENTS.—Made by wading or from cable.

CHANNEL AND CONTROL.—One channel at all stages. Banks high; not subject to overflow. Control is riffle in heavy boulders 100 feet below gage. At extremely high stage, gage is on riffle.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from water-stage recorder, 6.4 feet at 3 p. m. January 7 (discharge, 2,220 second-feet); minimum stage recorded, 0.94 foot on September 9 (discharge, 8 second-feet). The discharge for several other days in September was but 8 second-feet.

1920–1923: Maximum and minimum stages recorded in 1923.

ICE.—Stage-discharge relation affected by ice during severe winters.

DIVERSION.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed January 7; affected by ice December 13–18. Rating curve used prior to January 7 well defined below 1,500 second-feet. Rating curve used after January 7 fairly well defined. Operation of water-stage recorder satisfactory except as noted in footnotes to table of daily discharge. Discharge ascertained by applying to rating table mean daily gage height obtained graphically from automatic record. Records good.

COOPERATION.—City of Tacoma furnished gage-height record.

Discharge measurements of Little Nisqually River near Alder, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
Apr. 18	Gatewood and Calkins	1.84	114
June 2	J. S. Gatewood	1.82	119
Sept. 11	Kilgore and Lanning	.96	8.6

Daily discharge, in second-feet, of Little Nisqually River near Alder, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	17	69	23	509	59	94	224	94	113	24	22	9
2	16	58	25	780	56	90	187	84	109	24	23	9
3	15	47	25	920	49	80	210	75	109	24	25	9
4	17	42	24	509	47	75	182	75	94	24	22	10
5	23	36	23	546	46	72	160	92	92	24	20	9
6	22	34	23	1,420	45	113	157	105	111	25	18	9
7	22	33	22	1,800	45	132	157	111	111	49	15	8
8	22	31	22	1,090	44	113	150	128	92	40	14	8
9	21	28	23	1,120	42	98	132	153	82	33	12	8
10	22	26	23	1,290	41	92	132	150	75	29	11	8
11	24	24	22	769	41	109		128	63	25	11	8
12	27	23	20	452	45	102		98	60	24	11	8
13	28	22		302	44	105	140	92	56	23	10	8
14	28	22		235	44	85		90	49	20	11	9
15	26	20	30	257	45	75	109	92	46	18	11	9
16	24	31		330	45	74	132	102	45	17	10	8
17	20	78		746	81	69	130	92	40	17	10	8
18	16	99		540	213	62	124	78	36	16	10	8
19	14	77	269	393	249	72	126	75	35	15	9	8
20	15	69	192	290	197	77	128	72	34	12	10	13
21	13	58	158	227	160	75	117	63	34	12	19	22
22	12	53	210	179	157	70	109	62	33	12	50	14
23	12	44	614	150	179	63	102	59	27	13	17	12
24	16	41	1,220	128	169	75	102	56	27	14	14	14
25	237	35	689	109	153	69	111	59	27	14	13	15
26	252	33	694	94	130	69	130	68	26	14	10	16
27	197	32	919	92	109	78	137	72	27	15	10	16
28	120	31	588	78	94	134	111	69	27	15	10	15
29	80	27	365	74	-------	210	92	160	24	16	9	12
30	63	25	266	62	-------	269	78	179	24	18	9	11
31	77	-------	672	60	-------	275	-------	137	-------	20	9	-------

NOTE.—Recorder not operating Apr. 11–14; discharge estimated from general information. Braced figures show mean discharge for periods indicated.

Monthly discharge of Little Nisqually River near Alder, Wash., for the year ending Sept. 30, 1923

[Drainage area, 28.5 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	252	12	48.3	1.69	1.95	2,970
November	99	20	41.6	1.46	1.63	2,480
December	1,220	----------	237	8.32	9.59	14,600
January	1,800	60	502	17.6	20.29	30,900
February	249	41	93.9	3.29	3.43	5,210
March	275	62	102	3.58	4.13	6,270
April	224	78	136	4.77	5.32	8,090
May	179	56	95.8	3.36	3.87	5,890
June	113	24	57.6	2.02	2.25	3,430
July	49	12	20.8	.730	.84	1,280
August	50	9	14.7	.516	.59	904
September	22	8	10.7	.375	.42	637
The year	1,800	8	114	4.00	54.31	82,700

TACOMA POWER CONDUIT NEAR LA GRANDE, WASH.

LOCATION.—In sec. 9, T. 15 N., R. 4 E., in Thurston County, 750 feet below headgate at diversion dam of city of Tacoma's municipal power plant and 2½ miles southeast of La Grande, Pierce County.

RECORDS AVAILABLE.—October 1, 1919, to September 30, 1923.

GAGE.—Stevens long-distance recorder on right side of conduit 750 feet below head gate; inspected by head-gate attendants.

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

CHANNEL AND CONTROL.—Open concrete-lined canal for 50 feet below gage merging into concrete-lined tunnel 1.9 miles in length.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 9.75 feet from 11 a. m. to 12.15 p. m. December 30 (discharge, 826 second-feet); no flow when operating gates are closed or when waste gates are opened wide for cleaning settling basin.

1920–1923: Maximum stage recorded from water-stage recorder, 10.0 feet February 16, 1920, and January 3, 1921 (discharge, 878 second-feet). No flow when operating gates are closed and when waste gates are opened wide.

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

REGULATION.—Flow regulated at head gate to meet requirements of power plant.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator. Records excellent.

Canal diverts water from left bank of Nisqually River in SW. ¼ sec. 9, T. 15 N., R. 4 E. Willamette meridian. Water used for muncipal power.

Discharge measurements of Tacoma power conduit near La Grande, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Apr. 17	Calkins and Gatewood	8.48	657	Sept. 11	Kilgore and Lanning	8.62	669
June 1	J. S. Gatewood	9.06	732	12	R. B. Kilgore	8.80	677

Daily discharge, in second-feet, of Tacoma power conduit near La Grande, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	332	566	380	498	668	630	520	622	597	408	552	540
2	396	560	400	575	629	592	559	552	566	498	536	506
3	354	549	430	584	646	600	579	584	536	508	558	594
4	362	546	390	638	550	502	558	584	597	388	552	601
5	363	398	371	586	620	642	578	531	612	524	398	554
6	349	493	368	595	598	604	626	482	508	562	492	541
7	332	458	349	378	582	634	569	612	515	546	517	591
8	304	441	339	480	572	628	520	582	512	420	526	690
9	336	422	362	572	526	622	591	562	420	492	536	640
10	352	391	390	559	523	647	590	574	358	484	496	648
11	372	367	320	564	520	562	569	563	497	518	535	556
12	379	360	260	567	503	664	566	572	426	491	418	614
13	380	344	280	629	465	657	562	531	428	514	528	646
14	378	344	306	582	450	642	585	613	433	510	536	619
15	368	327	352	616	552	655	540	627	422	397	540	574
16	410	418	300	624	570	636	562	563	422	526	525	485
17	401	578	263	632	589	564	550	520	322	532	532	466
18	389	562	441	635	550	515	608	620	444	524	534	452
19	386	486	590	605	636	635	593	645	431	516	426	510
20	314	580	608	584	648	608	586	516	438	506	534	448
21	284	578	613	546	638	661	594	626	431	496	502	468
22	280	574	620	603	608	622	530	628	444	374	520	331
23	332	546	610	588	626	630	639	548	415	510	528	308
24	362	514	510	598	626	608	560	550	302	557	531	277
25	496	496	490	596	597	530	542	562	410	532	538	301
26	509	454	608	626	624	535	544	580	415	526	408	282
27	500	502	616	658	622	564	604	572	448	530	529	270
28	496	444	599	612	622	530	570	634	488	523	530	267
29	421	436	609	675	-------	546	578	632	471	404	520	299
30	542	414	613	672	-------	560	626	530	466	558	534	324
31	549	-------	505	643	-------	562	-------	563	-------	566	545	-------

NOTE.—Faulty gage-height record for very few days completed from record of gate openings and used for determination of flow.

Monthly discharge of Tacoma power conduit near La Grande, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	549	280	388	23,900
November	580	327	472	28,100
December	620	260	448	27,500
January	675	378	591	36,300
February	668	450	584	32,400
March	664	502	600	36,900
April	639	520	573	34,100
May	645	482	577	35,500
June	612	302	459	27,300
July	566	374	498	30,600
August	558	398	515	31,700
September	690	267	480	28,600
The year	690	260	515	373,000

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 Power & Light Co.'s flume, a quarter of a mile below Mowich River, and 10 miles southeast of Electron, Pierce County.

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

RECORDS AVAILABLE.—January 1, 1909, to September 30, 1923.

GAGE.—Friez water-stage recorder on left bank at gaging bridge 1,000 feet above intake; inspected by William Chambers. Datum lowered 1 foot, March 9, 1918.

DISCHARGE MEASUREMENTS.—Made from gaging bridge at gage.

CHANNEL AND CONTROL.—Channel straight for 150 feet above and below gage. Banks high and wooded. One channel at all stages. Bed composed of boulders and glacial débris; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 6.45 feet at 7 a. m., January 6 (discharge, 4,350 second-feet); minimum discharge estimated at 100 second-feet on December 12, when stage-discharge relation was affected by ice.

1909–1923: Maximum discharge estimated from partial gage height record, December 18, 1917 (discharge, 4,800 second-feet); minimum discharge, that of December 12, 1922.

ICE.—Stage-discharge relation slightly affected by ice except during mild winters.

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed frequently prior to January 6; was practically permanent January 6 to August 2; changed gradually August 3 to September 30; affected by ice December 12–18 and February 13–15. Rating curve developed in 1922 and well defined below 2,000 second-feet used as a standard to January 5, and changes in control indicated by frequent discharge measurements have been assumed to yield curves parallel to this. See footnote to table of daily discharge. The curve developed and used directly January 6 to August 2 and used as standard form thereafter is well defined below 1,500 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting recorder graph or, for days of considerable variation of stage, by averaging results obtained by applying mean gage heights for shorter intervals. Records excellent.

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

Discharge measurements of Puyallup River near Electron, Wash., during the year ending Sept. 30, 1923

[Made by William Chambers]

Date	Gage height	Discharge	Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Oct. 5	0.92	196	Mar. 2	1.11	239	July 3	2.37	790
12	1.02	230	18	.86	179	8	2.43	827
Nov. 3	1.09	248	Apr. 1	1.90	514	Aug. 2	1.80	457
20	1.19	259	24	1.30	298	21	2.23	626
Dec. 21	1.25	292	May 2	1.29	276	Sept. 2	1.96	462
Jan. 4	2.28	574	24	1.77	468	18	1.66	330
15	1.90	495	June 3	2.17	663			
Feb. 4	.87	176	16	1.80	474			
19	1.73	433						

Daily discharge, in second-feet, of Puyallup River near Electron, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	265	359	153	600	199	256	520	330	502	1,180	486	550
2	225	294	157	790	195	239	470	293	675	1,100	502	582
3	262	253	159	790	187	224	478	278	693	912	520	550
4	236	270	155	570	180	219	430	311	749	675	474	458
5	205	245	149	1,170	176	216	406	390	950	645	422	442
6	185	225	151	3,650	174	276	390	466	1,260	723	390	462
7	183	215	142	3,190	178	250	390	560	1,220	1,060	383	560
8	212	205	148	2,240	167	224	358	770	1,180	854	418	663
9	242	192	151	2,060	160	207	330	1,180	1,180	854	430	555
10	270	180	146	2,060	155	209	320	1,380	1,220	935	438	506
11	279	172	123	1,340	155	204	344	1,060	1,020	988	566	506
12	270	168		928	144	202	406	717	784	988	627	545
13	242	161		687		199	355	598	633	1,100	615	576
14	245	157		566	130	185	334	540	535	1,220	633	520
15	253	157	150	520		180	390	675	494	1,060	610	454
16	253	444		520	176	192	486	935	470	819	711	410
17	256	423		693	229	190	540	784	458	675	826	369
18	242	333		545	442	180	482	651	438	571	756	410
19	225	294	404	482	442	204	418	588	410	560	693	402
20	188	265	312	414	369	199	386	515	446	560	805	422
21	178	239	297	383	330	190	338	490	478	749	770	334
22	202	225	315	352	327	190	305	502	510	928	861	250
23	253	207	855	327	327	185	296	502	470	950	502	226
24	276	200	2,130	305	311	204	299	474	545	840	490	253
25	960	200	1,220	281	287	195	334	540	588	687	502	237
26	540	200	820	267	264	207	426	498	633	675	530	267
27	423	192	1,390	256	248	253	478	478	645	749	604	245
28	321	185	925	248	239	348	414	450	890	763	669	245
29	262	170	646	229	-------	462	369	502	1,300	756	777	242
30	324	161	580	212	-------	593	330	474	1,380	633	639	267
31	522	-------	790	216	-------	615	-------	446	-------	510	525	-------

NOTE.—Rating curves parallel to and varying from 0.11 foot to 0.41 foot higher in datum than standard curve were used for the period Oct. 12 to Nov. 23, and Dec. 24 to Jan. 5. Shifting-control method used Oct. 1–11, Nov. 24 to Dec. 23, and Aug. 3 to Sept. 30. Braced figures show mean discharge for periods indicated. Stage-discharge relation affected by ice Dec. 12–18 and Feb. 13–15.

Monthly discharge of Puyallup River near Electron, Wash., for the year ending Sept. 30, 1923

[Drainage area, 91 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	960	178	290	3.19	3.68	17,800
November	444	157	233	2.56	2.86	13,900
December	2,130	----------	431	4.74	5.46	26,500
January	3,650	212	867	9.53	10.99	53,300
February	442	----------	230	2.53	2.64	12,800
March	615	180	248	2.73	3.15	15,200
April	540	296	394	4.33	4.83	23,400
May	1,380	278	593	6.52	7.52	36,500
June	1,380	410	759	8.34	9.30	45,200
July	1,220	510	830	9.12	10.51	51,000
August	861	383	586	6.44	7.42	36,000
September	663	226	417	4.58	5.11	24,800
The year	3,650	----------	492	5.41	73.47	356,000

PUYALLUP RIVER AT ALDERTON, WASH.

LOCATION.—On line between sec. 25, T. 20 N., R. 4 E., and sec. 30, T. 20 N., R. 5 E., at highway bridge 1 mile north of Alderton, Pierce County, and 1½ miles above Stuck River.

DRAINAGE AREA.—410 square miles (measured on Pl. IV, Water-Supply Paper 313).

RECORDS AVAILABLE.—November 20, 1914, to September 30, 1923.

GAGE.—Chain gage on highway bridge; installed December 15, 1920; read by Mrs. H. D. Foster. Vertical staff in two sections on downstream side of bridge pier on right bank used prior to January 15, 1920. Several temporary staff gages just below bridge used January 16 to December 14, 1920. Datum of gage lowered 1.00 foot August 5, 1918.

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 9 feet; left bank high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.7 feet on January 6 (discharge, 15,000 second-feet); minimum stage recorded, 0.57 foot October 20 (discharge, 362 second-feet).

1915–1923: Maximum stage recorded, 11.5 feet at 11 a. m. December 12, 1921 (discharge, 21,200 second-feet); minimum discharge recorded, 342 second-feet October 10, 1919.

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

DIVERSION.—None.

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

ACCURACY.—Stage-discharge relation changed gradually December 24 to January 3; January 6–9 and January 13 to July 9. Standard rating curve fairly well defined. Gage read to hundredths once daily. Slight diurnal fluctuation. Daily discharge ascertained by applying daily gage height to rating table. Shifting-control method used December 24 to January 3, January 6–9, and January 13 to July 9. Records good.

Discharge measurements of Puyallup River at Alderton, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 2	D. J. F. Calkins	0.94	636	Mar. 30	Calkins and Gatewood	2.14	2,110
Nov. 18	R. B. Kilgore	1.95	1,540	May 31	J. S. Gatewood	1.90	1,610
Jan. 4	Calkins and Baldwin	2.93	3,100	July 10	do	2.48	2,150
10	Calkins and Bullard	5.65	9,280	Aug. 30	do	1.58	1,180

Daily discharge, in second-feet, of Puyallup River at Alderton, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	600	1,800	600	2,550	1,370	1,470	1,920	1,370	1,800	2,290	948	1,040
2	638	1,220	675	2,830	1,370	1,470	1,920	1,370	2,830	2,290	990	1,040
3	460	990	712	3,890	1,220	1,580	1,920	1,370	2,830	2,160	990	905
4	460	825	675	3,110	1,170	1,270	1,690	1,270	2,830	2,040	948	905
5	530	788	600	2,830	1,120	1,120	1,800	1,370	2,830	2,160	905	865
6	530	788	600	15,000	1,120	1,470	1,800		2,830	1,920	948	905
7	495	750	600	11,500	1,120	1,920	1,800		2,690	2,040	905	1,080
8	460	750	495	10,000	1,080	1,800	1,800		2,830	2,040	905	1,080
9	460	788	530	7,270	1,040	1,800	1,800		2,690	1,920	825	1,080
10	395	600	675	9,370	990	1,470	1,920	2,800	2,690	2,040	865	1,080
11	495	600	600	7,270	990	1,690	1,690		2,550	2,040	905	1,040
12	460	600	600	8,740	990	1,800	1,580		2,420	2,040	990	990
13	428	600	675	4,940	948	1,800	1,580		1,690	2,160	1,220	990
14	460	495	675	3,260	905	1,580	1,690	1,800	1,690	2,160	1,220	948
15	460	530	495	2,970	990	1,470	1,690	1,920	1,470	2,290	1,170	905
16	460	495	460	2,690	1,120	1,370	1,690	1,920	1,370	1,920	1,170	865
17	460	1,800	460	2,970	1,470	1,470	1,690	1,920	1,370	1,580	1,170	750
18	395	1,470	460	3,410	2,290	1,470	1,690	2,040	1,270	1,470	1,170	750
19	428	1,270	1,690	3,110	2,970	1,370	1,690	2,040	1,370	1,470	1,170	750
20	362	1,170	1,800	2,690	2,290	1,470	1,580	1,800	1,370	1,580	1,170	788
21	395	905	1,580	2,420	2,160	1,470	1,270	1,470	1,370	1,580	1,220	825
22	428	865	1,370	2,420	2,160	1,270	1,220	1,580	1,470	1,580	1,170	750
23	428	788	1,690	2,290	2,160	1,170	1,120	1,370	1,370	1,800	1,170	675
24	460	750	9,160	2,040	1,920	1,220	1,170	1,370	1,470	1,580	1,170	565
25	1,370	825	4,940	2,040	1,920	1,270	1,370	1,470	1,690	1,470	1,220	565
26	2,420	825	3,260	1,800	1,920	1,270	1,690	1,470	1,690	1,220	1,170	428
27	1,690	788	3,410	1,800	1,470	1,270	1,580	1,690	1,800	1,470	1,170	395
28	1,270	750	3,570	1,690	1,580	1,270	1,370	1,690	2,040	1,580	1,170	395
29	1,170	638	2,550	1,690	-------	1,270	1,370	1,580	2,420	1,470	1,170	395
30	1,470	600	2,550	1,470	-------	2,160	1,270	1,580	2,290	990	1,170	460
31	2,420	-------	3,260	1,470	-------	2,160	-------	1,690	-------	1,080	1,080	-------

NOTE.—Gage not read May 6–13, discharge estimated by comparison with flow near Electron. Braced figures show mean discharge for period indicated.

Monthly discharge of Puyallup River at Alderton, Wash., for the year ending Sept. 30, 1923

[Drainage area, 410 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	2,420	362	741	1.81	2.09	45,600
November	1,800	495	869	2.12	2.36	51,700
December	9,160	460	1,660	4.05	4.67	102,000
January	15,000	1,470	4,240	10.30	11.87	261,000
February	2,970	905	1,490	3.63	3.78	82,800
March	2,160	1,120	1,510	3.68	4.24	92,800
April	1,920	1,120	1,610	3.93	4.38	95,800
May	-------	1,270	1,920	4.68	5.40	118,000
June	2,830	1,270	2,030	4.95	5.52	121,000
July	2,290	990	1,790	4.37	5.04	110,000
August	1,220	825	1,080	2.63	3.03	66,400
September	1,080	395	807	1.97	2.20	48,000
The year	15,000	362	1,650	4.02	54.58	1,200,000

PUYALLUP RIVER AT PUYALLUP, WASH.

LOCATION.—Since November 16, 1919, in NE. ¼ sec. 20, T. 20 N., R. 4 E., seven-eighths of a mile below Puget Sound Electric Co.'s railway bridge, 1 mile northwest of Puyallup, Pierce County, three-fourths of a mile above Clark Creek, and 3½ miles below mouth of Stuck River.

DRAINAGE AREA.—914 square miles (measured on Pls. IV and XI, Water-Supply Paper 313).

RECORDS AVAILABLE.—May 1, 1914, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank since December 3, 1919. Previous gages as follows: May 1, 1914, to November 15, 1919, Stevens continuous water-stage recorder on right bank about 1¼ miles above present site and at different datum; July 24, 1918, to December 3, 1919, Stevens continuous water-stage recorder on left bank about 400 feet above present location and at datum approximately 10 feet lower than present gage.

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

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from water-stage recorder, 14.98 feet at 3.15 a. m. January 6 (discharge, 31,000 second-feet). Water below intake October 1–26; minimum stage and discharge not determined.

1914–1923: Maximum stage recorded, 34.15 feet at 4.45 p. m. December 18, 1917 (discharge, 40,500 second-feet); minimum discharge, 726 second-feet at 8 p. m. November 18, 1917.

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

DIVERSIONS.—Two hydroelectric plants owned by the Puget Sound Power & Light 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 into the river. Water for the Dieringer plant is diverted from White River at 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 frequently. Well-defined rating curve developed during 1921 used as standard form of curve for this station and changes in control indicated by frequent discharge measurements have been assumed to yield curves parallel to this. Water below intake October 1–26; intake clogged May 4–28 and September 26–30. Operation of water-stage recorder satisfactory when stage was above intake except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height obtained by inspecting recorder graph and corrected as to time and amount of shift in accordance with results of discharge measurements. Records good except for periods represented by flat estimates.

Discharge measurements of Puyallup River at Puyallup, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 17	R. B Kilgore	3.23	2,750	May 29	J. S. Gatewood	4.78	4,070
Jan. 4	Calkins and Baldwin	5.46	6,600	July 10	....do	5.01	4,610
10	Parker and Baldwin	10.41	18,500	Aug. 30	....do	3.51	2,740
Mar. 30	Calkins and Gatewood	4.40	4,040				

Daily discharge in second-feet, of Puyallup River at Puyallup, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		2,620	2,030	3,550	2,530	2,530	3,860	3,160	3,410	5,310	2,350	2,440
2		2,190	2,030	4,430	2,350	2,620	4,870	3,160	4,650	5,310	2,350	2,190
3		2,030	1,890	7,120	2,190	2,440	4,650	2,930	4,870	4,430	2,440	2,190
4		1,890	2,110	6,430	1,750	2,030	4,650		4,650	3,550	2,270	2,440
5		1,630	2,190	6,200	2,110	2,350	4,430		5,090	3,410	1,890	2,440
6		1,890	1,960	24,900	2,270	2,620	4,220		6,200	3,280	2,190	2,350
7		1,890	1,960	23,300	2,270	2,930	4,030		6,430	5,310	2,270	2,440
8		1,890	1,890	19,700	2,270	2,720	2,820		7,580	4,650	2,270	2,530
9		1,820	1,890	14,200	2,270	2,620	3,860		7,350	4,430	2,350	2,190
10		1,890	1,750	16,800	2,190	2,530	3,700		6,890	4,220	2,110	2,440
11		1,890	1,890	13,500	1,750	2,270	3,410		5,310	4,220	2,350	2,350
12		1,460	1,750	9,250	2,190	2,620	3,160		4,220	4,030	2,110	2,350
13		1,890	1,750	6,660	2,350	2,820	3,040		3,700	3,860	2,620	2,440
14	1,120	1,890	1,690	4,870	2,350	2,620	2,820		3,280	4,220	2,620	2,350
15		1,820	1,630	4,870	2,440	2,620	2,820		2,930	4,030	2,620	2,190
16		2,110	1,510	4,430	2,720	2,620	4,220	4,570	2,820	3,860	2,720	1,890
17		2,720	1,570	4,650	2,720	2,530	4,430		2,530	3,280	2,930	2,030
18		2,440	1,820	4,430	2,930	2,030	4,650		3,040	2,820	2,720	2,030
19		1,960	2,530	5,090	3,860	2,350	3,860		2,930	2,720	2,270	2,190
20		2,190	2,440	4,030	3,280	2,530	3,700		3,160	2,620	2,820	2,190
21		2,110	2,190	3,860	3,040	2,440	3,410		2,820	2,620	2,720	2,190
22		2,110	2,190	3,860	2,530	2,350	2,930		3,160	2,720	3,280	2,030
23		2,030	2,930	3,410	2,820	2,350	2,930		2,930	3,280	2,530	1,750
24		2,030	13,500	3,160	2,820	2,350	2,930		3,040	3,280	2,440	1,890
25		1,960	9,500	3,040	2,350	1,960	3,040		3,550	2,930		1,890
26		1,570	5,970	2,930	2,620	2,190	3,410		3,410	2,820	2,440	
27	2,440	1,960	5,530	2,930	2,530	2,270	4,030		3,410	2,720		
28	2,110	2,030	5,750	2,820	2,530	2,440	3,860		4,030	2,820		1,650
29	1,570	2,030	3,550	2,930	-------	2,930	3,410	4,220	5,090	2,620		
30	1,750	1,570	3,160	2,620	-------	3,700	3,550	3,410	5,530	2,930	2,720	
31	2,930	-------	3,700	2,620	-------	4,430	-------	3,280	-------	2,440	2,620	-------

NOTE.—Discharge Oct. 1–26, May 4–28, and Sept. 26–30 estimated from records of flow of tributaries. Water-stage recorder not operating Aug. 25–29; discharge estimated from recorded range of stage. Braced figures show mean discharge for periods indicated.

Monthly discharge of Puyallup River at Puyallup, Wash., for the year ending Sept. 30, 1923

[Drainage area, 914 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	2,930	----------	1,290	----------	----------	79,300
November	2,720	1,460	1,980	----------	----------	118,000
December	13,500	1,510	3,100	----------	----------	191,000
January	24,900	2,620	7,180	----------	----------	441,000
February	3,860	1,750	2,500	----------	----------	139,000
March	4,430	1,960	2,570	----------	----------	158,000
April	4,870	2,820	3,690	----------	----------	220,000
May	----------	----------	4,340	----------	----------	267,000
June	7,580	2,530	4,270	----------	----------	254,000
July	5,310	2,440	3,570	----------	----------	220,000
August	3,280	1,890	2,480	----------	----------	152,000
September	2,530	----------	2,120	----------	----------	126,000
The year	24,900	----------	3,270	3.58	48.60	2,370,000

NOTE.—Storage and release of water in Lake Tapps reservoir influences monthly flow appreciably but has little influence on mean annual flow.

WHITE RIVER AT BUCKLEY, WASH.

LOCATION.—In SE. ¼ sec. 34, T. 20 N., R. 6 E., at Northern Pacific Railway bridge 1 mile northeast of Buckley, Pierce County.

DRAINAGE AREA.—424 square miles (measured on Pl. 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 to December 31, 1911; January 18, 1913, to September 30, 1923.

GAGE.—Stevens eight-day water-stage recorder on left bank 40 feet below railway bridge at end of concrete wall protecting abutment of bridge; installed January 9, 1917; inpsected by O. E. Osgood. Record from this gage supplemented during extremely low water April 25 to May 8, 1920, by measurements from a reference point on railway bridge to water surface, and after May 9, 1920, by readings from chain gage installed at same reference point. For description of previous gages see Water-Supply Paper 462.

The high water of January 23, 1919, cut through the left bank, making a channel back of the water-stage recorder. In this channel a staff gage was installed at railway bridge April 2, 1919; moved 700 feet upstream June 11, 1919. Gage read by O. E. Osgood.

DISCHARGE MEASUREMENTS.—Measurements of flow in both channels made by wading or from railway bridge.

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; shifting; gradient steep. One channel prior to flood of January 23, 1919; two channels thereafter. Right bank of main channel low and flat; left bank protected by concrete wing wall. Various types of protection to under crossing of city of Tacoma's municipal water supply have also been factors in control for this station.

EXTREMES OF DISCHARGE.—Maximum combined daily discharge of river and flume, 10,900 second-feet January 6; minimum combined daily discharge, probably occurred in December when stage-discharge relation for both river and flume was affected by ice.

1899–1901; 1911; and 1913–1923: Maximum daily discharge including flume, 18,100 second-feet, December 18, 1917; minimum daily discharge including flume, 349 second-feet, November 19, 1917.

ICE.—Stage-discharge relation slightly affected by ice during severe winters.

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 several times during autumn and late summer; practically permanent December 26 to August 25; affected by ice December 12–14; rating curves developed in 1923, used directly or as standard forms, fairly well defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph by inspection. Shifting-control method used November 11–25, December 23, 24, and August 26 to September 30. Records good.

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

Discharge measurements of White River at Buckley, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
Oct. 10	Quenon and Osgood	20.90	10.0	Apr. 11	Quenon and Wenby	22.01	143
Nov. 1	do	21.32	40.0	26	Quenon, Williams, and Osgood	23.81	939
10	do	21.17	25.7	May 15	Quenon and Osgood	24.97	1,660
25	do	21.39	35.3	26	do	24.39	1,370
Dec. 22	do	21.30	51.7	June 11	Marschke and Osgood	24.98	1,800
Jan. 9	Quenon, Marschke, and Osgood	27.06	5,820	25	do	23.90	965
15	Quenon, Nearhood, and Osgood	24.32	1,130	July 10	do	24.40	1,270
25	Quenon and Marschke	21.98	172	25	do	22.97	429
Feb. 10	Quenon and Osgood	20.90	25.3	Aug. 9	do	21.14	43.5
27	do	21.27	56.2	25	do	21.22	51.8
Mar. 14	do	21.32	62.0	Sept. 10	do	21.01	25.2
26	do	21.32	64.1	25	do	20.94	19.3

Daily discharge, in second-feet, of White River at Buckley, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	12	50	27	78	47	61	1,630	744	930	2,250	66	37
2	12	34	29	190	46	60	1,750	600	1,520	1,840	49	37
3	13	32	31	1,670	42	58	1,890	515	1,560	1,480	48	37
4	14	31	30	1,710	42	55	2,000	520	1,480	1,520	46	33
5	12	28	26	1,800	41	64	1,750	930	1,630	1,240	49	30
6	12	28	8	10,200	37	77	1,670	1,560	2,000	1,060	44	27
7	10	27	8	8,920	37	80	1,200	1,480	2,550	1,840	42	28
8	10	27	7	7,050	34	76	572	1,750	3,400	1,890	43	27
9	10	27	34	5,780	27	70	1,420	2,470	3,510	1,480	42	27
10	10	27	90	6,620	25	69	1,310	3,300	2,990	1,340	42	26
11	11	27	29	5,370	25	72	750	2,900	1,750	1,310	44	26
12	12	26		3,620	48	68	430	2,400	1,420	1,240	46	26
13	10	24	50	1,890	190	66	370	2,250	1,240	1,170	46	25
14	10	20		1,420	226	63	370	1,800	995	1,340	47	26
15	9	14	12	1,200	335	61	1,170	1,710	840	1,630	48	24
16	10	28	19	606	394	63	1,420	2,050	870	1,240	49	24
17	10	61	8	490	146	65	1,560	2,120	780	810	50	23
18	10	60	12	515	100	65	1,630	1,840	1,030	530	49	23
19	10	54	88	870	97	66	1,280	1,710	870	530	48	22
20	10	49	66	714	70	69	1,100	1,750	1,140	390	56	23
21	9	45	54	1,100	65	68	1,140	1,560	840	418	49	22
22	8	43	52	482	64	68	1,100	1,240	930	840	197	20
23	10	41	355	304	64	66	678	1,240	960	810	60	20
24	13	38	4,220	215	61	65	630	1,200	1,420	630	52	20
25	50	36	2,320	163	61	63	618	1,420	1,140	434	50	20
26	41	36	1,380	142	59	61	930	1,380	1,030	314	48	20
27	26	36	1,100	160	58	66	1,200	1,380	1,060	310	48	20
28	26	34	960	430	56	92	1,340	930	1,340	482	48	20
29	25	28	267	70	-------	450	1,480	900	1,590	780	49	20
30	27	28	96	49	-------	1,060	960	840	1,840	240	48	20
31	64	-------	96	47	-------	1,380	-------	720	-------	85	46	-------

NOTE.—Water-stage recorder not operating satisfactorily Oct. 18, 19, Nov. 4, 5, 12, and 19; discharge Nov. 4 and 5 determined from staff-gage reading; otherwise estimated by interpolation.

Monthly discharge of White River and flume at Buckley, Wash., for the year ending Sept. 30, 1923

[Drainage area, 424 square miles]

Month	Discharge in second-feet						Run-off (combined)	
	River (mean)	Flume (mean)	Combined				Depth in inches on drainage area	Total in acre-feet
			Maximum	Minimum	Mean	Per square mile		
October	16.6	544	1,460	378	561	1.32	1.52	34,500
November	34.6	635	1,700	398	670	1.58	1.76	39,900
December	373	857	6,300	----------	1,230	2.90	3.34	75,600
January	2,060	816	10,900	785	2,880	6.79	7.83	177,000
February	89.2	730	1,350	----------	819	1.93	2.01	45,500
March	154	977	2,870	799	1,130	2.67	3.08	69,500
April	1,180	763	2,400	1,420	1,940	4.58	5.11	115,000
May	1,520	780	4,110	1,410	2,300	5.42	6.25	141,000
June	1,490	767	3,670	1,620	2,260	5.33	5.95	134,000
July	1,020	812	2,760	1,160	1,830	4.32	4.98	113,000
August	53.2	1,040	2,110	864	1,090	2.57	2.96	67,000
September	25.1	671	995	462	696	1.64	1.83	41,400
The year	672	784	10,900	----------	1,460	3.44	46.62	1,050,000

WHITE RIVER FLUME AT BUCKLEY, WASH.

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

RECORDS AVAILABLE.—January 18, 1913, to September 30, 1923.

GAGE.—Stevens long-distance water-stage recorder with transmitter at stilling well, on right side of flume 800 feet below headgate and recorder in gate house; installed January 12, 1918; inspected by O. E. Osgood. Prior to January 12, 1918, Fuller water-stage recorder 800 feet below headgate.

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

CHANNEL AND CONTROL.—Control formed by long section of flume bottom below gage. A rock spill a quarter of a mile below gage is partial control also. Stage-discharge relation affected by variable quantity of rocks which work their way from intake to rock spill.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 6.60 feet from 10 to 11 p. m. December 24 (discharge, 2,190 second-feet). No flow in flume when headgates are closed for cleaning flume or on account of high water.

1913–1923: Maximum stage recorded, that of December 24, 1922. No flow in flume when headgates were closed.

ICE.—Stage-discharge relation affected by ice during severe winters.

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

ACCURACY.—Stage-discharge relation changed continuously throughout year, affected by ice December 11–17 and February 13–15. Rating curve developed in 1918 used as standard form of curve for this station and changes in control indicated by frequent discharge measurements have been assumed to yield curves parallel to this. Operation of water-stage recorder satisfactory. Daily discharge ascertained by shifting-control method, except for several short periods October to December when daily discharge was ascertained by applying to rating table daily mean gage height determined from recorder graph by inspection. Records good.

COOPERATION.—Puget Sound Power & Light Co. furnished gage-height record and 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 then discharged into Stuck River.

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Discharge measurements of White River flume at Buckley, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 10	Quenon and Osgood	2.02	408	Apr. 11	Quenon and Wenby	6.02	1,600
31	do	5.44	1,500	25	Quenon and Williams	4.12	980
Nov. 10	do	2.11	428	May 11	Quenon and Osgood	3.30	724
25	do	2.40	539	28	Marschke and Quenon	4.32	932
Dec. 22	do	3.43	800	June 11	Marschke and Osgood	5.04	1,300
28	do	6.54	1,990	26	do	3.83	897
Jan. 15	Quenon and Nearhood	4.38	931	July 10	do	3.98	966
23	Quenon and Marschke	4.15	862	25	do	3.90	959
Feb. 10	Quenon and Osgood	3.14	587	Aug. 8	do	3.68	884
27	do	4.00	836	25	do	3.92	970
Mar. 14	do	3.46	738	Sept. 10	do	3.00	698
26	do	3.84	846	25	do	2.19	453

Daily discharge, in second-feet, of White River flume at Buckley, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	502	994	427	1,440	674	958	768	994	716	442	994	85
2	442	706	442	1,480	658	994	474	924	368	739	994	890
3	487	562	457	675	610	890	494	924	376	800	994	958
4	472	547	442	171	610	839	317	890	685	395	958	788
5	427	532	442	729	626	862	352	725	839	709	924	754
6	412	487	427	669	610	1,030	298	394	890	856	839	706
7	384	472	412	214	658	1,140	905	807	576	923	822	754
8	384	457	412	388	642	994	1,410	994	84	404	856	890
9	398	457	386	697	578	890	384	994	161	779	856	856
10	412	427	342	458	610	890	417	806	377	958	856	788
11	427	412		442	594	924	845	722	1,300	958	924	738
12	457	384		656	528	890	1,540	608	1,180	924	1,030	754
13	427	384		1,210		856	1,440	350	1,140	924	1,030	805
14	412	384	380	1,100	200	771	1,230	578	1,070	856	1,030	805
15	412	384		958		738	502	674	1,030	424	1,030	690
16	412	1,060		1,280	431	788	603	690	1,030	745	1,070	658
17	398	1,640		1,690	547	856	696	773	1,030	938	1,140	578
18	398	1,260	408	1,380	1,100	788	545	839	679	924	1,180	578
19	398	994	991	891	1,250	822	856	732	751	924	1,140	610
20	427	856	1,030	854	1,220	924	839	445	660	964	1,440	690
21	384	738	805	318	1,070	856	742	573	900	1,010	1,140	706
22	370	674	805	759	1,030	856	482	1,070	839	721	1,910	532
23	384	610	1,610	856	1,070	839	745	1,070	703	747	1,220	487
24	442	578	2,080	839	1,070	924	808	949	330	924	1,030	472
25	1,320	547	1,480	839	1,030	856	958	788	703	958	994	457
26	1,250	532	1,240	839	924	856	1,070	723	890	924	994	502
27	994	532	2,020	779	856	994	1,140	524	924	958	958	487
28	754	517	1,960	427	839	1,440	776	861	840	804	958	457
29	562	472	1,910	788	-------	1,690	430	958	994	532	1,070	442
30	530	442	1,640	738	-------	1,640	829	924	932	932	1,030	442
31	1,400	-------	1,740	738	-------	1,490	-------	890	-------	1,070	924	-------

Monthly discharge of White River flume at Buckley, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	1,400	370	544	33,400
November	1,640	384	635	37,800
December	2,080	----------	857	52,700
January	1,690	171	816	50,200
February	1,250	----------	730	40,500
March	1,690	738	977	60,100
April	1,540	298	763	45,400
May	1,070	350	780	48,000
June	1,300	84	767	45,600
July	1,070	395	812	49,900
August	1,910	822	1,040	64,000
September	958	442	671	39,900
The year	2,080	84	784	568,000

LAKE WASHINGTON BASIN

CEDAR RIVER AT CEDAR FALLS, WASH.

LOCATION.—In sec. 4, T. 22 N., R. 8 E., below Seattle municipal power plant, at Cedar Falls, King County, and 3½ miles above Taylor Creek.

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

RECORDS AVAILABLE.—April 9, 1914, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on right bank, 0.7 mile below power plant; installed April 8, 1914; inspected by E. C. and F. H. Hoffstrom.

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

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; shifts at extremely high water. Banks high. One channel at all stages. Stage of zero flow, according to measurements made September 25–26, 1922, at gage height 3.7 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 8.72 feet at 5.45 p. m. January 10 (discharge, 2,790 second-feet); minimum stage recorded, 3.7 feet at 3 p. m. August 18 (discharge, zero).

1914–1923: Maximum stage recorded, 11.4 feet at 9 a. m. December 19, 1917 (discharge, 6,290 second-feet); minimum stage recorded 4 p. m. November 25, 1917, and August 18, 1923 (discharge, zero).

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

DIVERSIONS.—Seattle municipal power plant diverts water directly from Cedar Lake through a pressure pipe and returns it to the river at the plant above the gage. Practically the entire flow at low water is carried through the plant.

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 changed January 7. Rating curves well defined. Operation of water-stage recorder excellent except as noted in footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator. Records excellent.

Discharge measurements of Cedar River at Cedar Falls, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 26	E. C. and F. H. Hoffstrom	5.85	317	Apr. 2	E. C. Hoffstrom	5.33	326
Nov. 17	do	5.92	352	16	do	5.37	343
Jan. 18	E. C. Hoffstrom	5.80	552	Sept. 5	F. H. and E. C. Hoffstrom	4.39	53.5
Feb. 22	do	4.97	186	15	do	4.27	33.2
Mar. 2	do	5.40	352				

Daily discharge, in second-feet, of Cedar River at Cedar Falls, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	52	276	286	322	522	311	245	364	432	254	266	106
2	91	282	288	404	512	303	293	354	425	322	261	88
3	106	292	245	398	500	285	320	360	362	326	265	58
4	86	289	264	399	379	254	307	348	398	242	254	56
5	98	237	290	402	480	299	324	334	404	309	215	58
6	82	282	294	454	518	304	289	288	402	317	263	54
7	64	286	294	811	512	304	263	348	409	308	266	54
8	44	282	294	2,340	490	308	248	369	408	230	269	54
9	54	282	296	2,340	484	302	298	361	395	283	265	55
10	54	276	250	2,590	428	298	318	380	339	263	245	56
11	54	257	278	2,390	343	245	329	385	408	260	255	43
12	54	230	282	1,900	319	292	332	400	419	254	217	40
13	55	270	280	980	306	290	328	348	436	250	269	40
14	50	272	283	544	288	284	322	414	415	236	269	36
15	47	262	282	540	268	290	250	430	399	196	259	34
16	54	288	279	536	244	285	324	428	398	264	261	35
17	34	295	254	546	218	273	337	420	338	284	262	34
18	30	298	282	539	218	232	339	427	387	280	209	32
19	54	274	283	568	212	289	338	414	396	278	214	30
20	56	292	272	542	199	279	346	352	396	274	258	30
21	67	290	272	492	190	282	325	419	390	263	265	51
22	46	288	277	548	190	284	268	420	384	211	262	54
23	65	291	308	550	181	287	322	420	362	254	256	53
24	82	290	370	524	182	279	333	424	316	280	258	66
25	204	278	314	544	171	226	344	429	342	272	254	75
26	270	240	328	532	212	266	350	420	342	275	207	76
27	266	285	346	473	139	271	360	366	336	240	248	61
28	276	285	332	448	105	283	348	410	328	256	254	53
29	230	283	375	516	-------	290	294	424	322	208	259	46
30	274	248	340	520	-------	289	360	362	308	280	214	40
31	294	-------	319	525	-------	290	-------	390	-------	276	130	-------

NOTE.—Float frozen in well Dec. 12-18; gage-height record faulty July 26-28, 30, 31, Aug. 1, 6-15, and Sept. 11-15; discharge based upon estimates made from Venturi meter and weir measurements by Seattle officials.

Monthly discharge of Cedar River at Cedar Falls, Wash., for the year ending Sept. 30, 1923

[Drainage area, 83 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	294	30	106	----------	----------	6,520
November	298	230	277	----------	----------	16,500
December	375	245	295	----------	----------	18,100
January	2,590	322	813	----------	----------	50,000
February	522	105	315	----------	----------	17,500
March	311	226	283	----------	----------	17,400
April	360	245	315	----------	----------	18,700
May	430	288	387	----------	----------	23,800
June	436	308	380	----------	----------	22,600
July	326	196	266	----------	----------	16,400
August	269	130	247	----------	----------	15,200
September	106	30	52.3	----------	----------	3,110
The year	2,590	30	312	3.76	51.04	226,000

NOTE.—Monthly discharge in second-feet per square mile and run-off in inches not computed owing to regulation. The yearly figures represent the natural yield quite closely.

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, King County, 3 miles northeast of Ravensdale, and 5 miles below Taylor Creek.

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

RECORDS AVAILABLE.—April 3, 1914, to September 30, 1923; 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 for present site because of small difference in drainage area.

GAGE.—Stevens continuous water-stage recorder on right bank installed April 29, 1914; inspected by T. S. Beals.

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

CHANNEL AND CONTROL.—Bed composed of large boulders and gravel. Control formed by broad riffle about 1,200 feet below gage; shifts at extremely high water. Logs may lodge on riffle. One channel at all stages. Stage of zero flow, according to measurements made August 27, 1917, about gage height 2.5 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 10.3 feet at 7 p. m. January 10 (discharge, 4,160 second-feet); minimum stage from recorder, 4.16 feet from 10.30 a. m. to 7 p. m. October 17 (discharge, 182 second-feet).

1914–1923: Maximum stage from recorder, 13.55 feet at 10 p. m. December 29, 1917 (discharge, 7,500 second-feet); minimum stage from recorder, 4.35 feet at 1 a. m. October 15, 1914 (discharge, 162 second-feet).

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

DIVERSION.—None above station. (See Cedar River at Cedar Falls, Wash.)

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 between 200 and 7,000 second-feet. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. For a very few days, daily discharge ascertained by applying to rating table mean daily gage height determined from gage-height graph by inspection; otherwise by use of discharge integrator. Records excellent.

No discharge measurement made during the year.

Daily discharge, in second-feet, of Cedar River near Landsberg, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	228	588	439	748	889	769	684	696	887	586	524	306
2	246	544	448	923	868	739	720	662	1,020	641	414	296
3	264	518	435	1,030	863	718	758	657	949	671	513	266
4	251	500	441	922	785	692	731	650	886	589	504	250
5	267	453	459	1,010	853	742	740	632	870	632	472	247
6	246	477	467	1,610	889	807	708	596	898	672	501	249
7	237	469	457	2,050	900	843	692	652	852	712	504	248
8	216	466	448	3,190	876	805	652	676	835	602	503	254
9	212	465	447	3,370	878	767	688	696	804	624	497	252
10	212	456	415	3,960	818	763	698	731	762	618	469	250
11	213	431	435	3,560		733	694	740	800	598	482	246
12	219	410	434	2,920		752	714	732	839	590	452	232
13	216	435	433	1,820		744	692	677	875	581	492	224
14	210	441	430	1,190		724	677	728	826	570	488	214
15	210	426	427	1,200	700	717	607	765	802	528	480	210
16	208	492	427	1,160		714	664	789	783	564	483	210
17	198	528	410	1,260		700	676	776	728	573	477	207
18	197	517	444	1,190		649	678	763	765	568	437	206
19	208	487	590	1,220		700	680	753	779	562	452	202
20	210	513	568	1,110	641	694	696	688	768	564	488	204
21	219	490	533	1,020	634	696	667	745	772	548	486	209
22	209	486	562	1,030	639	720	599	771	758	508	509	215
23	215	470	818	1,020	690	703	634	776	729	549	484	213
24	229	467	1,610	968	676	735	646	769	677	564	472	214
25	447	454	1,100	996	650	660	650	797	694	554	469	222
26	496	426	902	959	656	692	654	783	698	554	429	226
27	527	455	926	893	618	694	666	746	688	511	463	218
28	594	460	850	852	512	721	642	778	674	532	466	208
29	488	452	786	906	-------	740	597	829	670	497	463	205
30	506	424	750	906	-------	756	646	767	645	549	442	206
31	660	-------	800	910	-------	755	-------	783	-------	530	350	-------

NOTE.—Intake clogged Feb. 11–19; discharge estimated from records at Cedar Falls. Braced figures show mean discharge for period indicated.

Monthly discharge of Cedar River near Landsberg, Wash., for the year ending Sept. 30, 1923

[Drainage area, 135 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	660	197	292			18,000
November	588	410	473			28,100
December	1,610	410	603			37,100
January	3,960	748	1,480			91,000
February	900	512	737			40,900
March	843	649	730			44,900
April	758	597	675			40,200
May	829	596	729			44,800
June	1,020	645	791			47,100
July	712	497	579			35,600
August	524	350	476			29,300
September	306	202	230			13,700
The year	3,960	197	650	4.81	65.29	471,000

NOTE.—Monthly discharge in second-feet per square mile and run-off in inches not computed owing to egulation. The yearly figures represent natural yield quite closely.

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 and 2 miles southeast of Index and mouth of North Fork, Snohomish County.

DRAINAGE AREA.—355 square miles (revised; measured on topographic map).

RECORDS AVAILABLE.—October 1, 1902, to September 30, 1905; April 26, 1911, to September 30, 1923.

GAGE.—Inclined and vertical staff gage on right bank; installed April 19, 1914; read by W. E. Duke and Mrs. George Bingham. Gage used in conjunction with Stevens continuous recorder September 14, 1920, to October 1, 1921. Location of gage unchanged since establishment; datum raised 0.61 foot April 26, 1911, and lowered 1.00 foot to present datum April 19, 1914.

DISCHARGE MEASUREMENTS.—Made from cable a mile below gage, from bridge 100 feet below gage, or by wading nearly 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. Stage-discharge relation changed by blasting at falls in July, 1914, and by shifting of channel above falls during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 14.0 feet on December 24 (discharge, 19,200 second-feet); minimum stage recorded, 0.96 foot on October 22 and September 19 (discharge, 346 second-feet).

1902–1905; 1911–1923: Maximum discharge, 47,000 second-feet at 9 a. m. December 18, 1917; minimum stage recorded, 0.54 foot September 30, 1915 (discharge, 262 second-feet).

ICE.—Stage-discharge relation slightly affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 11–19 and February 14–16. Rating curve well defined below 16,000 second-feet. Staff gage read to hundredths once daily. Daily discharge ascertained by applying daily gage heights to rating table. Records good.

COOPERATION.—Gage-height record furnished by Stone-Webster Engineering Corporation.

Daily discharge, in second-feet, of South Fork of Skykomish River near Index, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	843	2,480	798	3,480	965	1,260	3,370	2,960	2,960	4,540	940	519
2	673	1,800	820	3,370	940	1,230	3,260	2,390	3,370	4,540	866	519
3	673	1,440	798	4,540	890	1,120	3,260	2,210	3,260	4,050	843	594
4	820	1,290	753	3,370	866	1,040	2,960	2,390	3,810	3,370	820	501
5	1,020	1,140	713	3,480	843	1,040	3,060	3,370	5,480	2,960	776	483
6	798	1,020	693	18,400	843	1,200	2,960	4,170	6,510	2,570	753	466
7	673	940	673	18,000	843	1,480	2,760	4,800	6,210	3,590	713	449
8	614	866	594	10,500	798	1,260	2,660	5,910	6,360	3,060	713	449
9	575	820	633	8,530	753	1,120	2,570	8,350	6,670	2,760	693	449
10	538	776	693	10,900	733	1,090	2,480	7,150	5,910	2,960	673	417
11	501	713		6,210	753	1,350	2,660	5,760	4,800	2,760	673	417
12	483	673		4,410	733	1,200	3,810	4,800	4,170	2,570	693	402
13	466	653		3,370	594	1,140	3,160	4,290	3,700	2,480	673	402
14	433	614		2,760		1,040	2,760	3,930	3,160	2,480	673	387
15	417	594	700	2,760	560	965	2,760	4,540	2,960	2,390	633	387
16	402	4,800		2,570		1,020	3,590	5,620	2,960	2,080	633	387
17	387	2,760		5,060	733	1,090	4,800	5,060	3,060	1,880	633	373
18	387	2,570		3,810	1,020	1,040	4,170	4,670	2,760	1,580	633	359
19	373	1,840		2,860	1,140	1,140	3,700	4,170	2,570	1,480	633	346
20	359	1,580	3,160	2,390	1,090	1,200	3,260	3,590	3,060	1,410	843	483
21	359	1,380	1,540	2,040	1,040	1,090	2,860	3,590	2,960	1,440	753	575
22	346	1,230	1,880	1,760	1,040	1,090	2,480	3,700	2,570	1,410	1,200	483
23	359	1,120	6,360	1,620	1,120	1,060	2,390	3,810	2,480	1,440	843	387
24	449	1,040	19,200	1,440	1,140	1,410	2,570	3,480	2,760	1,350	713	387
25	6,360	1,020	9,100	1,350	1,090	1,290	3,260	4,170	2,760	1,230	673	417
26	3,160	1,090	6,990	1,290	1,040	1,230	4,410	3,700	2,570	1,170	653	483
27	2,260	1,060	9,290	1,260	1,020	1,350	5,200	3,590	3,590	1,140	614	466
28	1,920	1,020	6,510	1,200	1,040	1,720	4,050	3,060	4,050	1,120	594	449
29	1,440	940	4,540	1,090	-------	2,570	3,480	3,810	4,670	1,120	594	417
30	1,260	866	3,480	990	-------	3,370	2,960	3,370	4,540	1,060	575	402
31	3,930	-------	3,480	1,020	-------	4,050	-------	3,060	-------	990	556	------

NOTE.—Braced figures show mean discharge estimated from study of weather records and gage height for periods affected by ice.

Monthly discharge of South Fork of Skykomish River near Index, Wash., for the year ending Sept. 30, 1923

[Drainage area, 355 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	6,360	346	1,070	3.01	3.47	65,800
November	4,800	594	1,340	3.77	4.21	79,700
December	19,200	----------	2,870	8.08	9.32	176,000
January	18,400	990	4,380	12.2	14.07	269,000
February	1,140	----------	884	2.49	2.59	49,100
March	4,050	965	1,400	3.94	4.54	86,100
April	5,200	2,390	3,260	9.18	10.24	194,000
May	8,350	2,210	4,180	11.8	13.60	257,000
June	6,670	2,480	3,890	11.0	12.27	231,000
July	4,540	990	2,230	6.28	7.24	137,000
August	1,200	556	719	2.03	2.34	44,200
September	594	346	442	1.25	1.40	26,300
The year	19,200	346	2,230	6.28	85.29	1,620,000

OLNEY CREEK NEAR STARTUP, WASH.

LOCATION.—In SE. ¼ sec. 12, T. 28 N., R. 8 E., 1½ miles above Stickney Bridge, 5 miles northeast of Startup, Snohomish County.

DRAINAGE AREA.—10 square miles (measured on topographic maps).

RECORDS AVAILABLE.—October 1, 1922, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank installed April 20, 1923. At a site on right bank about 2 miles below, a Lietz water-stage register was used prior to January 10, 1923, and a Stevens continuous recorder January 10 to April 19, 1923; also an auxiliary staff gage at present site was read occasionally January 11 to April 20, 1923. Gages inspected by J. L. Bearse and Dale Annis. Gage-height records at former station referred to present gage by means of relation curves.

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

CHANNEL AND CONTROL.—Banks high; not subject to overflow. Channel straight for 300 feet below gage. Control is of boulders and solid rock outcroppings; may shift at high water. Stage of zero flow at gage height 0.0 foot ± 0.2 foot according to measurements made in 1923.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder at former site, 5.35 feet at 7.30 a. m., January 10, estimated by extending curve of relation, to be equivalent to a stage of 5.7 feet at present site (discharge, 1,320 second-feet); minimum stage from recorder, 0.68 foot September 17–19 (discharge, 5.5 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice February 13–17. Rating curve well defined below 250 second-feet. Operation of water-stage recorders satisfactory except as noted in footnote to table of daily discharge. Curves of relation for referring gage heights October 1 to March 29 and April 1 and 7 to present gage, poorly defined. Daily discharge ascertained by applying to rating table mean daily gage height determined from curves of relation between the two gages, October 1 to March 29, and April 1 and 7; from staff-gage readings March 30, 31, and April 2–6 and 8–19, and from gage-height graph by inspection April 20 to September 30. Records October to March, poor; excellent thereafter.

Discharge measurements of Olney Creek near Startup, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft*			*Feet*	*Sec.-ft*
Mar. 8	Calkins and Gatewood	1.54	53	Apr. 21	R. B. Kilgore	1.85	87
10	do	1.46	42	June 7	J. S. Gatewood	2.23	151

Daily discharge, in second-feet, of Olney Creek near Startup, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	30	158	25	141	26	59	117	76	205	35	7.5	6
2	17	88	27	187	23	52	102	51	333	31	7.5	12
3	25	61	27	208	22	42	141	48	177	31	7.5	15
4	36	50	25	117	21	36	117	68	150	26	7	8
5	35	41	24	177	20	42	125	82	158	25	7	7.5
6	33	37	23	333	19	88	109	82	133	27	7	7.5
7	32	34	23	319	19	70	125	95	125	32	7	7
8	30	32	22	208	18	53	141	117	109	34	7	7
9	28	30	22	406	18	42	102	150	95	26	7	6.5
10	25	29	22	867	17	42	88	117	82	23	7	6.5
11	24	27	21	292	17	52	95	102	67	22	7	6.5
12	23	26	20	158	16	44	242	74	57	19	7	6
13	23	25	19	109	}	42	125	70	58	17	6.5	6
14	22	23	19	95	}	39	95	77	55	17	6.5	6
15	21	22	18	177	10	37	109	82	57	15	6	6
16	20	67	21	141	}	52	109	109	50	14	6	6
17	19	88	28	187	}	55	102	81	43	13	6	5.5
18	18	58	61	141	133	45	95	65	37	12	6	5.5
19	18	45	70	109	95	64	95	57	38	11	6	5.5
20	17	49	68	82	63	59	109	55	38	10	9	30
21	17	42	78	72	50	46	95	55	34	9	8	65
22	17	38	102	64	67	52	88	88	34	9	25	20
23	18	35	306	55	125	54	82	67	34	9.5	10	13
24	47	33	750	51	78	133	95	63	42	9	8	14
25	319	32	266	47	53	95	109	117	39	9	8	15
26	158	31	242	46	49	82	125	120	}	8.5	7.5	14
27	133	30	333	45	43	88	109	141	}	9	7	11
28	102	29	266	42	40	117	77	95	} 50	9	7	10
29	64	27	150	38	-------	150	64	141	}	8.5	6.5	9
30	95	26	125	34	-------	158	61	102	}	8	6	8.5
31	362	-------	150	30	-------	141	-------	79	-------	8	6	-------

NOTE.—Water-stage recorder not operating satisfactorily Oct. 5, 6, and June 26 to July 1. Discharge estimated by interpolation Oct. 5, 6, and by comparison with records of near-by streams June 26 to July 1. Braced figures show mean discharge estimated from study of observers notes, gage heights, and weather records for periods indicated.

Monthly discharge of Olney Creek near Startup, Wash., for the year ending Sept. 30, 1923

[Drainage area, 10.0 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	362	17	59.0	5.90	6.80	3,630
November	158	22	43.8	4.38	4.89	2,610
December	750	18	108	10.8	12.45	6,640
January	867	30	161	16.1	18.56	9,900
February	133	----------	38.6	3.86	4.02	2,140
March	158	36	68.7	6.87	7.92	4,220
April	242	61	108	10.8	12.05	6,430
May	150	48	87.9	8.79	10.13	5,400
June	333	----------	83.3	8.33	9.29	4,960
July	35	8	17.3	1.73	1.99	1,060
August	25	6	7.63	.763	.88	469
September	65	5.5	11.5	1.15	1.28	684
The year	867	5.5	66.5	6.65	90.26	48,100

32430—26†—WSP 572——4

SULTAN RIVER NEAR SULTAN, WASH.

LOCATION.—In sec. 8, T. 28 N., R. 8 E., at Horseshoe Bend, 4½ miles north of Sultan and mouth of river, Snohomish County.

DRAINAGE AREA.—88 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 18, 1911, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank one-fourth mile above Horseshoe Bend; inspected by Jesse Reese. Prior to October 29, 1915, Lietz water-stage recorder at Camp Habecker 1½ miles upstream.

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

CHANNEL AND CONTROL.—In canyon; control formed by large rocks, boulders, and heavy gravel; not likely to change except at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from high-water mark in well, 14.0 feet on January 6 (discharge, 15,600 second-feet); minimum stage from water-stage recorder, 0.02 foot at 1 a. m. September 19 (discharge, 51 second-feet).

1911–1923: Maximum stage recorded from high-water mark in well, 18.5 feet on December 12, 1921 (discharge, 24,600 second-feet); minimum stage recorded, that of September 19, 1923.

ICE.—Stage-discharge relation seldom affected by ice. Water in well freezes during very cold weather.

DIVERSIONS.—City of Everett diverts water above station for municipal use.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed at high water January 7; affected by ice February 13–15. Rating curves well defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph by inspection, or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Records good for December; otherwise excellent.

COOPERATION.—Gage-height record furnished by city of Everett, Wash.

Discharge measurements of Sultan River near Sultan, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Dec. 13	R. B. Kilgore	1.16	139	June 8	J. S. Gatewood	4.31	1,260
Jan. 12	do	4.44	1,360	8	do	4.23	1,260

Daily discharge, in second-feet, of Sultan River near Sultan, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	585	1,340	194	1,370	266	568	1,140	825	926	802	137	82
2	385	880	202	1,740	240	498	1,070	620	1,510	720	126	88
3	348	641	190	1,660	215	400	970	532	1,170	585	120	134
4	585	549	184	1,190	189	370	848	665	1,200	480	117	104
5	585	480	170	1,940	176	355	848	995	1,450	430	114	91
6	395	414	160	10,000	175	661	802	1,100	1,390	415	107	84
7	298	360	152	5,480	191	620	802	1,200	1,360	498	104	79
8	235	333	142	2,880	175	602	825	1,420	1,390	532	101	74
9	199	309	145	5,010	164	415	700	1,820	1,240	498	99	72
10	172	278	142	5,890	159	415	620	1,540	1,070	532	97	70
11	155	248	124	2,460	158	515	680	1,270	870	515	94	68
12	147	228	116	1,440	}	445	1,020	995	700	462	97	65
13	145	215	140	1,040	140	400	620	848	660	445	99	62
14	141	209	143	848	}	355	530	825	585	445	100	59
15	132	190	143	1,460	222	330	730	895	568	415	96	57
16	124	985	123	1,240	206	393	1,140	1,170	620	355	95	55
17	117	1,190	115	2,310	296	430	1,140	1,070	550	306	96	54
18	111	861	980	1,510	961	355	1,120	870	498	257	98	52
19	108	604	2,380	1,070	848	422	1,140	740	480	231	96	52
20	106	532	1,520	802	660	430	1,020	680	498	222	118	176
21	104	464	1,100	640	550	355	870	660	462	233	125	445
22	99	430	1,740	568	620	355	760	740	430	244	243	233
23	114	366	4,360	498	970	400	760	760	430	248	180	146
24	969	324	8,980	472	740	760	870	660	480	237	137	135
25	6,500	309	3,060	446	602	550	1,100	895	480	200	117	147
26	2,900	321	2,940	421	515	445	1,390	895	568	180	104	138
27	1,850	284	4,640	395	445	515	1,390	1,020	620	185	98	119
28	1,310	263	2,700	369	430	770	1,020	780	760	189	93	104
29	856	280	1,520	344	-------	1,100	825	1,040	870	182	91	94
30	1,260	207	1,250	318	-------	1,450	720	970	870	173	89	89
31	2,430	-------	1,430	292	-------	1,480	-------	760	-------	152	87	-------

NOTE.—Water-stage recorder not operating Dec. 18–31, Jan. 1,2, 7, 24–31, Feb. 1–3, Apr. 14 and 15; flow Dec. 18 to Jan. 2 and Jan. 7 determined by use of gage heights obtained from curve of relation between gage heights at this station and at a station maintained by Sound Power Co. 1½ miles upstream; estimated by interpolation Jan. 24 to Feb. 3 and by comparison with flow of Deer Creek at Oso, Apr. 14 and 15.

Monthly discharge of Sultan River near Sultan, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	6,500	99	757	46,500
November	1,340	190	468	27,800
December	8,980	115	1,330	81,800
January	10,000	292	1,810	111,000
February	970	----------	378	21,000
March	1,480	330	554	34,100
April	1,390	530	916	54,500
May	1,820	532	944	58,000
June	1,510	430	824	49,000
July	802	152	367	22,600
August	243	87	112	6,890
September	445	52	108	6,430
The year	10,000	52	718	520,000

MIDDLE FORK OF SNOQUALMIE RIVER NEAR NORTH BEND, WASH.

LOCATION.—In NE. ¼ SE. ¼ sec. 10, T. 23 N., R. 8 E., 1 mile southeast of North Bend, King County, and 2¾ miles above junction with North Fork.

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

RECORDS AVAILABLE.—August 10, 1907, to February 29, 1908; August 25, 1908, to September 30, 1923, when records were discontinued.

GAGE.—Stevens continuous water-stage recorder on left bank; installed August 7, 1915; inspected by A. R. Neth, J. Bertrand, and H. L. Kimmel. Prior to August 7, 1915, various gages at highway bridge, 2¼ miles below present site, were used.

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 shifts at extremely high water. Left bank high; right bank low and heavily wooded. Stage of zero flow, according to measurements made September 11, 1919, gage height −0.7 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 9.8 feet at 6.30 a. m. December 24 (discharge, 12,700 second-feet); minimum stage, from recorder, 1.45 feet from noon until midnight September 30 (discharge, 163 second-feet).

1907–1923: Maximum stage from recorder, 12.2 feet at 10 a. m. December 18, 1917 (discharge, 18,300 second-feet); discharge may have been greater during floods of November, 1909, and November, 1910; minimum stage from recorder, 1.50 feet at 1 p. m. September 30, 1915 (discharge, 146 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice February 14–16. Rating curve well defined below 7,000 second-feet. Operation of water-stage recorder fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph by inspection or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Partial clogging of intake pipe caused lag of stage in well behind that in river. This caused slight uncertainty in daily records for periods of rapidly changing stage, but had little or no effect on monthly mean discharge. Records good.

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

Discharge measurements of Middle Fork of Snoqualmie River near North Bend, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
May 5	Neth and Kimmel	3.84	1,630
June 6	do	4.92	3,220
Sept. 5	Bertrand and Neth	1.67	214

Daily discharge, in second-feet, of Middle Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	590	1,930	385	2,200	465	799	1,830	1,400	1,550	2,140	410	238
2	470	1,260	385	2,780	440	778	1,720	1,130	2,270	2,010	366	235
3	425	962	420	3,460	415	663	1,770	1,050	2,140	1,770	344	266
4	591	848	395	2,270	400	620	1,550	1,260	2,340	1,450	339	241
5	722	764	357	3,020	390	644	1,600	1,770	3,140	1,300	330	221
6	519	632	334	8,830	385	1,040	1,550	2,140	3,380	1,170	314	212
7	410	572	322	9,260	395	1,220	1,500	2,550	3,060	1,890	298	207
8	362	548	314	5,940	380	946	1,400	3,140	3,060	1,660	287	204
9	326	524	339	6,040	352	757	1,260	3,140	2,990	1,450	280	202
10	306	492	370	6,080	344	696	1,220	2,840	2,760	1,500	276	202
11	287	440	318	3,940	348	855	1,350	3,060	2,200	1,400	273	194
12	280	410	256	2,690	344	771	1,720	2,270	1,770	1,300	280	186
13	270	380	294	2,010	283	702	1,400	1,830	2,010	1,220	287	186
14	256	362	339	1,600	260	614	1,220	1,720	1,660	1,220	287	186
15	247	348	375	1,720		572	1,350	1,830	1,450	1,130	283	192
16	232	1,870	318	1,660		608	1,890	2,620	1,550	1,010	273	196
17	221	2,080	314	2,840	450	670	2,140	2,410	1,450	885	280	202
18	212		532	2,340	913	614	1,950	1,890	1,300	743	287	212
19	210		2,470	1,850	1,050	676	1,710	1,660	1,260	689	276	221
20	218		2,030	1,350	878	743	1,460	1,450	1,450	650	366	210
21	212	850	1,350	1,170	771	644	1,220	1,450	1,350	650	366	256
22	204		1,600	1,050	757	689	1,130	1,550	1,220	670	892	238
23	194		5,520	922	915	696	1,090	1,770	1,090	670	530	194
24	233		10,200	813	878	994	1,220	1,550	1,220	638	375	196
25	2,760		5,180	743	799	841	1,600	1,830	1,220	566	318	194
26	2,150	560	4,100	696	708	757	2,200	1,770	1,450	524	294	212
27	1,660	536	4,780	682	650	870	2,270	2,010	1,600	508	276	226
28	1,500	508	3,580	644	626	1,220	1,660	1,550	1,890	519	270	194
29	1,050	460	2,410	578	-------	1,770	1,400	1,830	2,270	502	266	174
30	1,060	415	1,890	524	-------	2,270	1,260	1,720	2,270	486	259	165
31	3,220	-------	2,270	514	-------	2,340	-------	1,500	-------	455	250	-------

NOTE.—Water-stage recorder not operating satisfactorily Nov. 18–25; Jan. 18, 19, and Apr. 19 and 20; discharge Nov. 18–25 estimated by extending fragmentary gage-height graph and by comparison with records of the North Fork; discharge for other periods of faulty gage-height record estimated by interpolation. Braced figures show mean discharge for periods indicated.

Monthly discharge of Middle Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1923

[Drainage area, 184 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	3,220	194	690	3.75	4.32	42,400
November	2,080	348	790	4.29	4.79	47,000
December	10,260	256	1,730	9.40	10.84	106,000
January	9,260	514	2,590	14.1	16.26	159,000
February	1,050	-------	540	2.93	3.05	30,000
March	2,340	572	906	4.92	5.67	55,700
April	2,270	1,090	1,550	8.42	9.39	92,200
May	3,140	1,050	1,930	10.5	12.11	119,000
June	3,380	1,090	1,950	10.6	11.83	116,000
July	2,140	455	1,060	5.76	6.64	65,200
August	892	250	330	1.79	2.06	20,300
September	266	165	209	1.14	1.27	12,400
The year	10,200	165	1,200	6.52	88.23	865,000

NORTH FORK OF SNOQUALMIE RIVER NEAR NORTH BEND, WASH.

LOCATION.—In NE. ¼ sec. 26, T. 24 N., R. 8 E., at Gabriel ranch, 2 miles above mouth and 3½ miles northeast of North Bend, King County.

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

RECORDS AVAILABLE.—July 4, 1907, to September 30, 1923, when records were discontinued.

GAGE.—Friez water-stage recorder on right bank 200 yards southeast of ranch house; installed September 26, 1916; inspected by employees of Puget Sound Power & Light Co. For description of previous gages see Water-Supply Paper 512.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 200 yards above mouth.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel; shifting at extremely high stages. Right bank not subject to overflow; left bank fairly high, not subject to overflow except at extremely high stages. Stage of zero flow, according to measurements made August 25, 1922, gage height 0.0 ± 0.3 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 9.05 feet at 7 a. m. December 24 (discharge, 7,370 second-feet); minimum stage from recorder, 1.65 feet September 15–20 (discharge, 64 second-feet).

1907–1923: 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, 1.0 foot September 26–28, 1910 (discharge, 56 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve revised slightly January 1; well defined below 3,000 second-feet. Operation of water-stage recorder fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined graphically from automatically made record or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Records excellent except for extremely high water and for periods when intake was clogged.

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

Discharge measurements of North Fork of Snoqualmie River near North Bend, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
May 8	Neth and Kimmel	4.40	1,450
Sept. 4	Neth and Bertrand	1.93	102
5	do	1.86	94.7

Daily discharge, in second-feet, of North Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	359	1,170	247	1,140	355	500			596	818	142	82
2	290	795	244	1,460	339	470			1,630	743	135	90
3	265	615	256	923	323	355		650		660	127	114
4	383	520	244	628	312					570	124	105
5	508	465	229	570	304		1,000	1,080		502	124	92
6	347	404	220	4,700	294	650		1,180	1,700	485	124	84
7	280	367	212	5,000	294			1,260		622	124	79
8	247	351	200	2,900	280			1,530			122	77
9	223	335		3,300	265				1,350		120	74
10	200	312		3,680	256	404	825	1,500	1,220	500	118	72
11	187	290		2,160	256				1,020		116	70
12	174	271		1,480	244		950	1,300	881		110	68
13	164	253	180	1,170				1,060	1,120	426	107	67
14	157	241		999	220	500	825	999	1,040	408	103	66
15	150	229		1,100			910	1,090	865	375	101	65
16	143	902		1,100	253		1,020		857	339	97	64
17	135	990	159	1,680	315	375	1,260	1,100	736	301	94	64
18	128	772	303	1,150		359			667	274	92	65
19	122	556	1,440	1,000		387	1,000	825	634	250	90	64
20	124	532	1,120	849		418		750	694	235	105	70
21	124	450	788	780	700	391	750	725	628	232	129	97
22	118	408	973	694		400		889	589	226	308	97
23	114	367	2,380	622		408		973	563	214	195	89
24	132	339	5,750	576	736	538		825		206	147	84
25	1,990	327	2,850	544	615	490	850	1,010		192	131	85
26	1,300	335		514	508	450		990	650	181	122	92
27	1,300	319		502	436	465		1,170		170	112	97
28	1,080	304	1,800	436	391		922	948		160	103	89
29	701	284		418	-------	950	800	1,130		158	97	82
30	742	262		391	-------		650	990	788	151	92	69
31	2,050	-------	1,300	375	-------	1,400	-------	694	-------	149	87	-------

NOTE.—No gage-height record Dec. 9–16 and June 24–29; intake clogged Dec. 26–30, parts of Jan. 6, 7, 18, 19, Feb. 18–24, Mar. 1–16, Mar. 28 to May 11, May 16–21, June 2–8, July 8–12; float frozen in well Feb. 13–15. Flow Dec. 9–16 estimated by interpolation; Feb. 24, Mar. 3, 10, 31, Apr. 10, 14, 17, 21, 28, May 5, 7, 8, 19, and June 2, from observer's staff gage reading. Other gaps in record filled by hydrographic comparison with other two forks of Snoqualmie River. Braced figures show mean discharge for periods indicated.

Monthly discharge of North Fork of Snoqualmie River near North Bend, Wash., for the year ending Sept. 30, 1923

[Drainage area, 102 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	2,050	114	459	4.50	5.19	28,200
November	1,170	229	459	4.50	5.02	27,300
December	5,750	159	947	9.28	10.70	58,200
January	5,000	375	1,380	13.5	15.56	84,800
February	----------	----------	416	4.08	4.25	23,100
March	1,400	355	566	5.55	6.40	34,800
April	----------	----------	930	9.12	10.18	55,300
May	----------	----------	1,030	10.1	11.64	63,300
June	----------	----------	999	9.79	10.92	59,400
July	818	149	372	3.65	4.21	22,900
August	308	87	123	1.21	1.40	7,560
September	114	64	80.4	.788	.88	4,780
The year	5,750	64	649	6.36	86.35	470,000

SOUTH FORK OF SNOQUALMIE RIVER AT NORTH BEND, WASH.

LOCATION.—In SE. ¼ sec. 9, T. 23 N., R. 8 E., at Cooper ranch, half a mile south of North Bend, King County, and 3½ miles by river above mouth.

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

RECORDS AVAILABLE.—July 21, 1907, to February 29, 1908, and June 26, 1908, to September 30, 1923, when records were discontinued.

GAGE.—Friez water-stage recorder on left bank at Cooper ranch; installed October 2, 1916; inspected by employees of Puget Sound Power & Light Co. For description of previous gages see Water-Supply Paper 512.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 150 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel; shifting at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 10.0 feet at 9.30 p. m. January 7 (discharge, 5,500 second-feet); minimum stage from recorder, 1.41 feet at midnight September 30 (discharge, 87 second-feet).

1907–1923: 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 and 11, 1908 (discharge, 68 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed at high water January 7, and gradually June 7 to July 20. Rating curves fairly well defined below 1,800 second-feet. Operation of water-stage recorder fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage heights determined from recorder graph by inspection or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Shifting-control method used June 7 to July 20. Records fair.

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

Discharge measurements of South Fork of Snoqualmie River at North Bend, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
May 7	Neth and Kimmel	4.19	1,090
June 6	....do	5.05	1,490
Sept. 4	Bertrand and Neth	1.57	104

Daily discharge, in second-feet, of South Fork of Snoqualmie River at North Bend, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	149	638	178	894	522	433	940	678	894	678	178	104
2	132	486	188	1,080	522	433	940	638	1,080	638	168	104
3	132	384	198	1,430	486	400	940	598	1,130	560	178	110
4	140	322	198	1,030	486	384	894	638	1,180	522	178	104
5	158	294	178	1,130	486	400	894	762	1,330	450	168	104
6	140	256	178	3,910	450	486	850	940	1,430	433	158	98
7	132	232	178	4,080	450	598	818	1,080	1,380	598	149	98
8	124	232	168	3,150	450	522	785	1,230	1,280	560	140	98
9	117	220	165	2,320	450	450	752	1,480	1,280	486	140	98
10	117	209	161	2,800	450	433	720	1,380	1,180	450	132	98
11	117	198	158	1,870	450	450	720	1,280	1,030	416	124	98
12	117	188	149	1,330	450	450	806	1,030	940	384	117	93
13	110	178	149	1,030	433	416	762	894	1,030	352	117	93
14	110	168	140	894	400	384	678	850	940	337	117	93
15	110	158	140	894	400	368	720	894	850	308	115	93
16	110	444	140	850	416	368	894	1,030	894	294	114	93
17	104	720	132	1,080	416	400	940	1,030	850	281	112	93
18	104	598	149	1,030	450		940	940	806	268	110	88
19	104	450	330	1,030	450		850	850	762	244	117	88
20	110	384	450	940	450		744	806	806	244	124	93
21	104	322	368	850	433	450	638	806	762	209	124	104
22	104	294	400	806	433		598	806	678	209	209	98
23	98	256	1,040	762	450		560	850	678	198	188	93
24	104	232	3,700	720	450	486	598	806	678	198	158	93
25		232	2,410	678	433	450	720	894	638	188	132	93
26	500	232	1,650	678	416	450	894	940	678	178	117	98
27		232	1,700	678	400	450	1,080	940	678	178	117	98
28		220	1,430	598	400	560	806	894	678	178	110	93
29	322	198	1,080	598	-------	762	762	940	720	168	110	88
30	294	188	894	560	-------	986	678	986	678	168	104	88
31	769	-------	986	522	-------	1,080	-------	940	-------	168	104	-------

NOTE.—Water-stage recorder not operating satisfactorily Oct. 25–28, Dec. 9, 10, Jan. 28, Feb. 24, Mar. 16–23, 31, Apr. 7–9, 20, 21, 28, June 16, July 21, Aug. 11, 12, 15–18, and Sept. 30; discharge Oct. 25–28 and Mar. 18–23 estimated by comparison with records of other forks of Snoqualmie River; Jan. 28, Feb. 24, Mar. 17, 31, Apr. 10, 21, 28, June 16, July 21, Aug. 12 and 18, from observer's staff gage reading; otherwise gaps in record filled by interpolation.

Monthly discharge of South Fork of Snoqualmie River at North Bend, Wash., for the year ending Sept. 30, 1923

[Drainage area, 84 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	769	98	201	2.39	2.76	12,400
November	720	158	306	3.64	4.06	18,200
December	3,700	132	625	7.44	8.58	38,400
January	4,080	522	1,300	15.5	17.87	79,900
February	522	400	446	5.31	5.53	24,800
March	1,080	368	494	5.88	6.78	30,400
April	1,080	560	797	9.49	10.59	47,400
May	1,480	598	930	11.1	12.80	57,200
June	1,430	638	931	11.1	12.38	55,400
July	678	168	340	4.05	4.67	20,900
August	209	104	136	1.62	1.87	8,360
September	110	88	96.2	1.15	1.28	5,720
The year	4,080	88	551	6.56	89.17	399,000

STILAGUAMISH RIVER BASIN

DEER CREEK AT OSO, WASH.

LOCATION.—In sec. 5, T. 32 N., R. 7 W., 1¼ miles above Oso and junction with North Fork of Stilaguamish River, Snohomish County.

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

RECORDS AVAILABLE.—August 11, 1917, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank about 250 feet below mouth of 3-mile canyon; inspected by F. L. Bloxham. Datum lowered 0.50 foot July 24, 1920.

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

CHANNEL AND CONTROL.—Bed composed of boulders and gravel overlying bedrock. Banks high. One channel at all stages. Stage of zero flow, according to measurements made September 13, 1921, gage height −0.50 foot ±0.25 foot.

EXTREMES OF DISCHARGE.—Maximum stage during year from high-water mark in well, 9.5 feet on October 25 (discharge, 7,230 second-feet); minimum stage from recorder, 0.40 foot at 5 p. m. September 17 (discharge, 27 second-feet).

1918–1923: Maximum stage from high-water mark in well, 11.7 feet December 12, 1921 (discharge, 10,400 second-feet); minimum discharge, 27 second-feet, September 29 and 30, 1919, and September 17, 1923.

ICE.—Stage-discharge relation affected by ice, during severe winters; flow estimated from discharge measurements, observer's notes, and weather records.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 11–17 and February 14–18. Rating curve well defined below 2,000 second-feet. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined by inspection from gage-height graph or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Records excellent except for period represented by flat estimates and for extreme high water.

COOPERATION.—Gage-height record furnished by the Interurban Land Co.

The following discharge measurement was made by J. S. Gatewood:

June 13, 1923: Gage height, 2.36 feet; discharge, 337 second-feet.

Daily discharge, in second-feet, of Deer Creek at Oso, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	391		132	1,120	124	273	672	500	912	215	46	32
2	297	650	145	2,540	122	248	672	451	1,240	196	45	36
3	289		137	1,760	118	196	795	434	770	237	44	61
4	433	273	127	905	121	183	519	570	850	186	42	42
5	350	248	118	1,390	124	188	606	744	1,020	147	41	36
6	233	211	114	3,730	116	687	744	822	988	130	40	33
7	186	196	99	2,980	132	785	560	932	905	162	39	31
8	157	211	88	2,020	121	374	519	1,100	795	207	38	30
9	142	192	104	4,260	113	260	473	1,370	672	143	38	30
10	130	173	104	3,470	108	359	458	1,040	540	130	37	30
11	116	148		1,420	106	378	600	722	430	118	37	29
12	111	137		878	89	279	988	603	388	104	37	29
13	99	130		603	83	231	560	540	344	93	37	29
14	93	122	100	507		215	444	560	309	88	37	28
15	88	116		1,400		186	582	626	303	82	37	28
16	83	379		960	350	253	850	695	314	80	36	28
17		1,180		1,420		256	795	603	258	75	34	28
18		548	1,650	879		194	695	507	233	72	34	28
19		332	2,750	560	628	224	695	437	229	75	34	28
20	80	306	1,330	484	458	215	603	410	231	69	45	526
21		253	1,000	407	366	181	488	434	222	64	57	470
22		240	1,800	309	426	224	441	519	198	61	82	140
23		215	3,040	260	540	263	444	466	190	60	52	77
24		198	4,950	229	410	617	566	417	192	57	42	222
25		194	2,600	211	341	343	770	785	192	55	39	160
26	1,560	192	2,710	194	279	286	932	562	215	53	37	114
27		194	3,390	190	243		812	560	229	52	36	81
28		190	1,800	179	220		560	560	246	51	36	69
29	469	159	961	145	-------	720	448	962	253	48	36	61
30	650	143	720	126	-------		391	734	236	47	35	55
31	1,200	-------	1,140	142	-------		-------	503	-------	46	34	-------

NOTE.—Water-stage recorder not operating satisfactorily Oct. 17 to Nov. 3 and Mar. 27-31. Discharge estimated Oct. 17-28 from high-water mark and by comparison with flow of Sultan River; Oct. 29 to Nov. 3 by expanding contracted graph; and Mar. 27-31 by comparison with flow of Sultan River. Braced figures show mean discharge for periods indicated.

Monthly discharge of Deer Creek at Oso, Wash., for the year ending Sept. 30, 1923

[Drainage area, 84 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	-------	-------	448	5.33	6.14	27,500
November	1,180	116	294	3.50	3.90	17,500
December	4,950	-------	1,020	12.1	13.95	62,700
January	4,260	126	1,150	13.7	15.79	70,700
February	-------	83	255	3.04	3.17	14,200
March	-------	181	371	4.42	5.10	22,800
April	988	391	623	7.42	8.28	37,100
May	1,370	410	651	7.75	8.94	40,000
June	1,240	190	463	5.51	6.15	27,600
July	237	46	103	1.23	1.42	6,330
August	82	34	40.8	.486	.56	2,510
September	526	28	86.4	1.03	1.15	5,140
The year	4,950	28	462	5.50	74.55	334,000

SKAGIT RIVER BASIN

SKAGIT RIVER BELOW RUBY CREEK, NEAR MARBLEMOUNT, WASH.

LOCATION.—In Whatcom County, three-fourths mile below Ruby Creek, 5 miles above Reflector Bar, and 23 miles northeast of Marblemount, Skagit County.

DRAINAGE AREA.—978 square miles. (Area in United States measured on Washington National Forest map, edition 1922; area in British Columbia, 390 square miles.[1])

[1] White, A. V. Water Powers of British Columbia, p. 483. Conservation Commission of Canada.

RECORDS AVAILABLE.—June 1, 1919, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on right bank, three-fourths mile below Ruby Creek; installed June 9, 1919, gage inspected by F. E. Davis.

DISCHARGE MEASUREMENTS.—Made from cable 40 feet below gage.

CHANNEL AND CONTROL.—Control at head of rapids about 125 feet below gage; composed of large, angular boulders and perhaps some bedrock; permanent. Banks high and wooded; not subject to overflow. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 10.75 feet at 11.30 p. m. June 8 (discharge, 19,200 second-feet); minimum discharge occurred during December while stage-discharge relation was affected by ice.

1919–1923: Maximum stage recorded, 16.1 feet at 7 p. m. December 12, 1921 (discharge, 45,700 second-feet); minimum stage recorded, 3.30 feet at 10 p. m. November 11, 1919 (discharge, 555 second-feet).

ICE.—Stage-discharge relation slightly affected by ice during severe winters. Flow estimated from observer's notes and weather records.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent and well defined below 20,000 second-feet; affected by ice December 7–19, January 30 to February 2, and February 12–18. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph by inspection or, for days when there was considerable variation in stage, by averaging results obtained by applying to rating table mean gage heights for shorter intervals. Records excellent.

Daily discharge, in second-feet, of Skagit River below Ruby Creek, near Marblemount, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,580	1,640	974	2,670	950	1,190	3,020	5,360	5,940	11,000	2,540	1,740
2	1,340	1,530	958	2,480	1,000	1,200	3,250	4,730	5,940	10,600	2,340	1,800
3	1,430	1,380	934	2,480	1,030	1,180	3,400	4,250	5,820	9,550	2,280	1,910
4	1,480	1,340	902	2,280	1,030	1,160	3,480	4,160	7,230	8,030	2,220	1,580
5	1,430	1,290	863	2,150	1,010	1,150	3,640	4,930	10,600	6,970	2,030	1,430
6	1,340	1,200	814	2,480	1,010	1,170	3,480	6,450	13,500	6,710	1,970	1,380
7	1,240	1,170		3,100	1,010	1,160	3,250	8,030	15,800	7,760	2,030	1,380
8	1,190	1,130		3,560	974	1,110	2,950	10,200	17,700	7,760	2,150	1,480
9	1,180	1,100		3,320	958	1,080	2,880	13,000	17,700	7,230	2,150	1,480
10	1,170	1,060		3,100	926	1,080	2,950	14,000	15,800	7,230	2,030	1,380
11	1,140	1,020		2,810	918	1,050	3,100	11,800	13,500	7,230	2,090	1,240
12	1,100	982		2,480		1,020	3,480	10,200	11,400	6,710	2,150	1,240
13	1,040	958	600	2,280		1,010	3,480	8,900	9,550	6,450	2,150	1,290
14	982	950		2,090		990	3,400	8,310	8,310	6,450	2,150	1,290
15	974	918		1,970	750	974	3,560	8,600	7,230	6,190	2,150	1,200
16	958	1,120		1,800		958	4,440	8,900	7,490	5,700	2,150	1,130
17	942	1,160		1,840		934	5,700	9,550	7,760	5,030	2,340	1,050
18	926	1,130		1,870		926	6,060	9,550	7,760	4,340	2,410	1,080
19	894	1,090		1,910	918	934	5,470	9,900	8,600	3,980	2,600	1,160
20	863	1,050	772	1,860	942	926	4,830	9,200	8,900	3,890	2,540	2,030
21	835	1,020	870	1,740	958	910	4,340	9,200	9,200	3,890	2,280	1,690
22	814	1,010	998	1,690	990	902	3,890	9,550	8,900	4,160	2,480	1,290
23	856	998	1,460	1,580	1,020	910	3,720	9,550	8,310	4,250	2,280	1,130
24	1,160	982	4,840	1,480	1,040	926	3,890	9,200	8,310	4,070	2,030	1,200
25	3,240	990	5,140	1,380	1,050	926	4,440	9,200	7,760	3,720	1,910	1,130
26	3,180	1,070	3,980	1,380	1,040	926	6,060	8,900	8,310	3,560	1,910	1,030
27	2,810	1,090	4,630	1,340	1,040	1,010	7,760	7,760	8,900	3,560	1,910	990
28	2,280	1,090	5,030	1,290	1,100	1,190	7,760	6,970	9,900	3,560	1,910	950
29	1,910	1,040	4,070	1,160	-------	1,530	6,970	6,970	10,600	3,480	2,030	942
30	1,800	1,010	3,320	850	-------	1,970	5,940	6,710	11,400	3,180	1,970	934
31	1,800	-------	2,950	900	-------	2,600	-------	6,320	-------	2,810	1,800	-------

NOTE.—Water-stage recorder not operating Jan. 17 and 18; discharge estimated by interpolation
Braced figures show mean discharge for periods indicated.

Monthly discharge of Skagit River below Ruby Creek, near Marblemount, Wash., for the year ending Sept. 30, 1923

[Drainage area, 978 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	3,240	814	1,420	1.45	1.67	87,300
November	1,640	918	1,120	1.15	1.28	66,600
December	5,140	----------	1,660	1.70	1.96	102,000
January	3,560	850	2,040	2.09	2.41	125,000
February	1,100	----------	934	.955	.99	51,900
March	2,600	902	1,130	1.16	1.34	69,500
April	7,760	2,880	4,350	4.45	4.96	259,000
May	14,000	4,160	8,400	8.59	9.90	516,000
June	17,700	5,820	9,940	10.2	11.38	591,000
July	11,000	2,810	5,780	5.91	6.81	355,000
August	2,600	1,800	2,160	2.21	2.55	133,000
September	2,030	934	1,320	1.35	1.51	78,600
The year	17,700	----------	3,360	3.44	46.76	2,430,000

SKAGIT RIVER NEAR MARBLEMOUNT, WASH.

LOCATION.—In SE. ¼ sec. 21, T. 37 N., R. 12 E., at city of Seattle power camp, Whatcom County, one-fourth of a mile above Newhalem Creek, 6½ miles below Stetattle Creek, and 16 miles above Marblemount.

DRAINAGE AREA.—1,160 square miles. (Area in Canada, 390 square miles[2]; area in United States measured on Washington national-forest maps.)

RECORDS AVAILABLE.—December 21, 1908, to May 23, 1914; October 1, 1920, to September 30, 1923.

GAGE.—Stevens water-stage recorder installed June 5, 1923, on right bank about 300 feet below suspension footbridge and trail to Newhalem Creek power plant; inspected by F. E. Davis. Previous gages as follows: December 21, 1908, to May 23, 1914, vertical staff on right bank a few hundred feet above Ladder Creek, about one-fourth of a mile above present site; November 15, 1920, to June 4, 1923, vertical staff gage on right bank about 500 feet above present site and a few hundred feet below Ladder Creek. Present gage datum 400 feet, United States Geological Survey datum.

DISCHARGE MEASUREMENTS.—Made from suspension footbridge and from measuring cable at gage.

CHANNEL AND CONTROL.—Right bank high, not subject to overflow; left bank gently sloping and wooded, is overflowed at extremely high stage. Channel straight for several hundred feet above and for long distance below gage. Control is gravel and boulder riffle; shifts at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the year ending September 30, 1923, from water-stage recorder, 89.1 feet from 9 p. m. June 8 to 5 a. m. June 9 (discharge, 21,400 second-feet); minimum discharge estimated at 770 second-feet on December 12, when stage-discharge relation was affected by ice.

1908–1914; 1920–1923: Maximum stage recorded, 94.2 feet at 8 p. m. December 12, 1921 (discharge, 60,000 second-feet); minimum stage recorded, 80.2 feet on March 7, 12, 13, 15–17, and 19, 1922 (discharge, 740 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

[2] White, A. V., Water powers of British Columbia, p. 483, Canada Conservation Comm.

ACCURACY.—Stage-discharge relation changed during high water December 12, 1921, gradually June 7–30, 1922, and with change of gages June 5, 1923; affected by ice December 11–15, 1922. Rating curves fairly well defined. Gage read to tenths once daily until recorder was installed June 5, 1923. Diurnal fluctuation considerable. Operation of water-stage recorder satisfactory. Daily discharge prior to June 5, 1923, ascertained by applying daily gage height to rating table; thereafter by applying to rating table mean daily gage height determined from recorder graph by inspection or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Shifting-control method used June 7–30, 1922. Records fair to May, 1923; good thereafter.

Discharge measurements of Skagit River near Marblemount, Wash., during the years ending Sept. 30, 1921–1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
1920		*Feet*	*Sec.-ft.*	1922		*Feet*	*Sec.-ft.*
Dec. 20	Judd and Paterson	81.20	1,640	Mar. 22	Davis and Evans	80.32	772
28	Judd and Evans	82.10	2,610	Apr. 25	McCombs and Paterson	82.80	3,070
30	Judd and Paterson	83.65	4,750	Sept. 12	Stewart and Judd	83.14	3,700
1921				17	J. E. Stewart	81.94	2,100
Aug. 5	McCombs and Breiding	83.38	4,190	1923			
Sept. 25	Calkins and Evans	81.70	2,110	June 13	Calkins and Ault	86.43	11,100
				16	D. J. F. Calkins	85.60	8,810

Daily discharge, in second-feet, of Skagit River near Marblemount, Wash., for the years ending Sept. 30, 1921–1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1920–21												
1			2,620	4,390	1,630	4,880	3,120	3,520	19,300	12,600	7,350	3,120
2			2,620	4,550	1,540	4,550	3,250	3,660	21,000	9,710	6,630	2,740
3			2,740	4,390	1,540	5,050	3,120	3,660	23,700	8,870	5,590	2,500
4			3,250	3,660	1,450	5,050	2,990	3,520	27,600	8,870	4,880	2,380
5			2,990	3,520	1,450	4,710	2,860	3,660	25,600	8,870	4,390	2,260
6	9,500		2,860	3,120	1,360	4,390	2,740	4,090	25,600	7,850	4,240	2,150
7			2,620	2,860	1,450	4,090	2,620	5,050	29,800	9,140	4,390	2,500
8		2,250	2,500	2,740	1,360	3,800	2,620	5,400	23,700	11,200	4,390	2,500
9			2,380	2,500	1,360	3,660	2,740	5,790	21,800	12,200	5,400	2,260
10			2,380	2,260	3,250	3,520	2,990	7,100	21,400	10,600	4,880	1,930
11			2,380	2,150	13,600	3,250	3,520	6,860	18,100	9,140	4,710	1,930
12			2,260	2,150	14,700	3,120	4,090	6,630	17,300	9,140	4,550	1,630
13			2,260	2,040	8,100	2,990	4,710	7,100	16,200	9,140	4,710	1,630
14			2,040	3,800	6,410	2,860	4,550	8,870	14,700	9,710	5,050	1,630
15		1,540	1,930	5,990	5,220	2,740	4,710	12,600	12,200	9,420	4,710	1,540
16	4,650	1,450	1,930	3,800	4,390	2,740	4,090	17,300	10,900	8,610	4,090	1,450
17		2,500	1,830	3,380	3,940	2,860	4,390	17,300	10,300	8,610	5,400	1,360
18		3,940	1,830	3,120	3,660	3,120	4,240	18,900	12,900	8,350	4,390	1,270
19		4,090	1,730	2,860	3,520	3,120	4,550	18,900	13,600	8,100	3,800	1,830
20		4,090	1,630	2,620	3,120	2,990	4,710	16,900	13,600	7,600	3,800	1,930
21		3,800	1,630	2,380	2,860	2,860	4,880	17,300	16,500	6,630	3,660	5,790
22		3,380	1,540	2,260	2,740	2,740	5,050	17,300	17,700	6,630	3,380	2,620
23		2,990	1,540	2,150	2,860	3,380	5,050	17,700	15,000	7,600	2,990	2,260
24		2,860	1,540	2,040	2,990	2,500	4,390	18,100	15,400	8,100	2,860	1,830
25		2,990	1,450	1,930	3,380	2,620	3,940	21,000	15,800	7,600	2,620	2,150
26	3,300	2,740	1,450	1,930	4,090	2,620	3,940	17,700	14,000	7,100	2,500	5,590
27		3,120	1,450	1,830	4,240	2,620	3,660	13,600	14,000	7,100	2,620	8,100
28		2,990	2,620	1,730	4,880	2,620	3,660	11,600	13,200	6,860	2,620	5,790
29		2,860	2,620	1,730	-------	2,740	3,660	11,900	12,600	6,860	2,740	3,800
30		2,990	4,880	1,630	-------	2,860	3,520	13,600	14,300	6,630	2,860	3,250
31		-------	4,240	1,630	-------	2,860	-------	16,500	-------	6,410	2,740	-------

Daily discharge, in second-feet, of Skagit River near Marblemount, Wash., for the years ending Sept. 30, 1921–1923—Continued

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1921–22												
1	2,990	8,100	5,050	2,310	1,080	800	1,080	5,380	21,600	8,780	4,450	4,620
2	2,380	6,630	4,390	2,100	1,080	800	1,160	5,380	23,800	10,100	4,280	3,150
3	1,930	5,790	3,800	1,900	1,080	800	1,640	5,380	27,400	10,700	4,110	3,010
4	2,150	6,200	3,520	1,900	1,010	800	1,720	5,980	28,000	10,400	3,940	3,150
5	1,630	6,200	3,250	2,100	1,010	800	1,720	5,980	26,200	9,040	3,620	2,420
6	1,730	6,630	2,990	1,900	1,010	800	1,720	6,190	21,100	8,290	3,460	2,100
7	1,830	6,410	2,740	1,900	1,010	740	2,200	5,380	17,000	7,830	3,150	3,010
8	1,830	5,400	2,740	1,720	1,010	800	2,100	5,180	13,600	6,810	3,300	2,100
9	1,830	4,710	2,860	1,900	1,010	800	2,000	4,580	12,900	6,430	4,110	1,810
10	1,830	4,390	8,350	1,720	1,010	800	2,000	4,180	13,600	6,060	4,110	2,880
11	1,830	4,550	28,200	1,640	940	800	1,900	3,810	13,200	5,880	3,940	3,460
12	1,830	3,800	42,400	1,640	940	740	1,900	3,630	14,000	6,060	3,460	3,620
13	1,930	3,660	28,600	1,560	940	740	1,720	4,380	14,300	6,060	3,010	3,010
14	3,380	3,520	18,700	1,480	940	800	1,720	6,410	15,400	5,880	2,760	4,110
15	3,520	3,380	12,600	1,480	870	740	1,640	8,610	14,000	5,160	5,160	3,010
16	3,520	3,250	10,300	1,400	940	740	1,560	13,600	12,900	4,980	3,460	2,760
17	3,380	2,990	7,600	1,400	940	740	1,560	19,600	11,900	5,160	3,460	2,100
18	3,380	2,620	6,190	1,320	940	800	1,560	19,600	10,600	5,340	3,620	2,100
19	10,300	2,380	5,380	1,320	940	740	1,560	15,400	10,000	5,340	3,940	2,100
20	7,350	2,260	4,780	1,320	870	800	1,810	12,200	12,200	4,980	3,940	2,100
21	5,220	2,150	4,380	1,320	870	870	2,530	10,300	12,200	4,450	3,150	1,560
22	4,550	2,260	3,990	1,320	870	800	3,150	8,870	10,600	4,110	2,880	2,420
23	3,800	2,260	3,630	1,240	870	940	3,460	7,850	9,140	3,780	2,880	2,100
24	3,120	2,260	3,300	1,240	870	870	3,150	8,350	9,420	3,940	3,010	2,000
25	2,990	2,500	3,150	1,240	870	800	3,150	8,350	10,300	4,110	2,880	1,900
26	3,520	2,740	2,880	1,240	800	800	3,300	7,850	11,200	4,110	3,780	3,300
27	3,250	5,590	2,760	1,240	800	800	3,630	7,600	11,600	4,110	4,110	3,300
28	15,000	4,390	2,530	1,160	800	870	3,810	9,420	10,900	4,110	3,940	2,530
29	20,600	3,800	2,530	1,160	-------	800	3,810	12,200	9,710	4,280	4,110	2,310
30	11,900	4,240	2,310	1,080	-------	940	4,380	15,400	8,870	4,280	3,940	2,640
31	10,600	-------	2,310	1,080	-------	1,010	-------	17,400	-------	4,280	4,110	-------
1922–23												
1	2,200	2,310	1,160	3,460	1,320	1,560	4,280	6,430	7,200	14,400	3,910	3,250
2	2,000	2,000	1,240	3,460	1,320	1,560	4,450	5,880	7,000	14,000	3,680	3,440
3	2,200	1,810	1,160	3,460	1,240	1,560	4,450	5,160	7,000	12,600	3,600	3,480
4	2,310	1,810	1,080	3,150	1,240	1,480	4,620	5,160	8,780	10,400	3,530	2,700
5	2,000	1,640	1,010	3,010	1,240	1,480	4,800	6,430	13,200	9,350	3,180	2,400
6	1,810	1,640	1,010	4,280	1,160	1,480	4,620	8,060	15,500	8,830	3,040	2,280
7	1,640	1,560	1,010	5,160	1,160	1,480	4,110	9,300	18,000	10,400	3,320	2,520
8	1,640	1,480	940	5,160	1,080	1,480	4,110	11,600	20,100	10,200	3,600	2,900
9	1,720	1,400	1,010	5,160	1,080	1,400	3,620	15,900	20,100	9,350	3,530	2,700
10	9,720	1,400	940	4,620	1,080	1,480	3,780	15,100	18,000	9,890	3,390	2,400
11	1,640	1,320		4,110	1,080	1,480	4,110	12,600	15,100	9,890	3,750	2,120
12	1,640	1,320		3,300	1,010	1,320	4,620	10,700	12,900	9,350	3,910	2,220
13	1,560	1,160	850	3,010	940	1,320	4,620	9,300	11,300	9,090	3,990	2,520
14	1,480	1,080		2,640	940	1,320	4,620	9,300	9,620	9,350	3,830	2,400
15	1,320	1,080		2,420	940	1,160	4,800	9,300	8,580	9,090	3,830	2,020
16	1,480	1,720	1,080	2,310	940	1,160	6,060	10,400	8,830	8,340	3,990	1,870
17	1,320	1,640	1,160	3,010	940	1,160	7,610	10,700	9,350	7,630	4,400	1,740
18	1,320	1,480	1,160	2,880	1,240	1,160	7,610	10,700	9,350	6,300	4,750	1,780
19	1,320	1,480	1,640	2,530	1,240	1,240	6,810	11,300	10,200	5,890	4,930	1,970
20	1,320	1,400	1,240	2,310	1,240	1,240	6,060	10,400	10,400	5,690	4,750	3,970
21	1,160	1,320	1,240	2,200	1,240	1,240	5,340	10,400	11,000	5,890	3,910	2,860
22	1,160	1,320	1,640	2,000	1,240	1,160	4,980	10,700	10,400	6,510	4,570	1,970
23	1,240	1,320	3,460	1,810	1,320	1,160	4,800	10,700	9,890	6,950	4,070	1,640
24	1,900	1,240	9,300	1,810	1,400	1,160	4,980	10,400	9,890	6,730	3,390	1,780
25	7,400	1,160	7,000	1,810	1,400	1,160	5,880	11,000	9,350	5,890	3,320	1,640
26	5,160	1,160	5,700	1,720	1,400	1,240	7,830	10,100	10,200	5,690	3,460	1,460
27	4,280	1,480	7,830	1,640	1,400	1,320	9,300	9,040	11,000	5,890	3,530	1,380
28	3,150	1,480	6,810	1,560	1,400	1,640	8,780	8,060	12,200	6,090	3,680	1,330
29	2,530	1,320	5,520	1,480	-------	2,000	7,200	8,060	13,600	5,890	3,910	1,330
30	2,420	1,320	4,450	1,400	-------	2,760	7,000	7,830	14,400	5,300	3,680	1,380
31	2,640	-------	3,780	1,320	-------	3,460	-------	7,400	-------	4,400	3,320	-------

NOTE.—No gage-height record Oct. 1 to Nov. 14, 1920; discharge estimated from hydrographic comparison with combined flow of Skagit River at Ruby dam site and Thunder Creek near Marblemount. Braced figures give mean discharge for periods indicated.

Monthly discharge of Skagit River near Marblemount, Wash., for the years ending Sept. 30, 1921–1923

[Drainage area, 1,160 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1920–21						
October			5,740	4.95	5.71	353,000
November	4,090	1,450	2,660	2.29	2.56	158,000
December	4,880	1,450	2,310	1.99	2.29	142,000
January	5,990	1,630	2,810	2.42	2.79	173,000
February	14,700	1,360	3,970	3.42	3.56	220,000
March	5,050	2,500	3,350	2.89	3.33	206,000
April	5,050	2,620	3,810	3.28	3.66	227,000
May	21,000	3,520	11,400	9.83	11.33	701,000
June	29,800	10,300	17,600	15.2	16.96	1,050,000
July	12,600	6,410	8,560	7.38	8.51	526,000
August	7,350	2,500	4,160	3.59	4.14	256,000
September	8,100	1,270	2,720	2.34	2.61	162,000
The year	29,800	1,270	5,760	4.97	67.45	4,170,000
1921–22						
October	20,600	1,630	4,680	4.03	4.65	288,000
November	8,100	2,150	4,170	3.59	4.00	248,000
December	42,400	2,310	7,680	6.62	7.63	472,000
January	2,310	1,080	1,530	1.32	1.52	94,100
February	1,080	800	938	.809	.84	52,100
March	1,010	740	809	.697	.80	49,700
April	4,380	1,080	2,290	1.97	2.20	136,000
May	19,600	3,630	8,850	7.63	8.80	544,000
June	28,000	8,870	14,600	12.6	14.06	869,000
July	10,700	3,780	5,960	5.14	5.93	366,000
August	5,160	2,760	3,680	3.17	3.66	226,000
September	4,620	1,560	2,690	2.32	2.59	160,000
The year	42,400	740	4,840	4.17	56.68	3,500,000
1922–23						
October	7,400	1,160	2,150	1.85	2.13	132,000
November	2,310	1,080	1,460	1.26	1.41	86,900
December	9,300		2,510	2.16	2.49	154,000
January	5,160	1,320	2,840	2.45	2.82	175,000
February	1,400	940	1,190	1.03	1.07	66,100
March	3,460	1,160	1,480	1.28	1.48	91,000
April	9,300	3,620	5,530	4.77	5.32	329,000
May	15,900	5,160	9,590	8.27	9.53	590,000
June	20,100	7,000	11,700	10.1	11.27	696,000
July	14,400	4,400	8,230	7.09	8.17	506,000
August	4,930	3,040	3,800	3.28	3.78	234,000
September	3,970	1,330	2,250	1.94	2.16	134,000
The year	20,100		4,420	3.81	51.63	3,190,000

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 of a mile below intake of Beatty's Slough, 1½ miles south of Sedro Woolley, Skagit County, 21 miles above mouth, 31 miles below The Dalles, and 32 miles below Baker River.

DRAINAGE AREA.—2,970 square miles (revised, measured on topographic and Washington National Forest maps, 1922 edition). Area in British Columbia, 390 square miles.[3]

RECORDS AVAILABLE.—May 1, 1908, to December 31, 1919, and February 1, 1921, to December 31, 1923, when records were discontinued.

GAGE.—Chain gage on railway bridge at site of gage used September 27, 1916, to September 2, 1919, installed November 21, 1921. For description of previous gages see Water-Supply Paper 552.

[3] White, A. V., Water powers of British Columbia, p. 483. Canada Conservation, Comm.

DISCHARGE MEASUREMENTS.—Made from highway bridge 1,500 feet above gage or from Northern Pacific Railway bridge at 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 period October 1, 1922, to December 31, 1923, 45.2 feet from high-water mark on gage, occurred about midnight December 24 (discharge, 71,000 second-feet); minimum stage recorded, 32.8 feet November 18, 1923 (discharge, 3,610 second-feet).

1908–1923: Maximum stage recorded, 56.6 feet at 9 a. m. November 30, 1909 (discharge, 220,000 second-feet); maximum stage and discharge of December, 1917, flood, published in Water-Supply Paper 482, p. 45, and Water-Supply Paper 512, p. 85, found to be in error. More complete information and additional high-water marks indicate maximum stage was 54.1 feet at 4 a. m. December 30, 1917 (discharge, 195,000 second-feet).

Earlier floods are known to have occurred about as follows: Between 1805 and 1825, as estimated from Indian tradition, maximum stage 63.5 feet determined by comparison with stage at The Dalles where stage was known by a deposit of flood sand in a protected eddy (discharge, about 400,000 second-feet by comparison with flow at The Dalles).

About 1856 as indicated by the age of trees growing on a bar at an elevation lower than stage of this flood and at a point where high velocity and drift at that time cleared the bar of any trees that may have been growing, and probably December, 1856, as indicated by precipitation at Vancouver, Wash., maximum stage determined at several points in the vicinity of the gage, by silt deposits in the bark of cedar trees and by stain on the bark of trees. Stage 60.0 feet according to the early settlers' records and also according to later checks by a United States Geological Survey engineer (discharge, about 300,000 second-feet by comparison with flow at The Dalles).

November 16, 1896, maximum stage determined from high-water marks, 54.8 feet (discharge, 185,000 second-feet).

November 19, 1897, maximum stage determined from high-water marks, 54.9 feet (discharge, 190,000 second-feet).

November 16, 1906, maximum stage determined from high-water marks, 54.7 (discharge, 180,000 second-feet).

Minimum stage recorded, 32.3 feet September 29–30 and October 10–11, 1915 (discharge, 2,830 second-feet).

ICE.—Stage-discharge relation slightly affected by ice during severe winters; flow estimated from discharge measurements, observers notes, and weather records.

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 on main channel. Flow in Beatty's Slough is included with the flow in the main channel in the records of this station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent; affected by ice December 10–19 and February 13–16. Rating curve fairly well defined. Gage read to tenths once daily. Practically no diurnal fluctuation. Daily discharge ascertained by applying daily gage heights to rating table. Records good.

Discharge measurements of Skagit River near Sedro Woolley, Wash., during the period Oct. 1, 1922, to Dec. 31, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 21	Stewart and Knight	34.52	6,680	Dec. 28	Stewart and Knight	42.85	48,500
22				Jan. 9	Stewart and Wright	41.01	38,400
Dec. 11	do	* 33.57	3,970	10	do	43.17	51,700
18	Stewart and Costello	* 33.57	4,340	11	do	41.13	35,600
19	do	36.92	16,000	12	do	39.40	26,600
19	do	37.26	17,000	15	do	37.80	19,200
24	J. E. Stewart	43.89	70,900	18	do	38.62	22,300
25	Stewart and Leplant	44.73	64,400	22	do	36.44	12,700
26	Stewart and Knight	40.95	38,000	June 15	J. S. Gatewood	38.64	22,300
27	do	41.56	43.400	Oct. 26	R. B. Kilgore	33.91	5,310
27	do	42.56	50,500				

* Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Skagit River at Sedro Woolley, Wash., for the period Oct. 1, 1922, to Dec. 31, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1922–23												
1	12,200	14,200	5,570	23,700	7,400	7,660	15,900	17,800	19,200	43,400	11,800	8,800
2	10,400	11,100	5,570	20,200	6,890	7,660	15,900	15,400	21,700	42,700	11,100	9,110
3	8,500	9,110	5,570	29,300	6,890	7,140	15,900	14,200	19,700	39,100	10,800	11,100
4	9,110	7,930	5,570	22,700	6,650	6,890	15,900	13,300	23,200	31,200	10,400	8,500
5	10,400	7,400	5,200	18,700	6,420	6,890	15,900	17,800	34,400	26,400	9,740	7,400
6	8,500	6,890	5,020	25,900	6,200	7,930	15,900	22,200	45,000	23,700	8,800	7,400
7	7,400	6,650	4,850	33,100	6,200	8,800	15,000	25,400	48,700	28,100	9,110	7,660
8	6,890	6,200	4,680	45,000	6,200	8,500	13,300	33,100	55,200	28,100	10,100	7,930
9	6,890	6,200	4,520	36,400	5,770	7,660	13,000	43,400	59,400	25,900	9,740	8,210
10	6,650	6,200		53,500	5,570	7,400	13,000	45,700	48,700	27,600	9,420	7,930
11	6,650	6,200		37,700	5,570	7,930	13,300	38,400	41,200	29,300	9,740	7,400
12	6,200	5,980		27,000	5,570	7,400	16,400	29,900	35,000	28,100	10,800	7,140
13	6,200	5,980		22,200		7,400	14,600	26,400	29,900	26,400	11,100	7,400
14	5,980	5,770	4,000	18,700		6,890	13,300	25,400	25,900	27,600	10,800	7,660
15	5,770	5,570		18,200	4,700	6,420	13,700	25,900	22,700	27,000	10,400	6,890
16	5,770	5,570		18,200		6,890	17,800	28,100	23,700	24,800	11,500	6,420
17	5,570	9,110		19,200	6,200	6,890	20,700	19,700	23,200	23,200	11,800	5,980
18	5,570	9,110		22,700	8,500	6,420	21,200	28,700	22,700	18,700	12,200	5,980
19	5,570	7,400	13,000	19,200	8,800	6,650	20,200	27,600	23,200	16,800	12,600	6,200
20	5,200	6,890	14,200	15,900	8,210	6,650	17,300	24,800	24,800	16,400	12,600	10,100
21	5,200	6,650	9,740	14,200	7,660	6,420	15,900	24,800	25,900	16,800	11,100	13,000
22	5,020	6,650	10,100	12,600	7,660	6,420	14,200	25,900	24,200	18,700	12,200	7,930
23	4,850	6,420	14,200	11,500	8,500	5,980	13,300	27,000	23,700	20,200	11,800	6,420
24	5,980	6,420	48,000	10,800	8,210	7,140	14,200	25,400	24,200	19,700	10,100	6,650
25	23,700	6,200	60,300	10,100	7,660	6,890	17,300	28,100	23,700	17,300	9,110	7,140
26	46,400	6,200	37,000	9,420	7,660	6,650	22,200	27,000	26,400	15,900	9,420	5,980
27	28,700	6,650	43,400	9,740	7,140	6,890	26,400	23,700	29,300	16,800	9,420	5,570
28	18,700	6,420	51,100	9,110	7,140	7,660	24,200	21,700	34,400	16,800	9,740	5,200
29	14,200	5,980	33,800	8,210		9,740	20,700	22,700	38,400	16,800	10,100	5,020
30	11,100	5,770	24,800	7,660		12,600	17,800	21,700	39,800	15,900	10,400	5,200
31	14,200		22,700	7,400		16,400		19,700		13,000	9,740	

Day	Oct.	Nov.	Dec.	Day	Oct.	Nov.	Dec.	Day	Oct.	Nov.	Dec.
1923				1923				1923			
1	5,380	4,200	7,930	11	4,850	4,050	15,000	21	9,110	4,360	12,600
2	5,570	8,210	7,400	12	4,850	4,050	14,600	22	10,400	4,680	11,800
3	5,770	6,200	7,930	13	4,520	3,900	11,800	23	7,660	6,650	12,200
4	6,200	5,380	8,500	14	4,520	4,050	11,500	24	6,650	22,200	12,200
5	5,980	5,200	14,200	15	5,980	4,050	19,700	25	5,980	18,700	12,200
6	6,890	4,850	20,700	16	9,420	3,900	24,800	26	5,380	15,000	10,400
7	6,420	4,680	25,900	17	11,500	3,750	20,200	27	5,200	10,800	9,740
8	5,770	4,360	16,800	18	9,420	3,610	22,700	28	5,020	12,600	10,400
9	5,380	4,360	12,200	19	7,400	4,200	19,200	29	4,680	11,100	9,740
10	5,020	4,200	10,800	20	7,930	4,360	15,000	30	4,520	9,420	8,210
								31	4,200		7,660

NOTE.—Braced figures show mean discharge for periods indicated.

Monthly discharge of Skagit River at Sedro Woolley, Wash., for the period Oct. 1, 1922, to Dec. 31, 1923

[Drainage area, 2,970 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1922-23						
October	46,400	4,850	10,400	3.50	4.04	640,000
November	14,200	5,570	7,090	2.39	2.67	422,000
December	60,300		15,000	5.05	5.82	922,000
January	53,500	7,400	20,600	6.94	8.00	1,270,000
February	8,800		6,700	2.26	2.35	372,000
March	16,400	5,980	7,710	2.60	3.00	474,000
April	26,400	13,000	16,800	5.66	6.32	1,000,000
May	45,700	13,300	25,500	8.59	9.90	1,570,000
June	59,400	19,200	31,200	10.5	11.71	1,860,000
July	43,400	13,000	23,900	8.05	9.28	1,470,000
August	12,600	8,800	10,600	3.57	4.12	652,000
September	13,000	5,020	7,440	2.51	2.80	443,000
The year	60,300		15,300	5.15	70.01	11,100,000
1923						
October	11,500	4,200	6,370	2.14	2.47	392,000
November	22,200	3,610	6,900	2.32	2.59	411,000
December	25,900	7,400	13,700	4.61	5.32	842,000

THUNDER CREEK NEAR MARBLEMOUNT, WASH.

LOCATION.—In Whatcom County, one-fourth of a mile above junction with Skagit River, 3½ miles from Reflector Bar ranger station, 20 miles northeast of Marblemount, Skagit County.

DRAINAGE AREA.—111 square miles (measured on Washington National Forest map, edition of 1922).

RECORDS AVAILABLE.—February 15, 1919, to September 30, 1923.

GAGE.—Stevens water-stage recorder on left bank a quarter of a mile above mouth; inspected by F. E. Davis.

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

CHANNEL AND CONTROL.—Control at high stage is at head of falls about 200 feet below gage; at low stage bed of stream between gage and falls, composed of gravel, forms control; shifting. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 8.60 feet at 1 a. m. June 9 (discharge, 2,670 second-feet); minimum discharge probably occurred in December while stage-discharge relation was affected by ice.

1919–1923: Maximum stage recorded, from high-water marks in well, 15.5 feet about 4.30 p. m. December 12, 1921 (discharge, 9,720 second-feet); minimum stage recorded, 2.88 feet from March 14 to 17, 1922 (discharge, 71 second-feet). Discharge may have been less in January and February, 1922, when stage-discharge relation was affected by ice.

ICE.—Stage-discharge relation affected by ice during severe winters. Flow estimated from study of observer's notes, weather records, and results at near-by gaging station.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed over period of glacial melt, July to September; affected by ice December 9–23 and January 30 to February 20. Rating curves fairly well defined up to 2,000 second-feet. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying to rating table mean daily gage heights determined from recorder graph by inspection or, for days of considerable variation in stage, by averaging results obtained by applying mean gage heights for shorter intervals. Records good.

Discharge measurements of Thunder Creek near Marblemount, Wash., during the year ending Sept. 30, 1923

[Made by D. J. F. Calkins]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
June 14	5.95	945
14	5.91	939

Daily discharge, in second-feet, of Thunder Creek near Marblemount, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	656	346	200	407		198	437	602	638	2,350	953	1,160
2	484	310	200	407		202	452	533	620	2,430	881	1,310
3	602	281	198	407		200	468	516	602	2,140	953	1,190
4	533	271	191	378		200	468	500	830	1,650	881	873
5	437	252	182	358		198	500	620	1,310	1,430	775	782
6	392	242	198	468		198	468	790	1,620	1,460	775	762
7	366	238	198	638		196	437	960	1,930	1,790	902	921
8	407	229	187	675		189	407	1,190	2,350	1,490	1,030	1,160
9	452	222		602		182	407	1,550	2,350	1,520	977	995
10	484	216		567		180	407	1,490	2,070	1,860	952	848
					170							
11	484	206		500		180	437	1,160	1,720	1,930	1,160	740
12	452	200		437		175	484	985	1,340	1,790	1,310	847
13	392	198		392		172	468	870	1,110	1,860	1,340	1,040
14	358	196		358		165	452	830	960	2,000	1,220	894
15	392	195		332		162	484	870	810	2,000	1,220	699
16	407	286	150	321		163	584	1,010	870	1,860	1,400	606
17	407	255		378		162	750	1,040	910	1,580	1,680	569
18	392	238		364		159	750	1,010	985	1,190	1,790	641
19	378	224		332		163	638	1,010	1,080	1,140	1,860	717
20	321	218		313		160	567	910	1,160	1,220	1,620	1,280
21	273	214		294	179	157	516	960	1,190	1,400	1,280	640
22	291	210		281	175	154	500	1,060	1,110	1,720	1,580	453
23	468	204		265	179	157	468	1,010	1,160	1,930	1,280	399
24	567	202	1,060	247	182	162	500	960	1,190	1,790	1,050	436
25	1,420	212	870	240	182	162	567	1,060	1,110	1,520	1,100	369
26	750	240	638	238	180	162	750	910	1,280	1,460	1,190	359
27	584	235	750	227	180	172	870	790	1,490	1,680	1,250	334
28	452	224	770	220	184	193	790	712	1,760	1,720	1,340	346
29	378	218	602	206	-------	231	712	750	2,070	1,650	1,490	381
30	378	210	500	190	-------	302	638	712	2,350	1,430	1,340	434
31	422	-------	452	165	-------	407	-------	675	-------	1,080	1,160	-------

NOTE.—Braced figures show mean discharge for periods indicated.

Monthly discharge of Thunder Creek near Marblemount, Wash., for the year ending Sept. 30, 1923

[Drainage area, 111 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	1,420	273	477	4.30	4.96	29,300
November	346	195	233	2.10	2.34	13,900
December	1,060	----------	305	2.75	3.17	18,800
January	675	165	362	3.26	3.76	22,300
February	----------	----------	173	1.56	1.62	9,610
March	407	154	189	1.70	1.96	11,600
April	870	407	546	4.92	5.49	32,500
May	1,550	500	905	8.15	9.40	55,600
June	2,350	602	1,330	12.0	13.39	79,100
July	2,430	1,080	1,680	15.1	17.41	103,000
August	1,860	775	1,220	11.0	12.68	75,000
September	1,310	334	740	6.67	7.44	44,000
The year	2,430	----------	684	6.16	83.62	495,000

SAUK RIVER AT DARRINGTON, WASH.

LOCATION.—In SE. ¼ sec. 24, T. 32 N., R. 9 E., at suspension footbridge half a mile southeast of Darrington, 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, 1923.

GAGE.—Vertical and inclined staff on right bank at suspension footbridge; installed April 14, 1922. 1914–1918 vertical staff on left bank 700 feet upstream. January 7, 1918, to April 13, 1922, vertical and inclined staff at same site and datum as first gage. Gages read by Paul Schmidt.

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

CHANNEL AND CONTROL.—Bed composed of gravel and large boulders. Right bank at gage high and not subject to overflow; left bank flat and subject to overflow at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from high-water mark near gage, 8.0 feet on December 24 (discharge, 11,800 second-feet); minimum stage recorded, 1.2 feet on October 22 and December 16 and 17 (discharge, 469 second-feet).

1914–1923: Maximum stage, 15.0 feet at 9 a. m. December 29, 1917, and 4 p. m. December 12, 1921, determined by levels to high-water mark (discharge, 36,000 second-feet); minimum discharge, 315 second-feet, on March 26, 1922.

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

DIVERSIONS.—An average diversion of possibly 10 second-feet is made from a point about one-fourth of a mile above gage for the purpose of driving shingle bolts to mill pond at Darrington.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed gradually July 6–25. Rating curve used prior to July 6 well defined below 6,000 second-feet; that used since July 25 fairly well defined. Gages read to half tenths, often to hundredths, once daily. Daily discharge ascertained by applying daily gage height to rating table. Shifting-control method used July 6–25. Records good except for extremely high stages.

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

The following discharge measurement was made by J. S. Gatewood:

June 13, 1923: Gage height, 4.08 feet; discharge 3,230 second-feet.

Daily discharge, in second-feet, of Sauk River at Darrington, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,050	1,650	792	3,190	918	1,190	2,100	1,980	2,470	5,310	1,130	910
2	1,120	1,450	732	4,000	918	1,120	2,100	1,870	2,470	4,720	1,050	980
3	1,270	1,270	732	3,350	918	1,050	2,220	1,760	2,470	3,830	1,050	980
4	1,550	1,190	704	3,030	854	982	2,220	1,980	3,350	3,350	980	910
5	1,270	1,120	675	2,740		982	2,220	2,220	4,000	3,030	910	840
6	1,050	1,050	646	3,030		1,050	2,220	2,340	5,110	2,740	910	750
7	732	982	590	10,300		1,050	1,980	3,030	5,520	2,470	910	692
8	704	918	562	5,520	700	982	1,980	4,170	5,940	2,340	875	638
9	646	918	562	7,080		1,050	1,760	5,940	5,520	2,740	840	582
10	646	854	562	5,940		1,050	1,760	4,910	4,350	3,030	780	582
11	618	792	538	4,720		1,050	1,760	4,170	3,830	3,190	780	555
12	590	762	538	4,000		982	1,760	3,670	3,350	3,350	840	555
13	590	732	515	3,350		918	1,870	3,030	3,030	3,510	910	530
14	562	704	492	2,880		918	1,760	3,190	2,470	3,670	980	530
15	562	675	492	2,600	700	918	1,980	3,350	2,470	3,670	1,050	505
16	562	675	469	2,340		918	1,980	3,510	2,470	2,880	1,130	505
17	538	1,120	469	2,740		918	2,100	3,350	2,470	2,220	1,210	505
18	538	1,360	4,350	3,030		918	2,220	3,350	2,340	1,760	1,210	505
19	515	1,270	3,350	2,470		918	2,220	3,030	2,470	1,760	1,290	555
20	492	1,190	2,740	2,100		918	2,470	2,740	2,470	1,870	1,370	665
21	492	1,050	2,470	1,760	1,600	854	2,470	2,740	2,740	1,980	1,130	910
22	469	982	2,220	1,550		854	2,470	2,740	2,740	2,100	980	665
23	618	918	4,720	1,450		854	2,220	2,880	2,880	1,980	840	505
24	1,550	918	11,800	1,360	1,190	918	1,980	2,740	3,030	1,760	780	530
25	6,840	918	5,940	1,270	1,190	982	2,220	2,740	3,030	1,550	810	555
26	3,830	918	5,730	1,190	1,190	1,050	2,470	2,600	3,190	1,460	840	610
27	2,740	918	5,520	1,190	1,190	1,190	2,600	2,470	3,670	1,550	840	582
28	1,980	918	5,310	1,190	1,190	1,270	2,740	2,470	4,350	1,550	810	555
29	1,550	854	3,190	1,120	-------	1,450	2,470	2,600	5,110	1,550	840	530
30	1,550	792	3,030	1,050	-------	1,650	2,220	2,470	5,310	1,370	875	505
31	1,760	-------	2,740	1,050	-------	1,980	-------	2,470	-------	1,210	910	-------

NOTE.—Gage not read Feb. 4-23; discharge estimated from comparison with records of Baker River below Anderson Creek, near Concrete, Wash. Braced figures show mean discharge for periods indicated

Monthly discharge of Sauk River at Darrington, Wash., for the year ending Sept. 30, 1923

[Drainage area, 293 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	6,840	469	1,260	4.30	4.96	77,500
November	1,650	675	996	3.40	3.79	59,300
December	11,800	469	2,360	8.05	9.28	145,000
January	10,300	1,050	2,990	10.2	11.76	184,000
February	-------	-------	1,010	3.45	3.59	56,100
March	1,980	854	1,060	3.62	4.17	65,200
April	2,740	1,760	2,150	7.34	8.19	128,000
May	5,940	1,760	2,980	10.2	11.76	183,000
June	5,940	2,340	3,490	11.9	13.28	208,000
July	5,310	1,210	2,560	8.74	10.08	157,000
August	1,370	780	963	3.29	3.79	59,200
September	980	505	641	2.19	2.44	38,100
The year	11,800	469	1,880	6.42	87.09	1,360,000

BAKER RIVER BELOW ANDERSON CREEK, NEAR CONCRETE, WASH.

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

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

RECORDS AVAILABLE.—September 10, 1910, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder referred to inside staff gage on left bank; installed September 24, 1915; inspected by Charles Bagnell. For description of previous gages see Water-Supply Paper 512.

DISCHARGE MEASUREMENTS.—Made from 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 from water-stage recorder, 8.1 feet at 4 p. m. December 24 (discharge, 11,800 second-feet); minimum stage probably occurred during period float was frozen in well; neither stage nor discharge determined.

1910–1923: Maximum stage recorded, 13.7 feet at 12.30 p. m. December 29, 1917 (discharge, 36,800 second-feet); minimum stage recorded, 1.21 feet on December 15–16, 1919 (discharge, 219 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined below 10,000 second-feet. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined graphically from automatically made record or, for a few days when range of stage was considerable, by averaging results obtained by applying mean gage heights for shorter intervals. Records good.

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, 1923

[Made by J. S. Gatewood]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
June 17	4.39	2,190
18	4.39	2,190

Daily discharge, in second-feet, of Baker River below Anderson Creek, near Concrete, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,260	1,640	669	1,860	615	972	2,010	1,600	1,960	4,930	1,440	1,440
2	1,640	1,360	658	1,860	590	935	1,860	1,440	2,160	4,480	1,400	1,520
3	1,730	1,200	620	2,010	575	852	1,820	1,320	2,060	5,170	1,440	1,560
4	1,640	1,160	595	1,640	560	800	1,730	1,480	3,140	3,880	1,360	1,320
5	1,640	1,010	565	1,560	548	764	1,780	1,960	4,930	3,000	1,200	1,120
6	1,360	942	530	2,430	536	852	1,680	2,550	5,820	2,930	1,160	1,120
7	1,200	907	501	3,000	524	935	1,520	3,140	5,950	3,880	1,280	1,280
8	1,160	907	493	3,070	513	865	1,400	3,980	6,090	3,880	1,320	1,400
9	1,120	865	505	3,070	505	770	1,320	5,420	5,680	3,450	1,320	1,280
10	1,120	806	489	3,220	493	764	1,320	5,300	4,480	3,700	1,320	1,280
11	1,120	752	454	2,320	485	758	1,440	4,070	3,700	3,790	1,480	1,160
12	1,050	728		1,780		716	1,680	3,070	3,000	3,530	1,560	1,200
13	942	686		1,520	450	686	1,560	2,610	2,740	3,530	1,560	1,280
14	907	664		1,360		642	1,480	2,490	2,260	3,620	1,480	1,160
15	935	652	800	1,360	560	620	1,600	2,740	2,110	3,530	1,520	1,080
16	907	1,010		1,360	530	630	2,110	3,070	2,430	3,140	1,640	935
17	872	1,160		1,860	612	620	2,380	3,140	2,260	2,670	1,820	886
18	839	1,050		1,730	1,280	585	2,260	2,860	2,210	2,160	1,820	900
19	752	942	1,360	1,480	1,200	600	1,960	2,550	2,260	1,960	1,860	980
20	680	865	1,320	1,320	1,080	585	1,730	2,320	2,380	1,960	1,730	3,380
21	652	813	1,200	1,160	1,010	565	1,480	2,380	2,380	2,110	1,560	2,620
22	680	832	1,520	1,080	1,050	560	1,360	2,740	2,210	2,430	1,780	1,480
23	915	820	2,830	988	1,120	580	1,360	2,800	2,210	2,550	1,560	1,050
24	1,940	800	9,510	907	1,080	664	1,560	2,610	2,320	2,380	1,400	1,820
25	8,980	852	6,380	852	1,010	686	2,110	3,000	2,490	2,110	1,400	1,400
26	7,430	921	4,070	806	935	800	2,860	2,670	3,070	2,010	1,400	1,080
27	4,060	935	6,000	800	865	935	3,220	2,160	3,620	2,160	1,480	900
28	2,490	872	4,400	758	858	1,160	2,550	1,910	4,270	2,210	1,600	846
29	1,730	794	2,780	692	-------	1,400	2,010	2,320	4,820	2,210	1,640	813
30	1,730	728	2,060	636	-------	1,860	1,730	2,160	5,050	1,910	1,600	846
31	2,010	-------	2,010	625	-------	2,110	-------	1,960	-------	1,560	1,480	-------

NOTE.—Float frozen in well Dec. 12-18 and Feb. 12-14; discharge estimated from comparison with temperature records and with records of Sauk River at Darrington. Recorder not operating Feb. 5-8 and Mar 22-29; discharge Feb. 5-7 estimated by interpolation. Discharge determined from one staff gage reading daily Mar. 22-29. Braced figures show mean discharge for periods indicated.

Monthly discharge of Baker River below Anderson Creek, near Concrete, Wash., for the year ending Sept. 30, 1923

[Drainage area, 184 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	8,980	652	1,820	9.89	11.40	112,000
November	1,640	652	922	5.01	5.59	54,900
December	9,510	----------	1,840	10.0	11.53	113,000
January	3,220	625	1,580	8.59	9.90	97,200
February	1,280	----------	732	3.98	4.14	40,700
March	2,110	560	847	4.60	5.30	52,100
April	3,220	1,320	1,830	9.95	11.10	109,000
May	5,420	1,320	2,700	14.7	16.95	166,000
June	6,090	1,960	3,340	18.2	20.31	199,000
July	5,170	1,560	2,990	16.2	18.68	184,000
August	1,860	1,160	1,500	8.15	9.40	92,200
September	3,380	813	1,300	7.07	7.89	77,400
The year	9,510	----------	1,790	9.73	132.19	1,300,000

UPPER COLUMBIA RIVER BASIN

MAIN STREAM

COLUMBIA RIVER AT TRAIL, B. C.

LOCATION.—At highway bridge at Trail, 15 miles above international boundary and mouth of Clark Fork and 18 miles below mouth of Kootenai River.

DRAINAGE AREA.—34,000 square miles (measured by Dominion Water Power Branch).

RECORDS AVAILABLE.—April 18, 1913, to September 30, 1923.

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

DISCHARGE MEASUREMENTS.—Made from bridge.

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

EXTREMES OF DISCHARGE.—Maximum mean daily stage recorded during year, 36.4 feet June 16 and 17 (discharge, 253,000 second-feet); minimum mean daily stage recorded, 7.75 feet February 28 to March 2 and March 25 (discharge, 13,000 second-feet).

1913–1923: Maximum stage recorded, 41.6 feet June 14 and 15, 1913 (discharge, 312,000 second-feet); minimum stage recorded, 7.40 feet March 28, 1917 (discharge, 9,600 second-feet).

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

DIVERSION.—A small amount of water is diverted above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table.

COOPERATION.—Complete record furnished by Dominion Water Power Branch, Department of the Interior, Canada.

Discharge measurements of Columbia River at Trail, B. C., during the year ending Sept. 30, 1923

[Made by G. K. Beeston]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
Feb. 13	8.71	15,400
May 9	17.85	71,000
July 6	33.29	209,000

Daily discharge, in second-feet, of Columbia River at Trail, B. C., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	60,000	37,600	23,600	18,400	17,800	13,000	15,100	55,200	162,000	228,000	157,000	104,000
2	59,000	37,900	23,300	18,600	17,500	13,000	15,800	59,300	159,000	227,000	153,000	103,000
3	57,900	37,800	23,000	18,800	17,300	13,200	16,400	61,000	164,000	226,000	147,000	102,000
4	57,100	37,600	22,500	19,000	16,900	13,500	16,800	62,400	167,000	226,000	142,000	103,000
5	56,400	37,500	22,000	19,100	16,600	13,600	17,200	63,800	172,000	223,000	135,000	102,000
6	55,900	37,200	21,500	19,300	16,400	13,700	17,800	65,600	178,000	221,000	130,000	101,000
7	55,800	36,500	21,000	19,400	16,200	13,600	18,200	67,200	184,000	216,000	124,000	97,800
8	55,400	35,900	20,600	19,500	16,100	13,500	18,800	69,200	192,000	211,000	120,000	96,100
9	54,300	35,200	20,200	19,600	16,200	13,400	19,400	74,800	201,000	206,000	115,000	93,900
10	53,000	34,500	19,900	19,600	16,500	13,600	20,000	80,500	209,000	202,000	111,000	91,800
11	51,800	33,700	19,500	19,500	16,600	13,800	20,600	86,000	218,000	198,000	108,000	89,800
12	50,600	33,400	19,200	19,700	16,800	13,700	22,100	91,800	228,000	194,000	105,000	89,000
13	49,200	32,800	18,800	19,700	16,900	13,500	22,900	97,000	238,000	191,000	104,000	86,800
14	48,100	32,200	18,500	19,600	16,900	13,400	23,600	102,000	244,000	188,000	102,000	84,800
15	46,800	31,600	18,100	19,700	16,800	13,200	24,200	107,000	250,000	186,000	102,000	82,300
16	45,700	30,800	17,800	19,800	16,500	13,200	26,500	111,000	253,000	184,000	102,000	79,800
17	44,700	30,100	17,400	19,800	16,200	13,300	29,200	115,000	253,000	180,000	102,000	77,600
18	43,700	29,600	17,000	19,700	15,900	13,400	32,000	119,000	252,000	178,000	102,000	74,800
19	42,700	29,000	16,700	19,800	15,500	13,400	33,400	121,000	250,000	175,000	104,000	72,000
20	41,700	28,300	16,400	19,900	15,200	13,300	35,300	124,000	246,000	172,000	104,000	70,000
21	40,700	28,000	16,100	20,000	14,900	13,200	36,700	127,000	243,000	168,000	107,000	68,200
22	39,700	27,400	16,100	19,900	14,600	13,100	38,500	131,000	243,000	166,000	109,000	67,400
23	38,800	26,900	16,300	19,800	14,200	13,200	39,700	137,000	243,000	163,000	111,000	66,000
24	38,000	26,400	16,400	19,500	13,900	13,100	40,600	142,000	243,000	162,000	112,000	63,200
25	37,300	26,000	16,600	19,400	13,600	13,000	41,500	148,000	240,000	162,000	112,000	62,400
26	37,000	25,500	16,700	19,300	13,400	13,100	42,400	153,000	238,000	163,000	111,000	59,000
27	36,900	25,100	16,900	19,200	13,200	13,400	43,700	158,000	234,000	162,000	111,000	57,200
28	37,000	24,700	17,100	19,100	13,000	13,600	45,100	159,000	231,000	159,000	108,000	56,500
29	36,900	24,300	17,400	18,900	-------	13,800	46,700	161,000	229,000	161,000	106,000	54,500
30	37,100	23,900	17,600	18,600	-------	14,100	50,900	162,000	229,000	160,000	105,000	52,600
31	37,400	-------	18,100	18,200	-------	14,500	-------	163,000	-------	159,000	105,000	-------

Monthly discharge of Columbia River at Trail, B. C., for the year ending Sept. 30, 1923

[Drainage area, 34,000 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	60,000	36,900	46,700	1.37	1.58	2,870,000
November	37,900	23,900	31,200	.92	1.03	1,860,000
December	23,600	16,100	18,800	.55	.63	1,160,000
January	20,000	18,200	19,400	.57	.66	1,190,000
February	17,800	13,000	15,800	.46	.48	878,000
March	14,500	13,000	13,400	.39	.45	824,000
April	50,900	15,100	29,000	.85	.95	1,730,000
May	163,000	55,200	109,000	3.21	3.70	6,700,000
June	253,000	159,000	220,000	6.47	7.22	13,100,000
July	228,000	159,000	188,000	5.53	6.38	11,600,000
August	157,000	102,000	115,000	3.38	3.90	7,070,000
September	104,000	52,600	80,300	2.36	2.63	4,780,000
The year	253,000	13,000	73,900	2.17	29.61	53,800,000

COLUMBIA RIVER AT KETTLE FALLS, WASH.

LOCATION.—In SW ¼ sec. 23, T. 36 N., R. 37 E., 150 feet above ferry at Kettle Falls, Stevens County, 1½ miles above mouth of Colville River, and 4½ miles below mouth of Kettle River.

DRAINAGE AREA.—64,500 square miles. (Areas in United States measured on maps issued by United States Geological Survey, scale 1:500,000. Areas in British Columbia measured on Department of the Interior railway belt maps, scale 1:500,000; Department of Mines, West Kootenay sheet, scale 1:253,440; and Department of Lands map, scale 1:1,125,000.)

RECORDS AVAILABLE.—April 1, 1916, to September 30, 1923, except during winter prior to winter of 1921–22. Monthly discharge, May, 1913, to March, 1916, and thereafter to fill gaps in the record, was computed from results at other gaging stations; see footnote to table of monthly discharge.

GAGE.—Since June 5, 1921, several sets of vertical and inclined staff gages on left bank at Kettle Falls ferry, set first at arbitrary datum and later to mean sea level datum, read by Ed. Pletcher. All gage heights at the Kettle Falls ferry have been reduced to mean sea level datum. Prior to June 5, 1921, and during part of the winter of 1922–23, vertical staff gage maintained by the United States Weather Bureau on the Great Northern Railway bridge at Marcus, 4½ miles upstream.

DISCHARGE MEASUREMENTS.—Made from cable at gage.

CHANNEL AND CONTROL.—Left bank high, right bank subject to overflow at extremely high stages; two channels at extremely low stage. Channel straight for half a mile above and 1 mile below gage. Bed composed of small boulders and gravel. Control consists of river channel below gage and Rickey Rapids, which is about 3 miles downstream from gage; permanent except at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year ending September 30, 1923, 1,190.6 feet June 17–18 (discharge, 371,000 second-feet); minimum discharge, 15,800 second-feet, as measured with current water February 16, when stage-discharge relation was affected by ice.

1913–1923; Maximum stage 34.2 during night of June 14–15, 1913, as determined from a well-defined high-water mark referred to United States Weather Bureau gage at Marcus (discharge, 468,000 second-feet). Minimum discharge prior to winter of 1921–22 not known because daily record of stage is not available.

The United States Weather Bureau reports a maximum stage of 44.7 feet on the Marcus gage during the June (probably June 7) flood of 1894; discharge, 735,000 second-feet, estimated by extending rating curve.

ICE.—Stage-discharge relation affected by ice during severe winters; flow estimated from gage-height record, discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Considerable water diverted for irrigation above gage but amount very small in proportion to flow past gage.

REGULATION.—None, except the effect of natural storage in Upper and Lower Arrow lakes, Kootenay, Flathead, Pend Oreille, Priest, and other smaller lakes.

ACCURACY.—Stage-discharge relation permanent, affected by ice December 11–19, 1922, and February 1–5, and 11–18, 1923. Rating curve well-defined below 500,000 second-feet. Results, during period when United States Weather Bureau records at Marcus were used, based upon well-defined curve indicating relation between stage at Marcus and stage at Kettle Falls. Kettle Falls gage read to hundredths twice daily; Marcus gage read to hundredths twice daily April 19 to June 4, 1921, otherwise once daily to tenths. Daily discharge ascertained by applying mean daily, or daily, gage height to rating table. Records prior to June 5, 1921, good; thereafter excellent except during periods when stage-discharge relation was affected by ice.

Discharge measurements of Columbia River at Kettle Falls, Wash., during the period Mar. 23, 1921, to Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
1921		*Feet*	*Sec.-ft.*	1922		*Feet*	*Sec.-ft.*
Aug. 7	Logan and Collins	1,179.64	158,000	Nov. 14	Ford and Barrett	1,167.44	36,300
15	Eugene Logan	1,177.61	130,000	Dec. 20	Collins and Milford	[a]1,164.72	21,900
26	do	1,176.47	116,000	1923			
Sept. 10	Logan and Watrous	1,172.60	75,600	Feb. 3	Kilgore and Ford	[a]1,166.08	25,600
20	Eugene Logan	1,170.47	57,800	6	Ford and Geil	[a]1,165.44	25,800
Oct. 8	do	1,169.30	48,700	16	Kilgore and Ford	[a]1,163.77	15,800
20	do	1,169.15	48,200	17	do	[a]1,163.72	18,100
Dec. 23	Collins and Dane	1,167.45	37,500	19	Ford and Geil	1,164.10	20,800
1922				Mar. 6	Kilgore and Burkett	1,164.68	22,500
Jan. 24	Collins and Woodside	1,165.80	28,000	14	Kilgore and Ford	1,164.52	21,900
Feb. 17	do	1,165.11	24,700	15	do	1,164.47	21,900
Mar. 10	Collins and Butler	1,164.34	21,400	Apr. 26	Ford and Harrington	1,172.62	73,500
May 21	E. H. Collins	1,180.07	168,000	May 7	Ford and Gatewood	1,175.80	106,000
June 2	Eugene Logan	1,186.35	279,000	8	do	1,176.11	109,000
8	do	1,189.75	357,000	26	R. B. Kilgore	1,184.00	227,000
20	Collins and Fish	1,190.20	367,000	June 16	Parker and Kilgore	1,190.49	366,000
July 13	Collins and Hearn	1,183.95	232,000	July 31	Gatewood and Ford	1,181.65	191,000
Sept. 17	Parker and Logan	1,173.30	80,500	Sept. 27	J. S. Gatewood	1,171.36	65,100

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Columbia River at Kettle Falls, Wash., for the period Apr. 1, 1916, to Sept. 30, 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1916							1916						
1	68,700	114,000	200,000	456,000	272,000	128,000	16	89,000	184,000	260,000	427,000	179,000	110,000
2	69,500	119,000	202,000	453,000	262,000	128,000	17	91,000	182,000	276,000	415,000	174,000	108,000
3	70,400	124,000	204,000	451,000	256,000	128,000	18	92,000	182,000	293,000	413,000	169,000	103,000
4	71,200	131,000	204,000	456,000	248,000	128,000	19	92,000	182,000	313,000	410,000	166,000	99,700
5	72,000	141,000	205,000	458,000	238,000	128,000	20	93,100	185,000	339,000	405,000	163,000	96,400
6	72,900	151,000	210,000	451,000	235,000	126,000	21	93,100	190,000	357,000	398,000	158,000	93,100
7	73,800	166,000	210,000	446,000	230,000	125,000	22	93,100	189,000	379,000	388,000	152,000	91,000
8	73,800	174,000	215,000	434,000	220,000	125,000	23	94,200	189,000	396,000	376,000	150,000	89,000
9	76,300	177,000	219,000	439,000	215,000	124,000	24	95,300	187,000	410,000	367,000	145,000	87,000
10	77,200	181,000	226,000	439,000	210,000	122,000	25	96,400	187,000	420,000	357,000	138,000	85,200
11	79,800	185,000	228,000	434,000	204,000	121,000	26	97,500	189,000	429,000	339,000	135,000	84,300
12	80,700	189,000	228,000	432,000	200,000	121,000	27	99,700	190,000	439,000	325,000	130,000	81,600
13	81,600	190,000	233,000	432,000	190,000	120,000	28	108,000	193,000	449,000	316,000	130,000	80,700
14	83,400	189,000	237,000	432,000	187,000	116,000	29	109,000	197,000	456,000	302,000	129,000	79,800
15	87,000	187,000	244,000	429,000	182,000	114,000	30	110,000	195,000	458,000	291,000	129,000	77,200
							31		197,000		278,000	129,000	

Daily discharge, in second-feet, of Columbia River at Kettle Falls, Wash., for the period Apr. 1, 1916, to Sept. 30, 1923—Continued

Day	Oct.	Nov.	Apr.	May	June	July	Aug.	Sept.
1916–17								
1	76,300	46,900	21,600	60,000	300,000	346,000	215,000	113,000
2	73,800	46,200	21,600	60,800	311,000	343,000	210,000	110,000
3	72,000	46,200	22,300	60,800	316,000	343,000	204,000	108,000
4	71,200	46,200	23,100	63,900	316,000	341,000	192,000	103,000
5	70,400	46,200	24,000	66,300	311,000	343,000	185,000	99,700
6	67,900	46,200	24,500	67,100	309,000	346,000	166,000	97,500
7	66,300	45,500	24,900	67,900	313,000	346,000	166,000	92,000
8	65,500	45,500	24,900	68,700	316,000	343,000	163,000	87,000
9	63,900	44,900	30,500	72,000	320,000	343,000	158,000	85,200
10	62,300	44,200	30,500	78,000	327,000	341,000	152,000	83,400
11	61,500	44,200	30,500	81,600	327,000	332,000	148,000	79,800
12	60,000	44,200	31,000	89,000	327,000	332,000	144,000	78,900
13	60,000	44,200	31,500	98,600	329,000	325,000	137,000	77,200
14	57,800	43,600	32,000	110,000	327,000	320,000	135,000	75,400
15	54,800	43,600	33,100	122,000	327,000	318,000	134,000	72,900
16	53,300	43,600	37,300	135,000	334,000	313,000	130,000	71,200
17	50,400	43,600	37,300	144,000	341,000	311,000	128,000	68,700
18	50,400	42,900	38,500	151,000	346,000	309,000	122,000	66,300
19	51,100	42,300	39,800	160,000	355,000	300,000	122,000	63,900
20	51,100	41,600	41,000	168,000	355,000	296,000	125,000	63,100
21	50,400	41,600	42,300	179,000	352,000	293,000	129,000	63,100
22	50,400	41,600	43,600	190,000	342,000	289,000	130,000	63,900
23	50,400	41,600	44,200	200,000	367,000	285,000	130,000	63,900
24	50,400	41,000	46,200	210,000	367,000	276,000	130,000	63,900
25	49,000	40,400	46,900	226,000	367,000	266,000	129,000	63,900
26	49,000	39,200	50,400	235,000	364,000	260,000	125,000	63,100
27	49,000	37,900	51,800	244,000	359,000	248,000	122,000	63,100
28	48,300	37,900	54,800	258,000	359,000	237,000	121,000	62,300
29	48,300	37,300	57,800	276,000	355,000	233,000	120,000	62,300
30	48,300	37,300	59,200	287,000	352,000	228,000	115,000	61,500
31	47,600	-------	-------	293,000	-------	222,000	113,000	-------

Day	Oct.	Nov.	Mar.	Apr.	May	June	July	Aug.	Sept.
1917–18									
1	60,000	46,200	37,300	37,900	111,000	189,000	355,000	174,000	97,500
2	59,200	48,300	37,900	40,400	116,000	187,000	339,000	171,000	97,500
3	57,800	42,900	37,900	41,600	128,000	185,000	325,000	171,000	97,500
4	57,800	42,300	37,900	42,900	137,000	185,000	316,000	173,000	96,400
5	59,200	41,000	37,900	44,900	144,000	184,000	304,000	173,000	95,300
6	60,000	41,000	37,900	46,200	158,000	187,000	287,000	171,000	94,200
7	61,500	40,400	37,300	48,300	163,000	189,000	281,000	168,000	94,200
8	63,100	39,800	37,300	51,100	171,000	193,000	274,000	160,000	92,000
9	64,700	39,200	36,100	51,800	179,000	200,000	266,000	154,000	90,000
10	66,300	38,500	35,500	56,200	184,000	214,000	258,000	151,000	89,000
11	67,100	37,900	35,500	60,000	190,000	230,000	256,000	150,000	88,000
12	67,100	37,900	34,300	66,300	193,000	244,000	256,000	144,000	88,000
13	67,100	37,300	34,300	69,500	195,000	260,000	256,000	142,000	87,000
14	66,300	37,300	34,300	73,800	200,000	289,000	256,000	140,000	85,200
15	64,700	37,300	34,300	76,300	212,000	316,000	252,000	122,000	85,200
16	63,900	36,100	32,600	76,300	217,000	332,000	248,000	122,000	84,300
17	61,500	35,500	32,000	77,200	217,000	348,000	242,000	122,000	84,300
18	61,500	34,900	32,600	78,000	224,000	359,000	240,000	120,000	83,400
19	51,800	34,300	33,100	80,700	228,000	367,000	238,000	119,000	83,400
20	51,800	34,300	33,700	81,600	228,000	376,000	240,000	116,000	83,400
21	51,800	34,300	34,300	85,200	228,000	381,000	238,000	116,000	83,400
22	51,100	34,300	34,900	88,000	224,000	386,000	237,000	115,000	84,300
23	51,100	33,700	34,900	92,000	222,000	391,000	235,000	114,000	85,200
24	50,400	33,700	34,900	94,200	217,000	391,000	231,000	113,000	85,200
25	51,100	33,700	35,500	95,300	214,000	396,000	228,000	111,000	85,200
26	51,800	33,100	35,500	97,500	209,000	396,000	217,000	111,000	84,300
27	52,500	33,100	36,100	97,500	202,000	396,000	209,000	97,500	84,300
28	52,500	33,100	36,100	98,600	195,000	386,000	200,000	97,500	84,300
29	51,100	33,100	37,300	103,000	190,000	379,000	193,000	97,500	85,200
30	49,000	32,600	38,500	109,000	190,000	369,000	184,000	97,500	85,200
31	47,600	-------	38,500	-------	189,000	-------	179,000	97,500	-------

Daily discharge, in second-feet, of Columbia River at Kettle Falls, Wash., for the period Apr. 1, 1916, to Sept. 30, 1923—Continued

Day	Mar.	Apr.	May	June	July	Aug.	Day	Mar.	Apr.	May	June	July	Aug.
1919							1919						
1	31,500	32,600	113,000	309,000	293,000	157,000	16	29,900	69,500	157,000	256,000	217,000	142,000
2	31,500	32,600	117,000	309,000	287,000	154,000	17	29,900	71,200	160,000	252,000	217,000	122,000
3	32,000	33,100	128,000	307,000	281,000	152,000	18	29,900	72,000	162,000	252,000	217,000	122,000
4	32,000	33,700	131,000	298,000	274,000	151,000	19	29,900	72,000	163,000	252,000	215,000	126,000
5	32,000	34,900	137,000	298,000	266,000	151,000	20	30,500	72,000	165,000	256,000	212,000	124,000
6	31,500	37,300	145,000	302,000	262,000	150,000	21	30,500	72,900	174,000	262,000	207,000	122,000
7	31,500	38,500	150,000	298,000	256,000	150,000	22	31,000	73,800	182,000	268,000	202,000	122,000
8	31,500	39,800	151,000	291,000	252,000	150,000	23	31,500	76,300	202,000	278,000	192,000	121,000
9	31,000	42,300	152,000	285,000	248,000	150,000	24	31,500	79,800	217,000	287,000	187,000	120,000
10	31,000	43,600	152,000	281,000	244,000	151,000	25	32,000	86,100	226,000	296,000	182,000	120,000
11	31,000	46,200	154,000	276,000	235,000	151,000	26	32,000	91,000	244,000	300,000	181,000	116,000
12	30,500	51,100	152,000	272,000	231,000	150,000	27	32,000	95,300	252,000	302,000	176,000	116,000
13	30,500	57,800	151,000	268,000	226,000	148,000	28	32,000	97,500	272,000	304,000	173,000	115,000
14	29,900	64,700	151,000	260,000	224,000	147,000	29	32,600	104,000	287,000	304,000	169,000	114,000
15	29,900	67,900	151,000	262,000	224,000	145,000	30	32,600	110,000	298,000	302,000	162,000	113,000
							31	32,600	-------	302,000	-------	158,000	111,000

Day	Oct.	Nov.	Mar.	Apr.	May	June	July	Aug.	Sept.
1919–20									
1	75,400	31,500	21,600	24,000	44,200	166,000	285,000	252,000	121,000
2	72,900	31,500	21,600	24,000	45,500	163,000	287,000	240,000	117,000
3	72,000	31,000	20,500	24,000	48,300	165,000	296,000	235,000	116,000
4	68,700	30,500	20,500	24,000	51,800	166,000	304,000	231,000	97,500
5	63,900	30,500	20,500	24,000	56,200	166,000	313,000	226,000	92,000
6	60,000	29,900	20,500	24,000	60,000	168,000	320,000	214,000	90,000
7	56,200	29,400	19,900	24,000	63,900	171,000	320,000	204,000	89,000
8	51,800	29,400	19,900	24,000	66,300	174,000	320,000	200,000	87,000
9	47,600	28,900	19,900	24,000	72,000	189,000	320,000	190,000	80,100
10	44,900	28,900	19,900	24,500	77,200	193,000	322,000	189,000	86,100
11	42,900	27,900	19,900	24,500	77,200	195,000	322,000	182,000	85,200
12	41,600	27,900	19,600	24,500	85,200	204,000	325,000	181,000	85,200
13	40,400	27,400	19,600	24,900	94,200	209,000	327,000	179,000	84,300
14	39,800	27,400	21,600	25,400	104,000	214,000	327,000	174,000	84,300
15	37,900	26,900	21,600	26,900	120,000	219,000	332,000	173,000	83,400
16	37,300	26,400	21,600	27,400	131,000	231,000	332,000	169,000	83,400
17	35,500	26,400	21,600	29,400	137,000	233,000	332,000	166,000	83,400
18	34,900	25,900	21,900	30,500	151,000	240,000	332,000	163,000	83,400
19	34,300	25,900	21,900	31,500	158,000	252,000	332,000	163,000	81,600
20	34,300	25,900	21,900	33,700	165,000	258,000	329,000	158,000	81,600
21	33,700	25,900	21,900	34,900	169,000	266,000	329,000	151,000	81,600
22	33,700	25,900	22,300	35,500	177,000	274,000	327,000	148,000	81,600
23	33,700	25,400	22,300	36,100	176,000	285,000	322,000	147,000	83,400
24	33,100	25,400	22,300	37,900	179,000	287,000	316,000	145,000	83,400
25	33,100	25,400	22,700	38,500	181,000	287,000	309,000	138,000	83,400
26	32,600	24,900	22,700	39,200	181,000	289,000	302,000	131,000	83,400
27	32,600	24,900	23,100	40,400	181,000	289,000	291,000	130,000	83,400
28	32,000	24,900	23,600	41,600	181,000	283,000	285,000	130,000	83,400
29	32,600	24,900	23,600	42,900	179,000	281,000	272,000	129,000	83,400
30	32,000	24,900	23,600	43,600	174,000	281,000	266,000	126,000	83,400
31	32,000	-------	24,000	-------	173,000	-------	256,000	122,000	-------

Daily discharge, in second-feet, of Columbia River at Kettle Falls, Wash., for the period Apr. 1, 1916, to Sept. 30, 1923—Continued

Day	Oct.	Nov.	Mar.	Apr.	May	June	July	Aug.	Sept.
1920–21									
1	81,600	78,000	41,000	51,800	97,500	332,000	350,000	181,000	95,300
2	81,600	77,200	41,000	51,800	97,500	336,000	343,000	177,000	93,100
3	81,600	77,200	40,400	52,500	101,100	341,000	336,000	174,000	91,000
4	81,600	76,300	37,900	53,300	102,000	348,000	329,000	169,000	88,000
5	81,600	75,400	37,900	53,300	102,000	362,000	320,000	166,000	85,200
6	81,600	73,800	37,900	53,300	104,000	368,000	309,000	163,000	83,400
7	81,600	72,900	37,900	55,500	109,000	378,000	298,000	158,000	81,600
8	81,600	72,000	37,300	55,500	115,000	394,000	289,000	151,000	78,900
9	81,600	70,400	37,300	55,500	120,000	405,000	274,000	145,000	77,200
10	81,600	67,900	37,300	57,800	126,000	408,000	270,000	142,000	74,600
11	83,400	66,300	37,900	57,800	135,000	420,000	264,000	140,000	72,900
12	83,400	63,900	40,400	59,200	140,000	413,000	256,000	137,000	71,200
13	83,400	60,800	43,600	59,200	145,000	413,000	250,000	134,000	69,500
14	84,300	56,200	43,600	63,100	154,000	413,000	242,000	131,000	67,900
15	85,200	53,300	42,900	63,100	163,000	408,000	235,000	129,000	65,500
16	86,100	51,100	42,300	63,900	174,000	401,000	231,000	128,000	63,900
17	86,100	48,300	42,300	67,100	184,000	394,000	226,000	126,000	61,500
18	86,100	47,600	42,300	67,100	193,000	387,000	222,000	126,000	60,000
19	86,100	47,600	42,900	75,400	212,000	378,000	217,000	126,000	59,200
20	86,100	47,600	43,600	80,700	222,000	371,000	214,000	125,000	57,800
21	86,100	49,000	44,200	84,300	237,000	366,000	210,000	124,000	57,000
22	85,200	50,400	48,300	86,100	256,600	364,000	207,000	122,000	56,200
23	85,200	50,400	49,000	87,000	268,000	362,000	204,000	120,000	54,800
24	85,200	50,400	47,600	89,000	281,000	359,000	200,000	119,000	54,000
25	84,300	50,400	50,400	91,000	298,000	359,000	195,000	116,000	53,300
26	84,300	49,000	51,100	92,000	311,000	362,000	193,000	115,000	52,500
27	81,600	50,400	51,100	94,200	320,000	362,000	193,000	111,000	51,100
28	80,700	49,000	51,100	95,300	320,000	359,000	192,000	108,000	50,400
29	80,700	49,000	51,100	95,300	320,000	357,000	189,000	105,000	50,400
30	79,800	48,300	51,100	96,400	322,000	352,000	187,000	102,000	49,700
31	78,900	-------	51,800	-------	327,000	-------	184,000	99,700	-------

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1921–22												
1	50,400	52,500	41,600	34,300	26,900	21,600	24,000	59,200	256,000	298,000	140,000	104,000
2	50,400	54,000	41,600	34,300	26,400	21,600	24,500	64,700	272,000	291,000	138,000	105,000
3	50,400	54,800	41,000	34,300	26,400	21,600	24,900	67,900	289,000	285,000	137,000	105,000
4	50,400	55,500	40,400	34,300	27,900	21,600	26,400	70,400	307,000	278,000	137,000	105,000
5	50,400	56,200	40,400	34,300	26,900	21,600	27,400	73,800	325,000	276,000	137,000	105,000
6	49,700	56,200	40,400	33,700	25,400	21,600	27,900	76,300	339,000	274,000	137,000	104,000
7	49,700	57,000	39,800	33,700	24,900	21,600	28,900	79,800	348,000	272,000	137,000	103,000
8	49,000	57,000	39,800	32,600	24,900	21,600	30,500	83,400	352,000	268,000	137,000	101,000
9	48,300	57,000	39,200	33,100	24,900	21,200	32,600	85,200	355,000	262,000	135,000	97,500
10	47,600	57,000	38,500	33,100	25,400	21,200	33,100	86,100	355,000	256,000	133,000	94,200
11	47,600	56,200	38,500	32,600	25,400	21,600	34,300	88,000	357,000	248,000	131,000	91,000
12	46,900	55,500	39,800	32,600	24,900	21,200	34,300	90,000	359,000	240,000	131,000	88,000
13	46,900	54,800	41,000	32,000	24,900	21,200	34,300	92,000	364,000	230,000	130,000	85,200
14	46,200	54,000	42,300	31,500	24,500	20,900	34,900	96,400	366,000	222,000	130,000	83,400
15	46,200	54,000	42,900	31,000	24,500	21,200	35,500	101,000	368,000	215,000	129,000	82,500
16	46,200	52,500	42,900	29,900	24,900	21,200	35,500	110,000	371,000	209,000	126,000	81,600
17	46,200	52,500	44,200	29,900	24,500	21,600	36,100	124,000	373,000	202,000	125,000	80,700
18	46,900	51,100	44,200	29,400	24,500	21,600	35,500	137,000	373,000	195,000	121,000	79,800
19	47,600	49,700	44,200	27,400	24,900	21,200	35,500	148,000	368,000	187,000	119,000	78,900
20	47,600	47,600	42,300	27,500	24,500	21,900	36,100	157,000	362,000	185,000	116,000	78,900
21	48,300	46,900	36,100	27,600	24,500	21,900	37,300	163,000	357,000	181,000	114,000	78,000
22	48,300	46,900	36,700	27,700	24,000	22,300	41,000	171,000	350,000	179,000	114,000	77,200
23	48,300	44,900	36,700	27,800	24,000	22,300	44,900	177,000	346,000	174,000	114,000	76,300
24	49,000	41,000	36,700	27,900	23,100	22,700	45,500	185,000	339,000	169,000	113,000	75,400
25	48,300	41,000	36,700	27,900	21,900	23,100	46,900	193,000	334,000	165,000	111,000	74,600
26	48,300	41,600	36,700	27,400	21,600	23,100	49,000	202,000	327,000	158,000	110,000	72,900
27	49,000	41,600	36,700	27,400	21,600	23,100	51,800	207,000	320,000	156,000	108,000	71,200
28	49,000	41,600	36,100	27,400	21,600	23,100	54,000	214,000	313,000	151,000	107,000	69,500
29	49,000	41,600	35,500	27,900	-------	23,600	55,500	222,000	309,000	148,000	105,000	67,900
30	49,700	41,600	35,500	27,400	-------	23,600	57,000	231,000	302,000	145,000	105,000	66,300
31	51,100	-------	34,300	26,900	-------	24,000	-------	242,000	-------	141,000	104,000	-------

Daily discharge, in second-feet, of Columbia River at Kettle Falls, Wash., for the period Apr. 1, 1916, to Sept. 30, 1923—Continued

Day.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1922-23												
1	64,700	43,600	28,900	26,400		22,300	25,900	92,000	244,000	325,000	187,000	111,000
2	63,900	43,600	28,400	26,900		22,700	27,400	93,100	246,000	320,000	182,000	110,000
3	63,100	43,600	28,400	27,400	25,500	22,300	29,400	95,300	252,000	316,000	174,000	110,000
4	62,300	42,900	27,900	27,900		22,300	31,500	97,500	256,000	311,000	166,000	109,000
5	62,300	42,300	28,400	27,900		22,300	33,100	99,700	260,000	309,000	160,000	109,000
6	61,500	41,600	28,400	27,900	25,900	22,700	35,500	102,000	268,000	304,000	151,000	108,000
7	61,500	41,600	28,400	27,900	25,400	22,700	37,300	107,000	276,000	298,000	145,000	105,000
8	60,800	41,600	24,900	29,400	25,400	22,700	37,300	110,000	285,000	293,000	140,000	103,000
9	60,000	41,000	22,300	29,400	24,500	21,900	37,900	119,000	293,000	296,000	134,000	99,700
10	59,200	40,400	21,600	30,500	24,000	21,900	38,500	128,000	304,000	276,000	129,000	97,500
11	57,800	39,200		31,000		21,900	39,800	135,000	320,000	268,000	126,000	95,300
12	57,000	38,500		31,000		21,600	41,600	141,000	334,000	262,000	122,000	94,200
13	55,500	38,500		31,500		21,600	43,600	150,000	346,000	256,000	120,000	91,000
14	53,300	36,700		30,500		21,900	44,900	157,000	357,000	248,000	117,000	89,000
15	52,500	36,100	19,500	30,500	19,000	21,900	45,500	163,000	366,000	244,000	116,000	87,000
16	51,100	35,500		30,500		21,600	48,300	169,000	368,000	238,000	115,000	85,200
17	49,700	34,300		30,500		21,600	51,800	174,000	371,000	233,000	114,000	82,500
18	49,000	34,300		30,500		21,600	58,500	179,000	371,000	230,000	114,000	80,700
19	47,600	33,700		31,000	20,500	21,600	64,700	184,000	366,000	222,000	114,000	78,000
20	46,200	33,700	21,600	31,000	20,900	21,600	64,700	189,000	362,000	219,000	115,000	75,400
21	45,500	33,700	21,600	31,000	21,600	21,200	65,500	193,000	357,000	214,000	116,000	74,600
22	44,200	32,600	21,600	31,000	21,600	21,200	67,900	200,000	355,000	209,000	119,000	72,900
23	43,600	32,600	21,600	31,000	21,900	21,600	69,500	209,000	355,000	205,000	120,000	71,200
24	42,900	32,600	22,300	30,500	21,900	21,600	70,400	215,000	355,000	202,000	120,000	69,500
25	42,300	31,500	23,100	29,900	22,300	21,600	72,900	219,000	355,000	198,000	121,000	67,900
26	42,300	31,000	23,100	29,400	22,300	21,900	74,600	230,000	350,000	197,000	120,000	66,300
27	42,900	31,000	23,600	29,400	22,300	22,300	78,900	235,000	341,000	197,000	120,000	63,900
28	43,600	30,500	24,500	29,400	22,300	22,700	83,400	237,000	336,000	195,000	117,000	62,300
29	43,600	29,400	25,400	27,900		23,100	87,000	238,000	329,000	193,000	116,000	60,800
30	43,600	29,400	25,900	26,900		23,600	90,000	240,000	327,000	192,000	114,000	58,500
31	43,600		25,900	25,400		24,500		244,000		189,000	113,000	

NOTE.—Gage-height records at Marcus, obtained by the United States Weather Bureau since Apr. 1, 1916, except for the months of December, January, and February, form the basis of determining daily discharge given in the foregoing table prior to June 5, 1921. A comparison with records at other gaging stations on Columbia River seem to indicate that the Marcus gage heights are unreliable during March, 1917, October, November, 1918, and September, 1919. Accordingly daily discharge for those months is not included in the table.

Monthly discharge of Columbia River at Kettle Falls, Wash., for the years ending Sept. 30, 1913–1923

[Drainage area, 64,500 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1913						
May			160,000	2.48	2.86	9,840,000
June	468,000		412,000	6.39	7.13	24,500,000
July			272,000	4.22	4.86	16,700,000
August			153,000	2.37	2.73	9,410,000
September			97,300	1.51	1.68	5,790,000
The period						66,200,000
1913-14						
October			58,200	.902	1.04	3,580,000
November			47,000	.729	.81	2,800,000
December			34,700	.538	.62	2,130,000
January			31,500	.488	.56	1,940,000
February			27,200	.422	.44	1,510,000
March			34,900	.541	.62	2,150,000
April			79,200	1.23	1.37	4,710,000
May			201,000	3.12	3.60	12,400,000
June			285,000	4.42	4.93	17,000,000
July			249,000	3.86	4.45	15,300,000
August			129,000	2.00	2.31	7,930,000
September			74,400	1.15	1.28	4,430,000
The year			105,000	1.63	22.03	75,900,000

Monthly discharge of Columbia River at Kettle Falls, Wash., for the years ending Sept. 30, 1913–1923—Continued

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1914–15						
October			59,800	0.927	1.07	3,680,000
November			61,700	.957	1.07	3,670,000
December			45,100	.699	.81	2,770,000
January			29,800	.462	.53	1,830,000
February			25,700	.398	.41	1,430,000
March			29,500	.457	.53	1,810,000
April			72,300	1.12	1.25	4,300,000
May			164,000	2.54	2.93	10,100,000
June			181,000	2.81	3.14	10,800,000
July			180,000	2.79	3.22	11,100,000
August			153,000	2.37	2.73	9,410,000
September			88,500	1.37	1.53	5,270,000
The year			91,400	1.42	19.22	66,200,000
1915–16						
October			47,900	.743	.86	2,950,000
November			46,000	.713	.80	2,740,000
December			36,000	.558	.64	2,210,000
January			24,600	.381	.44	1,510,000
February			24,600	.381	.41	1,420,000
March			44,800	.695	.80	2,750,000
April	110,000	68,700	86,400	1.34	1.50	5,140,000
May	197,000	114,000	175,000	2.71	3.12	10,800,000
June	458,000	200,000	298,000	4.62	5.16	17,700,000
July	458,000	278,000	402,000	6.23	7.18	24,700,000
August	272,000	129,000	185,000	2.87	3.31	11,400,000
September	128,000	77,200	107,000	1.66	1.85	6,370,000
The year	458,000		124,000	1.92	26.07	89,700,000
1916–17						
October	76,300	47,600	57,500	.891	1.03	3,540,000
November	46,900	37,300	42,900	.665	.74	2,550,000
December			29,000	.450	.52	1,780,000
January			22,900	.355	.41	1,410,000
February			22,100	.343	.36	1,230,000
March			20,200	.313	.36	1,240,000
April	59,200	21,600	36,600	.567	.63	2,180,000
May	293,000	60,000	146,000	2.26	2.61	8,980,000
June	367,000	300,000	337,000	5.22	5.82	20,100,000
July	346,000	222,000	304,000	4.71	5.43	18,700,000
August	215,000	113,000	145,000	2.25	2.59	8,920,000
September	113,000	61,500	77,600	1.20	1.34	4,620,000
The year	367,000		104,000	1.61	21.84	75,200,000
1917–18						
October	67,100	47,600	57,800	.896	1.03	3,550,000
November	48,300	32,600	37,200	.577	.64	2,210,000
December			35,200	.546	.63	2,160,000
January			57,800	.896	1.03	3,550,000
February			41,100	.637	.66	2,280,000
March	38,500	32,000	35,700	.553	.64	2,200,000
April	109,000	37,900	72,000	1.12	1.25	4,280,000
May	228,000	111,000	190,000	2.95	3.40	11,700,000
June	396,000	184,000	297,000	4.60	5.13	17,700,000
July	355,000	179,000	253,000	3.92	4.52	15,600,000
August	174,000	97,500	133,000	2.06	2.38	8,180,000
September	97,500	83,400	88,100	1.37	1.53	5,240,000
The year	396,000		109,000	1.69	22.84	78,600,000
1918–19						
October			62,300	.966	1.11	3,830,000
November			44,700	.693	.77	2,660,000
December			33,200	.515	.59	2,040,000
January			29,200	.453	.52	1,800,000
February			35,300	.547	.57	1,960,000
March	32,600	29,900	31,200	.484	.56	1,920,000
April	110,000	32,600	63,300	.981	1.09	3,770,000
May	302,000	113,000	181,000	2.81	3.24	11,100,000
June	309,000	252,000	283,000	4.39	4.90	16,800,000
July	293,000	158,000	222,000	3.44	3.97	13,600,000
August	157,000	111,000	135,000	2.09	2.41	8,300,000
September			77,900	1.21	1.35	4,640,000
The year	309,000		100,000	1.55	21.08	72,400,000

Monthly discharge of Columbia River at Kettle Falls, Wash., for the years ending Sept. 30, 1913–1923—Continued

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1919–20						
October	75,400	32,000	43,600	0.676	0.78	2,680,000
November	31,500	24,900	27,400	.425	.47	1,630,000
December			20,200	.313	.36	1,240,000
January			20,400	.316	.36	1,250,000
February			21,700	.336	.36	1,250,000
March	24,000	19,600	21,600	.335	.39	1,330,000
April	43,600	24,000	30,300	.470	.52	1,800,000
May	181,000	44,200	121,000	1.88	2.17	7,440,000
June	289,000	163,000	227,000	3.52	3.93	13,500,000
July	332,000	256,000	311,000	4.82	5.56	19,100,000
August	252,000	122,000	174,000	2.70	3.11	10,700,000
September	121,000	81,600	88,300	1.37	1.53	5,250,000
The year	332,000		92,500	1.43	19.54	67,200,000
1920–21						
October	86,100	78,900	83,200	1.29	1.49	5,120,000
November	78,000	47,600	59,300	.919	1.03	3,530,000
December			40,400	.626	.72	2,480,000
January			35,900	.557	.64	2,210,000
February			34,100	.529	.55	1,890,000
March	51,800	37,300	43,700	.678	.78	2,690,000
April	96,400	51,800	70,200	1.09	1.22	4,180,000
May	327,000	97,500	195,000	3.02	3.48	12,000,000
June	420,000	332,000	376,000	5.83	6.50	22,400,000
July	350,000	184,000	246,000	3.81	4.39	15,100,000
August	181,000	99,700	135,000	2.09	2.41	8,300,000
September	95,300	49,700	67,600	1.05	1.17	4,020,000
The year	420,000		116,000	1.80	24.38	83,900,000
1921–22						
October	51,100	46,200	48,500	.752	.87	2,980,000
November	57,000	41,000	50,500	.783	.87	3,000,000
December	44,200	34,300	39,400	.611	.70	2,420,000
January	34,300	26,900	30,500	.473	.55	1,880,000
February	27,900	21,600	24,600	.381	.40	1,370,000
March	24,000	20,900	22,000	.341	.39	1,350,000
April	57,000	24,000	37,200	.577	.64	2,210,000
May	242,000	59,200	132,000	2.05	2.36	8,120,000
June	373,000	256,000	339,000	5.26	5.87	20,200,000
July	298,000	141,000	215,000	3.33	3.84	13,200,000
August	140,000	104,000	124,000	1.92	2.21	7,620,000
September	105,000	66,300	86,100	1.33	1.48	5,120,000
The year	373,000	20,900	95,900	1.49	20.18	69,500,000
1922–23						
October	64,700	42,300	52,200	.809	.93	3,210,000
November	43,600	29,400	36,600	.567	.63	2,180,000
December	28,900		23,300	.361	.42	1,430,000
January	31,500	25,400	29,400	.456	.53	1,810,000
February	25,900		22,200	.344	.36	1,230,000
March	24,500	21,200	22,100	.343	.40	1,360,000
April	90,000	25,900	53,200	.825	.92	3,170,000
May	244,000	92,000	166,000	2.57	2.96	10,200,000
June	371,000	244,000	324,000	5.02	5.60	19,300,000
July	325,000	189,000	247,000	3.83	4.42	15,200,000
August	187,000	113,000	130,000	2.02	2.33	7,990,000
September	111,000	58,500	86,300	1.34	1.50	5,140,000
The year	371,000		99,700	1.55	21.00	72,200,000

NOTE.—Records were not obtained at Marcus, or seem to be unreliable when compared with results at other gaging stations, for the following periods: April, 1913, to March, 1916; December, 1916, to March 1917; December, 1917, to February, 1918; October, 1918, to February, 1919; September, 1919; December 1919, to February, 1920; and December, 1920, to February, 1921. Monthly discharge for these periods was computed as follows: The monthly discharge of Columbia River at Vernita from May, 1913, to June, 1923, was decreased by the sum of the monthly discharges of Wenatchee, Entiat, Chelan, Methow, Okanogan, and Spokane rivers to give one estimate of monthly discharge at Kettle Falls. Another estimate of monthly discharge at Kettle Falls was obtained by adding to the monthly discharge of Columbia River at Trail, from May, 1913, to June, 1923, the monthly discharges of Clark Fork at Metaline Falls, and Kettle River at Cascade or Boyds. The average of these two estimates for each month from May, 1913, to June, 1923, represent fairly well the monthly discharge at Kettle Falls for that period but comparison with monthly discharge computed from results given in the tables of daily discharge indicated that better estimates of monthly discharge could be obtained by the use of coefficients representing the relation between monthly discharges computed from daily results and those obtained by averaging the two estimates mentioned above. Accordingly average coefficients for each month of the year were derived and applied to the average of the two estimates to obtain the monthly discharges during the periods when records were lacking at Marcus or were considered unreliable. The monthly discharge for April, 1913, was determined from discharge of Columbia River at The Dalles, taking into account the flow of intervening tributaries.

32430—26†—WSP 572——6

COLUMBIA RIVER AT GRAND COULEE, NEAR NESPELEM, WASH.

LOCATION.—In NE. ¼ sec. 1, T. 28 N., R. 30 E., Okanogan County, opposite upper end of Grand Coulee, 14 miles above Nespelem River, 15 miles south of Nespelem, and 19½ miles below Sanpoil River.

DRAINAGE AREA.—74,100 square miles. (Areas in United States measured on maps issued by United States Geological Survey, scale 1:500,000. Areas in British Columbia measured on British Columbia sheet maps, Nelson sheet, scale 1:126,720; Department of Mines, West Kootenay sheet, scale 1:253,440; Department of the Interior railway belt map, scale 1: 500,000; and Department of Lands map, scale 1:1,125,000.)

RECORDS AVAILABLE.—June 17 to December 31, 1923. Monthly discharge April, 1913, to June, 1923, and January, 1924, computed from records at other gaging stations; see footnote to table of monthly discharge.

GAGE.—Vertical staff in four sections on right bank opposite upper end of Grand Coulee; referred to mean sea level datum; read by S. J. Seaton.

DISCHARGE MEASUREMENTS.—None made; see "Accuracy."

CHANNEL AND CONTROL.—Bed composed of gravel and boulders, no well-defined control; permanent except at extremely high stage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period June 17 to December 31, 1923, 979.5 feet on June 17 (discharge, 395,000 second-feet); minimum stage, 937.4 feet on December 25 (discharge, 25,800 second-feet).

1913–1924: Maximum discharge, determined from records at other gaging stations, 492,000 second-feet, June 15, 1913; minimum discharge, about 20,000 second-feet, occurred during December, 1919, and January, 1924.

Maximum discharge during flood of June, 1894, estimated at 760,000 second-feet.

ICE.—Stage-discharge relation affected by ice except during mild winters.

DIVERSIONS.—Considerable water diverted above gaging station for irrigation, but amount small in comparison to flow past gage.

REGULATION.—Some regulation above gaging station for power; effect on flow of little consequence.

ACCURACY.—Stage-discharge relation well defined between 25,000 and 400,000 second-feet by comparing mean gage heights for periods varying from two to ten days with mean discharge of Columbia River at Kettle Falls and Spokane River below Little Falls for like periods, taking into account time intervals and by estimating discharge of other intervening drainage area from records on Colville and Sanpoil rivers and on Hall and Stranger creeks. Gage read to nearest tenth twice daily. Results excellent June to December, 1923, and good for period during which monthly discharge was estimated.

Daily discharge, in second-feet, of Columbia River at Grand Coulee, near Nespelem, Wash., for the period June 17 to Dec. 31, 1923

Day	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		333,000	194,000	116,000	62,000	39,000	30,600
2		332,000	189,000	115,000	59,600	38,500	29,600
3		329,000	183,000	114,000	58,400	37,000	29,200
4		321,000	176,000	113,000	57,800	36,500	28,800
5		319,000	169,000	113,000	56,000	36,000	28,800
6		315,000	161,000	112,000	54,300	36,000	30,100
7		311,000	154,000	112,000	53,800	35,500	29,600
8		305,000	146,000	110,000	52,100	35,500	31,000
9		299,000	142,000	106,000	51,600	35,500	31,000
10		293,000	137,000	103,000	51,000	34,600	31,000
11		281,000	132,000	102,000	49,400	34,200	31,000
12		274,000	129,000	101,000	48,800	33,200	30,100
13		267,000	126,000	99,400	48,200	32,800	28,800
14		262,000	124,000	96,800	47,700	32,800	28,300
15		256,000	122,000	95,500	46,600	32,400	27,800
16		251,000	120,000	92,200	46,600	32,400	27,000
17	395,000	245,000	118,000	89,600	46,000	31,900	27,400
18		240,000	118,000	87,800	45,500	31,400	27,400
19		235,000	118,000	85,400	44,500	31,000	27,800
20		231,000	118,000	82,400	45,000	30,600	27,400
21		225,000	120,000	80,000	45,000	30,600	27,400
22		219,000	121,000	78,800	44,500	30,100	26,600
23		214,000	122,000	77,600	43,500	30,100	27,000
24		210,000	123,000	75,800	44,000	30,100	26,200
25		206,000	124,000	74,600	43,500	30,100	25,800
26		205,000	124,000	72,800	43,500	29,600	26,200
27	354,000	204,000	124,000	70,400	42,500	29,600	27,000
28	350,000	203,000	122,000	68,600	42,000	29,600	27,000
29	342,000	200,000	121,000	66,800	40,500	29,600	26,200
30	335,000	197,000	120,000	63,800	40,500	29,200	28,300
31		196,000	117,000		39,500		27,000

Monthly discharge of Columbia River at Grand Coulee, near Nespelem, Wash., for the period Apr. 1, 1913, to Jan. 31, 1924

[Drainage area, 74,100 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1913						
April	91,000	46,000	67,700	0.914	1.02	4,030,000
May	305,000	135,000	190,000	2.56	2.95	11,700,000
June	492,000	325,000	436,000	5.88	6.56	25,900,000
July	410,000	200,000	279,000	3.77	4.35	17,200,000
August	205,000	125,000	156,000	2.11	2.43	9,590,000
September	110,000	73,000	100,000	1.35	1.51	5,950,000
The period						70,300,000
1913-14						
October	73,000	56,000	61,800	.834	.96	3,800,000
November	55,000	48,500	51,700	.698	.78	3,080,000
December	47,000	32,500	38,500	.520	.60	2,370,000
January	38,500	33,500	36,200	.489	.56	2,230,000
February	39,500	32,000	34,700	.468	.49	1,930,000
March	58,000	41,000	48,300	.652	.75	2,970,000
April	145,000	53,000	99,600	1.34	1.50	5,930,000
May	280,000	140,000	220,000	2.97	3.42	13,500,000
June	300,000	270,000	293,000	3.95	4.41	17,400,000
July	270,000	185,000	252,000	3.40	3.92	15,500,000
August	180,000	98,000	132,000	1.78	2.05	8,120,000
September	95,000	62,000	76,900	1.04	1.16	4,580,000
The year	300,000	32,000	112,000	1.51	20.60	81,400,000

Monthly discharge of Columbia River at Grand Coulee, near Nespelem, Wash., for the period Apr. 1, 1913, to Jan. 31, 1924—Continued

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1914–15						
October	64,000	61,000	62,500	0.843	0.97	3,840,000
November	68,000	62,000	65,700	.887	.99	3,910,000
December	61,000	33,000	48,300	.652	.75	2,970,000
January	36,000	28,000	32,700	.441	.51	2,010,000
February	30,500	28,500	28,900	.390	.41	1,600,000
March	48,500	31,000	36,700	.495	.57	2,260,000
April	120,000	50,000	86,600	1.17	1.30	5,150,000
May	215,000	130,000	175,000	2.36	2.72	10,800,000
June	210,000	175,000	188,000	2.54	2.83	11,200,000
July	195,000	170,000	184,000	2.48	2.86	11,300,000
August	170,000	135,000	156,000	2.11	2.43	9,590,000
September	130,000	57,000	91,200	1.23	1.37	5,430,000
The year	215,000	28,000	96,800	1.31	17.71	70,100,000
1915–16						
October	60,000	47,000	50,800	.686	.79	3,120,000
November	51,000	46,500	49,000	.661	.74	2,920,000
December	44,500	33,500	39,600	.534	.62	2,430,000
January	36,000	----------	28,400	.383	.44	1,750,000
February	39,500	28,000	31,600	.426	.46	1,820,000
March	98,000	39,000	62,800	.848	.98	3,860,000
April	135,000	90,500	113,000	1.52	1.70	6,720,000
May	220,000	135,000	201,000	2.71	3.12	12,400,000
June	477,000	220,000	320,000	4.32	4.82	19,000,000
July	476,000	290,000	419,000	5.65	6.51	25,800,000
August	273,000	133,000	189,000	2.55	2.94	11,600,000
September	132,000	80,000	110,000	1.48	1.65	6,550,000
The year	477,000	----------	135,000	1.82	24.77	98,000,000
1916–17						
October	79,000	50,000	60,600	.818	.94	3,730,000
November	50,000	40,000	46,200	.623	.70	2,750,000
December	37,000	26,000	32,300	.436	.50	1,990,000
January	28,000	----------	26,200	.354	.41	1,610,000
February	27,500	23,000	26,000	.351	.37	1,440,000
March	29,000	23,000	25,400	.343	.40	1,560,000
April	85,000	32,000	55,900	.754	.84	3,330,000
May	330,000	88,000	183,000	2.47	2.85	11,300,000
June	400,000	330,000	368,000	4.97	5.54	21,900,000
July	355,000	230,000	313,000	4.22	4.86	19,200,000
August	218,000	116,000	149,000	2.01	2.32	9,160,000
September	115,000	64,000	80,900	1.09	1.22	4,810,000
The year	400,000	----------	114,000	1.54	20.95	82,800,000
1917–18						
October	70,000	50,000	61,000	.823	.95	3,750,000
November	50,000	35,500	40,300	.544	.61	2,400,000
December	74,000	35,000	41,800	.564	.65	2,570,000
January	100,000	62,000	83,800	1.13	1.30	5,150,000
February	60,000	42,500	52,100	.703	.73	2,890,000
March	49,000	41,000	45,600	.615	.71	2,800,000
April	125,000	54,000	92,600	1.25	1.40	5,510,000
May	245,000	125,000	209,000	2.82	3.25	12,900,000
June	405,000	190,000	307,000	4.14	4.62	18,300,000
July	357,000	182,000	256,000	3.45	3.98	15,700,000
August	177,000	100,000	136,000	1.84	2.12	8,360,000
September	100,000	86,000	90,400	1.22	1.36	5,380,000
The year	405,000	35,000	118,000	1.59	21.68	85,700,000
1918–19						
October	76,000	56,000	64,800	.874	1.01	3,980,000
November	56,000	40,000	47,600	.642	.72	2,830,000
December	40,500	34,500	37,800	.510	.59	2,320,000
January	49,500	23,000	35,500	.479	.55	2,180,000
February	52,000	36,000	43,400	.586	.61	2,410,000
March	45,000	40,000	42,600	.575	.66	2,620,000
April	135,000	52,000	88,300	1.19	1.33	5,250,000
May	325,000	130,000	204,000	2.75	3.17	12,500,000
June	320,000	260,000	294,000	3.97	4.43	17,500,000
July	297,000	161,000	226,000	3.05	3.52	13,900,000
August	160,000	114,000	138,000	1.86	2.14	8,480,000
September	105,000	61,000	80,700	1.09	1.22	4,800,000
The year	325,000	23,000	109,000	1.47	19.95	78,800,000

Monthly discharge of Columbia River at Grand Coulee, near Nespelem, Wash., for the period Apr. 1, 1913, to Jan. 31, 1924—Continued

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1919–20						
October	79,500	34,000	46,400	0.626	0.72	2,850,000
November	34,000	27,500	30,300	.409	.46	1,800,000
December	29,000		23,200	.313	.36	1,430,000
January	26,000		23,400	.316	.36	1,440,000
February	27,500	23,000	25,400	.343	.37	1,460,000
March	32,500	26,000	29,200	.394	.45	1,800,000
April	57,000	34,000	43,900	.592	.66	2,610,000
May	200,000	58,000	140,000	1.89	2.18	8,610,000
June	300,000	170,000	237,000	3.20	3.57	14,100,000
July	335,000	260,000	315,000	4.25	4.90	19,400,000
August	255,000	125,000	177,000	2.39	2.76	10,900,000
September	123,000	84,000	90,700	1.22	1.36	5,400,000
The year	335,000		98,900	1.33	18.15	71,800,000
1920–21						
October	89,000	82,000	86,800	1.17	1.35	5,340,000
November	85,000	51,000	64,300	.868	.97	3,830,000
December	54,000	39,000	46,100	.622	.72	2,830,000
January	53,000	41,000	47,300	.638	.74	2,910,000
February	55,000	37,000	46,400	.626	.65	2,580,000
March	74,000	53,000	62,300	.841	.97	3,830,000
April	120,000	69,000	92,600	1.25	1.40	5,510,000
May	350,000	120,000	222,000	3.00	3.46	13,600,000
June	440,000	340,000	390,000	5.26	5.87	23,200,000
July	354,000	190,000	250,000	3.37	3.88	15,400,000
August	183,000	102,000	138,000	1.86	2.14	8,480,000
September	98,000	52,000	70,100	.946	1.06	4,170,000
The year	440,000	37,000	127,000	1.71	23.21	91,700,000
1921–22						
October	53,500	48,500	51,200	.691	.80	3,150,000
November	60,000	43,500	53,500	.720	.80	3,180,000
December	53,000	41,000	46,900	.633	.73	2,880,000
January	38,500	30,000	34,200	.462	.53	2,100,000
February	30,000	24,000	27,300	.368	.38	1,520,000
March	29,500	26,000	27,200	.367	.42	1,670,000
April	74,000	34,500	53,600	.723	.81	3,190,000
May	267,000	77,000	157,000	2.12	2.44	9,650,000
June	390,000	270,000	354,000	4.78	5.33	21,100,000
July	302,000	145,000	218,000	2.94	3.39	13,400,000
August	142,000	107,000	127,000	1.71	1.97	7,810,000
September	107,000	69,000	88,500	1.19	1.33	5,270,000
The year	390,000	24,000	103,000	1.39	18.93	74,900,000
1922–23						
October	67,000	44,500	54,700	.738	.85	3,360,000
November	46,000	31,500	39,200	.529	.59	2,330,000
December	32,500		26,300	.355	.41	1,620,000
January	41,000	33,000	38,300	.517	.60	2,360,000
February	31,000		26,300	.355	.37	1,460,000
March	31,500	26,000	28,300	.382	.44	1,740,000
April	110,000	38,500	74,300	1.00	1.12	4,420,000
May	265,000	112,000	189,000	2.55	2.94	11,600,000
June	395,000	255,000	342,000	4.62	5.16	20,400,000
July	333,000	196,000	257,000	3.47	4.00	15,800,000
August	194,000	117,000	136,000	1.84	2.12	8,360,000
September	116,000	63,800	92,500	1.25	1.40	5,500,000
The year	395,000		109,000	1.47	20.00	79,000,000
1923–24						
October	62,000	39,500	48,200	.650	.75	2,960,000
November	39,000	29,200	32,800	.443	.49	1,950,000
December	31,000	25,800	28,300	.382	.44	1,740,000
January	32,000		23,200	.313	.36	1,430,000

NOTE.—Monthly discharge April, 1913, to June, 1923, and January, 1924, determined from records at gaging stations on Columbia River at Kettle Falls, Spokane River below Little Falls, Colville River at Meyers Falls, Hall and Stranger creeks near Inchelium, and Sanpoil River at Keller. Intervening area, exclusive of that above these gaging stations, is only slightly over 1 per cent of the drainage area at Grand Coulee and the yield from it is smaller per unit of area than for the whole area.

Maximum and minimum were estimated by comparison with results at other gaging stations on Columbia River. As the flow of Columbia River is quite uniform, the estimated maximum and minimum are probably correct within 5 per cent for discharges above 100,000 second-feet and well within 10 per cent for discharges below 100,000 second-feet.

COLUMBIA RIVER AT VERNITA, WASH.

LOCATION.—In sec. 11, T. 13 N., R. 24 E., at Richmond Ferry, half a mile north of Vernita and 6 miles below Priest Rapids, Benton County.

DRAINAGE AREA.—95,500 square miles. (Areas in the United States measured on topographic maps and on maps issued by United States Geological Survey, scale 1:500,000. Areas in British Columbia measured on Department of the Interior railway belt maps, scale 1:500,000; Department of Mines, West Kootenai sheet, scale 1:253,440; and Department of Lands map, scale 1:1,125,000.)

RECORDS AVAILABLE.—Flood heights only, at Wenatchee, 1894 to 1903; continuous gage-height record at Wenatchee, April 18, 1904, to December 31, 1916; at Beverly January 1–13, 1917; at Vernita January 14, 1917, to September 30, 1923. Gage-height record at Wenatchee published by United States Weather Bureau.

GAGE.—Since March 25, 1918, vertical staff gage in eight sections, on right bank at ferry; read by J. P. Richmond. For description of previous gages see Water-Supply Paper 512. All the gage readings at Vernita refer to same datum, 388.7 feet above sea level. Gages at Wenatchee read by Weather Bureau observers.

DISCHARGE MEASUREMENTS.—Made from standard gaging car on ferry cable at Vernita, or, when ice conditions are severe, from railroad bridge at Beverly.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders. High-water control Coyote Rapids 6 or 7 miles below gage; low-water control riffle noticeable at low stages, about three-fourths mile below gage; apparently permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 29.0 feet June 19 (discharge, 429,000 second-feet); minimum discharge estimated at 25,700 second-feet for February 14–16, while stage-discharge relation was affected by ice.

1913–1923: Maximum stage recorded, 45.7 feet at Wenatchee June 15 and 16, 1913 (discharge, 528,000 second-feet); minimum discharge, 23,900 second-feet (current-meter measurements) January 31, 1917, and December 14, 1919, when stage-discharge relation was affected by ice.

Maximum stage recorded at Wenatchee by United States Weather Bureau and Great Northern Railway Co., 58.0 feet June 7, 1894 (estimated discharge by extending rating curve 710,000 second-feet). The Chief of Engineers, United States Army,[4] gives a crest elevation of the flood of 1894 and an elevation of zero on the Weather Bureau gage, from which it appears that the gage height was 59.8 feet (estimated discharge, by extending rating curve, 740,000 second-feet).

ICE.—Stage-discharge relation affected by ice except during mild winters. Flow estimated from gage-height record, discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Some water diverted for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 7–24 and January 31 to February 21. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records excellent except for periods of ice effect.

[4] Chief Eng. U. S. Army Rept., 1895, pt. 5, p. 3542.

Discharge measurements of Columbia River at Vernita, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 1-2	R. B. Kilgore	4.04	50,900	Feb. 21	R. B. Kilgore	[a] 0.30	27,400
Feb. 6	do	[a] 1.62	33,800	July 19	do	21.26	255,000
8	do	[a] 1.55	33,800	Aug. 19	J. S. Gatewood	12.19	128,000
19	do	[a] .16	26,400				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Columbia River at Vernita, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	76,600	50,500	37,500	35,100		30,500	40,000	128,000	292,000	377,000	206,000	125,000
2	74,000	50,500	36,900	35,100		31,000	41,900	131,000	292,000	373,000	202,000	124,000
3	73,100	50,500	36,300	36,300		30,500	46,400	132,000	294,000	370,000	199,000	123,000
4	71,400	50,500	36,300	36,900		30,500	49,100	132,000	298,000	366,000	193,000	120,000
5	71,400	50,500	35,700	37,500		31,000	54,200	133,000	311,000	357,000	187,000	119,000
6	70,600	50,500	35,100	36,900	33,500	30,500	58,600	137,000	317,000	352,000	179,000	119,000
7	69,700	49,800		41,400		31,000	62,900	140,000	328,000	348,000	172,000	119,000
8	69,700	49,100		45,800		31,600	61,300	144,000	339,000	343,000	165,000	118,000
9	68,800	49,100		45,200		31,600	65,400	153,000	345,000	337,000	160,000	117,000
10	68,000	49,100		51,200		31,600	65,400	165,000	364,000	330,000	153,000	114,000
11	68,000	47,800	31,000	48,400		31,600	64,600	175,000	373,000	323,000	148,000	111,000
12	67,200	47,800		48,400		31,600	65,400	187,000	382,000	315,000	143,000	108,000
13	65,400	46,400		48,400		31,600	67,200	193,000	391,000	302,000	139,000	107,000
14	64,600	45,800		49,100		31,600	68,800	200,000	403,000	296,000	136,000	104,000
15	62,900	45,200		49,100		31,000	70,600	205,000	410,000	288,000	133,000	101,000
16	61,300	44,500		48,400	27,500	30,500	74,800	214,000	415,000	282,000	131,000	98,700
17	59,700	44,500		47,800		30,500	76,600	221,000	419,000	274,000	128,000	96,800
18	58,100	43,800		47,800		31,600	80,200	226,000	424,000	267,000	127,000	94,900
19	57,300	42,600		47,800		31,600	83,800	231,000	429,000	261,000	126,000	92,000
20	56,500	41,900	28,500	47,100		30,500	91,100	236,000	415,000	254,000	126,000	90,200
21	55,000	41,200		46,400		31,600	98,700	241,000	407,000	248,000	126,000	87,400
22	53,400	40,600		45,800	28,300	32,700	102,000	246,000	410,000	243,000	127,000	85,600
23	52,700	40,600		45,200	29,400	31,600	102,000	254,000	407,000	238,000	130,000	83,800
24	52,000	40,600		45,200	29,400	31,600	103,000	261,000	405,000	231,000	131,000	82,000
25	51,200	40,000	30,500	44,500	30,000	31,600	105,000	268,000	405,000	227,000	131,000	80,200
26	50,500	40,000	32,700	43,800	30,000	32,200	106,000	274,000	403,000	221,000	132,000	79,300
27	50,500	39,300	32,200	43,800	30,000	32,700	109,000	280,000	398,000	218,000	132,000	77,500
28	49,800	38,700	31,600	43,200	31,000	33,900	113,000	286,000	391,000	216,000	131,000	74,800
29	50,500	37,500	32,700	42,600		35,100	118,000	290,000	389,000	214,000	131,000	73,100
30	50,500	37,500	33,300	41,900		36,300	124,000	290,000	382,000	211,000	130,000	71,400
31	50,500		33,900	40,000		38,100		290,000		208,000	126,000	

NOTE.—Gage not read Jan. 7 and Apr. 6; discharge estimated by interpolation. Braced figures show mean discharge for periods indicated.

Monthly discharge of Columbia River at Vernita, Wash., for the year ending Sept. 30, 1923

[Drainage area, 95,500 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	76,600	49,800	61,300	0.642	0.74	3,770,000
November	50,500	37,500	44,900	.470	.52	2,670,000
December	37,500		31,600	.331	.38	1,940,000
January	51,200	35,100	44,100	.462	.53	2,710,000
February			30,200	.316	.33	1,680,000
March	38,100	30,500	31,900	.334	.39	1,960,000
April	124,000	40,000	79,000	.827	.92	4,700,000
May	290,000	128,000	208,000	2.18	2.51	12,800,000
June	429,000	292,000	375,000	3.93	4.38	22,300,000
July	377,000	208,000	287,000	3.01	3.47	17,600,000
August	206,000	126,000	148,000	1.55	1.79	9,100,000
September	125,000	71,400	99,900	1.05	1.17	5,940,000
The year	429,000		120,000	1.26	17.13	87,200,000

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, Lincoln County.

DRAINAGE AREA.—11,000 square miles.

RECORDS AVAILABLE.—October 13, 1910, to September 30, 1923.

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

DISCHARGE MEASUREMENTS.—Made from highway bridge.

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

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 13.67 feet June 14 (discharge, 71,300 second-feet); minimum stage, 1.64 feet February 3 (discharge, 1,880 second-feet).

1910–1923: Maximum stage, 19.17 feet June 21, 1916 (discharge, 130,000 second-feet); minimum stage, 1.4 feet February 7, 1914 (discharge, 1,480 second-feet).

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

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except when affected by ice. Rating curve well defined from 2,500 to 40,000 second-feet and fairly well defined above 40,000 second-feet. Gage usually read to hundredths once daily except Sunday with occasional readings during winter. Daily discharge ascertained by applying daily gage height to rating table. Discharge interpolated for days of no gage readings. Records good.

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

Discharge measurements of Kootenai River at Libby, Mont., during the year ending Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
Oct. 22	2.59	3,460
Dec. 27	3.37	* 3,730

* Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Kootenai River at Libby, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4,640	5,170	2,840	------	2,210	3,000	5,500	16,300	41,300	37,300	12,400	7,560
2	4,640	4,910	2,760	------	1,960	2,960	6,280	15,400	46,400	36,600	11,800	7,480
3	4,640	4,720	2,720	------	1,880	2,900	5,970	13,800	49,500	33,800	11,100	7,400
4	4,690	4,320	2,680	3,880	2,010	2,860	5,730	13,200	52,600	31,800	10,600	7,330
5	4,800	4,100	------	------	2,140	2,820	5,610	12,500	45,600	29,800	10,200	7,190
6	4,750	3,880	------	------	2,440	2,780	5,460	14,800	46,400	26,300	9,880	7,010
7	4,690	3,780	------	------	2,550	2,820	5,170	17,100	49,700	26,200	9,730	6,910
8	4,610	3,780	------	------	------	2,860	4,960	20,000	53,500	26,100	9,580	6,720
9	4,530	3,710	------	------	------	2,820	4,750	24,000	55,900	26,000	9,500	6,530
10	4,530	3,880	------	------	------	2,760	4,860	28,300	60,300	23,900	9,500	6,340
11	4,430	3,690	------	------	------	2,690	5,310	31,400	64,700	21,700	9,480	6,250
12	4,370	3,600	------	------	------	2,620	5,430	31,500	69,700	20,700	9,450	6,220
13	4,270	3,510	------	------	------	2,610	5,550	31,500	70,700	20,600	9,430	6,160
14	4,170	3,480	------	------	------	2,570	6,220	31,500	71,300	20,200	9,140	5,850
15	4,080	3,220	------	------	------	2,550	7,430	29,800	66,600	19,800	8,990	5,720
16	4,000	3,270	------	------	------	2,510	8,640	27,400	63,800	19,400	8,890	5,590
17	4,000	3,310	------	3,880	------	2,610	12,900	25,000	53,900	19,200	8,780	5,460
18	3,970	3,330	------	------	------	2,620	13,200	24,300	44,000	19,100	8,870	5,340
19	3,920	3,440	------	------	------	2,620	13,800	25,000	41,200	18,300	8,970	5,210
20	3,880	3,550	------	------	------	2,780	14,200	26,200	38,800	17,100	9,060	5,080
21	3,850	3,460	------	------	------	2,800	13,200	27,400	39,500	16,600	9,140	5,050
22	3,770	3,290	------	------	------	2,760	11,600	31,600	41,100	16,000	9,500	5,190
23	3,690	3,250	------	------	------	2,740	10,000	37,400	42,700	15,500	9,280	5,320
24	3,730	3,250	------	------	------	2,780	9,500	41,200	44,200	15,300	9,140	5,460
25	3,730	3,220	------	2,900	------	2,800	9,950	40,300	45,600	15,300	8,840	5,520
26	3,880	3,150	------	------	------	2,820	10,400	40,400	44,800	15,200	8,540	5,020
27	4,400	3,080	3,730	------	------	2,940	11,600	40,700	41,300	15,100	8,230	4,750
28	4,690	3,040	------	------	------	3,310	13,600	41,000	40,200	14,500	8,200	4,690
29	5,210	2,920	------	2,900	------	3,800	16,000	34,300	39,500	13,800	8,090	4,690
30	5,790	2,880	------	2,550	------	4,450	18,400	31,600	38,800	13,200	7,760	4,690
31	5,880	------	------	2,320	------	4,720	------	29,000	------	12,900	7,630	------

NOTE.—Discharge interpolated for following days when gage was not read: Oct. 1, 8, 15, 29, Nov. 5, 12, 19, 26, 30, Dec. 3, Feb. 4, Mar. 4, 11, 18, 25, Apr. 1, 8, 15, 22, 29, May 4, 6, 13, 16, 20, 27, 30, June 3, 10, 17, 21, 24, 30, July 1, 4, 8, 14, 15, 21, 22, 28, 29, Aug. 4, 5, 11, 12, 18, 19, 25, 26, Sept. 1–3, 8, 9, 15–19, 22, 23, 30. Discharge not computed for days affected by ice.

Monthly discharge of Kootenai River near Libby, Mont., for the year ending Sept. 30, 1923

[Drainage area, 11,000 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	5,880	3,690	4,400	0.400	0.46	271,000
November	5,170	2,880	3,610	.328	.37	215,000
March	4,720	2,510	2,930	.266	.31	180,000
April	18,400	4,750	9,040	.822	.92	538,000
May	41,200	12,500	27,500	2.50	2.88	1,690,000
June	71,300	38,800	50,100	4.55	5.08	2,980,000
July	37,300	12,900	21,200	1.93	2.22	1,300,000
August	12,400	7,630	9,350	.850	.98	575,000
September	7,560	4,690	5,920	.538	.60	352,000

GRAVE CREEK NEAR FORTINE, MONT.

LOCATION.—In SW ¼ sec. 5, T. 35 N., R. 25 W., 6 miles northeast of Fortine, Lincoln County, and 12 miles southeast of Eureka.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 16, 1923, to September 30, 1923.

GAGE.—Overhanging weight and wire gage nailed to trees on right bank 1½ miles above ranger station; read by William Marston.

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

CHANNEL AND CONTROL.—Bed of stream at gage composed of boulders and cobblestones and probably forms a permanent control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period April 16 to September 30, 3.00 feet June 11 (discharge, 690 second-feet); minimum stage, 1.08 feet September 29 and 30 (discharge, 45 second-feet).

DIVERSIONS.—None above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 30 and 500 second-feet. Gage read to hundredths usually once a day. Occasionally twice during fluctuating stages. Daily discharge ascertained by applying daily gage heights to rating table. Records good.

COOPERATION.—Maintained in cooperation with Eureka Hydro-Electric Co.

Discharge measurements of Grave Creek near Fortine, Mont., during the period Apr. 16 to Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
Apr. 16	1.19	62
June 17	2.42	455
July 26	1.40	108

Daily discharge, in second-feet, of Grave Creek near Fortine, Mont., for the period Apr. 16 to Sept. 30, 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1	------	148	486	318	108	62	16	65	333	494	168	77	51
2	------	121	466	311	103	58	17	65	371	447	162	77	51
3	------	96	486	303	99	58	18	75	390	424	162	77	51
4	------	96	466	303	94	55	19	96	466	443	162	73	51
5	------	75	486	303	94	55	20	108	546	424	151	73	51
6	------	134	486	303	94	55	21	96	526	424	145	73	51
7	------	192	526	311	90	55	22	75	566	413	134	69	51
8	------	224	546	274	90	55	23	75	526	409	129	69	48
9	------	259	586	231	90	55	24	65	486	394	129	69	48
10	------	371	607	198	90	55	25	85	526	371	124	69	48
11	------	409	690	205	85	55	26	96	526	356	113	69	48
12	------	428	669	186	85	55	27	121	526	348	113	69	48
13	------	371	628	174	81	51	28	134	546	348	108	69	48
14	------	333	546	174	81	51	29	134	526	341	108	65	45
15	------	333	494	168	77	51	30	148	447	341	103	65	45
							31	------	486	------	103	62	------

Monthly discharge of Grave Creek near Fortine, Mont., for the period Apr. 16 to Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
April 16–30	148	65	95.9	2,850
May	566	75	367	22,600
June	690	341	472	28,100
July	318	103	190	11,700
August	108	62	80.2	4,930
September	62	45	52.0	3,090
The period				73,000

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, Bonner County, 3½ miles below Round Prairie, and 12 miles above mouth.

DRAINAGE AREA.—717 square miles. (Area in United States measured on map issued by United States Geological Survey scale 1: 250,000; area in British Columbia measured on Cranbrook sheet, British Columbia map.)

RECORDS AVAILABLE.—February 21, 1912, to September 30, 1916, and March 1, 1919, to September 30, 1923, when records were discontinued at present site; March 10, 1911, to February 20, 1912, at railway bridge, 1 mile downstream.

GAGE.—Vertical staff and inclined staff on left bank, 150 feet west of Snyder ranger station; installed October 21, 1919; read by W. O. Blackman and H. Ludington. For description of previous gages see Water-Supply Paper 512.

DISCHARGE MEASUREMENTS.—Made by wading or from cable near gage. High-water measurements formerly made 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. Stage of zero flow determined September 29, 1922, gage height, 1.9 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.3 feet at 6 p. m. June 1 (discharge, 5,860 second-feet); minimum discharge occurred during winter when stage-discharge relation was affected by ice.

1911–1916; 1919–1923: Maximum stage recorded, 11.0 feet at 4 p. m. June 19, 1916 (discharge, 10,800 second-feet); minimum stage recorded, 2.80 feet October 25 and 26, 1919 (discharge, 56 second-feet). Discharge probably lower in December, 1919, January, February, and December, 1922, and February, 1923, when stage-discharge relation was affected by ice.

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

ACCURACY.—Stage-discharge relation permanent; affected by ice December 5–27 and January 31 to February 24. Rating curve well defined below 4,500 second-feet. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good except for period when stage-discharge relation was affected by ice.

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

Daily discharge, in second-feet, of Moyie River at Snyder, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	72	167	106	164		142	498	2,010	5,180	1,290	274	131
2	72	154	122	151		117	589	1,680	5,520	1,290	270	128
3	72	148	122	161		114	622	1,580	4,710	1,070	249	125
4	88	145	98	149		125	589	1,580	3,900	990	240	125
5	109	140		137		142	688	1,680	3,900	950	232	125
6	109	131		154		142	589	2,130	3,900	910	224	125
7	103	131		167		142	498	2,500	4,050	950	213	122
8	98	134		180		137	468	3,030	4,050	950	206	120
9	98	131		232		114	498	3,600	4,050	950	202	109
10	98	128	70	283		140	558	4,050	3,900	950	194	109
11	98	125		249		134	688	4,050	3,750	870	191	109
12	96	125		217	100	125	1,030	3,900	3,750	794	191	109
13	96	125		198		125	1,120	3,900	3,900	654	191	103
14	93	125		180		117	1,070	3,900	3,030	622	194	103
15	96	125		184		117	1,120	3,450	2,630	589	191	101
16	96	131		170		140	1,290	3,310	2,500	558	170	98
17	93	131		180		120	1,680	3,310	2,250	558	170	98
18	93	137		191		134	2,250	3,310	2,010	558	167	93
19	91	137		194		140	2,010	3,310	1,900	527	167	93
20	106	137		183		140	1,790	3,750	1,790	498	164	91
21	109	125	140	172		131	1,480	3,750	1,900	440	164	98
22	103	109		161		125	1,200	3,900	2,010	440	161	98
23	101	109		161		125	1,200	4,200	2,010	412	161	97
24	106	125		122		109	1,200	4,050	1,900	359	161	97
25	131	125		157	142	128	1,290	3,900	1,900	359	157	96
26	278	109		154	137	137	1,580	4,050	1,900	334	154	96
27	278	103		148	137	151	2,010	3,900	1,680	306	154	96
28	194	122	240	142	134	180	2,130	3,450	1,580	288	148	95
29	167	122	228	131	-------	209	2,370	3,030	1,480	292	137	94
30	167	122	191	98	-------	292	2,130	2,890	1,380	292	134	93
31	174	-------	174	90	-------	440	-------	4,050	-------	283	131	-------

NOTE.—Gage not read Nov. 29, Jan. 4, 9, 17, 20, 21, June 3, Sept. 22–25, and 27–30: discharge estimated by interpolation. Braced figures are estimates for period indicated.

Monthly discharge of Moyie River at Snyder, Idaho, for the year ending Sept. 30, 1923

[Drainage area, 717 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	278	72	119	0.166	0.19	7,320
November	167	103	129	.180	.20	7,680
December	-------	-------	120	.167	.19	7,380
January	283	90	170	.237	.27	10,500
February	-------	-------	105	.146	.15	5,830
March	440	109	149	.208	.24	9,160
April	2,370	468	1,210	1.69	1.89	72,000
May	4,200	1,580	3,260	4.55	5.25	200,000
June	5,520	1,380	2,950	4.11	4.59	176,000
July	1,290	283	656	.915	1.05	40,300
August	274	131	186	.259	.30	11,400
September	131	91	106	.148	.17	6,310
The year	5,520	-------	765	1.07	14.49	554,000

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, Mineral County, half a mile below mouth of St. Regis River.

DRAINAGE AREA.—10,500 square miles.

RECORDS AVAILABLE.—October 26, 1910, to September 30, 1923, when station was discontinued.

GAGE.—Vertical staff in two sections on left bank at old ferry landing; read once daily by Archie McLeod and H. M. Miller.

DISCHARGE MEASUREMENTS.—Made from highway bridge above mouth of St. Regis River since 1918. Flow of St. Regis River added to obtain flow passing gage.

CHANNEL AND CONTROL. Bed permanent both above and below station. Banks are high and not subject to overflow. Control is not sharply defined, being formed by the bed of stream for a distance of several hundred feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage reported during year, 13.8 feet June 12 (discharge, 33,100 second-feet); minimum stage, 3.4 feet December 7 and 8 (discharge, 1,680 second-feet).

1910–1923: Maximum stage recorded, 19.1 feet May 30–31, 1913 (discharge, 62,800 second-feet); minimum stage, 3.0 feet February 29, March 1, 1920, November 21, 1921, and February 5, 1922 (discharge, 1,330 second-feet).

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

DIVERSIONS.—Water diverted from several of the tributaries to irrigate land in Bitterroot Valley and near Missoula.

REGULATION.—Practically none.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 2,000 and 60,000 second-feet. Gage read to tenths once daily. Daily discharge determined by applying daily gage height to rating table except February 18–21 when discharge was interpolated. Records good.

No discharge measurements made during the year.

Daily discharge, in second-feet, of Clark Fork at St. Regis, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.
1	2,720	2,620	2,790	3,010	2,220	3,160	7,960	12,600	21,000	15,900	4,820	3,160
2	2,720	2,620	2,830	3,160	1,990	3,160	8,950	13,500	21,400	15,200	4,720	3,010
3	2,720	2,660	2,720	3,160	1,990	3,010	8,200	9,970	21,400	14,800	4,620	3,010
4	2,750	2,660	2,720	3,010	2,220	3,010	7,720	12,900	21,000	14,200	4,620	2,940
5	2,750	2,720	2,660	3,010	2,460	3,010	7,720	13,500	21,000	13,800	4,420	2,940
6	2,720	2,720	2,590	2,860	2,340	3,010	7,240	19,500	23,000	13,200	4,420	2,860
7	2,720	2,790	1,680	3,320	2,340	3,010	7,000	20,600	23,800	12,900	4,320	2,860
8	2,660	2,860	1,680	4,230	2,340	3,010	6,230	21,400	24,600	12,600	4,230	2,860
9	2,660	2,860	1,780	4,230	2,340	2,860	6,340	21,000	29,300	12,000	4,040	2,790
10	2,620	2,860	2,100	4,140	2,340	2,860	6,560	21,000	30,700	12,000	3,850	2,790
11	2,620	2,860	2,220	3,850	2,340	3,010	6,780	20,600	32,600	10,800	3,850	2,720
12	2,620	2,860	2,340	3,670	2,340	3,160	6,890	19,900	33,100	9,700	3,850	2,590
13	2,620	2,860	2,460	3,580	2,220	3,160	7,360	19,500	31,600	8,700	3,850	2,590
14	2,620	2,890	2,460	3,490	1,990	2,860	7,480	19,500	30,700	8,450	3,760	2,520
15	2,590	2,940	2,340	3,490	1,990	2,860	8,200	21,000	30,200	8,950	3,760	2,460
16	2,520	2,940	2,340	3,400	2,100	3,160	8,700	19,500	28,000	8,950	3,670	2,460
17	2,490	2,940	2,460	3,160	2,220	3,010	9,970	19,500	27,200	8,700	3,580	2,460
18	2,590	2,940	2,460	3,160	2,510	2,860	12,600	19,900	26,700	8,450	3,490	2,460
19	2,590	3,010	2,590	3,320	2,800	3,010	13,500	19,500	25,000	8,200	3,320	2,400
20	2,620	3,010	2,720	3,320	3,090	3,010	13,800	20,300	22,600	7,960	3,400	2,340
21	2,620	2,940	2,720	3,320	3,380	3,010	13,800	20,600	21,000	7,720	3,670	2,340
22	2,590	2,940	2,720	3,320	3,670	3,160	12,600	21,000	19,200	7,240	3,670	2,340
23	2,590	2,940	2,720	2,860	3,160	3,320	10,800	23,400	18,800	6,560	3,490	2,340
24	2,590	2,860	3,010	2,720	3,160	3,490	9,700	26,300	16,600	6,340	3,320	2,460
25	2,590	2,860	3,160	2,720	3,010	3,490	9,700	29,300	16,200	6,120	3,320	2,460
26	2,620	2,720	3,490	2,720	3,010	4,230	9,970	30,200	15,900	6,120	3,320	2,460
27	2,620	2,720	3,670	2,720	3,160	5,030	10,500	30,200	15,900	6,340	3,320	2,460
28	2,590	2,720	3,490	2,720	3,160	5,900	10,800	28,400	15,600	6,120	3,320	2,590
29	2,620	2,790	3,160	2,590	-------	6,780	13,800	26,300	15,900	5,680	3,320	2,720
30	2,620	2,790	3,010	2,590	-------	7,240	13,800	21,800	15,600	5,460	3,160	2,790
31	2,620	-------	3,160	2,220	-------	7,240	-------	21,400	-------	5,030	3,160	-------

NOTE.—Stage-discharge relation affected by ice Feb. 18–21; discharge interpolated.

Monthly discharge of Clark Fork at St. Regis, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	2,750	2,490	2,630	162,000
November	3,010	2,620	2,830	168,000
December	3,670	1,680	2,650	163,000
January	4,230	2,220	3,200	197,000
February	3,670	1,990	2,570	143,000
March	7,240	2,860	3,650	224,000
April	13,800	6,230	9,490	565,000
May	30,200	9,970	20,800	1,280,000
June	33,100	15,600	23,200	1,380,000
July	15,900	5,030	9,490	584,000
August	4,820	3,160	3,800	234,000
September	3,160	2,340	2,640	157,000
The year	33,100	1,680	7,260	5,260,000

CLARK FORK NEAR PLAINS, MONT.

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

DRAINAGE AREA.—19,900 square miles.

RECORDS AVAILABLE.—October 28, 1910, to September 30, 1923.

GAGE.—Barratt & Lawrence water-stage recorder; inspected by A. L. Steiner.

DISCHARGE MEASUREMENTS.—Made from cable.

CHANNEL AND CONTROL.—River deep and current only moderately swift even at flood stages. Banks high and are not overflowed. Bed practically permanent. No well-defined control.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.5 feet at noon June 14 (discharge, 96,500 second-feet); minimum flow, December 9 (stage-discharge relation affected by ice; discharge computed 4,900 second-feet).

1910–1923: Maximum stage recorded, 17.9 feet June 5, 1913, and July 2, 1916 (discharge, 115,000 second-feet); minimum open-water stage, 3.7 feet several times during October and November, 1919 (discharge, 4,890 second-feet); lower flow probably occurred during ice periods.

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

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

REGULATION.—Flathead Lake furnishes a natural but uncontrolled regulation for part of flow.

ACCURACY.—Stage-discharge relation permanent during year except when affected by ice. Rating curve used during the open-channel flow is fairly well defined below 90,000 second-feet. Daily gage heights obtained by inspection of graph of Barratt & Lawrence gage. Daily discharge for open channel ascertained by applying mean daily gage height to rating table, except May 21–26, when discharge was interpolated. Record for open water good; others fair.

No discharge measurements made during the year.

Daily discharge, in second-feet, of Clark Fork near Plains, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7,120	6,490	6,340	6,000	6,490	6,390	11,400	24,300	67,700	58,300	18,800	10,500
2	7,120	6,490	6,340	6,150	6,490	6,390	11,800	24,300	67,700	56,300	18,800	10,100
3	7,280	6,640	6,340	6,100	6,340	6,220	12,200	24,900	67,700	53,300	17,800	10,100
4	7,280	6,800	6,340	6,050	6,490	6,220	11,400	25,500	67,700	51,300	17,200	9,670
5	7,120	6,800	6,200	6,050	6,490	6,180	10,900	25,500	66,600	50,400	17,200	9,670
6	7,120	6,640	6,060	5,950	6,250	6,180	10,500	26,200	67,700	47,500	16,800	9,270
7	7,120	6,640	6,060	6,350	6,150	6,150	10,900	30,200	68,800	45,600	16,800	8,880
8	7,120	6,640	5,500	7,120	6,050	6,150	10,500	33,800	71,900	44,700	15,800	8,880
9	7,120	6,490	4,900	7,120	5,950	5,980	10,300	38,600	76,100	43,800	15,800	8,880
10	7,120	6,640	5,100	7,450	5,850	6,070	10,300	42,900	78,200	40,300	15,400	8,880
11	7,120	6,800	5,200	7,450	5,750	6,230	10,500	47,500	83,400	38,600	14,900	8,500
12	7,120	6,640	5,350	7,450	5,750	6,490	10,500	48,400	88,800	37,800	14,400	8,500
13	7,120	6,640	5,500	7,280	5,650	6,340	10,500	48,400	92,100	36,200	14,400	8,140
14	7,120	6,490	5,350	7,120	5,650	6,340	11,400	49,400	94,300	34,600	14,000	8,140
15	7,120	6,490	5,250	6,800	5,650	6,340	11,400	49,400	89,900	33,000	13,600	7,790
16	7,120	6,340	5,250	6,640	5,550	6,340	12,200	50,400	81,400	32,300	13,100	7,790
17	7,120	6,340	5,450	6,800	5,350	6,340	14,000	51,300	78,200	30,800	12,700	7,790
18	7,120	6,490	5,600	6,960	5,650	6,340	15,800	52,300	77,200	30,200	12,200	7,790
19	7,120	6,640	5,700	7,120	5,930	6,340	17,800	51,300	75,000	29,400	12,200	7,790
20	6,960	6,640	5,900	7,120	6,220	6,340	18,200	51,300	71,900	28,100	12,200	7,450
21	6,960	6,640	5,900	7,120	6,520	6,340	18,800	57,800	70,800	26,800	11,800	7,450
22	6,960	6,640	6,000	7,120	6,810	6,490	18,800	58,400	69,800	26,200	12,200	7,450
23	6,960	6,490	6,000	7,120	6,280	6,640	18,200	61,900	68,800	25,500	11,800	7,450
24	6,800	6,490	6,300	6,960	6,280	6,640	17,800	65,500	68,800	24,900	11,400	7,450
25	6,800	6,490	6,400	6,960	6,110	6,800	17,800	69,000	68,800	23,700	11,400	7,450
26	6,800	6,490	6,650	6,800	6,050	6,800	17,800	72,600	65,600	23,200	11,400	7,450
27	6,640	6,490	6,700	6,800	6,170	7,120	19,800	76,100	62,400	22,600	11,400	7,450
28	6,490	6,490	6,400	6,800	6,170	7,620	22,000	77,200	65,600	22,000	10,900	7,120
29	6,340	6,490	6,000	6,800	-------	7,620	22,000	73,000	64,600	21,500	10,500	7,120
30	6,340	6,340	5,850	6,490	-------	9,880	23,200	69,800	61,400	20,400	10,500	6,800
31	6,490	-------	5,950	6,490	-------	10,900	-------	68,800	-------	18,800	10,500	-------

NOTE.—Stage-discharge relation affected by ice Dec. 8 to Jan. 7, and Feb. 6 to Mar. 11, discharge obtained by combining flow of Flathead River near Polson with that of Clark Fork at St. Regis. Discharge interpolated May 21–26 on account of missing gage heights, water-stage recorder not operating properly.

Monthly discharge of Clark Fork near Plains, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	7,280	6,340	6,970	429,000
November	6,800	6,340	6,560	390,000
December	6,700	4,900	5,870	361,000
January	7,450	5,950	6,790	418,000
February	6,810	5,350	6,070	337,000
March	10,900	5,980	6,720	413,000
April	23,200	10,300	14,600	869,000
May	77,200	24,300	49,900	3,070,000
June	94,300	61,400	73,300	4,360,000
July	58,300	18,800	34,800	2,140,000
August	18,800	10,500	13,800	848,000
September	10,500	6,800	8,260	492,000
The year	94,300	4,900	19,500	14,100,000

PEND OREILLE LAKE AT HOPE, IDAHO

LOCATION.—In lot 2, sec. 35, T. 57 N., R. 1 E. Boise meridian, at floating dock near Northern Pacific Railway station at Hope, Bonner County.

DRAINAGE AREA.—22,900 square miles. (Areas in United States measured on maps issued by United States Geological Survey, scale 1: 500,000; area of Flathead River basin in British Columbia measured on Department of Lands map, scale 1: 1,125,000.)

RECORDS AVAILABLE.—September 17, 1921, to September 30, 1923.

GAGE.—Vertical staff in three sections on piles at floating dock; read by Capt. E. E. Moore. Zero of gage at elevation 2,048.88 feet, when referred to bench mark at Hope described on page 94, Bulletin 567, United States Geological Survey. Zero of gage at elevation 2,045.67 feet, United States Coast and Geodetic Survey datum.

EXTREMES OF STAGE.—Maximum stage recorded during year, 16.85 feet on June 16; minimum stage recorded, 1.62 feet on December 20.

1922–23: Maximum stage recorded, 19.00 feet on June 14, 1922; minimum stage recorded, 1.50 feet March 14–15, 1922.

Crest elevation during flood of June, 1894, was 2,079.29 feet as determined by William Ashley who referred the height of the water to the United States Geological Survey bench mark at Hope, Idaho. This crest elevation is equivalent to a gage height of 30.41 feet on gage at Hope and of 33.71 feet on gage formerly used at Sandpoint, when referred to bench mark described on page 94, Bulletin 567, United States Geological Survey.

ICE.—Ice conditions not serious at this station.

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

REGULATION.—None.

ACCURACY.—Gage read to hundredths once on each day for which gage height is shown.

COOPERATION.—Record furnished by United States Forest Service.

Daily gage height, in feet, of Pend Oreille Lake at Hope, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			1.70		2.32						6.85	3.50
2	2.18	1.98	1.70	2.10	2.28	1.92	2.56	6.80	14.95	14.55	6.60	
3	2.14	1.94			2.26	1.90	2.84	6.95		14.30	6.50	
4	2.14	1.92	1.72	2.36			3.04	7.00	15.00		6.20	3.25
5	2.20		1.70	2.40	2.16	1.89		7.10	15.05	13.70		
6	2.18	1.86			2.08		3.30		15.10	13.45	6.00	3.10
7	2.16	1.78			2.10		3.40	7.50	15.20	13.10	5.80	3.05
8		1.78	1.82	2.64	2.08			7.70	15.30		5.65	3.00
9	2.06	1.78	1.90	2.64	2.02	1.88	3.50	8.10	15.50	12.45	5.50	
10	2.04	1.76					3.58	8.60		12.30	5.40	2.90
11	2.00	1.76	1.84				3.60	9.10	15.90	12.00	5.25	2.80
12	2.00		1.84	2.80	2.00	1.88		9.50	16.15	11.70		2.78
13	2.00	1.74	1.82	2.82	2.04	1.88	3.75		16.40	11.40	5.05	2.70
14	1.98	1.74	1.80		2.10		3.80	10.35	16.60	11.10	4.90	2.68
15		1.74	1.78	2.84	2.14			10.70			4.80	
16	1.96		1.74	2.82	2.14		3.95	10.95	16.85	10.55	4.65	
17	1.94	1.76			2.10	1.82	4.15	11.25		10.30	4.55	2.52
18	1.92		1.68				4.40	11.45	16.80	10.10	4.45	2.48
19	1.90		1.68	2.82	2.06			11.70	16.70	9.75		2.44
20	1.90	1.80	1.62	2.82	2.02	1.80	5.00		16.60	9.55		
21	1.92	1.80	1.68		2.02	1.78	5.25	12.10	16.50	9.30	4.20	2.40
22		1.78	1.64	2.76	2.02	1.76		12.35	16.40		4.10	2.36
23	1.90	1.78	1.70	2.68	2.02	1.74	5.50	12.55	16.25	8.80		
24	1.90	1.78		2.64	2.02		5.60	12.80		8.60	4.00	2.30
25		1.76		2.62			5.65	13.05	15.90		3.95	2.26
26	1.96		1.80	2.60	2.00	1.86	5.75			8.10		2.22
27	1.96	1.74			1.98	1.88			15.60	7.90	3.75	2.20
28		1.74	2.00		1.98	1.92	6.00	14.20	15.35	7.65	3.70	2.18
29		1.72	2.10	2.56		1.96		14.45	15.15		3.65	2.16
30	1.98	1.70	2.18	2.50		2.04		14.60	15.05		3.60	
31				2.40		2.20		14.70		7.10	3.55	

CLARK FORK AT METALINE FALLS, WASH.

LOCATION.—In SE. ¼ sec. 21, T. 39 N., R. 43 E., three-eighths of a mile above Metaline Falls, opposite town of Metaline Falls, Pend Oreille County, 11 miles south of international boundary.

DRAINAGE AREA.—25,100 square miles. (Areas in United States measured on maps issued by United States Geological Survey, scale 1 : 500,000; area of Flathead River basin in British Columbia measured on Department of Lands map, scale 1 : 1,125,000; area of Priest River basin in British Columbia measured on Nelson sheet, British Columbia map.)

RECORDS AVAILABLE.—November 4, 1908, to September 4, 1910 (gage heights only; data insufficient for determination of discharge); October 1, 1912, to September 30, 1923.

GAGE.—Vertical and inclined staff, in five sections, reading from 0 to 55 feet, on right bank, three-eighths of a mile above falls; installed December 10, 1916; read by Leland West. For history of previous gages see Water-Supply Paper 462.

DISCHARGE MEASUREMENTS.—Made from cable three-eighths of a mile above falls. Flow of Sullivan Creek added to flow measured at cable.

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

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 30.0 feet June 17 and 18 (discharge, 91,900 second-feet); minimum stage recorded, —2.02 feet December 10 (discharge, 3,800 second-feet).

1912–1923: Maximum stage recorded, 41.2 feet June 16, 1913 (discharge, 139,000 second-feet); minimum stage recorded, —2.4 feet December 12, 1919 (discharge, 2,500 second-feet).

Maximum stage at Newport (900 square miles less drainage area), independently determined from three separate high-water marks left by the flood of June, 1894, 38.9 feet; discharge, 217,000 second-feet, estimated by extending rating curve.

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

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

REGULATION.—None.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined above 8,000 second-feet. Gage read to hundredths once daily. No diurnal fluctuation. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

COOPERATION.—Station maintained in cooperation with Dominion Water Power Branch. Gage-height record furnished by Hugh L. Cooper Co.

Discharge measurements of Clark Fork at Metaline Falls, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 2-3	James E. Stewart	3.17	9,290	May 15	J. S. Gatewood	20.44	51,900
Mar. 12	R. B. Kilgore	2.91	8,860	15	do	20.56	52,000

Daily discharge, in second-feet, of Clark Fork at Metaline Falls, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	9,440	8,740	7,780	10,100	9,160	9,440	11,200	29,400	78,500	79,800	31,800	15,300
2	9,300	8,740	7,660	10,400	9,160	9,020	11,900	30,100	79,400	78,500	31,300	14,900
3	9,300	8,600	7,780	10,700	9,600	9,020	12,800	31,300	79,400	76,600	30,100	14,500
4	9,300	8,740	7,900	11,000	9,440	9,020	13,500	32,200	79,800	75,300	29,400	14,500
5	9,160	8,460	8,180	11,000	9,300	9,600	14,300	32,700	80,300	73,500	28,200	14,100
6	9,300	8,460	8,040	11,200	9,160	9,600	15,300	33,000	80,800	71,300	27,500	13,900
7	9,300	8,320	7,420	11,400	9,600	9,600	16,300	33,500	81,200	70,900	26,800	13,500
8	9,160	8,460	4,870	11,700	9,160	9,300	16,500	34,500	81,700	68,700	26,200	13,300
9	9,160	8,460	3,880	11,700	8,740	9,020	16,300	35,800	82,100	66,900	25,300	13,000
10	9,020	8,180	3,800	12,200	9,020	9,020	16,500	37,900	82,600	65,100	24,900	12,800
11	9,160	8,180	5,140	12,600	9,160	9,020	16,500	40,000	83,500	63,400	24,000	12,600
12	9,160	8,040	5,140	12,600	8,040	8,880	16,900	42,200	85,400	61,300	23,300	12,600
13	9,020	8,040	6,700	13,000	8,040	9,020	16,900	45,400	87,200	59,700	22,700	12,200
14	8,600	8,040	7,180	13,000	6,000	9,160	17,500	47,900	88,100	57,600	22,200	11,900
15	8,460	8,040	7,420	13,000	4,960	9,020	17,900	50,500	89,500	55,600	21,600	11,500
16	8,460	7,900	7,060	13,000	5,320	9,160	18,300	52,400	91,400	53,600	21,100	11,400
17	8,460	7,900	6,940	13,000	6,000	9,020	18,900	54,400	91,900	52,000	20,700	11,200
18	8,460	7,900	6,700	13,000	7,060	9,020	20,000	56,000	91,900	50,100	20,000	11,000
19	8,460	7,900	6,600	12,400	7,420	9,020	20,500	57,200	91,400	48,300	19,600	10,700
20	8,320	8,040	6,700	12,600	7,900	8,740	21,300	59,200	91,400	46,500	19,400	10,400
21	8,320	8,180	6,700	12,600	8,320	8,740	22,900	60,100	90,500	45,400	18,900	10,200
22	8,460	8,040	6,600	12,600	8,740	8,880	24,200	61,300	90,500	43,800	18,700	9,920
23	8,320	8,180	6,700	12,600	9,160	9,020	25,300	63,000	89,000	42,800	18,300	10,100
24	8,320	8,180	7,780	12,800	9,160	9,020	26,000	63,900	88,100	41,400	17,700	10,100
25	8,320	8,180	8,040	12,400	9,020	9,160	26,200	66,000	87,200	40,200	17,300	9,920
26	8,460	8,040	8,320	12,200	9,020	9,600	26,200	67,300	85,800	38,700	17,100	9,760
27	8,600	8,040	8,740	11,900	9,020	9,760	26,600	69,500	85,400	37,600	16,700	9,600
28	8,740	7,900	9,160	11,900	9,160	10,100	26,800	71,700	83,500	36,600	16,300	9,440
29	8,740	7,780	9,600	10,600	-------	10,200	27,500	73,500	82,600	35,000	16,300	9,300
30	8,740	7,780	9,760	10,400	-------	10,200	28,200	75,700	81,200	34,300	16,100	9,300
31	8,740	-------	9,760	9,160	-------	10,700	-------	77,100	-------	33,000	15,900	-------

Monthly discharge of Clark Fork at Metaline Falls, Wash., for the year ending Sept. 30, 1923

[Drainage area, 25,100 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	9,440	8,320	8,800	0.351	0.40	541,000
November	8,740	7,780	8,180	.326	.36	487,000
December	9,760	3,800	7,230	.288	.33	445,000
January	13,000	9,160	11,900	.474	.55	732,000
February	9,600	4,960	8,350	.333	.35	464,000
March	10,700	8,740	9,290	.370	.43	571,000
April	28,200	11,200	19,600	.781	.87	1,170,000
May	77,100	29,400	51,100	2.04	2.35	3,140,000
June	91,900	78,500	85,400	3.40	3.79	5,080,000
July	79,800	33,000	55,000	2.19	2.52	3,380,000
August	31,800	15,900	22,100	.880	1.01	1,360,000
September	15,300	9,300	11,800	.470	.52	702,000
The year	91,900	3,800	25,000	.996	13.48	18,100,000

ROCK CREEK NEAR QUIGLEY, MONT.

LOCATION.—In SW. ¼ sec. 36, T. 10 N., R. 17 W. (unsurveyed) at highway bridge, one-fourth mile above mouth of Ranch Creek and 2½ miles south of Quigley, Granite County.

DRAINAGE AREA.—772 square miles (measured on topographic map).

RECORDS AVAILABLE.—May 1, 1922, to September 30, 1923, at present site; September 22, 1910, to November 17, 1912, at a site below mouth of Ranch Creek.

GAGE.—Standard wire and weight on downstream side of highway bridge; read by Harvey Shields.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Bed composed of heavy boulders. Two channels at high stages. Control is bed of stream for several hundred feet below gage; probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.49 feet at 8 a. m. May 26 (discharge, 2,760 second-feet); minimum discharge (151 second-feet from measurement of January 28, 1923; ice present).

1922–23: Maximum stage recorded, 6.32 feet June 5, 1922 (discharge, 6,260 second-feet); minimum discharge (from measurement of January 28, 1923, 151 second-feet; ice present).

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

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—Stage-discharge relation affected by ice, otherwise permanent. Rating curve well defined between 150 and 3,500 second-feet. Daily gage heights are observer's readings to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good for open channel and fair during ice period.

COOPERATION.—Maintained in cooperation with Rock Creek Power Co.

Discharge measurements of Rock Creek near Quigley, Mont., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Jan. 5	W. A. Lamb	1.87	[b] 216	Apr. 8	H. W. Shields	1.62	267
14	H. W. Shields [a]	1.87	[b] 200	11	W. A. Lamb	1.64	274
28	do	1.81	[b] 151	Aug. 24	do	1.68	304
Mar. 24	do	2.47	[b] 218				

[a] Engineer for Rock Creek Power Co. [b] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Rock Creek near Quigley, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	192	205	182				293	511	1,650	1,200	393	246
2	197	205	182				299	453	1,530	1,110	393	240
3	197	205	182				299	422	1,530	1,020	393	235
4	192	210	182				312	453	1,300	960	407	229
5	192	237	182				312	516	1,200	945	407	224
6	192	237	182				299	494	1,410	945	393	218
7	192	237	182				293	747	1,590	945	386	213
8	192	237	182				275	888	1,530	945	386	208
9	187	226	182				281	1,060	1,920	945	372	203
10	192	221					281	1,250	2,210	874	372	197
11	192	219					287	1,040	2,520	809	358	192
12	187	210					305	901	2,520	747	358	187
13	187	200					305	901	2,210	716	345	187
14	187	200					312	945	2,060	689	328	184
15	187	200			170		345	945	1,920	689	312	184
16	187	200		180		230	407	945	1,780	636	305	184
17	187	210					503	1,020	1,590	625	305	184
18	187	237					576	1,020	1,590	586	293	177
19	187	237					615	1,200	1,410	538	293	177
20	187	232	175				503	1,250	1,650	538	293	177
21	192	226					422	1,410	1,650	494	293	172
22	192	210					379	1,530	1,650	494	299	172
23	192	200					345	1,780	1,650	453	293	172
24	192	184					345	2,140	1,650	453	293	172
25	197	184					312	2,520	1,530	538	293	187
26	197	237					345	2,760	1,410	494	281	203
27	197	221					379	2,680	1,650	453	269	224
28	197	210					422	2,210	1,780	415	257	218
29	197	205			-------		422	2,060	1,530	415	252	208
30	197	184			-------		473	1,920	1,200	393	252	203
31	192	-------			-------		-------	1,780	-------	393	246	-------

NOTE.—Stage-discharge seriously affected by ice Dec. 10 to Mar. 31; braced figures represent mean discharge for periods indicated.

Monthly discharge of Rock Creek near Quigley, Mont., for the year ending Sept. 30, 1923

[Drainage area, 772 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	197	187	192	0.249	0.29	11,800
November	237	184	214	.277	.31	12,700
December	182		177	.229	.26	10,900
January			[a] 180	.233	.27	11,100
February			[a] 170	.220	.23	9,440
March			[a] 230	.298	.34	14,100
April	615	275	365	.473	.53	21,700
May	2,760	422	1,280	1.66	1.91	78,700
June	2,520	1,200	1,690	2.19	2.44	101,000
July	1,200	393	692	.896	1.03	42,500
August	407	246	326	.422	.49	20,000
September	246	172	199	.258	.29	11,800
The year	2,760		478	.619	8.39	346,000

[a] Estimated.

RANCH CREEK NEAR QUIGLEY, MONT.

LOCATION.—In NE. ¼ sec. 36, T. 10 N., R. 17 W. (unsurveyed), one-fourth of a mile above mouth and 2¼ miles south of Quigley, Granite County.

DRAINAGE AREA.—42.7 square miles (measured on topographic sheet).

RECORDS AVAILABLE.—May 2, 1922, to September 30, 1923.

GAGE.—Vertical staff with enamel face on right abutment of highway bridge; read by Harvey Shields.

DISCHARGE MEASUREMENTS.—Made from bridge or by wading.

CHANNEL AND CONTROL.—Bed composed of cobblestones. Control is riffle 20 feet below gage, subject to slight shifts. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.20 feet May 24–28 (discharge, 145 second-feet); minimum discharge, 14 second-feet, March 3. Stage-discharge relation affected by ice.

1922–23: Maximum stage, 1.50 feet May 19 and 20, 1922 (discharge, 238 second-feet); minimum discharge, 14 second-feet (measurement of March 3, 1923, ice present).

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

DIVERSIONS.—None of importance.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by ice. Rating curves well defined between 20 and 220 second-feet, one applicable for open channel October 1 to March 18, the other applicable March 19 to September 30. Daily gage heights are observer's readings once daily to half-tenths; occasionally to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records good for open channel and fair during ice period.

COOPERATION.—Maintained in cooperation with Rock Creek Power Co.

Discharge measurements of Ranch Creek near Quigley, Mont., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	Sec.-ft.			Feet	Sec.-ft.
Jan. 5	W. A. Lamb	0.57	16.2	Mar. 24	H. W. Shields [a]	0.50	15.0
14	H. W. Shields [a]	.70	[b] 16.9	Apr. 8	do	.55	18.4
28	do	1.10	[b] 19.3	11	W. A. Lamb	.63	25.4
Feb. 11	do	2.70	[b] 20.3	Aug. 24	do	.70	29.3
Mar. 3	do	1.02	[b] 14.1				

[a] Engineer Rock Creek Power Co.

[b] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Ranch Creek near Quigley, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	23	20		18			30	42	86	73	36	30
2	23	20		18			25	35	86	73	36	30
3	23	20		18			24	37	86	73	36	30
4	23	20		17			22	42	73	73	36	30
5	21	20		16			21	42	73	60	36	30
6	21	20		18			21	42	73	73	36	30
7	21	20		17			21	60	73	73	42	30
8	21	20		17			18	70	73	60	42	30
9	21	20		18			19	86	86	60	36	30
10	21	18		18		15	16	86	86	60	36	30
11	21	18		18			24	73	86	60	36	30
12	20	18		18			27	65	115	60	36	30
13	20	18		18			27	65	86	60	36	30
14	20	18		17			30	60	86	60	36	30
15	20	18		17	16		30	70	86	60	36	30
16	20	18	18	17			30	65	86	60	36	30
17	20	18		17			40	70	86	60	36	30
18	20	18		17			51	73	73	60	36	30
19	20	18		17			56	86	73	60	36	30
20	20	18		17		15	46	86	73	60	36	30
21	21	18		19		15	40	86	73	60	36	30
22	21	18		19		15	32	86	73	60	36	30
23	20	18		19		15	30	115	73	42	36	30
24	20	18		19		15	30	145	73	42	32	30
25	19	18		19		15	30	145	73	42	36	30
26	18	18		19		18	36	145	73	36	36	30
27	18	18		19		18	42	145	86	36	36	30
28	18	18		19		18	53	145	86	36	36	30
29	18	18		19		22	56	115	73	36	30	30
30	18	18		19	-------	24	56	86	73	36	30	30
31	18	-------		19	-------	30	-------	86	-------	36	30	-------

NOTE.—Stage-discharge relation affected by ice Nov. 28 to Jan. 5 and Jan. 14 to Mar. 19; braced figures represent mean discharge for periods indicated.

Monthly discharge of Ranch Creek near Quigley, Mont., for the year ending Sept. 30, 1923

[Drainage area, 42.7 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	23	18	20.3	0.475	0.55	1,250
November	20	18	18.6	.436	.47	1,110
December	-------	-------	18.0	.422	.49	1,110
January	19	16	18.0	.422	.47	1,110
February	-------	-------	16.0	.375	.39	889
March	30	15	16.3	.382	.44	1,000
April	56	16	32.8	.768	.86	1,950
May	145	35	82.4	1.93	2.22	5,070
June	115	73	80.0	1.87	2.09	4,760
July	73	36	56.1	1.31	1.51	3,450
August	42	30	35.7	.836	.96	2,200
September	30	30	30.0	.703	.78	1,790
The year	145	15	35.4	.829	11.25	25,700

BLACKFOOT RIVER AT CLEARWATER, MONT.

LOCATION.—In sec. 16, T. 14 N., R. 14 W., 300 feet above mouth of Clearwater River, 200 feet above highway bridge, and 1 mile south of Clearwater post office, Missoula County.

DRAINAGE AREA.—1,320 square miles (measured on Forest Service map).

RECORDS AVAILABLE.—June 9, 1921, to September 30, 1923, when station was discontinued.

GAGE.—Overhanging wire gage on right bank 200 feet above highway bridge; read by Lue Parker.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Bed composed of large boulders and gravel. Banks high and covered with timber. Control is riffle of heavy boulders below highway bridge, probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 5.7 feet at 10.45 a. m. May 26 (discharge, 6,630 second-feet); minimum stage, 1.00 foot November 13–21 (discharge, 410 second-feet).

1921–1923: Maximum stage recorded, 6.4 feet June 6, 1922 (discharge, 7,820 second-feet); minimum stage, that of November 13–21, 1923.

ICE.—Records discontinued during winter.

DIVERSIONS.—Several small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 500 and 6,500 second-feet. Gage read to half-tenths once daily except Sunday. Daily discharge obtained by applying daily gage height to rating table for days of gage readings and by interpolation for other days. Records good.

The following discharge measurement was made by W. A. Lamb:
August 31, 1923: Gage height, 1.33 feet; discharge, 590 second-feet.

Daily discharge, in second-feet, of Blackfoot River at Clearwater, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Apr.	May	June	July	Aug.	Sept.
1	448	435	460	------	1,330	4,170	2,200	851	572
2	460	435	460	------	1,330	4,330	1,930	812	558
3	460	435	------	------	1,230	4,330	1,930	772	543
4	460	435	------	------	1,230	4,330	1,800	736	514
5	460	435	------	------	1,230	4,330	1,800	718	514
6	460	435	------	------	1,780	4,250	1,930	700	514
7	460	435	------	------	2,340	4,250	1,930	700	514
8	448	435	------	------	2,780	4,650	1,800	700	514
9	435	435	------	------	3,690	5,210	1,680	700	514
10	435	435	------	------	3,850	5,290	1,560	700	514
11	435	435	------	------	3,930	5,370	1,500	700	514
12	435	422	------	------	3,930	5,950	1,440	700	514
13	435	410	------	------	3,660	5,610	1,330	700	514
14	435	410	------	------	3,380	5,130	1,230	700	514
15	435	410	------	------	3,080	4,490	1,230	700	514
16	435	410	------	514	3,080	4,010	1,230	667	514
17	435	410	------	634	3,080	3,850	1,230	667	514
18	435	410	------	894	3,000	3,690	1,180	667	514
19	435	410	------	984	3,000	3,530	1,130	684	487
20	435	410	------	894	3,420	3,230	1,030	700	487
21	435	410	------	812	3,850	3,080	984	736	487
22	435	435	------	756	4,170	3,230	960	736	487
23	435	435	------	700	4,650	3,380	937	736	487
24	435	435	------	634	5,290	3,160	937	700	487
25	435	435	------	634	6,120	2,930	937	700	487
26	435	435	------	667	6,630	2,780	937	667	514
27	435	435	------	772	5,800	2,780	937	634	514
28	435	435	------	851	4,970	2,780	937	603	514
29	435	460	------	990	4,650	2,630	937	603	514
30	435	460	------	1,130	4,490	2,480	937	572	514
31	435	------	------	------	4,250	------	894	572	------

NOTE.—Gage not read on Sundays; discharge interpolated. No record Dec. 3 to Apr. 15.

Monthly discharge of Blackfoot River at Clearwater, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	460	435	441	27,100
November	460	410	429	25,500
April 16–30	1,130	514	791	23,500
May	6,630	1,230	3,520	216,000
June	5,950	2,480	3,970	236,000
July	2,200	894	1,340	82,400
August	851	572	695	42,700
September	572	487	512	30,500

NOTE.—No record Dec. 3 to Apr. 15

NORTH FORK OF BLACKFOOT RIVER NEAR OVANDO, MONT.

LOCATION.—In NW. ¼ sec. 22, T. 15 N., R. 11 W., at Pitkin's ranch, 11 miles northeast of Ovando, Powell County.

DRAINAGE AREA.—227 square miles (measured on topographic map).

RECORDS AVAILABLE.—June 8, 1921, to September 15, 1923, when station was discontinued.

GAGE.—Wire gage with enamel face on left bank 400 feet north of observer's house; read twice daily by James Pitkin.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed of stream composed of large boulders. Control not well defined, but not subject to shift. Left bank high and timbered. Right bank covered with heavy brush and timber, subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period April 15 to September 15, 7.22 feet at 9 a. m. May 26 (discharge, 2,560 second-feet); minimum stage, 2.43 feet April 15 (discharge, 27 second-feet).

1921–1923: Maximum stage recorded, 7.58 feet June 5, 1922 (discharge, 2,900 second-feet); minimum discharge, 27 second-feet November 6–16, 1922, and April 15, 1923.

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

DIVERSIONS.—Two small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent for period of record. Rating curve well defined between 40 and 2,600 second-feet. Gage read to half-tenths twice daily. Daily discharge determined by applying mean daily gage height to rating table. Records good.

Discharge measurements of North Fork of Blackfoot River near Ovando, Mont., during the period ending Sept. 15, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
June 14	6.37	1,880
Aug. 31	3.20	98

Daily discharge, in second-feet, of North Fork of Blackfoot River near Ovando, Mont., for the period Apr. 15 to Sept. 15, 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1	------	322	1,460	748	146	90	16	28	846	1,420	302	97	------
2	------	271	1,390	729	138	86	17	35	846	1,390	290	97	------
3	------	242	1,310	716	132	81	18	49	1,060	1,260	271	97	------
4	------	260	1,300	704	123	76	19	61	1,050	1,180	260	90	------
5	------	438	1,460	627	123	73	20	77	1,260	1,120	242	108	------
6	------	685	1,580	555	123	72	21	66	1,440	1,120	237	146	------
7	------	858	1,710	627	123	70	22	66	1,750	1,100	232	126	------
8	------	1,140	1,990	555	119	70	23	77	1,970	1,220	223	108	------
9	------	1,440	2,110	503	123	68	24	97	2,020	1,140	216	105	------
10	------	1,460	2,170	456	123	67	25	123	2,350	1,060	206	102	------
11	------	1,380	2,290	447	123	66	26	142	2,500	1,020	198	97	------
12	------	1,200	2,320	396	114	66	27	146	2,060	1,020	186	93	------
13	------	1,080	2,150	358	108	65	28	168	1,670	1,000	182	90	------
14	------	1,020	1,730	336	105	64	29	329	1,470	950	168	90	------
15	27	900	1,500	322	102	64	30	358	1,390	858	152	90	------
							31	------	1,360	------	142	91	------

Monthly discharge of North Fork of Blackfoot River near Ovando, Mont., for the period Apr. 15 to Sept. 15, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
April 15-30	358	27	116	3,680
May	2,500	242	1,220	75,000
June	2,320	858	1,440	85,700
July	748	142	374	23,000
August	146	90	111	6,820
September 1-15	90	64	71.9	2,140

CLEARWATER RIVER AT CLEARWATER, MONT.

LOCATION.—In sec. 16, T. 14 N., R. 14 W., 400 feet above mouth and 1 mile south of Clearwater post office, Missoula County.

DRAINAGE AREA.—398 square miles (measured on Forest Service map).

RECORDS AVAILABLE.—June 9, 1921, to September 30, 1923, when station was discontinued.

GAGE.—Overhanging wire gage on left bank; read by Lue Parker.

DISCHARGE MEASUREMENTS.—Made by wading at gage or from bridge at Clearwater 1 mile above gage.

CHANNEL AND CONTROL.—Bed composed of heavy boulders and gravel. Control not well defined, probably formed by channel below gage; permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.1 feet May 12 and 26 (discharge, 1,600 second-feet); minimum stage, 0.70 foot October 23 to November 21 (discharge, 30 second-feet).

1921–1923: Maximum stage recorded, 3.9 feet May 12 and 26, 1922 (discharge, 2,400 second-feet); minimum stage, 0.7 foot October 23 to November 21, 1922 (discharge, 30 second-feet).

ICE.—Records discontinued during winter.

DIVERSIONS.—Some water is diverted for irrigation above gage.

REGULATION.—Dam at Seeley Lake may be used to regulate flow, but has not been operated for several years.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 40 and 2,400 second-feet. Gage read to half-tenths once daily except Sunday. Daily discharge obtained by applying daily gage height to rating table for days of gage readings and by interpolation for other days. Records good.

Discharge measurements of Clearwater River at Clearwater, Mont., during the year ending Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge
	Feet	*Sec.-ft.*
June 14	2.70	1,310
Aug. 31	1.03	96

Daily discharge, in second-feet, of Clearwater River at Clearwater, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Apr.	May	June	July	Aug.	Sept.
1	52	30	45	------	1,080	1,080	470	155	90
2	38	30	45	------	1,040	1,040	470	155	90
3	38	30	------	------	950	1,040	438	135	90
4	38	30	------	------	860	1,040	405	135	90
5	38	30	------	------	860	1,040	405	128	78
6	38	30	------	------	1,040	1,040	438	120	78
7	38	30	------	------	1,220	1,040	438	120	78
8	38	30	------	------	1,310	1,130	406	120	78
9	38	30	------	------	1,310	1,130	375	120	78
10	38	30	------	------	1,310	1,220	345	120	78
11	38	30	------	------	1,500	1,310	345	120	78
12	38	30	------	------	1,600	1,400	345	120	78
13	38	30	------	------	1,550	1,360	290	120	78
14	38	30	------	------	1,500	1,310	240	120	78
15	38	30	------	------	1,400	1,220	229	120	78
16	38	30	------	345	1,310	1,130	218	120	72
17	38	30	------	375	1,310	1,080	218	105	65
18	38	30	------	505	1,220	1,040	195	105	55
19	38	30	------	578	1,220	860	175	112	55
20	38	30	------	615	1,220	775	155	120	45
21	38	30	------	615	1,220	695	138	120	45
22	34	38	------	615	1,220	695	146	120	45
23	30	38	------	615	1,310	695	155	120	45
24	30	38	------	695	1,400	655	175	120	45
25	30	38	------	695	1,500	615	175	120	45
26	30	38	------	655	1,600	615	175	112	45
27	30	38	------	655	1,500	578	175	105	45
28	30	38	------	695	1,400	578	175	105	45
29	30	45	------	822	1,310	540	165	90	45
30	30	45	------	950	1,220	470	155	90	45
31	30	------	------	------	1,130	------	155	90	------

NOTE.—Gage not read on Sundays and holidays. Discharge interpolated. No record Dec. 3 to Apr. 15.

Monthly discharge of Clearwater River at Clearwater, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	52	30	36.0	2,210
November	45	30	32.9	1,960
April 16–30	950	345	629	18,700
May	1,600	860	1,280	78,700
June	1,400	470	947	56,400
July	470	138	271	16,700
August	155	90	118	7,260
September	90	45	65.3	3,890

NOTE.—No record Dec. 3 to Apr. 15.

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SKALKAHO CREEK NEAR HAMILTON, MONT.

LOCATION.—In SW. ¼ sec. 28, T. 5 N., R. 19 W., at farm bridge 1,000 feet south of ranch buildings on J. A. Brennan's ranch, 9 miles southeast of Hamilton, Ravalli County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 20, 1920, to September 30, 1923.

GAGE.—Vertical staff with enamel face on downstream end of left abutment of bridge; read by J. S. Brennan.

DISCHARGE MEASUREMENTS.—Made by wading near gage or from farm bridge half a mile below.

CHANNEL AND CONTROL.—Bed composed of boulders and cobblestones for several hundred feet above and below gage. Control is same for all stages and is practically permanent. One channel at all stages. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 3.20 feet at 7 p. m. June 12 (discharge, 648 second-feet); minimum stage, 1.35 feet April 1 (discharge, 30 second-feet).

1920–1923: Maximum stage recorded, 3.80 feet June 14, 1922 (discharge, 1,110 second-feet); minimum stage, 1.30 feet April 21–25, 1920, March 1–4, 6, 8, 9, 1921, and April 16, 1922 (discharge, 27 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 25 and 400 second-feet. Gage read twice daily to half-tenths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good, except those for September, which are poor.

The following discharge measurement was made by W. A. Lamb:
August 30, 1923: Gage height, 1.65 feet; discharge, 53 second-feet.

Daily discharge, in second-feet, of Skalkaho Creek near Hamilton, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Apr.	May	June	July	Aug.	Sept.
1	37	30	54	243	363	100	47
2	37	34	50	236	363	96	47
3	37	34	47	243	341	89	47
4	37	32	50	250	319	89	47
5	37	32	64	279	287	89	47
6	37	32	82	279	272	82	47
7	37	32	105	299	272	78	47
8	34	32	130	421	236	78	45
9	34	32	158	509	226	78	42
10	34	32	180	520	217	78	42
11	34	32	147	532	204	74	42
12	34	32	138	595	195	69	42
13	34	32	138	570	186	69	39
14	34	32	130	492	180	64	37
15	34	32	120	437	174	60	37
16	34	34	112	453	180	60	37
17	34	50	138	492	158	60	42
18	34	69	147	437	147	60	42
19	34	60	138	411	138	60	42
20	34	54	180	411	138	60	42
21	34	47	186	411	130	60	39
22	34	42	210	421	125	60	37
23	34	37	250	437	125	60	37
24	34	37	311	437	125	60	37
25	34	37	421	411	147	60	37
26	34	37	437	453	125	60	42
27	34	39	328	453	120	57	42
28	34	45	272	437	112	54	39
29	37	47	243	411	105	54	37
30	37	60	250	373	100	50	37
31	32		243		100	47	

NOTE.—No record Nov. 1 to Mar. 31.

Monthly discharge of Skalkaho Creek near Hamilton, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	37	32	34.8	2,140
April	69	30	39.2	2,330
May	437	47	176	10,800
June	595	236	412	24,500
July	363	100	191	11,700
August	100	47	68.2	4,190
September	47	37	41.5	2,470

NOTE.—No record Nov. 1 to Mar. 31.

WILLOW CREEK NEAR CORVALLIS, MONT.

LOCATION.—In sec. 8, T. 6 N., R. 19 W., at Willey ranch, 6 miles southeast of Corvallis, Ravalli County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 20, 1920, to September 30, 1923.

GAGE.—Vertical staff with enamel face, on right bank about 150 feet upstream from the Willey ranch house; read by Mrs. Bray Willey.

DISCHARGE MEASUREMENTS.—Made at ford about 50 feet below gage. Channel is smooth, and the current is evenly distributed. Banks are high and not subject to overflow. One channel at all stages.

CHANNEL AND CONTROL.—Bed of stream composed of boulders and cobblestones, fairly permanent. One channel at all stages. Banks not subject to overflow. Control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.80 feet at 7 p. m. June 26 (discharge, 92 second-feet); minimum stage, 0.58 foot March 24, 25, and April 7–9 (discharge, 5.2 second-feet).

1920–1923: Maximum stage, 2.20 feet June 15, 1922 (discharge, 130 second-feet); minimum stage, 0.56 foot November 8–19, 1921, and March 29 to April 5, 1922 (discharge, 4.7 second-feet).

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

DIVERSIONS.—One ditch diverts a small quantity of water above gage.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year except when affected by ice. Rating curve well defined between 7 and 80 second-feet. Gage read once daily October 1 to December 31, March 18 to 25, and August 23 to September 30; twice daily March 26 to August 22. Daily discharge ascertained by applying daily gage height to rating table. July 4 and August 4 discharge interpolated. December 8–18 discharge estimated on account of ice at 6 second-feet. Records good.

Discharge measurements of Willow Creek near Corvallis, Mont., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
May 22	W. A. Lamb	0.78	13.1
Sept. 9	C. S. Heidel	.66	7.8

Daily discharge, in second-feet, of Willow Creek near Corvallis, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7.9	6.4	5.7	-------	6.1	8.2	17	52	15	9.3
2	7.1	6.4	5.7	-------	6.1	7.1	19	48	15	8.6
3	7.1	6.4	5.7	-------	6.1	6.8	19	47	15	7.9
4	7.1	6.4	5.7	-------	6.1	6.8	20	40	15	7.1
5	7.1	6.4	5.7	-------	6.4	9.3	23	44	16	7.1
6	7.1	6.4	5.7	-------	5.7	10	26	41	16	6.4
7	7.1	6.4	5.7	-------	5.2	11	26	43	15	6.4
8	7.1	6.4	6.0	-------	5.2	12	31	38	15	6.4
9	6.4	6.4	6.0	-------	5.2	9.3	33	33	14	6.4
10	6.4	6.4	6.0	-------	5.4	9.3	40	32	14	6.4
11	6.4	6.4	6.0	-------	5.7	8.9	51	31	14	6.4
12	6.4	6.4	6.0	-------	5.7	7.1	53	28	14	6.4
13	6.4	6.4	6.0	-------	5.7	7.1	47	19	13	6.4
14	6.4	6.4	6.0	-------	5.7	6.4	42	17	13	6.4
15	6.4	5.7	6.0	-------	6.1	6.4	41	16	13	6.4
16	6.4	5.7	6.0	-------	8.2	6.4	50	16	13	6.4
17	6.4	5.7	6.0	-------	8.6	6.8	52	30	13	6.4
18	6.4	5.7	6.0	7.1	8.9	7.1	49	26	13	6.4
19	6.4	5.7	6.4	7.1	8.2	7.1	48	24	13	6.4
20	6.4	5.7	6.4	6.4	7.1	7.1	51	24	14	5.7
21	6.4	5.7	6.4	6.4	6.4	7.1	52	21	13	5.7
22	6.4	5.7	6.4	6.4	5.7	15	50	20	12	5.7
23	6.4	5.7	6.4	7.1	5.7	15	52	20	12	5.7
24	6.4	5.7	6.4	5.2	6.1	18	52	19	12	5.7
25	6.4	5.7	6.4	5.2	6.1	21	52	18	12	5.7
26	6.4	5.7	6.4	5.7	6.1	21	54	18	11	5.7
27	6.4	5.7	6.4	6.1	12	20	58	16	11	5.7
28	6.4	5.7	6.4	5.4	13	17	55	16	11	5.7
29	6.4	5.7	6.4	5.4	12	16	53	16	10	5.7
30	6.4	5.7	6.4	5.7	8.6	15	52	16	10	5.7
31	6.4	-------	6.4	6.1	-------	15	-------	15	9.3	-------

NOTE.—No record Jan. 1 to Mar. 17.

Monthly discharge of Willow Creek near Corvallis, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	7.9	6.4	6.61	406
November	6.4	5.7	6.03	359
December	6.4	5.7	6.10	375
March 18–31	7.1	5.2	6.09	169
April	13	5.2	6.97	415
May	21	6.4	11.0	676
June	58	17	42.3	2,520
July	52	15	27.2	1,670
August	16	9.3	13.1	806
September	9.3	5.7	6.41	381

NOTE.—No record Jan. 1 to Mar. 17.

BURNT FORK CREEK NEAR STEVENSVILLE, MONT.

LOCATION.—In SW. ¼ sec. 11, T. 8 N., R. 19 W., at highway bridge at John Buck's ranch about 9 miles southeast of Stevensville, Ravalli County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 9, 1920, to September 30, 1923 (fragmentary).

GAGE.—Staff gage, with enamel face graduated from 0 to 3.3 on downstream end of left abutment of highway bridge; read by Cecil Bellomy and Oscar Smith.

DISCHARGE MEASUREMENTS.—Made from highway bridge or by wading below the gage. There is but one channel at all stages at the gage. Banks are high and are not overflowed.

CHANNEL AND CONTROL.—Bed composed of cobblestones and gravel; fairly smooth and not subject to shift. One channel at all stages; straight for 50 feet above and below gage. Banks not subject to overflow. Control is a gravel and cobblestone bar at point where stream forks about 100 feet below gage; fairly permanent. Stage-discharge relation may be affected by driftwood collecting at this point.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.92 feet, June 19 (discharge, 276 second-feet); minimum stage, 0.48 foot, March 22–25 (discharge, 15 second-feet).

1920–1923: Maximum stage, 2.64 feet June 10, 1922 (discharge, 620 second-feet); minimum stage, that of March 22–25, 1923.

ICE.—Stage-discharge relation seriously affected by ice, record discontinued during winter.

DIVERSIONS.—One or two small diversions above gage.

ACCURACY.—Stage-discharge relation permanent, except when affected by ice. Rating curve well defined between 16 and 350 second-feet. Gage read to even hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table except during ice-affected periods. Records good.

COOPERATION.—Maintained in cooperation with the Bitterroot Valley Irrigation District.

Discharge measurements of Burnt Fork Creek near Stevensville, Mont., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
May 23	W. A. Lamb	1.38	105
June 19	do	1.65	173
Sept. 9	C. S. Heidel	.57	20.6

Daily discharge, in second-feet, of Burnt Fork Creek near Stevensville, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	------	22	24	------	40	------	118	141	45	21
2	------	24	24	------	38	------	123	118	45	21
3	------	26	24	------	34	------	132	118	45	21
4	21	30	20	------	35	------	127	100	44	21
5	21	30		------	32	------	132	97	44	21
6	22	30			30	------	136	94	42	24
7	24	29		------	27	------	132	100	37	22
8	24	29		------	27	------	141	91	37	22
9	24	30		------	27	------	157	91	34	21
10	24	32		------	27	------	141	85	32	21
11	24	25		------	29	------	141	75	30	21
12	24	25	20	------	30	------	192	72	30	21
13	24	24		------	32	------	198	67	34	21
14	24	27		------	32	------	198	60	32	22
15	24	30		------	38	------	238	58	30	24
16	24	32		------	45	------	246	58	29	24
17	24	32		------	168	------	253	72	27	27
18	24	30		------	72	------	268	58	26	27
19	24	28		------	72	------	276	58	26	26
20	24	26	26	------	40	------	268	58	29	26
21	24	24	24	------	24	------	253	56	26	24
22	24	24	29	15	------	------	253	56	24	24
23	22	24	29	15	------	------	238	53	24	24
24	21	24	24	15	------	------	218	53	22	24
25	21	24	22	15	------	------	218	91	22	26
26	19	24	22	18	------	------	198	58	22	24
27	19	24	21	21	------	100	186	53	21	24
28	19	24	22	22	------	100	186	49	22	27
29	22	24	22	26	------	107	168	47	22	27
30	27	24	20	32	------	111	155	45	22	27
31	22	------	19	35	------	118	------	44	21	------

NOTE.—Braced figures represent mean discharge of the period indicated. Stage-discharge relation affected by ice Nov. 5–7, 14, 15, 19, 22–26, 30, Dec. 1, 4–19, and 30. No record, Oct. 1–3, Jan. 1 to Mar. 21, and Apr. 22 to May 26.

Monthly discharge of Burnt Fork Creek near Stevensville, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October 4–31	27	19	22.9	1,270
November	32	22	26.7	1,590
December	29	19	21.7	1,330
March 22–31	35	15	21.4	424
April 1–21	168	24	42.8	1,780
May 27–31	118	100	107	1,060
June	276	118	190	11,300
July	141	44	73.4	4,510
August	45	21	30.5	1,880
September	27	21	23.5	1,400

NOTE.—See footnote to table of daily discharge.

FLATHEAD RIVER AT COLUMBIA FALLS, MONT.

LOCATION.—SW. ¼ sec. 17, T. 30 N., R. 20 W., on highway bridge on Roosevelt Highway at Columbia Falls, Flathead County, 6 miles below mouth of South Fork of Flathead River.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 14, 1922, to August 25, 1922, and April 13 to September 29, 1923 (fragmentary).

GAGE.—Wire gage on upstream guardrail of highway bridge; read by A. L. Jordan.

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

CHANNEL AND CONTROL.—Bed composed of boulders and gravel. Right bank high, clean, and subject to overflow. Left bank, heavily timbered, and subject to overflow at high stages. Current swift at all stages. Control not well defined and probably is channel for half a mile below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period April 13 to September 29, 17.3 feet June 5 (discharge, 102,000 second-feet); minimum stage, 1.50 feet September 21–29 (discharge, 2,170 second-feet).

1922–1923: Maximum stage recorded, that of June 5, 1923; minimum stage, that of September 21–29, 1923.

ICE.—None.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 2,620 and 12,000 second-feet and fairly well defined to 74,000 second-feet. Gage read to hundredths occasionally. Numerous gaps in records. Daily discharges ascertained by applying daily gage height to rating table. Discharge published for days of gage readings only. Records poor.

Discharge measurements of Flathead River at Columbia Falls, Mont., during the period Apr. 13 to Sept. 29, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Apr. 13	3.65	5,410	July 27	4.84	7,300
June 19	11.96	38,300	Aug. 26	2.84	3,590

Daily discharge, in second-feet, of Flathead River at Columbia Falls, Mont., for the period Apr. 13 to Sept. 29, 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1		24,300	102,000		6,250		16	10,200			10,700		
2		18,600					17	15,100			12,600	3,660	
3		17,600	92,700				18	21,400			13,200	3,600	
4		19,300					19	21,700		44,000		3,740	
5		20,300					20	20,600	43,100				
6		25,300		18,200			21	14,700	41,200				2,170
7				17,400			22	11,600			9,300		2,170
8				16,500			23	11,100					2,170
9			72,300				24	11,200					2,170
10			67,800		4,400		25	11,400	53,000	29,100			2,170
11				14,500			26	13,700	81,000			3,720	2,170
12							27	19,300	63,500		8,090		2,170
13	5,150						28	21,200		26,900			2,170
14				11,400			29	27,200					2,170
15	6,610			10,300			30	26,400			6,490		
							31						

FLATHEAD LAKE AT SOMERS, MONT.

LOCATION.—In NE ¼ sec. 26, T. 27 N., R. 21 W., at steamboat dock at Somers, Flathead County.

RECORDS AVAILABLE.—April 25, 1922, to September 30, 1923.

GAGE.—Stevens water-stage recorder in wooden shelter referenced to staff gage in well set at sea-level datum.

EXTREMES OF STAGE.—Maximum stage recorded during year, 2,891.3 feet at 8 p. m. May 29; minimum stage, 2,882.15 feet at 7 a. m. October 19, 1922. 1922-23: Maximum stage, 2,892.75 feet June 10, 1922; minimum stage 2,882.15 feet October 19, 1922.

ACCURACY.—Records good.

Daily gage height, in feet, of Flathead Lake at Somers, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Apr.	May	June	July	Aug.	Sept
1	82.7		85.15	91.0	89.9	85.4	83.7
2	82.65		85.3	91.0	89.8	85.3	83.7
3	82.65		85.45	91.1	89.6	85.3	83.6
4	82.65		85.55	91.1	89.5	85.1	83.6
5	82.65		85.65	91.0	89.4	84.9	83.6
6	82.55		85.75	91.0	89.2	84.8	83.5
7	82.55		85.85	91.0	89.0	84.8	83.4
8	82.55		86.05	91.1	88.8	84.9	83.4
9	82.55		86.4		88.6	84.7	83.3
10	82.55		86.8		88.4	84.6	83.2
11	82.5		87.2		88.3	84.6	83.2
12	82.4	82.4	87.6		88.1	84.5	83.1
13	82.4	82.45	88.05		87.9	84.4	83.1
14	82.35	82.45	88.3		87.8	84.4	83.1
15	82.3	82.5	88.55		87.6	84.4	83.0
16	82.3	82.6	88.7		87.5	84.3	83.0
17	82.3	82.7	88.8		87.3	84.3	82.9
18	82.25	82.9	88.8		87.2	84.2	82.9
19	82.2	83.15	88.85		87.1	84.1	82.9
20		83.4	88.95		86.9	84.1	82.9
21		82.55	89.0		86.8	84.0	82.8
22		83.7	89.15		86.7	84.0	82.8
23		83.8	89.4		86.6	83.9	82.7
24		83.9	89.65		86.5	83.9	82.7
25		84.0	90.1		86.3	83.9	82.7
26		84.1	90.3		86.2	83.9	82.7
27		84.25	90.7		86.1	83.8	82.7
28		84.4	91.0		86.0	83.8	82.6
29		84.6	91.1		85.9	83.8	82.6
30		84.9	91.1		85.8	83.8	82.6
31			91.0		85.6	83.7	

NOTE.—Add 2,800.00 feet to reduce to sea level. Record discontinued during winter Oct. 20 to Apr. 11. No record June 9-30.

FLATHEAD LAKE AT POLSON, MONT.

LOCATION.—In SE. ¼ sec. 4, T. 22 N., R. 20 W., at steamboat dock at south end of lake at Polson, Lake County.

RECORDS AVAILABLE.—August 23, 1908, to September 30, 1923.

GAGE.—Stevens water-stage recorder in wooden shelter installed April 23, 1922, and referenced to staff gage in well. Original staff gage on pile read by observer is at datum 3 feet lower and readings were reduced to sea-level datum by adding 2,803 feet.

EXTREMES OF STAGE.—Maximum stage recorded during year, 2,892.3 feet above sea level, June 16; minimum stage recorded, 2,881.7 feet December 23 to January 1.

1908–1923: Maximum stage recorded 2,895.7 feet above sea level, July 1, 2, and 4, 1916; minimum stage, 2,881.5 feet February 16–22, 1913.

COOPERATION.—Gage heights for staff gage furnished by United States Bureau of Reclamation.

Daily gage height, in feet, of Flathead Lake at Polson, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	82.6	82.2	81.9	81.7	82.7	81.8	82.0	84.9	90.7	89.9	85.5	83.5
2	82.6	82.3	81.9	81.8	82.1	81.8	82.0	85.2	90.8	89.7	85.3	83.5
3	82.5	82.2	82.0	81.8	82.0	81.8	82.1	85.3	90.9	89.5	85.2	83.4
4	82.5	82.2	81.9	81.8	82.0	81.8	82.1	85.4	90.9	89.4	85.1	83.4
5	82.5	82.2	81.9	81.8	82.0	81.8	82.1	85.4	90.9	89.2	85.0	83.3
6	82.5	82.2	81.9	81.9	82.0	81.8	82.1	85.5	-------	89.0	85.0	83.3
7	82.4	82.1	81.9	81.9	82.0	81.8	82.1	85.7	-------	88.9	84.9	83.3
8	82.4	82.1	81.9	81.9	82.0	81.8	82.1	85.8	-------	88.7	84.9	83.2
9	82.4	82.1	81.9	81.9	82.0	81.8	82.1	86.2	-------	88.5	84.7	83.2
10	82.4	82.1	81.9	82.0	81.9	81.8	82.2	86.6	-------	88.3	84.6	83.2
11	82.4	82.1	81.9	82.0	81.9	81.8	82.2	87.0	-------	88.1	84.5	83.2
12	82.4	82.1	81.9	82.0	81.9	81.8	82.2	87.5	-------	87.9	84.4	83.0
13	82.3	82.0	81.8	82.1	81.9	81.8	82.3	87.8	-------	87.7	84.3	83.0
14	82.3	82.0	81.8	82.1	81.9	81.8	82.3	88.1	-------	87.6	84.3	82.9
15	82.3	82.0	81.8	82.1	81.9	81.8	82.4	88.3	-------	87.4	84.2	82.9
16	82.3	82.0	81.8	82.1	81.9	81.8	82.4	88.4	92.3	87.3	84.2	83.0
17	82.3	82.0	81.8	82.2	81.8	81.8	82.6	88.5	92.2	87.1	84.2	82.9
18	82.3	82.0	81.8	82.2	81.8	81.8	82.7	88.6	92.2	87.0	84.1	82.8
19	82.2	82.0	81.8	82.2	81.8	81.8	82.9	88.7	92.0	86.9	84.1	82.8
20	82.2	82.0	81.8	82.2	81.8	81.8	83.2	88.8	91.8	86.8	84.0	82.8
21	82.2	82.0	81.8	82.2	81.8	81.8	83.6	88.9	91.6	86.7	84.0	82.8
22	82.2	82.0	81.8	82.3	81.8	81.75	83.7	89.0	91.4	86.5	84.0	82.8
23	82.1	82.0	81.7	82.3	81.8	81.75	83.8	89.3	91.3	86.4	84.0	82.7
24	82.1	82.0	81.7	82.3	81.8	81.73	83.8	89.6	91.1	86.3	83.9	82.7
25	82.2	82.0	81.7	82.3	81.8	81.75	83.9	89.8	91.0	86.2	83.9	82.7
26	82.2	82.0	81.7	82.3	81.8	81.75	84.0	90.1	90.8	86.1	83.8	82.7
27	82.1	82.0	81.7	82.3	81.8	81.75	84.1	90.5	90.6	86.0	83.7	82.6
28	82.1	82.0	81.7	82.2	81.8	81.75	84.3	90.8	90.4	85.9	83.7	82.6
29	82.1	82.1	81.7	82.2	-------	81.8	84.5	90.9	90.2	85.7	83.7	82.6
30	82.1	82.0	81.7	82.2	-------	81.85	84.7	90.9	90.1	85.6	83.6	82.6
31	82.1	-------	81.7	82.1	-------	81.9	-------	90.8	-------	85.5	83.6	-------

NOTE.—Add 2,800.00 feet to reduce to sea level. Automatic records Oct. 19–26, Nov. 1 to Dec. 3, and Apr. 12 to Sept. 30. No record June 6–15.

FLATHEAD RIVER NEAR POLSON, MONT.

LOCATION.—In sec. 19, T. 22 N., R. 21 W., on highway bridge at Norrisvale, 5 miles below Newell tunnel, 15 miles northwest of Ronana, and 12 miles below Polson, Lake County.

DRAINAGE AREA.—7,010 square miles.

RECORDS AVAILABLE.—July 23, 1907, to September 30, 1923.

GAGE.—Chain gage on downstream side of bridge installed March 10, 1921; read by Mrs. Jennie Wigen, April 9, 1916, to March 10, 1921, vertical staff in four sections on left bank. July 23, 1907, to April 9, 1916, chain gage on right bank. All gages at same datum.

DISCHARGE MEASUREMENTS.—Made from highway bridge at site of old ferry.

CHANNEL AND CONTROL.—Control not well defined but apparently permanent. Current fairly swift. Banks high.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 13.43 feet June 15 (discharge, 55,900 second-feet); minimum stage, 1.10 feet January 14 (discharge, 2,330 second-feet).

1907–1923: Maximum stage recorded, 16.4 feet June 12, 1913 (discharge, 75,400 second-feet); minimum stage recorded, —0.1 foot December 9–14 1919, and March 14, 1920 (discharge, 1,360 second-feet).

ICE.—Stage-discharge relation not affected by ice except during extremely cold winters.

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

REGULATION.—Flathead Lake forms a natural regulation.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 2,000 and 60,000 second-feet. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table except for periods affected by ice.

COOPERATION.—Gage heights furnished by United States Bureau of Reclamation; computations by United States Geological Survey.

Discharge measurements of Flathead River near Polson, Mont., during the year ending Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Apr. 12	1.83	2,920	June 19	13.05	55,000
May 23	10.30	34,600	Aug. 26	4.18	7,370

Daily discharge, in second-feet, of Flathead River near Polson, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3,650	3,130	2,660	2,580	2,930	2,530	2,510	12,700	44,400	38,800	14,600	6,650
2	3,650	3,020	2,650	2,600	2,870	2,530	2,600	14,100	44,400	38,500	14,100	6,560
3	3,650	3,020	2,640	2,560	2,860	2,510	2,710	14,200	45,000	37,700	14,000	6,430
4	3,650	3,020	2,640	2,660	2,800	2,510	2,800	14,200	45,200	36,900	13,300	6,300
5	3,510	2,960	2,630	2,650	2,800	2,470	2,910	14,000	45,800	36,300	13,400	6,670
6	3,510	2,960	2,670	2,680	2,820	2,460	3,150	15,700	45,800	35,100	12,900	6,120
7	3,510	2,960	2,650	2,620	2,820	2,420	3,150	16,200	45,800	33,900	12,500	5,910
8	3,510	2,940	2,650	2,630	2,820	2,420	3,150	17,300	46,400	33,300	11,400	5,700
9	3,510	2,930	2,720	2,600	2,890	2,420	3,140	20,900	46,800	31,500	11,400	5,110
10	3,510	2,930	2,600	2,580	2,910	2,510	3,140	22,000	47,800	30,300	11,000	5,300
11	3,510	2,930	2,600	2,580	2,910	2,510	3,130	23,000	49,300	29,200	10,900	4,750
12	3,510	2,920	2,600	2,530	2,930	2,470	3,040	25,800	50,500	28,000	10,700	4,720
13	3,510	2,920	2,620	2,540	2,930	2,470	3,010	26,900	53,000	27,400	10,300	4,660
14	3,510	2,900	2,510	2,330	2,950	2,460	3,250	29,500	55,500	26,300	10,200	4,580
15	3,380	2,890	2,530	2,420	2,950	2,460	3,510	31,500	55,900	26,000	10,000	4,580
16	3,380	2,890	2,520	2,910	2,950	2,440	3,650	32,000	55,200	25,800	9,900	4,580
17	3,380	2,880	2,600	2,700	2,660	2,440	3,800	32,100	55,300	24,700	9,830	4,500
18	3,380	2,870	2,630	2,600	2,660	2,420	4,100	32,800	54,300	24,100	9,770	4,420
19	3,380	2,870	2,720	2,700	2,630	2,420	4,420	33,200	53,700	23,000	9,410	4,420
20	3,380	2,870	2,760	2,800	2,630	2,420	6,780	33,000	53,000	22,500	9,410	4,420
21	3,380	2,860	2,800	2,860	2,640	2,420	7,010	33,900	50,400	21,400	8,660	4,340
22	3,250	2,830	2,840	2,910	2,640	2,420	7,250	34,500	49,400	21,400	8,490	4,260
23	3,250	2,830	2,870	2,910	2,620	2,420	7,740	35,500	48,300	21,400	7,490	4,260
24	3,250	2,820	2,910	2,910	2,600	2,420	8,050	37,600	46,400	21,400	6,780	4,130
25	3,250	2,820	2,860	2,960	2,600	2,440	7,770	38,800	45,800	21,400	6,780	4,100
26	3,250	2,750	2,750	2,980	2,530	2,440	7,820	40,600	41,400	19,800	6,780	4,010
27	3,250	2,740	2,620	2,990	2,510	2,460	7,920	42,500	40,000	17,300	6,780	3,950
28	3,250	2,680	2,510	3,020	2,510	2,460	9,410	44,400	39,600	16,800	7,250	3,860
29	3,130	2,670	2,420	3,110	-------	2,470	10,700	45,100	39,400	16,100	7,250	3,800
30	3,130	2,670	2,420	2,990	-------	2,490	11,200	46,200	39,000	15,900	7,110	3,800
31	3,130	-------	2,420	2,950	-------	2,490	-------	46,300	-------	15,400	6,780	-------

Monthly discharge of Flathead River near Polson, Mont., for the year ending Sept. 30, 1923

[Drainage area, 7,010 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	3,650	3,130	3,400	0.485	0.56	209,000
November	3,130	2,670	2,880	.411	.46	171,000
December	2,910	2,420	2,650	.378	.44	163,000
January	3,110	2,330	2,740	.391	.45	168,000
February	2,950	2,510	2,760	.394	.41	153,000
March	2,530	2,420	2,460	.351	.40	151,000
April	11,200	2,510	5,090	.726	.81	303,000
May	46,300	12,700	29,300	4.18	4.82	1,800,000
June	55,900	39,000	47,800	6.82	7.61	2,840,000
July	38,800	15,400	26,400	3.77	4.35	1,620,000
August	14,600	6,780	9,970	1.42	1.64	613,000
September	6,670	3,800	4,900	.699	.78	292,000
The year	55,900	2,330	11,700	1.67	22.73	8,480,000

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, Flathead County, and 2 miles above Lake MacDonald outlet.

DRAINAGE AREA.—900 square miles.

RECORDS AVAILABLE.—October 5, 1910, to September 30, 1923, when station was discontinued.

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

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

CHANNEL AND CONTROL.—Practically permanent. Banks high and not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 11.0 feet May 25 and 26 (discharge, 16,500 second-feet); minimum stage, 1.50 feet October 3 and 4 (discharge, 290 second-feet).

1910–1923: Maximum stage recorded, 20.0 feet June 21, 1916 (discharge determined by extension of rating curve, 49,000 second-feet); minimum stage, 0.7 foot March 19–28, 1922 (discharge, 122 second-feet).

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent except when affected by ice. Rating curve well defined between 325 and 20,000 second-feet. Gage read once daily to tenths, occasionally to half-tenths. Daily discharge ascertained by applying daily gage height to rating table. Records good.

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

October 20, 1923: Gage height, 1.65 feet; discharge, 340 second-feet.

Daily discharge, in second-feet, of Middle Fork of Flathead River at Belton, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	320	320	410		1,080	5,380	12,600	6,400	1,550	700
2	305	320	410		1,080	5,780	11,500	5,980	1,390	700
3	290	320	410		1,160	6,190	11,000	5,190	1,230	700
4	290	320	410		1,230	7,470	9,780	4,810	1,160	700
5	320	320	390		1,310	8,600	10,500	4,200	1,080	700
6	320	320	390		1,390	9,540	11,000	3,540	940	670
7	320	320	372		1,470	10,000	12,800	3,130	820	670
8	320	320	372		1,510	10,500	13,100	3,000	700	670
9	320	230	372		1,550	12,000	13,100	2,740	580	670
10	320	320	320		1,640	11,000	13,600	2,510	558	640
11	320	320	320		1,730	10,300	15,000	2,400	515	640
12	320	320	320		1,730	10,000	14,000	2,190	525	640
13	320	320	320		1,860	9,060	13,100	2,090	525	610
14	320	320			1,910	8,600	12,000	2,000	525	610
15	320	338			2,090	8,140	10,800	1,910	552	580
16	320	338			2,240	8,940	13,100	1,910	580	580
17	320	355			2,400	9,780	12,800	1,910	640	552
18	320	355			2,740	10,500	13,100	2,000	640	525
19	320	355			3,000	10,800	13,400	1,910	700	525
20	320	355			3,060	11,000	12,300	1,910	700	525
21	320	355			4,450	11,800	11,000	1,910	670	500
22	320	372		320	4,810	13,500	10,800	1,860	670	475
23	320	372		338	4,120	15,000	10,800	1,860	640	475
24	320	372		355	3,000	15,300	9,540	1,820	640	452
25	320	390		372	2,510	16,500	9,060	1,820	640	430
26	320	390		430	3,130	16,500	8,370	1,780	640	430
27	320	390		475	4,450	15,900	7,690	1,780	640	410
28	320	390		500	6,400	15,300	7,250	1,730	640	410
29	320	390		640	7,470	15,000	7,030	1,730	640	390
30	320	410		880	5,580	14,500	6,610	1,680	700	390
31	320			1,010		13,600		1,640	700	

NOTE.—Stage-discharge relation affected by ice Dec. 14 to Mar. 21; discharge not computed.

Monthly discharge of Middle Fork of Flathead River at Belton, Mont., for the year ending Sept. 30, 1923

[Drainage area, 900 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	320	290	318	0.353	0.41	19,600
November	410	320	347	.386	.43	20,600
December, 1–13	410	320	370	.411	.20	9,540
March, 22–31	1,010	320	532	.591	.22	10,600
April	7,470	1,080	2,740	3.04	3.39	163,000
May	16,500	5,380	11,200	12.4	14.30	689,000
June	15,000	6,610	11,200	12.4	13.83	666,000
July	6,400	1,640	2,620	2.91	3.36	161,000
August	1,550	515	746	.829	.96	45,900
September	700	390	566	.629	.70	33,700

NOTE.—See footnote to table of daily discharge.

SOUTH FORK OF FLATHEAD RIVER NEAR COLUMBIA FALLS, MONT.

LOCATION.—In NW. ¼ sec. 7, T. 30 N., R. 19 W., at highway bridge half a mile above mouth and 7 miles east of Columbia Falls, Flathead County.

DRAINAGE AREA.—1,640 square miles.

RECORDS AVAILABLE.—September 20, 1910, to September 30, 1916, and April 13, 1923, to September 30, 1923.

GAGE.—Stevens water-stage recorder installed April 13, 1923, in gage shelter on downstream side of pier. Datum same as chain gage used 1910–1916.

DISCHARGE MEASUREMENTS.—Made from highway bridge.

CHANNEL AND CONTROL.—Channel composed of boulders and cobblestones, probably permanent. No definite control. Banks high not subject to overflow.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period April 13 to September 30, 11.55 feet at 12.30 p. m. May 26 (discharge, 22,400 second-feet); minimum stage 2.18 feet at midnight September 30 (discharge, 394 second-feet).

1910–1916; 1923: Maximum stage recorded, 16.6 feet June 19, 1916 (discharge estimated by extension of rating table, 46,200 second-feet); minimum stage, that of September 30, 1923.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during the period. Rating curve well defined between 400 and 20,000 second-feet. Gage height ascertained from graph of Stevens water-stage recorder by inspection or by straight-line method. Hourly records used April 18, May 26–28, and June 13–14. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

Discharge measurements of South Fork of Flathead River near Columbia Falls, Mont., during the year ending Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge	Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Oct. 20	2.25	432	May 25	10.60	17,000	Aug. 26	2.96	1,040
Apr. 13	3.80	2,000	June 17	8.10	12,100			

Daily discharge, in second-feet, of South Fork of Flathead River near Columbia Falls Mont., for the period Apr. 13 to Sept. 30, 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1		7,400	9,510	6,490	1,670	788	16	3,640	8,970	12,700	3,050	1,220	579
2		5,860	11,500	6,140	1,640	752	17	4,960	8,580	11,500	3,330	1,200	586
3		5,020	10,300	5,750	1,620	734	18	6,790	9,510	10,300	3,740	1,180	579
4		4,860	9,240	5,310	1,590	718	19	7,140	9,780	9,380	3,370	1,160	572
5		5,970	9,380	4,880	1,510	700	20	5,900	10,300	8,580	3,060	1,140	565
6		8,080	11,100	4,600	1,460	684	21	4,790	12,500	8,450	2,860	1,100	551
7		9,920	13,200	4,500	1,440	660	22	4,080	14,600	9,240	2,690	1,080	544
8		11,900	14,900	4,750	1,400	652	23	3,640	17,300	8,970	2,560	1,060	544
9		14,300	16,300	4,360	1,380	638	24	3,590	16,900	8,710	2,400	1,040	530
10		15,800	18,100	4,060	1,360	630	25	3,600	17,500	8,080	2,320	1,020	524
11		16,600	20,000	3,800	1,340	622	26	4,200	20,900	7,580	2,240	1,010	537
13		14,200	19,500	3,700	1,310	615	27	5,570	18,000	7,260	2,120	976	517
13	2,020	11,800	19,600	3,510	1,290	600	28	7,500	13,400	7,160	1,990	935	524
14	2,460	11,600	15,300	3,330	1,270	593	29	8,280	10,600	6,970	1,890	885	491
15	2,780	10,300	12,800	3,120	1,250	579	30	8,320	9,640	6,850	1,820	855	417
							31		9,100		1,730	826	

Monthly discharge of South Fork of Flathead River near Columbia Falls, Mont., for the period Apr. 13 to Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
April 13-30	8,320	2,020	4,960	177,000
May	20,900	4,860	11,600	713,000
June	20,000	6,850	11,400	678,000
July	6,490	1,730	3,530	217,000
August	1,670	826	1,230	75,600
September	788	417	601	35,800

SWAN RIVER NEAR BIG FORK, MONT.

LOCATION.—In NW. ¼ sec. 14, T. 26 N., R. 19 W., at outlet of Swan Lake, 7 miles southeast of Big Fork, Flathead County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—April 28, 1922, to September 30, 1923.

GAGE.—Vertical staff with enamel face fastened to pier on left bank 1,000 feet below outlet of the lake; read by Pat Murphy.

DISCHARGE MEASUREMENTS.—Made from highway bridge three-fourths of a mile below gage or from boat.

CHANNEL AND CONTROL.—Bed composed of boulders and gravel. Banks subject to overflow at high stages. Control is rock ledge about 300 feet below gage, probably permanent.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.29 feet June 14 and 15 (discharge, 4,680 second-feet); minimum stage, 0.33 foot February 25 to March 24 (discharge, 268 second-feet).

1922–23: Maximum stage recorded, 4.85 feet at 7 a. m. June 8, 1922 (discharge, 5,500 second-feet); minimum stage that of February 25 to March 24, 1923.

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

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent during year. Rating curve well defined between 300 and 4,500 second-feet. Gage read twice daily October 1 to December 2, and once daily thereafter, occasionally twice during rapid change in stage. Daily discharge ascertained by applying daily gage height to rating table. Records, good.

Discharge measurements of Swan River near Big Fork, Mont., during the year ending Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Oct. 19	0.57	372	June 16	3.93	4,150
Apr. 15	1.28	850	Aug. 29	.96	565

Daily discharge, in second-feet, of Swan River near Big Fork, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	414	374	364	490	354	268	468	1,590	2,680	2,420	924	556
2	409	393	364	490	345	268	556	1,590	2,630	2,420	884	544
3	404	393	364	479	336	268	654	1,510	2,630	2,290	836	520
4	424	393	364	479	336	268	753	1,510	2,600	2,180	821	508
5	414	383	354	468	336	268	768	1,490	2,550	2,130	806	474
6	414	374	354	468	336	268	813	1,490	2,500	2,040	775	474
7	404	364	336	479	336	268	813	1,610	2,500	1,990	760	474
8	404	354	336	502	336	268	813	1,940	2,600	1,890	746	474
9	404	354	336	526	336	268	798	2,110	2,880	1,870	717	451
10	404	354	327	538	336	268	724	2,470	3,180	1,760	702	451
11	404	354	327	562	336	268	798	2,850	3,780	1,720	702	440
12	393	354	327	550	-------	268	813	3,140	4,020	1,670	688	440
13	393	354	318	550	-------	268	828	3,070	4,380	1,590	674	430
14	393	345	318	538	-------	268	876	3,000	4,680	1,550	647	435
15	393	345	318	538	-------	268	1,310	2,850	4,680	1,490	634	409
16	393	345	318	526	-------	268	958	2,550	4,000	1,410	634	409
17	393	369	318	514	-------	268	1,080	2,470	3,590	1,470	620	409
18	383	393	318	538	-------	268	1,220	2,290	3,350	1,500	607	435
19	383	374	318	490	-------	268	1,510	2,260	3,140	1,500	569	409
20	374	374	327	479	-------	268	1,720	2,210	2,960	1,500	569	409
21	393	374	336	457	-------	268	1,720	2,180	2,950	1,460	594	398
22	393	374	345	457	-------	268	1,670	2,320	2,880	1,400	647	388
23	393	374	354	446	-------	268	1,510	2,580	3,040	1,360	647	388
24	393	374	364	435	-------	268	1,410	2,850	3,120	1,280	647	388
25	393	364	364	424	268	276	1,360	3,140	3,040	1,210	620	388
26	393	354	364	424	268	284	1,280	3,490	2,890	1,180	620	388
27	393	354	393	414	268	300	1,240	3,860	2,820	1,140	620	419
28	393	354	414	414	268	318	1,320	4,000	2,650	1,080	620	388
29	393	354	468	404	-------	296	1,410	3,540	2,550	1,030	607	378
30	393	354	490	374	-------	364	1,610	3,140	2,440	983	594	388
31	383	-------	490	364	-------	414	-------	2,910	-------	933	582	-------

NOTE.—Stage-discharge relation affected by ice Feb. 12-24, discharge not computed.

Monthly discharge of Swan River near Big Fork, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	424	374	397	24,400
November	393	345	366	21,800
December	490	318	358	22,000
January	562	364	478	29,400
February 1-11, 25-28	354	268	320	9,520
March	414	268	280	17,200
April	1,720	468	1,090	64,900
May	4,000	1,490	2,520	155,000
June	4,680	2,440	3,120	186,000
July	2,420	933	1,600	98,400
August	924	569	681	41,900
September	556	378	435	25,900

BIG CREEK NEAR POLSON, MONT.

LOCATION.—In NW. ¼ sec. 4, T. 22 N., R. 19 W., just below power house of Mission Range Power Co., three-fourths of a mile above mouth, and 7 miles east of Polson, Flathead County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—June 1, 1917, to September 30, 1923.

GAGE.—Stevens eight-day water-stage recorder on left bank, used since June 14, 1917; prior to that date temporary gage on left bank 200 feet below. Recorder inspected by employees of Mission Range Power Co.

CHANNEL AND CONTROL.—An artificial control about 2 feet below gage. One channel at all stages. Banks high and not subject to overflow.

DISCHARGE MEASUREMENTS.—Made from foot log just below gage or by wading.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.96 feet at 8.30 a. m. June 22 (discharge, 27.1 second-feet). Canal and pipe line diverting 2.6 second-feet above gage. Total maximum flow 29.7 second-feet; minimum discharge, no flow as power plant was closed down for short periods during November and December—seldom longer than one or two hours.

1917–1923: Maximum stage recorded, 2.4 feet June 9, 1917 (discharge, from extended rating curve, 104 second-feet); mininum discharge, that of November and December, 1922.

ICE.—Stage-discharge relation affected by ice during extremely cold winters.

DIVERSIONS.—Polson A canal of United States Bureau of Reclamation diverts water between power house and gage, and intake for Polson pipe line is between canal and gage.

REGULATION.—Operation of power plant materially affects flow, maximum effect being during low-water period.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined between 2 and 30 second-feet. Daily gage heights determined from graph of Stevens water-stage recorder by using planimeter. Daily discharge ascertained by applying mean daily gage height to rating table and adding the flow in United States Bureau of Reclamation canal, and that in the Polson water-supply pipe line. Records good.

Discharge measurements of Big Creek near Polson, Mont., during the year ending Sept. 30, 1923

[Made by W. A. Lamb]

Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Oct. 19	1.32	3.6	June 16	1.48	8.2
May 24	1.47	7.1	Aug. 25	1.32	3.4

Daily discharge, in second-feet, of Big Creek near Polson, Mont., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.2	4.9	7.0	6.4	5.9	5.0	4.9	6.1	7.3	6.0	9.0	6.8
2	5.2	4.9	7.8	6.6	6.1	5.4	5.4	7.0	7.5	7.2	6.7	5.1
3	5.2	4.5	5.4	6.6	5.9	5.0	5.7	5.9	9.2	6.9	7.3	5.8
4	4.7	4.5	7.8	6.6	5.4	5.0	5.4	6.6	12.6	6.4	6.8	6.1
5	3.3	4.2	7.8	6.6	6.6	5.4	5.7	6.4	10.6	6.9	5.6	6.1
6	4.0	5.4	7.5	6.8	6.1	5.4	5.2	5.9	7.8	6.5	6.5	6.8
7	5.2	6.1	6.8	5.0	5.9	5.4	5.2	6.6	8.6	8.0	6.8	6.8
8	3.3	5.9	6.8	6.8	6.6	5.4	5.2	5.9	8.9	5.9	6.8	6.6
9	4.5	5.9	6.6	7.0	6.6	5.2	5.2	6.6	9.2	7.1	6.5	6.7
10	4.2	6.1	5.0	7.3	6.8	5.4	5.2	12.0	8.3	7.0	6.1	6.8
11	3.4	5.4	7.3	6.6	5.9	5.0	5.2	12.3	14.1	8.7	5.6	5.8
12	3.4	4.7	6.8	7.0	6.6	5.4	5.2	10.6	15.0	6.7	5.4	5.1
13	4.9	6.6	6.8	7.0	6.6	5.0	5.2	6.6	14.3	8.2	6.8	6.5
14	4.5	7.3	6.8	5.4	6.6	5.2	5.2	7.0	13.4	8.1	6.6	6.1
15	3.0	6.8	6.8	6.8	6.6	5.2	4.9	6.8	10.7	6.9	6.8	5.8
16	4.5	6.2	6.8	6.8	5.7	5.2	5.7	8.6	8.0	7.1	6.8	5.4
17	4.2	5.7	5.7	6.8	5.4	5.9	5.7	7.3	6.8	8.8	6.5	6.3
18	4.5	6.1	6.1	6.8	4.9	5.0	6.4	7.8	8.4	9.0	6.3	6.1
19	4.2	5.7	6.4	7.0	5.2	5.4	6.1	7.5	8.2	9.0	5.4	6.3
20	4.9	6.1	6.4	6.4	5.2	5.7	6.6	5.7	8.0	9.5	6.5	6.5
21	4.9	6.1	6.4	5.0	5.4	5.2	5.7	8.1	7.7	9.2	6.1	5.7
22	3.5	5.2	6.4	6.8	5.4	5.0	5.7	7.5	18.4	8.7	6.5	6.7
23	4.9	5.7	5.0	6.6	5.4	5.2	6.8	7.5	14.2	8.8	7.0	6.0
24	5.0	5.4	5.4	6.8	5.4	5.4	6.4	7.5	12.6	9.4	6.3	5.3
25	5.2	6.4	5.9	6.6	5.0	4.9	6.8	7.8	8.9	9.4	6.6	6.4
26	5.0	5.4	6.1	6.6	5.0	5.0	6.6	10.0	5.8	9.0	5.6	7.1
27	5.2	7.0	6.8	6.1	5.2	5.4	6.4	8.1	6.7	9.7	7.0	6.8
28	5.2	7.3	6.6	5.4	5.0	5.2	6.6	8.1	6.7	9.2	6.6	7.1
29	4.2	7.5	6.8	5.7	-------	5.0	6.4	7.3	7.4	8.7	6.3	6.6
30	5.0	5.7	6.8	5.9	-------	5.0	6.6	6.4	7.4	9.2	6.5	5.8
31	5.2	-------	6.6	5.9	-------	5.0	-------	7.3	-------	9.2	6.8	-------

Monthly discharge of Big Creek near Polson, Mont., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	5.2	3.0	4.47	275
November	7.5	4.2	5.82	346
December	7.8	5.0	6.55	403
January	7.3	5.0	6.44	396
February	6.8	4.9	5.80	322
March	5.9	4.9	5.22	321
April	6.8	4.9	5.78	344
May	12.3	5.7	7.57	465
June	18.4	5.8	9.76	581
July	9.7	5.9	8.08	497
August	9.0	5.4	6.52	401
September	7.1	5.1	6.23	371
The year	18.4	3.0	6.52	4,720

PRIEST RIVER AT OUTLET OF PRIEST LAKE, NEAR COOLIN, IDAHO

LOCATION.—In SW. ¼ sec. 5, T. 59 N., R. 4 W., at southwest end of Priest Lake, 2 miles northwest of Coolin, Bonner County.

DRAINAGE AREA.—572 square miles.

RECORDS AVAILABLE.—June 18, 1911, to September 30, 1918; May 1, 1919, to September 30, 1923.

GAGE.—Stevens water-stage recorder on right bank 600 feet below outlet; installed November 24, 1914; inspected by F. S. Williamson.

DISCHARGE MEASUREMENTS.—Prior to September 17, 1913, made from a boat at outlet; after that date from a cable about 300 feet above or by wading.

CHANNEL AND CONTROL.—Bed rough. Banks high. Control boulder riffle. Many large boulders and angular rocks at control catch logs and cause backwater.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from water-stage recorder, 4.5 feet on May 27 (discharge, 4,080 second-feet); minimum stage, from recorder, 0.38 foot some time between October 23–28 (discharge, 211 second-feet).

1911–1923: Maximum stage recorded from water-stage recorder, 6.83 feet at 1.30 p. m. May 30, 1917 (discharge, 7,290 second-feet); minimum stage, from recorder, 0.29 foot November 1 and 2, 1917 (discharge, 172 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 changed slightly during spring high water; affected by logs April 17 to May 5. Rating curves well defined. Operation of water-stage recorder fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from gage-height graph by inspection. Records good except for periods represented by flat estimates of discharge.

Discharge measurements of Priest River at outlet of Priest Lake, near Coolin, Idaho, during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 6	J. E. Stewart	0.56	275	June 29	R. B. Kilgore	3.55	2,810
May 13	J. S. Gatewood	4.17	3,620	Aug. 5	J. S. Gatewood	1.40	705
13	do	4.17	3,650	16	do	1.16	546
23	do	4.43	3,980				

Daily discharge, in second-feet, of Priest River at outlet of Priest Lake, near Coolin, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	255	362	281	412	472	354	362		3,800	2,700	830	431
2	262	358	277	439	472	354	366		3,800	2,520	788	423
3	259	354	281	452	467	354	378	2,600	3,800	2,400	754	415
4	274	350	281	467	457	366	395		3,800	2,340	721	399
5	288	350	277	487	452	366	439		3,660	2,220	702	395
6	285	350	285	513	448	370	507	2,760	3,800	2,170	689	383
7	277	338	259	524	444	370	507	2,820	3,800	2,060	677	375
8	274	338	259	536	444	370	524	2,880	3,800	2,000	665	371
9	270	338	274	547	439	362	530	3,080	3,940	1,950	641	367
10	267	334	292	564	439	362	547	3,270	3,940	1,900	635	363
11	264	330	281	564	439	362	582	3,400	3,940	1,840	624	359
12	261	330	277	553	439	362	644	3,530	3,940	1,730	608	347
13	258	326	274	553	426	362	690	3,660	3,940	1,680	596	335
14	255	322	270	536	416	358	746	3,660	4,080	1,620	591	323
15	255	315	266	536	421	358	781	3,660	3,940	1,570	580	315
16	248	307	270	536	416	354	823	3,660	3,800	1,470	560	303
17	248	311	266	536	408	358		3,800	3,800	1,420	545	295
18	240	322	274	541	395	350		3,800	3,660	1,420	530	291
19	236	322	277	541	374	346		3,800	3,530	1,370	515	291
20	236	322	281	536	378	342	1,100	3,940	3,400	1,280	510	291
21	236	319	277	530	374	338		3,940	3,400	1,230	530	295
22	233	315	277	524	374	338		3,940	3,400	1,180	525	299
23	229	311	288	524	374	338		3,940	3,270	1,140	520	291
24	248	307	307	507	370	346		3,940	3,270	1,100	505	279
25	267	307	315	497	370	342		3,940	3,200	1,060	500	272
26	285	303	334	487	366	342	1,900	3,940	3,080	1,040	490	258
27	304	300	374	492	362	346		4,080	3,010	1,010	480	254
28	323	296	399	502	358	346		3,940	2,880	972	471	250
29	342	288	412	497	-------	350		3,940	2,820	928	466	247
30	346	285	416	487	-------	354		3,800	2,700	890	453	247
31	358	-------	412	472	-------	354	-------	3,800	-------	852	444	-------

NOTE.—Water-stage recorder not operating Oct. 8-13, 24-28, and May 25; discharge estimated by interpolation. Braced figures show mean discharge for period April 17 to May 5 affected by backwater from logs.

Monthly discharge of Priest River at outlet of Priest Lake, near Coolin, Idaho, for the year ending Sept. 30, 1923

[Drainage area, 572 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	358	229	270	0.472	0.54	16,600
November	362	285	324	.566	.63	19,300
December	416	259	300	.524	.60	18,400
January	564	412	513	.897	1.03	31,500
February	472	358	414	.724	.75	23,000
March	370	338	354	.619	.71	21,800
April	-------	362	994	1.74	1.94	59,100
May	4,080	-------	3,480	6.08	7.01	214,000
June	4,080	2,700	3,570	6.25	6.97	212,000
July	2,700	852	1,580	2.76	3.18	97,200
August	830	444	585	1.02	1.18	36,000
September	431	247	325	.568	.63	19,300
The year	4,080	229	1,060	1.85	25.17	768,000

PRIEST RIVER AT PRIEST RIVER, IDAHO

LOCATION.—In T. 56 N., R. 5 W. Boise meridian, at highway bridge 1½ miles above mouth, 1 mile by road from town of Priest River, Bonner County.

DRAINAGE AREA.—904 square miles.

RECORDS AVAILABLE.—June 28, 1903, to April 30, 1905; November 17, 1910, to April 29, 1911; May 11, 1923, to December 31, 1923, when station was discontinued. Results for the period June 28, 1903, to April 30, 1905, are revised in this report and supersede those published in Water Supply Papers 100, 135, and 178.

GAGE.—Vertical staff on left bank at highway bridge established May 11, 1923; read by E. E. Shoup and M. V. Shoup. Earlier gages on right bank at same bridge but different datum.

DISCHARGE MEASUREMENTS.—Made from highway bridge at gage and railway bridge 1 mile below gage, or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders. Banks high. Control is gravel and boulder riffle; shifts at high stages.

EXTREMES OF DISCHARGE.—Maximum flow during period May 11 to December 31, 1923, occurred during May or June while stage-discharge relation was affected by logs and backwater from Clark Fork; stage and discharge not determined. Minimum stage recorded, 2.65 feet November 16 and 17 (discharge, 315 second-feet).

1903–1905; 1911; 1923: Maximum stage recorded, 7.65 feet, April 30, 1904 (discharge, 6,300 second-feet); minimum stage, that of November 16–17, 1923.

ICE.—Stage-discharge relation seriously affected by ice during severe winters.

DIVERSIONS.—None.

REGULATION.—Flash dam on West Branch used to store water for flushing logs down river during high-water periods. Dam probably operated daily during log-flushing season.

ACCURACY.—Stage-discharge relation changed some time between April 29, 1911, and May 11, 1923, while gaging station was not in operation; affected by ice, December 16–23, 1903, January 12–31, and February 1–10 and 12–20, 1905; affected by logs and backwater from Clark Fork June 28 to July 17, 1903, May 6 to July 1, 1904, and April 22 to July 11, 1923. Rating curve used for revision of early records is same as indicated in Water-Supply Paper 135. It is well defined between 500 and 6,500 second-feet. Rating curve used during 1923, is well defined. Gage read once daily to hundredths 1903 to 1905, and twice daily during 1923. Daily discharge ascertained by applying to rating table, daily gage height or mean daily gage height, corrected for amount of backwater in accordance with fairly well defined backwater curves. Records fair June and July, 1903, May and June, 1904, and May to July 1, 1923, and for periods of ice effect; otherwise good.

Discharge measurements of Priest River at Priest River, Idaho, during the period May 11 to Dec. 31, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
May 11	Parker and Gatewood	7.14	4,620	Aug. 5	J. S. Gatewood	3.81	941
23	J. S. Gatewood	7.47	4,690	17	do	3.47	731
24	do	7.47	4,940	Oct. 8	do	2.76	360
June 28	R. B. Kilgore	* 7.10	3,170	9	do	2.74	351
29	do	* 6.97	3,180				

* Backwater due to stage of Clark Fork.

Daily discharge, in second-feet, of Priest River near Priest River, Idaho, for the periods June 28, 1903, to Apr. 30, 1905, and May 11, 1923, to Dec. 31, 1923

Day	June	July	Aug.	Sept.	Day	June	July	Aug.	Sept.
1903					1903				
1		4,700	1,590	950	16		2,850	1,410	890
2		4,700	1,690	920	17		2,720	1,320	860
3		4,700	1,590	890	18		2,720	1,320	860
4		4,520	1,590	860	19		2,600	1,280	920
5		4,350	1,590	890	20		2,480	1,240	860
6		4,260	1,590	920	21		2,360	1,100	920
7		4,020	1,590	1,080	22		2,360	1,100	1,050
8		3,940	1,590	1,050	23		2,240	1,100	1,080
9		3,780	1,590	1,050	24		2,180	1,100	835
10		3,700	1,590	1,020	25		2,240	1,100	835
11		3,550	1,590	1,020	26		2,180	1,120	835
12		3,550	1,540	980	27		2,120	1,080	835
13		3,120	1,500	980	28	4,970	1,800	1,050	835
14		2,920	1,460	920	29	4,970	1,780	1,050	835
15		2,980	1,410	890	30	4,790	1,740	1,020	835
					31		1,740	950	

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1903-4												
1	835	950	1,240	1,020	920	890	1,100	4,350	5,000	2,980	1,240	675
2	835	950	1,370	1,020	862	920	1,240	4,970	5,250	3,120	1,200	675
3	835	950	1,240	1,020	890	890	1,280	5,920	5,100	2,980	1,100	655
4	810	890	1,200	1,020	920	920	1,370	5,920	5,250	2,980	1,120	655
5	862	950	1,100	1,020	950	920	1,460	5,920	5,000	2,850	1,080	635
6	1,080	1,080	1,160	980	950	980	1,840	5,820	5,100	2,600	1,000	615
7	1,050	1,320	1,200	980	950	1,050	1,840	5,720	5,250	2,540	1,000	615
8	980	1,200	1,100	980	950	1,250	1,840	5,540	5,250	2,480	1,020	615
9	950	1,100	1,160	980	950	1,540	1,900	5,440	5,100	2,300	980	598
10	950	1,200	1,160	980	920	1,500	2,000	5,340	5,160	2,250	950	598
11	980	1,120	1,160	980	950	1,500	2,300	5,250	5,000	2,250	920	580
12	1,020	1,020	1,120	980	950	1,410	2,600	5,100	4,880	2,000	890	580
13	1,020	1,050	1,120	980	950	1,410	2,980	5,000	4,520	2,120	890	580
14	1,020	1,080	1,120	980	950	1,370	3,400	5,000	4,520	2,010	862	580
15	1,020	1,050	1,160	1,020	950	1,320	4,180	5,000	4,350	2,010	862	562
16	1,020	1,020		1,080	950	1,240	4,520	5,000	4,350	1,900	835	562
17	1,020	950		1,120	950	1,410	4,520	5,000	4,270	1,900	835	562
18	1,050	950		1,120	950	1,280	4,350	5,000	4,200	1,800	810	562
19	1,020	890		1,080	920	1,240	4,180	5,100	4,350	1,790	810	545
20	1,050	950	1,100	1,020	920	1,280	4,180	5,250	4,200	1,740	785	545
21	1,050	980		1,050	920	1,240	4,350	5,250	4,020	1,690	762	530
22	1,020	1,080		1,120	920	1,240	4,700	5,540	3,940	1,640	762	562
23	1,020	1,080		1,020	890	1,200	4,880	5,630	3,800	1,590	740	562
24	1,020	1,050	1,200	1,020	920	1,200	4,880	5,630	3,780	1,540	718	562
25	1,020	1,020	1,160	980	920	1,080	4,790	5,540	3,550	1,500	718	545
26	980	1,020	1,160	980	950	1,080	4,880	5,340	3,400	1,460	695	530
27	980	1,020	1,120	950	950	1,080	5,250	5,440	3,330	1,410	695	530
28	980	1,020	1,080	950	890	1,120	5,630	5,250	3,190	1,370	695	530
29	950	1,020	1,050	950	920	1,120	6,200	5,250	3,200	1,320	695	530
30	950	1,120	1,050	920	------	1,160	6,300	5,250	3,050	1,280	695	530
31	950	------	1,050	920	------	1,160	------	5,060	------	1,240	675	------

Daily discharge, in second-feet, of Priest River near Priest River, Idaho, for the periods June 28, 1903, to Apr. 30, 1905, and May 11, 1923, to Dec. 31, 1923—Continued

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
1904–5							
1	530	515	635	695	580	890	1,790
2	515	515	615	655		920	1,740
3	515	500	615	695		980	1,690
4	515	500	615	718		1,050	1,640
5	515	500	615	740		1,020	1,640
6	515	500	598	740	600	1,080	1,640
7	530	500	598	740		1,080	1,640
8	545	500	598	740		1,120	1,640
9	545	500	598	675		1,120	1,690
10	545	500	598	675		1,160	1,640
11	545	485	598	635	635	1,200	1,640
12	530	485	615			1,160	1,640
13	515	485	598			1,120	1,640
14	530	485	615			1,120	1,690
15	515	500	655			1,120	1,690
16	530	515	655	550	700	1,160	1,790
17	515	515	655			1,160	1,640
18	515	515	635			1,240	1,690
19	515	515	635			1,280	1,590
20	515	598	635			1,370	1,690
21	515	835	635		890	1,590	1,690
22	515	810	635		890	1,690	1,740
23	500	675	598		890	1,690	1,790
24	500	655	615		890	1,790	1,790
25	500	635	615		890	1,790	1,900
26	500	635	615	600	950	1,790	2,010
27	500	635	615		1,020	1,790	2,240
28	500	635	615		890	1,790	2,240
29	500	635	615			1,740	2,240
30	500	635	695			1,790	2,360
31	515		718			1,790	

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1923						1923					
1				1,050	575	16	5,030		1,700	740	450
2				980	575	17	4,710		1,700	740	450
3				980	550	18	4,710	4,600	1,700	712	425
4				980	550	19	4,710		1,700	712	425
5		5,000		920	525	20	5,350		1,520	740	425
6			2,400	860	525	21	4,870		1,520	800	425
7				860	525	22			1,430	740	425
8				860	500	23			1,430	712	425
9				860	500	24			1,350	685	402
10				860	475	25			1,270	685	402
11	5,190			800	475	26	5,400	3,500	1,270	685	380
12	5,190		2,090	800	475	27			1,190	658	402
13	5,350	4,600	1,990	800	450	28			1,190	630	380
14	5,350		1,990	800	450	29			1,120	630	380
15	4,710		1,790	740	450	30			1,120	630	380
						31			1,050	602	

Day	Oct.	Nov.	Dec.	Day	Oct.	Nov.	Dec.	Day	Oct.	Nov.	Dec.
1923				1923				1923			
1	380	358	402	11	335	358	425	21	358	358	380
2	358	358	402	12	335	335	402	22	402	358	358
3	358	358	402	13	335	335	335	23	425	425	402
4	358	335	380	14	335	335	402	24	402	525	450
5	358	335	380	15	335	335	402	25	380	525	380
6	335	358	425	16	380	315	402	26	380	500	402
7	358	358	575	17	402	335	402	27	358	475	402
8	358	335	500	18	380	335	402	28	358	450	425
9	358	380	425	19	380	358	380	29	358	450	425
10	335	335	450	20	358	358	380	30	358	425	402
								31	335		335

Monthly discharge of Priest River at Priest River, Idaho, for the period July 1, 1903, to Apr. 30, 1905, and May 11, 1923, to Dec. 31, 1923.

[Drainage area, 904 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
1903						
July	4,700	1,740	3,060	3.38	3.90	188,000
August	1,690	950	1,360	1.50	1.73	83,600
September	1,080	835	928	1.03	1.15	55,200
The period						327,000
1903–4						
October	1,080	810	978	1.08	1.24	60,100
November	1,320	890	1,040	1.15	1.28	61,900
December	1,370	1,050	1,140	1.26	1.45	70,100
January	1,120	920	1,010	1.12	1.29	62,100
February	950	862	930	1.03	1.11	53,500
March	1,540	890	1,190	1.32	1.52	73,200
April	6,300	1,160	3,510	3.88	4.33	209,000
May	5,920	4,350	5,330	5.90	6.80	328,000
June	5,250	3,050	4,400	4.87	5.43	262,000
July	3,120	1,240	2,030	2.25	2.59	125,000
August	1,240	675	877	.970	1.12	53,900
September	675	530	580	.642	.72	34,500
The year	6,300	530	1,920	2.12	28.88	1,390,000
1905						
October	545	500	517	0.572	0.66	31,800
November	835	485	564	.624	.70	33,600
December	718	598	624	.690	.80	38,400
January	740		621	.687	.79	38,200
February	1,020		722	.799	.83	40,100
March	1,790	890	1,340	1.48	1.71	82,400
April	2,360	1,590	1,780	1.97	2.20	106,000
The period						370,000
1923						
May 11–31		4,710	5,200	5.75	4.49	217,000
June			4,370	4.83	5.39	260,000
July		1,050	1,820	2.01	2.32	112,000
August	1,050	602	782	.865	1.00	48,100
September	575	380	459	.508	.57	27,300
The period						664,000
1923						
October	425	335	363	.402	.46	22,300
November	525	315	380	.420	.47	22,600
December	575	335	408	.451	.52	25,100

SULLIVAN LAKE NEAR METALINE FALLS, WASH.

LOCATION.—About in sec. 31, T. 39 N., R. 44 E. (unsurveyed), near forest-ranger station at north end of Sullivan Lake, 4¼ miles east of Metaline Falls, Pend Oreille County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1923.

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 gage at same site and datum.

EXTREMES OF STAGE.—Maximum stage recorded during year, 24.2 feet July 12 to 14; minimum stage recorded, 3.9 feet on April 16–17.

1912–1923: Maximum stage recorded, 26.6 feet June 17–20, 1916, and May 23, 1919; minimum stage recorded, 0.7 foot on April 9–10, 1920.

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, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	19.75	18.15	15.3	11.1	7.1	6.4	4.55	6.5	16.3	23.8	23.1	-------
2	19.6	18.1	15.1	11.0	7.0	6.4	4.5	6.65	16.55	23.8	23.0	-------
3	19.55	18.05	14.95	10.95	-------	6.4	4.45	6.75	16.95	23.8	22.95	-------
4	19.5	18.0	14.85	10.9	-------	6.35	4.35	6.8	17.35	23.85	22.95	-------
5	19.45	17.9	14.75	10.85	-------	6.3	4.3	6.85	17.7	23.95	22.9	-------
6	19.4	17.8	14.65	10.65	-------	6.2	4.25	6.9	18.2	24.0	22.85	-------
7	19.35	17.8	14.45	10.4	-------	6.15	4.25	6.95	18.6	24.0	22.75	21.3
8	19.3	17.75	14.25	10.2	-------	6.1	4.2	6.95	19.0	24.0	22.7	21.3
9	19.25	17.7	14.05	10.0	6.8	6.1	4.2	6.95	19.4	24.0	22.7	21.3
10	19.2	17.65	13.85	9.9	6.75	6.1	4.15	7.15	19.7	24.1	22.65	21.25
11	19.2	17.6	13.7	9.8	6.75	6.1	4.1	7.5	20.3	24.15	22.5	21.15
12	19.15	17.5	13.4	9.7	6.75	6.1	4.05	8.0	20.6	24.2	22.4	20.0
13	19.1	17.4	13.1	9.6	6.7	6.1	4.0	8.2	21.0	24.2	22.3	20.8
14	19.0	17.3	12.9	9.55	6.7	6.1	4.0	8.4	21.3	24.2	22.25	20.65
15	19.0	17.2	12.7	9.45	6.7	6.1	3.95	8.55	21.5	24.15	22.2	20.55
16	18.9	17.1	12.55	9.4	6.7	6.0	3.9	8.9	21.85	24.1	22.15	20.45
17	18.85	17.0	12.3	9.35	6.7	6.0	3.9	10.0	21.9	24.1	22.15	20.3
18	18.8	16.85	12.0	9.3	6.7	5.85	3.95	10.5	22.0	24.0	22.15	20.2
19	18.75	16.7	11.85	9.2	6.65	5.7	4.15	10.8	22.4	24.0	22.0	20.1
20	18.7	16.55	11.75	9.1	6.6	5.55	4.25	10.9	22.5	23.95	21.9	20.0
21	18.65	16.4	11.65	8.85	6.55	5.35	4.2	10.95	22.7	23.95	21.85	20.0
22	18.6	16.3	11.55	8.6	6.5	5.2	4.25	11.6	23.0	23.9	21.75	19.95
23	18.55	16.2	11.45	8.4	6.5	5.1	4.3	12.1	23.1	23.85	21.7	19.9
24	18.5	16.1	11.4	8.15	6.5	5.0	4.35	12.8	23.25	23.8	21.65	19.85
25	18.45	16.0	-------	8.0	6.5	4.95	4.4	13.4	23.4	23.7	21.6	19.8
26	18.4	15.9	11.6	7.8	6.45	4.85	4.4	13.7	23.45	23.65	21.55	19.75
27	18.3	15.8	11.8	7.6	6.45	4.8	5.0	13.9	23.5	23.6	21.55	19.65
28	18.35	15.7	11.65	7.5	6.45	4.75	5.5	14.5	23.5	23.5	21.5	19.55
29	18.3	15.55	11.55	7.4	-------	4.7	5.9	15.0	23.7	23.4	21.5	19.5
30	18.25	15.45	11.4	7.3	-------	4.65	6.3	15.4	23.7	23.3	21.45	19.45
31	18.2	-------	11.2	7.2	-------	4.6	-------	15.9	-------	23.2	21.4	-------

NOTE.—Gage not read on days for which no record is given.

SULLIVAN CREEK NEAR METALINE FALLS, WASH.

LOCATION.—In sec. 30, T. 39 N., R. 44 E., one-eighth of a mile below Outlet Creek, half a mile below Sullivan Lake, and 4 miles east of Metaline Falls, Pend Oreille County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 16, 1912, to September 30, 1923.

GAGE.—Inclined staff on left bank installed October 27, 1919; read by A. J. McDougall. Previous gages as follows: May 16, 1912, to September 20, 1917, vertical staff on right bank directly opposite present gage and at same datum; September 21, 1917, to May 17, 1919, vertical staff in four sections at site and datum of present gage. Temporary staff gage installed May 25, 1919, and read until October 26, 1919. Readings on temporary gage referred to datum of previous gage.

DISCHARGE MEASUREMENTS.—Made by wading or from cable 40 feet below gage.

CHANNEL AND CONTROL.—Bed of cobblestones and coarse gravel; shifting. Banks high and not subject to overflow. Gradient steep. Stage of zero flow according to measurements made October 2, 1920, gage height —0.3 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.65 feet on May 12 (discharge, 682 second-feet); minimum stage recorded, 0.95 foot March 23 (discharge, 56 second-feet).

1912–1923: Maximum stage recorded, 4.2 feet June 2, 1913 (discharge, 1,650 second-feet); minimum stage recorded, 0.80 foot April 17–19, 1922 (discharge, 41 second-feet).

ICE.—Stage-discharge relation affected by ice only during extremely severe winters.

DIVERSION.—Water is diverted from Sullivan Creek about a mile above station for storage in Sullivan Lake, 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 December 11 and July 1; not affected by ice. Rating curves fairly well defined. Gage read to hundredths once daily. Surge makes it difficult to read gage accurately. Daily discharge ascertained by applying daily gage height to rating table. Records fair for May; otherwise good.

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, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
Oct. 3	J. E. Stewart	1.17	86
May 16	J. S. Gatewood	2.15	434
16	....do	2.14	414

Daily discharge, in second-feet, of Sullivan Creek near Metaline Falls, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	92	92	116	113	96	72	77	199	450	268	113	83
2	89	92	116	116	96	72	78	199	495	256	118	82
3	87	89	116	116	95	72	77	206	428	236	113	81
4	87	89	118	116	95	72	77	206	405	218	113	81
5	90	84	118	113	94	72	77	206	450	218	108	80
6	87	80	118	113	94	72	78	276	450	199	108	79
7	87	78	116	113	93	69	77	318	495	167	100	78
8	89	78	116	113	93	68	77	318	545	167	100	78
9	89	78	113	116	92	67	75	428	545	167	93	78
10	89	78	113	118	92	67	61	545	545	193	93	78
11	89	78	109	118	92	64	75	628	520	177	93	78
12	89	78	118	118	90	64	78	682	520	167	93	73
13	87	78	118	113	89	64	80	628	495	161	88	73
14	87	78	118	113	89	64	82	520	472	153	88	73
15	87	78	118	118	84	64	85	472	472	147	93	73
16	87	96	113	118	84	62	94	428	450	139	88	73
17	87	102	113	113	84	61	98	450	405	139	88	73
18	87	107	118	113	84	61	113	450	405	139	88	69
19	84	107	118	118	84	68	167	450	361	134	88	69
20	84	107	118	118	82	62	161	472	361	134	93	69
21	84	113	118	116	82	62	145	495	361	134	93	69
22	84	113	118	116	78	61	139	520	361	126	93	73
23	84	113	118	113	78	56	139	520	361	126	88	73
24	84	113	121	109	78	64	139	495	361	126	88	69
25	82	113	126	109	75	68	145	520	361	145	84	69
26	102	113	131	109	75	67	145	520	318	134	84	69
27	107	113	113	109	75	67	173	520	318	134	84	69
28	107	113	116	109	75	64	199	472	297	121	84	69
29	102	113	113	105	------	64	206	472	276	118	84	68
30	98	113	113	102	------	68	206	450	276	113	84	68
31	92	------	113	100	------	74	------	361	------	113	84	------

NOTE.—Gage not read Dec. 25, Feb. 3-8, and Sept. 1-6; flow estimated by interpolation.

Monthly discharge of Sullivan Creek near Metaline Falls, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	107	82	89.7	5,520
November	113	78	95.9	5,710
December	131	109	117	7,190
January	118	100	113	6,950
February	96	75	86.4	4,800
March	74	56	66.2	4,070
April	206	61	114	6,780
May	682	199	433	26,600
June	545	276	419	24,900
July	268	113	160	9,840
August	118	84	93.8	5,770
September	83	68	73.9	4,400
The year	682	56	155	113,000

COLVILLE RIVER BASIN

COLVILLE RIVER AT BLUE CREEK, WASH.

LOCATION.—In sec. 31, T. 33 N., R. 40 E., above small dam at sawmill just below mouth of Blue Creek, a quarter of a mile above Great Northern Railway crossing at Blue Creek, Stevens County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 28, 1922, to September 30, 1923.

GAGE.—Vertical staff gage on left bank installed October 28, 1922; read by Walter Peterson, G. R. Spink, and Howard Kjolseth.

DISCHARGE MEASUREMENTS.—Made from highway bridge, railway bridge below gage, or by wading.

CHANNEL AND CONTROL.—Banks moderately high; not subject to overflow. Bed is composed of soft mud. Control at low stage is small timber dam; overgrown bank and highway crossing are factors in high-water control. Stage of zero flow, according to measurement made August 3, 1923, gage height 0.02 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period October 28, 1922, to September 30, 1923, 4.5 feet April 8 (discharge, 468 second-feet); minimum discharge probably occurred during winter while gage was not being read.

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

DIVERSION.—A large percentage of summer flow diverted for irrigation above the station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation not permanent; affected by trash on control October 28, and for several long periods not definitely determined. Rating curves used prior to June 1 fairly well defined, curve used after June 1 poorly defined. Gage read to hundredths once daily October 28 to November 8, and with few exceptions twice daily thereafter. Daily discharge ascertained by applying mean daily gage height to rating table. Shifting-control method used April 2–8, June 1–14, and July 23 to September 30. Records fair.

Discharge measurements of Colville River at Blue Creek, Wash., during the period Oct. 29, 1922, to Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 29	R. B. Kilgore	1.03	72	May 24	R. B. Kilgore	1.52	126
Mar. 7	do	1.32	134	June 14	Kilgore and Parker	1.96	153
May 9	J. S. Gatewood	2.13	184	Aug. 3	J. S. Gatewood	.86	37.1
9	do	2.14	185	Sept. 29	do	.99	44.2

Daily discharge, in second-feet, of Colville River at Blue Creek, Wash., for the period Oct. 28, 1922, to Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		65	52	144			316		124	70	28	45
2		61	50	138			372		144	62	34	45
3		58	52	178			402		154	52	34	45
4		56		178		140	430		154	45	25	43
5		58		167			446	220	102	42	24	42
6		61		178			462		86	40	24	42
7		56		202		132	465		129	68	25	45
8		58		227		138	468		163	110	28	47
9		56		239		138	445	181	134	110	31	52
10		56		291		144	432		124	92	43	52
11		52		291		150	419		124	89	42	52
12		52		278		178	406		134	83	34	52
13		52		227		178	393		154	77	32	47
14		52		239		178	393		157	74	34	43
15		52	50	202	110	167	380		137	65	36	43
16		52		167		167	368	180	127	76	30	40
17		54		167		190	368		122	92	30	40
18		65		190		215	368		116	89	30	23
19		56		178		227	380		116	76	30	28
20		56		150		239	380		110	52	38	28
21		56		138		227	380		122	55	97	28
22		56		138		227	380		122	68	91	31
23		54		138		215	380		116	47	61	34
24		54		138		190	356	124	116	40	56	32
25		56		132		190	320	124	127	32	52	34
26		56	132	132		190	296	124	127	32	54	37
27		56	156	126		202	242	124	122	31	54	42
28	81	56	202			215		124	105	31	52	40
29	75	56	190	90		239	290	119	98	24	50	42
30	58	52	156			265		119	86	23	47	30
31	61		138			316		119		24	45	

NOTE.—Gage not read because of ice Dec. 4–25, because of ice and indifference of observer Jan. 28 to Mar. 6, and for other reasons Apr. 28 to May 8, and May 10–23; discharge estimated by comparison with flow at Meyers Falls. Braced figures show mean discharge for periods indicated.

Monthly discharge of Colville River at Blue Creek, Wash., for the period Oct. 28, 1922, to Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October 28–31	81	58	68.8	546
November	65	52	56.0	3,330
December	202		71.9	4,420
January	291		172	10,600
February			110	6,110
March	316		186	11,400
April	468		377	22,400
May		119	175	10,800
June	163	86	125	7,440
July	110	23	60.4	3,710
August	97	24	41.6	2,560
September	52	23	40.1	2,390
The period	468			85,700

COLVILLE RIVER AT MEYERS FALLS, WASH.

LOCATION.—In sec. 29, T. 36 N., R. 38 E., at Stevens County Light & Power Co.'s plant at foot of Meyers Falls, at town of Meyers Falls, Stevens County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—October 26, 1922, to September 30, 1923.

GAGE.—Vertical staff in two sections at confluence of power plant tailrace and river; read by plant attendants.

DISCHARGE MEASUREMENTS.—Made from cable or by wading a few hundred feet below gage.

CHANNEL AND CONTROL.—Right bank high, not subject to overflow; left bank may be overflowed at extremely high water. Channel straight for several hundred feet below gage. Control is of sand, gravel, and boulders which form pool at foot of falls; shifts at high stage. Stage of zero flow, according to measurement made September 28, 1923, gage height −0.17 foot, ±0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during period October 26, 1922, to September 30, 1923, 3.9 feet April 20 (discharge, 916 second-feet); minimum flow occurred during December when stage-discharge relation was affected by ice.

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

DIVERSIONS.—Several small ditches divert water for irrigation above station.

REGULATION.—Small reservoir above falls; effect probably slight.

ACCURACY.—Stage-discharge relation changed gradually August 1 to September 26; affected by ice December 8–23, 28, 31, and January 31 to February 23. Rating curve used directly until July 31 and as standard for shifting control thereafter is well defined. Gage read to hundredths two or three times daily. Daily discharge ascertained by applying mean daily gage height to rating table. Shifting-control method used August 1 to September 26; records good.

Discharge measurements of Colville River at Meyers Falls, Wash., during the period Oct. 26, 1922, to Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 26	R. B. Kilgore	1.44	100	May 6	J. S. Gatewood	3.26	616
27	do	1.46	102	25	R. B. Kilgore	2.66	375
Feb. 4	do	*1.84	135	27	do	2.58	363
16	Kilgore and Ford	*1.86	146	June 15	Kilgore and Parker	2.65	406
Mar. 5	R. B. Kilgore	1.98	192	Aug. 1	J. S. Gatewood	1.36	93
16	do	2.14	246	Sept. 26	do	1.33	77
May 6	J. S. Gatewood	3.26	629	28	do	1.35	83

* Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Colville River at Meyers Falls, Wash., for the period Oct. 26, 1922, to Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1		116	108	225		181	404	683	338	250	95	83
2		116	108	214		171	459	683	354	238	95	78
3		116	108	214		214	557	683	387	225	95	78
4		116	95	214		192	557	640	387	202	95	78
5		116	83	225		192	598	598	370	202	89	78
6		108	83	238	140	192	640	640	370	202	89	73
7		108	73	250		192	683	640	338	225	89	78
8		108		264		192	683	598	338	250	89	78
9		116		307		171	683	598	338	307	83	78
10		116	70	322		192	683	640	354	307	89	68
11		116		322		202	727	640	338	264	89	78
12		108		338		214	727	640	354	238	95	78
13		116		338		214	772	640	370	225	95	78
14		116		338		225	772	598	404	214	89	78
15		108	60	307		422	772	598	387	202	89	78
16		108		292		238	772	598	387	192	83	73
17		108		264	150	238	772	557	387	192	83	73
18		116		264		238	819	557	370	181	78	73
19		108		264		264	867	517	338	124	78	73
20		116	80	264		292	916	517	338	171	83	73
21		108		225		307	867	478	338	161	89	73
22		108		238		307	867	459	322	142	108	73
23		108		214		307	819	440	322	124	116	78
24		108	102	181	171	307	772	404	338	108	102	78
25		108	124	192	181	307	727	387	322	124	95	78
26	102	116	142	238	192	307	727	370	307	116	89	78
27	102	108	192	202	181	292	727	370	322	108	89	78
28	108	108	240	142	171	307	727	354	307	102	89	83
29	108	95	238	181	-------	307	727	338	277	108	89	78
30	108	95	238	133	-------	338	727	322	250	95	83	78
31	116	-------	240	110	-------	338	-------	338	-------	95	83	-------

NOTE.—Stage-discharge relation affected by ice Dec. 8–23, 28, 31, and Jan. 31 to Feb. 23; discharge estimated from study of observers' notes and weather record.

Monthly discharge of Colville River at Meyers Falls, Wash., for the period Oct. 26, 1922, to Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October 26–31	116	102	107	1,270
November	116	95	111	6,600
December	240	-------	107	6,580
January	338	110	243	14,900
February	192	-------	151	8,390
March	422	171	254	15,600
April	916	404	718	42,700
May	683	322	533	32,800
June	404	250	345	20,500
July	307	95	184	11,300
August	116	78	90.4	5,560
September	83	68	76.7	4,560
The period	916	-------	-------	171,000

HALL CREEK BASIN

HALL CREEK AT INCHELIUM, WASH.

LOCATION.—In NE. ¼ sec. 6, T. 32 N., R. 37 E., half a mile above highway bridge, three-fourths of a mile above mouth, and three-fourths of a mile northwest of Inchelium, Ferry County.

DRAINAGE AREA.—163 square miles; at former location at Wires Bridge, 3 miles above mouth, 160 square miles (measured on topographic map and maps of Colville Indian Reservation and Colville National Forest.)

RECORDS AVAILABLE.—December 18, 1912, to September 30, 1923.

GAGE.—Stevens water-stage recorder on right bank half a mile above highway bridge since August 27, 1916; inspected by H. G. Parmeter. For description of previous gages see Water-Supply Paper 442.

DISCHARGE MEASUREMENTS.—Made from cable 15 feet downstream from gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; shifts at extremely high stages. Channel straight above and below gage. Banks high. Stage of zero flow according to measurements made August 23, 1919, and August 27, 1920, gage height 0.7 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 3.13 feet at 2 a. m. April 19 (discharge, 306 second-feet); minimum discharge not determined; probably occurred during period October to March while station was not in operation.

1912–1923: Maximum stage recorded, 3.10 feet at 6.20 a. m. April 16, 1914 (discharge, 965 second-feet); minimum discharge probably occurred on January 1, 1919, when stage-discharge relation was affected by ice; discharge estimated at 4 second-feet.

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

DIVERSION.—Water is diverted for use in Gwen mine power plant but is returned above gage.

REGULATION.—Effect of operation of power plant negligible.

ACCURACY.—Stage-discharge relation permanent. Rating curve fairly well defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table the mean daily gage height determined by inspection from gage-height graph. Records good.

Discharge measurements of Hall Creek at Inchelium, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 16	R. B. Kilgore	1.50	17.0	June 20	Kilgore and Parker	2.50	135
Mar. 8	do	1.55	18.4	Sept. 24	J. S. Gatewood	1.56	19.0
May 3	J. S. Gatewood	2.72	194	25	do	1.55	18.7
3	do	2.72	196				

Daily discharge, in second-feet, of Hall Creek at Inchelium, Wash., for the year ending Sept. 30, 1923

Day	Mar.	Apr.	May	June	July	Aug.	Sept.
1		118	217	131	93	35	22
2		183	204	168	88	35	22
3		215	192	190	85	34	21
4		185	187	173	82	32	21
5		182	185	156	82	31	21
6		175	182	147	86	31	20
7		161	182	158	97	29	20
8	19	147	185	154	136	30	20
9	18	147	190	168	112	30	20
10	20	156	204	156	97	32	20
11	20	175	230	154	88	30	19
12	20	204	228	163	82	27	18
13	20	210	222	170	75	25	18
14	18	204	212	170	70	25	18
15	18	202	204	161	67	24	17
16	20	215	197	154	64	23	16
17	20	249	190	163	63	22	16
18	20	281	180	152	62	22	17
19	21	299	175	145	61	22	
20	23	275	170	138	59	35	
21	24	252	163	136	56	65	20
22	25	225	154	133	54	43	
23	25	210	147	127	52	36	
24	26	200	140	129	44	32	20
25	29	197	138	133	48	30	20
26	32	204	138	125	45	32	20
27	37	215	138	114	44	28	21
28	44	220	129	107	42	26	20
29	58	220	127	101	40	25	19
30	77	215	129	96	37	24	18
31	101		122		35	23	

NOTE.—Water-stage recorder not operating Sept. 19–23; discharge estimated from comparison with combined flow of Nespelem River and canal for same period. No record Oct. 1 to Mar. 7.

Monthly discharge of Hall Creek at Inchelium, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
March 8–31	101	18	30.6	1,460
April	299	118	205	12,200
May	230	122	176	10,800
June	190	96	146	8,690
July	136	35	69.2	4,250
August	65	22	30.3	1,860
September	22	16	19.5	1,160
The period				40,400

NOTE.—No record Oct. 1 to Mar. 7.

STRANGER CREEK BASIN

STRANGER CREEK AT METEOR, WASH.

LOCATION.—In sec. 21, T. 32 N., R. 36 E., at highway bridge at Meteor, 8 miles southwest of Inchelium, Ferry County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—August 29, 1916, to September 30, 1923.

GAGE.—Vertical staff on right bank 15 feet downstream from bridge; read by J. P. Collogan and Andrew Kilgore.

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

CHANNEL AND CONTROL.—Bed composed of gravel. One channel at all stages. Left bank subject to overflow at extremely high stages. Concrete control 6 feet downstream from gage. Stage of zero flow, according to measurements made April 6 and September 25, 1923, gage height zero.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.16 feet at 5 p. m. April 26 (discharge, 55 second-feet); minimum stage recorded, 0.22 foot March 11–13, 15, 16, 19–21 (discharge, 1.7 second-feet). Discharge probably lower during half year when records were not kept.

1916–1923: Maximum stage recorded, 2.0 feet from May 15–19, 1917, April 7–12, and April 20 to May 3, 1919 (discharge, 164 second-feet); probably no flow on December 12, 1919; creek frozen almost solid.

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

DIVERSIONS.—None.

REGULATION.—None.

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 good.

Discharge measurements of Stranger Creek at Meteor, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 17	R. B. Kilgore	0.21	1.5	May 5	J. S. Gatewood	1.11	50.2
17	do	.21	1.6	June 20	Kilgore and Parker	.73	18.6
Mar. 9	do	[a].25	2.5	20	do	.73	18.2
May 4	J. S. Gatewood	1.13	50.5	Sept. 25	J. S. Gatewood	.27	2.5
4	do	1.13	52.2				

[a] Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Stranger Creek at Meteor, Wash., for the year ending Sept. 30, 1923

Day	Mar.	Apr.	May	June	July	Aug.	Sept.
1		20	52	25	15.1	7.8	4.0
2		31	51	28	14.6	7.4	3.6
3		29	50	27	14.1	6.8	3.6
4		25	52	25	13.2	6.8	4.0
5		27	50	25	13.2	6.5	4.0
6		26	48	24	14.1	6.5	3.6
7		26	46	26	16.5	6.2	3.6
8		27	44	25	17.6	6.2	3.6
9		28	44	24	15.6	6.2	3.6
10		27	46	22	15.1	5.9	3.6
11	1.7	26	46	22	15.1	6.2	3.2
12	1.7	28	45	22	14.6	5.6	3.0
13	1.7	30	44	22	14.1	5.6	2.8
14	1.9	30	44	22	13.6	5.3	2.6
15	1.7	34	42	20	13.2	5.3	2.8
16	1.7	36	42	20	12.2	5.0	2.8
17	1.9	38	42	20	11.8	4.8	2.6
18	2.0	41	40	19	12.2	4.5	2.6
19	1.7	46	39	19	11.8	4.8	2.5
20	1.7	46	38	18	11.4	8.1	2.5
21	1.7	47	36	18	11.1	5.6	2.8
22	2.0	50	34	18	11.1	5.6	2.6
23	2.0	52	33	17	10.7	5.0	2.6
24	2.3	49	31	18	10.7	4.8	2.5
25		50	30	17	10.3	4.5	2.3
26		54	29	17	9.9	4.8	2.6
27		52	27	16.5	9.2	4.5	2.5
28	5.0	49	26	16.0	8.8	4.5	2.3
29		50	26	16.0	8.4	4.3	2.3
30		50	25	15.6	8.1	4.0	2.3
31			25		7.4	4.0	

NOTE.—No record Oct. 1 to Mar. 10. Record for Mar. 25–31 estimated by comparison with Hall Creek.

Monthly discharge of Stranger Creek at Meteor, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
March 11-31	----------	1.7	2.89	120
April	54	20	37.5	2,230
May	52	25	39.6	2,430
June	28	15.6	20.8	1,240
July	17.6	7.4	12.4	762
August	8.1	4.0	5.58	343
September	4.0	2.3	2.98	177
The period	----------	----------	----------	7,300

NOTE.—No record Oct. 1 to Mar. 10.

SPOKANE RIVER BASIN

COEUR D'ALENE RIVER NEAR CATALDO, IDAHO

LOCATION.—In sec. 26, T. 49 N., R. 1 E. Boise meridian, in Shoshone County, 1½ miles above Cataldo, Kootenai County, and 3 miles below junction of North and South forks.

DRAINAGE AREA.—1,220 square miles (measured by engineers of Washington Water Power Co. on map of Spokane River drainage basin compiled from best information available).

RECORDS AVAILABLE.—April 25, 1911, to December 31, 1912; July 29, 1920, to September 30, 1923.

GAGE.—Inclined staff on right bank, 1½ miles above Cataldo; installed August 4, 1921. Previous gages as follows: April 25, 1911, to December 31, 1912, vertical staff in two sections on right bank just below present site; July 29, 1920, to February 11, 1921, temporary vertical and inclined staff in two sections at site of present gage; February 12 to August 4, 1921, gage height obtained from reference points at same site and datum. Gages read by William Petznick and Lola Wilcox. Elevation of gage datum about 2,100 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable about 50 feet above gage or by wading.

CHANNEL AND CONTROL.—Channel straight for 500 feet above and 1,500 feet below gage. Left bank high and wooded; not subject to overflow. Right bank subject to overflow at gage height about 50 feet. Low-water control is boulder and gravel riffle about 1,500 feet below gage; high-water control not well defined, but is probably long stretch of river channel.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 47.3 feet on April 18 (discharge, 17,000 second-feet); minimum stage probably occurred during December while gage was not being read.

1911-12 and 1920-1923: Maximum stage recorded, 49.0 feet on March 18, 1921 (discharge, 22,000 second-feet); minimum discharge probably occurred during December, 1922, when gage was not read.

ICE.—Stage-discharge relation seriously affected by ice during severe winters; flow estimated from discharge measurements, observer's notes, and weather records.

DIVERSIONS.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed January 8; affected by ice February 11-19. Rating curve used prior to change fairly well defined below 15,000 second-feet; curve used after January 8 well defined between 500 and 10,000 second-feet. Gage read to half-tenths once daily. Daily discharge ascertained by applying daily gage heights to rating table. Records good.

COOPERATION.—Gage-height record and some discharge measurements furnished by Washington Water Power Co.

Discharge measurements of Coeur d'Alene River near Cataldo, Idaho, during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft*			*Feet*	*Sec.-ft.*
Oct. 2	Ford and Fisken	37.41	334	May 18	Ford and Kilgore	43.74	7,670
Jan. 25	J. L. Ford	39.46	1,680	June 5	J. L. Ford	43.11	6,420
Apr. 24	do	43.02	6,350	Aug. 10	Gatewood and Ford	37.92	584
May 17	Kilgore and Ford	43.38	6,790				

Daily discharge, in second-feet, of Coeur d'Alene River near Cataldo, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	315	440	335	1,600	950	1,150	9,220	7,720	4,690	1,740	672	468
2	315	490	315	1,360	885	1,220	11,600	6,440	7,720	1,740	618	422
3	315	440		1,430	820	1,150	9,720	5,310	7,150	1,600	618	422
4	335	395		1,300	730	1,080	7,720	5,150	6,610	1,580	618	422
5	335	355		1,290	672	1,220	7,530	5,790	6,440	1,500	618	422
6	355	355		2,670	672	1,360	7,340	9,470	6,270	1,500	618	422
7	355	355		5,050	618	1,220	6,110	11,600	6,610	1,430	618	422
8	355	335		11,600	565	1,150	5,470	14,900	6,110	1,300	618	422
9	335	335		7,910	515	1,020	4,990	13,500	5,790	1,290	618	422
10	315	335		5,630	468	950	5,310	13,000	5,470	1,220	590	422
11	315	335		5,950		1,020	6,440	11,300	5,310	1,220	590	400
12	315	335		5,790		1,020	7,910	8,980	5,150	1,150	590	400
13	295	335		4,540		1,020	9,980	8,320	4,540	1,150	515	400
14	295	335	280	3,110		950	9,220	7,910	3,940	1,150	515	400
15	295	335		2,480	350	885	8,980	7,530	3,510	1,150	515	380
16	295	335		2,250		1,150	12,400	7,150	3,240	1,080	515	380
17	295	375		2,980		1,020	16,100	6,970	3,110	1,080	515	380
18	295	465		3,650		950	17,000	7,720	2,850	1,080	490	380
19	295	540		3,370		1,080	14,400	7,720	2,850	1,020	565	380
20	295	515		2,850	380	1,290	10,500	7,340	2,850	950	885	380
21	315	490		2,480	380	1,360	8,110	6,970	2,720	885		380
22	335	440		2,150	565	1,900	6,270	7,150	2,720	885		380
23	335	395		1,980	730	1,660	6,110	7,150	2,600	885		380
24	355	395		1,740	950	1,660	6,610	6,610	2,480	885		380
25	375	375	1,290	1,660	1,080	1,740	7,150	6,110	2,360	885	610	380
26	515	375	1,430	1,580	1,020	2,060	8,320	7,340	2,060	820		380
27	540	355	1,660	1,430	1,020	2,300	10,200	6,270	1,980	820		380
28	490	355	2,890	1,290	1,080	4,090	11,800	5,150	1,900	730		380
29	440	335	3,000	1,220	-------	5,950	11,600	4,690	1,820	700	468	380
30	418	335	2,370	1,080	-------	7,720	9,470	4,240	1,740	672	468	380
31	440	-------	1,820	1,020	-------	9,470	-------	3,940	-------	672	468	-------

NOTE.—Gage not read Dec. 3-24; discharge estimated from weather records. Gage-height record Aug. 21-28 questionable; discharge determined after changing recorded gage heights to conform with a record kept at Cataldo Bridge 1 mile below.

Monthly discharge of Coeur d'Alene River near Cataldo, Idaho, for the year ending Sept. 30, 1923

[Drainage area, 1,220 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	540	295	351	0.288	0.33	21,600
November	540	335	386	.316	.35	23,000
December	3,000	----------	686	.562	.65	42,200
January	11,600	1,020	3,050	2.50	2.88	188,000
February	1,080	----------	616	.505	.53	34,200
March	9,470	885	2,000	1.64	1.89	123,000
April	17,000	4,990	9,120	7.48	8.34	543,000
May	14,900	3,940	7,720	6.33	7.30	475,000
June	7,720	1,740	4,090	3.35	3.74	243,000
July	1,740	672	1,130	.926	1.07	69,500
August	885	468	587	.481	.55	36,100
September	468	380	398	.326	.36	23,700
The year	17,000	----------	2,520	2.07	27.99	1,820,000

COEUR D'ALENE LAKE AT COEUR D'ALENE, IDAHO

LOCATION.—In SW. ¼ sec. 13, T. 50 N., R. 4 W., at Johnson's wharf, 800 feet southeast of railroad station at Coeur d'Alene, Kootenai County.

DRAINAGE AREA.—3,750 square miles (measured by Washington Water Power Co. on map of Spokane River drainage basin compiled from best available sources).

RECORDS AVAILABLE.—February 11, 1905, to September 30, 1923; April 25, 1903, to February 11, 1905, at St. Joe Boom Co.'s gage at mouth of St. Joe River.

GAGE.—Stevens continuous water-stage recorder at wharf; inspected by employees of Washington Water Power Co. Prior to March 24, 1921, gage was vertical staff at same site; read by Henry Kloppenburg. Gage datum is 2,100 feet above mean sea level.

EXTREMES OF STAGE.—Maximum stage recorded during year from water-stage recorder, 30.63 feet at noon May 13; minimum stage recorded, 22.10 feet from 10 a. m. February 24 to 10 p. m. February 25.

1903–1923: Maximum stage recorded, 36.00 feet at 6.15 p. m. January 3, 1918; minimum stage recorded, 19.9 feet on October 10–12, 1904, September 24–25, 1905, and October 14 to November 3, 1906.

The maximum stage known to early settlers, 37.6 feet as determined from high-water marks, occurred May 31, 1894.

DIVERSIONS.—None.

REGULATION.—Considerable storage is used by the Washington Water Power Co. Flow is regulated by Taintor gates and bear-trap dam at Post Falls.

ACCURACY.—Except for a very few days gage heights have been determined by inspection from gage-height graph. Records excellent.

COOPERATION.—Gage-height record furnished by 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, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	24.62	24.10	23.17	23.49	23.23	22.23	25.51	30.09	28.70	26.49	26.42	26.12
2	24.60	24.07	23.13	23.53	23.09	22.29	26.18	29.97	28.83	26.41	26.42	26.08
3	24.57	24.03	23.12	23.56	22.98	22.34	26.92	29.79	29.08	26.40	26.43	26.04
4	24.59	24.00	23.08	23.51	22.85	22.39	27.41	29.52	29.22	26.45	26.44	26.00
5	24.56	23.96	23.03	23.56	22.76	22.44	27.69	29.29	29.29	26.51	26.43	25.96
6	24.55	23.94	22.97	23.68	22.67	22.52	27.87	29.17	29.31	26.50	26.42	25.91
7	-------	23.91	22.87	24.16	22.58	22.51	28.00	29.19	29.33	26.52	26.41	25.87
8	-------	23.85	22.82	24.85	22.51	22.54	28.03	29.38	29.39	26.52	26.41	25.82
9	24.51	23.78	22.82	25.51	22.41	22.51	27.98	29.70	29.41	26.47	26.39	25.79
10	24.50	23.73	22.83	25.84	22.34	22.53	27.86	30.13	29.41	26.44	26.38	25.72
11	24.48	23.70	22.75	26.00	22.28	22.49	27.83	30.41	29.37	26.49	26.37	25.65
12	24.48	23.68	22.68	26.11	22.32	22.47	27.87	30.60	29.32	26.51	26.36	25.61
13	24.46	23.65	22.59	26.12	22.19	22.48	27.96	30.61	29.17	26.51	26.35	25.58
14	24.43	23.60	22.52	26.03	22.19	22.47	28.10	30.57	29.10	26.50	26.32	25.53
15	24.41	23.57	22.44	25.86	22.19	22.44	28.22	30.40	28.83	26.47	26.29	25.46
16	24.39	23.51	22.38	25.61	22.20	22.39	28.41	30.33	28.58	26.45	26.27	25.38
17	24.36	23.55	22.32	25.47	22.22	22.42	28.71	30.22	28.33	26.49	26.23	25.31
18	24.33	23.58	22.27	25.35	22.22	22.45	29.20	30.10	28.08	26.48	26.21	25.28
19	24.31	23.59	22.24	25.24	22.24	22.50	29.69	30.02	27.84	26.47	26.19	25.24
20	24.30	23.59	22.21	25.17	22.22	22.54	30.09	29.99	27.61	26.49	26.27	25.18
21	24.30	23.57	22.17	25.00	22.21	22.63	30.29	29.93	27.39	26.50	26.30	25.15
22	24.28	23.55	22.16	24.85	22.12	22.76	30.21	29.83	27.19	26.50	26.30	25.11
23	24.30	23.50	22.16	24.69	22.11	22.82	30.04	29.80	26.95	26.50	26.31	25.07
24	24.30	23.47	22.22	24.50	22.10	22.89	29.78	29.73	26.75	26.50	26.30	25.02
25	24.30	23.41	22.30	24.36	22.10	22.98	29.61	29.63	26.55	26.50	26.28	25.00
26	24.30	23.36	22.41	24.20	22.13	23.07	29.49	29.54	26.36	26.49	26.26	24.97
27	24.30	23.31	22.60	24.07	22.13	23.18	29.50	29.55	26.29	26.49	26.26	24.93
28	24.30	23.27	22.85	23.90	22.18	23.39	29.57	29.47	26.54	26.50	26.23	24.89
29	24.15	23.23	23.12	23.73	-------	23.78	29.79	29.30	26.45	26.51	26.21	24.86
30	24.10	23.20	23.30	23.56	-------	24.27	30.00	29.06	26.51	26.51	26.19	24.82
31	-------	-------	23.44	23.37	-------	24.92	-------	28.84	-------	26.49	26.16	-------

NOTE.—Water-stage recorder not operating and gage not read Oct. 7–8 and 31.

32430—26†—WSP 572——9

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 of a mile below intake of Spokane Valley Land & Water Co.'s canal, and 1 mile west of Post Falls, Kootenai County.

DRAINAGE AREA.—3,880 square miles (measured by engineers of Washington Water Power Co. on map of Spokane River drainage basin to scale of one-half inch to the mile, compiled from best sources available).

RECORDS AVAILABLE.—January 1, 1913, to September 30, 1923.

GAGE.—Stevens water-stage recorder on right bank since November 22, 1920; inspected by employees of Washington Water Power Co. Previous gage vertical staff in three sections on left bank. Elevation of zero of gage, 2,000 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable 600 feet above gage.

CHANNEL AND CONTROL.—Bed composed of coarse gravel and boulders; shifts during floods. One channel at all stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 73.35 feet at 4.30 a. m. on May 13 (discharge, 21,400 second-feet); minimum stage, from recorder, 65.75 feet at 5.30 a. m. August 9 (discharge, 780 second-feet).

1913–1923: Maximum stage recorded, 79.20 feet at 7.30 a. m. May 18, 1917 (discharge, 39,800 second-feet); minimum stage recorded, 65.15 feet at 11 a. m. September 5, 1922 (discharge, 578 second-feet).

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

DIVERSION.—Spokane Valley Land & Water Co.'s canal diverts water above gage for irrigation. Mean diversion during 1923, 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; rating curve well defined. Operation of water-stage recorder satisfactory except as stated in footnote to table of daily discharge. Daily discharge April 17 to June 15 ascertained by applying to rating table mean daily gage height determined by inspection from gage height graph, otherwise by use of discharge integrator. Records excellent.

COOPERATION.—Gage-height record and some discharge measurements furnished by Washington Water Power Co.

Discharge measurements of Spokane River at Post Falls, Idaho, during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Mar. 28	J. L. Ford	68.66	4,370	May 23	Kilgore and Ford	72.87	18,500
May 19	Ford and Kilgore	72.98	19,700	Aug. 7	Ford and Gatewood	66.14	914

Daily discharge, in second-feet, of Spokane River at Post Falls, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,020	1,240	1,460	3,540	4,310	2,210	9,000	19,600	16,200	5,930	878	1,140
2	1,000	1,260	1,520	3,840	4,110	2,300	10,000	19,600	16,200	5,380	930	1,110
3	1,000	1,330	1,400	4,020	3,980	2,460	11,300	18,700	16,600	3,270	934	
4	995	1,350	1,320	3,740	3,810	2,680	12,600	18,300	17,000	2,170	922	
5	1,020	1,290	1,270	4,070		2,720	13,100	17,900	17,000	2,850	940	
6	982	1,270	1,450	5,000		2,860		17,400	17,000	3,320	946	
7	990	1,220	1,580	6,520		3,040	14,000	17,400	17,000	3,610	958	
8	1,030	1,240	1,660	7,480		2,820		17,900	17,000	4,240	976	1,170
9	1,050	1,250	1,610	8,400	2,300	2,930	14,400	18,700	17,400	3,560	1,040	
10	1,010	1,240	1,630	9,220		2,920	14,200	19,600	17,000	2,270	1,040	
11	1,050	1,240		9,520		2,790	14,100	20,500	17,000	1,820	1,030	
12	1,020	1,220		9,880		2,850	14,200	21,000	17,000	2,380	1,050	
13	1,040	1,360		9,920		2,760	14,400	21,000	16,600	2,560	1,140	
14	1,020	1,340		9,860	1,260	2,730	14,700	21,000	16,200	2,800	1,050	1,450
15	1,040	1,360	1,550	9,540	1,360	2,750	15,000	20,500	15,800	2,660	1,100	1,410
16	1,000	1,380		9,050	1,320	2,680	15,300	20,500	15,000	1,760	1,200	1,400
17	1,010	1,400		8,630	1,460	2,620	16,200	20,000	14,400	1,720	1,230	1,350
18	988	1,340		8,300	1,260	2,660	17,000	20,000	13,900	2,200	1,240	1,310
19	986	1,390	1,730	8,090	1,980	2,760	18,700	19,600	13,300	1,440	1,400	1,270
20	1,010	1,250	1,580	7,780	2,490	3,020	19,600	19,600	12,800	1,290	1,360	1,370
21	1,040	1,400	1,410	7,320	2,560	3,230	20,000	19,200	12,300	1,500	1,260	1,400
22	1,000	1,530	1,310	7,180	2,300	3,620	20,000	19,200	11,900	1,430	1,100	1,380
23	951	1,530	1,160	6,830	2,300	3,870	19,600	19,200	11,400	1,200	1,060	1,420
24	1,030	1,520	1,090	6,460	2,300	4,160	18,700	18,700	11,000	1,350	1,110	1,330
25	1,080	1,520	1,120	5,940	2,300	4,440	18,700	18,700	10,300	1,400	1,100	1,380
26	1,020	1,500	1,290	5,580	2,320	4,470	18,300	18,300	8,320	970	1,000	1,420
27	1,040	1,510	1,300	5,320	2,330	4,410	18,300	18,300	5,220	918	955	1,430
28	1,100	1,400	1,640	4,860	1,840	4,680	18,300	17,900	3,600	922	986	1,270
29	1,160	1,270	2,110	4,680	-------	5,280	18,700	17,400	3,500	923	1,110	1,240
30	1,180	1,260	2,440	4,860	-------	6,000	19,600	17,000	4,560	958	1,070	1,200
31	1,200	-------	3,040	4,520	-------	7,000	--------	16,200	--------	932	1,060	-------

NOTE.—Water-stage recorder not operating Dec. 11–18, Feb. 5–13, Mar. 30 to Apr. 2, Apr. 6–8, and Sept. 3–13; discharge Dec. 11–18 and Feb. 5–13 estimated from records of Coeur d'Alene Lake and tributaries. Other gaps in record filled by comparison with records of flow at Spokane. Braced figures show mean discharge for periods indicated.

Monthly discharge of Spokane River and Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, for the year ending Sept. 30, 1923

[Drainage area, 3,880 square miles]

Month	Discharge in second-feet						Run-off (combined)	
	River			Canal (mean)	Combined			
	Maximum	Minimum	Mean		Mean	Per square mile	Inches	Acre-fe
October	1,200	951	1,030	38	1,070	----------	----------	65,800
November	1,530	1,220	1,350	14	1,360	----------	----------	80,900
December	3,040	1,090	1,570	0	1,570	----------	----------	96,500
January	9,920	3,540	6,770	0	6,770	----------	----------	416,000
February	4,310	----------	2,370	0	2,370	----------	----------	132,000
March	7,000	2,210	3,410	0	3,410	----------	----------	210,000
April	20,000	9,000	15,900	0	15,900	----------	----------	946,000
May	21,000	16,200	19,000	28	19,000	----------	----------	1,170,00
June	17,400	3,500	13,400	180	13,600	----------	----------	809,000
July	5,930	918	2,250	223	2,470	----------	----------	152,000
August	1,400	878	1,070	203	1,270	----------	----------	78,10
September	----------	----------	1,270	90	1,360	----------	----------	80,90
The year	21,000	878	5,780	65+	5,850	1.51	20.50	4,240,00

NOTE.—Monthly discharge in second-feet per square mile and run-off in inches not computed owing to regulation. The yearly figures represent the natural yield quite closely.

SPOKANE RIVER AT SPOKANE, WASH.

LOCATION.—In sec. 13, T. 25 N., R. 42 E., about opposite Cochrane Street, Spokane, Spokane County, one-fourth of a mile above high railroad viaduct, and 3 miles above Latah Creek.

DRAINAGE AREA.—4,350 square miles (measured by engineers of Washington Water Power Co. on maps of Spokane River drainage basin, scale one-half inch to the mile, compiled from the best available sources.

RECORDS AVAILABLE.—April 1, 1891, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on right bank at Cochrane Street about 1 mile below Monroe Street Bridge, installed May 9, 1921, and used since July 1, 1921. For description of previous gages see Water-Supply Paper 552. Approximate elevation of gage datum, 1,700 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable at gage.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders. One channel at all stages. Control is well-defined riffle one-fourth of a mile below gage; permanent. Stage of zero flow estimated at gage height 14.5 feet on October 7, 1922.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 24.5 feet at 10.30 a. m. on May 13 (discharge, 22,000 second-feet); minimum stage from recorder, 16.70 feet at 8.30 a. m. October 21 (discharge, 500 second-feet).

1891–1923: Maximum stage recorded, 12.42 feet (on gage at dam above Spokane Falls) May 31, 1894 (discharge, 49,000 second-feet); minimum discharge that of October 21, 1922.

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

DIVERSION.—Water is diverted above the station for irrigation by the Spokane Valley Land & Water Co.

REGULATION.—Flow partly regulated by storage in Coeur d'Alene Lake since July, 1906.

ACCURACY.—Stage-discharge relation at present site permanent. Rating curve revised slightly January 1 and is well defined. Operation of water-stage recorder satisfactory, except as noted in footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator. Records excellent.

COOPERATION.—Gage-height record and some discharge measurements furnished by Washington Water Power Co.

Discharge measurements of Spokane River at Spokane, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 7	J. E. Stewart	17.68	1,520	May 21	J. S. Gatewood	24.02	19,500
Mar. 29	J. L. Ford	19.81	5,080	June 26	J. L. Ford	21.67	10,500
Apr. 23	Ford and Becker	24.10	20,100	July 27	do	17.84	1,720
May 18	Gatewood and Becker	24.10	19,400	Sept. 6	do	17.74	1,630

Daily discharge, in second-feet, of Spokane River at Spokane, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,510	1,720	1,820	3,680	5,060	2,560	8,720	20,500	16,500	6,650	1,700	1,700
2	1,530	1,720	1,930	3,760	4,820	2,820	9,920	20,100	16,400	6,820	1,580	1,780
3	1,520	1,780	1,940	4,120	4,660	2,860	11,400	19,600	16,800	5,070	1,690	1,740
4	1,520	1,790	1,780	3,910	4,500	3,010	12,600	19,000	17,200	3,750	1,660	1,600
5	1,560	1,770	1,710	3,970	4,250	3,140	13,300	18,400	17,400	3,580	1,660	1,620
6	1,500	1,800	1,880	4,780	4,100	3,110	13,900	17,900	17,600	4,440	1,600	1,700
7	1,500	1,770	1,990	6,110	3,940	3,280	14,300	18,000	17,600	4,320	1,630	1,740
8	1,460	1,760	2,100		3,730	3,270	14,400	18,500	17,600	5,000	1,620	1,780
9	1,530	1,740	2,100		3,430	3,180	14,400	19,200	17,700	4,620	1,630	1,790
10	1,460	1,740	2,110		3,340	3,260	14,300	20,100	17,700	3,460	1,770	1,840
11	1,510	1,740	2,060	9,600	3,240	3,230	14,200	21,000	17,400	2,940	1,700	1,920
12	1,520	1,740	2,090		3,250	3,290	14,300	21,500	17,400	3,170	1,700	2,000
13	1,620	1,790	2,200		2,720	3,320	14,500	21,500	17,200	3,300	1,720	2,080
14	1,720	1,790	2,270		2,050	3,280	14,800	21,500	17,000	3,630	1,720	2,080
15	1,550	1,850	2,280		1,980	3,230	15,100	21,500	16,400	3,460	1,750	2,010
16	1,540	1,870	2,280	9,590	2,080	3,240	15,500	21,000	16,000	3,030	1,730	2,050
17	1,550	1,910	2,280	9,190	2,200	3,220	16,100	20,500	15,300	2,540	1,860	1,970
18	1,560	1,790	2,270	8,980	2,100	3,220	17,000	20,500	14,700	3,000	1,820	1,980
19	1,530	1,840	2,240	8,790	2,300	3,300	18,300	20,100	14,100	2,640	1,890	1,950
20	1,560	1,820	2,100	8,640	2,930	3,280	19,600	20,100	13,600	2,100	2,180	1,960
21	1,550	1,820	2,000	8,260	3,040	3,400	20,500	19,600	13,200	2,380	1,900	2,060
22	1,560	1,960	1,790	7,890	2,900	3,560	20,500	19,600	12,800	2,350	1,870	2,040
23	1,510	1,940	1,800	7,640	2,850	3,760	20,100	19,500	12,400	2,140	1,660	2,040
24	1,450	1,990	1,620	7,360	2,820	3,940	19,600	19,400	11,900	2,200	1,720	2,040
25	1,610	1,980	1,580	6,980	2,840	3,980	19,100	19,000	11,600	2,300	1,720	1,960
26	1,620	1,940	1,730	6,800	2,850	4,220	19,000	18,800	10,100	2,000	1,660	2,070
27	1,540	1,940	1,820	6,520	2,820	4,400	18,900	18,800	7,450	1,780	1,640	2,080
28	1,570	1,940	1,920	6,350	2,660	4,730	19,200	18,500	5,390	1,720	1,640	1,920
29	1,680	1,770	2,320	5,630	------	5,220	19,600	18,000	4,890	1,740	1,640	1,850
30	1,730	1,680	2,680	5,660	------	6,140	20,100	17,300	5,320	1,690	1,740	1,900
31	1,750	------	2,870	5,300	------	7,080	------	16,700	------	1,700	1,680	------

NOTE.—No gage-height record Jan. 8–15; discharge estimated from comparison with flow at Post Falls, Idaho. Braced figures show mean discharge for period indicated.

Monthly discharge of Spokane River at Spokane, Wash., for the year ending Sept. 30, 1923

[Drainage area, 4,350 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	1,750	1,450	1,560	----------	----------	95,900
November	1,990	1,680	1,820	----------	----------	108,000
December	2,870	1,580	2,050	----------	----------	126,000
January	----------	3,680	7,310	----------	----------	449,000
February	5,060	1,980	3,200	----------	----------	178,000
March	7,080	2,560	3,660	----------	----------	225,000
April	20,500	8,720	16,100	----------	----------	958,000
May	21,500	16,700	19,500	----------	----------	1,200,000
June	17,700	4,890	14,200	----------	----------	845,000
July	6,820	1,690	3,210	----------	----------	197,000
August	2,180	1,580	1,730	----------	----------	106,000
September	2,080	1,600	1,910	----------	----------	114,000
The year	21,500	1,450	6,360	1.46	19.82	4,600,000

NOTE.—Monthly discharge in second-feet per square mile and run-off in inches not computed owing to regulation. The yearly figures represent the natural yield quite closely.

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 5 miles below Long Lake, Lincoln County.

DRAINAGE AREA.—6,380 square miles (measured by engineers of Washington Water Power Co. on maps compiled from best sources available).

RECORDS AVAILABLE.—November 5, 1912, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank; datum 1,200 feet above mean sea level.

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

CHANNEL AND CONTROL.—Bed composed of large boulders; shifting at high stages. Banks high. One channel at all stages. No noticeable riffle control below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from water-stage recorder, 87.33 feet at 10 a. m. June 18 (discharge, 30,400 second-feet); minimum stage from recorder, 73.68 feet at 5.20 a. m. November 20 (discharge, 1,170 second-feet).

1912–1923: Maximum stage, from water-stage recorder, 90.32 feet at 8.30 p. m. May 18, 1917 (discharge, 41,300 second-feet). Minimum stage recorded, that of November 20, 1922.

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

DIVERSIONS.—Water is diverted by the Spokane Valley Land & Water Co. for irrigation above the station.

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. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator or by applying to rating table the mean gage heights determined from graph by inspection or, during period of faulty record, by applying to rating table gage heights determined from curve of relation between station gage and tailrace gage at Little Falls power plant. Records excellent.

COOPERATION.—Gage-height record and some of the discharge measurements furnished by Washington Water Power Co.

Discharge measurements of Spokane River below Little Falls, near Long Lake Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
May 19	Gatewood and Becker	84.91	22,000
June 25	Ford and Godfrey	82.08	14,100

Daily discharge, in second-feet, of Spokane River below Little Falls, near Long Lake, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,880	2,350	2,480	3,900	5,060	3,790	12,000	22,200	17,000	6,460	2,340	2,420
2	2,190	2,440	2,350	4,950	5,090	3,900	12,800	21,900	17,900	8,540	2,380	2,020
3	2,160	2,380	1,920	4,500	5,020	4,480	15,700	21,600	20,000	5,680	2,360	1,940
4	2,460	2,320	2,710	5,490	4,440	3,690	19,400	21,600	21,300	4,180	2,400	2,360
5	2,160	1,800	2,810	4,240	4,460	4,630	18,800	20,900	19,700	4,920	1,970	2,430
6	2,270	2,160	2,820	6,750	4,620	4,240	15,900	19,700	19,400	4,200	2,180	2,340
7	2,240	2,260	2,750	11,000	4,680	4,790	18,800	19,100	19,700	4,870	2,340	2,380
8	1,820	2,300	2,770	13,200	4,650	5,400	17,400	20,000	19,700	4,740	2,470	2,390
9	2,140	2,500	2,680	11,100	4,360	4,840	16,400	20,300	20,000	6,740	2,430	2,150
10	2,280	2,410	2,260	10,900	3,720	4,340	17,100	21,300	20,300	5,440	2,260	2,550
11	2,220	2,130	2,670	11,800	3,240	4,710	16,600	22,900	19,100	3,400	2,260	2,780
12	2,240	2,300	2,990	12,100	4,630	5,180	15,700	23,200	20,600	2,880	2,050	2,760
13	2,260	2,680	2,880	11,600	3,800	4,740	15,800	22,500	19,700	3,070	2,300	2,620
14	2,130	2,680	2,800	11,400	2,440	4,120	17,000	23,800	19,400	4,590	2,370	2,550
15	1,890	2,680	2,720	11,400	2,370	4,120	17,000	23,200	18,500	3,800	2,400	2,520
16	2,400	2,480	2,820	10,400	2,500	5,280	17,000	22,900	21,600	4,080	2,420	2,100
17	2,210	2,160	2,330	10,700	2,560	4,600	17,600	21,900	24,200	3,130	2,350	2,460
18	2,250	2,220	2,710	9,550	3,100	4,690	18,800	22,200	18,800	3,000	2,310	2,610
19	2,120	1,660	2,720	10,500	2,480	5,320	18,800	21,600	5,500	3,200	1,860	2,640
20	2,100	2,020	2,640	9,980	4,170	5,600	22,900	21,600	9,140	3,560	2,060	2,600
21	2,390	2,750	2,650	9,360	2,960	5,070	22,200	20,900	14,500	2,750	2,220	2,700
22	1,820	2,160	2,770	8,940	4,730	5,200	22,500	21,300	14,200	2,320	2,320	2,540
23	2,280	2,080	2,600	8,320	3,350	4,720	22,900	20,300	13,800	3,510	2,340	2,400
24	2,540	2,010	2,610	7,920	3,320	5,680	21,900	21,300	12,900	2,860	2,370	2,650
25	2,320	1,970	2,050	8,490	3,740	5,250	21,300	20,300	13,500	2,040	2,360	2,720
26	2,330	1,600	2,660	8,180	4,020	6,320	20,900	20,000	8,980	3,190	2,020	2,600
27	2,490	2,100	2,460	7,240	4,000	6,220	20,000	19,100	9,580	2,600	2,340	2,440
28	2,560	2,320	2,640	7,060	3,910	6,300	20,000	20,600	7,720	2,220	2,420	2,630
29	1,770	2,760	2,750	6,860	-------	7,750	20,600	20,000	9,840	1,960	2,430	2,660
30	2,380	2,330	4,040	4,970	-------	7,680	22,500	18,800	8,400	2,590	2,500	2,350
31	2,460	-------	3,510	4,900	-------	9,570	-------	19,100	-------	2,370	2,500	-------

NOTE.—Recorder not operating May 20 to June 18. Discharge determined from curve of relation between station gage and tailrace gage at Little Falls power plant.

Monthly discharge of Spokane River below Little Falls, near Long Lake, Wash., for the year ending Sept. 30, 1923

[Drainage area, 6,380 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	2,560	1,770	2,220	----------	----------	136,000
November	2,760	1,600	2,270	----------	----------	135,000
December	4,040	1,920	2,700	----------	----------	166,000
January	13,200	3,900	8,630	----------	----------	531,000
February	5,090	2,370	3,840	----------	----------	213,000
March	9,570	3,690	5,230	----------	----------	322,000
April	22,900	12,000	18,500	----------	----------	1,100,000
May	23,800	18,800	21,200	----------	----------	1,300,000
June	24,200	5,500	16,200	----------	----------	964,000
July	8,540	1,960	3,840	----------	----------	236,000
August	2,500	1,860	2,300	----------	----------	141,000
September	2,780	1,940	2,480	----------	----------	148,000
The year	24,200	1,600	7,450	1.17	15.88	5,390,000

NOTE.—Monthly discharge in second-feet per square mile and run-off in inches not computed owing to regulation. The yearly figures represent the natural yield quite closely.

ST. JOE RIVER AT CALDER, IDAHO

LOCATION.—In sec. 3, T. 45 N., R. 2 E. Boise meridian, at ferry 150 feet southwest of Chicago, Milwaukee & St. Paul Railway station at Calder, Shoshone County, 5 miles below Marble Creek, and 11 miles east of St. Joe.

DRAINAGE AREA.—1,080 square miles (measured by engineers of Washington Water Power Co. on map of Spokane River drainage basin compiled from all sources available).

RECORDS AVAILABLE.—July 13, 1920, to September 30, 1923; April 14, 1911, to September 30, 1912, at station about 2½ miles downstream.

GAGE.—Stevens continuous water-stage recorder on right bank at ferry landing at Calder; installed December 22, 1920; inspected by C. P. Latham. Gage at former station April 14, 1911, to September 30, 1912, was vertical staff on right bank 2½ miles below present site; July 13 to December 21, 1920, vertical staff gage at practically same site and datum as present gage Present gage datum is about 2,100 feet above sea level.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Right bank high, not subject to overflow; left bank subject to overflow at high stages. Shifting gravel riffle 800 feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, from water-stage recorder, 86.6 feet from 5–7 a. m. and at 12.30 p. m. May 9 (discharge, 13,600 second-feet); minimum stage from recorder, 78.67 feet at 9.30 and 11 a. m. to noon November 25 (discharge, 194 second-feet); discharge was probably lower during December, when stage-discharge relation was affected by ice.

1911–12, 1920–1923: Maximum stage recorded, from water-stage recorder, 87.8 feet at 7 a. m. May 18, 1922 (discharge, 17,600 second-feet); minimum stage recorded that of November 25, 1922.

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

DIVERSIONS.—None.

REGULATION.—Flash dam at Marble Creek used to store water for flushing logs down river during low water. Water released at regular intervals during driving season. Operation of dam causes diurnal fluctuation at gage of about 1 foot. Duration of effect about 4 hours.

ACCURACY.—Stage-discharge relation permanent; affected by ice November 30 to December 21 and January 31 to February 18. Rating curves fairly well defined. Operation of water-stage recorder fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by use of discharge integrator. Records good.

COOPERATION.—Gage-height record and some discharge measurements furnished by Washington Water Power Co.

Discharge measurements of St. Joe River at Calder, Idaho, during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Jan. 23	Ford and Godfrey	80.26	880	May 21	Kilgore and Ford	84.94	8,430
May 1	do	83.93	5,710	Aug. 9	Ford and Gatewood	80.15	810

Daily discharge, in second-feet, of St. Joe River at Calder, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	366	370		757		824	6,060	6,080	6,000	2,620	876	510
2	314	372		678		872	6,240	5,060	7,190	2,520	807	517
3	349	316		733		843	5,130	4,380	7,220	2,390	842	512
4	378	276		707		724	4,120	4,640	6,970	2,220	738	540
5	468	252		658		748	4,040	6,760	7,060	2,140	808	487
6	388	280		1,760		711	3,740	9,070	7,570	2,080	754	485
7	356	227		3,520		712	3,240	10,800	8,280	2,010	757	520
8	330	359		4,540		662	2,960	12,000	8,170	1,880	758	546
9	332	292		2,580		606	3,100	13,000	7,990	1,830	720	558
10	324	324		2,090	450	617	3,600	12,300	8,310	1,730	756	502
11	352	280	240	1,930		618	4,680	10,500	8,120	1,640	720	499
12	363	310		1,580		616	4,620	9,270	7,730	1,520	704	426
13	388	268		1,330		610	5,080	8,920	7,000	1,500	640	460
14	306	270		1,140		580	5,220	9,140	6,260	1,410	652	429
15	310	202		998		609	6,120	8,520	5,530	1,390	638	451
16	282	274		918		653	8,530	8,370	4,800	1,350	659	413
17	299	967		1,200		668	11,000	8,440	4,510	1,440	588	435
18	276	964		1,500		611	11,400	9,250	4,240	1,440	592	397
19	301	806		1,360	572	673	9,550	8,670	4,020	1,280	555	414
20	298	647		1,160	652	775	7,160	8,510	4,020	1,200	796	389
21	338	488		1,020	630	1,000	5,520	8,710	3,960	1,160	932	415
22	322	330	518	949	674	996	4,620	9,080	3,640	1,100	663	416
23	306	246	520	889	684	1,070	4,450	8,820	3,450	1,080	611	414
24	290	270	1,020	793	787	1,100	5,290	7,870	3,430	1,060	600	389
25	358	282	1,640	764	798	985	6,090	8,640	3,280	1,000	588	439
26	394	282	1,250	777	757	1,040	7,490	9,680	3,120	1,020	578	442
27	349	328	1,160	705	721	1,500	9,200	7,830	2,880	1,040	648	427
28	301	362	1,610	704	722	2,510	10,200	6,290	2,860	967	552	375
29	321	272	1,390	512	------	3,850	10,000	5,490	2,810	1,010	526	394
30	286	300	1,020	438	------	4,730	7,560	5,280	2,700	945	532	375
31	326	------	833	350	------	5,950	------	4,830	------	892	565	------

NOTE.—Water-stage recorder not operating satisfactorily Nov. 19–21 and June 13–15; discharge estimated by interpolation. Braced figures indicate estimated mean discharge for period when stage-discharge relation was affected by ice.

Monthly discharge of St. Joe River at Calder, Idaho, for the year ending Sept. 30, 1923

[Drainage area, 1,080 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	468	276	334	0.309	0.36	20,500
November	967	202	374	.346	.39	22,300
December	1,640	------	516	.478	.55	31,700
January	4,540	350	1,260	1.17	1.35	77,500
February	798	------	539	.499	.52	29,900
March	5,950	580	1,240	1.15	1.33	76,200
April	11,400	2,960	6,200	5.74	6.40	369,000
May	13,000	4,380	8,260	7.65	8.82	508,000
June	8,310	2,700	5,440	5.04	5.62	324,000
July	2,620	892	1,510	1.40	1.61	92,800
August	932	526	682	.631	.73	41,900
September	558	375	453	.419	.47	27,000
The year	13,000	------	2,240	2.07	28.15	1,620,000

32430—26†—WSP 572——10

ST. MARIES RIVER AT LOTUS, IDAHO

LOCATION.—In sec. 20, T. 45 N., R. 2 W. Boise meridian, 1,600 feet below Lotus station on Elk River branch of Chicago, Milwaukee & St. Paul Railway and 9 miles above St. Maries and mouth of river, Benewah County.

DRAINAGE AREA.—420 square miles (measured by engineers of Washington Water Power Co. on map of Spokane River drainage basin compiled from all available sources).

RECORDS AVAILABLE.—July 9, 1911, to October 31, 1912, and July 15, 1920, to September 30, 1923.

GAGE.—Since July 15, 1920, vertical and inclined staffs installed July 15, 1920, on left bank; read by Mrs. Naoma Carter. Also inclined staff on left bank, 500 feet above, read since October 1, 1922. July 9, 1911, to October 31, 1912, vertical staff on right bank about half a mile downstream.

DISCHARGE MEASUREMENTS.—Made by wading or from suspension footbridge at railway station.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders. Channel straight for 500 feet below gage. Left bank high, not subject to overflow at gage. Right bank subject to overflow at high stages. Riffle control 300 feet below gage; shifting at high stages.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 63.15 feet on April 3 (discharge, 3,950 second-feet); minimum discharge occurred during winter when stage-discharge relation was affected by ice and logs (certainly less than 30 second-feet).

1911–12; 1920–1923: Maximum stage recorded 66.5 feet at 6 a. m. March 18, 1921 (discharge, 8,660 second-feet); minimum discharge probably occurred during winter 1922–23.

ICE.—Stage-discharge relation seriously affected by ice. Flow estimated from discharge measurements, observer's notes, and weather records.

ACCURACY.—Stage-discharge relation changed gradually May 3–10; affected by ice and logs November 4, 6, 7, 15, December 1 to January 5, January 28 to March 15 and March 17 and 18; by logs alone March 30 to April 30. Rating curves fairly well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Shifting-control method used May 3–10. Records good October, November, January, and June to September, otherwise fair except for periods covered by flat estimates which are poor.

COOPERATION.—Gage-height record and some discharge measurements furnished by Washington Water Power Co.

Discharge measurements of St. Maries River at Lotus, Idaho, during the year ending Sept. 30, 1923

Date	Made by—	Gage No. 1	Gage No. 2	Discharge	Date	Made by—	Gage No. 1	Gage No. 2	Discharge
			Feet	*Sec.-ft.*				*Feet*	*Sec.-ft.*
Jan. 24	Ford and Godfrey	60.04	3.20	207	May 22	Ford and Kilgore	60.62	4.03	660
May 2	J. L. Ford	60.95	4.35	966	July 3	J. L. Ford	59.89	3.34	224
11	Ford and Godfrey	61.12	4.55	1,110	Aug. 8	Gatewood and Ford	59.39	2.92	85.9
22	Kilgore and Ford	60.62	4.03	653					

Gage No. 1 rated prior to Oct. 1, 1922.
Gage No. 2 rated during climatic year 1923.

Daily discharge, in second-feet, of St. Maries River at Lotus, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.
1	51	88					2,170	1,060	1,620	243	92	58
2	51	98					3,420	965	3,030	231	89	58
3	53	59		300			3,950	830	2,550	235	89	58
4	53	56					2,610	790	1,820	218	89	58
5	92	53					2,310	875	1,420	203	86	58
6	70	53		1,160			2,610	1,060	1,300	203	86	53
7	56	53		2,310			2,030	1,110	1,070	218	86	53
8	51	59		2,920	80	330	1,750	1,110	1,070	203	86	53
9	49	59		1,750			1,610	1,340	970	199	86	53
10	49	61		1,160			1,610	1,110	835	188	86	53
11	47	61		1,160			1,680	1,070	750	176	86	51
12	47	61		750			1,890	970	672	162	80	51
13	42	59	40	530			2,310	880	635	148	77	51
14	47	56		440			1,890	925	598	137	77	51
15	47	59		382			1,680	925	598	137	75	51
16	47	61		355		355	1,680	970	560	144	72	51
17	47	109		530		355	2,170	880	490	169	69	51
18	45	382		670		410	2,310	790	413	180	66	49
19	45	150		530		440	2,170	750	389	162	66	49
20	53	109		410		790	1,750	716	389	137	169	49
21	61	81		355		790	1,540	672	389	134	231	49
22	81	70		355	250	600	1,470	672	383	124	117	53
23	59	51		382		500	1,160	635	348	110	95	51
24	53	64		215		530	1,010	598	360	130	77	56
25	61	64		230		635	1,010	560	348	127	69	58
26	70	32		196		830	1,010	560	348	117	69	58
27	75	47		177		1,160	1,160	635	326	113	72	64
28	70	49	250			1,540	1,280	560	290	104	72	61
29	70	67		110	-------	1,750	1,280	525	270	98	66	58
30	64	49			-------	2,030	1,160	490	256	98	64	56
31	64	-------			-------	2,310	-------	425	-------	92	64	-------

NOTE.—Gage not read because of high water Mar. 31, Apr. 1–7, 13, and 17–19; gage height from which discharge was determined was obtained from fairly well defined curve of relation between the two gages.

Monthly discharge of St. Maries River at Lotus, Idaho, for the year ending Sept. 30, 1923

[Drainage area, 420 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	92	45	57.1	0.136	0.16	3,510
November	382	32	77.3	.184	.21	4,600
December	----------	----------	80.6	.192	.22	4,960
January	2,920	----------	610	1.45	1.67	37,500
February	----------	----------	159	.379	.39	8,830
March	2,310	----------	644	1.53	1.76	39,600
April	3,950	1,010	1,860	4.43	4.94	111,000
May	1,340	425	821	1.95	2.25	50,500
June	3,030	256	817	1.95	2.18	48,600
July	243	92	159	.379	.44	9,780
August	231	64	87.4	.208	.24	5,370
September	64	49	54.1	.129	.14	3,220
The year	3,950	----------	452	1.08	14.60	327,000

HAYDEN LAKE AT HAYDEN LAKE, IDAHO

LOCATION.—In sec. 18, T. 51 N., R. 3 W. Boise meridian, at Avondale and Hayden Lake pumping plants, a quarter of a mile north of Hayden Lake depot of Spokane & Eastern Railway & Power Co., Kootenai County.

DRAINAGE AREA.—Not measured.

RECORDS AVAILABLE.—May 19, 1920, to September 30, 1923.

GAGE.—Vertical staff in two sections fastened to rock and to rock crib foundation of boat house about 300 feet north of substation of Spokane & Eastern Railway & Power Co. A vertical staff in sump of Hayden Lake pumping plant about 200 feet north of the substation was used occasionally during ice season prior to September 30, 1921. Gage read by Sigurd Berven. Zero of gage at elevation 2,233.13 feet, United States Geological Survey datum, when referred to bench mark at Hudlow's ranch, described in United States Geological Survey Bulletin 567, on page 80.

EXTREMES OF STAGE.—Maximum stage recorded during year, 6.00 feet June 9–11; minimum stage recorded, 0.19 foot December 22 and 23.

1920–1923: Maximum stage recorded, 10.06 feet April 30 to May 18, 1921; minimum stage recorded that of December 22 and 23, 1922.

ICE.—No ice during period of record.

DIVERSION.—Water pumped from lake for irrigation and domestic purposes.

REGULATION.—None.

ACCURACY.—Gage read to hundredths once daily.

Daily gage height, in feet, of Hayden Lake at Hayden Lake, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.30	0.73	0.33	0.44	1.57	1.41	2.19	5.40	5.86	5.64	4.18	2.88
2	1.28	.72	.32	.47	1.57	1.41	2.30	5.45	5.90	5.61	4.12	2.83
3	1.26	.71	.31	.50	1.57	1.41	2.50	5.48	5.92	5.58	4.06	2.78
4	1.23	.70	.30	.52	1.56	1.42	2.70	5.50	5.93	5.56	4.00	2.74
5	1.21	.69	.29	.57	1.55	1.43	2.90	5.52	5.94	5.52	3.96	2.70
6	1.18	.68	.28	.65	1.54	1.44	3.05	5.55	5.96	5.50	3.90	2.66
7	1.16	.66	.28	.76	1.53	1.44	3.20	5.59	5.97	5.47	3.84	2.62
8	1.14	.64	.27	.88	1.53	1.44	3.30	5.62	5.98	5.42	3.78	2.57
9	1.12	.63	.27	1.00	1.52	1.45	3.40	5.65	6.00	5.38	3.72	2.52
10	1.10	.61	.26	1.07	1.52	1.46	3.50	5.69	6.00	5.33	3.66	2.46
11	1.08	.60	.26	1.14	1.51	1.46	3.60	5.72	6.00	5.28	3.60	2.42
12	1.06	.58	.25	1.20	1.50	1.47	3.70	5.76	5.99	5.22	3.56	2.38
13	1.03	.57	.25	1.25	1.49	1.47	3.85	5.76	5.98	5.16	3.52	2.33
14	1.02	.56	.24	1.33	1.48	1.48	4.00	5.79	5.98	5.12	3.45	2.28
15	1.00	.55	.24	1.40	1.47	1.48	4.10	5.84	5.97	5.08	3.42	2.23
16	.98	.54	.23	1.44	1.46	1.49	4.25	5.82	5.96	5.04	3.40	2.18
17	.96	.53	.23	1.46	1.45	1.50	4.40	5.83	5.95	5.00	3.37	2.14
18	.94	.52	.22	1.48	1.45	1.51	4.55	5.84	5.95	4.97	3.35	2.10
19	.92	.51	.22	1.49	1.45	1.52	4.70	5.85	5.94	4.93	3.32	2.07
20	.90	.50	.20	1.51	1.44	1.53	4.80	5.85	5.92	4.90	3.29	2.04
21	.88	.49	.20	1.51	1.44	1.55	4.90	5.86	5.90	4.86	3.26	2.01
22	.86	.48	.19	1.51	1.43	1.56	4.95	5.86	5.88	4.83	3.22	1.98
23	.84	.46	.19	1.52	1.43	1.58	5.00	5.87	5.85	4.78	3.19	1.96
24	.83	.44	.21	1.53	1.43	1.59	5.05	5.88	5.83	4.74	3.16	1.93
25	.81	.42	.24	1.54	1.43	1.63	5.12	5.89	5.80	4.68	3.13	1.92
26	.79	.40	.26	1.55	1.42	1.66	5.16	5.89	5.78	4.62	3.11	1.90
27	.78	.38	.30	1.56	1.42	1.73	5.20	5.88	5.76	4.55	3.08	1.88
28	.76	.36	.32	1.57	1.42	1.79	5.25	5.87	5.73	4.48	3.06	1.86
29	.75	.35	.34	1.57	-------	1.88	5.30	5.86	5.70	4.40	3.02	1.84
30	.74	.34	.36	1.57	-------	1.96	5.35	5.85	5.67	4.34	2.98	1.82
31	.73	-------	.38	1.57	-------	2.09	-------	5.84	-------	4.26	2.93	-------

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, Kootenai County.

RECORDS AVAILABLE.—May 20, 1911, to September 30, 1917; September 6, 1919, to September 30, 1923.

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 at all stages owing to effect of gravel bar at end of flume and plant growth, and possibly to regulation of headgates of diversion ditches below gage. Stage of zero flow, according to measurement made May 23, 1923, gage height −0.1 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 4.45 feet July 16–21 (discharge, 238 second-feet); no water in canal November 15 to May 19.

1911–1917 and 1919–1923: Maximum stage recorded that of July 16–21, 1923. No water in canal during periods in 1911, 1912, 1916, 1917, 1919, 1920, 1921, 1922, and 1923.

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

ACCURACY.—Stage-discharge relation changed during period of no flow and gradually June 9 to August 7. Rating curves fairly well defined. Gage read to hundredths once daily, which is considered adequate for determination of mean daily gage height since two submerged orifices and wasteway above canal headgates are instrumental in causing gage height in canal to remain constant even though the stage of the river is subject to considerable daily fluctuation. Daily discharge ascertained by applying daily gage height to rating table. Shifting-control method used June 9 to August 7. Records good.

COOPERATION.—Gage-height record furnished by Spokane Valley Land & Water Co. and some discharge measurements furnished by Washington Water Power Co.

Canal diverts water from right bank of Spokane River in SE. ¼ sec. 3, T. 50 N., R. 5 W. Boise meridian. 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, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
May 23	Kilgore and Ford	1.98	72.3	July 24	J. L. Ford	4.40	228
June 8	J. L. Ford	3.10	150	Aug. 7	Gatewood and Ford	4.42	221
27	do	3.70	189	Sept. 12	J. L. Ford	3.22	134
July 16	Collins and Godfrey	4.45	237	17	do	1.09	20.6

Daily discharge, in second-feet, of Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, for the year ending Sept. 30, 1923

Day	Oct.	Nov.	May	June	July	Aug.	Sept.
1	44	31	-------	142	206	230	161
2	44	31	-------	150	206	230	161
3	44	31	-------	150	206	222	161
4	44	31	-------	150	198	222	154
5	42	31	-------	150	206	222	154
6	42	31	-------	150	206	222	154
7	42	31	-------	158	214	222	154
8	40	31	-------	158	214	219	154
9	40	31	-------	158	222	219	154
10	40	31	-------	166	214	219	154
11	40	31	-------	166	214	211	147
12	40	31	-------	174	222	211	147
13	40	27	-------	182	222	211	147
14	40	27	-------	190	222	211	147
15	37	-------	-------	190	222	211	147
16	37	-------	-------	190	238	211	147
17	37	-------	-------	190	238	211	20
18	35	-------	-------	190	238	211	20
19	35	-------	-------	190	238	211	20
20	35	-------		198	238	211	20
21	35	-------	40	198	238	182	20
22	35	-------		206	230	182	20
23	35	-------	74	206	230	182	20
24	35	-------		206	230	182	20
25	35	-------	74	198	230	182	18.8
26	35	-------		198	230	175	18.8
27	33	-------	74	198	230	175	18.8
28	33	-------	74	198	230	175	17.2
29	33	-------	86	198	230	175	17.2
30	33	-------	106	198	230	175	17.2
31	31	-------	127	-------	230	175	-------

NOTE.—Canal dry Nov. 15 to May 19.

Monthly discharge of Spokane Valley Land & Water Co.'s canal at Post Falls, Idaho, for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	44	31	37.8	2,320
November	31	0	14.2	845
May	127	0	28.5	1,750
June	206	142	180	10,700
July	238	198	223	13,700
August	230	175	203	12,500
September	161	17.2	90.4	5,380
The period	238	0	65.2	47,200

NOTE.—Canal dry Nov. 15 to May 19.

NESPELEM RIVER BASIN

NESPELEM RIVER AT NESPELEM, WASH.

LOCATION.—In SE. ¼ sec. 24, T. 31 N., R. 30 E., half a mile above Nespelem, Okanogan County, 5 miles above Little Nespelem River, and 6 miles above mouth.

DRAINAGE AREA.—122 square miles (measured on map of Colville Indian Reservation, edition of 1911).

RECORDS AVAILABLE.—May 1, 1911, to September 30, 1923.

GAGE.—Vertical staff on left bank at gaging bridge; installed October 19, 1916; read by J. L. Davis. For description of previous gages see Water-Supply Paper 512.

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

CHANNEL AND CONTROL.—Bed composed of gravel and boulders. Concrete control. Moss grows on concrete control during summer. Right bank flat; subject to overflow at gage height 4.0 feet. Left bank high; not subject to overflow. Stage of zero flow, gage height, 0.4 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period April 1 to September 30, 1.75 feet on April 19 (discharge, 102 second-feet); minimum stage recorded, 0.73 foot September 9–11 and 13–18 (discharge, 4.5 second-feet). Flow may have been less during winter while gage was not read.

1911–1923: Maximum stage recorded, 4.9 feet April 5, 1919, determined from leveling to high-water mark (discharge, 483 second-feet); minimum stage recorded, 0.75 foot September 25–26, 1922 (discharge, 3.7 second-feet).

ICE.—Records discontinued during winter.

DIVERSIONS.—Nespelem canal diverts water for irrigation from a point above gage. See records for Nespelem canal.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by aquatic growth July 31 to September 30. Rating curve well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table, or by shifting-control method during periods when stage-discharge relation was affected by aquatic growth. Records below 10 second-feet good; otherwise excellent.

Discharge measurements of Nespelem River at Nespelem, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 14	R. B. Kilgore	0.72	5.0	Apr. 29	J. S. Gatewood	1.55	80.7
14	do	.72	4.9	30	do	1.54	78.2
Apr. 29	J. S. Gatewood	1.55	84.3	June 26	Kilgore and Parker	1.27	51.8

Daily discharge, in second-feet, of Nespelem River at Nespelem, Wash., for the period Apr. 1 to Sept. 30, 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1	43	86	48	32	9.0	5.9	16	80	54	62	19	7.2	4.5
2	53	80	58	31	9.0	5.4	17	86	50	60	17	7.2	4.5
3	56	75	70	29	9.0	5.0	18	97	50	58	17	7.2	4.5
4	61	70	64	27	8.5	5.0	19	102	50	56	17	6.7	5.0
5	64	64	56	27	8.5	5.0	20	97	50	53	17	7.6	5.0
6	70	64	56	27	8.5	5.0	21	97	49	50	14	6.7	5.0
7	70	64	56	32	8.1	5.0	22	97	46	50	13	6.3	5.0
8	70	62	52	39	8.1	5.0	23	92	43	49	12	7.6	5.0
9	64	61	49	38	9.0	4.5	24	86	40	48	12	7.2	5.0
10	70	62	58	31	8.5	4.5	25	86	44	50	11	7.2	5.2
11	70	63	62	27	8.5	4.5	26	86	46	49	11	8.1	5.4
12	75	64	64	25	8.1	4.5	27	80	44	44	11	7.2	5.0
13	80	62	64	23	8.1	4.5	28	80	41	40	11	6.7	5.0
14	80	61	70	22	7.6	4.5	29	80	41	38	9.6	6.3	5.0
15	80	57	64	20	7.6	4.5	30	80	41	36	9.6	6.3	5.0
							31		43		9.0	6.3	

NOTE.—Gage not read June 19, Aug. 2, and Sept. 2, 12, and 25; discharge estimated by interpolation.

Combined monthly discharge of Nespelem River and Nespelem canal at Nespelem, Wash., for the period Apr. 1 to Sept. 30, 1923

Month	Discharge in second-feet					Combined run-off in acre-feet
	River (mean)	Canal (mean)	Combined		Mean	
			Maximum	Minimum		
April	77.7	0.88	104	43	78.6	4,680
May	55.7	6.64	89.3	47.6	62.3	3,830
June	54.5	8.39	78.1	45.6	62.9	3,740
July	20.7	9.01	48.6	15.8	29.7	1,830
August	7.67	5.93	15.8	11.8	13.6	836
September	4.90	4.71	11.4	9.0	9.61	572
The period						15,500

NESPELEM CANAL AT NESPELEM, WASH.

LOCATION.—In sec. 24, T. 31 N., R. 30 E., three-fourths of a mile below canal intake and three-fourths of a mile northwest of Nespelem post office, Okanogan County.

RECORDS AVAILABLE.—April 1, 1921, to September 30, 1923.

GAGE.—Vertical staff on right side of canal; read by Claude Marble.

DISCHARGE MEASUREMENTS.—Made by wading near gage.

CHANNEL AND CONTROL.—Canal section. Plant growth during summer usually affects stage-discharge relation. Stage of zero flow, 0.25 foot ±0.1 foot according to measurements made in June and October, 1923.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.75 feet June 29 to July 13 (discharge, 9.6 second-feet). No flow through canal December 6 to April 18.

1921–1923: Maximum stage recorded 1.74 feet June 1 and 2, 1922 (discharge, 11.2 second-feet). No flow through canal during winter.

ACCURACY.—Stage-discharge relation changed, during period when water was turned out of canal. Rating curves fairly well defined. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Canal diverts water from right bank of Nespelem River about on line between sections 24 and 13, T. 31 N., R. 30 E.

Discharge measurements of Nespelem canal at Nespelem, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 14	R. B. Kilgore	1.15	3.9	Apr. 29	J. S. Gatewood	1.08	3.6
Apr. 29	J. S. Gatewood	1.08	3.6	June 26	Kilgore and Parker	1.69	9.0

Daily discharge, in second-feet, of Nespelem canal at Nespelem, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Apr.	May	June	July	Aug.	Sept.
1	4.1	4.2	4.2	------	3.3	7.2	9.6	6.8	5.5
2	4.1	4.2	4.2	------	3.3	7.2	9.6	6.8	5.4
3	4.1	4.2	4.2	------	6.8	7.2	9.6	6.8	4.9
4	4.5	4.2	4.2	------	6.8	8.1	9.6	6.8	4.9
5	4.3	4.2	4.2	------	6.8	8.1	9.6	6.8	4.9
6	4.1	4.2	------	------	6.8	8.1	9.6	6.8	4.9
7	4.1	4.2	------	------	6.8	8.1	9.6	6.8	4.9
8	4.1	4.2	------	------	6.8	8.1	9.6	5.9	4.9
9	4.1	4.2	------	------	6.8	8.1	9.6	5.9	4.9
10	4.1	4.2	------	------	6.8	8.1	9.6	5.9	4.8
11	4.1	4.2	------	------	6.8	8.1	9.6	5.9	4.8
12	4.1	4.2	------	------	6.8	8.1	9.6	5.8	4.8
13	4.1	4.2	------	------	6.8	8.1	9.6	5.8	4.7
14	4.1	4.2	------	------	6.8	8.1	9.1	5.8	4.7
15	4.1	4.2	------	------	6.8	8.1	9.1	5.8	4.7
16	4.1	4.2	------	------	6.8	8.1	9.1	5.8	4.6
17	4.1	4.2	------	------	6.8	8.1	9.1	5.6	4.5
18	4.1	4.2	------	------	6.8	9.1	9.1	5.6	4.5
19	4.1	4.2	------	1.8	6.8	9.1	9.1	5.6	4.5
20	4.1	4.2	------	1.8	6.3	9.1	9.1	5.6	4.5
21	4.1	4.2	------	2.0	6.2	9.1	9.1	5.6	4.5
22	4.1	4.2	------	2.0	5.8	9.1	9.1	5.6	4.5
23	4.1	4.2	------	2.0	5.8	9.1	9.1	5.6	4.5
24	4.1	4.2	------	2.0	7.6	8.6	8.6	5.6	4.5
25	4.1	4.2	------	2.0	7.6	8.6	8.6	5.6	4.5
26	4.1	4.2	------	2.0	7.6	8.6	8.6	5.6	4.5
27	4.1	4.2	------	2.2	7.6	8.6	8.6	5.5	4.5
28	4.1	4.2	------	2.6	7.6	8.6	8.6	5.5	4.5
29	4.1	4.2	------	2.6	7.2	9.6	6.8	5.5	4.5
30	4.1	4.2	------	3.3	7.2	9.6	6.8	5.5	4.5
31	4.2	------	------	------	7.2	------	6.8	5.5	------

NOTE.—No water in canal Dec. 6 to Apr. 18.

Monthly discharge of Nespelem canal at Nespelem, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	4.5	4.1	4.12	253
November	4.2	4.2	4.20	250
December	4.2	0	.68	41.8
April	3.3	0	.88	52.4
May	7.6	3.3	6.64	408
June	9.6	7.2	8.39	499
July	9.6	6.8	9.01	554
August	6.8	5.5	5.93	365
September	5.5	4.5	4.71	280
The year				2,700

NOTE.—No water in canal Dec. 5 to Apr. 18.

OKANOGAN RIVER BASIN

OKANOGAN RIVER AT OKANOGAN, WASH.

LOCATION.—In sec. 16, T. 33 N., R. 26 E., at Okanogan, 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, 1923.

GAGE.—Chain gage on highway bridge; installed June 10, 1920; read by W. A. Steiner. For description of previous gages see Water-Supply Paper 512.

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. Stage of zero flow estimated on October 4, 1918, at gage height 2.4 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 10.4 feet June 12 (discharge, 16,200 second-feet); minimum stage recorded, 0.96 foot, February 13 (discharge, 385 second-feet). Flow may have been less in December while stage-discharge relation was affected by ice.

1911–1923: Maximum stage recorded, 12.21 feet, June 20, 1916 (discharge, 22,200 second-feet); minimum stage recorded that of February 13, 1923.

ICE.—Stage-discharge relation affected by ice except during mild winters.

DIVERSIONS.—Numerous small ditches divert water for irrigation above station.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 14–25; by logs October 30 to November 4, and May 29 to June 15. Rating curve fairly well defined. Gage read to hundredths once daily, except as indicated in footnote to tables of daily discharge. 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 Okanogan River at Okanogan, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 3	R. B. Kilgore	1.94	870	July 27	J. S. Gatewood	3.96	2,890
July 2	J. S. Gatewood	7.28	8,530	Sept. 27	D. J. F. Calkins	2.20	1,070

Daily discharge, in second-feet, of Okanogan River at Okanogan, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	840	1,140	1,140	1,510	1,050	1,140	780	5,470	8,130	9,100	2,370	1,610
2	900	1,140	1,140	1,510	1,230	1,060	780	5,130	8,340	8,770	2,250	1,540
3	900	1,140	1,140	1,510	1,050	970	840	4,800	8,880	8,130	2,250	1,480
4	900	1,140	1,140	1,510	1,080	1,010	970	4,480	9,430	7,920	2,140	1,410
5	900	1,140	1,050	1,510	1,110	1,050	1,050	4,320	9,870	7,720	2,080	1,410
6	900	1,140	750	1,510	1,140	1,050	1,230	4,980	11,300	6,930	2,030	1,410
7	970	1,140	765	1,610	1,140	1,050	1,320	5,640	12,200	6,740	1,920	1,410
8	1,010	1,140	780	1,710	1,050	1,050	1,360	6,740	13,300	7,230	1,920	1,320
9	1,050	1,140	900	1,510	1,050	1,050	1,410	8,130	13,800	7,720	1,810	1,320
10	1,050	1,140	840	1,510	1,050	1,050	1,410	9,870	14,700	6,930	1,860	1,320
11	1,050	1,230	780	1,480	829	1,050	1,410	11,300	15,600	6,550	1,920	1,230
12	1,050	1,160	675	1,450	607	1,050	1,510	10,800	16,200	6,180	1,920	1,230
13	1,050	1,100	570	1,420	385	1,050	1,610	10,300	15,900	5,820	1,920	1,230
14	970	1,040		1,380	780	1,050	1,710	9,870	15,400	5,470	1,810	1,230
15	935	970		1,350	780	1,050	1,810	9,870	13,800	5,220	1,810	1,140
16	900	970	600	1,320	900	1,050	1,810	9,870	12,700	4,960	1,760	1,140
17	900	970		1,510	900	1,050	2,030	9,870	12,200	4,800	1,710	1,140
18	900	1,050		1,410	935	1,050	2,250	10,100	11,700	4,320	1,710	1,140
19	900	1,100		1,410	970	1,050	3,140	10,600	11,300	4,160	1,710	1,050
20	900	1,140		1,410	970	1,050	3,560	10,800	11,300	4,010	1,710	1,140
21	970	1,140		1,280	970	1,050	3,420	11,000	11,300	3,710	1,710	1,050
22	970	1,140	1,100	1,140	1,010	1,050	3,280	11,000	11,300	3,560	1,810	1,050
23	970	1,140		1,050	1,050	1,050	3,140	11,500	11,300	3,420	1,810	1,050
24	970	1,140		970	1,050	1,020	3,000	11,700	11,000	3,280	1,920	1,050
25	970	1,110		970	1,100	997	3,000	11,500	10,800	3,140	1,920	1,050
26	970	1,080	1,320	970	1,140	970	3,140	11,300	10,800	3,140	1,860	1,050
27	970	1,050	1,320	887	1,140	970	3,710	11,200	10,100	2,870	1,810	1,050
28	1,230	1,050	1,410	803	1,140	970	4,800	11,000	9,870	2,780	1,710	1,070
29	1,230	1,140	1,410	720	-------	970	5,220	9,650	9,650	2,700	1,710	1,090
30	1,230	1,140	1,510	720	-------	1,050	5,640	9,100	9,430	2,610	1,610	1,100
31	1,140	-------	1,510	750	-------	780	-------	8,550	---------	2,490	1,610	-------

NOTE.—Gage not read Oct. 1, 8, 15, 22–26, 29, Nov. 5, 12–14, 19, 25, 26, 30, Dec. 3, 7, 10, 12, 31, Jan. 1, 7, 11–15, 21, 27, 28, Feb. 4, 5, 11, 12, 18, 22, 25, Mar. 2, 4, 11, 18, 24, 25, Apr. 1, 8, 22, 29, May 6, 13, 20, 27, 30, June 3, 10, 17, 24, July 1, 4, 8, 15, 22, 28, 29, Aug. 5, 10, 12, 16, 19, 26, Sept. 2, 3, 9, 16, 17, 23, 28–30; discharge interpolated. Braced figures give mean estimated discharge for periods when stage-discharge relation was affected by ice.

Monthly discharge of Okanogan River at Okanogan, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	1,230	840	987	60,700
November	1,230	970	1,110	66,000
December	1,510		979	60,200
January	1,710	720	1,280	78,700
February	1,230	385	986	54,800
March	1,140	780	1,030	63,300
April	5,640	780	2,340	139,000
May	11,700	4,320	9,050	556,000
June	16,200	8,130	11,700	696,000
July	9,100	2,490	5,240	322,000
August	2,370	1,610	1,870	115,000
September	1,610	1,050	1,220	72,600
The year	16,200	385	3,160	2,280,000

SIMILKAMEEN RIVER NEAR OROVILLE, WASH.

LOCATION.—In SE. ¼ sec. 13, T. 40 N., R. 26 E., at Okanogan Valley Power Co.'s plant, 4 miles above Oroville, Okanogan County, and 5 miles above mouth; below all tributaries.

DRAINAGE AREA.—3,450 square miles (measured on topographic and Canadian railway-belt maps).

RECORDS AVAILABLE.—May 14, 1911, to September 30, 1923.

GAGE.—Vertical staff on concrete foundation wall of power house on right bank; installed January 31, 1921; read by employees of Washington Water Power Co. Prior to January 31, 1921, gage was a vertical staff in seven sections on left bank just above present site and at different datum.

DISCHARGE MEASUREMENTS.—Made by wading or 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. Control for low and medium stage is riffle formed by bedrock and boulders; high-water control not well defined.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 15.8 feet at 6 p. m. June 10 (discharge, 16,200 second-feet); minimum stage recorded, 2.6 feet at 4.30 p. m. January 30 (discharge, 200 second-feet).

1911–1923: Maximum stage recorded, 18.5 feet on June 5, 1922 (discharge, 21,400 second-feet); river dry at 4 p. m. December 5, 1920, while filling pond behind dam.

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

DIVERSIONS.—Some water is diverted for irrigation from tributaries above the station. The principal diversion is made from the river above the gage by the West Okanogan Irrigation District.[5]

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water June 10; not affected by ice. Rating curve well defined. Gage read to tenths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—Gage height furnished by the Washington Water Power Co.

[5] See records of West Okanogan Irrigation canal, p. 146.

Discharge measurements of Similkameen River near Oroville, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 4	R. B. Kilgore	3.75	670	July 28	J. S. Gatewood	5.17	1,570
May 31	do	10.30	7,320	Aug. 30	J. L. Ford	3.90	686
July 1	J. S. Gatewood	10.20	7,030	Sept. 28	D. J. F. Calkins	3.40	422

Daily discharge, in second-feet, of Similkameen River near Oroville, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	575	720	552	620	405	445	508	4,490	7,240	7,110	1,220	630
2	598	720	530	620	405	445	620	4,160	8,510	6,590	1,150	630
3	620	670	485	598	445	445	720	3,720	8,810	6,850	1,150	630
4	645	645	485	575	425	405	820	3,500	9,410	6,330	1,080	575
5	670	620	465	598	445	425	880	3,830	9,410	5,550	1,010	575
6	720	620	365	598	465	425	1,010	4,600	11,600	5,310	940	575
7	770	620	330	598	405	445	1,010	5,810	13,000	5,310	940	575
8	720	620	330	598	465	445	1,010	7,110	13,500	6,980	875	575
9	720	620	330	598	445	445	1,010	8,960	14,500	6,070	875	525
10	770	620	330	598	445	425	940	11,000	16,000	5,310	1,010	525
11	670	598	330	598	385	445	1,010	11,000	15,500	5,070	1,080	525
12	645	575	330	575	348	405	1,080	9,710	15,100	4,600	1,010	500
13	620	575	330	552	278	425	1,150	9,410	14,900	4,380	875	475
14	620	530	330	530	365	405	1,220	8,960	12,800	3,940	842	427
15	598	508	330	508	330	405	1,290	8,960	11,300	3,500	810	383
16	575	575	330	485	348	405	1,360	9,110	10,000	3,280	778	427
17	575	575	330	530	385	405	1,770	9,410	10,300	3,080	715	427
18	552	620	330	530	405	385	2,680	9,710	9,860	2,980	685	383
19	552	620	330	530	425	405	2,980	9,710	9,710	2,880	685	383
20	530	620	330	485	445	385	2,780	10,300	9,710	2,680	715	383
21	530	598	330	445	425	405	2,680	10,500	9,710	2,490	842	405
22	530	575	365	445	425	405	2,490	11,000	9,360	2,310	1,010	427
23	530	575	405	445	425	385	2,400	11,500	9,710	2,130	1,010	427
24	530	575	445	445	445	385	2,310	11,600	9,410	2,040	1,010	427
25	508	530	465	405	425	405	2,490	10,700	9,410	1,950	1,010	427
26	530	530	465	445	445	405	2,980	11,300	8,510	1,770	842	427
27	940	536	552	485	445	405	4,270	10,300	8,070	1,680	778	427
28	820	575	620	465	445	405	5,310	9,110	7,930	1,600	745	427
29	820	575	620	405	-------	405	5,190	8,210	7,660	1,440	685	427
30	770	552	575	260	-------	425	4,830	7,790	7,510	1,440	658	427
31	720	-------	620	405	-------	445	-------	7,240	-------	1,290	630	-------

Monthly discharge of Similkameen River and West Okanogan Irrigation District canal, near Oroville, Wash., for year ending Sept. 30, 1923

[Drainage area, 3,450 square miles]

Month	Discharge in second-feet						Run-off (combined)	
	River (mean)	Canal (mean)	Combined					
			Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	644	0	940	508	644	0.187	0.22	39,600
November	596	0	720	508	596	.173	.19	35,500
December	418	0	620	330	418	.121	.14	25,700
January	515	0	620	260	515	.149	.17	31,700
February	412	0	465	278	412	.119	.12	22,900
March	416	0	445	385	416	.121	.14	25,600
April	2,030	1	5,320	508	2,030	.588	.66	121,000
May	8,470	95	11,700	3,520	8,560	2.48	2.86	526,000
June	10,600	100	16,100	7,380	10,700	3.10	3.46	637,000
July	3,800	129	7,240	1,430	3,930	1.14	1.31	242,000
August	892	148	1,360	774	1,040	.301	.35	64,000
September	479	116	774	427	595	.172	.19	35,400
The year	2,450	49	16,100	260	2,500	.725	9.81	1,810,000

SINLAHEKIN CREEK AT TWIN BRIDGES, NEAR LOOMIS, WASH.

LOCATION.—In NE. ¼ sec. 3, T. 37 N., R. 25 E., 100 feet above lower bridge, half a mile below Sarsapkin Creek, 6 miles southwest of Loomis, Okanogan County, and 3½ miles below former gaging station at Blue Lake.

DRAINAGE AREA.—75.5 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 1, 1921, to September 30, 1923, at site below Sarsapkin Creek, when records were discontinued; June 13, 1903, to March 30, 1905, at site 3 miles above Loomis; and June 1 to October 31, 1920 at Blue Lake.

GAGE.—Staff gage on right bank; read by N. R. Judson. June 1 to October 31, 1920, vertical staff on left bank near Blue Lake, 3½ miles upstream.

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

CHANNEL AND CONTROL.—Left bank high; right bank low but not subject to overflow. One channel at all stages. Control well-defined riffle of small boulders and gravel a few feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the period May 12 to September 30, 1.02 feet June 24 (discharge, 69 second-feet); minimum stage recorded, 0.28 foot August 31 and September 4–8, 11, 12, 16–17 (discharge, 1.9 second-feet).

1921–1923: Maximum stage recorded, 2.6 feet May 18, 1922 (discharge, 363 second-feet); minimum stage recorded, 0.24 foot August 7 and 8, 1922 (discharge, 1.6 second-feet).

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

REGULATION.—None.

DIVERSIONS.—Water diverted above gage for irrigation of few acres.

ACCURACY.—Stage-discharge relation changed during period gage was not read. Rating curve well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Except for extremely low water, records good.

COOPERATION.—Station maintained in cooperation with Whitestone Irrigation District.

Discharge measurements of Sinlahekin Creek at Twin Bridges, near Loomis, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 12	R. B. Kilgore	0.44	6	June 29	J. S. Gatewood	0.83	34.6
May 12	do	.83	37.8	July 25	do	.48	7.02
30	do	.73	24.6	Sept. 30	D. J. F. Calkins	.40	4.26
June 29	J. S. Gatewood	.84	37.4				

Daily discharge, in second-feet, of Sinlahekin Creek at Twin Bridges, near Loomis, Wash., for the period May 12 to Sept. 30, 1923

Day	May	June	July	Aug.	Sept.	Day	May	June	July	Aug.	Sept.
1		30	30	3.4	2.1	16	32	64	16	2.5	1.9
2		54	25	3.4	2.1	17	31	63	14	2.5	1.9
3		40	25	6.1	2.1	18	30	61	14	2.5	3.4
4		32	23	3.0	1.9	19	32	58	12	2.1	3.4
5		32	23	3.4	1.9	20	36	54	11	7.9	3.4
6		30	21	3.0	1.9	21	32	47	10	7.9	3.4
7		28	51	3.0	1.9	22	32	47	9.0	7.9	3.4
8		25	47	2.8	1.9	23	32	46	7.9	6.5	4.3
9		38	35	2.5	7.9	24	28	69	6.5	5.7	14.0
10		54	30	5.7	2.1	25	35	61	7.2	4.7	7.9
11		44	26	4.3	1.9	26	30	51	6.5	5.0	10.0
12	36	61	23	4.3	1.9	27	25	44	4.3	4.3	7.9
13	35	61	21	3.4	2.1	28	23	38	3.9	3.9	4.3
14	32	65	18	3.4	3.0	29	30	36	3.6	3.9	4.3
15	32	65	18	3.0	3.0	30	24	34	3.4	3.9	4.3
						31	23		3.4	1.9	

NOTE.—Gage not read June 16; discharge estimated by interpolation.

Monthly discharge of Sinlahekin Creek at Twin Bridges, near Loomis, Wash., for the period May 12 to Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
May 12–31	36	23	30.5	1,210
June	69	25	47.7	2,840
July	51	3.4	17.7	1,090
August	7.9	1.9	4.12	253
September	14	1.9	3.85	229
The period				5,620

TOATS COULEE CREEK NEAR LOOMIS, WASH.

LOCATION.—In SE. ¼ sec. 33, T. 39 N., R. 25 E., just below Deer Creek, 1,200 feet above intake of Whitestone Irrigation District flume, and 3 miles northwest of Loomis, Okanogan County.

DRAINAGE AREA.—132 square miles (measured on topographic maps).

RECORDS AVAILABLE.—May 1, 1920, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank at head of falls, installed June 3, 1920; inspected by C. L. Jones and Harold Eastman. May 11 to June 2, 1920, temporary staff gage at same site but at different datum. All readings prior to installation of water-stage recorder reduced to datum of present gage. Discharge measurements have also been referred to a vertical staff gage near right bank at high-water measuring section, a few feet above weir and intake of Whitestone Irrigation District flume. This gage was used by the irrigation district in obtaining records prior to the establishment of present station. A Stevens continuous water-stage recorder on right bank a few feet above weir was used as an auxiliary gage May 13 to September 29, 1923.

DISCHARGE MEASUREMENTS.—Made from footbridge just above irrigation flume intake or by wading.

CHANNEL AND CONTROL.—Bed composed of large boulders and gravel. One channel at all stages. Banks high and wooded. Control at head of 20-foot falls several feet below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from recorded range of stage, 3.36 feet some time June 2–9, probably June 9 (discharge, 480 second-feet); minimum stage, from recorder, 1.04 feet at 10 a. m. November 3 (discharge, 3.8 second-feet); flow may have been lower during winter when recorder was not operating.

1920–1923: Maximum stage recorded, 4.8 feet at 8 p. m. June 3, 1922 (discharge, 925 second-feet); minimum stage recorded, 0.84 foot at noon November 17, 1921 (discharge, 2.6 second-feet).

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

DIVERSIONS.—None.

REGULATIONS.—None.

ACCURACY.—Stage-discharge relation changed gradually May 14 to July 24; not affected by ice while recorder was in operation. Rating curve used directly and as standard form for shifting control fairly well defined. Operation of water-stage recorders fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table daily mean gage height determined from recorder graph by inspection. Shifting-control method used May 14 to July 24. Records fair.

Discharge measurements of Toats Coulee Creek near Loomis, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height		Discharge	Date	Made by—	Gage height		Discharge
		Weir gage	Station gage				Weir gage	Station gage	
		Feet	*Feet*	*Sec.-ft.*			*Feet*	*Feet*	*Sec.-ft.*
Oct. 5	R. B. Kilgore	0.35	1.96	23.7	June 28	J. S. Gatewood	1.10	2.84	157
10	do	.26	1.78	15.2	29	do	1.07	2.79	151
May 13	do	.98	2.67	112	July 24	do	.50	2.27	46.1
14	do	1.03	2.71	128	26	do	.47	2.20	38.9
29	do	1.02	2.68	136	Sept. 29	D. J. F. Calkins	.98	1.56	10.5
30	do	1.01	2.66	126	29	do	.97	1.54	10.3

Daily discharge, in second-feet, of Toats Coulee Creek near Loomis, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	May	June	July	Aug.	Sept.
1	11	9	--------	180	125	26	14
2	11	7	--------	253	123	26	13
3	12	6	--------	244	138	23	12
4	20	9	--------	240	120	23	12
5	24	9	--------	240	112	23	11
6	20	8	--------	235	114	22	11
7	18	9	--------	253	207	22	11
8	17	10	--------	278	206		11
9	16	11	--------	274	138	30	10
10	16	10	--------	300	131		10
11	14	9	--------	300	118	32	9
12	14	7	--------	326	123	26	9
13	13	--------	112	313	108	21	9
14	12	--------	127	284	94	19	8
15	12	--------	125	269	78	18	8
16	11	--------	129	274	76	16	8
17	11	--------	129	279	72	15	8
18	11	--------	129	269	108	14	8
19	11	--------	141	244	76	13	8
20	11	--------	143	221	70	20	9
21	11	--------	160	212	65	59	12
22	11	--------	222	221	59	40	11
23	11	--------	195	248	54	35	11
24	10	--------	167	274	47	28	11
25	11	--------	235	284	44	24	12
26	12	--------	222	221	40	24	12
27	14	--------	162	192	37	22	13
28	13	--------	134	162	32	19	11
29	11	--------	131	149	30	16	10
30	12	--------	129	136	27	16	10
31	11	--------	134	--------	26	14	--------

NOTE.—Water-stage recorder at regular station not operating May 22–26, June 2–9, and Aug. 3–10; discharge ascertained by use of gage-height record from recorder just above weir, and rating tables developed for weir gage. No record Nov. 13 to May 12.

Monthly discharge of Toats Coulee Creek near Loomis, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	24	10	13.3	818
November 1–12	11	6	8.7	207
May 13–31	235	112	154	5,800
June	326	136	246	14,600
July	207	26	90.3	5,550
August	59	13	24.1	1,480
September	14	8	10.4	619

NOTE.—No record Nov. 13 to May 12.

WEST OKANOGAN VALLEY IRRIGATION DISTRICT CANAL NEAR OROVILLE, WASH.

LOCATION.—In sec. 20, T. 40 N., R. 27 E., 1,500 feet below undercrossing of road to power plant, 1½ miles northwest of Oroville, Okanogan County.

RECORDS AVAILABLE.—Irrigation seasons 1922 to 1923.

GAGE.—Staff gage on right side of flume read by Henry Guterney and John Truax.

DISCHARGE MEASUREMENTS.—Made from plank over flume just below undercrossing of road to power plant.

CHANNEL AND CONTROL.—Control is long section of metal-lined flume. There is a possibility that stage-discharge relation is affected somewhat by operation of lateral gates some considerable distance below gage.

EXTREMES OF DISCHARGE.—Maximum stage recorded during the irrigation season 1922, 3.45 feet on June 6 and 9 (discharge, 172 second-feet). Maximum stage recorded during irrigation season 1923, 3.2 feet July 15–19, 21, 23, and August 14–18, 20, 22, and 24–30 (discharge, 152 second-feet). Canal dry during nonirrigating season and on June 15, 1923.

ICE.—Canal dry during winter.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Gage read once, more often twice daily to hundredths. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Gage-height record furnished by West Okanogan Valley Irrigation District.

Canal diverts water from left bank of Similkameen River in sec. 7, T. 40 N., R. 26 E. Water is used for irrigation.

Discharge measurements of West Okanogan Valley Irrigation District canal near Oroville, Wash., during the irrigation seasons 1922 and 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
1922		*Feet*	*Sec.-ft.*	1923		*Feet*	*Sec.-ft.*
June 8	R. B. Kilgore	3.00	138	July 1	J. S. Gatewood	2.89	132
18	do	3.12	138	2	do	2.96	136
Oct. 4	do	1.02	25	28	do	3.10	148
				29	do	3.10	148
1923				Aug. 30	J. L. Ford	3.15	147
May 31	do	3.06	139	Sept. 27	D. J. F. Calkins	2.56	99

Daily discharge, in second-feet, of West Okanogan Valley Irrigation District canal near Oroville, Wash., for the irrigation seasons 1922 and 1923

Day	Apr.	May	June	July	Aug.	Sept.	Day	Apr.	May	June	July	Aug.	Sept.
1922							1923						
1	------	35	136	168	160	121	1	------	10	144	128	144	144
2	------	41	136	168	160	107	2	------	13	107	136	144	136
3	------	47	136	168	160	107	3	------	18	100	136	144	136
4	------	50	136	168	152	107	4	------	15	121	35	144	136
5	------	52	136	168	152	107	5	------	21	136	33	144	136
6	------	52	136	168	160	107	6	------	24	136	50	144	136
7	------	52	136	168	160	107	7	------	24	136	128	144	128
8	------	54	136	168	160	107	8	------	31	136	128	144	128
9	------	60	136	168	160	107	9	------	45	121	128	144	128
10	------	65	136	164	160	107	10	------	60	107	136	144	128
11	------	71	136	160	160	107	11	------	62	65	136	144	121
12	------	77	136	160	160	------	12	------	68	77	136	144	121
13	------	80	136	168	152	------	13	------	93	77	144	144	121
14	------	93	136	160	152	------	14	------	121	77	144	152	128
15	------	100	136	160	114	------	15	------	136	0	152	152	121
16	------	107	144	160	71	------	16	------	128	77	152	152	121
17	------	121	144	168	74	------	17	------	128	77	152	152	121
18	------	121	144	160	74	------	18	------	136	77	152	152	121
19	------	121	144	160	74	------	19	------	136	77	152	144	121
20	------	121	144	160	107	------	20	------	136	93	144	152	114
21	------	121	144	160	136	------	21	------	136	100	152	144	107
22	------	128	144	160	136	------	22	------	144	100	144	152	100
23	------	128	152	160	136	------	23	------	136	100	152	144	107
24	------	128	152	160	136	------	24	------	136	100	144	152	107
25	12	128	152	160	136	------	25	------	144	100	45	152	100
26	20	121	152	160	136	------	26	------	144	107	136	152	100
27	29	128	160	160	136	------	27	------	136	107	144	152	107
28	29	128	160	152	144	------	28	14	144	114	144	152	107
29	33	128	160	152	136	------	29	14	144	114	144	152	100
30	35	128	168	160	144	------	30	8	144	114	144	152	0
31	------	128	------	160	144	------	31	------	144	------	144	144	------

Monthly discharge of West Okanogan Valley Irrigation District canal near Oroville, Wash., during irrigation seasons 1922 and 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
1922				
April 25–30	35	12	26.3	313
May	128	35	94	5,780
June	168	136	143	8,510
July	168	152	162	9,960
August	160	71	137	8,420
September 1–11	121	107	108	2,360
The period				35,300
1923				
May	144	10	95.4	5,870
June	144	0	99.9	5,940
July	152	33	129	7,930
August	152	144	148	9,100
September	144	0	116	6,900
The period				35,700

METHOW RIVER BASIN

METHOW RIVER AT TWISP, WASH.

LOCATION.—In sec. 17, T. 33 N., R. 22 E., at highway bridge at Twisp, Okanogan County, a quarter of a mile below mouth of Twisp River.

DRAINAGE AREA.—1,330 square miles (measured on topographic and Forest Service maps).

RECORDS AVAILABLE.—June 1, 1919, to September 30, 1923.

GAGE.—Chain gage on upstream side of highway bridge; installed June 14, 1920; read by G. M. Gibson and E. V. Christie. June 13 to July 25, 1919, vertical staff in two sections on right bank 40 feet above highway bridge, at present datum; July 26 to August 12, 1919, temporary vertical section for low water at same site but different datum; August 13 to October 2, 1919, vertical section on left bank, 25 feet below bridge, at different datum; October 3, 1919, to June 13, 1920, chain gage on bridge, at different datum. All gage heights have been referred to datum of present gage.

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

CHANNEL AND CONTROL.—One channel at all stages; straight for long distance above and below gage. Bed composed of boulders and gravel. Control is a riffle of large boulders about 300 feet below gage; may shift during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.1 feet at noon June 9 (discharge, 8,420 second-feet); minimum stage recorded, 1.65 feet on December 12, January 30, February 13 and 14 (discharge, 203 second-feet).

1919–1923: Maximum stage recorded, 10.4 feet at 9 a. m. on June 5, 1921 (discharge, 13,400 second-feet); minimum discharge, estimated at 144 second-feet December 13–15, 1919, when stage-discharge relation was affected by ice.

ICE.—Stage-discharge relation seriously affected by ice during severe winters.

DIVERSIONS.—Numerous diversions above station for irrigation.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent; not affected by ice. Rating curve well defined below 6,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying daily gage height to rating table. Records excellent.

COOPERATION.—Gage-height record furnished by Methow Okanogan Irrigation District.

Discharge measurements of Methow River at Twisp, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
June 26	J. S. Gatewood	5.82	4,240
Sept. 25	D. J. F. Calkins	1.90	275

Daily discharge, in second-feet, of Methow River at Twisp, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	324	344	285	249	249	217	453	3,360	3,840	4,650	780	430
2	324	344	276	249	233	217	500	2,360	4,000	4,480	748	408
3	344	324	267	249	249	217	600	2,240	4,320	4,480	715	386
4	365	324	267	249	249	217	715	2,120	4,320	3,840	685	365
5	386	324	267	249	249	217	748	2,240	4,650	3,200	628	344
6	386	324	267	267	267	217	815	2,900	5,690	2,900	600	344
7	365	324	267	304	304	217	815	3,050	6,630	3,050	600	324
8	386	344	267	285	324	217	832	3,840	7,610	3,200	574	304
9	386	344	267	267	285	217	850	5,870	8,420	3,200	574	304
10	386	344	267	267	267	217	850	7,210	8,010	3,050	574	304
11	386	334	267	258	267	217	920	5,870	8,210	3,050	549	304
12	386	324	203	250	217	217	1,060	5,510	8,210	2,900	524	285
13	376	324	344	242	203	233	1,140	4,650	7,810	2,490	500	285
14	365	324	344	233	203	233	1,140	4,650	5,510	2,620	500	285
15	365	304	344	245	217	233	1,220	4,160	4,480	2,360	500	285
16	344	324	331	267	233	233	1,310	4,480	4,480	2,240	500	285
17	344	324	317	267	217	233	2,010	4,650	4,480	1,900	476	285
18	344	304	304	249	217	233	2,360	4,650	4,480	1,800	453	285
19	344	304	304	249	217	233	2,490	4,820	4,480	1,600	453	285
20	344	304	304	249	233	233	1,900	5,330	4,480	1,500	476	285
21	324	304	295	249	249	233	1,800	5,690	4,820	1,400	628	285
22	344	285	286	249	233	233	1,980	6,630	4,820	1,360	628	285
23	344	267	276	267	217	233	2,120	6,440	4,650	1,310	628	285
24	324	304	267	233	217	233	2,240	5,690	4,650	1,310	600	285
25	344	304	267	233	217	249	2,240	5,160	4,320	1,220	600	285
26	365	304	267	233	217	249	2,620	4,990	4,160	1,060	549	304
27	365	304	267	249	217	285	2,900	4,650	4,480	990	524	304
28	365	304	267	241	217	304	3,050	4,320	4,480	990	500	304
29	344	285	249	233	-------	324	3,050	4,160	4,480	920	476	304
30	344	304	249	203	-------	365	2,900	3,520	4,480	885	453	304
31	344	-------	249	217	-------	408	-------	3,520	-------	815	453	-------

NOTE.—Gage not read Oct. 4, 13, 17, 27, 31, Nov. 11, Dec. 2, 6, 8, 9, 14, 16, 17, 19, 21–23, Jan. 11–13, 15, 19, 20, 28, Mar. 17, Apr. 8, 22, July 4, 22, and Sept. 20–24; discharge estimated by interpolation.

Monthly discharge of Methow River at Twisp, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	386	324	357	22,000
November	344	267	316	18,800
December	344	203	281	17,300
January	304	203	250	15,400
February	324	203	239	13,300
March	408	217	245	15,100
April	3,050	453	1,590	94,600
May	7,210	2,120	4,480	275,000
June	8,420	3,840	5,320	317,000
July	4,650	815	2,280	140,000
August	780	453	563	34,600
September	430	285	311	18,500
The year	8,420	203	1,360	982,000

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, Chelan County, a quarter of a mile above highway bridge at outlet.

DRAINAGE AREA.—950 square miles (measured on topographic and Forest Service maps).

RECORDS AVAILABLE.—September 1 to October 15, 1897; January 1, 1898, to December 31, 1899; January 1 to June 30, 1905; and December 5, 1910, to September 30, 1923.

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 1 mile west of Chelan; datum, 1,070.18 feet above sea level. In 1905 gage was on a bent of upper bridge at Chelan; elevation not determined. Gage read by C. A. Bennett.

EXTREMES OF STAGE.—Maximum stage recorded during year, 5.94 feet on June 12; minimum stage recorded, 1.54 feet on December 23.

1898–99; 1911–1923: Maximum stage recorded, 8.2 feet on June 8, 1921; minimum stage recorded, 6.60 feet (elevation, 1,076.78 feet) January 27–28 and December 2–5, 1898.

REGULATION.—The lake level is controlled at low water by operation of flashboard dam at outlet in the interest of navigation.

ACCURACY.—Gage read to hundredths once on days for which gage heights are recorded.

COOPERATION.—Gage-height record furnished by Chelan Electric Co.

Daily gage height, in feet, of Lake Chelan at Chelan, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			1.65	1.81				2.98	4.58		3.91	3.67
2			1.70	1.84			2.11	2.96	4.50	5.44	3.91	
3					2.45	2.33	2.20	2.89		5,55	3.91	
4		1.87					2.16	2.90	4.30	5.45	3.91	
5							2.28	2.92	4.31	5.35		
6				2.16			2.25	2.99	4.59	5.23	3.80	3.49
7	2.42						2.25	3.06	4.81	5.18		
8								3.25	5.06		3.72	3.46
9			1.55					3.60	5.40	5.05		
10					2.35	2.45	2.19	3.92		5.00		
11		1.90					2.16	4.05	5.80	4.94	3.70	
12						2.54	2.20	4.20	5.94	4.90		
13				2.32			2.14	4.22	5.88	4.85	3.72	
14	2.28						2.20	4.25	5.68	4.80	3.71	
15								4.29	5.52			3.30
16			1.55				2.15	4.35	5.36			
17					2.55	2.37	2.32					
18		1.77					2.45		5.18		3.84	
19						2.80	2.55	4.54	5.07	4.40		
20				2.55		2.47	2.54		5.02	4.30	3.85	
21	2.17					2.45	2.50	4.74	5.01	4.20	3.83	
22						2.55		4.86	4.99			3.12
23			1.54			2.53	2.47	4.94	4.97	4.16		
24					2.45	2.50	2.45	5.00	4.97	4.15		
25		1.74				2.43	2.46	4.95	4.97	4.15	3.83	
26							2.54	4.99	4.94	4.05		
27				2.50		2.44	2.68		4.93	3.99	3.75	
28	2.09				2.37	2.28	2.77	4.88	4.97	3.97		
29						2.28		4.85	5.06			2.96
30		1.65	1.76			2.21	2.90	4.75	5.22	3.95		2.97
31	2.05		1.79	2.45		2.17		4.65		3.91	3.69	

CHELAN RIVER AT CHELAN, WASH.

LOCATION.—In sec. 13, T. 27 N., R. 22 E., at lower bridge at Chelan, Chelan County, 800 feet below flashboard dam at outlet of Chelan Lake, and 4 miles northwest of Chelan Falls.

DRAINAGE AREA.—950 square miles (measured on topographic and Forest Service maps).

RECORDS AVAILABLE.—November 1, 1903, to September 30, 1923.

GAGE.—Vertical staff on fourth bent of left approach to lower bridge; read by C. A. Bennett.

DISCHARGE MEASUREMENTS.—Made from upper bridge 1,000 feet above gage, from boat, 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, 10.1 feet June 11–13 (discharge, 7,520 second-feet); minimum stage recorded, 3.74 feet March 12 (discharge, 289 second-feet).

1903–1923: Maximum stage recorded, 12.3 feet June 8, 1921 (discharge, 11,600 second-feet). Practically no flow for at least part of day on January 30, 1917, when outlet to lake was blocked solidly with ice so that no water could flow over dam.

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

DIVERSION.—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 interest of navigation. Monthly summaries of flow have been corrected for storage.

ACCURACY.—Stage-discharge relation changed June 12. Rating curves used prior to the change well defined between 400 and 10,000 second-feet. That used after the change well defined between 700 and 10,000 second-feet. Gage read to hundredths once daily. Daily discharge ascertained by applying mean daily gage heights to rating table. Records good November to March; otherwise excellent.

COOPERATION.—Gage-height record furnished by Chelan Electric Co.

Discharge measurements of Chelan River at Chelan, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
June 24	J. S. Gatewood	9.35	6,230
Sept. 24	D. J. F. Calkins	5.30	856

Daily discharge, in second-feet, of Chelan River at Chelan, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	730	678	381	381	360	340	1,890	3,040	5,580	6,620	1,890	1,670
2	730	678	381	403	360	322	2,010	3,040	5,410	6,800	1,890	1,560
3	730	678	381	403	360	322	2,010	3,040	5,250	6,980	1,780	1,560
4	730	678	381	403	360	322	2,010	3,040	5,090	6,800	1,890	1,560
5	730	630	381	403	360	305	2,130	3,040	5,250	6,620	1,780	1,460
6	730	630	381	427	340	305	2,130	3,040	5,580	6,440	1,780	1,460
7	730	512	381	403	340	305	2,130	3,190	5,920	6,440	1,670	1,360
8	730	547	381	381	340	305	2,090	3,490	6,260	6,260	1,670	1,360
9	730	547	381	360	340	305	2,050	3,970	6,980	6,090	1,670	1,360
10	730	547	381	360	340	305	2,010	4,450	7,160	6,090	1,670	1,360
11	730	547	381	360	340	305	2,010	4,610	7,520	5,920	1,670	1,360
12	730	512	381	360	340	289	2,130	4,930	7,520	5,920	1,670	1,360
13	678	512	381	360	340	305	2,010	4,930	7,520	5,920	1,670	1,270
14	678	586	381	360	340	305	2,130	4,930	7,340	5,750	1,670	1,110
15	678	512	360	360	340	305	2,130	5,090	6,980	5,660	1,560	1,040
16	678	480	360	360	340	403	2,130	5,090	6,800	5,580	1,780	970
17	678	427	360	381	340	381	2,250	5,250	6,620	5,580	1,780	970
18	678	381	360	360	340	452	2,370	5,410	6,440	5,250	1,780	910
19	678	381	360	360	340	547	2,500	5,410	6,260	4,930	1,780	910
20	678	381	360	360	340	452	2,500	5,580	6,260	4,450	1,780	910
21	630	381	360	360	340	452	2,500	5,750	6,260	4,290	1,780	910
22	630	427	360	340	340	480	2,500	5,920	6,090	4,130	1,780	910
23	586	403	360	340	340	586	2,370	6,090	6,090	3,970	1,780	880
24	730	403	381	340	340	630	2,370	6,260	6,090	3,970	1,780	850
25	845	427	381	360	340	708	2,370	6,090	6,090	3,970	1,780	850
26	845	403	403	360	340	785	2,500	6,260	6,090	3,650	1,780	800
27	845	403	403	360	340	1,060	2,630	6,090	5,920	3,190	1,780	800
28	730	403	381	360	340	1,340	2,760	5,920	6,090	3,190	1,670	800
29	730	403	381	340	-------	1,550	2,900	5,920	6,260	2,720	1,670	800
30	730	381	381	360	-------	1,770	3,040	5,750	6,440	2,250	1,670	800
31	730	-------	381	360	-------	1,770	-------	5,580	-------	2,130	1,670	-------

Monthly discharge of Chelan River at Chelan, Wash., for the year ending Sept. 30, 1923

[Drainage area, 950 square miles]

Month	Observed discharge in second-feet			Run-off in acre-feet			Discharge without storage in second-feet		Run-off in inches
	Maximum	Minimum	Mean	Observed	Stored	Without storage	Mean	Per square mile	
October	845	586	717	44,100	−11,000	33,100	538	0.566	0.65
November	678	381	496	29,500	−12,500	17,000	286	.301	.34
December	403	360	376	23,100	+4,650	27,800	452	.476	.55
January	427	340	369	22,700	+20,400	43,100	701	.738	.85
February	360	340	344	19,100	−2,550	16,600	299	.315	.33
March	1,770	289	581	35,700	−6,350	29,400	478	.503	.58
April	3,040	1,890	2,290	136,000	+22,900	159,000	2,670	2.81	3.14
May	6,260	3,040	4,850	298,000	+54,000	352,000	5,720	6.02	6.94
June	7,520	5,090	6,310	375,000	+17,600	393,000	6,600	6.95	7.75
July	6,980	2,130	5,080	312,000	−40,300	272,000	4,420	4.65	5.36
August	1,890	1,560	1,740	107,000	−6,650	100,000	1,630	1.72	1.98
September	1,670	800	1,130	67,200	−22,600	44,600	750	.789	.88
The year	7,520	289	2,030	1,470,000	+17,600	1,490,000	2,050	2.16	29.35

ENTIAT RIVER BASIN

ENTIAT RIVER AT ENTIAT, WASH.

LOCATION.—In sec. 18, T. 25 N., R. 21 E., one-eighth of a mile below power plant of Wenatchee Valley Gas & Electric Co., three-fourths of a mile west of Entiat, Chelan County, and 1 mile above mouth.

DRAINAGE AREA.—419 square miles (measured on topographic maps).

RECORDS AVAILABLE.—October 5, 1910, to September 30, 1923.

GAGE.—Inclined staff on left bank one-eighth of a mile below power plant; read by L. G. Asher.

DISCHARGE MEASUREMENTS.—Made from private bridge 200 feet below power plant or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and boulders; shifting. One channel at all stages. Left bank high; not subject to overflow. Right bank slopes gradually. Stage of zero flow, 0.5 ±0.1 foot, determined September 24, 1922

EXTREMES OF DISCHARGE.—Maximum stage recorded, 4.0 feet June 9–11 (discharge, 3,120 second-feet); minimum discharge, 32 second-feet, the result of current meter measurement made January 30; flow probably lower on some other days during periods stage-discharge relation was affected by ice.

1910–1923: Maximum stage recorded, 5.0 feet June 17, 1916 (discharge, 5,150 second-feet); minimum discharge on record, that of January 30, 1923.

ICE.—Stage-discharge relation affected by ice; flow estimated from gage-height record, discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Several diversions above station for irrigation. Entiat Irrigation Co.'s high line canal (capacity, about 20 second-feet) carries water past station.

REGULATION.—Flow affected by changes in load at power plant.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 8–27 and January 29 to February 23. Rating curve well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records good except during periods when stage-discharge relation was affected by ice.

COOPERATION.—Gage-height records furnished by Washington Coast Utilities Co.

Discharge measurements of Entiat River near Entiat, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
Jan. 30	R. B. Kilgore	* 0.86	32
June 23	Gatewood and Hill	3.03	1,560
Sept. 23	D. J. F. Calkins	.90	106

* Stage-discharge relation affected by ice.

Daily discharge, in second-feet, of Entiat River at Entiat, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	109	116	79	129		83	355	850	1,350	1,980	310	174
2	106	106	79	127		85	380	850	1,290	1,900	310	174
3	101	106	79	116		85	404	768	1,290	1,900	310	167
4	106	111	83	106		83	404	653	1,410	1,830	310	155
5	106	111	83	106		92	431	728	1,830	1,410	268	132
6	97	101	79	138		97	431	808	2,450	1,130	252	127
7	129	97	79	229	60	101	404	984	2,610	1,180	237	127
8	116	111		229		101	404	984	2,780	1,180	237	127
9	116	116		222		99	355	1,030	3,120	1,030	229	124
10	106	127		200		101	355	1,350	3,120	984	222	119
11	106	111		161		101	380	1,480	3,120	984	215	116
12	101	101		149		99	404	1,540	2,950	984	207	111
13	101	97	40	144		99	404	1,540	2,450	938	207	111
14	101	92		144		101	404	1,540	1,980	893	200	111
15	97	88		132		101	431	1,610	1,540	893	200	106
16	92	88		127		101	458	1,680	1,540	808	200	106
17	83	88		127		106	458	1,760	1,480	728	193	104
18	92	92		122	50	109	653	1,760	1,410	728	200	101
19	97	97		122		111	618	1,830	1,410	583	229	101
20	92	101		116		111	583	1,900	1,480	583	289	106
21	97	94		88		116	583	1,900	1,540	550	289	106
22	127	92		92		122	550	1,980	1,680	518	310	111
23	127	83	100	101		127	488	2,130	1,610	518	289	106
24	122	81		97	88	132	488	2,130	1,540	518	252	106
25	106	88		92	85	132	488	2,130	1,540	518	207	111
26	127	92		92	83	138	583	1,680	1,540	518	193	138
27	122	92		97	83	144	653	1,680	1,540	518	187	138
28	122	88	132	92	83	161	728	1,540	1,540	431	187	129
29	127	83	127		-------	211	728	1,480	1,760	404	180	127
30	116	83	127	50	-------	268	768	1,410	1,830	355	180	129
31	127	-------	127		-------	310	-------	1,410	-------	332	177	-------

NOTE.—Braced figures show mean discharge for periods indicated.

Monthly discharge of Entiat River at Entiat, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	129	83	109	6,700
November	127	81	97.8	5,820
December	----------	----------	79.8	4,910
January	229	----------	124	7,620
February	----------	----------	60.4	3,350
March	310	83	123	7,560
April	768	355	492	29,300
May	2,130	653	1,460	89,800
June	3,120	1,290	1,890	112,000
July	1,980	332	898	55,200
August	310	177	235	14,400
September	174	101	123	7,320
The year	3,120	----------	476	344,000

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 at Plain, half a mile below Beaver Creek, and 14 miles north of Leavenworth, Chelan County.

DRAINAGE AREA.—591 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 27, 1910, to September 30, 1923.

GAGE.—Since September 6, 1913, vertical and inclined staff gage on left bank, 1,500 feet below highway bridge; read by P. H. Hertzog. November 28, 1910, to September 5, 1913, vertical staff 15 feet downstream at same datum.

DISCHARGE MEASUREMENTS.—Made from cable three-eighths of a mile above gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and small boulders. Control 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 September 27, 1918, gage height, 1.2 feet ± 0.2 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 8.1 feet June 9 (discharge, 10,100 second-feet); discharge may have been slightly greater on May 10 when stage-discharge relation was affected by logs. Minimum discharge probably occurred in December while stage-discharge relation was affected by ice and logs.

1910–1923: Maximum stage recorded, 11.8 feet December 13, 1921 (discharge, 20,800 second-feet); minimum discharge, 316 second-feet September 29, 30, and October 11 and 12, 1915.

ICE.—Stage-discharge relation affected by ice during severe winters; flow estimated from gage-height record, discharge measurements, observer's notes, and weather records.

DIVERSION.—The Wenatchee Park Land & Irrigation Co. diverts a maximum of about 12 second-feet from Chiwawa River during irrigation season.

Regulation.—None.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 8–24 and February 11–20; affected by logs January 9 to March 31, April 21 to May 15 and July 18 to September 30. Rating curve well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records good, except for periods represented by flat estimates of discharge.

COOPERATION.—Gage-height record furnished by Greater Wenatchee Irrigation District.

Discharge measurements of Wenatchee River near Leavenworth, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Jan. 31	R. B. Kilgore	• 3.20	657	June 22	Gatewood and McDonald.	6.01	4,940
May 10	do	• 8.32	10,200	Sept. 22	D. J. F. Calkins	• 3.70	516

• Stage-discharge relation affected by logs.

Daily discharge, in second-feet, of Wenatchee River near Leavenworth, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	540	660	470	1,140	660	580	2,050		4,490	7,970		
2	522	660	470	1,140	660	560	2,910		4,300	7,970		
3	505	620	470	1,140	620	540	3,070		4,110	7,200		
4	580	620	470	1,080	620	540	3,230		4,670	5,770		
5	620	580	464	1,080	660	580	2,910		6,230	5,110		
6	580	540	457	1,140	660	620	3,230		7,200	4,900		
6	540	540	444	1,790	660	620	3,070		8,490	4,900		
8	505	540		2,760	660	620	2,910	6,500	9,300	4,490	1,700	800
9	505	540		2,180	620	620	2,910		10,100	4,300		
10	505	540		2,180	620	620	2,760		9,840	4,300		
11	505	505		2,050		620	2,760		8,760	4,110		
12	470	580		1,790		620	3,230		7,450	4,110		
13	470	540		1,660		620	3,230		6,950	3,740		
14	470	505		1,540		620	3,070		5,770	3,740		
15	470	470		1,420		580	3,230		4,900	3,740		
16	464	505	350	1,300	550	620	3,740	7,200	4,490	3,390		
17	457	745		1,270		620	6,000	7,450	4,490	3,390		
18	450	745		1,240		580	6,950	7,200	4,490			
19	450	700		1,140		620	6,000	7,200	4,490			
20	444	660		1,030		620	5,110	6,470	4,900			
21	444	660		980	620	620		6,470	4,900			
22	438	620		980	620	620		7,200	4,900			
23	457	580		930	580	620		7,200	4,900		1,500	450
24	470	580		880	580	620		6,710	6,110	2,300		
25	505	540	1,420	880	580	660	5,000	6,470	5,110			
26	580	540	1,920	835	580	660		6,000	5,110			
27	745	540	1,790	835	540	745		5,550	5,330			
28	745	505	1,660	790	540	745		4,900	6,230			
29	700	505	1,540	745	-------	1,140		4,900	6,710			
30	700	505	1,360	620	-------	1,420		4,900	7,710			
31	700	-------	1,300	660	-------	1,790	-------	4,490	-------			-------

NOTE.—Gage not read Jan. 17 and June 4. Discharge determined by interpolation Jan. 17 and by comparison with records of Entiat River June 4. Braced figures show mean discharge for periods indicated.

Monthly discharge of Wenatchee River near Leavenworth, Wash., for the year ending Sept. 30, 1923

[Drainage area, 591 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
October	745	438	533	0.902	1.04	32,800
November	745	470	579	.980	1.09	34,500
December	1,920	----------	651	1.10	1.27	40,000
January	2,760	620	1,260	2.13	2.46	77,500
February	660	----------	592	1.00	1.04	32,900
March	1,790	540	699	1.18	1.36	43,000
April	----------	2,050	4,080	6.90	7.70	243,000
May	----------	----------	6,380	10.8	12.45	392,000
June	10,100	4,110	6,050	10.2	11.38	360,000
July	7,970	----------	3,720	6.29	7.25	229,000
August	----------	----------	1,600	2.71	3.12	98,400
September	----------	----------	625	1.06	1.18	37,200
The year	10,100	----------	2,240	3.79	51.34	1,620,000

YAKIMA RIVER BASIN

KEECHELUS LAKE NEAR MARTIN, WASH.

LOCATION.—At outlet of lake, 1¼ miles northeast of Meadow Creek railroad station, 3½ miles northwest of Martin, Kittitas County, and 9½ miles northwest of Easton.

DRAINAGE AREA.—55 square miles (measured on topographic maps).

RECORDS AVAILABLE.—January 12, 1906, to September 30, 1923.

GAGE.—Vertical staff attached to pier of bridge to gage house; read by C. O. Shupe and L. M. Ralph. 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 STORAGE.—Maximum stage recorded during year, 2,517.52 feet from 5 p. m. July 7 to 5.25 p. m. July 8 (storage, 159,100 acre-feet); minimum stage recorded, 2,429.26 feet from 5.25 p. m. October 5 to 7 a. m. October 6 (storage, 5,330 acre-feet).

1906–1923: Maximum and minimum stages recorded during climatic year 1923.

STORAGE.—Capacity of new reservoir, 152,000 acre-feet; elevation of gate sill, 2,425 feet, and of spillway crest, 2,515 feet. Record of storage or release each month used to determine discharge without storage at gaging station below dam.

ACCURACY.—Staff gage read twice daily to hundredths. Records excellent.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Storage, in acre-feet, in Keechelus Lake near Martin, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept
1	5,580	10,840	20,490	39,100	72,440	76,800	84,320	112,690	152,140	157,340	143,520	51,140
2	5,520	11,220	20,700	39,710	72,610	76,960	85,160	113,410	151,980	158,260	141,270	48,270
3	5,470	11,600	20,980	40,440	72,700	77,130	86,060	113,970	152,060	158,820	139,080	45,480
4	5,440	11,930	21,320	40,960	72,820	77,300	86,940	114,560	152,440	158,950	136,550	42,580
5	5,360	12,210	21,530	41,680	73,040	77,480	87,860	115,420	152,970	158,930	133,220	39,680
6	5,350	12,430	21,720	44,850	73,240	77,780	88,710	116,850	153,470	158,900	129,860	36,790
7	5,420	12,690	21,930	50,420	73,430	78,070	89,570	118,580	153,400	159,060	125,310	34,090
8	5,480	12,920	22,090	56,150	73,620	78,240	90,360	120,770	152,920	159,060	121,640	31,500
9	5,670	13,160	22,420	58,850	73,720	78,400	91,040	123,590	152,660	159,000	118,640	29,620
10	5,870	13,350	22,700	61,050	73,860	78,580	91,730	126,600	153,980	158,900	115,660	27,870
11	5,960	13,530	22,820	62,950	74,030	78,920	92,430	128,930	155,630	158,850	112,690	26,520
12	6,070	13,720	22,890	64,210	74,280	79,110	93,330	130,960	156,800	158,820	109,750	25,310
13	6,150	13,880	22,980	65,110	74,480	79,360	94,150	132,440	157,850	158,750	106,930	24,150
14	6,260	14,040	23,200	65,920	74,710	79,520	94,900	133,810	157,640	158,700	103,940	22,970
15	6,360	14,160	23,330	66,650	74,920	79,610	95,670	135,230	154,870	158,640	100,810	21,720
16	6,460	14,860	23,480	67,260	75,070	79,790	96,710	136,910	153,250	158,540	97,770	20,460
17	6,520	15,980	23,600	67,870	75,230	80,000	98,050	138,690	153,040	158,490	94,680	19,450
18	6,620	16,700	23,750	68,480	75,380	80,110	99,460	140,410	153,550	158,390	91,810	17,890
19	6,740	17,370	24,080	68,990	75,520	80,270	100,720	141,800	153,630	158,310	88,670	16,570
20	6,790	17,720	24,320	69,440	75,640	80,510	101,770	143,000	152,640	158,280	85,870	15,310
21	6,920	18,110	24,630	69,760	75,780	80,650	102,570	144,080	151,980	158,280	82,960	14,020
22	7,000	18,380	24,860	70,080	75,900	80,850	103,200	145,260	151,880	158,180	80,240	12,790
23	7,080	18,620	25,370	70,310	76,060	80,990	103,860	146,550	151,610	158,000	77,390	11,640
24	7,270	18,930	28,260	70,540	76,180	81,230	104,480	147,800	151,430	157,520	74,470	10,700
25	7,680	19,180	31,280	70,800	76,290	81,410	105,360	149,040	151,710	156,550	71,520	9,980
26	8,190	19,440	33,020	71,100	76,430	81,560	106,640	150,320	152,060	155,200	68,540	9,550
27	8,560	19,680	34,350	71,440	76,550	81,720	108,220	151,630	152,690	153,450	65,640	9,420
28	8,920	19,880	35,680	71,690	76,680	81,940	109,660	152,560	153,800	151,530	62,690	9,350
29	9,210	20,070	36,660	71,930	-------	82,250	110,780	152,770	154,940	149,800	59,890	9,310
30	9,460	20,270	37,490	72,120	-------	82,720	111,740	152,720	156,210	147,870	56,890	9,270
31	10,160	-------	38,360	72,290	-------	83,490	--------	152,410	--------	145,740	53,990	-------

YAKIMA RIVER NEAR MARTIN, WASH.

LOCATION.—Below dam at outlet of Keechelus Lake, 1½ miles east of Meadow Creek railroad station, 3½ miles northwest of Martin, Kittitas County, and 9½ miles northwest of Easton.

DRAINAGE AREA.—55 square miles (measured on topographic maps).

RECORDS AVAILABLE.—October 18 to November 14, 1903; January 28, 1904, to September 30, 1923.

GAGE.—Inclined staff gage in paved section on left side of outlet works; installed December 2, 1916; read by C. O. Shupe and L. M. Ralph. For description of previous gages see Water-Supply Paper 442.

DISCHARGE MEASUREMENTS.—Made from cable 700 feet below dam or by wading.

CHANNEL AND CONTROL.—Bed composed or gravel; shifts at high stages. Logs and brush sometimes lodge on riffle control below gage and affect stage-discharge relation.

EXTREMES OF DISCHARGE.—Maximum discharge during year, 4,680 second-feet at noon June 14 (computed from spillway overflow and tunnel discharge). No flow October 7 to January 19, while reservoir gates were closed.

1904–1923: Maximum discharge, 7,370 second-feet at 10.45 a. m. March 25, 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 by lowering grade of channel October 25. Rating curves well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records good.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Discharge measurements of Yakima River near Martin, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
July 26	D. E. Ball	6.50	729	Aug. 6	D. E. Ball	9.48	2,060
26	do	7.10	936	Sept. 15	R. O. Crawford	6.45	662

Daily discharge, in second-feet, of Yakima River near Martin, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	126		17	19	24	40	706	95	1,200	1,670
2	118		18	19	25	41	650	178	1,160	1,620
3	111		18	19	25	42	650	347	1,160	1,620
4	119		18	19	25	42	650	400	1,730	1,620
5	130		18	19	25	42	873	389	2,030	1,670
6	19		18	19	25	42	1,200	379	2,030	1,620
7			18	19	25	42	1,380	444	2,030	1,620
8			18	19	25	42	1,420	444	1,790	1,340
9			18	19	27	42	991	421	1,570	1,040
10			18	19	27	42	110	379	1,570	906
11			18	19	27	43	110	357	1,570	779
12			18	19	28	43	110	347	1,520	749
13			18	19	29	44	190	317	1,570	749
14			18	19	29	44	2,260	298	1,620	749
15			18	20	29	45	2,040	279	1,620	720
16			18	20	29	46	1,000	242	1,620	749
17			19	21	30	47	328	225	1,620	810
18			19	22	31	48	282	191	1,620	810
19			19	22	33	49	930	168	1,620	810
20		2	19	21	34	49	950	159	1,620	810
21		16	19	22	34	48	667	179	1,620	779
22		16	19	22	34	48	471	196	1,620	720
23		16	19	22	35	48	637	252	1,670	664
24		16	19	22	35	50	405	495	1,670	545
25		17	19	23	35	50	303	664	1,670	460
26		17	19	23	35	52	290	810	1,670	192
27		17	19	23	36	52	100	939	1,670	227
28		17	19	23	36	216	99	973	1,670	77
29		17		23	36	545	96	1,010	1,670	77
30		17		23	36	779	95	1,080	1,670	77
31		17		24		749		1,160	1,670	

NOTE.—No flow Oct. 7 to Jan. 19.

Monthly discharge of Yakima River near Martin, Wash., for the year ending Sept. 30, 1923

[Drainage area, 55 square miles]

Month	Observed discharge (second-feet)			Run-off (acre-feet)			Discharge without storage (second-feet)		Run-off in inche
	Maximum	Minimum	Mean	Observed	Stored	Without storage	Mean	Per square mile	
October	130	0	20.1	1,240	+4,520	5,760	93.7	1.70	1.96
November	0	0	0	0	+10,100	10,100	170	3.09	3.45
December	0	0	0	0	+18,100	18,100	294	5.35	6.17
January	17	0	5.97	367	+33,900	34,300	558	10.1	11.64
February	19	17	18.4	1,020	+4,390	5,410	97.4	1.77	1.84
March	24	19	20.7	1,270	+6,810	8,080	131	2.38	2.74
April	36	24	30.1	1,790	+28,200	30,000	504	9.16	10.22
May	779	40	113	6,960	+40,700	47,700	776	14.1	16.26
June	2,260	95	666	39,600	+3,800	43,400	729	13.3	14.84
July	1,160	95	446	27,400	−10,500	16,900	275	5.00	5.76
August	2,030	1,160	1,630	100,000	−91,800	8,200	133	2.42	2.79
September	1,670	77	876	52,100	−44,700	7,400	124	2.25	2.51
The year	2,260	0	321	232,000	+3,520	235,000	325	5.91	80.18

YAKIMA RIVER AT CLE ELUM, WASH.

LOCATION.—In sec. 27, T. 20 N., R. 15 E., at highway bridge at Cle Elum, Kittitas County, just above Roslyn Creek, 3 miles below mouth of Cle Elum River, and 6½ miles above Teanaway Creek.

DRAINAGE AREA.—500 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 24, 1906, to September 30, 1923.

GAGE.—Friez, later Stevens, water-stage recorder on right bank under highway bridge, installed July 12, 1911; used to June 27, 1923, after which readings were made from a temporary vertical staff on left bank 75 feet below bridge. Recorder inspected and gage read by J. F. Huffman. Previous gages as follows: Prior to August 12, 1910, chain gage on bridge at datum varying from 0.14 foot higher to 0.12 foot lower than that used since August 12, 1910; August 12, 1910, to June 27, 1916, vertical and inclined staff on right bank 30 feet below bridge; June 28, 1916, to June 27, 1923, vertical staff on wall of recorder shelter. A temporary low-water staff was read January 30 to April 6, 1922.

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

CHANNEL AND CONTROL.—Bed composed of gravel and cobblestones. One channel at all stages. Control at low water formed by broad riffle about 1,200 feet below gage; riffle drowned out at high water. Control shifts during floods.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from water-stage recorder, 6.20 feet at 6.30 p. m. January 8 (discharge, 7,330 second-feet); minimum discharge, 200 second-feet on October 12 (estimated from combined flow of Yakima River at Martin, Kachess River near Easton, and Cle Elum River near Roslyn.

1906–1923: Maximum stage measured from high-water marks, 12.5 feet November 14, 1906 (discharge, about 25,600 second-feet); minimum stage recorded, 0.71 foot March 2, 4, and 5, 1922 (discharge, 178 second-feet).

ICE.—Stage-discharge relation seriously affected by ice during severe winters.

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 practically permanent; not affected by ice. Rating curves well defined below 10,000 second-feet. Water-stage recorder inspected daily until removed June 27, after which staff gage was read to hundredths twice daily. Gage-height record excellent. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—Complete record furnished by United States Bureau of Reclamation.

Discharge measurements of Yakima River at Cle Elum, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 11	R. O. Crawford	1.68	579	June 12	R. O. Crawford	4.49	3,940
Nov. 28	do	1.00	272	" 19	do	3.48	2,390
Jan. 8	do	5.92	6,620	Aug. 2	D. E. Ball	4.30	3,590
Apr. 27	do	4.53	3,910	Sept. 14	R. O. Crawford	3.19	2,110

Daily discharge, in second-feet, of Yakima River at Cle Elum, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1,050	294	265	1,210	592	406	2,540	2,950	3,020	2,880	3,480	2,470
2	1,030	297	265	1,110	586	406	2,670	2,600	2,880	2,810	3,480	2,410
3	950	287	269	1,110	563	430	2,740	2,280	2,740	2,740	3,480	2,410
4	879	283	272	1,070	563	480	2,740	2,150	2,950	2,600	3,170	2,470
5	942	283	276	1,060	563	534	2,810	2,340	3,730	2,400	3,250	2,470
6	887	283	279	2,670	580	611	2,810	3,090	4,850	2,210	3,240	2,340
7	879	283	272	5,150	598	655	2,670	3,910	5,550	2,210	3,170	2,340
8	773	283	269	6,620	611	649	2,600	4,850	5,760	2,340	3,100	2,340
9	737	279	262	5,650	592	592	2,470	6,180	5,970	2,210	2,810	2,400
10	703	283	262	4,280	586	592	2,400	6,850	5,150	2,090	2,810	2,400
11	418	287	269	3,480	569	696	2,400	6,180	4,470	2,030	2,740	2,270
12	200	287	276	2,810	546	689	2,530	5,550	3,740	1,970	2,740	2,090
13	220	290	287	2,150	534	675	2,540	4,650	3,170	1,850	2,740	1,970
14	232	294	283	1,970	529	642	2,530	4,000	2,950	1,790	2,810	1,970
15	262	301	279	1,680	534	592	2,470	4,000	4,280	1,740	2,810	1,850
16	266	313	272	1,510	523	617	2,740	4,560	3,400	1,790	2,810	1,790
17	268	383	265	1,400	491	669	3,400	4,950	2,740	1,790	2,810	1,910
18	270	425	265	1,310	480	630	4,000	4,750	2,340	1,850	2,810	1,910
19	272	425	265	1,210	485	655	3,820	4,460	2,340	2,150	2,740	1,850
20	270	416	269	1,120	507	709	3,240	3,910	2,950	2,280	2,810	1,850
21	260	402	283	992	507	709	2,880	3,740	3,020	2,340	2,740	1,850
22	265	397	301	942	491	696	2,530	3,910	2,540	2,600	2,810	1,740
23	255	379	324	887	460	696	2,280	3,910	2,540	2,880	2,740	1,740
24	255	366	491	848	430	773	2,210	3,740	2,600	3,020	2,670	1,680
25	262	353	718	810	411	766	2,470	3,560	2,470	3,020	2,670	1,570
26	272	294	737	766	406	781	3,100	3,320	2,400	3,170	2,670	1,560
27	276	272	723	759	406	887	3,910	3,020	2,340	3,250	2,600	1,570
28	272	272	958	737	406	1,030	4,180	2,810	2,280	3,320	2,340	1,210
29	276	269	1,160	682	-------	1,260	3,820	2,950	2,470	3,320	2,470	862
30	276	265	1,210	630	-------	1,620	3,320	3,170	2,670	3,320	2,470	534
31	279	-------	1,210	592	-------	2,210	-------	3,170	-------	3,480	2,470	-------

NOTE.—Gage not read Oct. 11-21 and Sept. 29 and 30. Discharge estimated by comparison with combined flow of Yakima River at Martin, Kachess River near Easton, and Cle Elum River near Roslyn.

Monthly discharge of Yakima River at Cle Elum, Wash., for the year ending Sept. 30, 1923

[Drainage area, 500 square miles]

Month	Observed discharge (second-feet)			Run-off (acre-feet)			Discharge without storage (second-feet)		Run-off in inches
	Maximum	Minimum	Mean	Observed	Stored	Without storage	Mean	Per square mile	
October	1,050	200	466	28,700	−3,600	25,100	408	0.816	0.94
November	425	265	318	18,900	+20,200	39,100	657	1.31	1.46
December	1,210	262	437	26,800	+44,100	70,900	1,150	2.30	2.65
January	6,620	592	1,830	112,000	+63,900	176,000	2,860	5.72	6.60
February	611	406	520	28,900	+11,600	40,500	729	1.46	1.52
March	2,210	406	753	46,300	+19,400	65,700	1,070	2.14	2.47
April	4,180	2,210	2,890	172,000	+63,400	235,000	3,950	7.90	8.81
May	6,850	2,150	3,920	241,000	+88,100	329,000	5,350	10.7	12.34
June	5,970	2,280	3,340	199,000	+40,400	239,000	4,020	8.04	8.97
July	3,480	1,740	2,500	154,000	−44,600	109,000	1,770	3.54	4.08
August	3,480	2,340	2,850	175,000	−167,000	8,000	130	.260	.30
September	2,470	534	1,930	115,000	−103,000	12,000	202	.404	.45
The year	6,850	200	1,820	1,320,000	+32,900	1,350,000	1,860	3.72	50.59

KACHESS LAKE NEAR EASTON, WASH.

LOCATION.—In sec. 24, T. 21 N., R. 13 E. (unsurveyed), at lake outlet, 2½ miles northwest of Easton, Kittitas County.

DRAINAGE AREA.—63 square miles (measured on topographic maps).

RECORDS AVAILABLE.—September 30, 1905, to September 30, 1923.

GAGE.—Stevens water-stage 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 halfway 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. Recorder inspected by Fred Diener.

EXTREMES OF STORAGE.—Maximum stage recorded during year, 2,259.17 feet on July 15 and 16 (storage, 226,250 acre-feet); minimum stage recorded, 2,203.12 feet on October 19 (storage, 28,720 acre-feet).

1906–1923: Maximum stage recorded, 2,261.14 feet at 4 p. m. July 21, 1920 (storage, 235,090 acre-feet); minimum stage recorded, 2,197.73 feet September 26–27, 1915 (storage, 13,730 acre-feet).

STORAGE.—Capacity of reservoir at crest of spillway, 221,000 acre-feet (revised determination). Elevation of gate sill, 2,192.75 feet; and of spillway crest, 2,258 feet. Record of storage or release each month used for determining discharge without storage at gaging station below dam.

ACCURACY.—Water-stage recorder in gage tower, used when gates were closed; referred to staff gage once daily. When gates were open staff gage read to hundredths twice daily. Records excellent.

COOPERATION.—Complete record furnished by United States Bureau of Reclamation.

Daily storage, in acre-feet, of Kachess Lake near Easton, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	40,480	31,180	36,780	50,450	81,210	88,710	99,400	133,620	181,220	217,240	182,110	124,100
2	39,250	31,620	37,030	51,470	81,470	89,000	100,450	134,560	182,230	218,250	178,800	122,960
3	37,900	31,850	37,590	52,400	81,760	89,260	101,580	135,390	183,320	219,130	175,470	121,550
4	36,610	32,020	37,930	53,310	81,990	89,520	102,460	136,300	184,550	219,750	172,320	120,160
5	35,350	32,180	38,180	54,020	82,280	89,750	103,590	137,290	186,280	220,370	170,060	118,550
6	34,280	32,270	38,350	55,680	82,510	90,070	104,440	138,520	188,230	220,950	168,050	116,910
7	33,220	32,460	38,490	59,570	82,800	90,360	105,580	140,350	190,270	221,930	168,090	115,280
8	32,210	32,600	38,660	63,760	83,080	90,660	106,650	142,580	192,230	222,590	164,010	112,960
9	31,290	32,770	39,000	66,480	83,320	90,950	107,580	145,360	194,410	223,130	162,070	111,760
10	30,400	32,860	39,160	69,000	83,580	91,250	108,360	148,390	196,340	223,800	160,140	109,500
11	29,700	32,940	39,330	72,210	83,810	91,630	109,360	150,620	197,970	224,370	158,100	106,680
12	29,470	33,050	39,470	72,760	84,180	92,010	110,320	152,460	199,260	224,950	156,220	104,230
13	29,450	33,190	39,530	73,500	84,390	92,390	111,440	154,240	200,430	225,440	154,280	101,930
14	28,970	33,300	39,560	74,160	84,650	92,770	112,310	155,780	201,330	225,930	152,230	99,580
15	28,970	33,390	39,640	74,560	84,960	93,050	113,250	157,380	202,240	226,250	150,220	97,440
16	28,920	33,720	39,810	75,050	85,220	93,430	114,620	159,300	203,240	226,200	148,200	95,200
17	28,860	34,280	39,840	75,480	85,460	93,780	116,180	161,270	204,150	225,840	146,250	92,770
18	28,780	34,760	39,920	76,090	85,690	94,120	117,930	163,040	205,110	225,040	144,120	90,480
19	28,720	35,070	40,180	76,600	85,980	94,470	119,420	164,700	205,930	223,350	142,190	89,000
20	28,780	35,260	40,400	77,030	86,240	94,820	120,670	166,130	206,850	221,130	140,550	86,940
21	28,800	35,380	40,540	77,410	86,530	95,100	121,620	167,560	207,760	218,690	138,630	85,250
22	28,800	35,600	40,680	77,750	86,820	95,440	122,440	169,110	208,630	215,740	137,250	83,370
23	28,920	35,680	41,190	78,160	87,050	95,790	123,320	170,670	209,500	212,090	135,730	81,440
24	29,110	35,850	42,510	78,560	87,310	96,140	124,060	172,070	210,380	208,500	134,260	79,280
25	29,530	35,940	44,390	78,880	87,540	96,490	125,140	173,440	211,210	205,240	132,560	77,500
26	29,920	36,100	46,220	79,250	87,860	96,840	126,540	174,760	211,910	201,980	131,060	75,830
27	30,120	36,220	47,550	79,680	88,180	97,230	128,220	175,960	212,880	198,700	129,750	74,100
28	30,260	36,410	48,060	80,000	88,440	97,580	129,780	177,090	213,980	195,480	128,810	72,350
29	30,370	36,500	48,400	80,320	-------	98,000	131,140	178,050	214,900	192,230	127,770	70,860
30	30,480	36,720	48,790	80,630	-------	98,350	132,300	179,170	216,180	188,910	126,470	70,350
31	30,870	-------	49,440	80,920	-------	98,770	-------	180,180	-------	185,520	125,290	-------

KACHESS RIVER NEAR EASTON, WASH.

LOCATION.—In sec. 3, T. 20 N., R. 13 E., three-fourths of a mile below Kachess storage dam, one-fourth of a mile above mouth, and 2 miles northwest of Easton, Kittitas County.

DRAINAGE AREA.—64 square miles (measured on topographic maps).

RECORDS AVAILABLE.—November 20, 1903, to September 30, 1923.

GAGE.—Stevens water-stage recorder at highway bridge; installed August 15, 1916; inspected by Fred Diener. 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.

DISCHARGE MEASUREMENTS.—Made from cable 20 feet below site of old gage or by wading.

CHANNEL AND CONTROL.—Bed composed of light gravel and sand; shifting frequently. One channel at all stages. Control formed by broad riffle 125 feet below gage.

EXTREMES OF DISCHARGE.—Maximum discharge recorded during year, 6.50 feet at 10.45 a. m. July 22 (discharge, 1,920 second-feet). Practically no flow when gates in dam are closed.

1904–1923: Maximum discharge, 2,240 second-feet (computed from gate opening) August 27, 1920; practically no flow when gates in dam are closed.

ICE.—Stage-discharge relation affected by ice at times.

DIVERSIONS.—None.

REGULATION.—Flow controlled by storage and release of water in Kachess Lake reservoir. Monthly discharge, without storage, determined from records of stage of reservoir.

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ACCURACY.—Stage-discharge relation changed October 21, August 4, and September 8; not affected by ice. Rating curves fairly well defined. Water-stage recorder inspected daily except when gates are closed. Daily discharge ascertained by applying mean daily gage height to rating table. When gates were closed leakage estimated from knowledge of governing conditions. Records good.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Discharge measurements of Kachess River near Easton, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 10	R. O. Crawford	4.10	466	Aug. 7	D. E. Ball	5.50	1,060
July 27	D. E. Ball	6.16	1,700	Sept. 21	R. O. Crawford	5.09	996

Daily discharge, in second-feet, of Kachess River near Easton, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	728	1	1	2	2	2	3	3	3	3	1,760	615
2	703	1	1	2	2	2	3	3	3	3	1,740	628
3	655	1	1	2	2	2	3	3	3	3	1,720	691
4	631	1	1	2	2	2	3	3	3	3	1,340	736
5	607	1	1	2	2	2	3	3	3	3	1,080	731
6	580	1	1	2	2	2	3	3	3	3	1,070	721
7	548	1	1	2	2	2	3	3	3	3	1,060	711
8	530	1	1	2	2	2	3	3	3	3	1,040	963
9	505	1	1	2	2	2	3	3	3	3	973	1,380
10	458	1	1	2	2	2	3	3	3	3	967	1,350
11	324	1	1	2	2	2	3	3	3	3	962	1,280
12	106	1	1	2	2	2	3	3	3	3	945	1,220
13	128	1	1	2	2	2	3	3	3	3	951	1,190
14	71	1	1	2	2	2	3	3	3	3	984	1,150
15	26	1	1	2	2	2	3	3	3	91	973	1,100
16	25	1	1	2	2	2	3	3	3	247	967	1,070
17	25	1	1	2	2	2	3	3	3	408	956	1,050
18	24	1	1	2	2	2	3	3	3	698	951	1,040
19	25	1	1	2	2	2	3	3	3	1,110	934	1,040
20	11	1	1	2	2	2	3	3	3	1,260	928	1,030
21	1	1	1	2	2	2	3	3	3	1,400	928	1,020
22	1	1	1	2	2	2	3	3	3	1,710	901	1,030
23	1	1	1	2	2	2	3	3	3	1,860	879	1,040
24	1	1	1	2	2	2	3	3	3	1,740	852	1,020
25	1	1	1	2	2	2	3	3	3	1,680	820	1,010
26	1	1	1	2	2	2	3	3	3	1,680	767	963
27	1	1	1	2	2	2	3	3	3	1,700	601	873
28	1	1	1	2	2	2	3	3	3	1,700	501	821
29	1	1	1	2	------	2	3	3	3	1,710	652	478
30	1	1	1	2	------	2	3	3	3	1,730	628	152
31	1	------	1	2	------	2	------	3	------	1,760	619	------

Monthly discharge of Kachess River near Easton, Wash., for the year ending Sept. 30, 1923

[Drainage area, 64 square miles]

Month	Observed discharge (second-feet)			Run-off (acre-feet)			Discharge without storage (second-feet)		Run-off in inches
	Maximum	Minimum	Mean	Observed	Stored	Without storage	Mean	Per square mile	
October	728	1	217	13,300	−11,000	2,300	37.4	0.584	0.67
November	1	1	1	59.5	+5,850	5,910	99.3	1.55	1.73
December	1	1	1	61.5	+12,700	12,800	208	3.25	3.75
January	2	2	2	123	+31,500	31,600	514	8.03	9.26
February	2	2	2	111	+7,520	7,630	137	2.14	2.23
March	2	2	2	123	+10,300	10,400	169	2.64	3.04
April	3	3	3	178	+33,500	33,700	566	8.84	9.86
May	3	3	3	184	+47,900	48,100	782	12.2	14.07
June	3	3	3	178	+36,000	36,200	608	9.5	10.6
July	1,860	3	727	44,700	−30,700	14,000	228	3.56	4.1
August	1,760	501	982	60,400	−60,200	200	3.25	.051	.06
September	1,380	152	937	55,700	−54,900	800	13.4	.209	.23
The year	1,860	1	242	175,000	+28,500	204,000	281	4.39	59.60

CLE ELUM LAKE NEAR ROSLYN, WASH.

LOCATION.—In sec. 10, T. 20 N., R. 14 E., at lake outlet, 4 miles northwest of Roslyn, Kittitas County, and 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, 1923.

GAGE.—Since November 8, 1916, Stevens water-stage recorder referred to vertical staff on left abutment of dam just above gates. This staff used since June 17, 1907; zero at elevation of gate sills, 2,122.75 feet. Considerable fall between lake and dam for storage below 5.0 feet. Auxiliary gages at same datum, about 400 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 present gage. Recorder inspected by J. G. Giddings and C. M. Keyes.

EXTREMES OF STORAGE.—Maximum stage during year from water-stage recorder, 14.97 feet at 7.30 a. m. May 10 (storage, 32,750 acre-feet); minimum stage recorded, 2.80 feet at 7.45 a. m. October 26 (storage, 5,830 acre-feet).

1907–1923: Maximum stage recorded, 19.10 feet at 6 p. m., December 30, 1917 (storage, 43,180 acre-feet); minimum stage estimated at 1.15 feet, August 31, 1906 (storage, 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 in determining discharge without storage for gaging station below dam.

ACCURACY.—Water-stage recorder referred to staff gage twice daily. Gage read to hundredths. Records excellent.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Daily storage, in acre-feet, of Cle Elum Lake near Roslyn, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	6,040	9,320	13,320	26,450	24,900	24,720	27,420	28,290	27,960	29,020	25,330	10,060
2	6,040	9,730	13,470	26,400	24,870	24,780	27,640	27,800	27,820	29,040	25,100	9,830
3	6,080	9,980	13,490	26,200	24,870	24,850	27,700	27,400	27,660	28,710	24,810	9,470
4	6,330	10,090	13,470	26,080	24,850	24,850	27,680	27,220	28,030	28,220	24,490	9,230
5	6,420	10,210	13,440	26,080	24,850	24,870	27,680	27,590	29,090	27,780	23,950	9,340
6	6,420	10,280	13,440	26,730	24,850	24,920	27,680	28,500	30,120	27,500	23,450	9,160
7	6,420	10,320	13,440	28,240	24,900	24,960	27,610	29,350	30,310	27,470	23,090	8,990
8	6,370	10,400	13,440	29,420	24,870	24,940	27,590	30,450	30,550	27,560	22,780	8,750
9	6,310	10,450	13,590	29,300	24,850	24,920	27,420	31,800	30,760	27,420	22,310	8,500
10	6,350	10,450	13,620	28,830	24,850	24,990	27,360	32,410	30,910	27,330	21,840	8,230
11	6,460	10,470	13,590	28,240	24,870	25,080	27,360	31,610	30,570	27,240	21,360	7,930
12	6,480	10,470	13,550	27,640	24,900	25,080	27,450	30,720	29,800	27,170	20,920	7,760
13	6,580	10,430	13,420	27,170	24,850	25,060	27,610	29,950	29,000	27,100	20,380	7,660
14	7,020	10,380	13,380	26,730	24,830	24,940	27,610	29,540	28,340	27,010	19,890	7,300
15	6,980	10,360	13,320	26,470	24,780	24,870	27,640	29,760	27,870	26,890	19,390	7,470
16	6,900	10,680	13,250	26,270	24,720	24,870	27,870	30,350	27,560	26,730	18,870	7,360
17	6,880	11,100	13,190	26,100	24,830	24,900	28,810	30,810	27,590	26,590	18,280	7,260
18	6,860	11,530	13,170	26,010	24,850	24,870	29,520	30,550	27,840	26,400	17,780	7,090
19	6,710	11,950	13,190	26,040	24,810	24,900	29,400	30,210	27,800	26,220	17,160	6,880
20	6,540	12,340	13,230	25,760	24,780	24,920	28,690	29,800	27,800	26,060	16,640	6,770
21	6,400	12,570	13,250	25,600	24,760	24,940	28,050	29,570	27,870	25,990	16,300	6,670
22	6,250	12,780	13,360	25,510	25,720	24,940	27,660	29,760	27,820	25,940	15,930	6,630
23	6,140	13,000	13,660	25,420	24,720	24,940	27,500	29,950	27,780	25,940	15,560	6,630
24	6,040	13,040	14,510	25,350	24,690	25,010	27,400	29,710	27,820	25,970	15,200	6,560
25	5,910	13,080	18,720	25,280	24,690	25,010	27,750	29,420	27,800	25,900	14,510	6,500
26	5,850	13,100	21,600	25,280	24,670	25,030	28,620	29,140	27,800	25,780	13,790	6,540
27	6,480	13,150	23,830	25,280	24,670	25,030	29,610	28,710	27,870	25,690	13,150	6,500
28	7,530	13,170	25,440	25,210	24,670	25,280	29,500	28,340	28,100	25,620	12,460	6,420
29	8,310	13,190	26,270	25,120	-------	25,600	29,230	28,150	28,450	25,580	11,780	6,420
30	8,500	13,210	26,500	25,030	-------	26,220	28,710	28,290	28,810	25,530	10,830	6,350
31	8,920	-------	26,500	24,960	-------	26,960	-------	28,200	-------	25,420	10,150	-------

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, 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, 1923.

GAGE.—Stevens water-stage recorder on left bank 800 feet below temporary crib dam; installed October 14, 1913; inspected by J. G. Giddings and C. M. Keyes. For description of previous gages see Water-Supply Paper 442.

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, from water-stage recorder, 7.51 feet at 10 a. m. May 10 (discharge, 5,030 second-feet); minimum stage, from recorder, 0.50 foot from noon to 2 p. m., October 11 (discharge, 27 second-feet).

1904–1923: 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 (practically no flow).

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water at Cle Elum Lake reservoir. Monthly discharge without storage determined from records of stage at reservoir.

ACCURACY.—Stage-discharge relation practically permanent. Rating curve well defined. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying mean daily gage heights to rating table. Records excellent.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Discharge measurements of Cle Elum River near Roslyn, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 10	R. O. Crawford	1.37	175	June 12	R. O. Crawford	5.57	2,510
Nov. 28	do	1.40	155	July 25	D. E. Ball	2.75	657
Jan. 26	Crawford and Johnston	2.22	400	Sept. 14	R. O. Crawford	1.67	236
Apr 27	R. O. Crawford	5.53	2,580				

Daily discharge, in second-feet, of Cle Elum River near Roslyn, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	174	174	168	820	314	262	1,390	1,840	1,640	2,320	511	477
2	177	159	172	765	305	279	1,500	1,570	1,570	2,220	524	449
3	120	168	177	738	296	285	1,530	1,360	1,500	2,140	511	441
4	109	164	188	661	293	288	1,530	1,260	1,720	1,880	529	410
5	214	172	186	712	290	299	1,530	1,390	2,360	1,610	529	361
6	174	172	184	1,160	293	326	1,530	1,960	3,060	1,420	529	305
7	166	170	184	2,010	302	332	1,460	2,610	3,270	1,420	529	299
8	164	172	188	3,060	296	311	1,390	3,270	3,380	1,460	529	302
9	166	174	190	2,760	290	288	1,320	4,360	3,500	1,390	507	299
10	91	172	190	2,410	282	317	1,320	4,880	3,620	1,320	511	296
11	28	170	186	2,010	299	371	1,320	4,230	3,270	1,320	511	296
12	30	172	177	1,570	314	354	1,390	3,500	2,760	1,290	498	279
13	28	172	177	1,290	290	338	1,420	2,960	2,320	1,220	511	262
14	89	174	172	1,090	282	323	1,390	2,660	1,920	1,190	520	222
15	166	172	170	966	279	296	1,390	2,760	1,640	1,120	507	202
16	164	170	166	820	276	296	1,570	3,160	1,530	1,060	503	195
17	170	172	162	765	285	282	2,090	3,620	1,570	966	529	217
18	166	179	162	738	288	256	2,610	3,380	1,640	877	529	240
19	168	177	159	686	282	282	2,410	3,060	1,570	820	520	227
20	172	174	164	603	276	285	2,050	2,760	1,610	738	529	214
21	172	181	166	552	273	285	1,680	2,760	1,680	686	529	177
22	166	179	166	511	270	290	1,460	2,860	1,610	661	529	170
23	164	177	172	477	265	285	1,320	2,860	1,610	661	524	172
24	170	172	224	449	256	305	1,320	2,760	1,610	661	524	168
25	172	172	262	418	256	299	1,500	2,560	1,570	636	524	170
26	172	172	245	410	251	299	1,920	2,360	1,530	603	534	168
27	177	172	235	433	245	317	2,560	2,090	1,570	565	516	166
28	172	172	511	410	248	361	2,760	1,840	1,760	534	529	164
29	179	172	686	382	-------	469	2,510	1,800	1,960	534	520	157
30	168	172	792	364	-------	712	2,090	1,840	2,180	529	516	155
31	155	-------	841	332	-------	1,090	-------	1,760	-------	529	507	-------

Monthly discharge of Cle Elum River near Roslyn, Wash., for the year ending Sept. 30, 1923

[Drainage area, 202 square miles]

Month	Observed discharge (second-feet)			Run-off (acre-feet)			Discharge without storage (second-feet)		Run-off in inches
	Maximum	Minimum	Mean	Observed	Stored	Without storage	Mean	Per square mile	
October	214	28	148	9,130	+2,880	12,000	195	0.965	1.11
November	181	159	172	10,300	+4,290	14,600	245	1.21	1.35
December	841	159	252	15,500	+13,300	28,800	468	2.32	2.68
January	3,060	332	980	60,200	−1,540	58,700	955	4.73	5.45
February	314	245	282	15,700	−290	15,400	277	1.37	1.43
March	1,090	256	348	21,400	+2,290	23,700	385	1.91	2.2
April	2,760	1,320	1,710	102,000	+1,750	104,000	1,750	8.66	9.66
May	4,880	1,260	2,650	163,000	−510	162,000	2,630	13	14.99
June	3,620	1,500	2,080	124,000	+610	125,000	2,100	10.4	11.6
July	2,320	529	1,110	68,200	−3,390	64,800	1,050	5.2	6
August	534	498	520	32,000	−15,300	16,700	272	1.35	1.56
September	477	155	255	15,200	−3,800	11,400	192	.95	1.06
The year	4,880	28	879	637,000	+290	637,000	880	4.36	59.09

NACHES RIVER BELOW TIETON RIVER, NEAR NACHES, WASH.

LOCATION.—In sec. 35, T. 15 N., R. 16 E., 600 feet below Tieton River, 500 feet above intake of Wapatox canal, and 5 miles northwest of Naches, Yakima County.

DRAINAGE AREA.—942 square miles (revised; measured on topographic maps and Pl. I, Water-Supply Paper 369).

RECORDS AVAILABLE.—August 4 to October 28, 1905; March 16, 1909, to October 31, 1912; May 10 to September 30, 1915; April 13, 1916, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank; installed December 7, 1916; inspected by C. O. Gatewood. Previous gages as follows: August 4 to October 28, 1905, vertical staff nailed to stump on left bank at nearly same site as present gage but at different datum; March 16, 1909, to December 7, 1916, inclined and vertical staff gage in two sections on left bank, 8 feet above cable; April 3, 1916, vertical staff installed to supplement inclined and vertical sections.

DISCHARGE MEASUREMENTS.—Made from cable at gage.

CHANNEL AND CONTROL.—Bed of stream composed of small boulders and gravel; shifts at extremely high water. One channel except at extremely high stages.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 7.15 feet at 8 a. m. May 10 (discharge, 7,380 second-feet); minimum stage, from recorder, 1.62 feet at 1.45 p. m. October 2 (discharge, 187 second-feet).

1905, 1909–1923: Maximum discharge, 18,800 second-feet at 8 a. m. November 24, 1909; minimum discharge, that of October 2, 1922.

ICE.—Stage-discharge relation seriously affected by ice during severe winters.

DIVERSIONS.—Above all important diversions except Selah Valley and Tieton canals. Diversion through canals added to mean monthly flow to determine natural flow past gage.

REGULATION.—Flow partly controlled by storage and release of water at Bumping Lake. See record for Bumping Lake and table of monthly discharge for Bumping River near Nile, Wash.

ACCURACY.—Stage-discharge relation practically permanent; slightly affected by ice for very few days in December, possibly affected during periods of low stage by backwater from Taintor gates at intake of Wapatox canal. Effect of backwater probably slight. Rating curve well defined. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage height to rating table. Records excellent.

COOPERATION.—Maintained by United States Bureau of Reclamation in cooperation with Pacific Power & Light Co. United States Bureau of Reclamation furnished records for publication.

Discharge measurements of Naches River below Tieton River, near Naches, Wash., during the ending Sept. 30, 1923

[Made by R. O. Crawford]

Date	Gage height	Discharge	Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Oct. 5	1.90	294	May 8	6.08	4,880	Sept. 28	2.00	373
26	2.80	837	July 18	3.31	1,220			
Dec. 30	3.18	1,100	Aug. 2	2.50	602			

Daily discharge, in second-feet, of Naches River below Tieton River, near Naches, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	244	545	312	910	925	985	3,060	2,640	2,500	3,860	614	490
2	194	467	335	873	985	1,020	2,980	2,320	2,380	3,600	621	473
3	207	444	350	910	985	970	3,130	2,080	2,380	3,200	614	532
4	265	444	375	836	985	948	3,060	2,020	2,770	2,640	595	496
5	281	439	350	814	1,020	955	3,060	2,380	3,680	2,320	595	467
6	273	433	322	1,970	985	918	3,060	3,130	4,880	2,320	595	473
7	256	428	317	3,940	985	903	2,770	3,860	5,490	3,600	582	473
8	244	433	340	4,300	978	866	2,640	4,880	5,700	3,130	627	479
9	233	433	335	3,440	910	851	2,640	6,570	6,130	2,640	576	551
10	233	395	331	3,440	978	843	2,640	7,260	6,800	2,770	569	428
11	233	401	317	2,980	970	843	2,840	6,130	6,130	2,910	557	450
12	244	467	277	2,500	932	822	3,200	5,080	4,580	2,570	595	450
13	241	395	256	2,200	843	771	3,130	4,300	3,680	2,320	608	461
14	229	375	229	1,970	800	715	3,060	4,030	3,200	2,260	621	456
15	225	375	233	1,800	750	722	3,130	4,030	2,700	2,080	614	467
16	244	380	269	1,460	888	729	3,770	5,080	2,640	1,800	582	390
17	237	551	370	1,500	948	729	4,580	6,130	2,640	1,600	569	385
18	225	551	412	1,380	940	722	4,300	5,910	2,700	1,220	595	390
19	277	496	467	1,300	948	764	3,770	5,280	2,570	1,220	576	365
20	345	467	514	1,180	910	829	3,280	4,880	2,700	1,140	764	375
21	335	444	485	1,140	822	814	2,840	4,880	2,640	932	722	360
22	312	406	456	1,220	786	778	2,500	5,080	2,570	932	985	317
23	303	331	508	1,220	764	800	2,320	5,080	2,440	1,220	800	286
24	317	326	1,260	1,180	764	829	2,320	4,680	2,320	1,020	681	273
25	485	303	1,420	1,140	757	843	2,500	4,300	2,260	873	614	294
26	800	273	1,220	1,100	757	918	3,060	4,030	2,260	807	576	345
27	708	286	1,300	1,140	778	1,140	3,860	3,600	2,320	764	563	360
28	608	312	1,550	1,060	880	1,460	3,770	3,200	2,700	722	545	360
29	551	326	1,260	1,020	-------	1,970	3,360	3,060	3,280	701	532	360
30	514	312	1,140	903	-------	2,500	2,980	2,910	3,770	660	526	350
31	545	-------	985	940	-------	3,060	-------	2,700	-------	750	508	-------

Estimated monthly natural discharge of Naches River below Tieton River, near Naches, Wash., for the year ending Sept. 30, 1923

[Drainage area, 942 square miles]

Month	Discharge of river in second-feet			Run-off in acre-feet					Estimated natural discharge in second-feet		Run-off in inches
	Maximum	Minimum	Mean	River (observed)	Diversions: Selah Valley canal	Diversions: Tieton canal	Storage in Bumping Lake reservoir	Without storage	Mean	Mean per square mile	
October	800	194	336	20,600	3,030	959	+570	25,200	410	0.435	0.50
November	551	273	408	24,300	-------	2,220	+830	27,400	460	.488	.54
December	1,550	229	590	36,300	-------	-------	+7,810	44,100	717	.761	.88
January	4,300	814	1,670	103,000	-------	-------	+8,380	111,000	1,810	1.92	2.21
February	1,020	750	892	49,500	-------	-------	−12,500	37,000	666	.707	.74
March	3,060	715	1,030	63,500	-------	-------	−4,550	59,000	960	1.02	1.18
April	4,580	2,320	3,120	186,000	1,590	2,770	+14,500	205,000	3,450	3.66	4.08
May	7,260	2,020	4,240	261,000	7,350	18,600	+20,200	307,000	4,990	5.30	6.11
June	6,800	2,260	3,430	204,000	7,350	18,100	+550	230,000	3,870	4.11	4.59
July	3,860	660	1,890	116,000	7,540	18,600	+470	143,000	2,330	2.47	2.85
August	985	508	617	37,900	6,960	19,500	−14,200	50,200	816	.866	1.00
September	551	273	412	24,500	7,160	15,900	−15,400	32,200	541	.574	.64
The year	7,260	194	1,560	1,130,000	-------	-------	+6,660	1,270,000	1,760	1.87	25.32

NOTE.—The run-off without storage and estimated natural discharge shown in the foregoing table, represents natural yield as nearly as may be computed from stream-flow records. They do not take into account depletion due to irrigation above the gaging station amounting to perhaps 6,000 acre-feet a year and unmeasured waste above the gaging station on Selah Valley canal, which reaches the river below the river gaging station. Accordingly the actual natural yield is larger than shown.

BUMPING LAKE NEAR NILE, WASH.

LOCATION.—At storage dam in outlet, 12 miles above American River and 19 miles west of Nile, 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, 1923.

GAGE.—Inclined staff 100 feet above gate tower installed November 3, 1922; used for lake elevations below 3,399 feet; previous gage vertical staff on gate tower used for higher elevations; gages read by J. H. Nelson. Datum, mean sea level. Prior to November 3, 1910, vertical staff on north shore of lake, one-fourth of a mile above outlet, at different datum.

EXTREMES OF STORAGE.—Maximum stage recorded during year, 3,429.74 feet from 6.15 a. m. July 30 to 5.40 a. m. July 31 (storage, 38,730 acre-feet); minimum stage recorded, 3,392.38 feet from 7.05 a. m. October 22 to 6.55 a. m. October 24 (storage, 2,140 acre-feet).

1911–1923: Maximum stage recorded, 3,430.40 feet from 7.30 a. m. July 11 to 5.30 p. m. July 12, 1921 (storage, 39,630 acre-feet); minimum stage recorded, 3,391.00 feet February 12–15, 1916 (storage, 1,260 acre-feet).

STORAGE.—Capacity of reservoir at crest of spillway, 33,700 acre-feet. Elevation of gate sill, 3,389 feet, and of spillway crest, 3,426 feet. Storage or release each month used for determining discharge without storage for gaging station below dam.

ACCURACY.—Gage read to hundredths twice daily. Records excellent.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Daily storage, in acre-feet, of Bumping Lake near Nile, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2,370	2,930	3,760	12,050	19,590	7,150	3,280	18,270	37,630	38,250	38,420	23,880
2	2,370	2,910	3,750	12,420	19,180	6,760	3,640	19,000	37,630	38,150	38,200	23,290
3	2,370	2,880	3,750	12,850	18,660	6,370	4,040	19,590	37,630	38,070	37,970	22,690
4	2,330	2,870	3,730	13,360	18,170	6,110	4,310	20,270	37,680	37,880	37,640	22,000
5	2,330	2,870	3,720	13,800	17,650	5,790	4,700	20,920	37,970	37,710	37,340	21,280
6	2,330	2,850	3,720	14,670	17,160	5,550	5,110	21,820	38,290	37,730	37,020	20,670
7	2,330	2,800	3,720	16,230	16,620	5,310	5,280	22,930	38,450	37,960	36,630	20,000
8	2,330	2,800	3,720	17,980	16,100	5,100	5,310	24,360	38,520	37,920	36,180	19,340
9	2,320	2,790	3,720	19,300	15,560	4,850	5,340	26,270	38,630	37,780	35,700	18,730
10	2,300	2,760	3,720	20,670	15,020	4,610	5,390	28,560	38,700	37,750	35,210	18,040
11	2,300	2,740	3,720	21,670	14,500	4,340	5,470	30,570	38,520	37,600	34,740	17,370
12	2,270	2,740	3,690	22,360	14,020	4,180	5,620	32,240	38,270	37,510	34,280	16,690
13	2,270	2,740	3,690	22,780	13,490	3,980	5,760	33,890	38,040	37,430	33,790	16,010
14	2,240	2,740	3,690	23,020	12,980	3,870	5,920	35,320	37,880	37,360	33,240	15,380
15	2,240	2,710	3,690	23,130	12,440	3,720	6,070	36,680	37,770	37,280	32,750	14,820
16	2,200	2,740	3,690	23,130	11,880	3,540	6,370	37,630	37,700	37,220	32,170	14,270
17	2,170	2,960	3,690	23,210	11,360	3,320	7,290	38,150	37,700	37,200	31,620	13,670
18	2,170	3,520	3,720	23,270	10,860	3,200	8,270	38,180	37,700	37,450	31,060	13,140
19	2,170	3,630	3,770	23,320	10,350	3,080	9,160	38,180	37,710	37,490	30,470	12,620
20	2,170	3,720	3,820	23,290	9,870	2,980	9,850	38,180	37,770	37,590	29,980	12,110
21	2,170	3,750	3,850	23,120	9,520	2,910	10,490	38,150	37,770	37,700	29,660	11,680
22	2,140	3,790	3,920	22,830	9,120	2,840	11,230	38,100	37,710	37,840	29,330	11,280
23	2,140	3,820	3,960	22,570	8,780	2,810	11,940	38,110	37,700	37,560	28,870	10,980
24	2,160	3,850	4,530	22,300	8,470	2,780	12,490	38,080	37,640	37,240	28,250	10,690
25	2,370	3,850	5,860	22,020	8,240	2,770	13,090	38,040	37,630	37,430	27,670	10,430
26	2,750	3,850	6,910	21,670	8,050	2,740	13,760	37,990	37,630	37,770	27,170	10,120
27	2,960	3,850	7,920	21,350	7,850	2,710	14,680	37,940	37,710	38,030	26,700	9,830
28	3,040	3,850	9,240	21,040	7,520	2,710	15,620	37,880	37,880	38,300	26,110	9,530
29	3,000	3,840	10,260	20,690	-------	2,710	16,620	37,810	38,010	38,550	25,550	9,260
30	2,980	3,790	11,030	20,360	-------	2,760	17,440	37,740	38,190	38,710	25,040	8,990
31	2,960	-------	11,600	19,980	-------	2,970	-------	37,640	-------	38,660	24,440	-------

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, 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, 1923.

GAGE.—Stevens water-stage recorder installed June 17, 1913; inspected daily by J. H. Nelson. Since June 17, 1913, vertical staff on left bank, one-fourth of a mile below spillway of storage dam; reconstructed at same site and datum April 27, 1915. For description of previous gages see Water-Supply Paper 442.

DISCHARGE MEASUREMENTS.—Made from cable about 40 feet below gage or by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and of large angular rocks; shifts at extremely high water. Riffle control, 60 feet below gage. Stage of zero flow about gage height, 0.4 foot.

EXTREMES OF DISCHARGE.—Maximum stage during year, from water-stage recorder, 4.7 feet on June 9 and 10 (discharge, 1,480 second-feet); minimum stage from recorder, 1.23 feet at 7.40 a. m. January 5 (discharge, 11 second-feet).

1906 and 1909–1923: Maximum stage recorded, 9.33 feet at 5 p. m. December 29, 1917 (discharge, 5,180 second-feet); practically no flow when gates in outlet conduit are closed.

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

DIVERSIONS.—None.

REGULATION.—Flow partly controlled by storage and release of water at Bumping Lake reservoir. Monthly discharge without storage determined from records of stage at reservoir.

ACCURACY.—Stage-discharge relation practically permanent; not affected by ice. Rating curve fairly well defined; revised slightly January 1. Water-stage recorder inspected daily. Daily discharge ascertained by applying mean daily gage height to rating table or, for a few days when range in stage was considerable, by averaging results obtained by applying mean gage heights for shorter intervals. Records good.

COOPERATION.—Complete records furnished by United States Bureau of Reclamation.

Discharge measurements of Bumping River near Nile, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*
Nov. 3	R. O. Crawford	2.11	90.8
June 14	Paul Taylor	3.69	762
Sept. 4	R. O. Crawford	3.11	417

Daily discharge, in second-feet, of Bumping River near Nile, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	62	106	58	12	357	250	120	32	568	1,060	234	379
2	58	103	58	12	401	247	148	30	540	948	241	419
3	60	94	60	12	401	244	168	27	529	848	264	414
4	60	89	60	12	401	244	181	27	608	720	282	410
5	58	86	60	12	396	241	192	28	820	632	297	414
6	58	82	60	94	396	237	203	31	1,100	608	297	414
7	57	79	60	234	396	231	212	33	1,250	841	336	419
8	57	76	60	241	392	225	215	40	1,280	786	336	419
9	55	76	60	247	387	218	218	53	1,400	720	336	414
10	54	73	60	254	392	203	225	61	1,480	688	332	419
11	52	68	60	258	396	178	221	61	1,320	632	332	414
12	51	66	58	258	396	163	237	56	1,100	597	336	410
13	50	63	58	254	392	155	244	51	883	524	374	414
14	50	61	58	254	396	151	250	48	739	497	370	379
15	49	58	57	254	392	144	264	133	657	462	370	361
16	47	65	57	254	392	135	173	657	620	405	370	353
17	46	69	57	258	392	131	29	1,020	608	257	370	357
18	45	58	56	258	392	122	29	1,100	632	188	365	357
19	45	61	56	258	392	114	29	1,020	644	272	365	320
20	45	62	56	258	309	108	28	926	669	195	374	316
21	45	61	56	293	250	101	28	926	669	124	374	264
22	44	61	57	328	247	95	26	948	657	331	374	241
23	44	61	58	328	247	92	25	984	597	383	374	237
24	45	61	34	328	247	88	24	934	591	179	370	228
25	65	61	13	324	247	87	26	890	579	24	370	218
26	105	61	13	324	247	85	29	820	602	24	365	218
27	120	61	14	320	241	83	31	739	651	24	370	218
28	122	61	14	320	244	82	32	663	746	24	370	215
29	116	60	15	316	-------	83	32	675	898	23	365	212
30	110	60	15	312	-------	88	32	657	1,060	105	370	206
31	106	-------	15	309	-------	101	-------	602	-------	176	370	-------

Monthly discharge of Bumping River near Nile, Wash., for the year ending Sept. 30, 1923

[Drainage area, 68 square miles]

Month	Observed discharge (second-feet)			Run-off (acre-feet)			Discharge without storage (second-feet)		Run-off in inches
	Maximum	Minimum	Mean	Observed	Stored	Without storage	Mean	Per square mile	
October	122	44	63.9	3,930	+570	4,500	73.2	1.08	1.24
November	106	58	70.1	4,170	+830	5,000	84.0	1.24	1.38
December	60	13	47.5	2,920	+7,810	10,700	174	2.56	2.95
January	328	12	232	14,300	+8,380	22,700	369	5.43	6.26
February	401	241	348	19,300	−12,500	6,800	122	1.79	1.86
March	250	82	152	9,370	−4,550	4,820	78.4	1.15	1.33
April	264	24	123	7,300	+14,500	21,800	366	5.38	6.00
May	1,100	27	460	28,300	+20,200	48,500	789	11.6	13.37
June	1,480	529	817	48,600	+550	49,200	827	12.2	13.61
July	1,060	23	429	26,400	+470	26,900	437	6.43	7.41
August	374	234	344	21,100	−14,200	6,900	112	1.65	1.90
September	419	206	335	19,900	−15,400	4,500	75.6	1.11	1.24
The year	1,480	12	284	206,000	+6,660	212,000	293	4.31	58.55

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 16 miles southwest of Naches, Yakima County.

DRAINAGE AREA.—240 square miles (measured on topographic maps).

RECORDS AVAILABLE.—April 17 to September 17, 1906 (fragmentary gage height record); July 5, 1907, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on right bank about 1,000 feet below intake of Tieton canal; inspected by G. G. Willis and Willis Taylor. Friez water-stage recorder at same site used July 8, 1911, to 1918. For description of previous gages see Water-Supply Paper 442.

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, 5.42 feet at 4 p. m. January 7 (discharge, 2,260 second feet); minimum stage from recorder, 1.90 feet on November 24–25 (discharge, 20 second-feet).

1907–1923: Maximum stage recorded from water-stage recorder, 8.15 feet at 1.20 a. m. December 13, 1921 (discharge, 6,150 second-feet); minimum stage from water-stage recorder, 1.55 feet at 6.30 p. m. August 26, 1920 (discharge, 5 second-feet).

ICE.—Stage-discharge relation affected by ice during severe winters.

DIVERSIONS.—Tieton canal has diverted water above 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 seasons.

ACCURACY.—Stage-discharge relation permanent; affected by ice December 10–24. Rating curve well defined. Operation of water-stage recorder satisfactory. Daily discharge ascertained by applying mean daily gage height to rating table. Records for December fair; otherwise good.

COOPERATION.—Complete record furnished by United States Bureau of Reclamation.

Discharge measurements of Tieton River at headworks of Tieton canal, near Naches, Wash., during the year ending Sept. 30, 1923

[Made by R. O. Crawford]

Date	Gage height	Discharge	Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Oct. 7	2.80	174	Dec. 28	3.84	725	July 5	3.82	699
27	3.14	324	Mar. 21	3.08	295	Aug. 8	2.45	92.5
Nov. 21	2.65	127	May 9	4.55	1,320	Sept. 24	2.05	28.8

Daily discharge, in second-feet, of Tieton River at headworks of Tieton canal, near Naches, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	178	240	153	482	384	271	961	604	636	1,310	162	50
2	150	221	165	444	384	280	842	527	598	1,220	131	52
3	131	204	175	434	389	263	910	477	592	1,080	123	78
4	118	204	178	389	389	259	902	455	675	893	123	29
5	214	194	178	414	375	263	893	522	1,010	717	111	26
6	207	194	165	1,060	409	267	884	662	1,310	745	104	52
7	190	187	175	1,840	371	263	817	801	1,460	1,260	87	28
8	187	184	181	1,560	322	263	785	1,070	1,510	986	94	37
9	184	181	175	1,260	288	259	785	1,360	1,670	801	96	43
10	184	178	172	1,310	280	255	809	1,780	1,840	927	96	37
11	187	168	165	1,170	275	263	850	1,510	1,560	1,080	94	30
12	187	162	144	1,060	267	259	910	1,260	1,170	393	116	34
13	184	159	130	978	259	251	893	1,120	961	809	142	39
14	181	150	117	902	271	229	893	1,080	817	834	123	89
15	175	156	116	761	267	229	936	1,080	703	777	121	67
16	159	175	134	556	263	240	1,080	1,260	675	689	118	54
17	156	263	181	574	271	263	1,260	1,360	717	592	116	53
18	165	244	202	539	288	267	1,120	1,260	724	504	123	42
19	178	190	224	504	267	296	1,060	1,170	662	439	102	52
20	178	145	247	488	263	322	995	1,080	717	380	194	59
21	148	136	228	466	259	280	902	1,120	675	211	139	48
22	145	23	217	461	255	322	825	1,220	668	348	296	40
23	159	23	237	466	251	334	761	1,170	623	389	184	35
24	194	20	580	450	248	348	738	1,080	550	352	134	38
25	326	40	649	429	240	366	769	1,010	493	288	114	62
26	450	72	522	414	236	399	777	944	550	251	91	85
27	339	72	675	414	240	493	825	825	616	244	76	91
28	259	87	689	399	251	598	769	738	785	259	70	104
29	229	162	598	389	-------	717	696	731	1,050	229	89	116
30	214	153	556	380	-------	868	630	738	1,310	334	94	116
31	240	-------	533	380	-------	995	-------	717	-------	267	74	-------

Combined monthly discharge of Tieton River and canal at headworks of Tieton canal, near Naches, Wash., for the year ending Sept. 30, 1923

[Drainage area, 240 square miles]

Month	Discharge in second-feet						Combined run-off	
	River (mean)	Canal (mean)	Combined				Inches	Acre-feet
			Maximum	Minimum	Mean	Per square mile		
October	200	16	450	145	216	0.900	1.04	13,300
November	153	37	263	150	190	.792	.88	11,300
December	286	----	689	116	286	1.19	1.37	17,600
January	689	----	1,840	380	689	2.87	3.31	42,400
February	295	----	409	236	295	1.23	1.28	16,400
March	354	----	995	229	354	1.48	1.71	21,800
April	876	46	1,260	785	922	3.84	4.28	54,900
May	991	302	2,080	755	1,290	5.38	6.20	79,300
June	911	305	2,140	798	1,220	5.08	5.67	72,600
July	649	303	1,620	508	952	3.97	4.58	58,500
August	121	317	614	386	438	1.82	2.10	26,900
September	56.2	267	395	253	323	1.35	1.51	19,200
The year	466	----	2,140	116	600	2.50	33.93	434,000

NOTE.—Gage-height record indicates canal dry October 4 to November 18 and November 29 to April 20.

TIETON CANAL NEAR NACHES, WASH.

LOCATION.—In sec. 30, T. 14 N., R. 15 E. (unsurveyed), below canal intake and 16 miles southwest of Naches, Yakima County.

RECORDS AVAILABLE.—Irrigation seasons 1910 to September 30, 1923.

GAGE.—Float gage installed in a stilling well about 500 feet below canal intake; read by G. G. Willis and Willis Taylor.

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.—Maximum stage recorded during year, 5.32 feet August 11 and 12 (discharge, 318 second-feet). No flow October 5 to November 18 and November 29 to April 20.

1910–1923: Maximum stage recorded, 5.53 feet for few hours September 9, 1921 (discharge, 344 second-feet); no flow when head gates are closed.

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

COOPERATION.—Complete record furnished by United States Bureau of Reclamation.

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, 1923

[Made by R. B. Van Horn]

Date	Gage height	Discharge	Date	Gage height	Discharge	Date	Gage height	Discharge
	Feet	*Sec.-ft.*		*Feet*	*Sec.-ft.*		*Feet*	*Sec.-ft.*
Apr. 23	1.70	57	May 21	5.16	304	July 20	5.12	307
26	3.01	154	June 11	5.09	301	Aug. 13	5.30	315
May 2	4.99	302	July 6	5.14	314	Sept. 5	5.30	315

Daily discharge, in second-feet, of Tieton canal near Naches, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Apr.	May	June	July	Aug.	Sept.
1	150			284	305	305	315	316
2	126			280	305	305	317	316
3	108			299	306	304	317	317
4	101			300	307	305	317	315
5				305	306	305	317	317
6				305	306	305	316	316
7				305	306	306	318	316
8				246	305	304	317	316
9				305	305	304	317	316
10				305	304	305	317	316
11				304	304	306	318	317
12				305	304	297	318	311
13				305	304	278	317	305
14				305	304	279	317	232
15				305	304	278	316	291
16				305	305	284	316	284
17				304	305	297	316	278
18				306	306	301	316	271
19		59		305	305	303	317	261
20		59		305	305	306	318	258
21		59	18	304	304	297	316	258
22		157	26	307	304	310	318	252
23		157	57	307	306	307	316	252
24		154	83	306	305	309	317	239
25		153	115	306	305	307	317	220
26		108	159	306	305	310	317	192
27		107	190	304	306	313	317	168
28		107	221	305	306	316	316	149
29			252	306	306	317	317	150
30			275	305	307	317	316	149
31				305		316	317	

NOTE.—Canal dry during periods for which discharge is not shown.

Monthly discharge of Tieton canal near Naches, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	150	0	15.6	959
November	157	0	37.3	2,220
April	275	0	46.5	2,770
May	307	246	302	18,600
June	307	304	305	18,100
July	317	278	303	18,600
August	318	315	317	19,500
September	317	149	267	15,900

NORTH FORK OF AHTANUM CREEK NEAR TAMPICO, WASH.

LOCATION.—In NW. ¼ sec. 2, T. 12 N., R. 15 E., at Prior ranch, 100 feet below Nasty Creek, and 3½ miles northwest of Tampico, Yakima County.

DRAINAGE AREA.—69 square miles (measured on topographic maps).

RECORDS AVAILABLE.—August 26, 1907, to September 30, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank, about 300 feet southeast of ranch house; installed April 6, 1919; inspected by R. S. Skillin and F. E. Moxley. 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; April 2, 1913, to August 19, 1915, and September 6, 1916, to September 30, 1917, Stevens continuous water-stage recorder; and April 14, 1918, to October 10, 1918, Stevens 8-day water-stage recorder at same site and datum.

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 50 feet below gage installed in November, 1915. Stage of zero flow at time of construction of control, gage height 1.45 feet.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from water-stage recorder, 3.30 feet at 9 p. m. July 13 (discharge, 299 second-feet); probably higher during period station was not in operation. Minimum stage from recorder, 1.80 feet on several days in September (discharge, 16 second-feet); actual minimum probably occurred in the winter while station was not in operation.

1907–1923: Maximum stage recorded, 4.60 feet at 9 a. m. June 18, 1916 (discharge, 728 second-feet); minimum stage recorded, 1.55 feet from 5 to 9 p. m. November 8, 1920 (discharge, 6.8 second-feet).

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

DIVERSIONS.—Station is above all diversions.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during period records were discontinued and on July 6. Rating curve used June 29 to July 6 poorly defined; that used after July 6 fairly well defined. Operation of water-stage recorder satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from recorder graph by inspection. Records good.

Discharge measurements of North Fork of Ahtanum Creek near Tampico, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
June 29	Moxley and Skillin	2.68	124	Aug. 9	F. E. Moxley	2.02	35.6
July 7	R. B. Kilgore	2.74	151	13	R. S. Skillin	1.97	34.4

Daily discharge, in second-feet, of North Fork of Ahtanum Creek near Tampico, Wash., for the year ending Sept. 30, 1923

Day	June	July	Aug.	Sept.	Day	June	July	Aug.	Sept.
1		122	42	23	16		75	28	17
2		120	42	22	17		71	28	17
3		112	42	22	18		68	28	17
4		104	39	21	19		65	27	17
5		102	39	21	20		61	36	17
6		135	38	21	21		59	29	18
7		176	37	21	22		56	39	18
8		128	36	20	23		54	30	18
9		114	35	20	24		51	28	18
10		107	34	19	25		50	27	20
11		105	33	19	26		48	26	24
12		96	32	19	27		47	25	20
13		106	30	18	28		45	24	18
14		98	31	17	29	126	43	23	17
15		83	29	17	30	127	42	24	16
					31		42	23	

NOTE.—Water-stage recorder not operating Aug 6–8; discharge estimated by interpolation. No record Oct. 1 to June 28.

Monthly discharge of North Fork of Ahtanum Creek near Tampico, Wash., for the year ending Sept. 30, 1923

[Drainage area, 69 square miles]

Month	Discharge in second-feet				Run-off	
	Maximum	Minimum	Mean	Per square mile	Inches	Acre-feet
July	176	42	83.4	1.21	1.40	5,130
August	42	23	31.7	.459	.53	1,950
September	24	16	19.1	.277	.31	1,140
The period						8,220

NOTE.—No record Oct. 1 to June 28.

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, Yakima County.

DRAINAGE AREA.—26 square miles (measured on topographic maps, and Pl. I, Water-Supply Paper 369).

RECORDS AVAILABLE.—March 15, 1915, to September 30, 1923.

GAGE.—Vertical staff on left bank about 75 feet from ranch house; read by Mrs. W. B. Conrad. Gage datum raised 1.00 foot on August 9, 1918.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Bed composed of gravel and sand. Banks high and wooded. Concrete control 7 feet downstream from gage. Stage of zero flow, according to levels run July 20, 1919, gage height +0.05 foot.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 1.35 feet on May 10 (discharge, 90 second-feet); minimum stage recorded, 0.45 foot October 1, 2, and 9–14 (discharge, 5.8 second-feet). Maximum and minimum stages for the year probably occurred during winter when observations were discontinued.

1915–1923: Maximum stage recorded, 3.1 feet June 19, 1916 (discharge, 216 second-feet); minimum discharge, 4.3 second-feet, September 25–26, 1915, and August 22 and 23, 1920.

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

DIVERSIONS.—Small ditch diverting above gage supplies water to Conrad's hop fields.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during winter. Rating curves fairly well defined. Gage read to hundredths twice daily. Daily discharge ascertained by applying mean daily gage height to rating table; records good.

Discharge measurements of South Fork of Ahtanum Creek at Conrad ranch, near Tampico, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
June 29	Moxley and Skillin	0.86	27.2	Aug. 9	F. E. Moxley	0.63	11.9
July 8	R. B. Kilgore	.88	32.7	13	R. S. Skillin	.61	11.3

Daily discharge, in second-feet, of South Fork of Ahtanum Creek at Conrad ranch near Tampico, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Apr.	May	June	July	Aug.	Sept.
1	6.2	70	41	46	27	15	8.9
2	6.2	70	37	43	27	14	8.9
3	6.2	70	35	43	25	14	8.9
4	6.2	66	35	46	24	14	8.5
5	6.2	63	41	48	25	14	8.1
6	6.2	59	48	53	33	14	8.1
7	6.2	52	57	63	37	13	8.1
8	6.2	47	63	67	30	13	8.1
9	6.2	46	84	64	27	13	8.1
10	6.2	43	90	64	25	12	8.1
11	5.8	43	83	67	26	12	8.1
12	5.8	48	70	56	25	12	7.7
13	5.8	48	66	56	24	10	7.3
14	5.8	46	62	53	37	10	7.3
15	------	48	62	50	29	10	7.3
16	------	50	67	47	25	10	7.3
17	------	59	67	43	25	10	7.3
18	------	56	64	43	24	9.7	7.3
19	------	51	70	41	22	9.7	7.3
20	------	47	64	39	22	14	7.3
21	------	43	67	38	19	10	7.3
22	------	38	70	36	19	15	7.3
23	------	35	70	35	18	10	7.3
24	------	33	70	33	18	10	7.3
25	------	35	69	33	17	10	8.1
26	------	37	67	33	16	9.7	8.9
27	------	46	64	31	16	9.7	7.7
28	------	48	56	30	16	9.7	7.3
29	------	48	53	29	16	8.9	7.3
30	------	43	51	27	16	9.7	7.3
31	------	------	47	------	15	8.9	------

NOTE.—No record Oct. 15 to Mar. 31.

Monthly discharge of South Fork of Ahtanum Creek at Conrad ranch, near Tampico, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October 1–14	6.2	5.8	6.09	169
April	70	33	49.6	2,950
May	90	35	61.0	3,750
June	67	27	45.2	2,690
July	37	15	23.4	1,440
August	15	8.9	11.5	707
September	8.9	7.3	7.79	464

TOPPENISH CREEK NEAR FORT SIMCOE, WASH.

LOCATION.—In sec. 35, T. 10 N., R. 16 E., 30 feet above dam and headworks of Toppenish feeder canal, 3 miles south of Fort Simcoe, Yakima County, and 5½ miles southeast of White Swan.

DRAINAGE AREA.—124 square miles (measured on Pl. I, Water-Supply Paper 369).

RECORDS AVAILABLE.—February 27, 1909, to September 30, 1923.

GAGE.—Inclined staff on left bank just above headworks of Toppenish feeder canal; installed by United States Indian Service in 1922; used since October 1, 1922; read by A. B. Morrison.

Previous gages as follows: February 27, 1909, to July 22, 1913, chain gage on left bank about a mile below present site; July 23, 1913, to August 18, 1915, a vertical staff attached to cottonwood tree on right bank, 150 feet above site of gage used August 19, 1915, to September 30, 1922; August 19, 1915, to September 30, 1922, a Stevens continuous water-stage recorder on left bank about 1¼ miles below present gage was used. Present gage datum different from that of former gages.

DISCHARGE MEASUREMENTS.—Made by wading.

CHANNEL AND CONTROL.—Control is concrete dam and headworks to Toppenish feeder canal. Channel is straight for some distance above and below gage. Banks moderately high; not subject to overflow. Zero of gage approximately at elevation of crest of dam.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year, 2.92 feet on January 7 (discharge, 1,030 second-feet); minimum stage recorded, 0.06 foot on July 30 and September 12 (discharge, 3 second-feet). Discharge may have been lower on some day in September when gage was not read.

1909–1923: Maximum discharge recorded, 1,650 second-feet at noon May 4, 1916; minimum stage recorded, from water-stage recorder, 0.96 foot at 9 p. m. August 25, 1922 (discharge, 2.6 second-feet).

ICE.—Stage-discharge relation affected by ice; flow estimated from gage-height record, discharge measurements, observer's notes, and weather records.

DIVERSIONS.—Toppenish feeder canal was in operation throughout year. Mean daily diversion ranged from 2.1 to 24 second-feet. In addition to new acreage, this canal fulfills irrigation requirements formerly taken care of by Nicol and Abe Lincoln ditches which have been abandoned. Diversion through canal added to flow at creek gaging station to determine natural monthly flow past gage. Diversion of spring run-off into reservoir on Simcoe Creek for use in irrigating Indian lands is proposed.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed at high water January 7; affected by ice December 5–15. Rating curves fairly well defined. Gage read once daily to hundredths. Daily discharge ascertained by applying daily gage height to rating table. Records good.

Discharge measurements of Toppenish Creek near Fort Simcoe, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 7	R. B. Kilgore	0.23	13.7	July 6	Kilgore and Skillin	0.22	20.2
May 7	Kilgore and Skillin	.94	154				

Daily discharge, in second-feet, of Toppenish Creek near Fort Simcoe, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7	10	11	65		110	340	174	40	4	6	4
2	8	9	13	84	55	94	320	165	39	5	6	4
3	9	10	13	153		83	360	141	38	6	6	4
4	9	10	13	116	57	83	340	147	38	5	6	4
5	9	10		93	57	92	320	150	27	6	5	4
6	9	11		615	57	103	320	168	27	29	5	4
7	8	14		1,030	58	88	280	174	27	42	5	4
8	8	14		860	58	81	262	174	27	24	4	4
9	8	14		480	58	77	245	177	27	17	4	4
10	8	14	10	480	58	74	245	245	26	16	5	4
11	7	13		420	58	74	245	168	24	15	5	4
12	7	11		320	58	74	262	141	24	12	4	3
13	8	13		262	42	74	280	116	23	14	4	4
14	8	13		204	39	74	280	110	22	15	5	4
15	8	13		198	44	72	280	110	19	13	4	4
16	8	14	11	198	48	70	300	112	18	10	4	
17	8	15	13		48	70	262	103	18	6	4	
18	8	15	16		48	72	262	88	16	4	4	
19	9	15	16		50	88	280	79	15	6	4	
20	9	15	16		48	100	245	74	14	6	14	
21	8	15	16		48	100	228	68	14	4	9	
22	8	14	16		48	98	210	63	13	4	9	
23	8	13	22		50	98	186	58	13	4	10	5
24	8	13	105	140	51	100	189	57	12	5	6	
25	11	13	84		54	100	183	56	10	5	5	
26	15	13	116		58	116	210	52	9	5	4	
27	11	13	174		68	133	228	51	10	5	4	
28	10	13	162		85	156	228	46	5	5	4	
29	9	11	138			210	207	46	4	4	4	
30	9	11	67			262	186	44	4	3	4	
31	10		61			320		42		6	4	

NOTE.—Gage not read Jan. 17 to Feb. 3 and Sept. 16–30; discharge estimated by comparison with flow of near-by streams. Braced figures show mean discharge for periods indicated.

Monthly discharge of Toppenish Creek and Toppenish feeder canal near Fort Simcoe, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet					Run-off in acre-feet (combined)
	Creek			Canal (mean)	Combined (mean)	
	Maximum	Minimum	Mean			
October	15	7	8.71	9.69	18.4	1,130
November	15	9	12.7	9.32	22.0	1,310
December	174		*38.5	3.40	41.9	2,580
January	1,030		248	2.45	250	15,400
February	85	39	54.0	2.40	56.4	3,130
March	320	70	108	2.40	110	6,760
April	360	183	259	5.76	265	15,800
May	245	42	110	18.8	129	7,930
June	40	4	20.1	23.4	43.5	2,590
July	42	3	9.84	16.2	26.0	1,600
August	14	4	5.39	10.6	16.0	984
September		3	4.47	10.2	14.7	875
The year	1,030	3	73.4	9.58	83.0	60,100

NOTE.—Canal discharge determined from complete gage-height record and fairly well defined rating curve.

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, Yakima County.

DRAINAGE AREA.—77 square miles (measured on Pl. I, Water-Supply Paper 369).

RECORDS AVAILABLE.—November 20, 1915, to September 30, 1923. For a station just above Spring Creek, February 28; 1909, to November 20, 1915.

GAGE.—Stevens continuous water-stage recorder on left bank just below Spring Creek; installed November 20, 1915; inspected by A. B. Morrison. Previous gages as follows: Prior to March 24, 1910, a chain gage 100 yards above Spring Creek; March 24, 1910, to November 20, 1915, staff gage at same site and datum.

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

CHANNEL AND CONTROL.—Bed composed of sand and gravel. Concrete control, 16 feet below gage. Right bank high; left bank is overflowed at medium stage

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from high-water marks in well, 5.2 feet January 7 (discharge not determined); minimum stage from recorder, 0.0 foot at 6.20 p. m. September 30 (discharge, zero).

1916–1923: Maximum stage recorded, 6.14 feet at 5 p. m. February 10, 1916 (discharge, 731 second-feet); minimum discharge occurred September 30, 1923.

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

DIVERSION.—Considerable water is diverted above the station for irrigation. Since about April, 1920, Simcoe Creek flume has diverted from 0.1 second-foot to 6 second-feet from a point just above Spring Creek. Monthly discharge has been corrected for estimated diversion through flume.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water January 5–14, and as a result of channel repairs March 29 and 30. Rating curves poorly defined. Operation of water-stage recorder fairly satisfactory. Daily discharge ascertained by applying to rating table the mean gage height determined from recorder graph by inspection. Records poor.

Discharge measurements of Simcoe Creek below Spring Creek, near Fort Simcoe, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 7	R. B. Kilgore	0.20	0.46	May 7	Kilgore and Skillin	0.98	59.5
Feb. 2	R. S. Skillin	.61	17.5	July 6	do	.35	2.7

Daily discharge, in second-feet, of Simcoe Creek below Spring Creek, near Fort Simcoe, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.2	0.8	1.3	3.8	17	50	94	54	10	4.7	1.3	0.5
2	.3	1.0	1.4	3.8	18	50	91	51	9.4	4.7	1.3	.5
3	.1	1.0	1.4	4.0	18	46	88	46	8.9	4.7	1.4	.5
4	.1	.9	1.4	4.3	17	43	86	45	8.3	4.3	1.4	.5
5	.1	.6	1.5	4.3	17	42	84	44	7.7	3.6	1.3	.6
6	.1	.5	1.5		18	42	80	46	7.2	3.3	1.4	.8
7	.1	.5	1.4		18	42	78	56	6.6	3.6	1.2	.8
8	.1	.5	1.4		18	39	72		6.6	3.0	1.2	.8
9	.1	.5	1.4		19	39	66		6.2	2.8	1.0	.6
10	.1	.5	1.4	170	19	37	65		5.9	2.6	1.0	.6
11	.1	.5	1.5		20	42	66		6.2	6.6	1.0	.5
12	.1	.5	1.7		18	40	67	55	6.6	5.9	1.0	.5
13	.1	.5	1.7		15	40	66		6.6	6.3	1.0	.5
14	.1	.8	1.8		16	37	65		6.6	9.4	.9	.5
15	.1	1.0	1.8	68	20	39	65		6.2	5.9	.8	.5
16	.1	.9	1.8	62	23	37	67		5.9	4.3	.8	.5
17	.1	.9	1.8	68	25	39	73	46	5.5	3.6	.7	.5
18	.3	1.0	1.8	59	25	39	76	43	4.3	3.0	.7	.5
19	.4	1.0	1.8	54	20	34	69	41	3.8	2.8	.6	.5
20	.3	1.0	2.0	48	19	36	66	38	3.6	2.8	.6	.5
21	.3	1.2	2.0	43	19	40	62	36	3.3	2.3	.5	.4
22	.2	1.2	2.0	42	21	42	58	33	3.0	2.0	.5	.5
23	.1	1.2	2.6	39	23	43	53	31	3.3	1.8	.8	.4
24	.1	1.2	3.0	36	27	45	49	28	3.3	1.8	1.0	.4
25	.1	1.2	3.0	33	34	46	48	25	3.3	1.8	.9	.5
26	.2	1.2	3.0	30	36	48	48	23	3.6	1.7	.8	.6
27	.3	1.2	3.2	30	39	53	52	20	3.6	1.5	.5	.5
28	.3	1.3	3.4	27	43	64	57	18	3.6	1.4	.5	.5
29	.4	1.3	3.6	25	-------	72	60	15	4.7	1.4	.5	.3
30	.5	1.3	3.6	18	-------	78	56	13	4.7	1.3	.6	.1
31	.8	-------	3.8	19	-------	86	-------	10	-------	1.4	.6	-------

NOTE.—Water-stage recorder not operating Dec. 17, 18, 27, 28, May 8–16, 18–30, June 2–6, Aug. 15–20; discharge May 8–16 estimated from recorded range of stage, otherwise by interpolation. Mean discharge Jan. 6–14 estimated from gage-height record and high-water mark in well.

Combined monthly discharge of Simcoe Creek below Spring Creek and Simcoe Creek flume near Fort Simcoe, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet					Combined run-off in acre-feet
	Creek			Flume (mean)	Combined (mean)	
	Maximum	Minimum	Mean			
October	0.8	0.1	0.20	0.4	0.60	36.9
November	1.3	.5	.91	.1	1.01	60.1
December	3.8	1.3	2.10	----------	2.10	129
January	----------	3.8	72.6	----------	72.6	4,460
February	43	15	22.2	----------	22.2	1,230
March	86	34	46.1	----------	46.1	2,830
April	94	48	67.6	6.0	73.6	4,380
May	----------	10	40.5	5.0	45.5	2,800
June	10	3.0	5.62	4.5	10.1	601
July	9.4	1.3	3.43	3.0	6.43	395
August	1.4	.5	.90	1.5	2.40	148
September	.8	.1	.51	.5	1.01	60.1
The year	----------	.1	21.9	----------	23.6	17,100

NOTE.—Probably no flow in canal from Nov. 14 to Apr. 3. Mean discharge for remainder of year estimated from four discharge measurements during 1922–23 and from two to five gage-height readings a month.

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, Yakima County, and 2 miles above mouth of drain.

RECORDS AVAILABLE.—December 5, 1912, to September 30, 1923. Miscellaneous measurements 1911 and 1912.

GAGE.—Stevens continuous water-stage recorder on right bank 30 feet above highway bridge; installed October 9, 1922; inspected by United States Indian Service employees. Gage read prior to October 9, 1922, was vertical staff on right bank, under highway bridge.

DISCHARGE MEASUREMENTS.—Made from footbridge, 1,000 feet below gage.

CHANNEL AND CONTROL.—Bed composed of gravel; shifting. Banks high. Current swift at all stages.

EXTREMES OF DISCHARGE.—Maximum stage from water-stage recorder during year, 5.3 feet July 9 and 10 (discharge, 717 second-feet); minimum stage from recorder, 2.95 feet December 21–23 (discharge, 194 second-feet).

1913–1923: Maximum stage recorded, 8.2 feet on January 2, 1918, from high-water mark (discharge, estimated at 1,500 second-feet). Minimum discharge, 131 second-feet, March 18, 1922.

ICE.—None.

REGULATION.—None.

ACCURACY.—Stage-discharge relation permanent. Rating curve well defined. Operation of water-stage recorder fairly satisfactory except as noted in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table mean daily gage height determined from gage-height graph by inspection. Records good except for periods represented by flat estimates of discharge which are fair.

Reservation drain carries the return water from irrigation by the reservation canals and the underflow of Toppenish Valley. During the low-water period practically the whole flow of Toppenish Creek is carried into this channel by seepage.

Discharge measurements of Reservation drain at Alfalfa, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Oct. 24	Raleigh Skillin	3.59	341	June 30	F. E. Moxley	4.26	462
Nov. 6	Kilgore and Skillin	3.58	315	July 5	R. B. Kilgore	4.56	525
Apr. 4	Raleigh Skillin	3.21	256	Aug. 30	Moxley and Skillin	* 2.66	504
May 4	Kilgore and Skillin	3.09	230	Sept. 28	Raleigh Skillin	* 2.89	573
June 2	Raleigh Skillin	4.27	470				

* Relation between this and former gages not established.

Daily discharge, in second-feet, of Reservation drain at Alfalfa, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	437	329	254	233	233	223	243	203	579	465		
2	432	329	254	233	223	213	243	203	602	488		
3	427	329	254	233	223	203	243	213	625	510		
4	422	329	254	233	223		243	213	625	533		
5	417	329	254	233	223		254	223	625	533		
6	412	329	243	223	223		264	243	625	556		
7	407	329	243	223	223		264	254	625	602		
8	402	329	243	233	213	200	285	254	625	671		
9	397	307	243	243	213		285	254	602	717		
10	374	307	243	264	213		285	264	602	694		
11	374	307	233	285	213		285	285	602	671		
12	374	307	233	307	223	203	233	285	602	648		
13	374	307	233	307	223	202	233	307	625	648		
14	374	307	231	307	213	200	233	329	602	625		
15	374	307	230	285		199	243	352	602	602		
16	352	307	228	285		198	233	374	602	579	550	600
17	352	307	226	264		197	213	397	579	556		
18	352	285	225	254		195	213	420	579	533		
19	352	285	223	254		194	223	420	579	533		
20	329	285	203	243		204	223	329	556	533		
21	329	285	194	243	220	214	243	374	533	533		
22	329	264	194	243		223	254	420	533	533		
23	329	264	194	243		223	254	442	533	533		
24	329	264	203	243		223	264	442	510	533		
25	329	264	233	254		223	254	442	510	510		
26	329	264	233	243		233	243	442	488	510		
27	329	264	233	243		243	243	465	465	510		
28	329	264	223	243		243	254	488	488	510		
29	329	264	233	243	-------	243	223	511	488	533		
30	329	264	233	243	-------	243	213	533	488	533		
31	329	-------	243	233	-------	243	-------	556	-------	556		-------

NOTE.—No gage-height record Oct. 1-8 and Aug. 1 to Sept. 30. Water-stage recorder not operating satisfactorily Dec. 14-18, Feb. 15 to Mar. 1, Mar. 4-11, 13-18, 20, 21, 28-31, Apr. 1-3, May 27-31, and June 1; discharge Oct. 1-8, Dec. 14-18, Mar. 13-18, 20, 21, 28-31, Apr. 1-3, and May 27-31, estimated by interpolation. Discharge Feb. 15 to Mar. 1, Mar. 4-6, and Aug. 1 to Sept. 30 estimated from general information and occasional discharge measurements made during and just following latter period.

Monthly discharge of Reservation drain at Alfalfa, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	437	329	366	22,500
November	329	264	297	17,700
December	254	194	231	14,200
January	307	223	252	15,500
February	----------	----------	220	12,200
March	243	----------	212	13,000
April	285	213	246	14,600
May	556	203	353	21,700
June	625	465	570	33,900
July	717	465	564	34,700
August	----------	----------	550	33,800
September	----------	----------	600	35,700
The year	717	194	372	270,000

SATUS CREEK BELOW DRY CREEK, NEAR TOPPENISH, WASH.

LOCATION.—In sec. 24, T. 9. N., R. 19 E., at dam site 1 mile below mouth of Dry Creek and 9 miles southwest of Toppenish, 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, 1923.

GAGE.—Stevens continuous water-stage recorder on left bank; inspected by R. S. Skillin and F. E. Moxley.

DISCHARGE MEASUREMENTS.—Made from cable or by wading.

CHANNEL AND CONTROL.—Bed composed of small boulders and gravel; shifting.

EXTREMES OF DISCHARGE.—Maximum stage recorded during year from high-water mark in well, 8.8 feet; probably occurred January 6 or 7 while water-stage recorder was not operating (discharge, 3,400 second-feet). Minimum stage from water-stage recorder, 1.31 feet on October 1 (discharge, 12 second-feet); discharge may have been less during some period recorder was not operating.

1913–1923: Maximum stage recorded, 9.15 feet December 22, 1915, from high-water mark in well (discharge, 3,870 second-feet); 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 affected by ice; flow estimated from gage-height record and observer's notes and weather records.

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 the upper Satus.

REGULATION.—None.

ACCURACY.—Stage-discharge relation changed during high water January 7, and gradually September 1–30; probably affected by ice during December when water-stage recorder was not operating. Rating curve used prior to January 7 well defined; curve used directly February 3 to August 31, and as standard form thereafter, fairly well defined. Operation of water-stage recorder unsatisfactory through several periods as indicated in footnote to table of daily discharge. Daily discharge ascertained by applying to rating table the mean daily gage height determined from recorder graph by inspection or, for a few days when variation in stage was considerable, by averaging results obtained by applying mean gage heights for shorter intervals. Shifting-control method used September 1–30. Records good except for periods represented by flat estimates of discharge.

Discharge measurements of Satus Creek near Toppenish, Wash., during the year ending Sept. 30, 1923

Date	Made by—	Gage height	Discharge	Date	Made by—	Gage height	Discharge
		Feet	*Sec.-ft.*			*Feet*	*Sec.-ft.*
Nov. 6	Kilgore and Skillin	1.45	21.0	June 13	R. S. Skillin	2.12	106
May 5	do	2.30	145	July 5	Kilgore and Skillin	1.73	37.4

Daily discharge, in second-feet, of Satus Creek below Dry Creek, near Toppenish, Wash., for the year ending Sept. 30, 1923

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	12			129	130	345	394	169	118	50	23	18
2	13			124	130	348	394	162	115	47	23	18
3	15	23		368	134	252	384	155	113	44	23	19
4	16			333	136	223	364	147	113	41	24	19
5	16			255	145	201	335	145	120	38	24	19
6		22		1,440	138	220	319	150	127	50	23	19
7					143	342	316	155	127	102	23	19
8					143	258	291	162	124	86	23	19
9					127	223	264	179	120	60	23	19
10			30		143	206	252	215	122	53	22	19
11					134	195	240	215	124	47	21	19
12					134	192	240	203	111	44	21	19
13					120	187	232	192	104	39	20	19
14					118	167	226	190	101	40	20	19
15		25			118	167	223	187	98	37	19	19
16					118	164	223	206	95	33	19	18
17					118	273	232	206	92	32	19	18
18	20				118	243	246	190	89	30	19	18
19				600	115	301	232	182	86	30	19	18
20					120	390	220	177	83	29	23	18
21			40		120	319	217	164	80	28	23	17
22					115	288	203	174	77	26	21	17
23					115	288	185	167	74	25	21	17
24					131	285	177	162	71	24	21	17
25		27	180		167	282	169	155	68	24	19	18
26		27			187	294	164	143	65	23	19	19
27		28			203	319	167	134	62	23	19	19
28		30	315		243	335	172	124	59	23	19	18
29		30	213		-------	348	172	134	56	23	19	17
30		30	152		-------	364	169	127	53	22	19	17
31		-------	139		-------	384	-------	118	-------	23	19	-------

NOTE.—Water-stage recorder not operating satisfactorily Oct. 6–31, Nov. 1–24, Nov. 30 to Dec. 27, Jan. 7 to Feb. 2, and June 14 to July 4; discharge Nov. 6 and Dec. 21, results of staff gage readings; June 14 to July 4 estimated by interpolation; otherwise by hydrographic comparison with combined flow of Toppenish Creek and Toppenish feeder canal.

Monthly discharge of Satus Creek below Dry Creek, near Toppenish, Wash., for the year ending Sept. 30, 1923

Month	Discharge in second-feet			Run-off in acre-feet
	Maximum	Minimum	Mean	
October	----------	12	19.1	1,170
November	30	----------	25.3	1,510
December	----------	----------	81.9	5,040
January	1,440	124	569	35,000
February	243	115	138	7,660
March	390	164	271	16,700
April	394	164	247	14,700
May	215	118	167	10,300
June	127	53	94.9	5,650
July	102	22	38.6	2,370
August	24	19	21.0	1,290
September	19	17	18.3	1,090
The year	1,440	12	142	102,000

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MISCELLANEOUS DISCHARGE MEASUREMENTS.

In addition to the records of stream flow obtained at gaging stations and reported in the preceding pages, measurements of flow 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, 1923

Date	Stream	Tributary to or diverting from—	Locality	Gage height	Discharge
		Quinault River basin			
Dec. 21	Quinault River	Pacific Ocean	Former gaging station at Quinault Lake, Wash.	*Feet* 4.08	*Sec.-ft.* 3,380
		Dungeness River basin			
Sept. 28	Dungeness River	Strait of Juan de Fuca	Gaging station at canyon, above fish hatchery.	1.62	164
		Skokomish River basin			
Oct. 10	Skokomish [a] River	Hood canal	Olympic highway bridge, near Union, Wash.		652
12	North Fork [a] of Skokomish River.	Skokomish River	Below McTag Creek, near Hoodsport, Wash.		247
Aug. 30	South Fork of Skokomish River.	do	At gaging station at canyon head, near Potlatch, Wash.	1.88	71
30	do	do	do	1.88	72
		Stilaguamish River basin			
Feb. 3	Pilchuck Creek	Stilaguamish River	800 feet below highway bridge at Pilchuck, Wash.		78
		Skagit River basin			
June 15	Skagit River	Skagit Bay	Former gaging station at Reflector Bar, near Marble mount, Wash.	5.44	8,270
		Clark Fork basin			
Oct. 3	Sullivan Creek	Clark Fork	50 feet below highway bridge, below diversion dam for Sullivan Creek flume.		31
		Spokane River basin			
Aug. 17	Little Spokane River	Spokane River	Former gaging station ½ mile above mouth.		376

[a] Furnished by city of Tacoma.

Miscellaneous discharge measurements in drainage basins in Washington during the year ending Sept. 30, 1923—Continued

Okanogan River basin

Date	Stream	Tributary to or diverting from—	Locality	Gage height	Discharge
Oct. 2	Salmon Creek	Okanogan River	Former gaging station near Conconully, Wash.	0.17	5.2
2	do	do	do	.17	5.1

Methow River basin

June 26	Methow Valley Irrigation District canal.	Diverts from left side of Methow River.	1,200 feet above highway bridge at Twisp, Wash.	1.58	34.5
27	do	do	do	1.72	39.1
Sept. 26	do	do	do	1.82	42.7
June 26	do	Diverts from right side of Twisp River.	3 miles below headwork, at Twisp, Wash.	2.05	37.3
Sept. 25	do	do	do	1.09	18.0
June 26	Risley ditch	Diverts from right side of Twisp River ½ mile above mouth.	½ mile below intake	3.76	2.6
Sept. 26	do	do	do	3.92	4.0

Yakima River basin

Oct. 30	Yakima River	Columbia River	Former gaging station near Prosser, Wash.	2.61	1,330
Dec. 1	do	do	do	2.69	1,350
Jan. 4	do	do	do	4.36	3,310
Nov. 7	Toppenish feeder canal.	Diverts from left side of Toppenish Creek.	Gaging station 250 feet below intake.	2.10	8.7
May 7	do	do	do	2.53	17.5
July 6	do	do	do	2.53	18.2
Nov. 7	Simcoe Creek flume	Diverts from left side of Simcoe Creek a short distance above gage.	Gaging station near head work.	.22	.2
May 7	do	do	do	1.46	6.5
July 6	do	do	do	.81	3.7

INDEX

STREAM-GAGING STATIONS

AND

PUBLICATIONS RELATING TO WATER RESOURCES

PART XII.—NORTH PACIFIC SLOPE BASINS

32430—26†—WSP 572——14

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 result of stream-flow measurements are now published annually in 12 parts, each part covering an area whose boundaries coincide with natural drainage as indicated below:

Part 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. 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 purchased at nominal cost from the Superintendent of Documents, Government Printing Office, Washington, D. C., who will on application furnish lists giving prices.

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

3. 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.
Trenton, N. J., Statehouse.
Asheville, N. C., 316 Jackson Building.
Chattanooga, Tenn., 37 Municipal Building.
Columbus, Ohio, Brown Hall, Ohio State University.
Chicago, Ill., 950 Transportation Building.
Madison, Wis., care of Railroad Commission of Wisconsin.
Ames, Iowa, State Highway Commission Building.
Rolla, Mo., Rolla Building, School of Mines and Metallurgy.
Topeka, Kans., 23 Federal Building.
Helena, Mont., 45–46 Federal Building.
Denver, Colo., 403 Post Office Building.
Salt Lake City, Utah, 313 Federal Building.
Idaho Fall, Idaho, 228 Federal Building.
Boise, Idaho, Federal Building.
Tacoma, Wash., 406 Federal Building.
Portland, Oreg., 606 Post Office Building.
San Francisco, Calif., 328 Customhouse.
Los Angeles, Calif., 600 Federal Building.
Tucson, Ariz., 210 Agricultural Building, University of Arizona.
Austin, Tex., State Capitol.
Honolulu, Hawaii, 25 Capitol Building.

A list of the Geological Survey's publications may be obtained by applying to the Director, United States Geological Survey, Washington, D. C.

STREAM-FLOW REPORTS

Stream-flow records have been obtained at more than 5,600 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.

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

Report	Character of data	Year
W 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th A, pt. 4	Monthly discharge (also for many earlier years)	1898.
W 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
W 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4	Monthly discharge	1900.
W 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W 75	Monthly discharge	1901.
W 82 to 85	Complete data	1902.
W 97 to 100	do	1903.
W 124 to 135	do	1904.
W 165 to 178	do	1905.
W 201 to 214	do	1906.
W 241 to 252	do	1907–8.
W 261 to 272	do	1909.
W 281 to 292	do	1910.
W 301 to 312	do	1911.
W 321 to 332	do	1912.
W 351 to 362	do	1913.
W 381 to 394	do	1914.
W 401 to 414	do	1915.
W 431 to 444	do	1916.
W 451 to 464	do	1917.
W 471 to 484	do	1918.
W 501 to 514	do	1919–20.
W 521 to 534	do	1921.
W 541 to 554	do	1922.
W 561 to 574	do	1923.

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 1919.

The table following gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1918. The data for any particular station will, as a rule, be found in the reports covering the years during which the station was maintained. For example, data for Machias River at Whitneyville, Maine, 1903 to 1921, are published in Water-Supply Papers 97, 124, 165, 201, 241, 261, 281, 301, 321, 351, 381, 401, 431, 451, 471, 501, and 521, which contain records for the New England streams from 1903 to 1921. 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.

Numbers of water-supply papers containing results of stream measurements, 1899–1923

[For basins included see p. III]

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
												A	B	C
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, [i] 50	50	50	50	51	51	51	51	51
1901	65, 75	65, 75	65, 75	65, 75	[k] 65, 66, 75	66, 75	[k] 65, 66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75	66, 75
1902	82	[b] 82, 83	83	[l] 82, 83	[k] 83, 85	84	[k] 83, 84	84	85	85	85	85	85	85
1903	97	[b] 97, 98	98	97	[k] 98, 99, [m] 100	99	[k] 98, 99	99	100	100	100	100	100	100
1904	[n] 124, [o] 125, [p] 126	[p] 126, 127	128	129	[k] 128, 130	130, [q] 131	[k] 128, 131	132	133	133, [r] 134	134	135	135	135
1905	[n] 165, [o] 166, [p] 167	[p] 167, 168	169	170	171	172	[k] 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	326	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
1917	451	452	453	454	455	456	457	458	459	460	461	462	463	464
1918	471	472	473	474	475	476	477	478	479	480	481	482	483	484
1919–20	501	502	503	504	505	506	507	508	509	510	511	512	513	514
1921	521	522	523	524	525	526	527	528	529	530	531	532	533	534
1922	541	542	543	544	545	546	547	548	549	550	551	552	553	554
1923	561	562	563	564	565	566	567	568	569	570	571	572	573	574

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39. Tables for 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 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 discharge for 1900 in Twenty-second Annual Report, Part IV.
[h] Wissahickon and Schuylkill rivers to James River.
[i] Scioto River.
[j] Loup and Platte rivers near Columbus, Nebr., and all tributaries below junction with Platte.
[k] Tributaries of Mississippi from east.
[l] Lake Ontario and tributaries to St. Lawrence River proper.
[m] Hudson Bay only.
[n] New England rivers only.
[o] Hudson River to Delaware River, inclusive.
[p] Susquehanna River to Yadkin River, inclusive.
[q] Platte and Kansas rivers.
[r] Great Basin in California, except Truckee and Carson river basins.
[s] Below junction with Gila.
[t] Rogue, Umpqua, and Siletz rivers only.

PRINCIPAL STREAMS

The 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, Lewis, and Cowlitz 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 also brief references to reports published by State and other organizations (p. xxxix).

GAGING STATIONS

NOTE.—Dash after date indicates that station was being maintained September 30, 1923. 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., 1911–1922.
Soleduck River (head of Quillayute River) near Fairholm, Wash., 1917–1921.
Soleduck River at Snider ranger station, near Beaver, Wash., 1921–
Soleduck River near Quillayute, Wash., 1897–1901.
Bogachiel River:
Kalawa River near Forks, Wash., 1897–1901.
Lake Crescent (head of Lyre River) at Piedmont, Wash., 1919–
Lyre River at Piedmont, Wash., 1917–1922; 1923–
Elwha River at McDonald, Wash., 1897–1901; 1918–
Elwha River near Port Angeles, Wash., 1911–12.
Dungeness River at Sequim, Wash., 1897–98.
Dungeness River at Dungeness, Wash., 1898–1901.

PUGET SOUND DRAINAGE BASINS

Dosewallips River at Brinnon, Wash., 1910–11.
Duckabush River near Duckabush, Wash., 1910–11.
Skokomish River, North Fork (head of Skokomish River), near Hoodsport, Wash., 1910–11; 1913–
Nisqually River near Ashford, Wash., 1910–1914.
Nisqually River near La Grande, Wash., 1906–1911; 1919–
East Creek near Elbe, Wash., 1918–1922.
Little Nisqually River near Alder, Wash., 1920–
Tacoma power conduit near La Grande, Wash., 1919–
Puyallup River near Electron, Wash., 1909–
Puyallup River at 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.
White River at Buckley, Wash., 1899–1903; 1910–11; 1913–
Greenwater River at mouth, near Enumclaw, Wash., 1911–12.
White River flume at Buckley, Wash., 1913–
Green River [1] (head of Duwamish River) at Kanaskat, Wash., 1911.
Lake Washington:
Cedar River [2] at Vaughn Bridge, near Cedar Lake, Wash., 1898–99.
Cedar River at Cedar Lake, near North Bend, Wash., 1902–3.
Cedar River at Cedar Falls, Wash., 1914–
Cedar River near Landsberg, Wash., 1914–
Cedar River near Ravensdale, Wash., 1901–1912.
Cedar River at Clifford Bridge, near Ravensdale, Wash., 1895–1898.
Cedar River at Renton, Wash., 1901–1907. (Published in Water-Supply Paper 313.)
Skykomish River, South Fork (head of Snohomish River), near Berlin, Wash., 1910–11.
Skykomish River, South Fork, near Index, Wash., 1902–1905; 1911–12; 1913–
Skykomish River at Sultan, Wash., 1910–11.
Foss River near Skykomish, Wash., 1911.
East Fork of Foss River near Skykomish, Wash., 1911.
Miller Creek near Miller River (Berlin), Wash., 1911–1919.
West Fork of Miller Creek near Miller River (Berlin), Wash., 1911.
North Fork of Skykomish River at Index, Wash., 1910–1922.
Wallace River:
Olney Creek near Startup, Wash., 1922–
Sultan River near Sultan, Wash., 1911–
Snoqualmie River, Middle Fork (head of Snoqualmie River), near North Bend, Wash., 1907– (Records up to 1915 for all stations in Snoqualmie River basin published in Water-Supply Paper 412.)
Snoqualmie River near Snoqualmie, Wash., 1898–99; 1900; 1902–1904. (Revised records published in Water-Supply Paper 412.)
North Fork of Snoqualmie River at cable bridge, near North Bend, Wash., 1913–1915.
North Fork of Snoqualmie River near North Bend, Wash., 1907–
South Fork of Snoqualmie River near Garcia, Wash., 1910–1915.
South Fork of Snoqualmie River at North Bend, Wash., 1907–
Tokul Creek near Snoqualmie, Wash., 1907–1914.
Pilchuck Creek near Granite Falls, Wash., 1911.
Stilaguamish River, South Fork (head of Stilaguamish River), near Silverton, Wash., 1910–1917.
Stilaguamish River, South Fork, near Robe, Wash., 1902–3.
Stilaguamish River, South Fork at Granite Falls, Wash., 1911; 1913–1915.
Canyon Creek near Granite Falls, Wash., 1911–1913.
North Fork of Stilaguamish River:
Deer Creek at Oso, Wash., 1917–
Skagit River below Ruby Creek, near Marblemount, Wash., 1919–
Skagit River at Reflector Bar, near Marblemount, Wash., 1913–1922.
Skagit River near Marblemount, Wash., 1908–1914; 1920–

[1] Green River now flows to the sea through Duwamish River.
[2] Cedar River, formerly tributary to Duwamish River, now flows to the sea through Lake Washington and Lake Washington canal.

Skagit River near Sedro Woolley, Wash., 1908–1919; 1921–1923.
Ruby Creek near Marblemount, Wash., 1919–20.
Thunder Creek near Marblemount, Wash., 1919–
Stetattle Creek near Marblemount, Wash., 1913–1915.
Cascade River near Marblemount, Wash., 1909–1913.
Sauk River, North Fork (head of Sauk River), near Barlow Pass, Wash., 1917–1920.
Sauk River above Whitechuck River, near Darrington, Wash., 1910; 1917–1922.
Sauk River above Clear Creek, near Darrington, Wash., 1910–1913.
Sauk River at Darrington, Wash., 1914–
Sauk River near Suiattle Crossing, near Sauk, Wash., 1910–1912.
South Fork of Sauk River near Barlow Pass, Wash., 1917–1921.
Whitechuck River near Darrington, Wash., 1910; 1919–1921.
Clear Creek near Darrington, Wash., 1910–11.
Suiattle River below Lime Creek, near Darrington, Wash., 1920–21.
Baker Lake (on Baker River) near Concrete, Wash., 1910–1915.
Baker River below Anderson Creek, near Concrete, Wash., 1910–
Baker River at Concrete, Wash., 1910–1915.
Whatcom Lake near Bellingham, Wash., 1913–14.
Whatcom Creek near Bellingham, Wash., 1910–1914.
Nooksack River [3] at Excelsior, Wash., 1920–21.
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.
Middle Fork of Nooksack River near Deming, Wash., 1910–11; 1920–21.
South Fork of Nooksack River at Saxon Bridge, Wash., 1920–21.

COLUMBIA RIVER BASIN

Columbia River at Trail, British Columbia, 1913–
Columbia River at Kettle Falls, Wash., 1913–
Columbia River at Grand Coulee, near Nespelem, Wash., 1923.
Columbia River at Wenatchee, Wash., 1910; 1913–1916.
Columbia River at Vernita, Wash., 1917–
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.
Tobacco River:
Grave Creek near Fortine, Mont., 1923–
Callahan Creek at Troy, Mont., 1911–1916.
Yaak River near Troy, Mont., 1910–1916.
Moyie River at Snyder, Idaho, 1911–1916; 1919–1923.
Clark Fork at Missoula, Mont., 1898–1907.
Clark Fork at St. Regis, Mont., 1910–1923.
Clark Fork near Plains, Mont., 1910–
Pend Oreille Lake at Hope, Idaho, 1921–
Pend Oreille Lake at Sandpoint, Idaho, 1914–1922.

[3] Revised decision of United States Geographic Board rendered Oct. 3, 1917.

Columbia River tributaries—Continued.
Keechelus Lake (on Yakima River) near Martin, Wash., 1906–
Yakima River near Martin, Wash., 1903–
Yakima River at Easton, Wash., 1904; 1910–1915.
Yakima River at Cle Elum, Wash., 1906–
Yakima River at Umtanum, Wash., 1906–1921.
Yakima River at Selah Gap, near North Yakima, Wash., 1897; 1904–5; 1911; 1912.
Yakima River at Union Gap, near Yakima City, Wash., 1894–1919.
Yakima River near Parker (Wapato), Wash., 1908–1921.
Yakima River near Mabton, Wash., 1911–12.
Yakima River near Prosser, Wash., 1904–1906; 1913–1922.
Yakima River at Kiona, Wash., 1895–1915.
Yakima River near Richland, Wash., 1906–1911 (irrigation seasons).
Cabin Creek near Easton, Wash., 1909–1911.
Kachess Lake (on Kachess River) near Easton, Wash., 1905–
Kachess River near Easton, Wash., 1903–
Big Creek near Cle Elum, Wash., 1909.
Cle Elum River, North Fork (head of Cle Elum River), at Galena, Wash., 1907; 1911.
Cle Elum Lake near Roslyn, Wash., 1906–
Cle Elum River near Roslyn, Wash., 1903–
Teanaway River below Forks, near Cle Elum, Wash., 1911–12.
Teanaway River near Cle Elum, Wash., 1909–1911; 1912–1914.
Swauk Creek near Cle Elum, Wash., 1909–1912.
Cascade canal near Ellensburg (Thorp), Wash., 1905; 1909–1911.
West Kittitas canal near Thorp, Wash., 1904–5; 1909–1911.
Ellensburg Water Co.'s canal near Ellensburg, Wash., 1904–5; 1909–1911.
Taneum Creek near Thorp, Wash., 1909–1912.
Manastash Creek near Ellensburg, Wash., 1909–1914.
Wilson Creek at Thrall, Wash., 1911.
Selah Moxee canal near Selah, Wash., 1904–5; 1909–1911.
Wenas Creek near Selah, Wash., 1909–1912.
Naches River at Anderson's ranch, near Nile, Wash., 1909–1914.
Naches River at Oak Flat, near Nile, Wash., 1904–1917.
Naches River below Tieton River, near Naches, Wash., 1905; 1909–1912; 1915–
Naches River near North Yakima, Wash., 1893–1897; 1898–1912.
Bumping Lake (on Bumping River) near Nile, Wash., 1909; 1910–
Bumping River at Bumping Lake, near Nile, Wash., 1906; 1909–
American River near Nile, Wash., 1909; 1910; 1911; 1913; 1914; 1915.
Selah Valley canal near Naches, Wash., 1904–5; 1909–1911.
Tieton River, North Fork, below Clear Creek, near Naches, Wash., 1914–15.
Tieton River at Rimrock,[4] Wash., 1908–1914; 1918–19.
Tieton River at headworks of Tieton canal, near Naches, Wash., 1906–
Tieton River at Cobb's ranch, near Naches, Wash., 1902–1913.
Tieton canal near Naches, Wash., 1910–
Wapatox canal near Naches, Wash., 1904–5; 1909–1911.
Naches Canal Co.'s (Gleed) canal near Naches, Wash., 1904–5; 1909–1911.

[4] Records, 1908–1914, published as "Tieton River at McAllister Meadows, near Naches, Wash."

[5] Decision of United States Geographic Board; formerly called South Fork of Snake River.

[6] Decision of United States Geographic Board; formerly called North Fork of Snake River.
[7] Records, 1902-1909, published as "North Fork of Snake River near Ora, Idaho."
[8] Records, 1904-1909, published as "Fall River at Fremont, Idaho."

Columbia River tributaries—Continued.
Snake River tributaries—Continued.
Mud Lake at Terreton, Idaho, 1921–
Camas Creek near Dubois, Idaho, 1921–
Camas Creek near Camas, Idaho, 1921–
Camas Creek near Hamer, Idaho, 1912–13.
Beaver Creek at Dubois, Idaho, 1921–
Beaver Creek at Camas, Idaho, 1921–
Medicine Lodge Creek near Small, Idaho, 1921–
Birch Creek near Reno,[9] Idaho, 1910–1912; 1921–1923.
Little Lost River near Clyde, Idaho, 1910–1913.
Little Lost River at Raymond's ranch, near Howe, Idaho, 1921–
Little Lost River near Howe, Idaho, 1921–
Wet Creek at Clyde school, near Howe, Idaho, 1921–1923.
Big Lost River at Howell's ranch, near Chilly, Idaho, 1904–1906; 1907–1914; 1920–
Big Lost River below Chilly canal, near Chilly, Idaho, 1921–22.
Big Lost River at Chilly Bridge, near Chi ly, Idaho, 1920.
Big Lost River below Chilly Sinks, near Chilly, Idaho, 1921–22.
Big Lost River (back channel) below Chilly Sinks, near Chilly, Idaho, 1921.
Big Lost River (east channel) above Mackay reservoir, near Mackay, Idaho, 1919–
Big Lost River (west channel) above Mackay reservoir, near Mackay, Idaho, 1919–
Mackay reservoir (Big Lost River) near Mackay, Idaho, 1919–
Big Lost River below Mackay reservoir, near Mackay, Idaho, 1903–1906; 1912–1915; 1919–
Big Lost River at Leslie, Idaho, 1919–1922.
Big Lost River near Moore, Idaho, 1919–
Thousand Springs Creek near Chilly, Idaho, 1912–13; 1914; 1920–1922.
Warm Spring Creek (east channel) near Mackay, Idaho, 1919–
Warm Spring Creek (west channel) near Mackay, Idaho, 1919–
Sharp ditch near Mackay, Idaho, 1912–1914; 1919–
Streeter ditch near Mackay, Idaho, 1913–14.
Cedar Creek above forks, near Mackay, Idaho, 1911–1913.
Cedar Creek below forks, near Mackay, Idaho, 1911–1913.
Cedar Creek below power plant, near Mackay, Idaho, 1920–1922.
Clark ditch near Mackay, Idaho, 1920–1922.
Alder Creek near Mackay, Idaho, 1920–1922.
Antelope Creek near Darlington, Idaho, 1913–1916; 1920–1922.
Pass Creek near Leslie, Idaho, 1920–1922.
Portneuf River above reservoir, near Chesterfield, Idaho, 1912–1914.
Portneuf diversion channel near Chesterfield, Idaho, 1914.
Portneuf River below reservoir, near Chesterfield, Idaho, 1912–1915.
Portneuf River near Pebble, Idaho, 1910–1913.
Portneuf River at Topaz, Idaho, 1913–1915; 1919–
Portneuf River near McCammon, Idaho, 1896.
Portneuf River at Pocatello, Idaho, 1897–1899; 1911–
Topons Creek near Chesterfield, Idaho, 1912–1914.
Pebble Creek near Pebble, Idaho, 1911–1914.
Birch Creek near Downey, Idaho, 1911–1914.

[9] Records, 1910–1912, published as "Birch Creek near Kaufman, Idaho."

Columbia River tributaries—Continued.
Snake River tributaries—Continued.
Big Wood River below Magic dam, near Richfield, Idaho, 1911–
Big Wood River above North Gooding canal, near Shoshone, Idaho, 1921–
Big Wood River below North Gooding canal, near Shoshone, Idaho, 1911–
Big Wood River near Shoshone, Idaho, 1905–6; 1908–1913.
Big Wood River at Gooding, Idaho, 1896–1899; [10] 1921–
Big Wood River near Gooding, Idaho, 1916–
Big Wood River near Bliss, Idaho, 1899.
Warm Springs Creek near Ketchum, Idaho, 1920–21.
Trail Creek at Ketchum, Idaho, 1920–21.
East Fork of Big Wood River at Gimlet, Idaho, 1920–21.
Big Wood Slough at Hailey, Idaho, 1915–
Camas Creek near Blaine, Idaho, 1912–
Dry Creek near Blanche, Idaho, 1911–1914.
Little Wood River near Carey, Idaho, 1904–5; 1920–
Little Wood River near Richfield, Idaho, 1911–
Little Wood River at Shoshone, Idaho, 1922–
Little Wood River at Toponis (Gooding), Idaho, 1896–1899.
Fish Creek above dam, near Carey, Idaho, 1920–
Fish Creek near Carey, Idaho, 1919–20; 1923–
West Fork of Fish Creek near Carey, Idaho, 1920–1922.
Silver Creek near Picabo, Idaho, 1920–
King Hill Creek near King Hill, Idaho, 1913.
Little Canyon Creek at Glenns Ferry, Idaho, 1909–1913.
Alkali Creek near Glenns Ferry, Idaho, 1909–1913.
Cold Springs Creek near Hammett, Idaho, 1909–1913.
Bennett Creek near Hammett, Idaho, 1909–1913.
Rattlesnake Creek near Mountain Home, Idaho, 1917.
Canyon Creek near Mountain Home, Idaho, 1917.
Long Tom Creek below reservoir near Bennett, Idaho, 1917.
Willowdale Creek near Bennett, Idaho, 1917.
Syrup Creek near Mountain Home, Idaho, 1917.
Bruneau River near Rowland, Nev., 1913–1918.
Bruneau River near Tindall, Idaho, 1910–1912.
Bruneau River near Hot Spring, Idaho, 1909–1915.
Bruneau River near Grandview, Idaho, 1895–1903; 1909–1916.
Sheep Creek near Tindall, Idaho, 1910–1913.
Marys Creek near Owyhee, Nev., 1913–1915.
Marys Creek at Tindall, Idaho, 1910–1913.
Louse Creek near Wickahoney, Idaho, 1911.
East Fork of Bruneau River near Three Creek, Idaho, 1912–1914 1916.
East Fork of Bruneau River near Hot Spring, Idaho, 1910–1915.
Three Creek near Three Creek, Idaho, 1912–1914; 1916.
Cherry Creek near Three Creek, Idaho, 1912–1914; 1916.
Deadwood Creek near Three Creek, Idaho, 1912–1914; 1916.
Buckaroo ditch at Hot Spring, Idaho, 1912–1914.
Grandview canal near Grandview, Idaho, 1912–1915.
Castle Creek near Castle Creek, Idaho, 1910–11.

[10] Records 1896–1899, published as "Malade River near Toponis, Idaho."

Columbia River tributaries—Continued.
Snake River tributaries—Continued.
Malheur River near Hope, Oreg., 1919–
Malheur River near Little Valley, Oreg., 1914.
Malheur River at McLaughlin bridge, near Vale, Oreg., 1904–1906.
Malheur River at Vale, Oreg., 1890–91; 1895–96; 1903–1914; 1919.
Malheur River at Halliday Bridge, near Ontario, Oreg., 1904–5.
Malheur River near Ontario, Oreg., 1903–4.
South Fork of Malheur River at Riverside, Oreg., 1910–1915; 1919–20.
North Fork of Malheur River at Scotts ranch, near Beulah, Oreg., 1914.
North Fork of Malheur River at Foley's ranch, near Beulah, Oreg., 1909–1912; 1913–14.
North Fork of Malheur River at Juntura, Oreg., 1919–20.
Vines ditch near Little Valley, Oreg., 1904–5; 1914.
Malheur Farmers' canal above Vale, Oreg., 1904–5.
McLaughlin ditch above Vale, Oreg., 1904–5.
"J. H." ditch above Vale, Oreg., 1904–5.
Gellerman & Frohman ditch above Vale, Oreg., 1904–5.
Sand Hollow ditch above Vale, Oreg., 1904–5.
Bully Creek near Westfall, Oreg., 1911–1913; 1923.
Bully Creek at Warm Springs, near Vale, Oreg., 1903–4; 1905–1907; 1911–1917; 1922–23.
Bully Creek at Vale, Oreg., 1904–5.
Cottonwood Creek near Westfall, Oreg., 1922–23.
Hope Mill ditch at Vale, Oreg., 1904–5.
Willow Creek near Malheur, Oreg., 1904–1906; 1910–11; 1912–1915; 1921–
Willow Creek near Brogan, Oreg., 1912–1914.
Willow Creek at Dell, Oreg., 1904–1906; 1910–11.
Cow Creek near Brogan, Oreg., 1912–1914.
Pole Creek near Brogan, Oreg., 1912–13.
Nevada ditch below Vale, Oreg., 1904–5.
Payette River at Banks, Idaho, 1922–
Payette River near Horseshoe Bend, Idaho, 1906–1916; 1919–
Payette River at Payette, Idaho, 1895–1897.
Payette Lake (North Fork of Payette River) at Lardo, Idaho, 1921–
North Fork of Payette River at Lardo, Idaho, 1908–1917; 1919–
North Fork of Payette River at Van Wyck, Idaho, 1912–1916; 1920–
Lake Fork of Payette River near McCall, Idaho, 1909–1914.
Gold Fork of Payette River near Roseberry, Idaho, 1920–21.
South Fork of Payette River near Garden Valley, Idaho, 1921–
South Fork of Payette River near Banks, Idaho, 1921–
Deadwood River near Lowman, Idaho, 1921–
Shafer Creek near Horseshoe Bend, Idaho, 1911–12.
Harris Creek near Horseshoe Bend, Idaho, 1911–12.
Weiser River at Starkey, Idaho, 1920.
Weiser River above Crane Creek, near Weiser, Idaho, 1920–
Weiser River near Weiser, Idaho, 1890–91; 1894–1904; 1910–1914.
Weiser River, West Fork, near Fruitvale, Idaho, 1910–1913; 1919–
Lost Creek near Tamarack, Idaho, 1910–1914; 1920–21.
Middle Fork of Weiser River at Middle Fork, Idaho, 1910–1913.

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[12] Records published in U. S. Geol. Survey Water-Supply Paper 272, pp. 428–429.

Columbia River tributaries—Continued.
Cowlitz River at Mayfield, Wash., 1910–11.
Ohanapecosh River near Lewis, Wash., 1907–1917.
Clear Fork near Lewis, Wash., 1907–1917.
Coal Creek near Lewis, Wash., 1910–1915.
Lake Creek at outlet of Packwood Lake, near Lewis, Wash., 1911–
Lake Creek at mouth, near Lewis, Wash., 1907–1915.
Hagar Creek near Lewis, Wash., 1911–12; 1913–14.
North Fork of Hagar Creek near Lewis, Wash., 1911–12; 1913–14.
Johnson Creek below West Fork, near Lewis, Wash., 1911–1914.
Johnson Creek at mouth, near Lewis, Wash., 1907–1914; 1918–
Glacier Creek near Lewis, Wash., 1911.
Cispus River near Randle, Wash., 1910–1912.
Toutle River at St. Helens, Wash., 1909.
Toutle River near Silver Lake, Wash., 1919–1923.
Toutle River near Castle Rock, Wash., 1909–1912.
Youngs River near Astoria, Oreg., 1916–1917.

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.
Rogue River at Raygold, near Central Point,[13] Oreg., 1905–
Rogue River near Galice, Oreg., 1906.
California-Oregon Power Co.'s flume near Prospect, Oreg., 1913–
Mill Creek near Prospect, Oreg., 1910.
Big Butte Creek, South Fork (head of Big Butte Creek), at Butte Falls, Oreg., 1910–11; 1915; 1917–
Big Butte Creek below Butte Falls, Oreg., 1918–1920.
Little Butte Creek, South Fork (head of Little Butte Creek), near Deadwood, Oreg., 1917–18.
Little Butte Creek, South Fork, near Lake Creek, Oreg., 1910–1913.
Little Butte Creek, South Fork, near Lake Creek (near mouth), Oreg., 1921–
Little Butte Creek above Eagle Point, Oreg., 1916–
Little Butte Creek near Eagle Point, Oreg., 1907–1916.
Dead Indian Creek near Lilyglen, Oreg., 1916–1919.
Fish Lake reservoir near Lake Creek, Oreg., 1915–
North Fork of Little Butte Creek at Fish Lake, near Lake Creek, Oreg., 1914–
North Fork of Little Butte Creek above Medford intake, near Lake Creek, Oreg., 1911–1913; 1922–
North Fork of Little Butte Creek above intake of Rogue River Valley canal, near Lake Creek, Oreg., 1916–1919; 1921–
Rogue River Valley canal at intake, near Lake Creek, Oreg., 1914; 1915; 1916.
Rogue River Valley canal near Brownsboro, Oreg., 1913; 1915–1919; 1921–
Medford Irrigation District canal near Brownsboro, Oreg., 1922–
Eagle Point canal near Eagle Point, Oreg., 1920–
Emigrant Creek (head of Bear Creek) near Ashland, Oreg., 1920–
Bear Creek near Ashland, Oreg., 1923–
Bear Creek at Talent, Oreg., 1907–1914.

[13] Formerly published as "Rogue River near Tolo, Oreg." Tolo is a discontinued post office.

REPORTS ON WATER RESOURCES OF THE NORTH PACIFIC SLOPE DRAINAGE BASINS

PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY

WATER-SUPPLY PAPERS

Water-supply papers may be purchased (at price quoted below) from the SUPERINTENDENT OF DOCUMENTS, Washington, D. C. An asterisk (*) indicates that the report is out of print. Water-supply papers are of octavo size.

*4. A reconnaissance in southeastern Washington, by I. C. Russell, 1897. 96 pp., 7 pls.

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.

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.

*61. Preliminary list of deep borings in the United States, Part II (Nebraska-Wyoming), by N. H. Darton. 1902. 67 pp.

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.; described 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. [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 Harney 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.

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.

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.

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, Oreg., 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.

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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.

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, Oreg., 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, Oreg., 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, Oreg., 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, Wash., 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, Wash., 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 stream-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, Wash., prepared under the direction of R. B. Marshall, chief geographer. 1915. 8 pp., 5 pls. 15c.

377. Profile surveys in Spokane River basin, Wash., and John Day River basin, Oreg., 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, Oreg., 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, Oreg., 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, Wash., 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. 5c.

469. Surface waters of Wyoming and their utilization, by Robert Follansbee. 1923. 331 pp., 1 pl. 40c.

Contains a brief discussion of the general features and power and irrigation possibilities of that part of the Snake River basin that lies in Wyoming.

486. Water powers of the Cascade Range, Part IV, Wenatchee and Entiat basins, by G. L. Parker and Lasley Lee. 1922. iv, 76 pp., 3 pls. 30c.

Describes the topography, drainage areas, climate, and forestation of these basins. Gives stream-flow records and discusses the conditions affecting stream flow. Discusses, also, irrigation and developed and undeveloped water power.

489. The occurrence of ground water in the United States, with a discussion of principles, by O. E. Meinzer. 1923. xi, 321 pp., 31 pls. 60c.

Discusses principles of occurrence of ground water; kinds of rocks and their water-bearing properties; structure of rocks and its influence on ground water; and water-bearing formations in the United States.

492. Summary of hydrometric data in Washington, 1878–1919, by G. L. Parker and Lasley Lee. 1923. viii, 363 pp., 9 pls. 40c.

Contains gaging-station records and a bibliography of hydrometric data in the State of Washington.

*500. Contributions to the hydrology of the United States, 1921; N. C. Grover, chief hydraulic engineer. 1922. iv, 74 pp., 4 pls. Contains:

*(a) Coeur d' Alene Lake, Idaho, and the overflow lands, by R. W. Davenport, pp. 1–31, pls. i–iii.

520. Contributions to the hydrology of the United States, 1923–24; N. C. Grover, chief hydraulic engineer. 1925. iv, 129 pp., 23 pls. 25c. Contains:

(c) Power resources of Snake River between Huntington, Oreg., and Lewiston, Idaho, by W. G. Hoyt, pp. 27–51. 10c.

PROFESSIONAL PAPERS

Professional papers may be purchased (at price quoted below) from the Superintendent of Documents, Washington, D. C. An asterisk (*) indicates that the report is out of print. Professional papers are of quarto size.

135. The composition of the river and lake waters of the United States, by F. W. Clarke. 1924. iv, 199 pp. 50c.

Contains analyses of principal streams and lakes.

BULLETINS

Bulletins may be purchased (at price quoted below) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. An asterisk (*) indicates that the report is out of print. 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.

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.

*298. Record of deep-well drilling for 1905, by M. L. Fuller and Samuel Sanford. 1906. 299 pp.

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 may be purchased (at price quoted below) from the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. An asterisk (*) indicates that the report is out of print.

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 land; 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. (16 maps in separate case.) $2.25. 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, Wash., by F. G. Plummer, pp. 81–143, Pls. 33–50.
*Olympic Forest Reserve, Wash., from field notes by Arthur Dodwell and T. F. Rixon, pp. 145–208, Pls. 51–70.
*Cascade Range Forest Reserve, Oreg., 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. Lieberg, 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.[14] 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

[14] 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.

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 folio is out of print.

*45. Boise, Idaho.

*86. Ellensburg, Wash.

*103. Nampa, Idaho-Oregon.

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.

*106. Mount Stuart, Wash.

*139. Snoqualmie, Wash.

218. Riddle, Oreg. 25c.

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 Bureau of Reclamation; and the reports of the Chief

of Engineers, United States 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.

INDEX BY AREAS AND SUBJECTS

[A=Annual Reports; M=Monograph; B=Bulletin; P=Professional Paper; W=Water-Supply Paper; G F=Geologic folio]

[15] Many analyses of river, spring, and well waters are scattered through publications, as noted in abstracts.

INDEX OF STREAMS

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